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Meaningful Encounters: Creating a multi-method site for interacting with nonhuman life through bioarts praxis

Donna Franklin
Edith Cowan University

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**Meaningful Encounters:
Creating a multi-method site for interacting with nonhuman life
through bioarts praxis**

Donna Franklin
MA (Visual Arts)

This thesis is presented in fulfilment of the requirements for the degree of

**Doctor of Philosophy
Faculty of Education and Arts
Edith Cowan University
September 2014**

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Abstract

This research advocates a multi-method approach to bioarts praxis, reflexively and critically questioning the contemporary contexts that frame our engagement with nonhuman life. In doing so, the research aims to generate further community engagement with nonhuman life and the environment, and engender critical discourse on the implications of developing biotechnologies.

Hegemonic institutions influence the way culture is produced and how information is constructed and understood. Habermas (1987) suggests that these institutions will inevitably influence the individual's lifeworld as they shape lived experience through the process of systemic colonisation. I assert that this process also shapes how individuals engage with or understand nonhuman life. Through the implementation of three major projects the research aims to develop the capacity of bioarts in challenging such institutions by providing the opportunity for hands-on life science activities and real-time interactions with nonhuman life. The research by employing such methods aims to counter-act the impact of urbanised living and indifference to environmental conservation.

Each aspect of the creative praxis provides a reflexive case study to establish the research aims and answer the research agenda. This includes my creative bioartworks, an art-science secondary educational course and a curated group exhibition, symposium and workshop. This research provides an alternative communicative approach to hegemonic institutions such as the mass media, scientific biotechnological industries and traditional gallery spaces (Shanken, 2011).

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

Acknowledgments

In loving memory of my father Trevor, who passed so suddenly earlier this year; you are greatly missed by many. Thank you for all of your love, support and technical prowess during exhibition time. I am so grateful for all the happy times we have spent together.

Endless thanks to my family and friends for all of your support, laughs and guidance especially my mother Nola, Aunty Daphne, Diane, David and Caitlin.

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Declaration

I certify that this thesis does not to the best of my knowledge and belief:

- i. incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education.
- ii. contain any material previously published or written by another person except where due reference is made in the text; or
- iii. contain any defamatory material

Signature: Donna Franklin

Date: 30.9.2014

1.0 Introduction

The research examines the communicative and pedagogical role my bioart praxis has in developing a critical creative engagement with nonhuman life in a biotechnological context. The research agenda aims to instil participants and viewers with further enthusiasm and wonder of the natural and scientific world through hands-on workshops, exhibitions and a symposium.

As Hauser (2005) states 'bioart' is a "proliferating and mutant term...and cannot be nailed down" (p. 1). This description indicates that the art form constantly changes in response to developing biotechnologies and scientific practices. Its significance lies in the way the cultural practice explores questions and examines how biotechnologies re-define our understanding of what constitutes life. Equally important the arts praxis experiential implication of engaging with living materials provides a deeper connection with sentient life beyond representation.

Following this position bioart involves practices that deal with the hands-on application of the life sciences or biotechnologies (Catts & Zurr, 2008; Da Costa, 2008; Hauser, 2008; Wilson, 2008). Implicit within this art form is the actual physical presentation of biological life or its processes known as "wet biological practices" (Catts, 2009, p. 1). These artworks can include, but are not limited to cell tissue culture, extracted DNA, bacteria, invertebrates, insects, fungi, plants and animals. For the purpose of this research, the focus covers the scope and diversity of the life sciences. This provides as varied an experience of the nonhuman through bioarts praxis as possible.

The intention of re-locating the 'wet biology' of science into an arts context becomes a significant aspect of the research to present nonhuman life in real-time. This extends the artwork beyond a symbolic object to draw associations with contexts that frame the biological life itself.

Further to this, Freeman (2011) contextualises the relationship of wet biology to bioart: "The use of the term 'nonhuman' though anthropocentric, reminds us of the qualities we share with animals and makes these practices all the more contentious" (p. 4). In this research, the term 'nonhuman' refers to the use of microbes, cells, invertebrates, fungi, plants, insects, fish, amphibians, birds, mammals and genetically modified organisms (GMOs).

This research navigates the hegemonic systems (corporations and mass media) that mediate nonhuman life in a contemporary biotechnological context. This is done via a multi-method approach to ascertain new forms of education curriculum linking to art exhibition practices that combine the life sciences and humanities. The multi-method approach to the bioarts praxis is defined and established by the development of three key projects. These include my creative bioartworks, a secondary art-science course and the curation of a group exhibition. Devlin's (2009) concept of interdisciplinary practices is applied to each context. Interdisciplinary activities according to Devlin (2009) are where each discipline is defined clearly and remains true to its established practices. However through collaboration each discipline can be freely scrutinized by this process. As applied to pedagogies, Jacobs (1989) notes this form of interdisciplinary teaching is based on "a knowledge, view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience" (cited in Coffey, 2009).

In the research, each aspect of the bioarts praxis combines art and life science practices, while developing a reflexive analysis of such practices. Of relevance to the research agenda "interest in art-science interaction arises from the plurality of approaches, the areas of difference and tension...areas of conceptualization" (Malina, 2011, para. 3). These points of interaction manifest through the articulation and exhibition of a bio-arts praxis.

The lifeworld "world as lived...*erlebt*...the always taken-for-granted...the world that is constantly pre-given" without reflection or analysis (Husserl, 1936; 1970, pp. 380-381). It consists of the everyday activities of an individual contingent and dependent on a particular set of cultural conditions. Sociologist Anthony Giddens (1990) suggests that there are many influential factors, such as institutions, media and religions that inform the production of an individual's lifeworld. An individual is not only a product of social construction, acted upon by external institutions but also a contributor to those governing systems. The research uses a methodology of praxis to situate theoretically the creative outcomes in relation to the cultural contexts in which they operate. This provides a model by which the communicative efficacy of the art form is critically examined as it develops. Cultural theorists Estelle Barrett and Barbara Bolt (2007) consider praxis to be a symbiosis of theory and practice integral to a critical analysis of art research. Through a multi-method bioarts praxis, my research aims to offer an alternative voice to hegemonic

institutions, such as corporations and mass media. In a contemporary biotechnological context, these institutions can shape how the individual engages with nonhuman life.

This form of engagement is becoming increasingly important in the context of a wealthy minority world as more individuals are living in highly urbanised environments (McKinney, 2002). Urban sprawl, particularly in the context of Perth, Western Australia, continues to replace ecologies rich in biodiversity with suburban environments (Lambert, 2011). As a result, Australia has one of the world's highest fauna and flora extinction rates (IUCN, 2013). Also pertinent in this context, resource-centric hegemonic institutions often frame attitudes towards nonhuman life: forestry, farming, agriculture and mining. This is the current economic foundation for Perth and as such (excluding associations with conservation and tourism) influences much of the general public discourse (Lindenmayer, 2013).

In terms of an individual's daily engagement with nonhuman life and the natural world in this context, like most people in Australia there is a general awareness of wildlife and the outdoors as an intrinsic part of Australian cultural identity (Fiske, 1983). As Elder (2007) explains the relationship between concepts of national identity, wilderness and conservation of the environment is manifest in our engagement with national parks and reserves. "The name 'national park' infers that the space set aside is not for any individual, family or community, but for all citizens of a nation" (p. 231). Historically parks were altered to resemble a British landscape, many European plants and animals were introduced. From the nineteen-seventies Elder (2007) identifies that understanding the human impact on the environment shaped further infrastructure to protect flora and fauna. This in recent history has led to an acknowledgement of Indigenous contributions to conservation and cultural knowledge about space.

This interaction with nature facilitated throughout an individual's life via outdoor leisure activities – beach culture, camping, fishing, or hiking (Fiske, 1983). This is often perpetuated from an early age through local literature/children's media such as *Bindi's Boot Camp* (Andrews, 2012), and *A Tale of Two Honey Possums* (Bradshaw and Negus, 2008).¹ What is evident throughout Australian history to the present is the tension between the preservation of the natural world and its use in Australia's economic growth (Elder, 2007). This problem is inherently linked to the national narrative of conquering the wilderness or protecting it as a part of our concepts of Australian identity (Elder, 2007).

As evidenced by our urbanised lifestyles daily engagement with nonhuman life, for some, is centralised around pets. While other animals are perceived to be ‘pests’ either encroaching on suburbia or becoming an issue for farmers through over-population or dislocation via urban sprawl: Flying foxes, possums, white ibis, rainbow lorikeets, cockatoos and historically wedge-tailed eagles (Sitko, 2012; Vavaro, 2011).

Within this contemporary context, biotechnologies are also rapidly assimilating into cultural consciousness via systems such as the mass media. For example, the colloquially termed ‘earmouse’ (1997, Vacanti, C. et al) see Figure 1, and Dolly the cloned sheep (b. 5 July 1996 – 14 February 2003, Campbell K.H., et al, 1996; & Wilmut, I. et al. 1997) see Figure 2.



L-R: Figure 1: Charles Vacanti, (1997), ‘earmouse’, digital still from film, 10cm x 15cm. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Figure 2: Toni Barros, (2009), *Hello, Dolly!*, photograph from blog, 10cm x 15cm. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

These biotechnologies become part of the lifeworld in a way that can sometimes be unreflective (Adams, 2006). This becomes an issue for scientists and researchers when mass media miscommunication and political agenda leads to public misunderstanding. An example recently illustrated by the public debate surrounding climate change. In this context, legitimate science verses hypothetical practice pertaining to environmental issues becomes fodder for debate (Horstman, 2011). This form of dissemination becomes even more problematic when filtered by “systemic colonisation” (Habermas, 1987). This process nullifies a critical engagement with biotechnologies and deters the individual from considering the ultimate implications of these technologies on day-to-day living and engagement with, or understanding of, nonhuman life. Through art communication, the research offers a space where the individual can pause and reflect on their contemporary engagements with nonhuman life and developing biotechnologies.

Habermas' (1997) defines the public sphere as a "network for communicating information and points of view. . . the streams of communication are, in the process, filtered and synthesized in such a way that they coalesce into bundles of topically specified public opinions" (p. 360). This process therefore becomes a central generating force in shaping how people think about nonhuman life and biotechnologies in our contemporary consumerist context. Biotechnologies, as Wilson explains, "can fundamentally change the way people think and act" (2007). The problem is exacerbated when as Cass and Catts (2008) state, "Our values and belief systems seem ill-equipped to deal with the consequences of the application of our new knowledge in the life sciences" (p. 178). The cultural role of bioart becomes crucial in offering a different platform to develop a greater awareness of these issues through the act of experiencing, questioning, communication and interrogation. The research provides strategies to engage with these biotechnologies through praxis by the development of key activities situated in the viewer/participant's lifeworld. In addition, this process sets up a dialogue that sits outside of insular specialist discourse that often frames how mass media engage with nonhuman life and developing biotechnologies (Cass, 2012; Levins, 2008; Robinson, 2010).

The research intends to establish the validity and implications of using 'wet biology' in bioart. Through this material process, the viewer is implicated within the bioartwork interacting with the nonhuman life in real-time. This is a significant anchor for the bioarts praxis as it determines my position in the field and drives the approach for all practical and theoretical aspects of the research. This theoretical position is examined in the Literature Review 3.0 with reference to key artists and scientists from local and global contexts.

It is important to note that due to its diverse subject matter and material association with life science, bioart traverses across local-global contexts. As demonstrated in the Literature Review 3.0, these practices directly respond to current contemporary situations already operating in the lifeworld, such as biotechnology and human relationships to the environment. The presentation of artworks beyond biological quarantine issues is not bound by a specific geographical location or dependent on a single cultural context. This is a significant aspect to the bioarts praxis. This position situates the praxis and its subject matter in relation to contemporary cultural conditions of globalisation. Giddens (1991) provides a reflexive methodology to aid in the examination of the cultural paradigms and conditions of the 21st century.

In contemporary society the individual maps out their lifeworld and identity based on the “dialectical interplay of the local and the global” (p. 5). Papastergiadis (2006) argues that the “diasporic narratives” often place individuals on the periphery; however, this process offers a way to navigate power struggles and question dominant discourse within any given cultural context. This he argues is usually activated through the development of artist collectives that network across the globe. In such groups, individuals come together with the intention of generating discourse. Relevant examples include collective networks that focus on contemporary engagements with biotechnology, identity and the life sciences (Malina, 2011). Some examples include *Leonardo*, *ANAT* and *SymbioticA*. These networks are open research sites and welcome individuals to participate irrespective of gender, class or ethnicity.

Papastergiadis argues artist collectives who traverse fixed fields – such as *SymbioticA*: “become context shifters...involved in the production and mediation of new social knowledge” (2008, para. 5). Bioarts embodies this position as the medium responds to developing biotechnologies as it unfolds. In this way, the medium is not constrained by one particular methodology, easily transferable and communicable across cultures and contexts. Giddens (1990) suggests that this is possible because culture is dynamic and always in a state of flux. These shifting conditions are a result of the processes of modernity and are symptomatic of late modernity. He argues that culture is determined by the future rather than looking into the past. Therefore, knowledge is revisable, questionable and the individual must reflexively adapt their sense of self, ideologies and lifeworld practices in light of in-coming information and cultural change. This includes the interrelationships between the local contexts and globalisation, the impact of developing technologies, or political and economic shift. Through this dynamic a bioartwork may deal with specific local concerns, while simultaneously encompass a global issue.

Giddens (1990) suggests that these cultural conditions influence the way we shape our values and how we participate in each context. In relation to the focus of the research, biotechnological research such as cloning, stem cells and synthetic biology, raise further questions on what constitutes life or who controls life at an unprecedented rate. Therefore, like all technological innovations – medicine, industrialisation, and information technologies – these potential scientific futures will have an impact and outreach that will inevitably span countries, culture and history.

One of the key catalysts for the research developed from a discussion with collaborator Gary Cass on the specialist practices of science and arts. During her research with the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO), artist Eleanor Gates-Stuart also observed that each department/discipline works in isolation (2013). G. A. Cass raised the issue that in this situation, researchers are under pressure from corporate bodies to focus only on their specialist areas. In this, climate individuals although encouraged at the undergraduate level have little time to reflect on the broader cultural implications. This is exacerbated by the high demand for immediate problem-solving outcome based research rather than open-ended long-term research. (personal communication, November 12, 2010). As neuro-scientist and co-founder of *SymbioticA*, Professor Stuart Bunt (2012) argues this is exemplified by the rapid development in biological engineering.

This form of infrastructure is not unique to the sciences. Robinson considers this problematic in terms of education curriculum models, as graduates are expected to be prepared, for an unknown world. Robinson (2006) declares: "Education is meant to take us into this future we can't grasp...a child starting school this year (2006) will be retiring in the year 2065...despite all the expertise...nobody has a clue what the world will look like in five years-time, and yet we're meant to be educating them for it". Robinson (2006) suggests complimenting the current systems. He advocates a shift from separate disciplines, to an education structure that integrates interdisciplinary practices to plan for such futures. The arguments for and against specifically examined in the Literature Review 3.0 and Chapter 6.0.

My research applies an interdisciplinary approach to secondary education curriculum and teaching methodologies. The intention is to encourage students to develop further reflexivity by thinking creatively through a combination of art and science disciplines. The premise in advocating this model is to ascertain its effectiveness in generating on-going appreciation for nonhuman life. Through this project students will gain an insight into how both "Artists and scientists...make sense and meaning out of the world we live in [even though their]...epistemologies [remain] distinct" (Malina, 2011, para 18).

Prior to the commencement of this research, my experience as a practicing bioartist started in 2003. The platform for my bioarts praxis initiated during an art residency at *SymbioticA: Centre of Excellence in Biological Arts* (2003-2004, 2006) at The University of Western Australia. This residency took place during its early development as an art-science collaborative space, detailed in the Background (Chapter 2.0). This experience

determines my position in the field and underpins the theories and concepts for the research. My bioart praxis has also previously involved the location of science-art practices and lectures locally, nationally and internationally within multiple contexts of the public sphere – including gallery spaces, conferences, science festivals, secondary schools, tertiary institutions, and agricultural shows. This approach reinforces Bourdieu's (1990, 1993) concept of the multidimensional field, where an individual inhabits and situates specific actions across a number of contexts simultaneously to generate cultural capital. The individual operates in each field according to the fundamental principles of the field – science, arts, and the mass media – pre-determined by dominant groups in the system. Through this process, the individual can change manifestations of the 'fixed' nature of their lifeworld through self-actualisation (Giddens, 1990).

The thesis reflexively analyses and contextualises the multi-method approach implemented through three major projects in the research. This includes the creation of specific bioartworks. The development of a secondary education art-science course *Bio-Tech Evolution: Future Engagement with Nonhuman Life (Bio-Tech Evolution)*, and; thirdly, curation of a group exhibition entitled *Creatures of the Future Garden*, which included a symposium and *WA Birds of Prey Centre Workshop*. The three aspects of the research set up different communicative models to counteract the hegemonic contexts of the mass media and commerce in the lifeworld. These hegemonic contexts prevent a reflexive questioning of biotechnologies that continue to shape how nonhuman life is valued and understood (Giddens, 1990; Jones 2012; McKinney, 2002). The premise for this, this provides an alternate voice to these contexts. The aim is to make transparent these contexts and extend the communicative possibilities of the bioarts praxis as a form of social agency by integrating it into the lifeworld of the viewer/participant (Sullivan, 2010).

Central research question

How can a multi-method approach to bioart praxis regenerate alternative ways to engage with nonhuman life in our contemporary biotechnological context?

This research premise intends to contribute to the individual's lifeworld by generating awareness of nonhuman life in multiple ways. Using this approach the bioarts praxis navigates the space between the systems that shape contemporary engagements with the nonhuman and the lifeworld of the viewer. The lifeworld of the viewer/participant is directly impacted upon by institutions of science, corporations and mass media. This

awareness is becoming more important in our contemporary context as day-to-day living mediated by digital technologies and the value and welfare of nonhuman life is often dependent on corporate or public opinion (Jones, 2012; McKinney, 2002; Vavaro, 2011).

I use a reflexive approach for this research to engage critically with the contexts that inform each artwork or activity. Reflexive analysis permits this as it situates the praxis within the broader socio-cultural world. Through this process, I analyse the theoretical framework that underpins the bioarts praxis. Crouch (2007) considers reflexivity to be a method of analysis that enables the creative practitioner to situate continuously their practice outside the limitations of individual “self-expression.” A reflexive methodology instead aims to generate creative works that belong to or encompass a broader set of local, global, sociological, cultural, historical and contemporary discourse. The application of a reflexive engagement within the art making and research process is reinforced by adopting the method of praxis. As promoted by Barrett and Bolt (2007), praxis considered an integration of theory and practice or “thought and action” (Gramsci, 1929-35). This embeds the artwork within a set of paradigms relevant to the lifeworld of the viewer. Reflexivity is therefore not an insular activity, as it requires the individual creative practitioner to consider the purpose of an artwork in relation to broader cultural contexts. This becomes particularly important for the multi-method approach within the praxis. By situating the projects within arts, science and education the research presents a layered examination of how these particular contexts contribute to the lifeworld and nonhuman life.

This process of reflexive analysis is manifest throughout the thesis. It is most explicit within key artworks developed in my bioart praxis (Chapter 5.0). I also assert that reflexivity is most applicable to the genre of bioarts as the content, subject matter and materials draw directly from the viewer’s lifeworld. This process then acts as a critical analysis of those contemporary cultural contexts and hegemonic institutions of which we are complicit through commodity consumption. In *Bio-Tech Evolution* (Chapter 6.0), the course aims to encourage participants to examine their lifeworld. The aim of this process is to encourage the participants to consider the communicative capacity of their artworks as a vehicle to actively contribute to cultural understanding.

The communicative capacity of an art object and its reflexive agency in understanding the lifeworld is examined further in the Literature Review 3.0. This will be framed by key sociological theorists in the field of cultural studies. The bioarts praxis thereby contextualised by the cultural discourse that shapes the lifeworld. The study of sociology

provides an examination of culture and the relationship between the individual and broader cultural contexts. It encompasses historical and contemporary understandings of the human condition, the production and consumption of cultural objects, and analyses the construction of meaning and ideas. As Papastergiadis (2008) states: “The place and function of art, as always, operates within the social...through the mediation of new forms of public knowledge” (para. 34).

Through the act of communication the praxis offers an alternative voice to capitalist hegemony in the lifeworld to generate awareness of nonhuman life using both qualitative and quantitative research methodologies. I propose that by using a multi-method approach, the communication of these issues is not just restricted to a gallery context but the praxis also operates in educational contexts and multiple locations in the public sphere. As such the research aims to disseminate bioart in multiple contexts in the field (Bourdieu, 1993) thus communicating to a more diverse audience.

Through this research, I advocate that art is a form of communication to question and generate discourse surrounding contemporary cultural conditions. Sullivan (2004) suggests that art research is the ability to think in a medium, language and context. He argues as praxis, it requires a consideration of how art making contributes to an understanding of a contemporary situation through communication. In the research, this objective is manifest through the development of workshops, exhibitions and educational activities. The intention of this multi-method approach aims to develop existing galleries and curriculum to incorporate bioarts practices and break down the notion of an ivory tower within the institutions of science and the arts (Groys, 2009; O’Doherty, 1986; Robinson, 2010; Shapin, 2012). This research maintains that the sociological roles of such bioart practices can be extended. This is achieved using multiple methods of public dissemination reshaping the idea of the gallery space, and through the inclusion of secondary students in *Creatures of the Future Garden*.

The research intends to navigate the elitist ideologies maintained by traditional gallery contexts and artwork consumption, corporate industry and the mass media by using interdisciplinary activities (Devlin, 2009; Robinson, 2010). This is a deliberate communicative act as each context operates within a set framework that has predetermined cultural expectations (Levins, 2008).

As is examined in the Literature Review 3.0 the lifeworld of the viewer/participant is located in the social realm (Giddens, 1990). By positioning my bioarts praxis in this

context, the three aspects add to the discourse surrounding contemporary engagements with nonhuman life. In using this process, the intention is to reinvigorate an awareness of nonhuman life. Generating a greater level of engagement with the natural world through participation is also a philosophical imperative for mycologist and artist Dr Alan Rayner. Termed “Natural Inclusion” Rayner’s research explores the potency of “experiential knowing” (Rayner & Goff, 2010, p. 1)². This is most pertinent in our contemporary context where lifeworld of the individual is increasingly urbanised and there is a potential risk for a cultural state of “environmental generational amnesia” (McKinney, 2002).

In order to establish how the research navigates systemic colonisation: the Literature Review 3.0 cites the theories of Giddens, 1990; Habermas, 1987; and Sullivan; 2010. This theoretical framework highlights how the social realm shapes an individual’s lifeworld (Habermas, 1987). This determines the sociological importance of art communication to foster alternative interactions with knowledge in the public sphere.

The body of the thesis is organised into six major chapters. Firstly, I provide a background to the research citing relevant exhibitions and collaborative bioart works (Chapter, 2.0). These projects demonstrate my practical and theoretical experience in the bioarts field.

The Literature Review 3.0 identifies the key theoretical positions that underpin the bioarts praxis and research intentions. Organised into four main sections the Literature Review examines the contexts the bioarts praxis navigates: engagements with nonhuman life, art, science, education.

The Methodology (Chapter 4.0) identifies the various technical approaches to the practice of bioarts, including ethical protocol, the overall approach framed by reflexive analysis. Reflexivity further enhanced by praxis, participatory action research models, and quantitative data collection. These models provide a way of facilitating and critically analysing the research.

The final three chapters detail the practical outcomes of the research as case studies, namely bioartworks (Chapter, 5.0), a secondary educational art-science course (Chapter, 6.0) concluding with the curated exhibition, its complimentary symposium, and workshop (Chapter, 7.0).

At the end of the thesis for further contextualisation, I provide a glossary of key terms and list of footnotes cited throughout the thesis, followed by three appendices. The appendices A-C provide web links of artists identified in the Literature Review 3.0, detail project precedents examined in Chapter 6.0 and provide biographies of participating artists in Chapter 7.0. To demonstrate further research outcomes I also provide list of exhibitions, conferences and publications. In addition, I provide external documentation (DVD), which includes my curriculum vitae, exhibition catalogue for Chapter 6.0 and additional photography and, exhibition catalogue for Chapter 7.0.

2.0 Background: Previous Bioarts Praxis 2003-2010

A. Curriculum Vitae and documentation of previous local, national and international exhibitions (refer to the DVD)

To contextualise my previous experience in the field of bioarts this chapter identifies significant individual and collaborative artworks, contexts and exhibitions that have led to the development of this research. In this chapter, I summarise key artworks and their conceptual, theoretical and practical concerns that provide markers for the doctoral research. Firstly, I detail my artist residency at *SymbioticA: Centre of Excellence in Biological Arts*, including related local, national and international exhibitions. Secondly, I detail the collaborative art-science project *Micro 'be' Fermented Fashion*, which included the development of artworks and workshops that traverse across a number of contexts in the public sphere.

2.1 Master of Arts (Visual Arts) and residency at SymbioticA (2003-2004)

In 2003, I received an artist residency award at *SymbioticA: Centre of Excellence in Biological Arts*.³ This residency provided the foundation for my research and artistic practice over the course of my Master of Arts (Visual Arts) at The School of Communications and Arts, Edith Cowan University. As *SymbioticA* had only recently been established in April 2000, the centre had not yet developed the Masters of Biological Arts Course or Undergraduate Units as identified in Chapter 6.0. At this stage, *SymbioticA* was the first research centre of its kind in the Southern Hemisphere and a unique space in Australia that offered an opportunity for artists and scientists to collaborate on projects. *SymbioticA* places an emphasis on open-ended research methodologies to determine cultural, ethical or political consequences of manipulating life. There are currently a number of similar centres situated globally and are detailed in section 3.3 of the Literature Review.

SymbioticA remains to this day an artist-run space located within The School of Anatomy, Physiology and Human Biology, at The University of Western Australia (UWA), in Perth, Western Australia. The centre co-founded in April 2000 by Scientific Director Professor Stuart Bunt (2000-2009), Scientific Advisor Professor Miranda Grounds (2000-current) and Artistic Director Oron Catts (2000-current). Specific activities and key artists

relevant to the research are discussed in further detail in the Literature Review 3.0 and Chapters 6.0 and 7.0.

The foundation for doctoral research was established during this residency in that I adopted the following *modus operandi* for my bioarts praxis. Within this context, participants can actively investigate the ethical and cultural implications of the artistic research. If using wet biology each resident is expected to learn and responsibly use the selected life science. As stated on the website the space is “an artistic laboratory dedicated to the research, learning and critique of life sciences...[residents] engage in wet biology practices...[through] interdisciplinary...curiosity-based research...complying with regulations...artists actively use...technologies of science, not just to comment about them...to explore their possibilities” (2009, p. 1).

During this residency, I was introduced to the field of science, and had the opportunity to foster an on-going discourse with a number of scientists within the field of neurology, soil science, mycology and cell-tissue culture. These interactions took place during group discussions on the ramifications of biotechnology, or specific research projects based in either the sciences or arts, with fellow residents or visiting presenters at the weekly forums conducted by *SymbioticA*.

The residency culminated in the graduate artwork *Fibre Reactive* (2004) (Figure 3). The inaugural exhibition of this piece shown at the *Biennale of Electronic Arts Perth (BEAP04) SameDifference*⁵, *Bio-Difference* at the Lawrence Wilson Art Gallery, is examined in the following section. To contextualise the exhibition of *Fibre Reactive* in *BEAP04*, this event provided a link to other practitioners in the field of bioarts or art-science initiatives. The exhibition was a part of a series of five exhibitions and conferences, which focused on new media and electronic arts. This situates the work in relation to contemporary arts practices, providing the initial platform for the exhibition of biological arts in Australia.

Fibre Reactive consists of a living garment grown from the mycelium⁴ of *Pycnoporus coccineus* (orange bracket fungus). In *Fibre Reactive*, the form of garment was chosen as a metaphor for the lifeworld (Habermas, 1987). The direct associations of wearing clothing on the body every day and the social and cultural identities that clothing inherently carries demonstrate this connection (Farren & Hutchison, 2004; McLuhan, 1964). The amalgamation of a biological process (living fungi) and familiar cultural object (garment) directly implicates the viewer within the work, setting up a platform of

negotiation with the biological life and the issues presented in an arts context. The doctoral research builds on this dynamic through the curatorial process in Chapter 7.0.



Figure 3: Donna Franklin, (2004), *Fibre Reactive* (detail), (from: *BEAP04 BioDifference: A Political Ecology* exhibition), *Pycnoporus coccineus*, silk, wood, Perspex, 198cm x 70cm x 70cm. Photographer: Robert Frith. (Copyright permission courtesy of *SymbioticA*).

As an art object, the work navigates contexts of arts, life science, commodity culture and the fashion industry. It examines the ethical implications of growing nonhuman life for artistic purposes. As a part of the research, these ethical considerations are debated by the addition of a complimentary symposium to *Creatures of the Future Garden* (Chapter 7.0). In this symposium, the artists debate the social and cultural implications of their artwork with the public.

In order to create this artwork, I practiced mycology (study of fungi) at the Faculty of Natural and Agricultural Sciences (FNAS) (UWA). This hands-on process implicit within

an artistic residency at *SymbioticA* involved attending OSH and practical laboratory sessions and lectures conducted by Professor K. Sivasithampraram and (FNAS) Student Practical Laboratories conducted by Senior Technician Gary Cass. These undergraduate units designed for soil science and mycology students focused on the identification, biology, use and behaviour of fungi, specifically in relation to agriculture and Australian ecology. Once I had established the correct protocols and demonstrated an understanding of mycological science, I was then able to experiment with potential artistic applications. In this situation, access to such facilities and knowledge in the life sciences was limited to a tertiary context. The research extends the possibilities of this through the implementation of hands-on life science activities in a secondary education context.

This direct engagement with the application of wet biological practices is a significant element in discerning my creative praxis from other forms of bioart within the field. This insight into the scientific applications of mycology and approach to knowledge dissemination became a significant influence and source of information for the public mycological workshops I developed and conducted in various art and educational contexts from 2006-2011. This experience led to the development of *Bio-Tech Evolution* detailed in Chapter 6.0.

Also during this residency, I attended the 11th *International Fungi and Fibre Symposium* in Denmark, Western Australia. Here I presented my masters research to a number of specialists including mycologists, chemists, environmental conservationists and textile artists. Participating in this activity demonstrated the creative communicative potential the work could have by crossing specialist disciplines. The research builds on these ideas by introducing the application of bioarts in the context of secondary education to encourage students to consider the relationship between their lifeworld, biotechnologies and the generation of art praxis. The process also demonstrated the scope of such bioarts practices as the topics addressed through *Fibre Reactive* and the materials used had the ability to transcend local and global cultural contexts.

This was most evident through the local, national and international interest in exhibiting *Fibre Reactive* within multiple contexts across the fields of contemporary arts, design, science, fashion and new media arts beyond the graduate exhibition in 2004. For the purpose of this research, I focus on the following exhibitions prior to my doctoral studies: *BEAP04 BioDifference* 2004, Australia, *Second Skin* 2006, Germany and *SymbioticA Showcase: ARS Electronica* 2007, Austria. These exhibitions contextualise my

background experience and demonstrate aspects of the field at the time. With each exhibition, I provide a reflexive engagement that clearly identifies significant relationships to the research. For information on additional exhibitions, please see curriculum vitae (refer to DVD).

BEAP04 Bio-Difference 2004

The Biennale of Electronic Arts (Perth) was established by Director Dr. Paul Thomas in 2002 and represented the first electronic arts event in Australia and in the Southern Hemisphere (2004, p. 1). Sequentially run from 2002-2008 each festival aimed to generate a critical engagement with contemporary contexts through new media arts, representing Australian and international artists. The event “examines...the intersection of art, science, and technology, by practitioners in the field of developing electronic technologies...[The events] focus on the need for dialogue and contextualisation to represent the current states in which we will find ourselves” (Thomas, n.d.).

BEAP04 was the second festival in the series and the second time biological arts had been exhibited in Perth in this capacity. The inaugural exhibition was held in 2002 as a part of *BEAP02*, at PICA (Perth Institute of Contemporary Art), entitled *BioFeel*, which is examined in Chapter 7.0. At this exhibition (2002), I was introduced to residents and personnel at *SymbioticA* and consequently began my artist residency in 2003.

The *BEAP04* program included “exhibitions, industry conferences, screenings of moving image content, 24 hour Internet hosted events, thematic workshops, public forums” (Thomas, n.d.) participants included critical theorists and creative practitioners who focus on the new media arts and in particular electronic arts. The selection process designated by the curators for the five exhibitions (Sonic-, Bio-, Data-, Perceptual- and Distributed-Difference) needed to demonstrate original research from 2002-2004. This criteria indicates the focus on contemporary cultural conditions and demonstrates how arts praxis can be used to examine and question current issues. The research adopts this approach through the development of *Bio-Tech Evolution* (Chapter 6.0), and *Creatures of the Future Garden*, (Chapter 7.0).

For *Bio-Difference: The Political Ecology* exhibition, curators Oron Catts and Ionat Zurr, selected the following artists or collectives: Hans Arkeveld (AU), George Gessert (US),⁶ *Bioteknica* - Jennifer Willet and Shawn Bailey (CA), George Dietzler (DEU) in collaboration with Gary Cass (SC), Marta de Menezes (PRT/USA), Phillip Ross (US),

Ken Rinaldo (USA), *SubRosa* - Faith Wilding, Hyla Willis, Lucia Sommer (US), Jun Takita (FR/JP), Polona Tratnik (SI), Paul Vanouse (JAM/US), Cynthia J. Verspaget (AU), and Stephen Wilson (US). The diversity of artists showcased here demonstrates the way in which bioarts practice can traverse across global contexts.

Having the opportunity to exhibit in this context provided an insight into the burgeoning field. The exhibition also included a symposium and artist floor talks by Phillip Ross, Marta de Menezes and Oron Catts. In this situation I was able to generate discourse with established practitioners and consider the conceptual and theoretical aims of *Fibre Reactive* in relation to others in the field.

Bio-Difference also identified the multiple approaches available in this field and how each practitioner engaged with the life sciences in different ways. However there were identifiable similarities. Also apparent in each of the works were several key agendas that are relevant to the aims of the research. Each artist had a particular interest in using their practice to draw attention to environmental concerns, generate a critical engagement with biotechnologies, or ethically consider the application/manipulation of life or “living systems” through art research (2004). The research builds on the agendas within these gallery-based forums by introducing bioart concepts into secondary educational contexts.

The exhibition demonstrated a number of bioart or interdisciplinary arts practices. The works examined developing biotechnologies and politics of manipulating biological materials for art and scientific purposes. Significant to this research, each work offered an alternative position to hegemonic institutions and exhibited wet biological practices in a traditional gallery space. As a gallery space that often exhibits traditional forms of art from significant historical and contemporary practitioners, there were strict regulations on the containment of biological specimens, especially fungi. This context therefore determined the final ‘museum aesthetic’ of *Fibre Reactive* (Figure 4).

This process also identified the levels of negotiation required in order to set up living biological art in an exhibition context, acknowledged by Gessert (2008) during his inaugural exhibition of hybridised iris plants (1970). Gessert refers to O’Doherty’s (1986) aura of the ‘white cube’ that continues to frame curatorial decisions and public expectations of the ‘art object’ (Raunig, and Ray, 2009). Furthermore Gessert (2008) suggests that developing bioarts practices could be housed in a space that is especially designated for a multipurpose use: As a site for wilderness, wet biology, education, and

hands-on art-science workshops. This approach to an exhibition space is developed further in the research and becomes a key influence on the curatorial decisions for *Creatures of the Future Garden*.



Figure 4: Donna Franklin, (2004), *Fibre Reactive*, (from: *BEAP04 BioDifference: A Political Ecology* exhibition), *Pycnoporus coccineus*, silk, wood Perspex, 198cm x 70cm x 70cm. Photographer: Robert Frith.
(Copyright permission courtesy of *SymbioticA*).

Second Skin, ENTRY06 2006 – How will we live tomorrow?

In 2006 I was invited to exhibit *Fibre Reactive* in *Second Skin* as a part of *ENTRY 2006*, curated by Ellen Lupton, in Essen, Germany. This exhibition was a sequel to Lupton's previous *Skin: Surface, Substance and Design 2002* exhibition at the Cooper-Hewitt, National Design Museum, Smithsonian Institution, New York City, USA.⁷

This required the organisation of biological quarantine clearance papers from the exhibiting country and for the flight from Australia. This process was also applied to *Creatures of the Future Garden*, Chapter 7.0. Where required, I followed quarantine regulations and protocols for biological material in selected national and international artworks.

ENTRY 2006 was used to launch the city of Essen as the 'cultural capital' of the year and to celebrate the transformation of one of Europe's largest coal mines and UNESCO World Heritage site, Zeche Zollverein, into a cultural hub. This space includes the location of the Zollverein School of Management and Design, extensive theatre, dance and orchestral performance venues, conference and exhibition spaces, restaurants, café's, site-specific museums, recreational facilities, parks, swimming pool and an ice rink.⁸

The agenda behind *ENTRY 2006* aimed to create a critical platform for the exhibition of design experiments and contemporary arts. Through exhibitions and accompanying conferences and publications the curators provided a forum to analyse the future implications of new technologies, biotechnologies and products on the environment and whole way of life. As curator Lippert (2006) states: "We are posing questions that effect everyone...How do we want to live tomorrow? How much risk will a society accept for scientific, medical and with these, finally economic progress?" (p. 33).

The exhibitions demonstrated potential futures in architecture and design that stepped into unknown territories – AI robotics, nanotechnology and stem-cell research. In this climate of product development and consumer goods, it became crucial for curators to pause "to consider the social and ethical dimensions of a development that uses design intervention to substitute artificial nature with the real thing" (Seltmann, 2006, p. 7).

Second Skin was a part of three hundred exhibits and forty design / product launching events. The exhibition included pieces that traversed across design, architecture, fashion, new technological innovations, health and media. Enclosed in a darker room entitled '*Beauty, Horror and Biotechnology*' my work was shown in the context of future fashion and biotechnological developments that had a particular focus on body alteration. As a participating exhibitor, my work was framed by global discourse. This exemplifies how bioarts practices easily traverses into global contexts through the technological associations.

From this experience I identified that the artwork produced for my masters could traverse a number of contexts in the field due to the way in which it combined life science, fashion technology and art praxis. The research opens up discourse beyond the contexts of fashion, garment and human body-biological interface to incorporate the sociological, environmental and educational capacities of an engagement with biological arts. This becomes an important position to the development of the research as it considers the broader implications of producing bioartworks and extends its communicative application. By situating the research in relation to broader cultural discourse the bioartworks produced aim to facilitate a reflexive engagement with contemporary cultural conditions in light of incoming biotechnologies. Developing connections with sociological, environmental and educational contexts through dialogue is essential if the research intends provide an alternate position to corporate influence on the lifeworld and nonhuman engagement.

What was also evident in this particular exhibition context is that the practice of bioarts was located within the periphery of the mainstream arts practices at the time. The implications of this dynamic is developed in the research in relation to Shanken (2011) theories on arts institutions governing arts practices in the Literature Review 3.0.

Including *Fibre Reactive* within this context there were only three representations of bioarts as defined by this research. This included *Biojewellery*⁹ grown from human and bovine bone marrow cells by “Tobie Kerridge and Nikki Stott in collaboration with Ian Thompson” (Birringer, and Danjoux, 2009) and an installation of coleus plants modified through selective breeding by George Gessert.

Gessert’s work entitled *Origin*, “intended to show how breeding and selection are a part of human culture” (Raderschad, 2006, p. 33). By asking viewers to pick their favourite plants Gessert reasons “Exhibition visitors are thus deciding with almost God-like power which plants will continue to exist in the future and which will not” (Lippert cited in Raderschad, 2006, p. 33). Gessert’s interactive approach is one I develop through the research and demonstrates the multi-method approach to the praxis. Through this process the research develops the capacity of art to be used as a form of communication. Gessert’s work will be examined further in the Literature Review 3.0, as a one of the founders of the bioarts field. He is also a participating artist in the curated exhibition, *Creatures of the Future Garden*, Chapter 7.0.

ARS Electronica 07, Linz, Austria

Hybrid Arts: SymbioticA Showcase Exhibition 2007

The *SymbioticA Showcase Exhibition* was a part of the *ARS Electronica 07* Festival in Linz, Austria, the works shown in the O.K. Centre for Contemporary Arts. At this event, *SymbioticA* was awarded the Golden NICA prize for the inaugural Hybrid Arts Category. This was an acknowledgement of the unique approach *SymbioticA* had in facilitating a critical engagement with life sciences and facilitating hybrid arts. This award indicated the establishment of the centre as a driving force behind the bioarts field in Australia and demonstrated the recognition of its global outreach (Pandilovski, 2009). As stated by the curators (2012) “The five works chosen represent the diversity of practices in SymbioticA,...molecular biology, mycology, tissue culture, entomology and biological materials gleaned from animals...express a wide scope of concerns stemming from the use of living systems/materials for human-centric ends” (para). Participating artists included: “Paul Vanouse (USA) – *Latent Figure Protocol*, Boo Chapple (AUS) – *Rat Tails*, Donna Franklin – *Fibre Reactive* (AUS) Nigel Helyer (UK/AUS) – *Host*, Tissue Culture and Art Project (AUS) – *Worry Doll G*” (ibid). Participating in this context provided a first-hand look into one of the established infrastructures that support new media arts.

The *ARS Electronica Festival* is examined further in the Literature Review 3.0 in relation to its development as an institution. In terms of artworks shown this exhibition also demonstrated that the form of biological art was a peripheral activity to mainstream arts - contextualised as a form of hybrid arts. This demonstrates the relationship between the institution of arts and individual arts practices, particularly in reference to Bourdieu’s concept of “plotting the field” (1993). An artist can locate their practice and frame their discipline in relation to the discourse set up by arts institutions, funding bodies and critics. According to Bourdieu (1993), the artist must do business with each of these institutions in order to generate cultural capital.

The research extends the possibilities of this process by introducing a different approach to the curation of an exhibition that seeks to cross boundaries between secondary, tertiary, local, global contexts and through the exhibition of artworks outside usual arts exhibition contexts. In this way the research develops a two-way relationship between the artist and the institution by initiating a different approach to art dissemination and development of art mediums (Sullivan, 2004); As was demonstrated in the case of *ARS Electronica*’s development of a ‘hybrid arts’ awards category in response to the activities

at *SymbioticA*. In this example the artists generated their own artist-run spaces that contribute to the pre-existing infrastructures that support them, instigating cultural and economic capital (Shanken, 2011, Bourdieu, 1993).

2.2 Fungi Art-Science Workshops in an arts context for the public participation

This previous work has also extended beyond the gallery space in the form of fungi and art workshops I have conducted at the *Mundaring Arts Centre*, Perth, as part of the *Annual Truffle Festival* held in Mundaring, Western Australia. During these lectures and workshops participants were introduced to local fungi, informed of their environmental importance and practiced hands-on mycology. I also used this opportunity to promote the work of the *Perth Urban and Bushland Fungi Group*.¹⁰ Through this experience the participants had the opportunity to engage with fungi beyond their commercial and culinary value. This acted as a form of re-appropriation of knowledge, re-positioning the viewers' understanding of fungi in relation to their ecological significance. A critically reflexive engagement with the nonhuman life beyond the mainstream contexts of commercialisation has become a pivotal marker for the development of the research agenda. By using a multi-method approach, I would like to propose that this process of information via communication through bioarts praxis becomes a site of social agency in the lifeworld (Giddens, 1990; Habermas, 1987; Sullivan, 2009).

2.3 Collaborative Bioarts Praxis:

Micro 'be' Fermented Fashion (Micro 'be' Project)

The activities and some key philosophies established in this collaborative work, although not a focus or part of the doctoral research, have led to the development of *Bio-Tech Evolution*, Chapter 6.0.

Concept and Technique

Micro 'be' is an on-going collaboration with Gary Cass, which received a New Concept and Young People and the Arts award from the Department of Culture and the Arts and an additional artist residency at *SymbioticA* in 2006.¹¹

The *Micro 'be'* garments are grown by aerobic fermentation using microbiology in-vitro culturing. This process consists of a colony of *acetobacter* bacteria that produce a skin as they convert wine into vinegar. As in *Fibre Reactive*, the form of garment was chosen

to draw parallels with its role as a form of cultural identity and social communication in relation to the lifeworld (Farren & Hutchison, 2004; McLuhan, 1964). The series of works entitled *Alterations* (2008) (Figure 5), *Metamorphosis* (2008) and *Decay* (2008) (Figures 6-7) focus on the raw fleshy elements of the biological processes. The aim was to draw attention to the implicit associations the human body has with nonhuman bacteria. These images are frequently shown alongside the actual garments themselves to provide the viewer with both the 'wet biological' aspect and 'dry' outcome of the work. The following artist statement further contextualises the work.



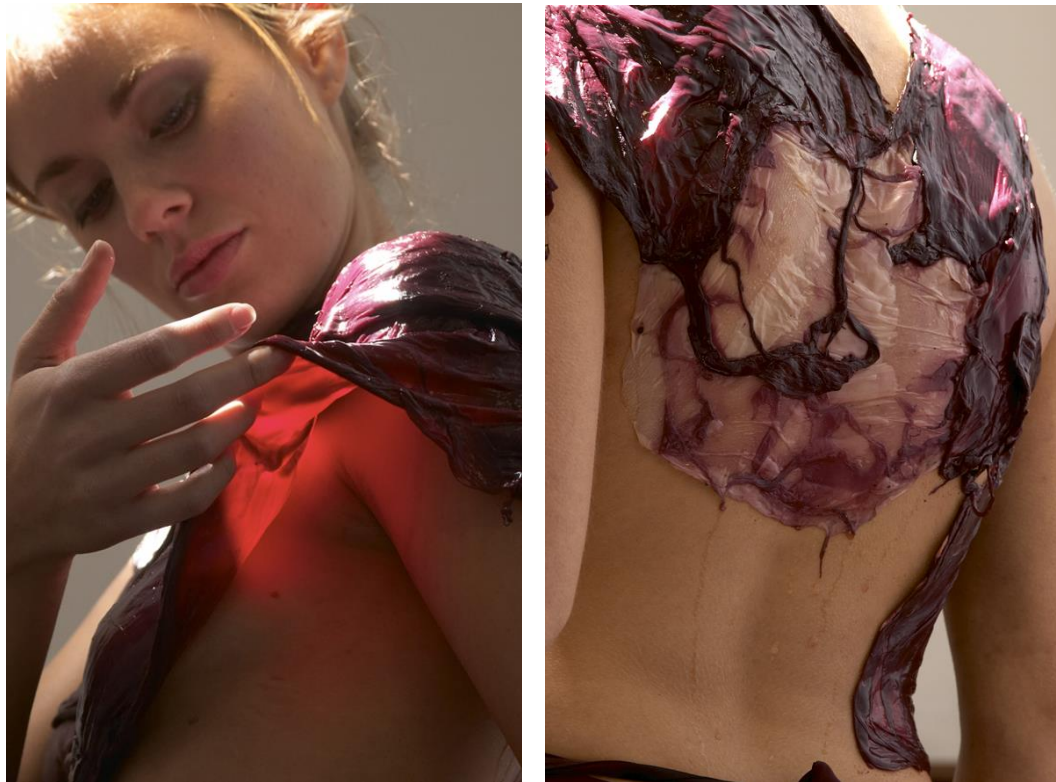
Figure 5: Gary Cass & Donna Franklin, (2008) *Alterations, Micro 'be' Fermented Fashion*, Metallic Print, 69cm x 58cm. Model: Jennieka Chattelle, Photographer: Ray Scott.

Artist Statement

Collaborators Gary Cass and Donna Franklin examine the aesthetic and fetish aspects of fashion. To consume is an act of acquiring status symbols (De Botton, 2004). By acquiring status symbols, we gain a sense of individuality. These symbols constructed by culture industries to maintain dominant ideologies within a society. Does fashion as one of the cultural tropes of identity, reinforce this illusion of individuality? "The visceral and biological nature of this work contradicts the fashion image in which the subject is

permanently suspended in time and unaffected by environmental conditions a reality of physical beauty is its inevitable decay” (McKnight, 2008). To modify the body through cosmetic surgery is an attempt to create material perfection and halt time, based on ‘the ideal’ human form. However, to skin or be skinned removes/adds the outer layer that creates difference, in so doing revealing the physical truth. It is an aim to draw attention to the ethics of textile production and change the current disassociation from the natural world. By going beyond the current anti-bacterial sterile world we have created, and infiltrate the potential new future life-world of the everyday. This new future will engage with the possible integration of the monstrous; which may be visually and fragrantly aesthetically hideous to one; yet attractive to another. The *Acetobacter* bacterium is a single celled organism – and is potentially immortal unlike ourselves who are multi-cellular. Death is a multi-cellular trait. “Death reveals the fragility and so perhaps the worthlessness of the attentions we stand to gain through status” (De Botton, 2004). “The use of wine intensifies the abject qualities of the fleshy material, being tied to the act of swallowing and consumption” (McKnight, 2008)

It has always been the intention to present the viewer with the sometimes, uncomfortable visceral qualities of the ‘wet biological’ process itself. This distinction between the representation of biology through documentation (photography) and the actual physical presentation of biological processes or living entities is a significant aspect of the bioarts praxis, secondary education art-science course and curated exhibition within the research. This agenda links to various artists within the bioarts field developed in the Literature Review (Chapter 3.0) as a key theoretical framework for the research. The research builds on this tension by setting up a framework for the viewer to consider their everyday, ethical and cultural relationship towards the wet biology on display within multiple contexts. This is achieved through the introduction of these wet biological practices into an educational context (Chapter 6.0) and through the selection of artists for *Creatures of the Future Garden* (Chapter 7.0).



L-R: Figure 6: Gary Cass & Donna Franklin, (2008), *Decay, Micro 'be' Fermented Fashion* (from: *Skin to Skin* exhibition), light box, 60cm x 42cm. Model: Jennieka Chattelle. Photographer: Bewley Shaylor. (Copyright permission courtesy of Fremantle Arts Centre).

Figure 7: Gary Cass & Donna Franklin, (2008), *Mutamorphosis, Micro 'be' Fermented Fashion* (from: *Skin to Skin* exhibition), light box, 60cm x 42cm. Model: Jennieka Chattelle. Photographer: Bewley Shaylor. (Copyright permission courtesy of Fremantle Arts Centre).

Over the last eight years (2006-2013), Cass and I have presented artworks and workshops locally, nationally and internationally. These activities have been located in multiple public spheres including museums, galleries, corporate events, conferences, secondary and tertiary institutions, lifestyle events, science festivals and via the mass media. Our motivation in doing this is to reach as many different viewers as possible to communicate our key concerns. This included our ethical position regarding new technological innovation, and a stake in promoting art-science collaboration. For Cass in particular there was also an educational agenda, in the hope that the works will encourage individuals to have an interest in microbiology and develop future art-science collaboration. See list of relevant publications in section 12.0.

By contrast, bioarts practices using these technologies could also be seen as a direct response to “biology’s ascent to the status of ‘hottest’ physical science” (Hauser, 2008, p. 8). Following this, it could be argued that they form more celebratory and spectacle related communicative outcomes, akin to those promoted by the mass media and culture industries. The context of the mass media only allows a superficial level of engagement with information as cited in the Literature Review (Chapter, 3.0) by Sturken and Cartwright, 2009; Adorno, 1991 and Giddens, 1991. The hype surrounding this form of art of which I have been complicit, challenges my critical communicative position of presenting a bioarts practice to one of conformity and normalisation. This mediation and appropriation of the artworks is most aptly represented by the cartoon *Dressed to the nines by the vines!* (Figure 8). Through this depiction, it became a celebratory tribute to the research while at the same time making the technology familiar and valued for its novelty rather than critical commentary in the public eye.

This process opens up the dialogue of bioarts beyond the context of the gallery space, but also domesticates the biotechnologies used in *Micro 'be,'* and its potency in communicating the original conceptual concerns. As a way to gain control over the dissemination of my bioarts practice and its use of biotechnologies, I present talks and art-science workshops for the public to engage directly with biological life. The intention is to provide access to the life sciences beyond the context of the laboratory, using the bioarts praxis as a vehicle to develop more interaction between human cultural activities, technology, biology and the environment.



Figure 8: Author unknown, (2007), *Dressed to the Nines by the vines!* Illustration, (from: *Grapegrowers & Vignerons*, May Issue, p. 11), 10cm x 15cm. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Secondary Education Workshops and Lectures

My experience in conducting and facilitating art-science workshops was also taken further through the *Micro 'be' Project*. This activity developed from requests to present lectures at secondary educational institutions across Perth. Within these lectures, we focus on encouraging the students to 'think outside the box' and to demonstrate what interdisciplinary research, constant questioning and critical thinking can achieve. Our aim is to encourage students to consider applying the reflexive methodologies used in the project to their lifeworld to foster a different approach to their learning by crossing disciplines.

2.4 Summary

As discussed in this section from my previous experience in the field of bioarts, key creative and conceptual activities have emerged. The development and extensive exhibition of the artwork *Fibre Reactive* has highlighted the way in which the piece can examine the tensions created between the commodification of nonhuman life and its manipulation for artistic ends. The piece also identified how an artwork can traverse multiple contexts. In addition, real-time engagement with such practices can encourage the viewer to consider their own relationships to the environment and the wet biology that is on display (Hauser, 2008). This position links directly to the research question, in that it provides a way to examine contemporary engagements with nonhuman life through interaction with an arts piece.

The previous exhibition examples identify significant influences on the development of the research. Each exhibition demonstrates the way in which the practice of bioart can traverse multiple contexts, through subject matter. This is particularly relevant for the multi-method approach I apply to the research. This section has also determined the way in which cross-disciplinary activities and collaboration develop new media practices, beyond the contexts of each specialist framework. This is most relevant to the development of *Bio-Tech Evolution* in the research. My previous experience in conducting workshops and lectures highlight a different way to communicate science to multiple audiences, but particularly in reaching young adults. The engagement with young adults aims to be a key trajectory throughout the research. This is a crucial element, as they are the ones who will influence interactions with nonhuman life for future generations.

3.0 Literature Review

Theoretical Framework

The literature review provides an examination of key areas relevant to the study to position the research in the contexts of science communication, art, and education. The literature uncovers the theoretical frameworks that the research builds on in each of these contexts. This is used to acknowledge the communicative capacities of the research as it traverses these fields, by using a multi-method interdisciplinary bioarts praxis. The research builds a network across art, science and education and explores how they can intersect. The examination of these areas are organised into four main sections.

Section 3.1 introduces discourse on the contemporary hegemonic contexts that currently frame how nonhuman life is understood and cites key theories from scientists, sociologists and environmentalists in the fields of the life sciences, biotechnologies and cultural studies. There is a particular emphasis on the contemporary concerns and issues raised by voices in these fields relating to our engagement with nonhuman life in a biotechnological and capitalist context.

By way of introduction to this section I examine key ideas from paintings by Joseph Wright of Derby and Jacques Louis David, Cabinets of Curiosity, and the Great Exhibition. These examples demonstrate the relationship between cultural ideology and nonhuman engagement. Following this is a contextualisation of key concepts that the research intends to navigate such as the “lifeworld” and “systemic colonisation” (Habermas, 1987). This follows with an analysis of the relationship between art communication and individual reflexivity as a way to navigate hegemonic systems in the lifeworld (Giddens, 1990; Crouch, 2007; Barret and Bolt, 2007; Sullivan, 2010). The aim is to set up a premise of art as part of the social realm and providing an alternative voice in the lifeworld. I refer directly to the works of Giddens, 1990; Habermas, 1987, 1989; Husserl 1936; and Sullivan, 2008, 2010.

Section 3.2 identifies relevant local and global practitioners in the field of biological arts and related theoretical discourse that underpins the research. I define key terms as used in the field. I refer to the arguments for and against bioart practice and its use as a term as presented by artists and scientists in the field. This section demonstrates how

artists actively situate and contribute to cultural understandings of the lifeworld, using their practice to navigate the hegemonic institutions and processes of systemic colonisation. Each practitioner selected demonstrates a hands-on approach by learning the relevant science, and reappropriates the technology outside of dominant discourse (mass media, corporations). Key practitioners relevant to the aims of research and application of bioarts praxis include; George Gessert, Tissue Culture & Art Project (TC&A), Stephen Wilson, Eduardo Kac and Brandon Ballengée.

Section 3.3 examines key contemporary local and global art-science spaces *Leonardo*, *ARS Electronica*, *Arts Catalyst*, *ANAT*, *SymbioticA* and the *Science Gallery*. And; the final Section 3.4 develops concepts relating to interdisciplinary education models. This section also includes examples of Australian art-science activities operating in the field of science communication and environmental conservation. The reference to these examples is used to situate *Bio-Tech Evolution* (Chapter 6.0), and the addition of *WA Birds of Prey Centre Workshop* in *Creatures of the Future Garden* (Chapter 7.0).

3.1a Contexts that shape contemporary engagements with nonhuman life: Hegemonic institutions, system colonisation, the individual and the lifeworld

3.1a.1 Historical precedents that frame engagements with nonhuman life

This section provides a brief insight into some of the historical precedents through which the public has engaged with nonhuman life in an industrialised context. I focus on the Cabinet of Curiosities 14th-15th Century Europe, paintings “by Joseph Wright of Derby, *Experiment on a bird in an air pump*”, (National Gallery London, n.a., n.d.) and Jacques Louis David: *Antoine-Laurent Lavoisier and His Wife*, (1788), and the *Great Exhibition* 1851. These examples “show the origins of different ways of thinking as non-human interaction started to be more closely considered” (L. Edwards, personal communication, October 6, 2013). They also show that cultural understanding shapes how we interact with nonhuman life, which in turn shapes attitudes towards their treatment (Rothfels, 2011). The inclusion of this section highlights the theoretical frameworks and ideologies that lead to contemporary institutions such as museums and is particularly relevant to *Creatures of the Future Garden* detailed in Chapter 7.0.

Cabinet of Curiosities

The collection of specimens for use in the private space of the home argues Rothfels (2011) demonstrates an ownership of animals and the natural world. In addition he states that this process also becomes a “constructed understanding of [animals] through taxidermy – capturing a cultural history of power in a tableau. Each scene sets up an imagined story for an imperishable form”. This process demonstrates how the collecting and display of specimens were used to locate the human in relation to the nonhuman. This process was epitomised by the development of the Wunderkammer. In the sixteenth century the collecting and display of artworks with fossils, ancient texts, specimens and scientific implements were not exhibited following strict conditions, but were more a show of the intellectual status of the educated Renaissance gentleman. Initiated in Germany and later enthusiastically adopted across Europe. The act of creating a Wunderkammer affirms the individual’s dominance of nature, displaying their intelligence, familiarity and sense of taste through the diversity and intricacy of assembling artefacts, tools of science and unusual biological specimens (2013).

According to sociologist, Raymond Williams (1976) it is through our engagement with objects that we generate meaning to understand the cultural contexts we inhabit. During this period art was entertainment, valued as a form of aesthetic pleasure and separate from every-day life and therefore not about social agency (Crouch, 1999). This separation from the social represents the antithesis of my bioarts praxis. It is also interesting to note, that as the process of collecting gained popularity it shifted from an elite practice into the broader social realm as “the emerging middle-class clamoured for their own smaller collections,...ready-made small cabinets of curiosities, often with secret compartments, pre-filled with curiosities...available for purchase” (2013). This demonstrates the relationship between commodity culture and lifeworld practices, and colonial superiority. The individual adopts cultural activities to generate a sense of self-identity through product consumption. The process of observing, collecting and categorising life in this way demonstrates how we use the natural world to shape an understanding of ourselves. It also demonstrates how ideologies of a human-centric position in the natural world are quickly accepted and practiced, framing further individual actions towards nonhuman life.

An Experiment on a Bird in the air pump, (1768), Joseph Wright of Derby (1734-1797)

Prior to these works, the visual amalgamation of art and science was depicted through seventeenth-century horticultural engravings. This process of recording grafting plant

techniques was a culturally established way of understanding the natural world. These examples demonstrate the relationship between science and arts through representation. The painting *An Experiment on a Bird in the air pump* however takes this experience to a new level. It represents the depiction of early engagement with nonhuman life as framed, mediated and manipulated by technology (Figure 9). This work can contextually read both symbolically and ideologically. Firstly through subject matter the painting depicts Wright's lifeworld activities. As a member of the 'Lunar Society' he would join a social gathering of intellectuals in the United Kingdom at each full moon. At these dinners individuals illustrated and conducted scientific investigations and debated "the latest developments in chemistry, medicine, electricity, gases... [noted members included]...Josiah Wedgwood, the ceramics manufacturer; James Watt, developer of the steam engine; Joseph Priestly, chemist; and Dr Erasmus Darwin" (Egerton J. and Fraser, D., 1990).

Secondly it represents the on-going dialogue between arts, science, and technology in the social realm. The painting shows a series of individual reactions to new technologies, life, and death: "from the frightened children, to the reflective philosopher, the excited interest of the youth on the left, to the indifferent young lovers concerned only with each other" (Uglow, 2008). This piece reflects Wright's "interest in the portrayal of the theme of human mortality, presenting a spectacle of death in the context of the Laws of Nature" (ibid). It frames the science as a way to understand the natural and physical world. This painting is further contextualised by the cultural intellectual movement of the time; the period of the Enlightenment – which became a nexus of scientific exploration, religion, philosophy and debate.

In this climate many scientific discoveries began to break down traditional ways of thinking about the natural world and our place within it. In this way, the period of the Enlightenment offered a new approach to human / nonhuman dichotomies through evidence of the physical similarities. Through industrial production however, it also reinforced the concept of man as superior to the nonhuman, a legacy of religious ideologies. This position was turned on its head by the works of naturalists, collectors and geologists. Most notably research by social activist, naturalist and evolutionary theorist Alfred Russell Wallace and publications by Charles Darwin; *On the Origin of the Species* (1859) and *The Expression of the Emotion in Man and Animals* (1872).

This demonstrates how science maps but also changes the understanding of our place in relation to nonhuman life and the physical environment. The painting also shows how science was a part of the everyday through display, travelling exhibition and debate. The

painting depicts how developing technologies shape our engagement with the nonhuman. This is most pertinent to the research as I explore contemporary influences of biotechnology on nonhuman life. It can also be seen as a reflection of current aristocratic entertainment, education and demonstrations of status and intellect; as scientific experiments travel across the country and are shown in domestic spaces.



Figure 9: Joseph Wright of Derby, England, (1768). *An Experiment on a Bird in the air pump*. Oil on canvas, 183cm x 224cm. National Gallery, London. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Antoine-Laurent Lavoisier and His Wife, (1788), Jacques Louis David (1748-1825)

As a prominent artist, Jacques Louis David was commissioned to paint “in the service of royalty...however he also depicted radical revolutionaries” (Galitz, 2004). Representing scientists through paint, David celebrates more radical enlightenment ideals through a very traditional and often elitist medium. This demonstrates the life world contexts that influenced David who dedicated his talents to producing works commissioned by aristocrats and popes while also “depicting classical Greek images; changing and transforming them with contemporary politics” (2002-2014). This is demonstrated by his alliance to the French Revolution illustrated in portraits of Napoléon and the painting *Marat Assassiné (The Death of Marat)* 1793.

The selected painting is an exemplar of his leading technical and conceptual approach in the French Neoclassical style “rigorous contours, sculpted forms, and polished surfaces”. This double-portrait (Figure 10) depicts two of scientific histories early

chemists. Antoine-Laurent Lavoisier (1743-1794) was famous for his revolutionary research into oxygen and gunpowder. His dissertation “on chemistry illustrated by his wife Marie-Anne-Pierrette Paulz (1758-1836) who had a passion for chemistry that matched her husbands” (2000-2013).

Conceptually like the piece by Wright, the work represents a precedent to bioarts by visually amalgamating art and science placing them on an equal footing. This can be seen through the visual clues of Marie-Anne-Pierrette Paulz’s drawing portfolio and by the painter’s choice of subject matter itself.



Figure 10: Jacques Louis David, (1788), *Antoine-Laurent Lavoisier and His Wife*, Oil on canvas, 259.7cm x 194.6cm. Metropolitan Museum of Art. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The act of painting this portrait and science as a subject matter was unusual for David as it differs greatly from all of his collected works. As opposed to his focus on classical Greek imagery, this painting most importantly represents an interest in science as the artistic subject and like Wright’s painting reflects the cultural climate. The painting demonstrates the way in which science continued to shape and influence cultural understanding. The painting alludes to an inherent respect for scientific endeavour and

scientific-based rational thought. David idolises the innovators, by contrast Wright shows the public's fear and confusion. These works therefore reflect the context of the time and ideologies of the Enlightenment where knowledge advances through science.

The depictions of science in each example raise a series of key theoretical positions and issues. Firstly, the works give scientific experiments an aura of authority while also allowing philosophical debate. Secondly, both paintings demonstrate how art could engage with the aesthetic and cultural conditions of the time. In addition, the works frame science as a part of the social realm. This is most explicit in Wright's work where viewers engaging with the experiment demonstrate multiple cultural positions to the technology and respond accordingly.

The Great Exhibition: Crystal Palace 1851, London, United Kingdom

The purpose of this section identifies historical art-science precedents applicable to the curatorial language used in *Creatures of the Future Garden*, Chapter 7.0. In referring to the *Great Exhibition: Crystal Palace*, this example provides background of how this type of space is analysed by scholars in the field of museum studies. This example and the cultural contexts that surround it illustrate the associations between institutions, the lifeworld and viewer engagement with nonhuman life or scientific technologies. These examples show how influential the museum context is in establishing a cultural and scientific engagement with the world through the display, collection and representation of objects. Whether natural, artificial, dead, alive, human, organic, inorganic, or representational (Alberti, 2005), these objects change in response to the cultural ideologies of the time. In conclusion, links are made to contemporary issues surrounding audience engagements within the museum context.

The *Great Exhibition* of 1851 encapsulates the fusion of art-science, in an early 'curatorial' setting under the roof of a symbol of industrial and engineering growth (L. Edwards, personal communication, May 15, 2013). Contemporaneously the artefacts from this exhibition are now in the Victoria and Albert Museum and formalised by The Royal Commission, "to increase the means of industrial education and extend the influence of science and art upon productive industry" (cited by Robertson, 2004, p.1). The Crystal Palace, designed by Joseph Paxton, was the first prefabricated large-scale building of its kind. It showcased the latest scientific inventions alongside natural wonders initially only for the wealthy to enjoy. As Crouch asserts it represented "a rejection of the past [and] a symbol of culture in which the relationship between human society and the natural world had become formalised through the mediation of science and the processes of mechanisation" (1999, pp. 11-12). This is exemplified by the way

the building also completely enclosed mature oak trees. In addition there was a merging of Renaissance thought with contemporary scientific endeavour. Through this, art, philosophy and scientific practices co-evolved. Science was “no longer something to be investigated to confirm reasoned deduction; the unknown was now seen as the potential holder of all manner of information” (Crouch, 2001, p. 16). Investigations into the microscopic natural world paralleled with anthropological studies and sociology (Crouch, 2001). This theoretical approach frames both science and art as tools to understand the world.

Through the *Great Exhibition* at the Crystal Palace 1851 and later the Victoria and Albert Museum: “[Prince] Albert envisioned a metropolis of learning, organized around the production of useful knowledge...He saw the benefits of learning based on objects” (Robertson, 2004, p. 2). This educational approach to the collection, display and development of exhibition spaces sets up a historical precedent to the research. By engaging with objects in this way, the exhibition highlights how such interaction helps determine an understanding of the cultural environment at the time.

It is only in recent history (1940-1960) that art and science disciplines have evolved separately; supported by different infrastructures, with different objectives, methods and theoretical positions. This reinforces the position of the research as it traverses art, science and education to communicate human engagements with the nonhuman. This act of communication and reflexive analysis of contemporary cultural conditions situates the bioarts praxis in the social realm. As established by the previous examples, the philosophies of Enlightenment combine intellectual thinking from both science and the humanities. This included debate and reflexive engagement with technologies as they developed. In terms of the wet biological practices involved in contemporary bioarts, Burbank in 1892 provides a precedent through his philosophical approach and methods. He considered plant breeding to be an art form: “He consciously viewed his work as art and considered that he did with living plants is the same as what a potter does with clay or a painter does with colour” (Popper, 2002, p. 53). Likewise, 18th century botanists and their engagement with early phycology and mycology demonstrate this approach. These intellectual amalgamations between art-science are verified through the philosophies behind the development of the Victoria and Albert Museum.

As Robertson (2004) suggests the foundation for science education determined by Prince Albert, Thomas Huxley and Henry Cole (1845) developed through the founding of museums/institutions of higher learning that encompassed multiple disciplines. During this time through the collection and presentation of specimens they also extended the

outreach beyond the traditional "...'exhibitionary [sic] complex' to menageries and circuses" (Alberti, 2005, p. 10). In contrast to its contemporaries the British Museum and the National Gallery, the "Victoria and Albert Museum was committed to the notion of purposeful educational activities directed consciously to its audiences" (Robertson, 2004, p. 4). They wanted an association to develop between the arts, sciences and industry. This process enhanced by the extended hours the museum was open, so that industry workers could also attend (Forgan, 2005). Robertson (2004) also describes Cole's interest in creating laboratories that were interdisciplinary, located in the Department of Science and Art (1867). Robertson (2004) follows citing (Forgan and Gooday, 1996) that as a result Huxley deliberately relocated his laboratories next to Cole's in order to actively engage with the "Museum's art galleries" (p. 3). This places emphasis on the science museum as a contributor to broader cultural understanding through cultural production. It also acts as a precedent for the multi-method approach to spaces that the research intends to advocate.

More recently, Amodio (2004) echoes Cole's theoretical position. He identifies that museums and "Science centres have an increasingly strong social role...[Developing an] of awareness of the importance of science and technology on society...as a place of life-long education and of informal learning" (cited in in Rodari, and Merzagora, 2007, p. 3). The museum as an institution is culturally seen as a voice of authority. The selection and presentation of artefacts and specimen collections are to an extent pre-determined by dominant ideologies within a given cultural context.

The museum context offers a space through which the individual can make sense of the cultural contexts that frame their life world. Of particular relevance to the research, scholars in the field have also debated how this is facilitated through engagements with specimens and objects in the museum context. How the displays are organised, categorised and represented reflects the cultural ideologies of the period, likewise viewer reactions to animal or human remains are also historically and culturally contingent. As the following example cited by Forgan (2005), demonstrates "naturalist and writer Eliza Brightwen's sympathetic reaction to a zoological display" emphasises the consideration required in showing taxidermy remains: "...'Looking at the section of the ox-horns', she wrote in 1892, 'one shudders to think of the agony of suffering the animal must endure when its horns are sawn off'..." (p. 571). This indicates the need to develop a methodological approach for the research in terms of data collection of viewer responses to artworks produced within the praxis. It also demonstrates how broader cultural conditions and ideologies frame this experience.

The canon of exhibiting taxidermy remains is still a staple approach today for many natural history and science museums. Through the inclusion of 'wet biological' practices, the research offers a unique experience for the viewer. To present living material in this context requires additional ethics and quarantine clearance, and does not sit easily within the parameters of a traditional exhibition space. The addition of 'wet biology' in the praxis aims to engender a sense of empathy as experienced by Brightwen. In a contemporary context where day-to-day living is increasingly urbanised and the realities of animal production and consumption kept a distance, the bioarts praxis builds a bridge between the lifeworld and these processes of systemic colonisation. As Forgan (2005) posits, "How do museums mediate between culture and commerce, a challenge that is all too obvious in the modern museum, which has ever-increasing space devoted to consumption?" (p. 581), adding another controlling dimension that illustrates the reach of commercialisation on cultural production. This has the potential to generate standardised museum model and spaces, reflecting the relationship between economic and cultural capital.

3.1a.2 Contemporary contexts that frame nonhuman life

This section identifies current debates surrounding the issues raised by our engagement / disengagement with the environment in a contemporary industrial context. Drawing on theorists, sociologists and scientists, I argue that the values in a culture have fundamental impact on the cultural understanding and manipulation of nonhuman life. There is a particular focus on industrial and corporate hegemonic contexts in setting up the contemporary framework for nonhuman engagement.

The historical influence of Industrialisation

As a part of the industrial revolution, the natural environment was considered a resource, such as mining and industrial agriculture. Through this process, the natural world becomes de-contextualised, isolated from its origin, and even standardised – as in the case of popular plant and animal breeding for sale and distribution (Gessert, 1994). Ponting (1998) describes the rapid assimilation, production and consumption of technologies that have developed during the nineteenth and twentieth centuries, "Technological change occurred in a series of 'waves'. New technologies were adopted, creating new markets and rapid growth was followed by saturation...before another wave developed...[including] steam power, mass production of textiles, iron, steel...railway construction, electricity and chemical industry" (p. 55).

These technologies fundamentally transformed the cultural engagement with the natural world and the ultimate shift from the “pastoral agricultural world to the social factory” (Hardt and Negri, 1993, p. 191). This history also indicates the close relationship between commodity consumption/marketing/demand and pace of technological advancement. Ponting (1998) continues to identify that these products for the most part, have historically been perpetuated within wealthy minority contexts, however the impact of this level of consumption in the twenty-first century is now acknowledged as global phenomenon; such as e-waste, out-sourced mass production / manufacturing, environmental degradation.¹²

As previously identified through the collection of curiosities and *Great Exhibition*, nature is framed through a lens of culture, specific to its time and place. Since the period of Enlightenment, many minority world “societies have experienced a hasty transformation from rural life [to a lived experience based] in a manufactured world of artificial products and [urbanised] settings” (Beck and Katcher, 1996; Gullone, 2000, cited at 2009 *RSPCA Australia Scientific Seminar*). Not to be mistaken as nostalgia for the past (pre-industry), I refer to this history in order to demonstrate the reality of its impact on contemporary contexts and its cultural and environmental implications.

To understand these conditions and the interplay between technology, commodity and nonhuman engagement is central to my bioarts praxis and its communicative efficacy. Contextualised by research conducted in wealthy minority world culture the following statement reinforces our current situation: “For the first time in known history, people are spending little to no time with the living environment” (Katcher and Beck, 1987, cited at 2009 *RSPCA Australia Scientific Seminar*). As shown in the U.S., “a study published in the *Journal of Environmental Management*, found that per-capita visits to the U.S. national parks have been declining for...twenty years...as a result of people watching television, movies, playing video games and surfing the web” (Suzuki, 2010, p. 208). Most pertinently children are no longer engaging with nature outside a controlled or mediated experience such as electronic media, zoos and suburban parks (RACP, 2004; Jones, 2011). As the research conducted by Moore and Wong 1997, White and Stoecklin 1998 showed, parents increasingly focus on structured activities, such as additional learning and sports – replacing free-play time outdoors. As White expands (2004): “Childhood and regular play in the outdoor natural world is no longer synonymous” (n.p.). Further citing Pyle (1993) he calls this “the ‘extinction of experience,’ which breeds apathy towards environmental concerns” (ibid). These arguments are echoed by Kellert (2002) who states that society today has become “so

estranged from its natural origins, it has failed to recognize our species' basic dependence on nature as a condition of growth and development".

This 'extinction of experience' is akin to McKinney's (2002) concept of 'environmental generational amnesia'. Likewise in the *Journal of the Science Teachers' Association of Western Australia (SCIOS)* "Dr Alan Donaldson, U.K. explorer, scientist and educator" is troubled that the increasing over-protection of children from natural world through direct contact and free-play is denying them the opportunity to develop "observing and building skills". This as a result leads to a lack of the "multiple benefits" that can be gained from interactions with nature, "such as increased concentration, independence and an appreciation for the environment that will be reflected in our decisions and actions" (2009, p. 9). The research aims to reinvigorate the importance of these interactions through an art-science secondary education course and curatorial exhibition.

By developing a course that places emphasis on the Australian environment, the student's awareness of surrounding ecosystems and nonhuman life is emphasised. This method of teaching aims to provide a foundation of thinking about co-habitation with local ecologies in their lifeworld to pass such practices onto the community.

By definition "biotechnologies involve the use of biological processes in industrial production" (Fee, 2010, p. 1). Since the first patent was passed on a bacterium,¹³ there has been an unprecedented scale of manipulating, controlling, standardising and abstracting non-human life. As specialist disciplines, sometimes insular and disassociated from broader contexts, I argue that this industrial paradigm does not allow space or time to reflect upon the consequences. This is of particular concern to a number of cultural theorists, scientists and arts practitioners across a number of fields (Cass and Catts, 2008; Levins, 2008; Wilson, 2008).

Within this research I argue how artistic involvement can sit alongside biotechnologies and in so doing militate against the processes of systemic colonisation by using a reflexive bioarts praxis model that is located across the contexts of education, arts and public sphere. Also relevant to the agendas behind this research within the context of the wealthy minority world, there is an increase in what (McKinney, 2002) terms "environmental generational amnesia". He suggests that in this context, the urban environment frames lived experience and that consequently the previous generation's experience/knowledge of the natural world is forgotten, lost or replaced. Many are concerned that this will have an on-going impact on our understanding of nonhuman life and will ultimately determine whether we value it or not (Jones, 2011; Sitko, 2012; Suzuki, 2010). Framing bioart through its' wet practices offers a renewed engagement

with the environment or related biological processes in real-time, which has become one of the primary aims of my research and the agenda behind artistic outcomes.

To contextualise the following references from Kalotas (2011) and O’Keefe (2011), this information was taken from two scientific conferences which I attended and exhibited works, in 2011. The first conference, *Fungi Map VI 2011, Denmark WA 15th July - 19th July* is a biannual event used to scientifically map, identify and record species in the environment for an on-going database. The conference is also a social event for mycologist groups to meet. Public involvement is encouraged however the demographic of attendees was mostly based in established systems of science; in the fields of conservation, agriculture and mycological research. The second example, the *4th Biennale Australian Animal Studies Group Conference, Griffith University 10th July - 13th July 2011*, is detailed further in section 5.2, Chapter 5.0.

There are a number of reasons why I participate and attend such events. The first is to better understand the scientific community and its infrastructure. Secondly to foster connections with practitioners in the field and to further reinforce my approach to the research. Presenting information on the fungi from arid regions in Australia, Kalotas (2011) states when “Traditional knowledge is increasingly endangered to being lost, there needs to be collaboration between elders, economists and mycologists to record history, and knowledge for the future generations”. Through a multi-method approach the research has a focus on setting up opportunities for young people to engage with the life sciences, particularly to gain an insight into local environmental knowledge. This is mainly done through the development of my art-science secondary education *Bio-Tech Evolution* in which specialists from different fields (conservation, biology, and art) teach wet laboratory workshops.

Biosecurity scientist O’Keefe (2011) also advocates an interactive environmental arena, and collaborative organisation. He points out that in the twenty-first century public consideration and engagement with animals is either based on a hierarchy of popularity such as koalas, kangaroos, emus, or as pest species:

The local population has very little knowledge of wildlife in their urban area, most are only aware of “pests”...We share physical space and resources with other species, however this is not thought of in day to day living for most.

Through this statement O’Keefe demonstrates that for some, consideration of ecosystems is not thought of during day-to-day activities. This indicates that the need for the research, its philosophical position and multi-method approach is even greater.

Bradby (2011) develops O’Keefe’s point further, by arguing that it is more important to focus on “Systems – not individual species. Conservation is traditionally seen as a form of social justice, this cannot be an optional extra anymore. Conservation is vital for survival”. This demonstrates the relationship between conservation, public opinion and animal activism.¹⁴

Australian Context: Gwandana Link Program rehabilitation and developing sustainable practices in agriculture

There is a significant reason for basing research activities in an Australian context. As Georgiadis (2013) states Australia covers only a “small area of the globe, but it contains more than 600,000 species of plants and animals...over 80% of those are found nowhere else on Earth, a place packed with biological diversity and therefore a place worthy of protection”. In an interview (2013) Professor David Lindenmayer, a conservation ecologist at the Australian National University, discussed the long running cultural focus in Australia on the environment’s “mineral and natural wealth”. In other words the consideration of the natural world as a resource and that each resource operates in isolation from the rest of the environment; As Lambert puts it; “nonhuman commodity replacing biodiversity” (2011).

Lindenmayer (2013) argues that in order to maintain this ‘resource’ there needs to be a shift of focus to consider the wealth and welfare of biodiversity as a part of maintaining this process. This example reinforces O’Keefe’s (2011) earlier comment on the importance of considering the complexity of ecosystems:

It’s really important that we turn that around because the status of biodiversity is an indicator of the status of our industries [fishing, forestry, farming]. Current management is demonstrably unsustainable...a classic example after 30 years of research, the Leadbeater’s Possum [also Victoria State’s Emblem] is on the way to extinction due to forest management...A positive example the farm here [in Victoria] shows that the interventions, planting, stock management, have greatly increased the biodiversity benefits not only for plants and animals but also for farm outputs.

This example indicates that cultural ideology greatly influences individual and institutional actions and policies. The research builds on this relationship through a multi-method approach that brings these contemporary issues into a number of different contexts. These connections draw associations between the art object and the viewer’s lifeworld.

The research does not claim to provide a panacea to the on-going environmental issues in Australia; it aims however, to provide an additional communicative platform and infrastructure in education. The aim is to generate awareness in the viewer/participant to

motivate action. Another example specific to the Australian context and relevant to the research is *Gwandana Link*. This conservation activity is facilitated by *Trust for Nature* and funded by *Bush Heritage Australia* a non-for-profit organisation protecting biodiversity on private land.

Interviewing active participant Simon Smale, Bryne (2013) describes the project and its importance, “Smale is a part of a network of people and organisations that are working to protect and reconnect one the most important biodiversity hot spots in the world...South-Western Australia.” As Smale (2013) states; “Gwandana Link is a ten year project to reconnect and re-establish 1000 kilometres of bushland...10-15 % of the species in this region are unknown to science...in the last fifty years 80% of the original vegetation has been removed by land-clearing” (2013). The need for this action demonstrates the tension created between conservation and increasing urbanisation/industry, highlighting another contemporary cultural condition not only in Australia, also across the globe.

The research aims to draw attention to the biodiversity of Australian ecosystems and the responsibilities we have in this particular context through the bioarts praxis. This includes the development of specific bioartworks that detail species-environment interrelationships and through hands-on art science activities that demonstrate biodiversity within secondary education and community contexts. The selection of artists for *Creatures of the Future Garden* also includes subject matter specifically relevant to the context of Australia and the viewer’s lifeworld.

Mass media misinformation

Marshall McLuhan (1964) argues that technologies and media are extensions of humanity and are not neutral but determined by economic, political and social forces. This position is important for the research in that the bioarts praxis navigates the processes of systemic colonisation that support these forces. Beyond directly and actively seeking out scientific journals and publications, the general public mostly gather information and often only engage with biotechnologies via systems of mass media. This leads to a shallow engagement with information to construct knowledge or understanding of contemporary culture. As Giddens states, “Everyone living in conditions of modernity is affected by a multitude of abstract systems; and can at best process only superficial knowledge of their technicalities” (1991, p. 22).

This theoretical position indicates a separation of nature, culture and technology, which in reality is not possible. As this research aims to establish, there is an inherent link between cultural ideologies, the development of biotechnologies and the ways in which

this shapes our engagement with nonhuman life. By bringing the material reality of life sciences and cultural production together through the praxis of bioarts, the research offers a way to examine this relationship.

“British theorist of science and medicine Nikolas Rose proposes that in the twenty-first century, we have come to know life through the biomedical paradigm...we conceptualize through systems of scientific representation” (Sturken and Cartwright, 2009, p. 349). As such, this informs how we conduct and culturally frame ourselves in relation to nonhuman life. Sturken and Cartwright also posit; “That scientific knowledge depends on social, political and cultural meanings and that what kind of science is practiced and rewarded is a highly political issue” (p. 347).

As stated by Lister et al. (2003) there is a:

tendency for cultural and media studies to dismiss the role that technology plays in shaping culture. (The question of whether technology is an agent which causes social and cultural change (technological determinism) formed the crux of the debate between McLuhan and Williams [see Glossary or *New Media: determining or determined?*]. (Lister, M., Dovey, J. et al (eds). 2003, p. 293)

The outcomes of each aspect of the research intend to be ultimately situated in the social realm to provide an alternative voice to these hegemonic systems. This will be achieved through the communicative role of the artworks, the curriculum approach to teaching, and selection of artists in the curated exhibition.

The manipulation of information or filtering effects of mass communication has an immediate and far-reaching influence on the public’s opinion of biotechnological developments, and current scientific research. These misinformation campaigns have led to the point where scientists receive death threats from the public in response to issues of global warming and the consequent carbon tax in Australia. This demonstrated by the following excerpts. In this *Catalyst* (2011) episode (television series) Horstman provides an insight into current debates surrounding climate change and public responses; “At the heart of this protest is the notion that the people here can see through the carbon lies” (Horstman, 2011), Figure 11.

This shows the impact mass media can have on public opinion through misrepresentation. As Arabia (2011) from Science and Technology Australia states in an interview with Horstman: “Scientists are quite concerned about the way their profession is being devalued...under attack....*The Respect the Science* campaign aims to help people understand how science is done, and really understand the peer review process.” Inglis (2007) suggests, “The ideas, values and beliefs of a group are profoundly

implicated in motivating people to act in certain ways” (p. 9). This is determined by an individual’s lifeworld, which is governed or shaped by external factors such as institutions, government, dominant ideologies and cultural contexts (Giddens, 1991).



Figure 11: Mark Horstman, (2011) from 'Science under Siege', *Catalyst*, still image from film. Australian Broadcasting Commission. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

By developing opportunities for the public to engage with these technologies beyond traditional hegemonic institutional frameworks such as the mass media, the aim is that the experience opens up a reflexive engagement with contemporary cultural conditions. This multi-method approach to the research allows the viewer/participant to develop a critical position on their understanding of an interaction with nonhuman life and biotechnologies beyond commodity culture, shock value and entertainment.

This mediating process through arts praxis enables an alternate position to develop in a context where “the whole world is passed through the filter of the culture industry” (Adorno, 1991; Horkheimer and Adorno, 1944, p. 99). Disseminated through the public sphere there is a “systematic blurring of the lines between information, entertainment, and promotion of products” (Sklair, 2008, p. 67) via the mass media. These systems directly affect the public understanding of biotechnologies and normalisation of commoditised nonhuman life.

The “culture industries” is “a term used to indicate how capitalism organizes and homogenizes culture, giving cultural consumers less freedom to construct their own meanings...encouraging conformity, promoting passivity” (cited in Sturken & Cartwright, 2001, p. 352). Sturken and Cartwright (2009) in citing Durkheim’s term (1895) “collective conscience of the masses” describe the connection between social formation in the lifeworld and systems that generate and govern this process. “It is the mass response in itself that shapes classifications, law and judgment about actions, and it is this function of

the collective— its determining social role – that characterises the masses as such” (p. 225). Illustrating there is a relationship between opinions, actions of the mass population and their acceptance or rejection of ideologies that shape the lifeworld.

Sturken and Cartwright (2009) state that within most media theory, individuals are passive consumers of mass media that for the most part is largely concerned with “messages authored by corporations with profit motives, whose messages support dominant ideologies and ruling class and / or government interests” (p. 225). John Fiske and Len Ang however, argue that the individual faced with information via the various forms of mass media (television, radio, publications, Internet) are more inclined to focus attention on topics specific to their own lifeworld interests. Citing the works of Fiske (1989) and Ang (1989) they “stress that members of an audience engage in ways that are both specific to their cultural context and at times resistant to normative and/or dominant ways of looking and interpreting” (Sturken and Cartwright, 2009, p. 237). The multiple ways in which individuals engage and make meaning directly correlates to their lifeworld. By using a multi-method approach, the research acknowledges the various ways institutions shape lived experience. A multi-layered approach situates the research outcomes across the contexts of public space, education and art exhibitions to extend its communicative capacity.

3.1b The individual and the lifeworld

This section sets up the theoretical framework for the research as it negates the spaces between the “lifeworld” and “systemic colonisation” (Habermas, 1987). To establish this premise, I use the sociological foundation of arguments made by Giddens, 1990; Habermas, 1987; Husserl 1936; and Sullivan, 2008, 2010 to inform my praxis.

3.1b.1 Systemic colonisation of the lifeworld

As identified in the introduction the lifeworld is defined as the everyday activities of an individual framed by circumstances based on a set of “presuppositions [and] constructions” (Husserl, 1936, p. 52) a “lived realm of informal, culturally-grounded understandings” (Husserl, 1954). These cultural conditions shaped by external factors are learnt and acted out in a way that can be taken for granted and unquestioned or considered normal. These external influences are contingent and based on cultural context. It can include the individual’s personal history, social, cultural and political circumstances in which the individual exists. The lifeworld also influences the personal subjectivities, ideologies and agendas of the individual and therefore shapes how they operate in the world. Each lifeworld is framed by a set of cultural conditions and

commonalties, nuanced with individual differences enacted day to day.. Kalantis and Cope (2012), draw on Husserl's phenomenological processes to reiterate this position. They argue that the individual determines and acts out the narrative of the lifeworld framed by a lens of cultural specificity. That we engage with the social and cultural environment "according to our interests" which are manufactured by the culture industries. Therefore the lifeworld is considered to be a subjective and social realm separate from scientific rational thought, but is however dependant on its mechanisms. As Moody and Powell (2003) explain, the lifeworld is acted out through established practices that make up an individual's daily reality.

Giddens (1990) suggests that external institutions such as mass media, governing bodies and institutions culturally understood as voices of authority (science, education) govern the information on which an individual develops an understanding of the world. These external influences shape the construction of the individual. However, the individual also has the capacity to shape the institution through reflexive acts. Giddens (1990) applies Husserl's study of phenomenology, through the reflexive project of the self.

For Giddens (1990) reflexivity applies to the way an individual frames their lived experience from an ethical position in relation to their conduct in the broader social world. This critical positioning of the self-narrative is a particularly important process, if the individual intends to engage actively with the shifting contemporary conditions that make up their lifeworld; Such as contemporary biotechnologies, local-global dynamics, politics, cultural histories and cross-cultural interactions.

Reflexivity can be used to understand the relationship between ideologies and action. O'Keefe (2011) cites Ajzen (1999) in relation to this, "socially influenced attitudes and subjective norms determine planned behaviours." Specific to the research, demonstrated through shifting public attitudes towards wildlife condemned either as pests or to be protected.

Situated within the social cultural realm, my bioarts praxis draws directly from the lifeworld and actively contributes to it. It is within the day-to-day activities of the lifeworld that an individual can make immediate decisions on their participation, consideration and care of the nonhuman. For example, this can be achieved either by contribution to environmental rehabilitation or by being more discerning of commodity consumption. This connection in the praxis is particularly important for drawing attention to the ways in which we engage with nonhuman life in a contemporary biotechnological context.

Habermas (1987) attests that there is the power struggle between the lifeworld and systemic colonisation. “[The] process of ‘colonization’ where instrumental rationality ‘surges beyond the bounds of the economy and state into other, communicatively structured areas of life and achieves dominance there at the expense of moral–practical and aesthetic–practical rationality’ ” (cited in Salter, 2007, p. 293). Salter (2003) builds on this “Systemic colonization [sic] doesn’t go so far as to *replace* action oriented to mutual understanding; rather it *disempowers* it” (p. 123). All of these processes inevitably influence how we conduct ourselves on a daily basis. Habermas (1987) advocates that the processes of communicative action can disrupt this process.

What this research offers is another way to engage reflexively with the power struggle between the systems and the lifeworld. Through the three main aspects of the praxis, the aim is to generate a reflexive understanding of the contemporary circumstances that frame how we interact with nonhuman life, biotechnologies and the environment. As such by instigating a multi-method approach, the research operates in the system and social realm and therefore acts as a mediator between the two. This is implemented through the development of bioartworks, interdisciplinary teaching methodologies instigated in *Bio-Tech Evolution*, through specific artworks shown in *Creatures of the Future Garden*, its symposium and *WA Birds of Prey Centre Workshop*. The praxis navigates the processes of systemic colonisation of the lifeworld, by using this multi-method approach. In offering alternate views to the central bodies of information about nonhuman life, the research draws attention to the way hegemonic systems frame our understanding of the world through dominant ideologies or values.

3.1 b.2 Hegemonic control: The institutions role in the development of cultural conditions of the lifeworld: mass media and the public sphere

According to Hall, a hegemonic viewpoint by definition is “the mental horizon...of possible meanings, of a whole sector of relations in a society or culture...that it carries with it the stamp of legitimacy – it appears coterminous with what is ‘natural’, ‘inevitable,’ ‘taken for granted’ about the social order” (cited in During, 2007, p. 486). Hall describes the processes encoding and decoding meaning produced by mass media communication in the way that it is used to reinforce a “dominant-hegemonic position...where the viewer takes the connoted meaning from newscast...and is operating inside the dominant code” (cited in During, 2007, p. 485). This process serves the interest of the dominant groups in a society where the way in which information is framed sets up a closed system where the individual only has an opportunity to engage

in mainstream discourse. This system is maintained by specialists or “professionals...that are linked to the defining elites not only by the institutional [positions in which they operate]...but by the structure of access” (cited in During, 2007, p. 486).

This dominance is reinforced by specialist language for example ‘lawyer-speak’ and modes of operation that are grounded in specialist methodology. McGuigan (1992) develops this position further in relation to the communication and representation of information in the public sphere: “Politics of representation, the mechanisms of inclusion and exclusion which regulate agency within the field: basically who gets to define the issues and with what purposes” (cited in Jenks, 2005, p. 206). Jean-Francois Lyotard, (1985, cited in Heywood, 1997, p. 145) builds on this in relation to the legitimisation of fields of science, arts and philosophy through the specialisation of language and practices.

In a contemporary context the instability of social, political, economic situations, offer multiplicities of cultural knowledge generation. However, as identified in the introduction with the example of Dolly the sheep (1996) and ‘earmouse’ (1997), the mediation of information via the culture industries in the public sphere potentially disrupts and misrepresents scientific research.

The public sphere is a social space in which dominant ideologies are perpetuated by institutions and systems of power (Habermas, 1987). He also suggests that it is a site where debate and discussion takes place offering alternate positions to the dominant discourse. As Sturken and Cartwright (2009) point out however, “this has never been realised because of the integration of private interests into public life and because it did not take into account how the dynamics of class, race and gender make access to the public sphere unequal” (p. 456). The public sphere is also where the culture industries operate and have the most influence on how an individual engages with the world.

There is however, a critique that Habermas provides a utopian ideal for this space of agency or active communication, arguing that it is limited to those in a context of academic specialist discourse (Negt, and Kluge, 1993). Within my research, I aim to employ particular tactics to offer another opportunity for participants and viewers to engage reflexively in their lifeworld. In particular, by communicating the multiple ways in which we engage with nonhuman in contemporary cultural context. This multi-method approach aims to extend the specialist discourse beyond the academic field. In this way, the research navigates the processes of systemic colonisation in the public sphere and lifeworld (Habermas, 1987). The activities developed in the bioarts praxis also re-appropriate the information perpetuated by the culture industries. This is particularly

evident in the artworks developed for exhibition and pieces exhibited by secondary school students Chapters 5.0 and 6.0.

The culture industry involves the various systems in a society that reproduce and reinforce dominant ideologies or values within a culture, through the mass media, advertising, corporations. Habermas (1989) argues that these governing institutions and corporations readily infiltrate the lifeworld of the individual in a way that is all pervasive. The industry maintains its authority as an infrastructure in its own right, with its own set of ethical principles and laws to protect and ensure its continuation. This industry traverses into the everyday lifeworld subtly influencing the social realm and the way an individual operates within this. Habermas (1989) explains: "In whatever way a large enterprise might be under the control of individual owners, large shareholders, or administrative executives; it is established as a sphere in its own right between private and public realms" (p. 152). This is how the process of "systemic colonisation" of the lifeworld takes place.

The mass media is a vehicle through which the culture industries shape the values, attitudes and behaviour of the individual. The focus on the individual's sense of identity and economic wealth in a capitalist context as Szczelkun identifies (1999) inhibits a reflexive engagement with the lifeworld. "There is then competition between these two principles of societal integration - language, orientated to understanding, and 'media', which are systems of success orientated action." Alain de Botton builds on this theory of "success orientated action" through his text *Status Anxiety* (2005). Hegemony introduced by Antonio Gramsci (1975) identifies "that dominant ideologies are often offered as common sense [however]...are in tension with other forces and hence constantly in flux. The term hegemony thus indicates how ideological meaning is an object of struggle rather than an oppressive force" (Sturken and Cartwright, 2009, p. 458).

Hegemonic institutions influence the way culture is produced and information is constructed and understood. It takes the form of governing bodies dominant to a group or situation. Habermas (1987) suggests that these institutions will inevitably influence the individual's lifeworld as they shape lived experience through the process of systemic colonisation. Through the implementation of a multi-method approach to the praxis, the research reappropriates this process. This decisive action aims to develop the capacity of bioarts to generate awareness of nonhuman life in multiple ways.

Art as a communicative act

An art object according to anthropologist Gell (1998) is situated in the social realm because it represents the creation of a social agent. A viewer substantiates this through the engagement with an artwork. The creation of meaning is dependent on a set of constructed codes specific to cultural conditions and contexts. Therefore the production and dissemination of art for Gell is about “social relationships” (1998, p. 4). This theory also brings into the question the communicative capacity of the art object. The interpretation of an artwork’s meaning can be multiple and is contingent upon the context each time it is viewed. This is where the multi-method approach to the research gains its potency. By presenting discourse across contexts, a layering of meaning and communication in its various forms will ensue. The praxis then navigates forms of communication within the system and the lifeworld.

3.2 Biological Art

This section is organised into four parts. The first section 3.2a provides key terms applied to this genre. I demonstrate the complexity of bioart with reference to Jens Hauser (2005-2008) due to its direct correlation with biotechnologies currently operating within the lifeworld. Section 3.2b identifies relevant local and global practitioners and related theoretical discourse that underpins the research. This includes references to various viewpoints on the social and cultural functions of bioart in relation to engagement with the nonhuman and its negation of hegemonic contexts. Section 3.2c identifies the role art-science collaboration can have in navigating hegemonic institutions, and identifies multiple viewpoints on the effectiveness-ineffectiveness of this aspiration. The final section 3.2d, presents examples of art/life science workshops operating in the field.

3.2a Contextualisation of Bioart applied to the research

Established biotechnologies, involve the use of life forms, biological matter and its processes as a resource for consumption and distribution. This ethos was initiated in 1980, when the first patent on life was passed, and has since increased in magnitude and pace. These can include both the historical and contemporary manifestations of the life sciences namely: Animal and human tissue culture, vivo culture, zoology, microbiology, genetics, trans-genetics, plant tissue culture, cell culture, molecular biology, bio-chemistry, embryology and bio-robotics. Such varied technologies and the

cultural conditions and questions about life that they develop, provide “artists simultaneously with the topics and new expressive media” to create multiple and diverse cultural texts (Hauser, 2008, p. 8). This can encompass representations of biology – such as botanical illustration, digital media; through to artworks that deal with the physical reality of actual biological processes themselves. Termed ‘wet biological life’, these range from cells, invertebrates, plants, animals and the human body as the basis for ‘art materials’.

This research deals with the application of ‘wet biology’ through arts praxis to generate a “critical interaction with the biosciences [and the nonhuman]” (Bunt, 2012, p. 1). The early manifestations of bioart have origins that institutionally trace back to the history of “information arts” or new media arts based in digital technologies (Wilson, 2008). As demonstrated by the “kinetic artist-astronautical pioneer” and co-founder of *Leonardo* Frank Joseph Malina (1936-1963) (Popper, 2000; 2012)¹⁵ and the later biological “transgenic” (Kac, 1998-99) works of Eduardo Kac (section 3.2b) and Joe Davis – one of the first artists to produce work in a laboratory context – who combine new media internet based art with living systems. Detailed in section 3.2b, George Gessert’s plant breeding work (1970) and theoretical discourse also represents a key foundation of the genre.

Kac (2008) states: “I have been employing the phrase ‘bioarts’ since 1997, in reference to my own works that involved biological agency (as opposed to object hood)” (p. 122). By taking the stance of the different approach between biological agency and object hood, Kac raises an issue of the complicit nature of bioarts. Kac’s work uses the shock value of ‘wet biology’ to examine biotechnological hype. This also puts the practice on a pedestal, using the hype as an advantage for publicity (Hauser, 2008). This aura of prestige is one that the research navigates through a multi-method approach.

Brodyk argues that each artist has a “comprehensive understanding of micro biological operations at a genetic level as well as computer information technology operations” (2002, p. 44). Davis’ agenda in producing ‘wet biological art’ aims to engender responsible genetics, particularly in relation to the environment.

Throughout the research, bioart is also defined as a recent term that describes a cultural, humanities and art based practice that deals with the technologies, issues and physical materials of biotechnology. Curator Melentie Padilovski (2009) states that bioart/biotech art is “science-art collaboration at its best and that it requires knowledge in processes in biology and biotechnology.” The importance of understanding the technology or life

science used to produce artworks is a significant aspect of each creative work developed in the research.

Bioart dealing directly with these technologies and the life sciences they use offers a communicative site where interactions between the viewer and the 'wet biological life' can take place to question issues such as, who controls life? What constitutes life? What will be the consequences of such technologies? How will these technologies affect interactions with the environment? These questions are raised by a number of pioneering practitioners in the field, particularly relevant to the research are; George Gessert, Tissue Culture & Art Project and Eduardo Kac, examined in section 3.2b, and Chapter 7.0. The research extends these questions through the selection of artists in the curatorial exhibition.

Also within this genre, a number of artists deal directly with biotechnologies as the central medium, often examining the consequent / potential politics, issues and ethics that have arisen as a result. Some key practitioners include, Critical Art Ensemble, Paul Vanouse, Beatriz de Costa, Boo Chapple and subRosa.¹⁶ The cultural texts produced by an artist or art-science collaboration have varied communicative outcomes and aid in the public's understanding, misunderstanding, questioning, acceptance or rejection of biotechnologies.

In *Tactical Bio-Politics*, Jacqueline Stevens (2008) builds on this argument by identifying the ways that the artist's agenda influences the different functions and outcomes of bioart. She frames the communicative outcomes of bioart works within the categories of socio-political, activism, spectacle, pro-commodity science or anti-commodity science. In this instance, the systems of industrialisation and biotechnological research sets up a way that allows a bioart practice to exist. This can create a tension of negation for some cultural practitioners between their reliance on using these technologies to produce the artworks, with the institutions and corporations from which they originate.

In this situation artists learn and apply the technologies using methodologies to examine areas of scientific research beyond mainstream agendas (Wilson, 2000). This provides the formula through which a bioarts practice can "deconstruct cultural patterns of integrating science and technology, to clarify underlying meanings ignored in the over-hyped flow of normal technological and commercial life" (Wilson, 2000, p. 6).

This process could be considered a way to generate a form of Habermas' "communicative action" (1970), where questions or gaps within specific systems are identified, and debated by multiple parties/perspectives or collaborative individuals to

develop an agreed upon social or cultural outcome or solution (Kaye, 2009). Locating these practices in the cultural and social realm situates the discourse in the lifeworld.

Hauser (2005) develops the idea of bioart as a reflection of the lifeworld and its material conditions further in saying: "Bio Art has not unfolded and developed in accordance with prescribed master codes...it has been subject to a process of social drift and diverse influences from its aesthetic environment" (p. 1). This demonstrates that bioart can shift simultaneously between the governing institutions of art, science and people. Moreover, there are inherent connections between arts practice and the material and social conditions within the lifeworld (Husserl 1954; Habermas, 1987).

Thornton (2002) argues that the development of bioarts and in particular the use of live animals may be considered as:

preparing society for the greater changes ahead in the fields of biotechnology or further along the dissolution of speciesism. More cynically, considering the static environment of the typical art institution, the inclusion of dynamic or controversial content may often operate as an attention-getting strategy. (p. 15)

This process opens up the dialogue of bioart beyond the context of the gallery space, but also domesticates the biotechnologies. Thornton also identifies the way such practices can be used to generate hype and spectacle (Debord, 1983). A creative strategy used by Kac, section 3.2b. As shown in *Micro 'be'*, the mass media nullified its potency in communicating the project's original conceptual concerns. As a way to gain control over the dissemination of my bioarts praxis in this research, I present talks and art-science workshops. The intention is to provide access to the life sciences beyond the context of the laboratory, using the bioarts praxis as a vehicle to develop further interaction between cultural activities, technology, biology and the environment.

Bioart is a global practice that transcends geographic and cultural boundaries as the topics addressed by cultural practitioners is diverse, and continually changes in light of developing technologies. As such the content that can be found in these art forms belongs to a global discourse. Through this research, I argue that with a focus on the nonhuman, bioart examines our on-going relationship to technology and the environment. This approach reinforces connections between local and global concerns.

The origin and lifespan of this genre as a form of 'wet biology' relevant to this research can be linked to a number of sources. Relevant to this research I refer to the theories and works produced by artists George Gessert, Eduardo Kac, Tissue Culture & Art Project (TC & A), and Stephen Wilson. The term it has been argued was coined by Kac as a part of his transgenic artwork *Genesis* (1999), shown at *ARS Electronica* in 1998.

The use of 'wet biology' also places the origin of the artform in relation to George Gessert's plant breeding work from 1970. This itself, can be seen to be inspired by an earlier form of bioart "found in Edward Steichen's delphiniums (bred from 1908, exhibited 1930)" (Coakley, 2011, n.p.). I argue that bioarts has developed in response to an increasing need to engage with the "ultimate cultural ramifications of technology" (Wilson, 2008, p. 23). However according to Voigt (2009):

Bioartists frequently object to being lumped together within a single movement. They point out that they aspire to artworks as distinct as a glowing bacterium versus a frog with a third eye. Moreover, their philosophical differences run deep: Some see their work celebrating science—even contributing to it—while others are critiquing a technological dystopia. For these reasons, artists working with biological materials often object to the very word "bioart." (pp. 1-8)

This statement again reinforces the diversity of the 'genre' through medium and intention. As Voigt points out many disagree with the use of such a term, arguing that it is "reductive" (Catts, 2014) and should only be considered as a point of academic departure (Hudson, 2014). As a creative practitioner in the field I tend to agree with these positions, in that the term needs to encompass Hauser's (2008) concept of fluidity and mutation. For most practitioners, such as Gessert, and TC & A, the significance of their work lies in how important these interactions with wet biology are. Through these intimate encounters the artist becomes a custodian for the biological life, and has to deal with the complexities of its welfare, ethical considerations and the complacency in using it for artistic means. For the purpose of clarity within the research, I use the term bioarts to focus attention on the use of 'wet biology' and the life sciences. For me this position supports the contemporary communication of nonhuman-human interactions.

Bioart and the ivory tower navigating the institution

To engage with the complicity of the research praxis, it is prudent to examine bioarts in relation to its status as an artform. What the research navigates through its multi-method approach is the notion that such practices reach beyond the domain of established contexts. Far more that the practice of bioarts should be situated in the lifeworld due to its multiplicity, response to developing technologies and ever-changing subject matter. As such, bioart is a nuanced field, however for the most part is limited to wealthy minority world contexts.

Often situated in the context of academia, this specialises the artform, language and codes of conduct, creating an aura of prestige, (Thornton, 2004). In addition, some bioarts practices are reliant on access to expensive materials, technologies and laboratory spaces, reinforcing its privileged context. As it is practiced, the codes of presentation or conceptual philosophies are repeated to become a set of established ideologies. Consequently, I question if this limits the scope of bioarts praxis.

As Hauser (2008) suggests there is also a certain amount of hype surrounding the use of biotechnologies in this manner. This can influence audience expectations of works or fuel the processes of systemic colonisation. The presentation of artworks by mass media nullifies potency or artwork aims. In this context, the work is re-valued as a novelty, form of entertainment, or used to engender shock. Such as Eduardo Kac's GFP bunny '*Alba*' (2000) examined in section 3.2b, p. 73-76 and *Helena* (2000) by Marco Evaristti, examined in section 7.5, p. 217-219.

To analyse these issues, the following section is organised into two parts. The first looks at the ways in which the gallery space has multiple functions. There is a particular focus on the relationships between exhibition paradigms and legitimisation of arts practices as framed by the theories of Groys (2009), and Weiss (2004). This is applicable to the exhibition of bioarts in that most activities take place within established contemporary gallery or tertiary contexts. The second section examines the complexity of bioarts practices in relation to its specialisation (Habermas, 1989).

Gallery Spaces

The following section examines the relationship between arts exhibitions as productive spaces for communication as opposed to contexts of power and commerce, as evident in the lifeworld. In the research, the bioarts praxis is located across a number of gallery contexts. This includes commercial and contemporary social spaces. Within each context, the ideologies of the space alter the reading of the artworks. Placing the works across varied contexts is an important aspect of the multi-method approach. By doing this, I assert, the praxis communicates to a broader audience.

Furthermore, Weiss cited in Snell (2004) notes that "Exhibitions are inherently reductive in that they select certain objects to the exclusion of all others in order to construct a narrative or argument that is deemed important." This research offers different models of exhibition using a multi-method approach by incorporating workshops and symposium for public participation and discussion.

The gallery space follows conventions in terms of interactions with art objects and expectations of medium content. As the mediums of paint, print and sculpture have an entrenched cultural history, it follows then that within exhibition spaces there is an established expectation of content and medium. This distinction contextualises bioarts material relationship in the arts field. In this context, the works must deal with the actuality of 'wet biological' component. However, the inclusion of 'wet biology' raises issues of complicity and novelty. This often poses a problem for the exhibition of bioarts in some contexts. What ensues is a negotiation between artist, curator intentions and OSH facilitators sometimes at the expense of the final visual outcomes or exclusion of works all together.

In addition as Hauser (2008), has noted the unfamiliarity of the medium potentially frames the work as hyped novelty or develops a narrative of prestige. The hype mostly reinforced through the mediation of mass communication, as evident in *Micro 'be'*. The artwork then becomes part of the processes of systemic colonisation. This process has the potential of normalising this type of engagement with nonhuman life in a biotechnological context. This is the complicit nature of bioarts, and therefore raises pitfalls for the intentions of the bioarts praxis.

In relation to the exhibition of bioarts the established audience expectations of what constitutes an art object is set into tension by the inclusion of 'wet biological life'. This shifts the art object from representation (made from nonliving materials such as wood, paint, stone) to presentation-physical actuality of biological specimens or processes (Catts, 2008, Hauser, 2008). The reality of producing artworks that contain biological material emphasises the invisible, ephemeral nature of the object. This literally situates the artworks in opposition within the art market context (Groys, 2009). If works do not physically last, or require maintenance that involve weekly feeding, sub-culturing or specialist equipment, it is unlikely to spark the interest of collectors or curators. In addition, if the work is to tour outside its country of origin, the pieces require additional quarantine clearance. Christine Paul (2006) identifies that this tension between artwork, technological developments and system is an important aspect of contemporary arts practice: "...immateriality is an important element of new media that has profound effects on artistic practice, cultural production and reception, as well as the curatorial process" (pp. 1-2). How then does the artist navigate the arts field based on these established practices of dealing with artworks?

A number of practitioners in the field produce 'relics' or preserved biological works to provide the material for collection. Other approaches include the curation of exhibitions

by practitioners in the field to begin the process of establishing infrastructure and institutions specifically for the genre. The artist as curator brings an adaptable position to the process of curation. The models used to display works can shift between traditional wall hanging-to spacial intervention-installation or performance. This approach opens up the engagement between object-viewer within a space and supports the materiality of the works (Paul, 2006). Taking on the role of artist as a curator allows the creative practitioner an opportunity to navigate or challenge hegemonic ideologies and the multiple ivory towers that form through specialist discourse. The artist as curator is no longer reliant entirely on the system of the art market incorporating pre-governed themes or agendas to disseminate and exhibit works. This gives the artist some autonomy in determining the way in which the public engages with their practice.

Building on this position Groys states; “A conventional exhibition is conceived as an accumulation of art objects to be viewed in succession...the exhibition works as an extension of neutral space, public urban space...empty...property of the public” (2009, p. 1). This sets up a premise of the exhibition context as another part of the public sphere that contributes to an understanding of the lifeworld through cultural production and consumption. The research builds on this framework in that the works selected for the *Creatures of the Future Garden* aim to link most directly with the viewer’s lifeworld, especially through the introduction of the *WA Birds of Prey Workshop*. The research applies a multi-method approach in addition to the location of the bioarts praxis across the contexts of the research. The curatorial exhibition in particular focuses on setting up a discourse between the public, practitioners in the field, and young people. In this way, it aims to break down notions of specialisation and the ivory tower in a traditional gallery setting: This is done by introducing new voices to the established contexts in the field of art exhibition and bioarts dissemination, in particular through educational contexts and the multi-use of the ‘gallery space’.

Bioarts negotiation of systemic colonisation

This section presents supporting and opposing arguments in relation to the way this art form has the ability to review the traditional role of art institutions. As Groys (2009) points out: “O’Doherty suggested in 1986 that the exhibition space carries with it an aura of the institution, as a voice of authority and an ivory tower, in some art market cases [Saatchi]...artworks are selected...are thus ‘legitimised’...” (p. 2). Much of the discourse that surrounds the sociological role of contemporary arts is the agenda of institutional

critique. The definition of the institution particularly relates to the power struggle between self-determination and enforcement of governing dominant ideologies.

Mader (2013) elucidates on this definition with reference to the theories determined by Louis Althusser who “places cultural institutions in the category of so called “ideological state apparatuses” that...educate citizens to function within dominant ideology and to uncritically reproduce its values within the confines of their position in the social structure” (p. 37). This relates directly to Habermas’ (1989) concepts of ‘systemic colonisation’ of the lifeworld. These dominant intellectual ideologies usurped by NSMs, or by alternate positions offered through the communication of new media art practices. This process is possible due to the materiality of the practices, like bioarts, which directly uses developing technologies or examines contemporary cultural contexts. Christine Paul (2006) describes this relationship:

While all art forms and the movements that sustain them are embedded in a larger cultural context, new media can never be understood from a strictly art historical perspective: the history of technology and media sciences plays an equally important role in the formation and reception of new media art practices. (p.1)

Rather than institutional critique, the research suggests bioart can “challenge the boundaries of the art object and represent the type of work that museums find difficult to support, maintain, document, collect and communicate to an audience” (Paul, 2006, p. 5). This theoretical position provides greater advantage for the proposed outcomes of the research. In advocating alternative models for exhibition spaces, there is a potential to extend the praxis “beyond the walls and structures of the museum and, at times, [undermine] the museum’s very logic of exhibition and collection” (Paul, 2006, p. 1). The research develops the communicative role arts praxis has in contemporary contexts that aims to navigate spaces of commerce, and audience participation through ‘wet’ biological-based works.

Although, however interdisciplinary the praxis becomes, it still draws on the systems of the institutions to disseminate works. Mader (2013) clarifies this contrasting argument to the power struggles between institutions and artistic intention that the research navigates: “it is the practices of institutional critique that turned art institutions into negotiable entities” (Mader, 2013, p. 41). This dynamism of infrastructure is illustrated by the development of festivals such as *Documenta* and *ARS Electronica*, and by the networks established through *Leonardo*.

Each of these institutions were developed in response to the cry for new media arts support, that at the time sat outside of the traditional art market context (Groys, 2009).

Building on this Mader cites Warnke (2013) “institutions are mediating entities in which divergent needs, norms and strategies of action arrange themselves; the institution itself is already product of an equilibrium of interests of various subjects” (2013, p. 38).

Within each aspect of the praxis, the research draws on established knowledge/predisposition of the codes, language and methodologies available in each context. This reinforces the effectiveness of the interdisciplinary methodology as a way to engage reflexively with the multiple systems that shape the lifeworld and our understanding of nonhuman life in contemporary cultural contexts.

In relation to the research, bioarts as a praxis transcends cultural boundaries and national borders as the medium draws directly from life science. These practices deal with universal questions or concerns: Such as life, death, the environment, developing technologies. Biotechnologies ultimately affect all through global outreach and through application. Its influence affects military technologies, the environment, our ‘whole way of life’, health, and agriculture and can be used for the greater good, economic wealth, or political advantage.

As identified by Stevens (2008) individual or collective aims and access to technology determines each artwork produced. By way of introduction, this section details how a multi-method approach to the praxis navigates specialist concerns raised by Habermas (1989). This follows with reference to the philosophies of bio-hacker movement *Digicult*. This group demonstrates how institutions have the potential to be fluid and can offer productive spaces for cultural communication.

Habermas (1989) argues that the conditions of late modernity organise day-to-day practices into specialised areas. This process extends to all aspects of culture framed by three systems of rationalisation, Law, Science and Arts. He follows that these areas are increasingly institutionalised and insular, and have a profound effect on the social world of the individual. The individual shapes their lifeworld through increased specialist concerns or interests to the detriment of collective consciousness or responsibility. This is particularly evident in the context of commodity consumption and increasingly propagated by the culture industries (Jameson, 1990; Debord, 1983). As Boucher, (2011) suggests this process of systemic colonisation ultimately shapes “cultural knowledge, social integration, and socialised personalities” (p. 69). Through this specialisation of knowledge and ‘information gathering’ in the lifeworld the individual loses agency; as potentially this process leads to lack of bigger picture or whole knowledge based information processing.

Szczelkun, (1999) takes this further, “The specialisation of cultural systems of action i.e. the scientific/academic, the legal/academic, the art/market, their centralisation and the increasing...action orientated to profit and power rather than understanding, arising from entrepreneurial capitalism” (p. 285). Those in power maintain their ideological position based on access, accumulated legitimised cultural knowledge that confers status. In relation to the research, the bioarts praxis and its exclusivity supported by established systems extended to incorporate greater inclusivity. By reflexively working within specialised contexts, the research adds new voices to the use of space to disseminate ideas about nonhuman.

These specific issues are addressed by *Digicult*, an open-collective facilitated through the Internet established in 2005: A “platform that examines the impact of digital technologies and sciences on the arts, design, culture and contemporary society...to give voice to...interdisciplinary authors, expand their circuits...break the existing inflexible publishing rules of the press” (Magaudda, 2013). This activity shows the breakdown of the ivory tower and processes of hierarchical access determined by established infrastructures. Through the network individuals develop and disseminate projects to offer alternate positions to central discourse surrounding biotechnological research and nonhuman life practices via bioarts activities: “Among DIYbio’s activities, the creation of a “hacked version” of important [privatised and expensive] laboratory equipment...[for] amateur biologists” (Magaudda, 2013).

The group also details how such levels of engagement have the potentially add sociological analysis to traditional research methodologies in “scientific practices, on professional dynamics and strategies used by scientists...on their own role [in] contemporary society” (Magaudda, 2013). This reinforces the reflexive capability of individuals and institutions and demonstrates Giddens (1990) theoretical position in relation to our engagement with information through the production of reflexive knowledge.

The bioarts field artistically encompasses many aspects of science. These include technologies that deal with digital software, networks, AI, robotics, life science, human biology, animal biology, nanotechnology, environmental conservation, and recently synthetic biology (Wilson, 2008). The diversity of the field indicates that the bioart ‘genre’ actively responds to contemporary cultural and biotechnological contexts. When art exhibitions, events and objects are placed in the public sphere, the discourse can add to cultural understanding and questioning of these technologies in the lifeworld. The diversity again reinforces my position that new media arts directly correspond to and

critically engage with contemporary cultural contexts: Particular to the purpose of this research, examining the ways in which biotechnologies and the mass media frame interactions with nonhuman life.

There are sometimes inherent costs of working within the genre of bioarts or biotech art (Pandilovski, 2009) that requires specialist equipment, found in specific institutions. Access to scientific equipment is often in-kind from the host department through the process of artist residency. Not all artists are reliant on these technologies to produce the work and some have sought alternatives. Some materials can come off-the shelf and procedures can be set up in kitchens, providing these follow OSH requirements. As shown in the 2009 *VIVOARTS* workshop run by Adam Zaretsky in Helsinki.¹⁷ This removes the exclusivity of the practice through the application of creative commons as suggested by Patterson (2010), “Creative commons act of public creating off-the shelf scientific experiments connecting via internet as a communication site, research based on betterment for communities, without funding restrictions” (p. 2). Other practitioners are also employees at the various institutions in which they produce the work, working across the fields of art, academia and science.

3.2b Identification of creative practitioners using life sciences and ‘wet biological life’

This section identifies the various manifestations of bioart in theory and practice operating within the bioarts fields and their potential communicative applications. The practitioners in this section are chosen to demonstrate established ‘wet biological’ methodologies and theoretical positions relevant to the research. Through this process, I demonstrate the intentions for my praxis in examining interactions with ‘wet biological life’.

Below is an overview of the life science areas explored in the bioarts fields and some related creative practitioners with reference to their country of origin and some of the contexts in which they operate:

Tissue culture (TC&A – AU), DNA sequencing (Paul Vanouse – CA), trans-genetics (Eduardo Kac – BR, US), mycology (Nöle Giuliani – DE, US), microbiology, plant biology and ecology (Phil Ross – CA, US, David Rockeby – US with Eric Samakh – FR, Brandon Ballengée, – US), animal and human biology, body performance (Kira O’Reily – UK), plant and animal behaviour (Perdita Phillips – AU), nano-technology, interfaces (Paul

Thomas – UK, AU), artificial bio-intelligence robotics, non-human interfaces, networks (Ken Rinaldo – US) neurophysiology, tissue culture, (Guy Ben-Ary – IL, AU with Stuart Bunt UK, AU (Fish and Chips) Tania Visosevic AU, and Bruce Murphy AU, (Bio-Kino), molecular biology (Adam Zaretsky – US). See Appendix A for web links to examples of works.

Beyond the specific conceptual concerns unique to each artist above, the purpose I have identified throughout these examples is the role bioarts has in presenting the interactions between humans, technology and biology. Of particular significance, is how important this bioarts engagement becomes for creating a platform through which a dialogue into the issues and questions raised by these interactions can take place. This is the immediate central function of my praxis in fostering an understanding of the biological aspects within bioarts to reinvigorate an engagement with nonhuman life in a contemporary context.

In order to achieve this aim, as established in previous work I deal directly with the biotechnologies in a “hands-on way” (Catts, 2010) learning the skills and scientific procedures required to create the artworks. This method is applied to the activities of *Bio-Tech Evolution*, and influence the selection of artists for *Creatures of the Future Garden*. In the context of the research, there is a key distinction between artistic practices that use the life sciences as a form of visual inspiration, using traditional mediums such as photography, paint and sculpture, as opposed to the art practices for which the life sciences are the “actual medium” (Corpet, 2002, p. 37).

This concept is shared with a number of participants within the field, some of whom are associated with centres such as *SymbioticA* (AU), *Arts Catalyst* (UK)¹⁸ and *Ectopia* (PT)¹⁹. These particular centres have a focus on artists dealing with ‘wet biology’, where there is an encouragement for the arts praxis to debate ethical concerns by dealing with the technologies and their socio-cultural implications (Mendiharat, 2009).

Pandilovski (2009) states that many bioart workshops and outreach programs instigated from Australia since 2007 have been generated internationally “as a developing field to urge to more artists to participate”. *Ectopia* also does this with the intention of “[creating] new representations of scientific or industrial development in order to disseminate the fruits of research within society at large” (2009, p. 15). In Section 3.3 I provide an examination of key centres in the field, namely *ARS Electronica*, *Arts Catalyst* and *ANAT*. The research adds to the field through the introduction of ecologically specific workshops and through the application of bioarts in a secondary educational context.

Due to the application of biotechnologies and/or life sciences involved in the construction of bioartworks, most practitioners have located their means of production in conjunction with scientific complexes or institutions. These artists either learn the technologies and procedures as artists in residence or take on the role of technicians within the institution itself. Others collaborate with specialists due to the complexity of the technology involved or time limitations.

The discerning act of using 'wet biological components', also clearly defines the process I use when creating bioartworks. The aim through this is to draw attention to the "very existence of some of the outcomes of biotechnologies [which] brings into question deep rooted perceptions in regard to life and identity, concept of self, and the position of human in regard to other living beings" (Catts & Zurr, 2004, p. 2). This theoretical stance also defines my position within the bioarts field. As Wilson states, "I think it is cultural suicide for the arts not to pay attention to new developments in biology research" (cited in Regine, 2007).

An artist using these technologies as a point of social commentary can affect public opinion on the development of new technologies and their applications. This leads to the question of what function and consequence do such practices have on the public understanding of biotechnologies. This can also create cause for misunderstanding of the scientific outcomes and agendas. What is evident within most of these practices is the inherent negotiation that must take place. In this situation, the artist works with the institutions and infrastructure that provide the technology while still maintaining the integrity of the artwork. The practice of bioarts can also become an interdisciplinary site of negotiation and art-science collaboration. This occurs when artists collaborate with scientists to develop research projects that intellectually add to discourse of science fields through either bioarts praxis outcomes or public dissemination.

George Gessert and TC & A: Artists dealing with the exhibition of 'wet biological practices'

George Gessert Hybridised Irises (1970-present)

As initially shown in the Background (Chapter, 2.0), Gessert has a substantial practice of plant hybridisation, with a particular emphasis on culture/nature debates (Figure 12). As a founder for the bioarts genre, Gessert "counter-[breeds] against the mainstream trying to retain characteristics that [are] usually bred out" (Darlaston, 2008, p. 185). He identifies that in the horticultural industry public demand for iris flowers with; "Heavy

ruffles reflect advanced consumer society, which exerts powerful evolutionary pressure on garden flowers to present themselves as stand-ins for nature, as emblems of nature's subservience to human whim" (2002, p. 41). In doing this he refers the ways in which culture places emphasis on nature from a human-centric position. This is also reflected in the names given to plants for example Pink Champagne or Skating Party. He argues that: "Most contemporary art reinforces anthropocentrism...to express exclusively human concerns. Much genetic art is no different. What are the implications of taking an anthropocentric approach to art, especially when the medium is alive, and nonhuman?" (2013).

Through his installations, Gessert questions the role of institutions in shaping an engagement with bioart practices, advocating spaces that have multiple uses and continue to support biological works. "His work highlights the hostility of the gallery environment for living artworks. Gessert knocked holes in gallery walls and in Japan, delivered light from the roof via optic cables" (Darlaston, 2008, p. 185). Gessert states that by working with wet biological practices "The intensity of the medium breaks the spell cast by traditional art, in which life seems to exist freed from death. No serious breeding project can indulge this illusion...evolution, even on the aesthetic level, cannot occur without death" (cited in Andrews, 2004, p. 7). Gessert draws attention to the moral and ethical complexity of working with living material as an art form and as an object of display and contemplation.

This conceptual and theoretical position situates my bioarts praxis and curated exhibition in a tension with the presentation of traditional art forms that also represent death, such as paint, sculpture, and Vanitas. As a result, the research offers an immediate fundamental experience of other living beings as they live, procreate and expire in real-time.

As discussed in the Background (Chapter, 2.0), Gessert deliberately asks the viewer to select their favourite flowers / plants out of all displayed and compost / destroy the least popular. Gessert asks us to think about the way we commodify nonhuman life. In addition, how this subliminally shapes how we consider the nonhuman relationships. Gessert states "Living kitsch...in public places, such as in the impeccably groomed...plantings outside banks, shopping malls, government buildings...focal points of the social order, reinforces associations between authority and nature that economics has replaced nature, or is somehow equivalent to it"(1997, p. 51).



Figure 12: George Gessert, (1997), *Natural Selection, Hybrid 487* (detail), dye sublimation prints with text and selected leaves, 18cm x 13cm. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

As mentioned in the Background 2.0, Gessert is an exhibiting artist in *Creatures of the Future Garden*, Chapter 7.0. Here Gessert produced a new work specifically for the show. The inclusion of Gessert (a well-established international artist) alongside student artwork is a deliberate choice to shatter the mechanisms of exclusivity, to extend discourse beyond the norms of the gallery.

Tissue Culture & Art Project (TC & A) Worry Dolls (2002) and collaboration with Stelarc: Extra Ear 1/4 scale (1997-2004)

The following examples are chosen to highlight the first exhibition model (to my knowledge) in Perth, as defined by this research. *Bio-Feel* was the inaugural platform for bioart as it housed 'wet biology'. The exhibition's associated symposium and publication *The Aesthetics of Care?* was in part used to launch *SymbioticA* (est. 2000) in Perth, Western Australia. This event was part of a larger series of exhibitions and conferences entitled *BEAP02 (Biennale of Electronic Arts Perth)*. Most significantly as Hauser (2008) identifies "BEAP, the Biennale of Electronic Arts, has been the first experimental art festival worldwide to regularly include wet biological art practices since its beginning." I argue that this event is an example of the actions new media practices have been taking to develop autonomous infrastructural networks beyond "mainstream contemporary art" (Shanken, 2011, p. 5).

To give an indication of some attitudes surrounding this form of praxis at the time, according to Wilson the artworks were considered to be an unknown quantity by the public and were met either with trepidation, considered to be representative of science fairs or hyped as the latest new media invention (cited in Regine, 2007). As Wilson directly states “I guess a lot of the fields in this hybrid art/science/tech world dwell in marginality. Some rise in attention and then recede” (ibid). At this stage the place in which the art form sits was still being mapped out and defined by interested parties and art-science collectives. As described by Catts, the agenda behind the *BioFeel* exhibition and symposium provided “a forum for deliberating on the artistic, social and scientific implications of the use of biological/medical technologies for artistic purposes...[and dealt] with the relationships artists and audience form with works of art that consist of living biological material” (2002, n.p.). This approach is made explicit through the artwork and installation by the Tissue Culture & Art Project (TC&A): *Semi-Living Worry Dolls* in *BioFeel*, (Figure 13), and *Extra Ear ¼ Scale* (1997-2004) in collaboration with Stelarc, (Figure 14).



Figure 13: Oron Catts, Ionat Zurr & Guy Ben Ary, (2002), *Tissue Culture and Art Project, Semi-Living Worry Dolls*, (from *BioFeel* exhibition), degradable polymers (PGA and P4HB), surgical sutures, endothelial, muscle, and osteoblasts cells (skin, muscle and bone tissue, dimensions variable. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Semi-Living Worry Dolls challenges the traditional use of the 'gallery' through the introduction of a working laboratory and 'wet biology' in the space and sets a precedent for the *Creatures of the Future Garden* by shifting perceptions of the art object. As stated by Munster, (2004) "[tissue engineering] now standard procedures in biotech laboratories and industries...their arrival in the gallery space conjures fears of a society's science gone mad" (p. 4). This example also places the onus on the viewer during their engagement with the 'wet biology'. The history behind this work developed from a collaboration between The Tissue Culture & Art Project, The Tissue Engineering and Organ Fabrication Laboratory, Massachusetts General Hospital/Harvard Medical School and *SymbioticA* (Oron Catts, Ionat Zurr & Guy Ben Ary, 2008). The intention behind this group aims to develop "a new form of artistic expression to focus attention and challenge perceptions regarding the fact that these technologies exist, are being utilized, and will have a major effect on the future" (Catts, Zurr & Ben Ary, 2008, n.p.).

The "semi-living" (ibid) worry dolls present a number of issues relevant to my curatorial exhibition. Firstly the works apply the methodology of wet biological practices. The artists actively learn the scientific technologies of tissue engineering to produce the sculptures. Secondly, as mentioned earlier, the piece also shifts the traditional use of a 'gallery' by introducing a working laboratory in the space. This act breaks down the ivory tower of both art and science contexts, by allowing the public to see the technologies and workings of laboratory practices and through the re-appropriation of the 'gallery space' beyond the exhibition of artworks. The installation was also interactive in that as a viewer you could "whisper your worries (not just in terms of biotechnology) to these dolls" (Catts, Zurr & Ben-Ary, 2008) via a computer blog. At the end of the exhibition period the viewers were also asked to participate in the 'killing ritual', where through the act of touching the dolls – presented in especially made coffins – the living tissue becomes contaminated and dies.

The collaborative work of TC & A and performance artist Stelarc *Extra Ear ¼ Scale* (2004), (Figure 14), was initially shown at the *Art of the Biotech Era* (2008) at *Experimental Arts Foundation* (EAF), Adelaide. The work aims to provoke debate surrounding the ethical responsibilities towards the "semi-living" as an artist, scientist, curator or participating viewer. "Extra Ear retains rather than resolves the ambiguities involved in its own production...rather than adopting an oppositional attitude towards biotechnology or using the gallery space to aestheticise science... [sitting] on the border of instrumentalisation and care" (Munster, 2004, p. 4).



Figure 14: Oron Catts, Ionat Zurr & Stelarc, (1997-2004), *Extra Ear 1/4 scale*, human cells, polymer scaffold, dimensions variable. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)

As these examples demonstrate, the viewer is actively involved in the welfare of the nonhuman life form or “semi-living” object. This offers an alternative level of engagement for the viewer to consider their relationship to the nonhuman in these works. However once the exhibition ends does the viewer continue to apply this level of consideration for the nonhuman within their lifeworld? This is why the research applies a multi-method approach. This is achieved by situating the praxis across a number of contexts. In addition, each aspect of the praxis reflexively considers the way each action contributes to a cultural understanding of the viewer’s lifeworld and nonhuman life in a contemporary context.

The research builds on this approach by introducing specific workshops that focus not only on critical discussions about biotechnological developments, but also local fauna and flora. In these workshops, the participants/students learn not only the related sciences; they are given tools to apply this knowledge within their daily lives. This is most explicit through the addition of the *WA Birds of Prey Centre Workshop*, where participants through hands-on experience learn about bird biology and welfare practices.

Stephen Wilson: Protozoa Games (2003-2004) and Eduardo Kac: Audience reaction to bioartwork

Stephen Wilson was an academic at the Department of Conceptual Information Arts at the San Francisco University State University. Like Gessert and TC & A, he has been acknowledged as one of the principal practitioners in the field. Wilson has written extensively on the role of art-science discourse in society. A key example (2002): *Information Arts: Intersections of Art, Science and Technology*: MIT Press. For the purpose of this research, I will only focus on the artwork *Protozoa Games* to demonstrate early public and institutional reactions to the genre. A pinball competition game between protozoa and viewers “mediated by digital microscope and motion tracking technologies...an unorthodox setting for thinking about relationship of species and paradigms of science” (Wilson, 2004). The artist worked with the “phototropic (attraction) or photophobic (repelled) by light and/or sound” quality of the species (ibid). Although considered a simple life form, Wilson (2004) identified personalities “They show individual differences - some seem frenetic, others seem contemplative. They explore their world in a great variety of ways and enact dramas of survival, affiliation...exploration not very different from humanity”.

Conceptually and theoretically Wilson argues that the work “asks audiences to consider new kinds of access made available through scientific tools and research...proposes new ways for audiences to engage this information in cultural niches outside of professional science” (2004). This agenda acts as a re-appropriation of the technology and sits between education and a critical arts practice. In this way, the artist navigates hegemonic institutions and asks the viewer to consider their relationship to nonhuman life in a contemporary biotechnological context. During an interview Regine asks Wilson (2007), “Does the public understand immediately what is at stake in your work? How do they react to your installations?”:

The audience can be provoked, intrigued and have fun even if they do not understand the bigger issues...children usually get involved in my installations. I am not sure how many in the audience think about the larger issues.

That is a problem not only with general audiences but even the judges in festivals...*Protozoa Games* were shown in a few places but mostly got rejections. Some judges felt they were too much like a 'science fair'.

Many audience members dealt with *Protozoa Games*...only as unusual games. But the installations did have more critical agendas...I wanted people to think about the complexity of life even at the single cell level and the relationship of humans to other animals.

These reactions to the work and concepts of bioart in the arts community indicated the fundamental complexity of balancing symbolic objects with the aesthetic of scientific equipment and processes, usually found in the laboratory or associated with museum

practices. It also indicated that further infrastructure needed to develop to support these types of art-science activities. This links to Groys (2009) argument on the relationships between the mainstream art market and contemporary arts, detailed in Section 3.3. In terms of the ways in which the work adds to broader discourse on our engagement with biotechnologies Wilson states (2007):

I felt that this level of unfamiliarity was culturally dangerous in an era where biology research was becoming so critical. I thought it was a fitting role for the arts to appropriate the tools, bring them into public media, and comment and intervene in this situation of unfamiliarity...My hope is that gradually the importance of many of the art/science fields will be recognized and that it will become part of the mainstream expectations for artists to work in these fields. I joke with my students that the art supply store of the future will include sections for electronics and biology research supplies. (Wilson cited in Regine, 2007)

Wilson (2007) points out that at the time there was a discrepancy between bioart practices and mainstream arts infrastructure. He also situates the role of the praxis in relation to its communicative possibilities in adding to the lifeworld through public dissemination. This premise relates specifically to the multi-method approach of the research. Although set up as a casual remark, the concept of purchasing equipment and biological supplies from shops opens up a number of ethical concerns in terms of OSH and animal welfare. By situating the praxis within the infrastructure of a secondary educational context, the research aims to prepare students for these 'hypothetical' potential futures, in laying another foundation for ethical conduct in the field. Further to this, Thomas (2009) echoes Wilson in relation to the role universities could have in providing further infrastructure for interdisciplinary art-science practices, Section 3.2c.



Figure 15: Stephen Wilson, (2003-2004), *Protozoa Games*, (stills from installations), (from: *BEAP04: Bio-Difference* exhibition and *Ylem Show-Interfacing Ideas*, San Francisco), motion detection software, electronic interface, protozoa, projection,

dimensions variable. (Exception to copyright. *Section:* ss40, 103C. *Exception:* Research or study.)

Eduardo Kac: Navigating hegemonic systems through arts practice

Adorno and Horkheimer set the binary of high / popular culture and art and mass production in place in 1944, concerning the passive consumption and engagement via the culture industry and mass entertainment, as opposed to an engagement with art practices. In the 21st Century however as Sturken and Cartwright (2009) describe, there are multiple ways in which the individual actively contributes to both high and mass-produced culture. The individual also contributes to mass communications using digital technologies and the Internet. In this, context artists also re-appropriate corporate advertising and systems of mass media to communicate a political message such as 'Ad busters' or the 'Yes Men'. As such, the boundaries of high art and popular culture become blurred. An example of this within the bioarts field is the works of Eduardo Kac.

Through his application of mass media systems, Kac re-appropriates the mechanisms that shape how most of the public engage with biotechnologies and nonhuman life. Kac works across a number of contexts: galleries, festivals, Internet, and public spaces. His previous works include photography and politically based works that deal with the processes of systemic colonisation. In 1998 he exhibited digital prints of *GFP- K9* (1998) a hypothetical transgenic dog altered to contain the bioluminescent GFP gene at *ARS Electronica: Paradise Now*, in the *O.K. Centre*, Linz, Austria and later the work *Genesis* (1999) (Figure 16) also initially shown in *ARS Electronica*. *Genesis* (1999) is a wet biological installation of *Escherichia coli* (*E. coli*) bacteria inserted with the Green Fluorescent Protein gene "that explores the intricate relationship between biology, belief systems, information technology, dialogical interaction, ethics, and the Internet" (Reichle, 1998, p. 5).

Using a passage from the Bible: *Let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth*, Kac translates "the words into Morse code and then again using the DNA sequencing code: GATTACA" (Travis, 2000). On opposite walls Kac has transcribed text taken from the "book of Genesis and the Genesis gene" (ibid). In the middle of the space a sculptural installation houses living GFP bacteria, whose growth is disrupted by participants. As Kac describes on his website: "...local [and] web participants...monitor the evolution of the work. Remote participants...interfere with the process by turning the UV light on" (2013). The bacteria growth changes as the

UV light “disrupts the DNA sequence in the plasmid, accelerating the mutation rate” (ibid).



Figure 16: Eduardo Kac, (1999), *Genesis*, (from: *ARSElectronica 99* exhibition), perti- dish, ECFP JM101 bacteria, microvideo camera, UV light, microscope illuminator, projection, networked computers, sound, dimensions variable. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)

This piece traverses public and private spheres and re-frames the fixed traditional ways of engaging with an art object in a gallery space, by linking directly to the ‘global network’. In this way, the work becomes a part of the lifeworld through experience and individual participation. In addition through the action of turning the UV light source on and off the viewer becomes a complicit actor in the welfare and development of the ‘wet biology’. This in a way Kac’s work becomes a collaborative arts practice as many individuals contribute to the piece simultaneously. The following example builds on this concept particularly in the way Kac navigates the processes of systemic colonisation in the lifeworld.

Alba, GFP bunny (2000)

The vast amount of discourse surrounding this hypothetical piece indicates the way that Kac uses systems of mass media, communication, and technology to disseminate his work. In a way Kac uses the hype surrounding the technologies, genre and audience expectation as Hauser (2008) identified to promote his agenda. The background to this piece draws on concepts initiated by the work *GFP-K9* (1998). As Kac states (2013), the ambiguity of whether the animal is genetically modified provided endless resources for public debate and spectacle:

“Alba”, the green fluorescent bunny, is an albino rabbit...She was created with EGFP, an enhanced version (i.e., a synthetic mutation) of the original wild type green fluorescent gene found in the jellyfish *Aequorea Victoria*.

The first phase of the “GFP Bunny” project was completed in February 2000 with the birth of “Alba” in Jouy-en-Josas, France. This was accomplished with the invaluable assistance of zoo systematist Louis Bec and scientists Louis-Marie Houdebine and Patrick Prunet...The second phase is the ongoing debate, which started with the first public announcement of Alba's birth, in the context of the Planet Work conference, in San Francisco, on May 14, 2000. The third phase will take place when the bunny comes home to Chicago, becoming part of my family and living with us from this point on.

The construction of the *FreeAlba!* Campaign is Kac's response to the debates surrounding the containment of GMO from the ecosystems (Figures 17-19). As a part of the *FreeAlba!* Series 2001-2002 Campaign Kac's public works included “posters, lectures, street conversation, radio interviews” (Kac, 2013). Kac is using the infrastructures in the lifeworld to perpetuate his artwork and its ideas to the masses – acting as an intervention. An act of intervention in this research details the ways in which arts praxis can navigate action within established institutions or systems of cultural production. In relation to the research by using a multi-method praxis, the activities are reflexively organised within the contexts of education, arts and science communication to provide alternate voices within these contexts.



Figure 17: Eduardo Kac, (2000), *Alba, the fluorescent bunny*, digital photograph, 10cm x 13cm. Photographer: Chrystelle Fontaine. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)



Figure 18: Eduardo Kac, (2001), *The Alba Flag*, Edition of 3, (Collection Verbeke Foundation, Belgium), cotton bunting with embroidered appliqué, 58cm x 89cm. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)



Figure 19: Eduardo Kac, (2001), *The Alba Flag*, (Outside artist's residence), cotton bunting with embroidered appliqué, 58cm x 89cm. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)

The representations of *Alba* through illustration, sculpture and textiles highlights one of the fundamental questions asked by curators in the bioart genre. How do you maintain,

preserve or sell 'wet biological' artworks? This is where the artists need to decide whether to kill the work in order to preserve a "relic" (O. Catts, personal communication, June 19, 2007) or continue to produce art for art's sake, positioning the genre outside the mainstream gallery system or work somewhere in-between these disparate positions (Groys, 2009). Kac's works cross boundaries of public, private, lifeworld and gallery institutions simultaneously.

Through this application of representative art, propaganda and "transgenic art" Kac plots the field (Bourdieu, 1993), while also debunking it. Kac uses his website as an archive, recording an extensive list of responses and debates across a number of contexts in the public realm, from art academia, journals, to newspapers and blogs.²⁰ This shows the global outreach of such practices and the re-appropriation of systemic colonisation via digital networks in the social realm. There are however mixed reactions to the work such as Professor George Annas (genetics law), "GFP bunny may make genetic engineering of humans more acceptable by making it seem safe (and cute)" (cited in Andrews, 2004, p. 7).

This demonstrates the tensions created in such new media arts practices that deal with contemporary contexts and blur boundaries of science-fiction/real-science. Artworks that communicate these issues are read in multiple ways as determined by Stevens (2008). They have the potential to be manipulated by corporations and defence to foster public familiarity and complacency. Mostly however, as Sullivan states, the outcome for practitioners is based in "Creating critical artistic encounters that change the way we think about things around us" (2006, p. 32). The research aims to develop this position with consideration of raising questions on how we understand, treat, manipulate and commodify nonhuman life in a contemporary context.

Animals in artwork, nonhuman – human interactions

As Thornton (2004) details, there is a long history of live animal display for public interaction/education/amusement. She breaks these down into two categories. The first is based in "popular culture appearing as: [more recently nature museums as detailed in Chapter 7.0] zoos, menageries, circuses, animal acts and sacrifice: [illegal] cock and dog-fighting, and factory farms, cultured pearls, honeybees and free-range farms"... [The second format is represented through the arts where animals are considered to be] "objects, performers, victims or co-creators" (p. 15). As she identifies the introduction of live animals in a gallery space can be found in the works of Phillip Johnston (cockroaches) (1934) MoMA, Salvador Dali (snails) (1938) Gallerie Beaux-Arts, Richard Serra (live caged animals and taxidermy installation) (1965-6) Gallery L'Attico, Rome,

and Jannis Kounellis (12 horses tethered in a space) (1969) also shown at Gallery L'Attico.

Many examples cited by Thorton (2004) indicate that this is not always the case as “performance artists...1970s and 80s act out...death/cruelty/species rift works” by killing chickens and rats. This particular act of killing is also a relocation of daily practices (meat industry, pest poisoning) from the lifeworld into the gallery space. Through this change in context, the invisible practices become visible. Thorton establishes however, that even if framed in the arts as a form of free expression, artists should still abide by the law and animal welfare rights.

The complexity and ethical problems that arise recently exemplified by the work of Wim Delvoy (2004), who tattoos live pigs, moving production to China and the *Art Farm*, where regulations differ. In relation to the recent developments in the field of bioarts, the literature and discourse surrounding the manipulation or incorporation of animals in artworks is often framed by ethical conduct: evident in the works of Julia Reodica and Boo Chapple (Appendix A). This framework also determines the curatorial decisions and procedures for *Creatures of the Future Garden* detailed in Chapter 7.0.

The research reinforces ethical processes throughout all aspects of the praxis: specifically, during hands-on ‘wet biology’ lab sessions and in developmental, exhibition and post-exhibition phases. These procedures are detailed in the methodology, Chapter 4.0.

3.2c Bioart as a cross-disciplinary site of negation and art-science collaboration

This section examines the ways in which art-science collaborative discourse can provide alternate positions to specialist fields of research. It also identifies the pitfalls, idealisms, and positive aspects of bioarts, cited by multiple voices across the fields of science, humanities, law and education. Considering her background, it is interesting to note Andrews’ (2002) position on bioarts practices as she identifies how it can actively contribute to the public’s critical engagement with biotechnologies. Lori B. Andrews, J. D. (2002, p. 2) states:

As a lawyer involved in creating social policies for the governance of biotechnologies, I am fascinated by the ways that, beyond its aesthetic value, life science art can help society to; confront the social implications of its technology choices, understand the limitations of much hyped biotechnologies, develop policies for the dealing with biotechnologies,

and confront larger issues of the role of science and the role of art in our society.

By situating the praxis in the social realm, the research can contribute an alternate voice to the central bodies in the public sphere as Andrews (2002) suggests. In addition, by implementing a multi-method approach to the praxis, such as the education context, consideration for the longevity of creative outcomes aims to go beyond a single exhibition event.

Due to the application of biotechnologies and/or life sciences involved in the construction of bioartworks, most practitioners have located their means of production in conjunction with scientific complexes or institutions. Munster (2004) identifies the relationship between infrastructure and opportunity. Here she argues potential difficulties for art-science collaboration in that specialist discourse and expectation or corporate funding still bind each discipline:

But a lot of grandiose statements are made about the commonalities between art and science: that they are symmetrical currents of human thought; that they spurt forth from the same wellspring of creativity; that they are equally concerned with innovation. What is overlooked is that neither art nor science is a homogenous field. Each has areas of specialisation with their own conceptual underpinnings, methodologies and—of particular relevance now—financial support and constraint. All these parameters affect the ability and willingness of artists and scientists to collaborate. We don't hear a huge amount about artistic collaborations in paleontology, for example, but we do see a lot of artists courting and being courted by the life sciences. Art and science are no longer disciplines existing within the rarefied atmosphere of the academy, but are increasingly engaged with and situated in relation to corporate capital. (2004, p. 4)

Drawing attention to various forms of bioart, Munster also identifies certain pitfalls in the collaborative ideals generated in this context. She points out that each discipline is framed by specialist discourse and reliant on fitting in with established infrastructural support mechanisms. This can hinder the freedom of creative endeavours. Another contradiction in these collaborations is the way arts practice differs greatly to the function of scientific methodology. As Bunt suggests; "Science at root is not about creativity or creating new knowledge it is about discovering what is there...confusion arises largely from the modern practice of denigrating pure research and emphasising the commercial and applied nature and funding for research" (2012, p. 10). These funding bodies, laboratory spaces, and exhibition spaces to an extent can determine the creative outcomes, but also limit the cross-disciplinary potential.

Munster (2004) also echoes Hauser's (2008) concerns in that most practices focus on the life sciences – more so than other practices. This reflects the popularity of biological science at present, and the arts response to current contemporary contexts and scientific activities prevalent in the mass media and lifeworld. The research acknowledges these issues by situating the bioarts praxis outcomes across the contexts of art, science, education and in the public sphere. Although each aspect of the praxis has a focus on the life sciences, there is also scope for participants and students to determine their own scientific interests and creative outcomes. Gessert's concept of a multi-use space perhaps also opens up a theoretical position to counter-act Munster's specialist concerns.

Artist and academic Phil Ross builds on this experience of art-science collaboration through the creation of spaces where such interdisciplinary exchange and knowledge generation can take place: "making interdisciplinary artwork is meeting people from so many different backgrounds and professions...science, technology, education, music, food and the environment. CRITTER presents talks, classes, workshops and events as a way to crawl around in this vital space" (Ross, 2013). For further information see Appendix A.

Within this context, there is however, a direct opportunity for cross-sector communication between arts, science and the public in which the bioart praxis can present alternate views to the technology developed within the scientific institution. Do artists reinforce dominant values, attitudes and beliefs towards life, or can this site offer a new perspective on said understandings? Perhaps this is where art and science collaboration can step in, to provide new ways of recording, generating and reflecting upon traditional research ideologies and their governing institutions?

This is an important distinction for the research as it provides scope to build a multi-faceted level of engagement with the non-human in a contemporary context. From a sociological position, this approach allows the full capacity of critical reflexive praxis to reach a broader audience. By traversing the institutions of art, science and education, the levels of engagement with nonhuman life reflect the realities of the lifeworld. The praxis through implementation draws attention to the ways each system works or influences day-to-day engagements with nonhuman life and biotechnologies.

The impact of collaboration or interdisciplinary practices on scientific methodologies was raised during a discussion at the *Mutamorphosis* Conference held in Prague, 2009 by academics and researchers in the field of new media arts. To contextualise, a number of practitioners attended this conference from the fields of bioarts, humanities, sciences,

and academia associated with *Leonardo*, detailed in Section 3.3. The premise for this conference themed *Extreme Environments* was to bring these researchers together to debate current biotechnological and environmental issues in an open forum. During a discussion entitled 'Artists in Science Labs,' Moderator Denise Kera asked the group this question as a way to map out the intellectual crossover between the two disciplines and the potential implications for future scientific work: "What happens to the research side when the artist joins the group in a lab?" (2009).

This question raises a number of concerns for both specialist disciplines, such as who participates in such collaborative activities and what are the benefits and pitfalls of these encounters? Firstly, a methodological concern, in that scientific research requires accountability, is reproducible, and has a practical application or outcome for the field. Arts practices however, often examine intellectual grey areas, which unless design based sometimes do not have a practical application and place emphasis on its ability to be unique. As artist Marta de Menezes responded that in her experience in the field, usually an artist does not fit in with the "objectives of the research" already taking place within an institution (2009, 9 October) and would prefer to have her "own artistic objectives" (ibid). This stance frames the artist as an instigator for the research as opposed to collaboration where both parties are equally determining the intentions/outcomes of the research. It also acknowledges the established distinction between scientific and artistic methodologies, of which art-science collaboration idealistically aims to blur.

Bioartist, academic and scientist Adam Zaretsky (2009, 9 October), builds on De Menezes response by saying that often the 'collaboration' process is one-way, the "artists want to go into the labs" however scientists rarely get to go into a "studio and have a freak-out". Artists' use the technologies of science to create artworks, however what do the scientists really gain from this form of collaboration? This approach is the initial step to bioarts practices for most, manifesting as 'artist in residence' within a scientific institution in collaboration with a scientist as technician.

Those in the field have acknowledged that the experience of art-science collaboration has offered an alternative perspective on the cultural role of science in the community. As Bunt (2012) states these interactions are "more likely to cause me to reflect on the social context of my work rather than the science". (p. 4). The interest or need for scientists to participate in artistic endeavours as suggested by Zaretsky, raises the issue or limitations of specialisation, which determines paradigms and opportunity. This notion relates to the issues raised by Munster (2008). Reflecting the issue, that scientific

research is under increasing corporate pressure confines its scope to “applied technology and bio-engineering” (Bunt, 2012, p. 6). As Bunt expands “The methodologies of finding solutions to problems are very different to those of pure research” which is open-ended (2012, p. 3). As raised by Munster (2008) each discipline comes to the collaboration with pre-determined ideologies and research expectations.

This research navigates the point of exchange between art and science methodologies.

Secondly, following this statement by Zaretsky in the group discussion, Thomas (2009) states: “That art and science schools are responsible for this specialisation...if there was more hybridity...use of the materiality...being invented...from a more structured position...so we’re not having this debate about how to do it...it is a part of conscious understanding”. This position can be developed, if as Bunt suggests, “the arts/science interface arises from the creative friction when these view points come up against each other and not in championing either at the expense of the other” (2012, p. 10).

The application of the research draws on each specialist discipline with the intention of encouraging participants to consider interdisciplinary methodologies. By providing life science techniques alongside artistic representation, the research aims to develop a reflexive engagement with nonhuman life. From here, the participant can continue to develop their scientific skills and/or artistic skills with further studies across each field. The significant point in initiating this modus operandi is that the individual can then continue to frame these skills from an interdisciplinary paradigm. In this way, the individual can reflexively engage with science and arts through practical experience.

The statement by Thomas (2012) asserts future possibilities for art-science collaboration and the function of bioarts in arts education. This is where the multi-method approaches to the research sits, providing the premise for locating the praxis in a secondary educational context. The research offers a productive space for interdisciplinary action, which aims to develop Thomas’ (2009) “part of conscious understanding”. In relation to the agenda behind the presentation of the bioart through my praxis, it is my intention to provide new levels of engagement in learning about the life sciences from an arts perspective.

The following example is of a practitioner in bioarts whose formal training and history stems from science. In this situation the trajectory ‘artist in the lab’ is reversed. This is a shift from “earlier artist-residencies, where the situation only benefits the artist” or the artist is the instigator of the creative research (Sowry, 2009). This exemplifies Zaretsky’s earlier statement of the scientist having a “freakout in the studio” (2009).

Artist and field science researcher-environmental educator, Brandon Ballengée, explains his cross-discipline approach. Firstly, he continues his role of a scientist through conducting “field research ... “[collecting] specimens for several scientific organizations” (2010, p. 1). As an artist, he uses “the visual impact of science to engage the public in a discussion of broader environmental issues ecology / field biology / genetics” (2010). As detailed on his website Ballengée is a “a visual artist, biologist and environmental activist...creates transdisciplinary artworks inspired from his ecological field and laboratory research...of...deformities and population declines among amphibians” (Ballengée, 2014), see Figure 20. He exhibits “documentation and biological specimens...[and is also a] Professor at the School of Visual Arts in New York City teaching in both the Fine Arts Department and the Humanities and Sciences Department” (ibid).

Ballengée therefore works across the fields (art-science-education), participating in lectures, exhibitions, running workshops and classes and publishing research papers in both art and scientific journals. His approach is a relevant precedent to the research as it demonstrates the breadth interdisciplinary methodologies can have. In relation to the praxis, the location of artworks, lectures, ‘wet’ biological workshops and exhibitions also spans across the contexts of art-science-education. The praxis takes Ballengée’s approach, however from tertiary contexts into a secondary educational context.

Ballengée’s praxis uses scientific methodologies, art as a communicative act, and responds to the contemporary conditions experienced in his immediate lifeworld as biologist and artist. “[My] practice has focused on sculpting society by implementing increased environmental awareness...organisms are utilized to portray localized environmental health. I create my artworks from direct experiences with animals in their natural environment as well as those in artificial conditions” (Ballengée, 2014).

His approach provides a platform to communicate scientific information to the public and data for future research. His work (Figure 20) sits between the representation (documentation) and presentation of actual living/preserved specimens of “wet biology” (Catts, 2004), while also challenging the traditional gallery model. He states: “[Using] paints made from collected pollutants, chemically altered specimens, living plants and animals in installations, I try to re-examine the context of the museum space from a static environment (implying rationality and control) into a more organic structure” (Ballengée, 2014).

Within the three aspects to the praxis, I combine scientific information via workshops and a hands-on engagement with the nonhuman. This approach adopts Ballengée’s praxis

methodology by encouraging participants/students to engage with the natural world via scientific investigation and practice. This knowledge informs the creation of artworks.



Figure 20: Brandon Ballengée, (2003-2008), *Cleared and Stained Hymenochirus Metamorph: Generation 6*, (Archibald Arts, NYC), IRIS print on watercolor paper, 47.5 x 36.5 inches. BEAP07 Stillness. [Brochure]. Perth, Australia. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Negotiating hegemonic contexts using interdisciplinary art practices

Building on Ballengée’s methodological approach of combining art-science practices, this section looks at the current debates surrounding the role “of public participation in scientific research” (2013, p. 6). The inclusion of these examples and theoretical positions, aims to demonstrate how the research could potentially add to this field via arts praxis, especially in relation to how scientific information is shared with the public. This is demonstrated by the implementation of workshops and teaching methodologies for *Bio-Tech Evolution*, Chapter 6.0 and *Creatures of the Future Garden*, Chapter 7.0. Each directly involves participants and aims to engender greater awareness of the nonhuman through real-time experience and scientific methodological ideology.

Meredith L. Patterson questions where “citizen science” has gone. The term as defined by Lindsay applied to “the amateur scientific work that has been undertaken by the informed, often self-educated and - trained citizenry...since the origins of science” (2013). Lindsay (2013) further advocates: “Field naturalists clubs in Australia and science-based clubs in North America (e.g. Audobon societies²¹) have been sites of mass, democratic interest and involvement in science since the nineteenth century”.

As a policy maker and member of the *Environmental Defence Office* (EDO) – responsible for monitoring government and business accountability – he is concerned that the contributions of members of the public to research is being ignored by larger institutions:

So might citizen science and community-based research be a pathway to genuine public participation in decision-making? This is very relevant...as nearly all of our environmental and planning matters are disputes relying heavily on scientific evidence. The observation, recording and monitoring of community experience should be a key source of data and information in these matters. But we have seen all too often these informal, semi-formal and 'non-expert' sources of information are disregarded or downplayed by official decision-makers in favour of professional experts. This is a big problem, as we detail in our environmental justice research report.²² (Lindsay, 2013)

Patterson suggests “Scientific literacy is not science education: A person educated in science can understand science; a scientifically literate person can *do* science” (2010, p. 1). Speaking on behalf of the bio-hacker movement, she rejects the “popular perception that science is only done in million-dollar university, government,...corporate labs;...we have no quarrel with Big Science; we merely recall that Small Science has always been just as critical to the development of the body of human knowledge...”(2010, p. 2).

By ‘small science’ Patterson refers to acts of civic science, where individuals outside institutional contexts conduct scientific inquiry and experimentation, historically exemplified by the research of English doctor Edward Jenner (1749-1823), who through practical experiments created the small pox vaccine. This initially met with ridicule, after his death it became a mandatory practice. However, Patterson comes from a socio-political position in relation to these methodologies.

Voices within the scientific community are also seeing the need to re-evaluate how to generate information due to the impact of external contexts. As Stodden suggests: “The promise of open research dissemination...is gradually being fulfilled by scientists...as contributions to science from beyond the ivory tower are forcing a rethinking of traditional models of knowledge generation, evaluation and communication” (2010, p. 4). In an interview with Athens bio-performance artist Yiannis Melantis, asks Joe Davis (2008) “Is the artist in a position, from a socio-political perspective, to direct this intervention? [He replies], “Artists would be if they were creators of public policy, and law, or the officers of regulatory agencies” (p. 111). Perhaps a step towards this aim in the future will be via art-science initiatives that collaborate with the public, scientific researchers, sociologists, artists and policy makers.

Through direct public engagement with the life sciences via a bioarts praxis and multi-method approach, there is a site for the dissemination of information about biotechnologies and their social implications. In the research, institutional shifting occurs through education curricula. By doing this, the course sets up an interdisciplinary teaching and learning methodology within the institution. In addition, it aims to foster this way of thinking about research in the minds of the next generation. I further examine these theories in Section 3.4.

3.3 Art-Science Spaces

This section aims to identify a number of global art-science spaces that are relevant to Gessert's (2008) concept of a multi-use space and to identify how these spaces navigate hegemonic institutions through interdisciplinary practices. The following examples are most relevant to the research; *Leonardo*, *ARS Electronica*, *Arts Catalyst*, *ANAT: Australian Network for Art and Technology*, *SymbioticA*; specific activities and the *Science Gallery*. This follows with links to a current bioart tertiary education program.

Art-Science Spaces

The following examples set up the broader context in which most art-science interdisciplinary acts take place. The combination of disparate contexts is becoming increasingly popular, locally, nationally and internationally, either as an artist run initiative, or as part of tertiary syllabus. This concept is evident in the multiple programs and centres being created across the globe that provides a site for such exchange to take place.

For example; Montalvo Arts Centre (CA), CADRE Laboratory for New Media, Ectopia (LI), Disonancias, Arts Council England (UK), Arts and Genomics Centre (The Netherlands), Artistsinlabs (Switzerland), Interactive Institute (Sweden), Hexagram (Montreal). See Appendix A for web links.

Most recently there have been discussions (Mendiharat, 2008) on creating networks between these centres. This is established by the action of the Artsactive²³ group who intends to foster knowledge generation and technological exchange between arts and the industries of science, design technologies and medicine. The driving force behind this network aims to “integrate ethical issues within any economic, social or scientific activity” (2008). This initiative was founded in 2005, in conjunction with key personal from

each of these centres, including Arantxa Mendiharat, Roger Malina-Frank, Malina's son, astronomer and chair of (Leonardo/ISAST), Jill Scotts (Artistsinlabs), Bronac Ferran (Arts Council England) and Emmanuel Mach`e (France Te`l`ecom). In addition, the more recently developed *Global Science Gallery Network*, initiated by the Science Gallery Dublin, uses *Google* to establish connection between likeminded centres. The development of these global interactions has the potential to develop new ways of generating knowledge through collaboration and further demonstrates how the field can facilitate social agency.

Leonardo: Est. 1968 (France) and (Leonardo/ISAST:The International Society for the Arts, Sciences and Technology) Est. 1982(U.S.)

Leonardo/ISTAST is a not-for-profit organisation that creates networks between artists, scientists, engineers and academics. This includes facilitating events, workshops, conferences, on-line discussion via website networks and extensive publications of peer-reviewed research through *Leonardo Electronic Almanac, Journal* and *Leonardo Book Series*/MIT Press. The concept for this network began when "Forty years ago in Paris, a group of artists, scientists and engineers got together and decried the lack of professional venues where emerging work bridging the two cultures [art-science] could be presented, debated and promoted" (Hawkins, H., Gutwill, J., Babcock, J. and McDougall, 2011). This example puts into practice Groys (2009) and Kleins (2010) theories by creating infrastructures for arts outside traditional mainstream commercial spaces. From the outset there has been an interdisciplinary approach, where scientific research is published alongside arts practices and sociological discussion. Such as the previously mentioned *Mutamorphosis* Conference in Prague²⁴. This event brought 20,000 members of *Leonardo* physically and virtually together, to debate current topics (universe of extreme environments) in the field.

ARS Electronica Linz, Austria, Est.1974

The *ARS Electronica*²⁵ Festival developed in response to the growth of new media arts practices. Like *Leonardo*, it also generates discourse on new technologies, creating infrastructure and public exhibitions to support these activities. This also includes financial support for institutions in the field presented via the Prix ARS competition "open to artists, scientists... [and a] variety of fields" (Schopf, 2007, p. 17). Similar in philosophy to *Leonardo*: "The Prix ARS competition was conceived along interdisciplinary lines so that a new basis could be created for discussing and designing what had previously been separate worlds: artists encountered interface

engineers...very divergent disciplines engaged in dialogues...ever more independent in its artistic formulations” (Schopf, 2007, p. 16).

This context also demonstrates the relationships between the arts practitioner and governing institutions in the field (Bourdieu, 1993). As such, the artist can ‘plot the field’ and enter into a dialogue with these institutions, co-contributing to its discourse and methodologies through participation. This is one of the aims highlighted by the *ARS Electronica Festival*. Pertinent to the research is an agenda behind the event and “...its function as a link between everyday culture and high culture: in daily life, media art uses popular technologies while simultaneously refining them” (ibid).

From my own participation the 2007 ARS Festival: *Goodbye Privacy*, it was interesting to note how these exhibitions were simultaneously located within established gallery spaces and public spaces in the city of Linz, Austria. The event exhibited works by established artists and design students. Also apparent at the event was the crossover between new media art practices and technological displays of innovation.

At this event, acknowledgement was awarded to those who contribute creatively to technologies situated in lifeworld: for example digital illustration in popular films, robotic toys and software. The *ARS Electronica* context demonstrates the multiple ways in which individual practitioners work in the fields, each with different intellectual and practical concerns. In relation to the bio-arts field this institution supports the exhibition of such art forms, but in doing so provides a framework for future outcomes in the genre. This links back to the importance of acknowledging the multiple approaches to bio-art in the research praxis - each artwork determined by individual agenda, contexts, and access to technologies. This process enhanced by situating the praxis across multiple contexts, which mediates the issue of ‘lumping together’ bioarts practices as raised by Voigt (2009). A process reinforced through the influence of the mass media and systemic colonisation.

FutureLab: ARS Electronica

Also relevant to the research is the development of *FutureLab*.²⁶ A space in the O.K. Centre dedicated “to developing contributions through methods and strategies of applied science, the results of which reveal new knowledge and experiences of societal relevance in art and science” (Hörtner, 2014). This occurs through on-going collaboration teams in the areas of “media art, architecture, design, interactive exhibitions, virtual reality and real-time graphics” (ibid). The outcomes of the experiments in the space in addition to the sociological and cultural applications also lead to innovations developed

with industry partners. Through this collaboration, there is a potential for interdisciplinary research-based products. This method broadens the developmental phase to encompass theoretically ethical, environmentally sustainable practices.

Arts Catalyst: London, U. K. Est. 1993

Arts Catalyst acts as a support system/facilitator for these practices providing networks between artists and scientists: “enabling artists to work in residencies in various laboratories...to utilise the technologies of modern bioscience: [as] an early exemplar of “bioart” [initiated in 1994 Helen Chadwick, Letizia Galli and Donald Rodney²⁷] (Triscott, N. and La Frenais, R., 2013). As an organisation they advocate that:

works should provoke self-reflection and a critical view...bringing the ideas, processes and environments of science to people’s attention. We believe that everyone should be able to have a role in the direction of scientific and technological research in terms of its impact (positive and negative) on society. (Triscott, N. and La Frenais, R., 2013)

This position reinforces the research as it aims to set up opportunities for discourse surrounding developing biotechnologies providing multiple levels of engagement with the nonhuman through bioarts praxis. The research builds on the statement above in that the course and curated exhibition involves young emerging artists. By developing specific lectures for *Bio-Tech Evolution* that debate these issues and provide examples of related practitioners in the field, participants have opportunity to critically engage with these issues.

ANAT: Australian Network for Art and Technology, Adelaide, South Australia Est. 1988

ANAT provides a network for developing connections between established artists and scientific researchers by providing contacts to the scientific community and host organisations within Australia. The group funds experimental art-science research – exhibitions, conferences, residencies and symposiums – to generate dialogue between cultural practitioners, designers, technologists and the public.

SymbioticA: Centre for Excellence in Biological Arts, Perth, Western Australia Est. 2000

As initially outlined in the Background (Chapter, 2.0) this artist-run space developed in 2000. Since that time, it has identified multiple approaches to biological arts and established its theoretical and practical discourse. The Centre (2007) initially began with an artist-in-residence program and weekly seminars. It has now branched into six main programs. These include:

Academic Program: The development of undergraduate and postgraduate programmes (2005). Academic coordinator: TC & A artist/researcher Dr Ionat Zurr. For the first undergraduate unit at *SymbioticA* -“Adam Zaretsky was the main driving force behind this course, drawing on his experiences teaching art and biology at Symbiotica’s *VIVOARTS* workshop (2001)...lab visits and practices, field days to the zoo and breeding arms, and many ethical discussions” (Bunt & Catts, 2002, n.p.). This original course is detailed in Chapters 6.0 and 7.0.

Research: Collaborations between artists, academics, scientists, residents covering the environment, life sciences and contemporary developments in biotechnology. As detailed from 2012-2015 main areas include; “Regenerative and Synthetic Biology, Ethics, Philosophies and Histories of bodies and technologies, Ecological Systems and experimental curating” (2013, n.p.).

Exhibitions: Local and global exhibitions situated in contemporary spaces. *BioFeel* BEAP02 examined further in relation to the curatorial exhibition, Chapter 7.0. See Appendix A for links to exhibition catalogues.

Artist/Researcher in Residence Program: Dedicated to the facilitation of “open-ended curiosity-based research...hands-on experience and skills acquisition needed for collaborative and independent research within life science labs” (2013, n.p.). The focus on curiosity-based research is in opposition to corporate interests and hegemonic institutions in that the outcomes are not necessarily viable for technological commodification. Residents have come from varied fields including “visual, sound and performance artists, science fiction writers, art historians, political theorists, geographers, scientists and musicians” (2013, n.p.).

Symposiums and Seminars: *The Aesthetics of Care? Metaphors and Misunderstanding, BioDifference, Still Talking, Body/art/bioethics, Unruly Ecologies, and Visceral.*

Workshops: *SymbioticA BioTech Workshop, SymbioticA Tissue Engineering Workshop, Synthesis: Synthetic Biology in Art and Society* and specialist workshop: *Adaptation*. In relation to the research, I focus on the five-day *SymbioticA Bio-Tech* workshop “led by SymbioticA’s Director Oron Catts” (2012).

The workshop introduces researchers/academics/theorists/artists from multiple fields to ‘wet biological’ practices in a laboratory setting. This includes hands-on engagement with life sciences: Such as tissue culture, and DNA extraction, during which the participants debate the ethical issues surrounding use in arts and science contexts (2012). This

workshop strongly influences the level of engagement the research develops within my art-science secondary course *Bio-Tech Evolution*. The way the research differs, however is through the addition of the live *WA Birds of Prey Centre Workshop*. This situates the hands-on experiences not only in relation to global technologies (biotech), but also within local ecologies. By doing so, the research provides additional ways to develop workshops.

Bioart Tertiary Education Programs

BioArt: Contemporary Art and the Life Sciences: Initiated at The University of Leiden, Canada. Est. 2008

BioArt: Contemporary Art and the Life Sciences: is run by academic, artist and lecturer Jennifer Willet who is the Director of “*INCUBATOR: Hybrid Laboratory at the Intersection of Art, Science and Ecology*, at the University of Windsor, Canada” (Willet, n.d.). Central to the role Willet actively practices bioart and interdisciplinary arts debunking the processes of systemic colonisation and corporatisation. Specifically her practice “explores notions of self and subjectivity in relation to biomedical, bioinformatics, and digital technologies with an emphasis on social and political criticism” (ibid). This was exemplified by the collaborative work with Shawn Bailey shown in *BEAP04: BioDifference*. The work entitled *Bioteknica* (2004) represented a hypothetical biotech company that provides tissue materials for research using teratoma technology. See link to *BEAP04* exhibition catalogue Appendix A.

The course caters for “non-specialist students to engage theoretically and practically in the biological sciences towards fostering a critical participatory engagement with the biological sciences from a fine art perspective” (Willet, 2008). In terms of the ‘wet biological’ sessions created by Willet, these include “introductory experience with mammalian tissue culture, microscopy, DNA extraction and imaging, and genetic modification” (ibid).

BioTech Evolution developed as a part of this research, differs to these precedents in that the activity is placed in a secondary educational context (Chapter 6.0). The ‘wet biology’ that is used in the praxis draws on these workshops. However, I provide real-time hands-on experience with local fauna, flora and fungi to situate the discussions in the students’ Australian context and lifeworld. This decision aims to encourage the

students to be more aware of the surrounding ecosystems and their responsibilities to its conservation.

Science Gallery, Trinity College, Dublin, Ireland Est. 2008

The *Science Gallery* created in 2008, is located on campus at Trinity College in Dublin, Ireland. This space has a history of crossing the boundaries between arts, new technologies and industry developments.²⁸ The most recent exhibition examines potential futures in synthetic biology - Responding to current developments in the life sciences.²⁹ The *GROW YOUR OWN* exhibition, exemplifies connections between art innovation and technology critical discourse. As stated by Science Gallery Director, Gorman (2013) the exhibition deals with “uncertain implications of synthetic life...gives you the opportunity to help shape future discussions around synthetic biology...bringing together engineers, scientists, designers, artists and biohackers to design ‘living machines’” (n.p.).

The following reference demonstrates the intricate networks created globally across the field, particularly how they intersect to develop new activities or artworks. This also indicates the way in which the networks continue to grow exponentially in varied ways. This reinforces Hauser’s (2008) statement that bioart is ever changing, in that the outcomes and manifestations vary depending on context, cultural conditions and technological innovations. Also significant for the research is the inclusion of tertiary students through workshops. The research builds on this idea by introducing secondary school students into the field through the curatorial process, (Chapter 7.0). Describing the *GROWN YOUR OWN* Gorman (2013) identifies the networks that continue to develop across a number of art-science spaces and infrastructures that support them. Curators “artist and designer Alexandra Daisy Ginsberg, Anthony Dunne (Royal College of Art), Paul Freemont (Imperial College), Cathal Garvey (bio-hacker) and Michael John Gorman (Science Gallery)...Ars Electronica Futurelab...Le Laboratoire in Paris...The Wellcome Trust.” This event also conducted an “Idea Translation Lab” for “undergraduate students to develop cross-disciplinary projects” (ibid).

This following quote illustrates the close relationship between bioarts practices and the lifeworld in particular the contemporary cultural conditions that frame our engagement with nonhuman life as it develops in real-time. “Because the debate around synthetic biology is still in the process of being framed, it is especially urgent to begin an informed and open discussion around the futures that it might enable” (Gorman, 2013). Following this regarding synthetic biology, the Royal Academy of Engineering (2009)

states: “public dialogue must begin ‘upstream’ before the parameters for debate have been narrowed down and decided upon” (cited in Gorman, 2013). Using this example Gorman argues that without this approach outcomes will result in a public response similar to that of the GMOs (2000). Which “failed conspicuously in public engagement efforts leading to...heavily polarised debate around the boundary between natural and unnatural” (Gorman, 2013). The research aims to extend these debates by introducing them into a secondary educational context and through the decisive selection of artists during the curating of the group exhibition.

The latest activity developed by the *Science Gallery* is a global network. By setting up its own infrastructure, it navigates hegemonic institutions and public communication. “The Global Science Gallery Network...[funded by a] €1 million gift from Google.org...aims to incorporate eight university-linked...nodes worldwide by 2020...King's College...New York, Bangalore and Melbourne” (2012).³⁰

This following example which has occurred co-currently (2012) to the research (2010-2013) is the *Science Gallery's* activities generated to reach young adults. This is pertinent to the aims of the research as a precedent in that its future intentions as a space aim to generate connections between: “creativity and discovery where science and art collide, through the development of an international network of science engagement activities inspiring young adults through exhibitions, educational workshops, training programmes and public events” (2012). These events are “for young adults to ignite a passion for science, technology and innovation, highlighting the rich network of interconnections between science, the arts, culture, design, business and innovation”. Similarly, the research aims to engender an interest in science, new technologies and the arts as Science Gallery has done.

The research however, aims to build on this agenda by firstly developing interdisciplinary creative teaching pedagogies for secondary schools, but also beyond this, by encouraging the students to be critically reflexive of their creative practice and lifeworld. Secondly, what the research intends to offer in the context of Perth, Western Australia is the conceptual framework of an exhibition space dedicated to biological practices combined with Gessert's (2008) concept of a multi-use space: a site for Australian wilderness, linked to on-going education/workshop facilities/seminars in the same location. In Perth, there are established sites that actively focus on and promote science through hands-on learning and display: Such as the *WA Museum*, *Scitech*, *National Science Week*, and *The Observatory*. Or sites that exhibit contemporary art, which have

included temporary biological art exhibitions/symposiums/workshops: *Perth Institute of Contemporary Art*, *Lawrence Wilson Art Gallery*, *The Bakery: ARTRAGE* and *John Curtin Gallery – SymbioticA* and the *BEAP Festivals 02-08* have initiated each of these events.

3.4 Interdisciplinary Education Models

This section develops concepts relating to interdisciplinary education models. Firstly I identify concerns relating to the continued specialisation in current education models used within Australia, which is closely aligned with American and United Kingdom models (NAPLAN testing). These arguments are presented by Robinson (2006, 2010, 2013) and Polesel, Dulfer, & Turnbull, (2012). This introduction is used to locate the research within local and global contexts in light of developing education infrastructure in Australia.

Secondly I refer to global discourse surrounding the application of interdisciplinary teaching methodologies citing Delvin, 2008; Hirst and Peters 1970; Jemison, 2002; and Venville, et al, (2002) and their role negotiating curriculum specialisation. Thirdly as applicable to the methodology of hands-on participation in the research I identify its relationship to McNiff and Whitehead (2006) and McTaggart's (1997) theories on "participatory action research" and its application to student reflexivity.

To locate *Bio-Tech Evolution* within similar activities in Australian science communication/education contexts the final section makes reference to the work of individuals located in the *Journal of the Science Teachers' Association of Western Australia (SCIOS)*, and environmentalist / educator Simon Cherriman (2011). This is used to examine the function that art-science collaborations have in generating further engagements with nonhuman life and environmental awareness.

3.4a Education specialisation: Impact on creativity and student learning

From my personal experience in the fields of arts, education and cultural theory, I consider that comprehensive education provides a good foundation for society. To increase learning, develop skills and gain knowledge in any field requires a willingness to question what is known or maintained by the dominant ideological discourse. In a contemporary context this approach becomes increasingly important as the conditions of

the lifeworld are shaped by global forces, which in turn impact the construction and communication of culture, engagements with the nonhuman and biotechnologies. The following examples identify current debates surrounding education reform and the long-term cultural consequences:

Every country is reforming public education at the moment. There are two reasons for this. The first is economic. We are trying to work out how do we educate our children to take their place in the economies of the 21st Century? Given that we can't anticipate what the economy will look like at the end of next week? The second though is cultural. Every country on earth is trying to work out how to educate our children so they have a sense of cultural identity? So that we can pass on the cultural genes of our communities, while being a part of the processes of globalisation. The problem is they are trying to meet the future by doing what they did in the past. (Robinson, 2010)

As presented by Robinson (2013) current education models based on industrial ideologies of conformity, separate disciplines and specialised output and testing (US, UK, AUS). As a result these systems are discouraging creative thinking. Robinson argues for further acknowledgement of the diverse ways in which individual students learn. He refers to the example of the current dropout crisis in American schools of sixty per cent of American children, and eighty per cent Native American children who leave school, and that this is "just the tip of the iceberg. What it [*No Child Left Behind*: Legislation developed in response to this drop out] does not count are all the kids who are in school but are being disengaged from it" (2013). He identifies a set of principles that should be a part of teaching to facilitate learning (2010):

1. That "human beings are naturally different and diverse"
2. In addition, "the second principle that drives human life flourishing is curiosity. If you can light the spark of curiosity in a child, they will learn without any further assistance"

In Australia in 2008, the government activated the NAPLAN program of testing and evaluation for education across primary and secondary institutions. This model has been operating in the US and UK for a number of years and is developed and maintained as a form of data collection to assess levels of arithmetic and English learning from "grades 3, 5, 7 and 9" (n.a. 2009). The results of each school are then published.

Recently collated by Polesel, Dulfer and Turnbull (2012) from the University of Western Sydney, Australia. *The Experience of Education: The impacts of high stakes testing on school students and their families teachers and its impact on the public perception of schools* (2012) by the Whitlam Institute with the Melbourne Graduate School of Education, is an extensive literature review report into the long term impact of findings

from the NAPLAN program in the US/UK. The report covers areas of concern identified in international literature sources from academics, educators, psychologists and sociologists. They argue that the program inhibits multi-method approaches to teaching, diverse student learning, becomes complicated for students on the periphery, such as non-English speakers, lower socio-economic groups and those with disability.

Polesel, Dulfer & Turnbull, (2012) state: “Skrtic (1995), cited in Peters and Oliver (2009, p. 273) describes the operation of the testing regime as a ‘machine bureaucracy’” (p. 12). This is akin to Robinson’s description of current education models structured based on “Intellectual Culture of the Enlightenment and economic circumstances of the Industrial Revolution” (2010). This process can be seen as yet another form of Habermas’ “systemic colonisation” (1970) and is in opposition to the aims of *Australian Curriculum, Assessment and Reporting Authority* (ACARA). As Randall (2013) states: “...teachers, academics and members of the community actively and productively participated in the development process and none of it became the Australian Curriculum until the federal, state and territory education ministers endorsed the final products”. This ideal approach to curriculum development and contribution by multiple parties in the field is an asset to the growth of education in Australia.

Also noted by Robinson (2013) in the context of Australia, “not evident in America,” is the on-going professional development and training support provided to teachers in the system. These methodologies open a door to the implementation of alternative teaching pedagogies and activities for students, such as Cass’s *Abiogenesis Unit* discussed in Chapter 6.0. However, as identified by (Polesel, Dulfer & Turnbull, 2012) out of an imposed necessity:

In the Australian context, the NAPLAN Senate report notes that a number of submissions to the Inquiry outline concerns regarding schools restricting the amount of enquiry-based learning and an increase in teacher instruction time...concerned that teachers have increasingly been ‘teaching to the test’ (Senate References Committee on Education, Employment & Workplace Relations 2010). Such findings echo predictions made by Hargreaves (1994), in light of international findings, of teachers increasingly becoming technicians, obliged to deliver a prescribed and narrow product.

Another element to this process identified by Johnson et al (2008) is the impact published results will have on school reputations and education. He states; “high stakes tests in the United States...have consequences for student success (e.g. grade promotion or graduation), teacher accountability, the reputation of schools or the funding of schools, reporting and public accountability are central to the issue.” The process, Johnson continues will influence the method of teaching and information taught to

develop a focus on outcome based learning. As stated: “low-level thinking and promoting outcome measures rather than the intrinsic processes of learning and acquiring knowledge” (2012). This is in Robinson’s (2013) view a serious problem if students are to be comprehensively and intellectually prepared for a world that requires creative thinking and problem solving in addition to literacy and numeracy – “Divergent thinking, the ability to see lots of possible answers, and is an essential part of creativity...citing Edward De Bono (2013) to think laterally.” Robinson (2013) states:

If you think of it the arts and I think it’s also true of science and of math. I say the arts particularly because they are the victims of this mentality currently...the arts especially address the idea of aesthetic experience. One in which your senses are operating at their peak. When you are resonating with the current moment when you are fully alive. But what we have is this: We have a system of education that is modeled on the interests of industrialisation and in the image of it. Based on factory line specialist into separate subjects, educated by batches, by age group and the assumption that what kids have in common is their age group.

The process of interdisciplinary teaching offers a platform to reconsider the use of discipline specialisation. In “1959, C.P. Snow commented on the gulf between the cultures of art and science and the ‘mutual incomprehension...sometimes...hostility and dislike’, but most of all lack of understanding” (Snow, 1993 cited in Munster, 2004, p. 4). As an industrial model each context operates in isolation and interactions are often framed by ideologies that are habitually learnt. As Robinson states; “The culture of institutional habits and the habitats that they occupy” (2010). The research as an interdisciplinary model, presents a case for such interactions to generate knowledge beyond the boundaries of context, specialisation and individual agenda.

Levins adds another controlling dimension that this mode of knowledge generation can negotiate: In staying with the traditional modes of practice “[the] outstanding feature of contemporary science is that the knowledge is increasingly a commodity produced by a knowledge industry to satisfy the goal of the owner of that industry, and therefore concerned with profitability, power, hegemony, and display” (2008, p. 36).

As Shapin (2012) identifies there are opposing positions against this concept and its relevance to the 21st Century. The angle I propose through the research sets up a model that challenges elitism in the specialisation of the arts and sciences. Therefore it can be argued that such interdisciplinary acts offer a site of dialogue to highlight the gaps and nuances or even issues present in each discipline involved. This process is developed within the curation of *Creatures of the Future Garden* and its complimentary symposium where artists and scientists in the field of biological arts present their methodologies to the public. This allows an open forum to debate contemporary contexts in the lifeworld,

such as the implications of biotechnologies, and contemporary engagements with nonhuman life beyond specialist discourse.

Szczelkun (1999) identifies the impact of governing institutions and collective ideologies: “According to Weber rationalisation creates three...differentiated zones: Science – Art – Law...characterised by a differentiation of spheres of value and structures of consciousness that make possible a critical transformation of traditional knowledge in relation to specifically given validity claims” (p. 340). He follows that this process of specialisation “then permeates and fragments everyday consciousness. This all pervasive rationalisation has negative effects on socialisation, social integration and cultural production...culture moves from a traditional base in a consensual collective endeavour to forms which are rationalised by commodification” (p. 289). By adopting an interdisciplinary model the participants in the research have the opportunity to consider the habits of each context and are also immediately positioned in the framework of a cross-discipline method of investigation. As cited by Sullivan (2006):

Tom Barone and Elliot Eisner (1997)...claim that arts-based research offers a distinctly different perspective on educational phenomena...the multiplicity of ways of encountering and representing experience, and the use of forms of expression that can effectively communicate these phenomena. (p. 23)

He follows with the example of the “research approach...‘A/r/tography’ (Irwin & de Cosson, 2004). A/r/tography references the multiple roles of Artist, Researcher and Teacher, as the frame of reference through which art practice is...a site for inquiry” (2010, p. 25). This theoretical approach relates directly to the implementation of multi-method bioarts praxis.

As Malina (2008) identifies even as early as forty years ago, “these creative disciplines existed in segregated institutional and social networks” (p. 10). This situation is counter-productive to interdisciplinary acts in terms of disseminating information on the life sciences from multiple perspectives through the development of new disciplines via the humanities. This approach offers a way for the individual to step outside of pre-conditioning social circumstances, contexts and dominant institutions and act autonomously using collaborative methods of knowledge generation. What I am suggesting here is an activity that encompasses interdisciplinary curriculum and pedagogies (Devlin, 2009). Bourdieu builds on the efficacy to develop this approach when we consider that education underpins the development of social norms, values and skills through knowledge generation. “The education system and the part that its institutions play in the construction and transmission of...legitimate knowledge...the

school system which...is capable of establishing them and developing them, through practice, as habits of thought common to a whole generation” (Bourdieu cited in Jenks, 2005, p. 127).

This also indicates the influence the education system has on the development of the lifeworld through cultural production, dissemination and communication. The intention is to offer a new research methodology, with a specific reference to Dumit’s (2008) argument on institutions and Levin’s (2008) views of how industry agendas influence the way scientific research is produced. By way of introduction to these arguments, Bunt (2012) cites the discrepancy between artistic and scientific research methodology and in particular disparate intentions:

artistic practice is all about communicating the artist’s own opinion and views, imbuing the work with a new vision. Sometimes this requires input from the audience; the artist stimulates conjecture by the viewer, alteration of viewpoint...a very personal...process as the artist explores his or her worldview. Contrast this with the scientific method, where the scientist is trained from the beginning to avoid all personal, contextual or viewer/reader ambiguity. (p. 11)

These theories link to secondary education art-science course *Bio-Tech Evolution* in terms of it being a collaborative one, involving multiple teachers from outside the arts in one program, encouraging students to merge disciplines but to acknowledge the reasons and importance of difference. The course also includes wet laboratory sessions, which are not often encouraged as a part of curriculum (Jemison, 2002), and as such students engage in a hands-on approach to science, in a context where science is usually not expected.

Asserted by Venville et al, (2002) “...Hirst (1974) and Hirst & Peters (1970) suggested that an integrated curriculum could be justified through the view of knowledge that is unified.” This position emphasises the development of knowledge based on a reflexive and ‘bigger picture’ perspective, incorporating an interdisciplinary mode of thought and analysis. Davis, Sumara and Luce-Kapler, (2000) follow: “curriculum integration has some intrinsic value, in terms of the way that knowledge is organised – as connected, embodied, ecological, harmonised and implicated in local and global conditions, large and small” (cited in Venville et al, 2002).

3.4b Interdisciplinary Teaching Models

To preface this section in relation to the research, I am arguing for a different approach to teaching methodology and a complimentary addition to the current curriculum in Australian schools. “Australian Curriculum Assessment and Reporting Authority (ACARA), chief executive officer Hill” cites (2010) Roger’s (1999) definitions of the four approaches to curriculum: core, formal, chosen and individual. “Core curriculum comprising those general capabilities that all people need, use...throughout their life and the big issues of the day that all need to know about...formal curriculum...rules...methods...chosen curriculum that individual students and teachers create...meta-curriculum...activities...personal development.” The course developed in this research (Chapter 6.0) adopts features that encompass the core, formal and meta-curriculum from both the arts and life sciences.

Astronaut and dancer Mae Jemison presented a lecture in 2002 on the need for arts and sciences to be taught together. She described the current shift in infrastructure to privatisation in the U.S. and its impact on science research, education, training and public dissemination. In this climate “corporate mentality” places limits on most funds and places expectations and pressure on researchers to provide “short term product development rather than long term science research” (2002). This position also acknowledged by Bunt (2012) “Commercial and governmental pressures require that researchers are ‘accountable’” (p. 3) and increase the use of specialist methodologies. This corporate force will ultimately affect the way knowledge is generated, recorded and the way science is used to map the world.

Jemison (2002) identifies another difference between science and arts methodologies. He asserts “Science provides an understanding of a universal experience and arts provides a universal understanding of a personal experience”. From my experience within the arts, I disagree with this position and would argue that the arts are also situated within universal experience. This is made manifest through the application of a reflexive methodology. In this situation the making and communication of art practices becomes more about the navigation between an artist’s subjective positions and broader cultural contemporary contexts. This research applies a reflexive methodology to determine the effectiveness of the multi-method approach in relation to the contexts in which it operates (education and arts). By instigating art-science practices in an education context, it offers a way of engaging with nonhuman life in a contemporary context. This is particularly important in light of the decline of fine arts and wet laboratories in secondary education institutions, as Jemison (2002) states, “education is

not keeping up". Wet labs are being replaced by computer simulations (2002) and "fine arts in schools is disappearing." This shift is echoed through the NAPLAN program and its specialising influence. These on-going situations will greatly impact the well-rounded learning experience as promoted by Robinson (2010).

Biologist, Richard Levins explains the way an interdisciplinary model presents a case to generate knowledge beyond the boundaries of context, specialisation and individual agenda. "Science [and Art] is informed by gender, class, locality and micro-locations – the kinds of institutions one is working within ... Every social location has its blindness and its insights" (2008, p. 35). Levins adds another controlling dimension that this interdisciplinary mode of knowledge generation can negotiate: In staying with the traditional modes of practice "[the] outstanding feature of contemporary science is that the knowledge is increasingly a commodity produced by a knowledge industry to satisfy the goal of the owner of that industry, and therefore concerned with profitability, power, hegemony, and display" (2008, p. 36). Therefore it can be argued that such interdisciplinary activities offer a site of dialogue to highlight the gaps and nuances or even issues present in each discipline involved.

In contrast to this argument Malina (2011) and Bunt (2012) citing Levy-Leblond (2010) are concerned that claims of agency through interdisciplinary art-science action are speculative and that each discipline should continue to operate by their own methodologies. Malina (2011) asserts that there are practical reasons for this distinction. The infrastructure, and processes of "empirical method" used in scientific research cannot be confused in the public's mind with arts practices that use science techniques and call it scientific research" (Bunt, 2012, p. 4). However, in saying this Bunt (2012) argues that the exchange of ideas between the two offers a space for development. It is in this space of "creative friction" (Bunt, 2012) that interdisciplinary methodologies could emerge.

Devlin (2009) has examined the current teaching pedagogies at the tertiary level within Australia. Problem solving issues in the world such as environmental conservation requires teams of specialists working together across many contexts. To prepare graduates with the tools to engage in a meaningful way with big topics such as these she argues that it "is difficult to study from one discipline" rather it is more useful if a graduate can "work across disciplines" effectively and see issues from multiple perspectives. As Robinson states: "School systems should base their curriculum not on the idea of separate subjects, but on the much more fertile idea of disciplines...which makes possible a fluid and dynamic curriculum that is interdisciplinary" (2010). This

argument is supported by a number of science educators from international contexts who advocate the need to address the over specialisation in science pedagogies to meet the needs of 21st Century education.³¹

Devlin (2009) argues that in order to achieve this, there needs to be more investment for courses that offer interdisciplinary possibilities and research. She defines five main models that apply to these curriculum development and teaching methodologies (2009). Cross-disciplinary curriculum is open to outside influences beyond established subjects: “For example The Physics of Music” (Devlin, 2009). This process used to extend the knowledge base of the student’s main subject. In this context, each subject taught separately. This form of education is the most readily used and allows educators the opportunity to develop classes that can specifically compliment the development of the main subject matter.

Interdisciplinary studies builds on the first model, where subjects are still distinctly taught, however through the interaction between the two disciplines the students can examine the workings and pedagogies of each to develop a new intellectual position. This process leads to the next form of curriculum defined by Devlin (2009) – collaboration. In this context, participants from both subjects actively acknowledge the “contribution of colleagues in order to make their own contribution.” This methodology links directly with reflexive analysis and participatory action research. Taken further this model can develop into “Pluri-disciplinary” curriculum.

Here according to Devlin (2009) “more disciplines combine to jointly address a common area of concern...many specialists are required to manage this.” Pluri-disciplinary curriculum combines all subjects to problem-solve contemporary issues, such as environmental degradation. This aligns closely with Robinson’s (2010) concept of critical and creative thinking in schools and its importance in preparing for the uncertain conditions in a globalised context (Giddens, 1990).

The final model for curriculum is transdisciplinary where there is a complete “collapse of academic boundaries and emergence of new disciplines” (2008). However, this model is in tension with current curriculum practices. The infrastructure required to measure, mark and facilitate transdisciplinary activities is yet to be established. In relation to the research, this model is ultimately the most flexible. Transdisciplinary practices focus on generating new curriculum in response to contemporary cultural conditions: particular to this research developing biotechnologies and environmental changes.

Through *Bio-Tech Evolution* this research aims to introduce the interdisciplinary methodology at the secondary education level. This action addresses the current gap in secondary education curriculum that modelled on separate disciplines (Robinson, 2010; Jemison, 2002). Interdisciplinary activities can also be used to break down traditional notions of the ivory tower in relation to the practices and dissemination of science and arts as belonging exclusively to an institution of intellectuals (Shapin, 2012). This is achieved through collaborations between the disciplines where each educator (science-art-conservation) contributing to the course is considered equally important to the student's experience.

In relation to this research I define the concept of the 'ivory tower' with reference to how it is framed by the post Second World War use of the term "when it became an understood way of expressing anti-elitist sentiments...which have traditionally found a more favourable cultural and political audience" (Shapin, 2012, p. 4). Shapin examines its use and cultural implications. He maps out the terminological shifts from antiquity to the 1970s with reference to scientists, sociologists, journalists and artists. He identifies that there is a close correlation between the generation/facilitation of academic knowledge, government funding and military investment, particularly during the Cold War era.

He notes that most consider the cultural trope to be derogative, deeming that individuals purposefully isolate and disengage "from the concerns of the wider community" (Shapin, 2012, p. 5). This concept is now considered an outmoded and problematic by many in the field of scientific research. Determining that the outcomes of science technologies (health, environmental conservation) are ultimately for the benefit of humankind, practitioners championed this acknowledgement of the relationships between research and the broader community. Shapin (2012) cites Bertrand Russell "As the world becomes more technically unified, life in an ivory tower becomes increasingly impossible...the modern world depends upon scientists, and, if they are insistent, they must be listened to" (p. 59).

I concur with Shapin as he asserts, "Philosophers could and should support engaged scientists' moral and political work...philosophers only play a supporting role" (2012, p. 8). What Shapin (2012) suggests is the first step, not unlike an 'artist in residence'. However, once an individual is science trained and self-sufficient could there not be more than a "supporting role" from within the infrastructure itself? As demonstrated in my previous collaborative art-science projects: production and exhibition of artworks, lectures and workshops were located across both fields. In addition, collaborative ideas

have led to scientific applications, while the artworks continue to examine the cultural implications of doing so.

The research takes this model further through the implementation of interdisciplinary teaching pedagogies that traverse art and science curricula, offering a platform for students to consider the new ways of engaging with scientific technologies, arts and knowledge generation beyond an ivory tower. However in relation to the crucial communication of these ideas in the broader community, Shapin (2012) identifies:

R.G.Collingwood's 1938 *Principles of Art* had an entire section called 'The curse of the ivory tower', Collingwood said, 'The corporate life of the artistic community became a kind of ivory tower whose prisoners could think and talk only of themselves, and had only one another for an audience. (p. 8)

This problem is broken down through the development of a multi-method approach to the praxis in that the activities and outcomes of the research are located across the contexts of art, education and external sites to the arts, such as conferences and the spaces in the public sphere. In this way, the research opens up the discourse beyond the arts community.

In 1938,...Irwin Edman wrote that a university situated in New York City could never be an Ivory Tower: There are no dreaming spires at Columbia...nor is it easy to attain aesthetic or philosophic detachment in a place of higher learning that maintains a school of journalism...a school of philosophy...which holds...itself to have social origins and social consequences. (cited in Shapin, 2012, p. 15)

Shapin (2012) argues universities are being shaped by systemic colonisation through associations and dependence on corporate funding; "The ivory tower of old has become an arm of the state and an arm of industry, and the students inside reach out toward the labor market and toward political influence" (Kerr, 2001, cited in Shapin, 2012, p. 20). This puts pressure on individual researchers to produce output in the market, particularly in relation to science research and specialist practices. This climate is not conducive to interdisciplinary modes of thought.

As a cultural artefact, bioart has the potential to negotiate established art and science contexts as the outcomes are not determined by either institutional context. This approach opens up possibilities for the participant/student to think outside specialist contexts and apply this methodology in developing reflexive and collaborative skills in contemporary culture (Robinson, 2008). However, it is significant to the research to note, that for the most part the public outcomes of such practices are usually located within the humanities (Bunt, 2012). This action however creates direct access for public participation with the nonhuman and hands-on science activities in an arts context.

Bunt argues that “there are two, seemingly contradictory, debates in progress... a Luddite reaction to science and technology” to halt scientific technologies “perceived to threaten humanity...[such as] pollution...genetic modification, nuclear power...nano-technology” (2012, p.7). The second is position framed by the “hybrid art community.” Bunt argues that this is mostly evident in bioarts where practitioners assert through the use “scientific techniques in the humanities...the production of hybrid artworks has somehow brought the fields together to form what some call a hybrid third culture” (ibid). That through this amalgamation - via bioartworks or “education initiatives” – these concerns and “problems could be [potentially] resolved or avoided” (Bunt, 2012, p. 7). Although the research advocates this second point of contention raised by Bunt (2012), it does not claim to provide a fix-all solution for on-going environmental issues or usurp the role of scientific research. Instead, by integrating art-science practices in a secondary context, the premise is to provide an opportunity for young adults to develop a critical cultural engagement with their lifeworld. The outcome of this course aims to illustrate how scientific investigation and arts communication used to examine contemporary understandings of nonhuman life and developing biotechnologies. As Bunt (2012) concludes, “The productivity of working on the arts/science interface arises from the creative friction when these viewpoints come up against each other and not in championing either at the expense of the other” (p.9).

3.4c Application of art-science teaching models in Australia

The following examples cited demonstrate a number of approaches to workshops that have recently been developed in the field of science communication in Australia. Each example has a particular focus on addressing public awareness of nonhuman life and the environment or develops teaching methods that combine art practices with scientific experimentation.

Free Range Science in Victoria involves pop up workshops and panel presentations in rural communities located in pubs and at music festivals, to foster direct engagement with scientists and community through interactive displays and performances. This is an interesting approach to science communication in that it re-locates the activity outside an institution and into the lifeworld and public sphere. Within the development of artworks and public exhibitions, the research will also endeavour to locate outcomes in the public sphere.

A recent early childhood teaching project developed at Curtin University of Technology (Perth) for pre-service teachers has the aim of encouraging more science in the classroom. As (2009) Howitt & Blake describe, the “Collaborative Science Project,” (p. 9) combines the expertise of “scientists, engineers, teacher educators and pre-service teachers together to develop, implement and evaluate various modules of science-related materials and experiences” (ibid). The collective group produced five science-based experiences for young children that encompassed ecology, astrophysics, forensics, personal hygiene and solar energy. Most relevant to the research is the outcome/aim of “children exploring their local environment, thus developing a greater sense of their environment and their place within that environment” (2009, Howitt & Blake, p. 9).

Another example relevant to the research is the teaching methods developed by environmental conservationist Simon Cherriman. He specialises in wedge-tailed eagles and actively participates in monitoring their welfare in the environment. This knowledge taught to primary school children through hands-on scientific workshops. In these classes, Cherriman asks the children to identify the contents in the constructed birds nest (bones, fur, and teeth) to teach students about the bird’s diet, lifestyle and biology. As stated by Moore, (2012) Cherriman wants “to break down this disconnect people feel with the environment. ‘It all starts with nature in your own backyard,’...that by providing just a few bits of knowledge about the environment around them we can help children gain an appreciation...” (p. 37).

This agenda highlights the importance of the research in that the aim is to generate further reflexive engagement with nonhuman life through direct participation across the each aspect of the praxis. The research also builds on Cherriman’s activities and the *Collaborative Science Project* by bringing this knowledge into multiple contexts in the public sphere. This extends beyond primary educational institutions and through the addition of workshops that deal with multiple life science practices and biotechnologies.

The following example cited in SCIOS is again based in primary education comes closer to the interdisciplinary aspects of the research. By consciously combining art and science practices to learn the science, the project also develops a reflexive engagement with nonhuman life. As detailed by Stein, M., McNair, S. et al, (2001), the project involved the illustration of invertebrates by young children during their discussion of their biology, and role in the ecosystem. The educational agenda behind this approach demonstrates Robinson’s argument that interdisciplinary thinking and learning offers a broader platform for students to engage reflexively with the information (2010). This

activity opened up each discipline involved while also situating the practice within larger sociological paradigms: “Broadening students’ perspectives...integrating art as a tool for scientific inquiry...to communicate...students experience science as a human endeavour that uses the full range of human creativity and does not promote science and art as opposite” (Stein, M., McNair, S. et al, 2001). This form of open-learning based on experimentation and art-science manifestations is also promoted by the *Eureka!* Children’s Museum, located in Yorkshire, United Kingdom.

The teaching philosophy is based on the Brooklyn Model (1899) of learning through play and interaction. *Eureka!* is also a part of the “Association of Children’s Museums (ACM)” exploring through play and interactive displays physics, sounds, space, the human body, natural environment, health and sports; “To learn by testing, experimenting, exploring their natural curiosity and using their senses and imagination” (2013).

*Scitech*³² in Perth, Western Australia (est.1988) is based on a similar model to *Eureka!* It provides opportunities for class field trips, in-cursions, and on-site lectures. At *Scitech* children and young adults can explore the human body, physics, technology, mathematics, engineering and representations of the natural world through interactive installations. This centre also has feature exhibitions that are themed, such as forensics and sports. Within the same complex there is also *The Horizon Planetarium* dome theatre that hosts popular films and space documentaries. With the exception of the recent addition of the farm petting zoo – temporary *Toddlerfest* event for Years 0-5; - the research while drawing on these examples differs by introducing real-time interactions with nonhuman life.

3.5 Summary

The literature review has identified the theoretical and practical precedents to the research citing relevant voices in the field of science, conservation, arts, cultural theory and education. The review has examined relevant contexts that the research aims to navigate. By way of introduction section 3.1 identified how scientific research and public exhibition shaped engagements with nonhuman life. During the period of Enlightenment there was a shift from the private collection to public exhibition of specimens and technology with the intention of generating an understanding of our place in the natural world through the intersection of education, science, technology and arts. This was exemplified by key historical events and intellectual philosophies. The literature review identified that the

presentation of nonhuman life mirrored dominant cultural ideologies specific to time and place and provided precedents to the museum models of today.

The literature review has also identified the impact of industrialisation on the contemporary cultural conditions of modernity. As discussed these conditions include: globalisation, environmental degradation, increased urbanisation and the cultural impact of mass media. Individuals in the fields of science conservation in particular have voiced their increasing concern of the effect this is having on current experience with nonhuman life and public understanding of biotechnologies. The cited literature identified the ways in which bioarts practices can navigate these contexts. It has been concluded for this research that the application of 'wet biology' underpins this process.

In citing relevant practitioners, theorists and scientists, section 3.2 identified the multiple conceptual and theoretical concerns in the bioarts field. This process illustrated that bioarts practices are contingently based on the cultural and biotechnological developments in the lifeworld. In addition, the literature has identified that the processes of collaboration between art and science in this field is still being mapped out and are often dependent on the infrastructures that support them.

In conclusion section 3.4 identified that in order to critically engage with contemporary cultural conditions; there needs to be more investment in interdisciplinary education practices. Many voices in the field of science communication, education and conservation have determined the importance of increased communication and collaboration between hegemonic systems, and infrastructure and need to further acknowledge public participation. This section identified pedagogical models from Australian and international contexts who focus on generating these connections.

The literature has uncovered various theoretical ideas to establish the agenda behind the research question and bioarts praxis. The following chapter details the ways in which a methodology of reflexive analysis informs the technical framework of this bioarts praxis. This approach is supported by specific ethical protocols and developed with the use of participatory action research and qualitative data collection from participants, students and viewers.

4.0 Methodology

The methodology outlines how reflexivity (Giddens, 1990; Sullivan, 2010) and praxis (Barrett and Bolt, 2007) support critical decisions made over the course of the research. Organised in seven sections, the first outlines the theoretical models of reflexivity and praxis, providing an analysis of each key term as applied to my art research. In addition to reflexivity and praxis, section 4.2 details the methodology that underpins art production in the research. Arguing that art is a communicative act, this section draws on relationships between reflexivity and social agency in the lifeworld.

Following this position section 4.3 identifies how the model of Participatory Action Research (PAR) applies to pedagogical aspects of the praxis. This methodology supports the inclusion of student and viewer participation in workshops (Chapters 6.0 and 7.0). To supplement the application of (PAR), the research methodology also includes an analysis of data gathered from participants and viewers, and the reasons for which are detailed in section 4.4. Analysis of these data is presented in Chapters 6.0 and 7.0.

As a number of artworks and activities involve additional personnel, section 4.5 outlines each individual's specific contribution to the production of artworks or workshops.

The final sections 4.6 and 4.7, detail the various ethical protocols used, drawing on established animal ethics practices and systems currently operating in the field of bioarts. These procedures are applied to the production of bioartworks, selection of artists in *Creatures of the Future Garden*, and during all classes and life science workshops.

4.1 Methodology

Reflexivity and Praxis

The multidisciplinary approach to my praxis, encompassing the creation of specific bioartworks, secondary course *Bio-Tech Evolution* and curation of the exhibition *Creatures of the Future Garden* is supported by a reflexive methodology. These projects are used to ascertain the most effective way of articulating my concerns and position within the bioarts field. Reflexivity and praxis locate the research within visual cultural production. This helps identify the ways in which the research contributes to knowledge

of contemporary cultural contexts in the lifeworld. A reflexive analysis requires the acknowledgment of divergent positions and agendas within a context, and then being able to act upon them through praxis.

Giddens (1999) explains reflexivity as “the basis of system reproduction, such that thought and action are constantly refracted back on one another. Actions are legitimated not by their relation to tradition, but by their principled defence in the light of incoming information” (p. 1). Kaye (2009) builds on this position; “Locating divergent positions and agendas and then being able to act upon them is at the core of reflexivity”. This methodology is particularly useful in terms of situating the bioarts praxis in relation to the cultural conditions that frame nonhuman life in a contemporary biotechnological context.

Crouch (2007) suggests that through the application of a critical reflexive model of analysis the process “creates the potential for the individual to assess the creative act from outside of the act...revealing a dynamic relationship between the context, construction and articulation of the act” (pp. 105-114). In this way, the creative practitioner sets up a dialogue with the structures that surrounds the art making process and its sociological communicative possibilities. Through this process, the researcher can objectively plot their practice in the field.

In relation to the research, these fields include bio-arts, education, exhibition contexts and science communication. Michael Lynch (2003) suggests that the application of reflexivity lays bare the limits of knowledge, and identifies why institutions operate in the way they do. This method provides the tools to position the three streams of the praxis in relation to broader theoretical frameworks. Reflexivity helps situate the communicative capacity each approach has in relation to the systems and institutions already operating in the lifeworld.

McNamara (2012) points out the recurring misuse of reflexivity. As a supervisor, he identifies that often candidates focus on using the theory to explain the creative practice or develop a thesis based on self-psychotherapy. Rather, reflexivity should interrogate and situate creative artworks via an analysis of the “conceptual and historical...intellectual influences...place it in a wider context, outlining how the research investigation produces new insights within its field of inquiry” (p. 7). That is, to develop a research agenda that draws from broader contextual precedents. By doing this, I acknowledge that the application of reflexive thinking is not exclusive to the humanities, or that art is the only field that has the capacity to analyse contemporary cultural issues.

What this research aims to provide through a reflexive methodology is the acknowledgment of multiple fields and positions that surround contemporary engagements with nonhuman life. This process situates the research as belonging to particular sets of discourse already operating in the social realm of the viewer (scientific technologies, mass media communications, Australian and global environmental issues/contexts). Karl Maton (2003) also notes that reflexivity is frequently misconstrued as reflectivity, where the researcher develops a thesis describing the creative practice from a personal subjective instead of an objective position. As such the research becomes autobiographical and again a form of psychological self-evaluation. Crouch (2007) elucidates on the distinction between reflexivity and self-reflection: “[B]y framing creative processes in this way the resulting research can then be considered as belonging to a community of social disciplines rather than being constituted solely as self-knowledge, or self-expression” (p. 1). The application of this methodology is enhanced through the addition of praxis. This involves the development of ideas, theories, and philosophies in conjunction with the act of doing.

Framing art as a form of research, Barrett and Bolt (2007) argue that the concept of praxis is an “inter-relationship...between theory and practice” (p. 1). The history of this term stems from ideas developed in *Prison Notebooks* (1975) by Antonio Gramsci. From the Frankfurt and Marxist school of thought Gramsci was a socio-political cultural theorist and politician, imprisoned by Mussolini during the Fascist regime. He argues that praxis acts as a form of social agency in the lifeworld. This position acknowledges that dialectical enlightenment is not the exclusive realm of intellectuals and academics, thereby taking it out of the ‘ivory tower’. As Gramsci (1975) states, “All men [sic] are intellectuals” (cited in Haug, 2005, p. 9). This relates specifically to the way an individual can critically navigate hegemonic forces of the superstructure – state systems of power, and dominant institutions that govern everyday cultural practices. Gramsci argued that these hegemonic forces perpetuate ideologies that reaffirm their positions of power. This occurs through the naturalisation or normalisation of dominant ideologies. Praxis acknowledges the relationships between practice and socio-political agenda; in particular, that historical and cultural forces shape the individual but also contributes to these structures through action in the lifeworld.

However, within any system of cultural production and consumption there are those it benefits and those it places on the periphery, often propagated by the mass media Gramsci (1975). He posits that as such, the re-consideration of educational practices

opens up the possibilities of changing the dominance of the superstructure through action and practical application. This theoretical position locates the social function of the research and bioarts praxis.

This theoretical approach of 'thinking and action' coupled with reflexive analysis is the most effective model to develop the communicative capacity of my bioarts praxis, the foundation of which is framed through on-going analysis of its purpose in cultural production. This process made manifest in the research in relation to the production and selection of public exhibition contexts, (Chapter 5.0). Moreover, through the facilitation of *Bio-Tech Evolution*, I encouraged the students to consider how their artworks relate to broader cultural discourse. In addition, I encouraged the students to adopt a reflexive methodology when researching ideas for their artwork and during the development of their artist statements, (Chapter 6.0). Thirdly, the research used this methodology during the curation of *Creatures of the Future Garden* (Chapter 7.0).

Sullivan (2006) explains how reflexive art based research is a crucial methodology to examine contemporary cultural conditions: "To appreciate how visual arts contribute to human understanding...to locate artistic research within the theories and practices that surround art making. It is from this...that other forms of inquiry emerge...critical and philosophical analysis, historical and cultural commentary...educational experience" (p. 96). This approach provides insight into the critical decisions made. Through this, I examine the sociological, theoretical and cultural applications of the research.

Reflexivity and praxis most effectively considers the relationship between the creation of an art object and its communicative role within broader cultural contexts; such as developing biotechnologies, and contemporary discourse within existing hegemonic institutions – corporate and mass media – that frame our understanding of nonhuman life. The application of reflexivity and praxis was also applied to the curatorial process where decisions were made in relation to selection of artists / artworks and analysis of the exhibition's contribution to the field of bioarts.

4.2 Art as a tool for reflexive enquiry into the lifeworld

This section presents an analysis of the relationship between art communication and individual reflexivity as a way to navigate hegemonic systems in the lifeworld. With reference to the theories of Sullivan (2006, 2007, 2010), I argue that art is situated in the social realm and therefore becomes a communicative act that offers an alternative

position to the processes of systemic colonisation. This theoretical framework is used as an agenda in developing aspects of my bioarts praxis.

Art as a form of social agency in the lifeworld

For the purpose of this research, art used as a form of communication to generate further cultural understandings of contemporary contexts and the lifeworld. Through the bioarts praxis I aim to set up situations where a viewer or participant considers their relationship to the object's subject matter and material reality, i.e., through 'wet biology', to engender personal reflexivity as a form of social agency in the lifeworld. As Sullivan (2010) asserts: "Reflexivity is a tool to develop and "to understand human agency - the capacity to make choices and to act on them" (p. 96). The intention, to motivate considered positive action towards the welfare and greater understanding of nonhuman/human relationships in a contemporary biotechnological context is a key agenda in the research. As Sullivan posits: "If the primary purpose of research is to increase awareness of ourselves and the world we live in...that understanding is a viable outcome of inquiry...[investigating] issues that have personal and public relevance" (2010, p. 97). This form of agency applied to the viewer or participant's lifeworld builds on Habermas' (1987) concept of communicative action, where there is a collective consensus of knowledge generation, based on equal participation. Johanna Mehan (n.d.) also identifies that through this the individual actively contributes to culture: "Communicative action can be understood as a circular process in which the actor is two things in one: an initiator...of groups whose cohesion is based on solidarity...and of processes of socialisation" (cited in Robinson, n.d., p. 1), which then becomes a part of the lifeworld.

Through a reflexive engagement the individual can mediate systemic colonisation and develop self-autonomy. As Sullivan (2007) states: "Agents have the ability either to reinforce or resist the influence of the cultural system." By using an interdisciplinary mode of operation within the research allows ideas to develop through the collaborative acts. As established in the Literature Review, section 3.4 (Robinson, 2010; and Devlin, 2009), the concept of interdisciplinary pedagogies is a formula that is becoming of greater interest in the field of art education. This is a response to the rapid shift in global cultural, technological environments and within the post-modern condition (Giddens, 1990):

In recent years, art educators have been exploring these research approaches as the arts disciplines try to claim a foothold in an information-based economy of educational rhetoric. Art educators, however, learned long ago that efforts to isolate human behaviour into

discrete, observable chunks did not capture the complexity of what it is to come to know something. (Sullivan, 2010, p. 20)

This process also reinforces the potential an artwork has in generating a form of social agency within the viewer, by offering an alternate view to the dominant discourse within the lifeworld. “Similarly, a viewer or reader is changed by an encounter with an art object or a research text as prior knowledge is troubled by new possibilities...Maxine Greene (2003), however, is fond of saying that art cannot change the world, but it can change someone who can” (Sullivan, 2006, pp. 29-32).

Bourdieu examines the relationship between an artist and the field of cultural production, in particular how an artist can plot their position in the field by determining their relationship “to social and economic fields, and to artistic traditions and values” (cited in Fensham, 2002, p. 171). Each of these structures in the field comes with a set of pre-determined modes of operation, infrastructure, expectations, production and communication. This position is most relevant to the development and communicative possibilities of art objects. It determines the subject matter of artworks produced (Chapter 5.0).

The relationship between an art object, social realm and broader community also informs the teaching methodologies for *Bio-Tech Evolution* and the curation process for *Creatures of the Future Garden*. Bioart becomes an amalgamation of art and science commonly seen by the systems of education and public dissemination as disparate practices. Wilson (2000) suggests this merger leads to an ideology where science becomes a cultural activity and where art is a form of research. The methodological position strengthens the communicative role of my bioarts praxis and in particular the development of *Creatures of the Future Garden*. During curation, I ensured selected artists who are research-driven and apply the model of praxis. This was achieved through investigations into each practitioner’s methodology and during individual discussions about artistic intent. Following this, the practice of bioart therefore creates a site of negotiation as it crosses art and science and can to an extent, sit between central paradigms that govern knowledge.

Through the generation of knowledge about biotechnologies from a philosophical perspective, bioart can become a site where the workings of systemic colonisation are exposed, encouraging the viewer to consider their role within this. This frames the research as belonging to the social realm, providing an insight into contemporary cultural contexts that facilitate nonhuman interactions.

“Always we reach out for what we need, and a work of art is never a thing in itself. It always requires interaction with a spectator. We discover the meaning of a work: but we also invest it with one” (Fischer, 1963, p. 140). This quote by Fischer reaches the crux of the matter in that an artwork is generated by an artist within a particular set of cultural conditions and in response to a set of ideas, it is therefore “considered as a social activity” (Heywood, 1997, p. 10). This can be a subjective exchange between artist-artwork-viewer, however what the research intends to facilitate through a reflexive methodology, is to locate this process in relation to a broader set of cultural conditions. In this way, the viewer has touchstones within their lifeworld through which to understand the intentions of the bioarts praxis. The three aspects of the praxis use this methodology and aim to foster reflexive and critical thinking in the students and participants. Through this interaction, art can be a form of social agency within the lifeworld.

This ideology is particularly applicable in relation to my negotiations with the various contexts that frame my praxis and during the art-making process. In addition, this ethos also framed the communicative function my bioarts. This process is evident in the workshops developed for *Bio-Tech Evolution* and during the selection of artworks for the *Creatures of the Future Garden*. I agree with Groy's in that “Art's function is to show...to make visible the realities that are generally overlooked” (2009, p. 8), to add to the discourse of lifeworld through communicative acts.

4.3 Participatory Action and student reflexivity

Participatory Action Research (PAR) is a community built form of research located directly in the lifeworld of the participants. The aim of this “approach involves testing ideas in practice as a means of improving social, economic or environmental conditions and increasing knowledge. Action research proceeds in a spiral of steps consisting of planning, action, and evaluation” (McTaggart, 1997). As explained by Wadsworth (1998), PAR can be closely aligned with reflexivity in that the process involves an examination of actions in relation to broader sociological and theoretical discourse as the research unfolds: “By critically reflecting on the historical, political, cultural, economic, geographic and other contexts which make sense of it...It is action which is researched, changed and re-researched, within the research process by participants” (cited in McNiff & Whitehead, 2006). This process is deemed a necessity in relation to environmental justice and conservation. For example the *Pacific West Community Forestry Centre*³⁵ in the U.S. who is arguing for infrastructures that support public participation and

contribution between government, communities, researchers and environmental conservationists.

This methodology was applied specifically to *Bio-Tech Evolution*. In this course the students were encouraged to apply reflexivity during their participation with each life science and during the conceptual development of their artworks. In addition by exhibiting their artworks, the student's conceptual ideas and ethical positions on biotechnology became a part of the broader community – this process is acknowledged by Wilson (2009). He identifies the potential of situating participatory action research within an educational context of art-based research, while also recognising the conformity of this act:

Educators, especially educators in self-proclaimed creative praxis, are attracted to a vision of themselves as agents of dynamic change and critical renewal, as bearers of cultural values, which are variously above the exchange system of the market place or connected to some humanizing propensity. However, it is important to register the essentially conservative force of institutionalized education: education is a key apparatus on social reproduction. (cited in Sullivan, 2010, p. 64)

Sullivan makes a point of defining the research as belonging to a set of established cultural conventions inside the educational institution. The research acknowledges the processes of “social reproduction” in this context. For the purpose of this research the focus remains on the ways in which a multi-method approach lends itself to generating an awareness of our engagement with nonhuman life. As Sullivan suggests, I aim to generate a critical engagement with contemporary cultural conditions, however, I also acknowledge through reflexive examination the contribution of other contexts (science education, conservation) in this process of change and agency.

As Wilson states, this can be seen as a form of agency beyond the processes of systemic colonisation (market place). Whether the development of the art-science secondary course leads to the conformity and specialisation of bioarts practices in an educational setting remains to be seen. PAR as a theoretical framework also reinforces the situation of the bioarts praxis and exhibition of artworks in the social realm. This is most pertinent during the interaction with bioart as the viewer can traverse across the object's symbolism and contemporary contexts in the lifeworld.

4.4 Data Gathering from Survey Questions and individual feedback

In addition to the application of a reflexive methodology throughout the three research components, I developed a series of questions for participants and viewers to answer

(sections 6.5 and 7.7). This form of data gathering used specifically for the students who participated in *Bio-Tech Evolution* (Chapter 6.0) and for the viewers who attended the *Creatures of the Future Garden* exhibition (Chapter 7.0). The reason for including such forms of data gathering used to identify what the students and viewers gained from the experience, and how each influenced their level of engagement with art, science and nonhuman life. It is also used to identify whether the selection of artworks in the exhibition directly correlate to the viewers' lifeworld. This process was subject to approval by the Human Ethics Committee at Edith Cowan University.

4.5 Collaboration

The role of collaboration within this research is limited to three main areas within the bioarts praxis. This includes:

- a) Assistance with the technical construction of specific artworks (Chapter 5.0)
- b) Two presenters in *Bio-Tech Evolution* - Gary Cass (DNA lecture and DNA extraction wet laboratory session) and Yvonne Sitko (*WA Birds of Prey Workshop*) (Chapter 6.0), and
- c) Exhibiting artists present talks on their work at the *Creatures of the Future Garden* symposium and Sitko repeats her live bird of prey workshop in the exhibition space (Chapter 7.0).

As a working methodology, this process developed the communicative capability of the three activities by introducing multiple bodies of knowledge and expertise into each context. This approach, I argue, also reinforces the interdisciplinary scope of the research and its position in relation to the bioarts field.

4.6 Ethical Procedures for working with nonhuman life through public exhibition and educational workshops

In order to establish my place within the bioarts field, as I have previously identified my artworks must contain biological practices that are dealt with from an informed position and in an ethically responsible manner. This coincides with the policies set up by Edith Cowan University and Australian National Health and Medical Research Council (ANHMRC) ethical committees as a part of a "confirmation of competency" (2010, n.p.). This framework significantly influenced the preparation of classes for *Bio-Tech Evolution*

and determined the selection process of artists for *Creatures of the Future Garden*. In relation to my creative works (with the exception of goldfish in *Diaspora Monopoly*, 2012), I chose to use non-hazardous and non-infectious fungi and bacteria, plants and invertebrates for the wet biological component, which is not of official ethical concern to the Animal Ethics Committee.³³

Both *Bio-Tech Evolution* and *Creatures of the Future Garden* in Chapters 6.0 and 7.0 contained animals (birds of prey and goldfish). I ensured that ethical protocols were followed during each stage of the process. As established by the:

Animal Welfare Act 2002: The Code of Practice defines an animal as: any live nonhuman vertebrate. This includes: fish, amphibians, reptiles, birds and mammals, encompassing domestic animals, purpose-bred animals, livestock and wildlife, and also cephalopods such as octopus and squid. (2010, p. 4)

The animals either were a considered part of an artwork, or displayed for facilitated educational/observational purposes. This process was done in collaboration with Yvonne Sitko by replicating the procedures used in schools to exhibit animals in a space (*WA Birds of Prey Centre*). During transport, animals were housed in enclosed environments according to procedures established by the Australian National Health Medical Research Council (ANGMRC). The identification of ethical concerns detailed in accordance with regulations and pre-established procedures operating in the field of art-science collaboration. As determined by the *Animal Welfare Act 2002*:

(The Act) provides for the welfare, safety and health of animals, regulates the use of animals for scientific purposes, and for related purposes...The license defines scientific purposes as: acquiring, developing or demonstrating knowledge or techniques in a scientific discipline other than in prescribed circumstance, [including] teaching. (2010, p. 4)

4.7 Ethical procedures for working with animals during the Secondary Educational Art-Science Course: Bio-Tech Evolution and Curated Exhibition: Creatures of the Future Garden

Life Science Workshops

The development of workshops for *Bio-Tech Evolution* and *Creatures of the Future Garden* were conducted in accordance with ethical and OHS protocols. Within the

research, the workshops complement the artwork content, while also disseminating knowledge about life science, animal biology and the environment. This approach becomes particularly significant for the development of gallery spaces that have multiple uses as presented in Chapter 7.0. The workshops also contributed to developing awareness in the viewer/participant of the relationship between their lived experience and cohabitation with the nonhuman, a key driving agenda for the research.

Wherever possible I applied the principle of the 3R's *Replacement*, *Reduction* and *Refinement* in accordance to the codes of practice set up by ANHMRC. This ethical policy has been established in all art-science collaborative activities and is applied by *SymbioticA* residents³⁴ at the University of Western Australia, and scientific researchers, students and staff at Edith Cowan University. All activities using animals were approved by Animal Ethics at Edith Cowan University, which to my knowledge in the context of art-based research, was an unprecedented request for the committee.

Replacement: Before commencing any animal-based activities I identified the specific species involved, and outlined how they would be used including standard operating procedures (SOPs). As part of the replacement protocol, I also attempted to source alternatives to actually having animals physically present in the exhibition space. This concept was developed further with my artwork (*Diaspora Monopoly*, 2012) shown in *Creatures of the Future Garden*. With the exception of goldfish in the installation a soundtrack of native bird calls provided the link to the nonhuman.

Reduction and Refinement: When there is no alternative to using animals as a part of the artwork, I attempted to reduce the quantity sourced. In order to do this ethically and successfully, I consulted with relevant expertise in the field and followed appropriate procedures in setting up, interacting with and caring for all animals within the activities. This included appropriate housing and environmental conditions for each species. Within the space, considerable attention was given to the social and environmental enrichment of the animals' enclosure, following species-specific designs in accordance with the guidelines established by ANHMRC.

Animal wellbeing was monitored throughout the duration of the exhibition and during audience interaction. As defined by Grant, et al (2010) "Animal wellbeing relates to evidence of how an animal is coping with a given situation and a judgment as to how the animal feels in these circumstances" (p. 5). There was also consideration towards the health and safety maintenance of the gallery space and the enclosure for both human and animal viewers. As a part of the animal welfare, I maintained the ongoing care of

the animal's enclosure after consultation with official personnel. This included "contingency plans for identifying and responding to emergencies" (2010, p. 43). These methods were also applied during life science workshops conducted either by myself, Cass or Sitko during *Bio-Tech Evolution* and *Creatures of the Future Garden*.

4.8 Summary

The key methodology for the research and its analysis has been reflexivity and praxis. Reflexivity and praxis situate the research in relation to broader cultural contexts and in particular the analysis of the lifeworld. As determined by Sullivan (2006, 2007, 2010), this process relates directly to the production and communication of culture through arts research. This theoretical position enhanced with the addition of PAR, survey questions for students, participants and viewers. Each activity that included participants, wet biology or animal interactions adhered to ethical protocols and requirements.

5.0 Production and Exhibition of Bioartworks

B. Documentation of artworks in exhibition (refer to the DVD)

With the exception of the installation work produced specifically for *Creatures of the Future Garden*, detailed in Chapter 7.0, this chapter examines the artworks I have created as part of the research. The intention of this chapter is to demonstrate the versatility of my bioarts praxis and articulate how each work answers aspects of the research agenda. Each piece presented contemporary cultural issues or biotechnological engagements between human and nonhuman life. This included local environmental scientific practices, animal extinction, and GMOs.

The following artworks are framed by key theoretical discourse identified by Catts, 2008; Giddens, 1990; Habermas, 1987 and Hauser, 2008. As established in the Literature Review (Chapter 3.0) these sociologists, cultural theorists and artists situate the research aims in relation to the field of bioarts practices and its role in providing an alternative voice in the lifeworld. Over the course of the research, I sought out specific 'artwork proposal calls' for local and national exhibitions. These exhibitions and events were contextualised either by commercial galleries, scientific and educational institutions, or located within everyday lifeworld contexts. This became paramount in establishing the communicative role of my praxis in the bioarts field and reinforced its multi-method approach.

By way of introduction, I cite the premise for each selected exhibition with reference to specific curatorial agendas or exhibiting artist examples. This demonstrates the way in which the artworks I have produced add to the discourse in the various fields. This follows with an analysis of each artwork produced, and details how each work conceptually addresses the research question. The experiences gained from these exhibitions and artworks fed into the conceptual development to the next stages in the praxis: *Bio-Tech Evolution* (Chapter 6.0), and *Creatures of the Future Garden* (Chapter 7.0).

5.1a Exhibiting in a Gallery Context:

Signs of Change: Jewellery Designed to make a better world.

Artworks: Mycotroph and Systemic Network of Social Darwinism

These pieces were created for exhibition in *Signs of Change: Jewellery designed to make a better world*, FORM Gallery³⁶, Kings Street Arts Centre, Perth Central Business District Western Australia April 9th to 30th May, 2010. As a not-for-profit gallery space this context has a focus on Western Australian craft and design to generate connections between local artists and the community. The exhibition curated by Elisha Buttler had a focus on exhibiting jewellery that had a transformative potential either through technological innovation or sociological symbolic communication (2010).

The context framing this exhibition and its associated practices regional, local and community based activities, echoes aims for the research in terms of its multiple approaches to the communication and social role of arts praxis. The exhibition *Signs of Change* provided an opportunity for me to examine the relationships between arts infrastructure and communication, and through my artwork develop an alternative position to commercial arts-based agendas (Groys, 2009). An exhibition of twenty three artists from local, national and international contexts aimed to demonstrate that there are alternative ways to approach jewellery design and its outcomes beyond the aesthetic and commercial. A number of works in the exhibition made particular reference to environmental and social acts of change. As illustrated by artist Heiss' *Arsenic Water Vessel* (2008) – An artwork where “art practice informs therapeutic technologies” (Heiss, 2009). The artist created a necklace that purifies water in majority world countries.

Another example that shifts concepts of jewellery design from the exhibition is Martina Dempf's collaborative jewellery pieces that set up economic and cultural infrastructures in Rwanda “developing micro-cultural enterprise as a way of connecting sustained financial gain with genuine cultural expression [that] is important to many Indigenous communities” (Buttler, 2010, p. 13). Both these works use the process of collaboration and interdisciplinarity – Heiss working with engineers and scientists to produce the work demonstrate the potential such acts can have in extending the function of an artwork beyond the exhibition space. These examples have a communicative and practical function. They draw attention to current contemporary global issues while also providing a potential solution.

Artworks: Mycotroph and Systemic Network of Social Darwinism

The two collaboratively produced sculptures entitled *Systemic Network of Social Darwinism* and *Mycotroph* use living fungi, borosilicate laboratory glass and recycled silver and copper as the medium (Figures 21-25). To clarify the collaborative method used for the production of these two artworks is outlined below:

Artist: Donna Franklin: Concept and design of works, fungi culturing and inoculation, metal work including construction and finishing. Collaborative Artist: Simone Hicks: Metal work including; casting of silver and copper forms, soldering and technical advice. Glass Artist: Peter Minson: Glass blowing and lamp work.³⁷ It is important to note that Minson is a part of a family of established specialists, renowned for laboratory glass making. This connection to science through the medium of glass is an essential element to the reading of the works.

The role of collaboration in this context sets up the premise that each individual brings to the work their specialist expertise. Hicks also provided conceptual influences in relation to the aesthetics of the metal casting. The component for these additions to the glass sculptures were created through the process of casting using jewellery techniques learnt during her studies. During this process I identified that the collaboration was mainly a technical consignment for Hicks and Minson; As opposed to my previous collaborative artworks (Background, 2.0). The activity opened up new approaches for the practice of both artists. Minson, in particular, felt that the exhibition of glass within the context of contemporary art was a new avenue he would like to pursue in the future especially through the development of collaborative activities. The process for me reinforced the potential way in which collaboration brings together specialist disciplines to create something new including an exchange of ideas, which would not have occurred if we remained within the paradigms of our usual arts discipline.

The role of collaboration in these activities also reinforced the function of reflexivity, as the praxis became a negotiation of the interests and needs of each individual contributing to the work, and therefore avoided any narcissistic or insular tendencies (Crouch, 2007). This insularity can be problematic because the individual is framed by particular cultural and contextual circumstances, which will inevitably shape how they engage with the creative process, but also inform the selection, presentation and communication of ideas. I assert an interdisciplinary approach can have the potential to counter-act Crouch's (2007) concerns.

Buttler (2010) identifies two key roles that praxis can achieve in the instigation of change: "On collective and universal scale and on an individual and personal scale" (p. 9). The artist can actively participate in this agenda not only through the ethical use of sustainable practices (a focal point for this exhibition), but also through the communicative act of the viewer's engagement with an object. *Mycotroph* (2010) and *Systemic Network of Social Darwinism* (2010) provided this experience for the viewer. It encouraged the viewer to consider their relationship to the environment, while also offering a way to act responsibly within their lifeworld by drawing connections to current scientific research and mycological groups in which the viewer can participate. The titles chosen for the first work: *Systemic Network of Social Darwinism* refers to "the application of Darwinian theory of evolution to the original growth and development of human society as animals" (Barnhart, 1964, pp. 1063-4). This title aimed to encourage the viewer to consider themselves as a part of the animal kingdom, rather than separate to it as framed by culture. This conceptual position relates to the aims of my central research question by drawing attention to the nonhuman. The second work entitled *Mycotroph* represents the germination relationship between Australian orchid seeds and mycorrhizal fungus. *Systemic Network of Social Darwinism* (2010) was originally designed to extend the body in space as shown in (Figure 22). For this context we decided to exhibit a segment to keep with the concept of jewellery and adornment.



Figure 21: Donna Franklin, Simone Hicks & Peter Minson, (2010), *Mycotroph*, (from: *Signs of Change: Jewellery Designed to make a Better World* exhibition) copper, silver, borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus) and *Fusarium* fungus mycelium/hyphae, 17cm x 10cm x 8cm & 15cm x 13cm x 4cm. (Copyright permission courtesy of FORM).

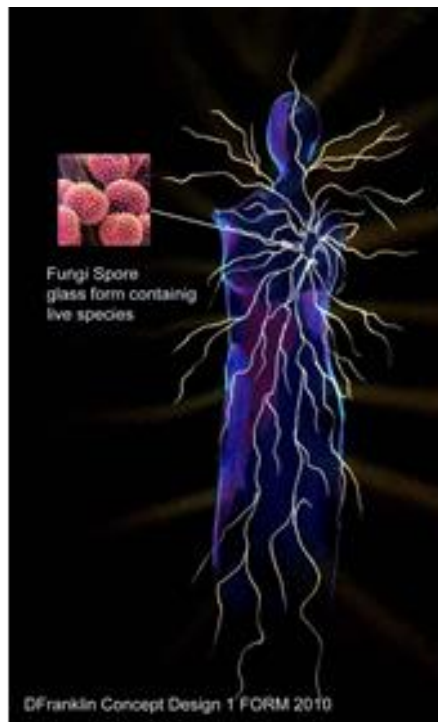


Figure 22: Donna Franklin, (2010), *Proposed Design Concept*, illustration, ink, acrylic paint, 30cm x 21cm



Figure 23: Donna Franklin, Simone Hicks & Peter Minson, (2010), *Systemic Network of Social Darwinism* (single segment) and *Mycotroph* (from: *Signs of Change: Jewellery Designed to make a Better World* exhibition) copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 18cm x 5cm x 3cm & 17cm x 10cm x 8cm.



Figure 24: Donna Franklin, Simone Hicks & Peter Minson, (2010), *Systemic Network of Social Darwinism*, (from: *Posted* exhibition), copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 150cm x 50cm x 8cm. Photographer: Heather Shaw.

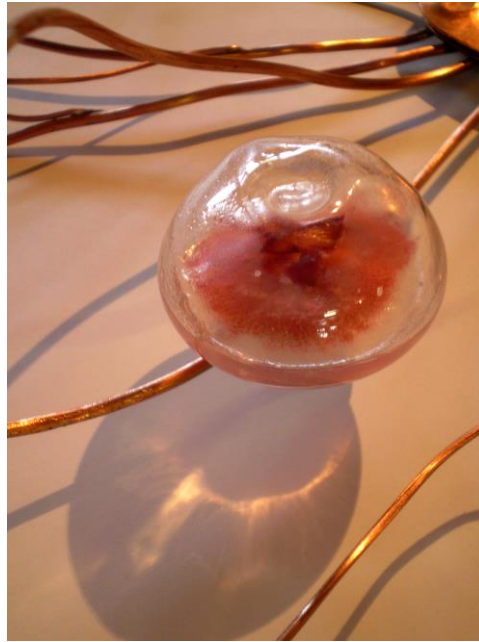


Figure 25: Donna Franklin, Simone Hicks & Peter Minson, (2010), *Systemic Network of Social Darwinism*, (detail), copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 150cm x 50cm x 8cm.

Conceptually the works intended to raise debate around the contentious manipulation of living entities as commodity; and explore culture-nature interfaces (Catts, 2008). In adopting this position however, the works also make explicit the ethical problem of using 'wet biology' to produce an art object.

Within the context of the exhibition, these pieces were the only representations of bioarts. This adds a new dynamic to the field of jewellery design. It also raises an ethical issue of complicity. By introducing these concepts into the field, it poses the problem of shifting the intention of the work. Although as established, the curatorial premise for the exhibition focussed on the social, cultural and ethical dimensions of design.

For this reason, I have included the artist statement essay published during the exhibition. The artist statement was developed with consideration of how the piece explores the research question and through a reflexive engagement with conceptual aims set up by the curator. The statement was also developed in consideration for the context of the exhibition location and audience demographic: jewellery designers, artists and arts students, tourists, craft specialists, academics.

Artist statement for Systemic Network of Social Darwinism and Mycotroph

Fungi have various roles in the environment. Some are pathogenic and hazardous to animals including humans, plants and insects. Others have a symbiotic relationship with plants and animals and most maintain the balance of complete ecosystems. As a group fungi spread through mycelium/hyphae networks underground. These filaments can travel vast distances and are crucial to the health of the environment – breaking down nutrients for plants and trees, insects, animals. *Systemic Network of Social Darwinism* symbolically represents this network of mycelium/hyphae. The pieces entitled *Mycotroph* are based on the relationship developed between Western Australian native orchid *Epiblema* and *mycorrhizal* fungus crucial to its germination.

This delicate relationship and network, we must understand, is a part of a system of which we are mutually dependant. These artworks are a metaphor for this symbiotic relationship. The application of recycled materials is a deliberate measure to comment on the e-waste produced through the production and consumption of goods in wealthy minority world and refers to the use of copper wire as a conductor representing fungi hyphae. The laboratory glass used to create the forms symbolize a site of containment and incubation for the catalyst of living fungi. The shapes represent orchid seeds and microscopic fungi spores. Held or attached to the body, the pieces represent adornment. Adornment of the body is often used to perpetuate a sense of self, status and identity (De Botton, 2004); as these pieces are also alive, the aim is to shatter this human-centric position, as the wearer and viewer must negotiate the care of the nonhuman (Catts, 2008; Hauser, 2008). In relation to exploring the research question this work develops the relationship between the art object and the viewer's lifeworld in particular the local environments of Western Australia. In this way, the artwork appropriates scientific knowledge and provides access for the viewer through the work to consider their cohabitation with nonhuman life.

We (the minority wealthy world) have been living in an increasingly mediated, technologically driven and culturally constructed environment. Interactions with the environment are in part, filtered through the mechanisms of economics and corporate ownership. Therefore only through education, knowledge and "collective consciousness", will we be able to progress into the future. It is an aim of this research that these works could provide a catalyst for discussion and change, as they are visual representations of the hidden world of fungi itself. As these pieces contain biological material (fungi), it is our intention to reinvigorate an engagement with the nonhuman.

Dr Neale Bougher has spent the last twenty-five years identifying fungi in the South West of WA and the Perth urban regions. He is the founder of the *Perth Urban Bush Fungi Group* who continue mapping, conserving and educating the youth and community about the role of fungi in sustaining our world's environment. As a communicative act, I used the exhibition pieces as an opportunity to educate the public as to what is happening within the Perth, Western Australian context. We are only now as a 'global community' considering the fact that in order to survive we will need to change our thinking to a more symbiotic and sustainable one. To make a better world, there needs to be a greater understanding of the complexity of the co-dependence we have with that which exists in the natural world (Suzuki, 2010).

5.1b Exhibiting in a Commercial Context: The Christmas Show, at Riseborough Winery and Art Gallery

The following sub-section represents another multi-method approach to the research in that my individual creative works are shown in multiple contexts – from contemporary art spaces, commercial galleries and science conferences. The artwork *Mycotroph* (2010) was also shown as a part of the group exhibition *The Christmas Show*, at Riseborough Winery and Art Gallery, located in rural town of GinGin, Western Australia. This presents a shift in context from my usual exhibition choices for bioart.

The Christmas Show held from 14th November - 19th December 2010. Exhibiting artists included Miranda Eaton, Stuart Elliott, Rosemary Fitzgerald, Jenni Gray, Julie Hylands, Matt Jackson, Tracey Luke, Susan Starcken and Ben Waters. Riseborough Winery advocates the promotion of contemporary Western Australian artists (painters, sculptors, craftspeople). It also hosts an annual competition and awards monetary prizes as well as acquisitions of finalist works. It has however never hosted a bioarts exhibition as defined by this research. The aim of exhibiting within this show was to re-locate the key issues communicated by the piece into a different context where the audience demographic situated outside the usual art community of which the bioarts field is associated.

This action builds on the research question in that the engagement with nonhuman life presented in varied contexts, implementing the multi-method approach. The reactions through personal communications with viewers were mostly ones of intrigue and interest

in the techniques used to produce the works, and although engaged with the work the viewers were mainly interested in the aesthetic qualities as a decorative item rather than communicative object. This situation also references the way in which viewers sometimes engage with bioart practices that use scientific technologies that are often invisible to the naked eye: such as cell-tissue culture. This is where the viewer comes with an expectation of what constitutes bioart using ‘wet biology’ to be flashy and dramatic, full of reactions and movement, where in reality some biological processes are quiet, and have growth rates that require long periods of time to visually change. As Andrews (2004) states:

Other artists use their work to critically assess the technologies or criticize the manner in which they are being integrated into society...[Catts and Zurr] grew living pig tissue in the shape of wings...to show people that their expectations about biotechnology are excessive. People came into the gallery expecting to see pigs that could fly – instead they saw tiny sculptures of tissue. (p. 2)

Catts calls this response “the aesthetics of disappointment” (personal communication, July 18, 2004). This context however offered a reflexive opportunity for me to consider the broader communicative techniques required to reach multiple audiences and reinforced the importance of a multi-method approach to the research and its practical development.

This shift in exhibition context was a useful experience in that I gained an insight to the infrastructure of commercial galleries and audiences, in this situation mostly tourist based. Prior to exhibiting works here, I have mainly located my practice in contemporary art spaces that have a particular cultural agenda as identified in the Background (Chapter 2.0) and Literature Review (Chapter 3.0).

5.1c Exhibiting in an Education Institution: Posted, Spectrum Project Space, Edith Cowan University

Posted: A curated group exhibition of post-graduate researchers provided an opportunity to show the complete version of *Systemic Network of Social Darwinism* (2011). The larger exhibition space allowed me to develop another element to the work. I included the addition of text, finely written in pencil hidden within the shadows cast by the sculpture (Figures 26-28). The text became a record of key quotes sourced from science

conferences I attended. These quotes either related specifically to the biology and ecological role of fungus growing in the exhibition or detailed various animal-fungi-environmental facts sourced from scientific research. Other quotes highlighted significant historical texts on mycology or philosophies/statements on human-nature interactions.³⁸ This added to the work and began a more direct process of including scientific information in an arts context for the viewer to make connections between the object and facts about their local environment.



Figure 26: Donna Franklin, Simone Hicks & Peter Minson, (2011), *Systemic Network for Social Darwinism*, (from: *Posted* exhibition), copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 150cm x 50cm x 8cm. Photographer: Heather Shaw.



Figure 27: Donna Franklin, Simone Hicks & Peter Minson, (2011), *Systemic Network for Social Darwinism*, (detail), (from: *Posted* exhibition), copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 150cm x 50cm x 8cm. Photographer: Heather Shaw.



Figure 28: Donna Franklin, Simone Hicks & Peter Minson, (2011), *Mycotroph*, (from: *Posted* exhibition), silver, borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus) mycelium/hyphae, 15cm x 13cm x 4cm. Photographer: Heather Shaw.

5.1 d Exhibiting in an everyday context: Claremont Hotel

Greenhill Galleries initiated this exhibition as a part of their support for emerging artists. A one-night exhibition entitled *The Grey Door Project Out of the Shadows* provided an opportunity to exhibit at the Claremont Hotel, Western Australia, with fellow PhD researcher and contemporary glass artist Naomi Hunter.

The Grey Door Project as a context in the field re-located the work outside of the institution of the ivory tower and as such disrupted the hegemonic processes that frame traditional art audiences (Habermas, 1987; Fensham; 2002). This methodology became influential on the process of curation for *Creatures of the Future Garden* (Chapter 7.0).

For this event, I re-exhibited *Mycotroph* (2011) and *Systemic Network for Social Darwinism* (2011) with three pieces from my previous art-science collaboration *Micro 'be'* as discussed in the Background (Chapter 2.0). These pieces *Alterations* (2008) *Decay* (2008) and *Metamorphosis* (2008) (Figures 29-30) were included on fellow exhibitor Hunter's request to provide a visual connection with her glass works that explore liminal spaces of the mind/body.

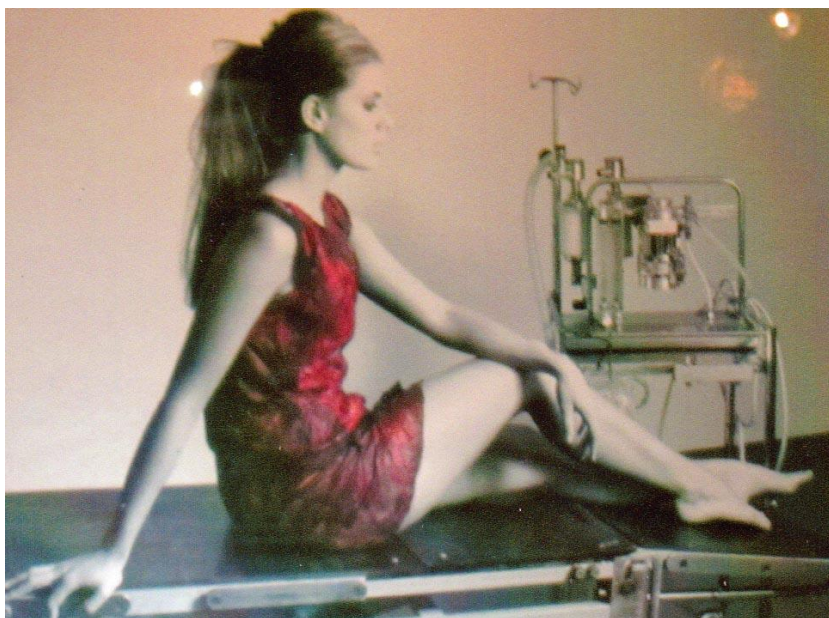


Figure 29: Gary Cass & Donna Franklin, (2008), *Alterations, Micro 'be' Fermented Fashion*, (from: *Out of the Shadows, The Grey Door Project* exhibition), metallic print behind glass, H: 69cm x L: 58cm. Model: Jennieka Chattelle, Photographer: Ray Scott.

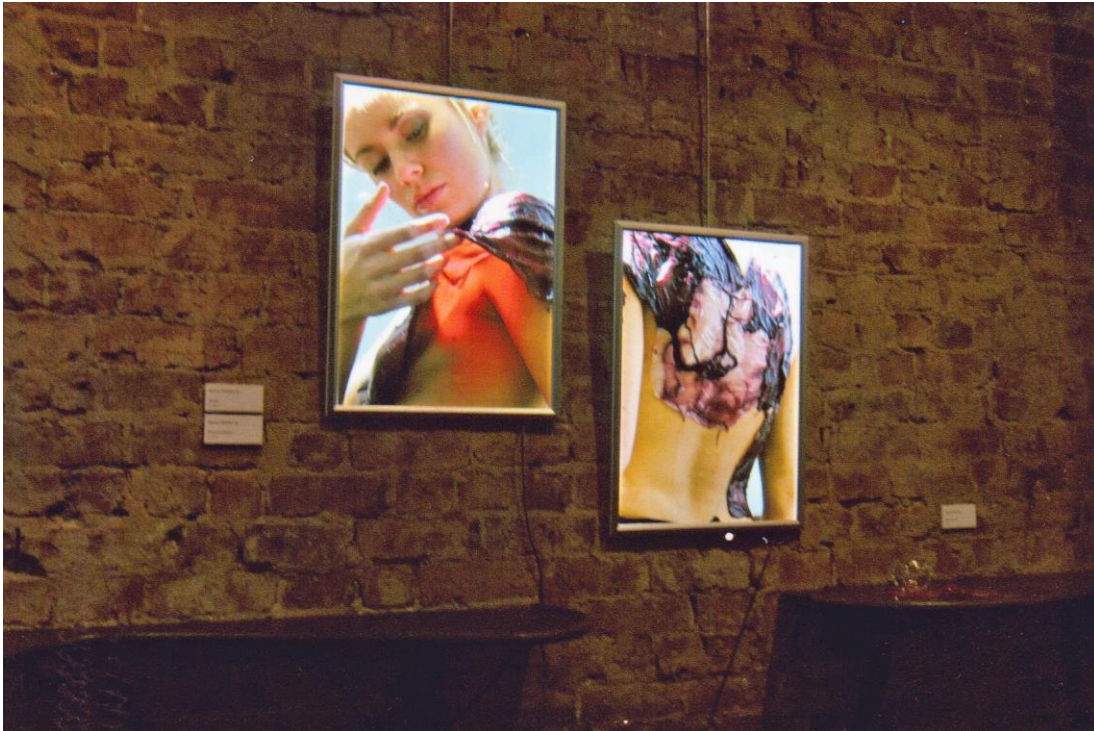


Figure 30: Gary Cass & Donna Franklin, (2008), *Decay and Metamorphosis*, (from: *Out of the Shadows, The Grey Door Project* exhibition), light boxes, H: 60cm x W: 42cm, Model: Jennieka Chattelle, Photographer: Bewley Shaylor.

The inclusion of these works although not part of the research, were used to reference the pub itself which distributes alcohol (staple nutrients for the bacteria) and the site of Claremont, a district that contains high-end couture fashion and is also geographically close to the city's cemetery. The decision to exhibit the *Micro 'be'* works in this context alludes to our key concerns of commodity consumption and mortality of human life as discussed in the Background (Chapter 2.0). In terms of audience responses to the works, viewers made connections between the notions of status with *Alterations* (2008) and the location of the 'gallery space'.

In relation to *Systemic Network for Social Darwinism* (Figure 31), viewers found the use of fungi as an art material and the science technique involved intriguing. Before this exhibition, work shown in this venue included paintings from various local artists. This demonstrates again (as discussed in the Background, Chapter 2.0) how bioarts is to an extent a peripheral activity.

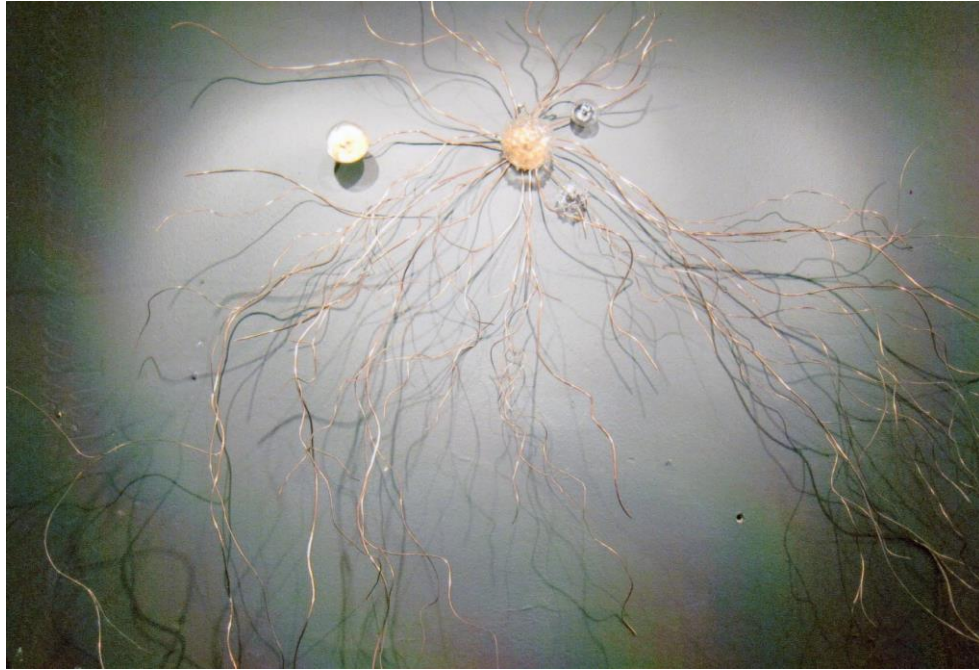


Figure 31: Donna Franklin, Simone Hicks & Peter Minson, (2011), *System Network for Social Darwinism*, (from: *Out of the Shadows, The Grey Door Project* exhibition), copper and borosilicate (laboratory glass), nutrients, *Pycnoporus coccineus* (orange bracket fungus), and *Fusarium* fungus mycelium/hyphae, 150cm x 50cm x 8cm.

5.2 Exhibiting in a Scientific-Art Educational Context:

***Animals, People – A Shared Environment...AN EXHIBITION.* Griffith University, POP Gallery, 3 - 23 July 2011.**

Whenever possible I attend life science conferences to gain an understanding or insight into the infrastructure, aims and agendas behind current scientific research. I assert that it is most important for my praxis as a bioartist that I come as much as possible from an informed position. These conferences allow me to access the minds, aspirations and points-of-view of scientists. The information gathered at the events also provides resources for the conceptual development of artworks. I have observed over the last few years that researchers have raised similar concerns to my own in relation to developing more areas of public communication and increasing a greater public interest in conservation and non-human life. This was particularly evident at the *4th Biennale Australian Animal Studies Group Conference*, Griffith University 10th July - 13th July 2011. Presenters included animal welfare activists, conservationists, scientists, theorists, academics, government organisations, NGOs from Australia, USA and Indonesia, and PhD students in Animal Studies.

Humanatis Series: Guam-Flying Fox, Red Chested Capuchin Monkey and GFP Marmosets (Kei and Kou) (2011)

For this series of works, an artwork proposal was submitted to the call for works webpage organised by conference facilitators as a part of the 4th *Biennial Australian Animal Studies Group Conference* held at Griffith University, Queensland. Exhibitions took place at the Queensland College of Art and POP Gallery, Queensland. The exhibition gave me the opportunity to show work to an audience from scientific and conservation contexts.

As the call for proposals indicated: “As part of their fourth conference, the Australian Animal Studies Group is joining with the Griffith University, Queensland College of Art to hold an exhibition that responds to the conference theme: Animals, People – a shared environment” (Woodrow, 2011). The audience for this series of works included local, national and international animal welfare activists, scientists and cultural communicators who have a particular interest in environmental conservation, education and animal welfare. As published on the website (2011), the call for works asked applicants to consider a number of relationships between human, nonhuman and their environments with a particular focus on generating an understanding of co-existence and habitation and human responsibilities for animal/environmental welfare. These topics addressed the multiple ways in which we engage with nonhuman life in a contemporary context and relates directly to the research.

The conference title and these series of questions provided as a part of the call for works indicates key concerns facing nonhuman engagements in our contemporary context. They also attempt to break down the anthropocentrism that usually frames such engagements and is often a criticism of bioarts practices that deal with nonhuman life. My artwork proposal addressed aspects of the following questions stated on the conference website (2011): “What moral considerations do animals and humans pay to each other and to their environments? What emotions characterise animal-human relationships in rural, urban, suburban, sustaining, neglected, damaged, sacred, conserved, indigenous, public, private, industrial, technological, playful, cross or multi-cultural places?”

The selection of subject matter for *Humanatis Series* was based on engagements with nonhuman life particularly extinctions taken from the text *Gap in Nature* by Flannery and

Schouten (2001). The works alluded to the consequences of human/nonhuman interactions biotechnological research. This research method draws parallels between the content of the artworks and contemporary lived experiences/knowledge available to the viewer.

This associative process for the viewer was reinforced through the topics used in the artworks *Humanatis Series* as they draw on current scientific research published in the public sphere and discussed in multiple mass media contexts. By using information directly sourced from the mass media and available to the viewer in the public sphere, the artwork now situated in the social realm offers an alternate level of engagement beyond hegemonic institutions. This process reinforces my methodological approach of reflexivity and reinforces arts role as a communicative act.

This connection is most explicit in the final piece *GFP Marmosets (Kei and Kou)*, (Figure 37), where scientific terminology was hand-written onto their bodies with ink. These terms directly sourced from the research papers: *Developmental biology: Transgenic primate offspring* (2009) by Gerald Schatten & Shoukhrat Mitalipov and *Generation of transgenic non-human primates with germline transmission* (2009) Erika Sasaki et al. both published in *Nature* 459. The glass component of the artworks for *Humanatis Series* produced again in collaboration with Peter Minson.

Artwork: Guam-Flying Fox

The *Guam-Flying Fox* (Figure 32-33) refers to the physical similarities we have with animals (indicated by the wings or modified hands). The animal was driven to extinction (1974) due to human activity. This representation in glass, which also houses DNA extracted from cycad plants the animal used to consume, metaphorically alludes to the fragility of the ecosystem. DNA: provides genetic information codes for life, gene technology, storage of animals, plants for future and used to indicate the physical connections between animals and humans.

The glass body formed as a hollow void in each sculpture talks about containment and emptiness, the material itself used in laboratories refers to the history of glass as an invention that changed forever our relationship to the natural world and revolutionised scientific research. The microbiological skin produced by *Acteobacter* bacteria used in each work alludes to current discussions of the origins of life on earth.



Figure 32: Donna Franklin & Peter Minson, (2011), *Guam-Flying Fox Humanitas Series*, Glass, DNA, Metal, Microbiological Skin (by-product from *Acetobacter* bacteria), Carbon, 46cm x 26cm x 14cm.

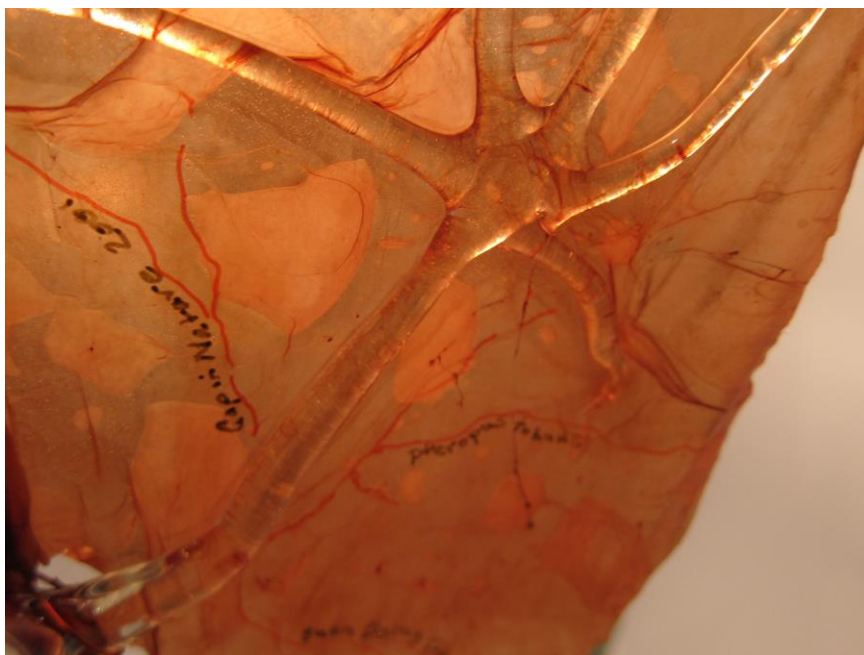


Figure 33: Donna Franklin & Peter Minson, (2011), *Guam-Flying Fox Humanitas Series* (detail), Glass, DNA, Metal, Microbiological Skin (by-product from *Acetobacter* bacteria), Carbon, 46cm x 26cm x 14cm.

Artwork: Red Chested Capuchin Monkey

This piece (Figures 34-35); depicted the critically endangered and illegally trafficked red chested capuchin monkey. The stance portrayed in the sculpture replicates footage taken of the monkey's behaviour in Africa. This monkey has taught itself to make specific tools and has developed a set of procedures in order to crack open hard palm nuts for food. The BBC documentary *Life* (2010) captured this process, and the footage shows the animal using especially selected stone tools, for crushing, rubbing and breaking, and shows passing the skills to the next generation. The piece also refers to Hugo Rheingold's sculpture "*Affe einen Schädel betrachtend* (monkey viewing/contemplating a skull³⁹), first exhibited in the Große Berliner Kunstausstellung (Great Berlin Art Exhibition) in 1893" (Schmetz, 2012).

The skin-like visual quality of the works, in particular the books in the work *Red Chested Capuchin Monkey*; refers to historical uses of vellum and leather as carriers of information and knowledge. *The Expression of Emotion in Man and Animal* (1872) and *On the Origin of Species* (1859) by Charles Darwin refers to anthropocentrism and "zoomorphism, the projection of animal characteristics, usually brutishness onto depictions of humans" (Woodrow, 2011, p. 3). The reference to this text in the artwork aims to disrupt the idea of human superiority, and alludes to the concepts of natural selection. As Gessert (2000) suggests: "*The Origin of Species*...laid the foundations for this non-dualistic [us and them-human / nonhuman] view of nature. Darwin described nature as a material system in which all living things are kin". Another book depicted in this artwork is the text *Status Anxiety* (2005) by Alain de Botton. This work examines the relationships between everyday lived experience, self-identity and commodity culture in the context of the wealthy minority world. The ultimate outcome of the philosophies behind this book indicates that it is a fruitless and culturally constructed task to measure the worth of a life based around the capitalist model. I included this text to refer to the current conditions of late modernity (Giddens, 1990) and to encourage the viewer to consider their lived experience in relation to this context.



Figure 34: Donna Franklin & Peter Minson, (2011), *Red Chested Capuchin Monkey Humanitas Series*, Glass, Metal, Microbiological Skin (by-product from *Acetobacter* bacteria), wood, 36cm x 30 cm x 23cm.

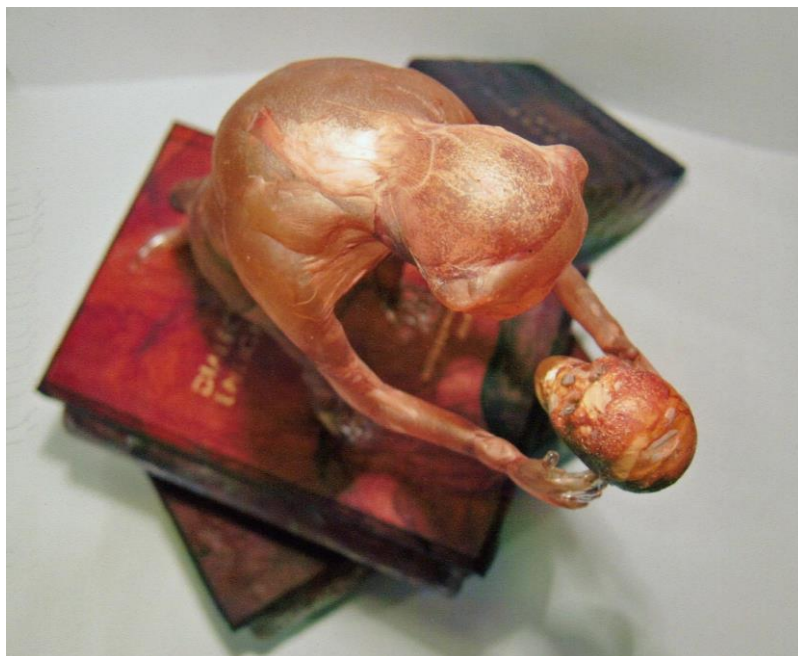


Figure 35: Donna Franklin & Peter Minson, (2011), *Red Chested Capuchin Monkey Humanitas Series*, (detail), Glass, Metal, Microbiological Skin (by-product from *Acetobacter* bacteria), wood, 36cm x 30 cm x 23cm.

Artwork: GFP Marmosets (Kei and Kou)

This piece (Figure 37) suggests a new form of 'natural selection' through biotechnology. It represents the complexities surrounding the use of the animal as commodity and as an on-going medical resource. The piece does not intend to criticise or generate fear, but to reflect and acknowledge the current fundamental changes determining the future of nonhuman life. Based on actual research this piece suggests a new form of 'natural selection' through biotechnology. The green fluorescent protein (GFP) inserted into the genes of the animals is used as a biological marker. As genetically modified organisms, these marmosets will never leave laboratory conditions.

The GFP marmosets depicted in the work were taken from a photograph (Figure 36) published in the news article *Researchers Engineer Green Glowing Monkeys*,⁴⁰ "This composite photo, provided by Nature magazine, shows newborn transgenic marmoset offspring Kei, left, and Kou. Insets show their feet under ultraviolet light" (Ritter, 2009). The sculpture covered in a bleached version of the microbiological skin. The surface of their skin used as a parchment. Using carbon in the form of modified ink and pencil provided another physical link between all living things, a topic investigated by Gessert in *Creatures of the Future Garden*. The text included scientific terms from the published research, sketches from Darwin's journals, and the names of the companies and institution in which the real marmosets live. Terms directly sourced from: *Developmental biology: Transgenic primate offspring* (2009) by Gerald Schatten & Shoukhrat Mitalipov and *Generation of transgenic non-human primates with germline transmission* (2009) Erika Sasaki et al. Published in *Nature* 459. As Ritter (2009) describes: "Scientists have shown that a gene they slipped into a monkey was transmitted to the offspring a step experts called a milestone for creating animals with versions of human diseases for study".

This work links directly to the research question as it deals with contemporary contexts that potentially frame the viewer's understanding of nonhuman life. By referencing actual research available in the public sphere the work sets up a direct correlation to the lifeworld.



Figure 36: Erica Sasaki, et. al, (2009), *(Kei and Kou) Central Institute for Experimental Animals, (Researchers Engineer Green Glowing monkeys, The Associated Press, New York, The Star. Ritter, M. Wednesday May 27, 2009). Digital Photograph. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)*



Figure 37: Donna Franklin & Peter Minson, (2011), *GFP Marmosets (Kei and Kou) Humanitas Series Glass, DNA, Metal, Microbiological Skin (by-product from Acetobacter bacteria), Ink.*

Artist Statement Humanatis Series: Guam Flying Fox, Red Chested Capuchin Monkey and GFP Marmosets (Kei and Kou)

In the 21st Century as biotechnologies continue to develop, the boundary between human and nonhuman continues to merge. Traced through the genes, the physical connection between humans and animals extends beyond primates to fruit fly, rats, pigs and zebra fish. The pieces collectively known as *Humanatis* refer to animals that have historical, social and physical links to humans – such as bats and primates. Each piece captures a moment from real footage that indicates physical and social connections between animals and humans.

Within the context of the wealthy minority world, our engagement with the nonhuman is framed by technological and cultural paradigms; As Da Costa (2008) asserts: “our ideas shape our environments”. Historically animals were collected for trophies, scientific study, and industrial production. This exploration reinforced the notion of human as dominant to the nonhuman and nature as separate to culture. Evolutionary theories contemporary research into genetics has not only broken down these cultural constructions, but has also provided the physical evidence of our interconnection between animals and the natural environment. This understanding could not have come at a more significant and crucial moment. As populations increase, and our day to day life becomes increasingly urbanised, our direct experience of animal interaction is held at a distance, natural biodiversity is replaced by monoculture and extinctions continue rise.

Will DNA collections, seed banks and synthesized life, become our ark for the future? This question led to the work *ARK* (2011), detailed in the following section which further examines contemporary engagements with nonhuman life.

***5.3 Blind Box Graduate Fundraising Exhibition
2011 Polytechnic West, Perth Western Australia***

The piece *ARK* (2011) (Figures 39-40) was created especially for this fundraising exhibition at Polytechnic West, Midland, Western Australia. The artwork itself was initially inspired by TC & A's *NoARK* (2007), Figure 38; A collaborative piece combining living cells from varied “tissue stock” and taxidermy remains; “NoArk is a research project exploring the taxonomical crisis that is presented by life forms created through biotechnology” (Catts, Zurr and Canning, 2007).

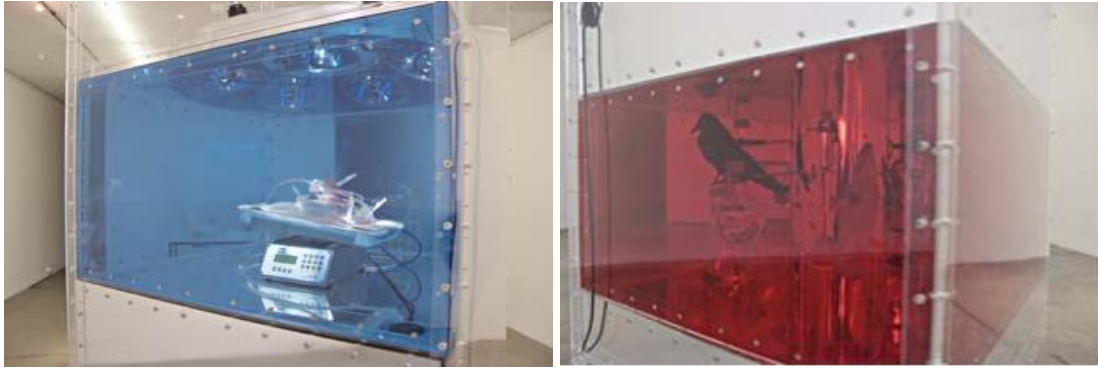


Figure 38: Oron Catts, Ionat Zurr & Marcus Canning, (2007). NoARK, (from: *BERAP08 Stillness* exhibition), cellular stock, taxidermy animals, 2m x 1m x1m. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 39: Donna Franklin, (2011), ARK, (detail), biological materials, paper 15cm x 15cm x 10cm.

In addition, the material and conceptual aspects of *ARK* (2011) were intended to develop associations with the “Svalbard Global Seed Vault, a repository built by the Norwegian

government to store backup copies of as many as three million different crop varieties” (Roach, 2007). This alludes to the animal preservation DNA caches in the British Natural History Museum. The animals and plants selected as listed in the certificate, explore the anthropomorphic relationships we develop with nonhuman life as identified by the public as associated with commodities, forms of scientific research and cultural symbols: in particular my invented ‘*Lady Gaga Gouldian Finches*’ and scientifically realised ‘*Dolly the sheep*’ as mentioned in the Introduction 1.0.

Other samples refer to the cultural historical associations that frame nonhuman life, such as the orange seeds (considered a sign of wealth, exoticism in 17th Europe). This tree was a part of “an assembly of cabinets of ‘curiosities’ which was so in vogue at this time...to display their cultural credentials” (Price, 2009). The tulip a pivotal influence on commerce, culture and resulted in the financial crash during 17th century Dutch history (Price, 2009). In addition, a number of Australian species represented both visually and physically using biological material that linked with the local ecosystem and Perth context. In the artwork, test tubes containing the biological components also appropriated and re-contextualised commercial logos that have a direct association with the nonhuman life preserved within. This indicates the relationships between biotechnological development and industrial outputs and provides a link between commodity culture and the potential future welfare of nonhuman life. This included wheat ‘owned by *Monsanto*’.

Monsanto, founded in 1901, is a global corporation that develops agricultural research and biotechnologies for the market. The company provides financial support for science research and university students. The corporation produces and sells seeds and chemical products to farmers in minority and majority world contexts. The company in recent history (2005) received bad press on the development and selling of ‘suicide seeds’ (first produced in 1988) – leading to concern of wild crop sterilisation (2005). There have also been court proceedings between U.S. farmers and the company concerning the spread of GM seeds in organic designated areas and accusations of infringement by farmers on technology patents.⁴¹ This is a complex issue for all parties involved. Such cases provoke further fear of genetically modified produce in the public’s mind. In terms of the pros and cons of genetic modification in agricultural research multiple arguments continue. By contrast Australian researchers are developing crops that require less water and have a greater up take of nutrients or improved disease resistance. In developing this work with reference to Monsanto and other biotechnological-based companies, the intention is not to incite blame or alarm, rather

illustrate the multiple ways in which nonhuman – human relationships evolve either framed by commodity consumption, co-habitation or technology. The links made to the following corporate bodies used to indicate the relationship between the system and lifeworld. The role of the artwork provides visual and physical representations of nonhuman life and the contexts that inform our understanding of this. It is ultimately up to the viewer through this engagement with the artefact to make an educated decision on the contexts represented here.

The following lists the appropriated corporations and actual biological material used enclosed in brackets:

Monsanto (wheat); This biological specimen was selected to reference one thousand years of agriculture and a contemporary economic base for Perth, Western Australia and the (European Honey Bee); was used to refer to current decline in bee populations. *Kailas Brothers* and *John West* (Salmon DNA); global fish farming, *Chevron* (soil sample); mining industries, *Purina* (canine DNA), to reference origins of nonhuman–human relationships.

The work also included a reference to *Australian Bush Heritage* (native seedlings). To contextualise, *Australian Heritage* is a conservation group founded by the great-great-grandson of Charles Darwin. To prevent industrial encroachment the group buys plots of land in Australia.

To incorporate connections to daily consumption of the nonhuman the logo of a major food company *Coles* a supermarket chain was included (orange seeds); and *AusBiotech*⁴² (apple seeds) *AusBiotech* is an organisation dedicated to infrastructural, educational support and the development of biotechnologies in Australia.

After the exhibition, the native seedlings were planted in Polytechnic West TAFE campus grounds. This action provided longevity to the work beyond the gallery space and situated the artwork in relation to the viewers lived experience. The generation of physical and conceptual connections between the artworks and the lifeworld of viewers is developed in *Creatures of the Future Garden* (Chapter 7.0).



Figure 40: Donna Franklin, (2011), *ARK*, ink illustration, 15cm x 10cm.

The accompanying illustration depicting the biological material referenced the 15th Century vanitas themed still life works considered to be “symbolic reminders of life’s impermanence and human’s transitory nature” (Hauser, 2008). Hidden within the images are links to the thylacine (hunted to extinction in Australia), *The Hillis Plot* “the largest scale attempt to present a diagram of the tree of life” (Dawkins, 2009), Charles Darwin’s *The Origin of the Species* and drawing associations with Kac’s *Genesis* (1999) piece, this verse from the King James edition of the Bible:

And God said; Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. (Genesis 2:26)

During this exhibition, I also presented a lecture on my research as a way to provide a background to the artwork and encourage the students to consider the creative possibilities of bioart to provide an opportunity for viewers to engage with nonhuman life in real-time and gain an insight into the life sciences. The lecture also covered my previous collaborative works (*Fibre Reactive* and *Micro ‘be’*) and stressed the role praxis has as a social and communicative act that empowers the lifeworld of the individual. I

also drew attention to Bourdieu's (cited in Jenkins, 2007) concepts of the relationships between art institutions, individual practitioners and "plotting the field" as I was aware that these students were soon to graduate. This exhibition and lecture identified a key issue that the research had yet to address. How can I facilitate art-science activities that examine contemporary engagements with nonhuman life in the context of education?

5.4 Exhibition in a Scientific Context: Exhibition of Fibre Reactive and paper presentation on this research at Fungi Map VI Denmark Agricultural College, Western Australia

This context offered an opportunity to present my research and artwork to a solely scientific community. The attendees included local, national and United States based mycologists, environmentalists, academics, researchers and educators in the fields of mycology and environmental science. For this exhibition, I presented the Masters piece *Fibre Reactive* (2004) *Mycotroph* (2011) and *Systemic Network of Social Darwinism* (2011). During observations and discussions with attendees it was clear that for most, their previous experience of contemporary fungi related art was based around botanical illustrations, photography, specimen preservation for collections, the use of fresh fungi as a dye product for textiles or felt sculpture. These artworks therefore presented an alternative fungi art genre for the viewers. Most were interested in the technique used to produce the works and species classification and enjoyed seeing a different approach to the dissemination of mycology.

As a part of my paper, I drew a particular emphasis towards the role of art-science collaboration as an effective form of communication and public education. *FungiMap VI*⁴³ also highlighted a demographic that was quite specialised and consisted of established older generations. This indicated that the outreach for such fields – although made manifest through activities organised by the *Perth Urban Bushland and Fungi Group, WA Museum* and *Scitech* – was not necessarily reaching the next generation. This situation later became an influence on the development of *Bio-Tech Evolution* (Chapter 6.0). As identified by a participating mycologist, I was also becoming concerned that this specialised information and "valuable knowledge about fungi could be lost" (A. Kalotas, personal communication, July 16, 2011).

5.5 Summary

These artworks represent a number of contemporary issues concerning nonhuman/human engagements. By locating the bioartworks across a number of contexts to engage a broader audience, I have demonstrated how the bioarts praxis and topics explored through the artworks are of relevance to a number of fields. This included animal welfare, environmental conservation and education. As a communicative act, the pieces aim to generate discussion around our technological, ethical, physical and cultural relationships to nonhuman life and as such mediate the hegemonic institutions that frame those interactions in the lifeworld.

This aspect of the praxis provided opportunity for conceptual development of ideas surrounding contemporary engagements with the nonhuman in biotechnological contexts. However, beyond symbolic objects, this does not reinforce the educational intentions of the praxis. Each work although it traverses the contexts of science and arts through medium was restricted to the paradigm of exhibition discourse.

During the process of artwork production and exhibition I have identified that the research can be developed to fill an educational need in relation to the next generation and that the exhibition of bioarts can potentially shift the preconceptions of a 'gallery space' (Shanken, 2011). This relationship between the production of an artwork and the development of an infrastructure that provides an alternate position to systemic colonisation influenced the conception of *Bio-Tech Evolution* (Chapter 6.0). This became a model that provided a platform for interdisciplinary curriculum combined with the development of individual student artworks. The intention was to encourage the participating artists and viewers to consider current contemporary biotechnologies and engage with environmental issues.

6.0 Secondary Education Art-Science Course Bio-TechFuture Evolution: Future Engagement with the Nonhuman

C. Documentation of Exhibition Catalogue, includes complete artist statements and photographs of classroom activities (refer to the DVD)

This chapter details my secondary school art-science course that was developed and run for Year 11 special art students. This involved three-hour classes over a nine-week period, located at Balcatta Senior High, Perth, WA, as an extra-curricular activity in the *Gifted and Talented Visual Arts (GATE)* program. The classes included a combination of lectures, wet laboratory sessions, art construction sessions and guest lectures. The intention behind this activity aimed to encourage students to consider their impact on the environment, their responsibilities towards other forms of life and to offer a site where related biotechnologies and their social and cultural implications debated through an arts activity.

The chapter initially outlines the key contexts that frame the course, including current Australian art and science secondary education curriculum. This follows with an analysis of art-science initiatives: tertiary education units and workshops and a developing secondary extra-curricular unit. In this section there is an examination of the ways the course builds on established curriculum, but also provides a site of negotiation and development of specialist disciplines with particular reference to Robinson (2010) and interdisciplinarity.

This follows with a reflexive analysis of *Bio-Tech Evolution* and how this contributes to the research question. This includes the outcomes of the students' artwork, exhibition and survey question feedback from participants. Through this process there is a discussion on the ways in which the activities develops a site of participatory action (Mc Taggart, 1997). The premise is for young people to interact with nonhuman life in real-time, and consider the implications of developing biotechnologies through the presentation and communication of an arts piece.

The outcome for the course aims to demonstrate its role in contributing to a reflexive engagement with contemporary cultural conditions. The agenda behind the development of this activity within secondary education contexts, aims to set up a new site of pedagogy that uses interdisciplinary arts-science practices as an artistic tool to critically engage with biotechnologies. The course also encouraged students to continue developing their own art/science initiatives in the future, which is made particularly

evident by the work of Nicholas Lozanovski and Sasha Whittle, who have commenced tertiary studies in a double art/science degree at Edith Cowan University and the Australian National University respectively.

6.1 Established Art and Science Secondary Education Contexts

Gifted and Talented Visual Arts (GATE)

Curriculum Council of Australia

As an interdisciplinary education model, the art-science course sets up a site to examine the interrelationship between biotechnologies, industry, public opinion and arts communication. This was achieved through the introduction of multiple teachers to the course from the contexts of environmental conservation, science and education. The lectures presented students with a number of perspectives and cultural debates in relation to the history of DNA, evolution, mycology, biology and bioarts. Within each class, the students were asked to consider their own ethical position on the developing technologies and in particular during their real-time engagement with nonhuman life. This process was extended during the development of student's artwork. This teaching methodology was used to draw on the learning guidelines set up by the WA science curriculum education models: "*Science: Acting Responsibly*: Students make decisions that include ethical consideration of the impact of the processes and likely products of science on people and the environment" (2011, p. 22).

Using hands-on science activities, real-time engagement with nonhuman life, juxtaposed with questions raised through the presentation of contemporary bioarts practices, the course put into practice key aims of the research question. This includes: generating real-time engagements with nonhuman life and wet biological practices in a reflexive manner that considers the ethical implications. The intention aimed to set up a situation where current and future biotechnological developments were critically discussed outside hegemonic institutions (mass media) by developing a relationship between arts praxis and the lifeworld.

This demonstrates how an interdisciplinary art-science project provides a site to examine the developing biotechnological impact on contemporary cultural conditions. Within the context of GATE and its facilitation of exhibitions in the school, this arts context offers a site where critical engagement and questioning acts are promoted and through student

artworks communicated to the public. This formula of reflexive engagement builds on the learning outcomes described by the *WA Curriculum* in the development of an “Arts Practice, which depends on high performance and develops key cognitive and competency skills – analysis, synthesis, creativity and decision-making-: Can help equip our young people for success in the 21st century” (2010, p. 2).

Within an Australian context precedents for this activity in terms of its execution (an external artist visiting and teaching at a secondary school) are based on programs endorsed by established institutions, such as: ArtsEdge, Department of Culture and the Arts and the Gifted and Talented programs in which *Bio-Tech Evolution* is located. See Notes 10.0 for links to global equivalents.⁴⁴

There are a number of reasons why the GATE program was chosen as a learning environment to set up this activity. Firstly it was to re-locate scientific practices within an arts context, and secondly there are number of theoretical and practical learning outcomes set up by GATE that reiterate and support key agendas behind this research.

This *Department of Education and Training* endorsed specialist art program⁴⁵ has been running at Balcatta Senior High School, since its conception in 1967. This is an extra-curricular extension activity on Saturday mornings, for year eight to twelve students. The context of Balcatta SHS was chosen based on my previous knowledge of the facilities available due to teaching experience in 2007. In this context the GATE students have also by this stage established a discourse in arts practice. With a background in arts, it seemed appropriate to challenge these recognised practices by introducing bioart concepts and combining this with established life science practices. In this way there would be an equal balance for each discipline in terms of curriculum and substance during the interdisciplinary process. It is however important at this juncture, to note that *Bio-Tech Evolution* can be situated in mainstream secondary school contexts that have access to arts facilities, and is not limited to ‘specialised’ contexts such as the GATE program. The purpose of focusing on one secondary institution in this research is to determine the success of the pilot course in relation to the promotion of nonhuman interactions and interdisciplinary practices.

The students who are selected for the GATE program demonstrate a keen interest in the arts often with the intention of working in the field in some way. Students are taught various art-making skills, develop their conceptual thinking, and are expected to produce an artwork at the completion of each unit for exhibition at the end of the year. The visual

materials and facilities available in this context include: Design (Graphics), Photography, Visual Arts, and Dance. The GATE program uses “practicing arts and crafts people as tutors” (2011). The unit topics or themes are open-ended and are determined by the visiting artist provided the content is suitable for the age group and considers the welfare of participants. Previous examples include: self-identity, contemporary culture, or a specific art movement. The program also offers “enrichment activities including art theory, studio practice, gallery and studio visits, sketching excursions and art camps” (ibid, 2011).

As a learning environment, the program also has a focus on setting up an “opportunity [for students] to gain an understanding of how their art-making fits into the larger community” (n.a., 2010, p. 1). This agenda reinforces a key aspect of *Bio-Tech Evolution* in terms of fostering the communicative capacity of an arts practice as a tool to examine contemporary contexts. Framing the lessons in this way allowed the students to use their artworks to explore and express contemporary issues, such as the pros and cons of developing biotechnologies and consequently locate their artwork and ideas within broader contexts. Through this process they could then consider the role of an arts practice in the development of the lifeworld. The Art: Curriculum Framework learning Statement for the Arts (1998) builds on this relationship. Artworks “inform, teach...provoke thought...reproduce...existing ideas and values, challenge them...offer new ways of thinking and feeling...and...bring about change...shaping our understanding of ourselves as individuals and members of society and our understanding of the world in which we live” (p. 17).

In the context of the GATE program and through the development of this course the students were given tools to understand and use their creativity as a way to extend their arts practice and generate acts of individual reflexivity. This was achieved through the process of investigating contemporary contexts that make up their lifeworld, such as: biotechnological developments, local and global environmental situations, the role of art and science institutions and the culture industries. This focus on reflexivity in education and art-based communicative acts is also endorsed by the ‘*Arts Learning Area*’ where the curriculum in secondary schools is set up to “contribute to the development of core shared values in students, in particular, helping them to critically reflect, make personal meaning and show enterprise, initiative [and]...promote emotional intelligence” (1998, p. 53). In addition, through the exhibition of their artworks and discussion of class topics within the school community and beyond, students were also able to actively contribute to the generation of knowledge within the public sphere. As one student remarked: “My

parents asked me ‘What is DNA?’ They didn’t know! I had to explain to them its use and where it comes from” (personal communication, November 9, 2011). As the student’s parents have grown up in a context where discussions about DNA were not readily a part of their lifeworld, this communicative act inadvertently opened up further discourse to develop an understanding of contemporary cultural conditions.

The lessons conducted during this course and topics discussed with students followed the learning outcomes required by the *Department of Education and Training*. The activities aimed to establish these outcomes detailed by the *Curriculum Framework Curriculum Guide* (2011) as follows. The students developed skills to understand the relationships between science and its application in “real world contexts” (2011). They also discussed the importance of an ethical infrastructure that considers multiple points of view, values and beliefs in terms of the development and conduct of scientific research.

Following this the course also established aims for secondary curriculum in the arts and sciences in setting up an opportunity for the students to develop these Learning Outcomes as detailed in my introductory letter on the course for staff, parents and the ethics committee:

1. Acting Responsibly: Care for others including nonhuman life and the environment.
2. Ethical and Reflexive research skills.
3. Teamwork and collaboration skills.
4. Emotional intelligence, self-expression, self-identity.
5. Active Citizenship: Students were encouraged to consider environmental sustainability in terms of art materials and day-to-day activities.
6. Skills in art presentation and responsible scientific practices.

The course embeds students in a framework of art-science interdisciplinary discourse. It is through the interplay between “systemic colonisation” and the “lifeworld” through which we construct ideologies to frame our lived experience (Husserl, 1954; Habermas, 1987; Frisen & Hug, 2009). The course mediates this process and offers an alternative approach to understanding developing biotechnologies, and the institutions that facilitate them such as the mass media.

6.2 Established Art-Science curriculum precedents:

Within the context of the Australian Curriculum, the current precedents for such cross-disciplinary / art-science educational units relevant to this research can be found within

two main examples. These include the courses run through *SymbioticA* and the *Abiogenesis* unit, run through *The Scientific Creativity Initiative* and the *WA Curriculum Council*. There is a discrepancy to be noted between these two models. The courses run through *SymbioticA* have a focus on developing tertiary curriculum extending to national, international arts and science contexts via the conduction of art-science workshops and artist-in-residence programs, while the *Abiogenesis* unit has a focus on the development of secondary education curriculum. This section details key aspects of each art-science unit in terms of how they have set up practical, conceptual and theoretical precedents for *Bio-Tech Evolution*, how they contribute to the development of alternative educational spaces and a reflexive engagement with the life sciences, biotechnologies and the lifeworld, and will emphasise what my approach adds to the existing units.

SymbioticA: Tertiary courses

Established in 2006, this includes the undergraduate electives *Aesthetic Crossovers of Art and Science*, *Art and Life Manipulation* and the postgraduate *Masters in Science (Biological Arts)* course. *SymbioticA*, through the School of Anatomy and Human Biology at The University of Western Australia, conducts these units. They are “available to any student from any discipline and institution” (2012) under the independent study, *Access* program. These units offer an alternative level of engagement with the life sciences beyond existing institutional frameworks within the University. As a learning environment the units foster a critical engagement with the life sciences, encouraging students to contemplate the cultural effects and ethics of developing crossovers between the arts and sciences through an application of practice and theory. As outlined in the learning outcomes for the undergraduate unit *Art and Life Manipulation*: “Students develop an understanding of the core issues of biological art; learn some basic practical methods for manipulating different levels of life for aesthetics ends; and learn how to articulate the theoretical and ethical aspects of such practices” (2012).

In relation to the development of an art-science curriculum framework within tertiary contexts, the methodology of cross-discipline education is relatively new. Although open to all students from all institutions the student would have to have an interest in the life sciences, and be willing to consider ethical implications to seek out in the units. *Bio-Tech Evolution* however, differs to *SymbioticA* in that it offers a starting point for secondary students to develop an interest in such fields, which will hopefully lead to future enrolments in the established courses. The workshops that are run through *SymbioticA* do, however extend further, through their application across local, national and

international contexts. These workshops are available on request for cultural events, conferences and exhibitions. Participation is open to all, from any field. In terms of public participation in a biological sciences laboratory session, this workshop offers a precedent and conceptual framework for the school-based activity:

SymbioticA's BioTech Workshop is an introduction to biological techniques and issues surrounding the manipulation of living systems. Artists, designers and researchers from various disciplines engage in the biological science lab to utilise language and techniques into their practice and research. The workshop is a practical and theoretical introduction to the basics of biological techniques...Through applied 'hands-on' methods, the broader philosophical and ethical implications of human intervention with other living things will be explored. (2012, n.p.)

The agenda and content covered in *SymbioticA's* workshop as detailed above, sets up a precedent for aspects within my course in particular developing an ethical position in relation to the application of biological materials in an arts practice.

Aesthetic Crossovers of Art and Science Undergraduate Unit

In terms of developing alternative approaches to tertiary curriculum, these units offer a site that puts into practice the agendas put forth by Ken Robinson (2010). Through the methodology of cross-disciplinary teaching and learning, the students are given a framework to think beyond the traditional specialist pedagogies of art and science and therefore the outcome becomes more about creative thinking rather than industrial output. In this site of cross-pollination the student is presented with multiple ways of negotiating the institutions that control and shape the life sciences and arts. This opens up an opportunity to foster a reflexive engagement with the various systems in which their practice will operate, and the potential for graduates to add to the expansion of new systems. As reiterated in the unit-outline (2012):

Students understand the social, ethical, aesthetical and conceptual aspects and limits of the use of the technologies of the life sciences in exploring art and science crossovers, and various examples of its application by national and international artists / scientists / communicators. Students learn to understand through the use of the technologies of the life sciences, ways for exploring practically and theoretically the methods and ideas concerned with the crossovers between fields / cultures of art and science (particularly the life sciences). (n.p.)

This cross-disciplinary interrogation sets up an exciting curriculum model, which has the potential to contribute development in any specialist situation, which could be extended

with the use of interdisciplinary methods of cultural communication, teaching, cultural production and reflexive engagement.

Art and Life Manipulation Undergraduate Unit

The *Art and Life Manipulation* unit also provided a precedent and conceptual framework for *Bio-Tech Evolution* in that its main focus is centered around the ethics, politics, aesthetics and communication of artwork that deals with nonhuman life and most importantly contains ‘wet biological’ practices – “introduc[ing] the basic practical and theoretical methodologies for the construction of works of art that include living elements” (2012). There is, however a focus on “tissue engineering, tissue culture, DNA isolation, breeding principles and genetic engineering” (ibid) in this unit, unlike *Bio-Tech Evolution* which covered a spectrum of the life sciences, from microbiology, mycology, entomology, DNA extraction, ecology and conservation.

Masters in Science (Biological Arts)

“The Master of Science (Biological Arts) is intended for people who already hold a degree in science, the humanities and the visual arts and who wish to undertake interdisciplinary studies to engage with the crossover of art and science” (2012). As a Masters course, there is a focus on established practitioners in the fields of humanities or sciences. The course reinforces the critical levels of engagement required in undertaking a post-graduate degree, with a particular emphasis on embedding students in interdisciplinary open-ended research methodologies. That is; science students are required to participate in art-based units and vice versa and have the opportunity to produce an arts piece.

The Scientific Creativity Initiative – Abiogenesis Secondary School Unit

There is current interest in the potential such art-science collaborative projects have in providing complimentary teaching methods to the current secondary curriculum (Karamuftuoglu, 2006). As the *WA Curriculum Council* asserts: “In order to keep up with the ever changing circumstances in the 21st Century, education models need to provide students with access to current debates and topics relevant to developing contemporary contexts” (2011, p. 24). This is developed in a number of ways throughout secondary curriculum, however as the research advocates this can be enhanced through the

development of interdisciplinary pedagogical models (Robinson, 2010, Devlin, 2009). This approach is demonstrated in the *Abiogenesis* unit, created by art-science collaborator Gary Cass. This unit is another precedent for the secondary education art-science *Bio-Tech Evolution*.

Cass runs *Abiogenesis* as an extra-curricular activity for Year 10 and recently Year 11 secondary school students. As described “The Scientific Creativity “Abiogenesis” program can contribute to senior secondary students’ WACE completion requirement through the Curriculum Council’s generic personal development program.” The deliberate placement of this unit within a secondary school context, at Year 10 level, aims to “bring the unit into the National Curriculum” (Cass, 2010), a process enhanced through the unit’s teaching resources web page. Cass conducts the unit across a number of schools in Perth, Western Australia. For ethos, curriculum details, and student and teacher testimonials see Appendix B.

The program teaches students current theories about evolution, using scientific laboratory sessions. Following this, the students develop an art piece to represent and communicate the science in a public exhibition. This unit was developed in response to discussions with peers on finding a way to re-invigorate creative thinking in science for young people, with a particular emphasis on generating a link between scientific practices and cultural analysis. G. A. Cass asserts, “The students must first understand the science, before they can produce the art, a method developed to discourage the formula of ‘scientist as technician and artist as creator’” (personal communication, March 27, 2012).

The emphasis on creative thinking in the unit aims to set up a premise for future science-art secondary education curriculum. However, such a model is not limited to only art-science contexts and discourse, and could be applied to all forms of secondary education, the consequent outcome of which could encourage a curriculum based on reflexivity rather than industrial output (Robinson, 2010). Cass (2011) builds on this; “The Scientific Creativity Initiative is one way of bridging the gaps between a compartmentalised educational system, allowing future students to become more interdisciplinary with a broader knowledge base”. As reiterated by Robinson (2010) in relation to problem solving education to operate in 21st Century contexts “creativity is as important as literacy”. This method of teaching provides an ideological space where the process of “systemic colonisation” (Habermas, 1970) could be negotiated within the contexts of scientific research. In this context, “systemic colonisation” refers to the

information and language specialisation that is usually associated with scientific fields. This ideological position could generate new ways of approaching the research methodologies and development of new technologies. As Cass asserts, “A possible re-introduction of philosophy and cultural theory into the sciences makes sense, to give the practitioners the opportunity of developing new ways of thinking about the future scientific and *social implications* of their research” [italics added] (2010). This agenda put into practice through the facilitation and development of the unit. It also reinforces the necessity of art to contribute directly to the development of social and cultural contexts in the lifeworld.

The *Abiogenesis* unit also builds on current interests in the science curriculum, especially relation to the importance of developing science communication skills. This is identified in the *WA Curriculum* “Science Inquiry Skills: Communicating scientific ideas” (2010). Through the unit, “students learn about expressing and understanding how to communicate science through art” (Cass, 2011).

There are a number of participant responses from the *Abiogenesis* unit that draw attention to the impact it has in setting up a framework to negotiate education specialisation: “I could demonstrate my knowledge free of boundaries” (Year 10 student, 2010). This response refers to the way in which the pedagogy of the unit has set up a site that has been transformative for the participant. Another response also indicates how the unit has contributed in developing an understanding of science and art practices beyond the school context: “For the first time, I could see that science could be applied in the real world and that I was able to discuss these theories beyond the school environment” (student feedback cited by Cass, 2011, *ibid*). Through the communicative possibilities of combining scientific knowledge within the outcome of an arts practice – the unit demonstrates how this interdisciplinary process can offer a new level of science communication in conjunction with the arts capacity to question. These motives set up one of the agendas for *Bio-Tech Evolution*.

This unit also reveals the educational value to be gained by merging the disciplines, also through this a capacity to introduce new ways of approaching the generation and development of knowledge beyond hegemonic contexts and traditional institutional frameworks: “Being challenged to think about things I hadn’t before” (Year 10 student, 2010). This opens up an opportunity to develop reflexive engagement within the school environment for the students and has the potential to generate an application of “communicative action” (Habermas, 1987).

In terms of the parameters set by the current contemporary bioart field: the students had no prior experience of these practices, therefore their aesthetic interpretation and production of artworks was open-ended. This situation was also echoed in the outcomes of my course. A teacher also remarked on the way in which the unit allows a space for students to examine the cultural conditions that influence and impact upon their lifeworld. This is achieved through specific content (evolution theories, DNA technologies, local ecology and geography) and the framing of traditional scientific theories and practices in relation to real-life situations: “[*Abiogenesis*] addresses contemporary issues that they face” (D. Perks, personal communication, December 21, 2011). It is also interesting to note that since the unit’s conception in 2010: Students from the pilot class now attend current classes in other institutions, creating a dynamic of student as educator and mentor while also generating interdisciplinary acts across school contexts. In addition *Abiogenesis* answers Bunt’s (2008) concern of the need for the science community to invest time in an engagement with art through the creation of art-science activity for science students “a kind of science-in-residence’ program...may produce more ‘scientists’ able to cross the cultural ‘divide” (p. 64). As identified this is one of the aims of Cass’ program, to encourage more creativity in science.

It is significant to note that Cass recently gathered data from undergraduate chemistry students concerning their interest in attending the *Abiogenesis* unit or units of this type at a tertiary level. As responses show, the majority would like to participate in art-science interdisciplinary electives. As follows (Cass, 2012):

If a ‘Creative Science’ unit, which would cover topics such as those mentioned by Gary Cass was available at ECU, would you be interested in studying such a unit as an elective, irrespective of what degree you were enrolled in?

1. Yes, definitely! 52%
2. Yes, but only if it was part of my degree 35%
3. No, not at all. 13%

To contextualise the second response, indicates that those students would only attend if it was a compulsory part of their course, in other words, they would not actively seek out such cross-disciplinary units. It is significant to note that more than half of the students responded with a keen interest to participate in this unit.

6.3 *Bio-Tech Evolution: Future Engagement with Nonhuman Life* **Curriculum Outcomes**

This section details the key activities that took place in *Bio-Tech Evolution* with a focus on how the curriculum deals with aspects of the research question. This section also reflexively examines the student responses to the course with a particular focus on their creative works and answers to the survey questions. This follows with a Chapter dedicated to a reflexive analysis of the projected outcomes from the activity in relation to the key agendas set up by previous art-science curriculum examples, Robinson's (2008-2010) theories on education specialisations, interdisciplinary models and the role of participatory action. In the section most theoretical examples are largely based within Australia, as the application of the course and its content has a focus on Australian biodiversity and ecology due to our particular cultural conditions previously discussed (Jones, 2011, McKinney, 2002, Georgiadis, 2013). What this means is that the research could be limited by site-specific pedagogies. However conceptually the activities can be applied to any educational context, particularly with the addition of biotechnological practices / environmental conservation methodologies; through 'wet biology'; the inclusion of practitioners via bioarts extends local discourse into a global discourse.

Here the individual can position their activities across a number of contexts to generate cultural, personal and economic capital. This approach situates class content in relation to the students lived experience. The aim is for the students to consider their responsibilities in relation to the welfare of nonhuman life. In addition the students can consider their role in broader socio-cultural conditions either through day-to-day activities or potentially through future studies and practices in science, arts, education or conservation.

Lesson Plans and Summary of Content

As an introduction to the overall content and learning outcomes selected for the course curriculum, I provide a summary of each class below and the key activities that have taken place. This is elaborated on in the following section detailing relevant aspects that develop key agendas of the research. The structure for each lesson began with an introductory lecture showing various aspects of the topic from the perspective of the arts and sciences and the contexts that frame them. In addition to this, students were also presented with contemporary visual art examples that are a response to the topics raised. This was followed with a wet laboratory session and a hands-on practical lesson,

where the students actively engaged with scientific technologies. This included Mycology (study of fungi), microbiology (study of bacteria), plant biology, entomology (study of insects), DNA extraction with *The Scientific Creativity Initiative* Director, Gary Cass and interaction with live birds of prey and pellet casting dissection with *WA Birds of Prey Centre* expert, Yvonne Sitko.

Day 1: Introduction to topic / presentation

Wet Lab: Bacteria, Fungi

Lecture Presentation.

Artist brings in samples of own research / artworks.

Set up context for the course and introduce mycology and microbiological practices

Wet Lab: Students will subculture non-hazardous and non-infectious bacteria (*Acetobacter*: used in the *Micro 'be'*) and fungi (*Pycnoporus coccineus*). Students introduced to local ecological and agricultural use of fungi.

Learning Objectives: To gain insight into ecosystems, biodiversity and plant – fungi relationships. Students are introduced to the idea that there is a relationship between art communication and cultural production.

Day 2: Wet Lab: Insects and Plants

Students interact with live insects from an urban location to observe and illustrate. Discussion of the human reliance on insect populations, bio-security and robotic bees, reference to the work of Professor of Invertebrate Conservation, Jonathan D. Majer, Department of Environment and Agriculture, Curtin University. Identify and illustrate, or sculpturally work with various plant materials and select a native plant to care for over the duration of the course. Learning Objectives: Provides an activity where students begin to consider the responsibilities of care when interacting with other living organisms and the environment.

Day 3: Wet Lab: Birds of Prey

Lecture Presentation: Yvonne Sitko, *WA Prey of Prey* visits the school to present a lecture on individual bird biology, ecology, and environmental conservation.

Wet Lab: Pellet dissection and microscope work. Students dissect regurgitated bird pellets to identify the various mammal, reptile and insect body parts that make up individual diets. Students have an individual bird placed on their hand (under supervision) to get a closer look at the animal, “for a long lasting impression” (Siko, 2007).

Learning Outcomes: Students learn about human impact on the environment, specifically in local and national contexts, are introduced to animal welfare responsibilities and learn about ecological relationships between species.

Day 4: Wet Lab: DNA extraction

Lecture Presentation: Gary Cass *The Scientific Creativity Initiative* visits the school to present a debate on Genetically Modified Organisms and the social, political and technical history of DNA.

Wet lab: DNA extraction from a pea plant and then students extract their own DNA.

Learning Objectives: Students consider the ethical and political implications of developing biotechnologies, and the impact this might have on their own identity in the future.

Day 5-9: Artwork Construction

Students collaborate or work individually to plan an artwork to examine conceptually one of the following or a topic of their choice:

- Human - Robots Avatars (cyborg, virtual)
- Chimeras (mutation, transformation, human –animal combinations)
- Synthetic Life (ethics and politics of biotechnology)
- Environment (biodiversity, conservation issues, research into a specific species)
- Human – Nonhuman Relationships (domestic, industrial, technological, anatomical, historical or contemporary)

Learning Objectives: Students will be encouraged to apply the model of FORM, CONTENT and CONTEXT in relation to material, research and creative choices. Students begin construction process using visual art and scientific techniques. Students

present their artwork and provide an artist statement. Students install artwork in school exhibition space and make decisions on final presentation of artworks in the space.

The topics and wet biological practices in each lesson were chosen to give a brief overview of some of the life sciences. The selection of themes for each student to choose: environment, biotechnology (synthetic life, chimeras, DNA), robotics, were all chosen to represent potential contemporary nonhuman – human relationships. This set up an opportunity for the students to develop aspects of the research question through the production of an artwork. The conceptual development art making offers was used to determine their understanding and awareness of nonhuman – human relationships, a process reinforced through the survey questions. These lessons detailed in the following section, with a particular focus on how each deals with aims of the research.

Generating cultural awareness of nonhuman life: Fungus, plants, worms and birds in an art class?

By using living organisms in a classroom activity the overarching premise aimed to counteract the developing cultural condition of environmental amnesia (McKinney, 2002). This also created a situation where real-time engagements with nonhuman life could take place in an arts and science context. Through this process, a key agenda behind the research has been put into practice, that is, a re-invigoration of interactions with nonhuman life and living systems, and the integration of this experience into the lifeworld of the participants. As guest presenter Yvonne Sitko describes:

This educational talk combined with a visual display is a stimulating way to teach your students about Birds of Prey within our environment. This presentation not only allows students to see a variety of birds up close, but also helps the students to identify birds of prey, learn about their diet and where they can be found in Australia. It also gives the students an insight on how unique these birds are, what role they play in our environment and how susceptible they are to human activity. On the day all the students will have the opportunity to hold one of the birds we bring along...Where possible the aim is to interact with the birds to achieve a long lasting impression. (2007, p. 1)

During the practical classes, the students were introduced to a number of issues relating to the individual species provided. The nonhuman life represented was selected to draw attention to the biodiversity and complexity of the natural world. Species included: bacteria, fungi, invertebrates (aquatic and terrestrial), plants, birds and mammals (human). Within each class, the biology, behaviour and environmental function of the

species was discussed. The nonhuman life was also framed by its use or relationship to science and everyday contexts. The scientific contexts were then examined with the use of cultural practitioners who deal with issues and communicate questions associated with the species in an artwork. This model set up a dialogue between scientific knowledge and an application of culturally framed critical analysis.

As established by the “Schools Animal Ethics Committee or SAEC (2005)”, the responsible presentation of animals can achieve this outcome: “Understanding about the care and safety of organisms and the environment” (2011, CCFG, p. 22a). As identified by the *Western Australian Curriculum Council*, these practical demonstrations provide the opportunity to develop the following learning outcomes: *Life and Living*...Students understand their own biology and that of other living things, and recognise the interdependence of Life (p. 10). The SAEC “[who] recognises that the responsible use of animals in teaching can enrich learning experiences for students ... [and] develop appropriate animal welfare values in society” (2005, p. 10) echoes my sentiment. As indicated above by the established guidelines, these activities have been an on-going part of the curriculum, mostly associated with biology units within secondary education. In addition, depending on the school’s approach, facilities and financial support, students also participate in nationally recognised conservation days – *Plant a Tree Day*, *Clean Up Australia Day* - attend field trips to the Perth Zoological Centre, or have purpose built vegetable gardens on site (most commonly located in primary schools). This demonstrates the merit such activities have in developing environmental consciousness in young people. As Sitko states:

Using entertainment as an educational tool works because the conservation message has far more impact when people can see, feel and experience the birds first hand...I am passionate about what I do, and that comes through when I am demonstrating. I love to bring the birds up nice and close, and at the same time educate, so that the birds will still be around in the future. (2006, cited in Lowe, p. 1)

This real-time experience carries more potency for the individual encouraging conservation acts within the lifeworld. Sitko gave an eloquent presentation of the interrelationships between human activity, urban environments and animal welfare. She provided a history and biology of each bird, where it can be seen in the wild or urban sites, its ecological role, and how it came into her rehabilitative care.

The most significant example is the history of Aussie, the Wedge-Tailed Eagle. Discovered by the RSPCA, Aussie had been stolen from the nest, living most of her life indoors. As a result did not know how to fly and was afraid of trees. This story had a lasting effect on one participant who would raise the topic during later conversations: “Shocked that a bird could be afraid of trees and conditioned that way” (personal communication, August 20, 2011). More accustomed to living in an environment based around human activity, and excessive noise pollution; Aussie has now been rehabilitated by Sitko and acts as the mascot for the ‘West Coast Eagles’ (football team), opening games by flying around the Subiaco Oval (Perth, Western Australia). Through this activity, Sitko also demonstrates her cross-contextual initiative towards conservation education by integrating nonhuman exchanges into pre-existing everyday contexts in an unexpected way.

Beyond the educational outcomes, direct contact during human and nonhuman interaction has also recently demonstrated health benefits, the research of which highlighted by O’Haire, 2009 is in need of more financial and infra-structural support. As discussed in; *Physical and Medical Benefits of Pets*, by the staff at the Veterinary Services Department in the United States: Studies have shown that there are multiple health benefits to be gained through interaction with animals, including faster recovery time after surgery, longevity, decreased blood pressure, increased mental wellbeing and increased physical activity (Foster, & Smith, et al, 2010).

Bio-Tech Evolution encouraged the students to consider the ways in which they interact with nonhuman life and how they could incorporate these ideas into an artwork. This was most evident in the work *Skin and Bones* (2011), (Figure 45), section 6.4..

The course therefore provided a platform and educational infrastructure to foster future consideration of nonhuman life beyond the practicalities of the course. As outlined by Maggie O’ Haire (2009) “The study of human-animal interactions bridges many fields... psychology, veterinary science, biology, medicine, public policy, sociology...environmental science. Interdisciplinary collaboration...has the potential to...increase the output of...research and subsequently...financial and political support of its programming on a practical level”. Throughout the course, there was a focus on the care and ethical responsibility required in dealing with nonhuman life as a part of an arts practice. A number of students were particularly interested in presenting these issues in their artworks, examined in section 6.4.

6.4 *Exhibition Outcomes and participation feedback*

This section examines the role of reflexive praxis in arts communication. Through an analysis of student artworks and their agendas, it demonstrates how arts communication can navigate and critically engage with the lifeworld. I detail student works and their communicative capacity and how each piece explores the topics set up by the course content. This section also demonstrates how the students actively engage contemporary cultural conditions through the exhibition outcomes of the course. For complete artist statements see exhibition catalogue (refer to the DVD).

The areas explored included: Ethics of biotechnology, identity in relation to the extraction of their own DNA, and biology and environmental issues. Students were also encouraged to examine the role of arts in society and culture as a form of communication. Over the nine weeks the students were shown examples of local and global contemporary artists, who work in the field of biological arts. The parameters of the artworks needed on some level to deal with the topics above and ideally contain or make reference to nonhuman life in a contemporary context and use a life science covered during the practical laboratory sessions. The students were given the option of including 'wet biology' as a part of the work. This process required consideration of the welfare of the living component during production, exhibition and post-exhibition. This method of developing a creative practice reflects the aims cited in current arts education curriculum. As cited in the Arts Curriculum (2010): Students cultivate the processes of "analysis, synthesis, creativity and decision-making" (p. 2). In addition to actively working "with a range of traditional and emerging technologies", applying this methodology the Arts Curriculum states aims to "equip our young people for success in the 21st century" (ibid). This statement echoes Robinson's (2006) position on the function of education as established in the Literature Review, 3.0.

During the lectures we discussed what the students considered the role of art to be within society and in particular, what they would like to add to the discourse of bioarts through the production of artworks. It is interesting to note that the students had no prior knowledge of bioart practices or its aesthetics and tropes. A number of students were inspired by the hands-on activities and produced artworks that explored animal-human interaction, environmental conservation issues, and specific species futures. Other students explored the ethical concerns in relation to genetic modification, global warming and human-animal manipulation.

The course set up a space to generate communicative action and was achieved through the production of artworks by the students that debate issues immediately found within their individual lifeworld. The students now come from an informed position, by knowing the life science used to make the artwork, and by applying critical thinking, they developed further confidence of their art practice. On observing the students speaking with the public and community about their ideas or concerns, the course developed longevity and extended beyond the production and exhibition of artwork. The topics presented by the students develop an on-going learning process; the viewer and participant are encouraged through this act to question the future of nonhuman life and our relationship to it. A number of these participants continued this form of art-science exploration by attending *Abiogenesis* which was run at the GATE program in the following year (2012).

Artworks that explore potential future environments and human-non-human interactions

The following artworks created by the students explore the shifting relationships between humans and the natural environment and human – nonhuman interactions. Machabee (2011) uses a combination of living and dead materials in her piece entitled *One of the challenges in defining death is in distinguishing it from life* (Figure 41). This artist draws attention to the relationship between culture and nature and asks the viewer to consider the way in which we frame and understand the natural world through the lens of human dominance. Machabee uses a combination of metaphorical symbolism and physicality (material reality–wet biology) of the work to develop this narrative. As she asserts her intention, “Many believe that...man has dominion over all living things. However...the planet will kill us before we can save ourselves. [The] artwork combines...technology, life and death...humanity in a mini-landscape...My ‘living sculpture’ is my response to the fusion of nature and humanity” (2011, Machabee, p. 13). Machabee also considered the ongoing care of the work during and after exhibition as required for the presentation of ‘bioart’ defined by this research and educational activity.



Figure 41: Anna-Marie Machabee, (2011), *One of the challenges in defining death is in distinguishing it from life*. (from: *BioTech Evolution* exhibition), plaster, plants, insects, microbiological skin, 44cm x 39cm x 30cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

This element of care and animal welfare was also considered by Hutt, who set up an installation containing goldfish and Siamese fighting fish species in the work *Genetic mutation in the future caused by events in the past* (2011). Hutt considered the welfare of the animals throughout the exhibition providing an invigilator (herself and fellow exhibitor Ewen) and for their ultimate re-location into her domestic environment. Hutt uses the fish as a symbol “to explore the concept of humanity after years of genetic alteration and how this changes the way in which we differentiate the self or not from other species” (2011, p. 9). Exploring a hypothetical future where global warming and flooding has created the evolution of chimera-like humans with the attributes of fish. Within this installation, Hutt provides the viewer with an insight into current biotechnological debates and seminal texts on evolutionary sciences through the introduction of hand-written notations. She appropriates the language and equipment of science (borrowed from the school’s science department) to set up a pseudo-laboratory within the gallery space (Figures 42-43).



Figure 42-43: Laura Hutt, (2011), *Genetic mutation in the future caused by events in the past*, (from: *BioTech Evolution* exhibition), installation, canvas, paint, ink, scientific glass equipment, fish tanks, pumps, Siamese fighting fish and gold fish, plants, dimensions variable. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The artwork *Modern Arachnids* (Figure 44) by Ewen explores the idea of the selection process for conservation and the potential future of mechanical animals replacing real animals. The installation included sculpture, plant material and contained live arachnids: (Daddy-long-legs Spider) *Pholcus phalangioides* (Orb Web Spider) *Eriophora Delaena nigriforons*.

The daddy-long legs spider is a species in Australia surrounded by urban myths regarding the toxic levels of its venom as it is known to eat red-back spiders (highly venomous), described as having fangs that do not penetrate human skin (Gray, 2012).

The orb web spider species is also commonly encountered in urban gardens around Australia, this spider also attracts local bird life, as it is a staple food source for many species (Gray, 2012). Even though the arachnids housed securely. Even so, Ewen set up a tension between the viewer and the nonhuman life on display.

By doing this, she drew attention to the everyday anecdotal relationships we form with nonhuman life, particularly in Australia. Through her statement, Ewen reminds us that it is vital for the welfare of complete ecosystems that all nonhuman contributors have a right to be protected regardless of popularity (2011) “We have evolved from a single-celled organism, into the whole variety of species...Where to next? As we choose to save those species which we associate with and ignore...others, we are effecting where evolution is taking us in the future” (p. 5).



Figure 44: Sarah Ewen, (2011), *Modern Arachnids* (detail and installation) (from: *BioTech Evolution* exhibition), (Daddy-long-legs Spider) *Pholcus phalangioides* (Orb Web Spider) *Eriophora Delaena nigriforons*, wire, glass tanks, dead plant matter, 33cm x 43cm x 33cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Skin and Bones (2011) a work by Percival (Figure 45) also examines tensions between human-nonhuman relationships. Percival created a piece that represents her connection to her pet snake as such producing a work that reflects on her own lived experience. This is depicted through the illustration of a human and snake skeleton and sample of the snake's shed skin. This skin is part of a collection produced by her snake, which becomes a measure of the time it has been her companion. Percival described the act of skin shedding by the snake as an act of "changing of clothes" (personal communication, August 20, 2011). During the conceptual development of the work, we discussed the personality of the snake and her experiences with it. I encouraged her to produce a film of her interactions with the animal, however due to time constraints this did not develop. What did become clear through these discussions was the communicative role this course had in providing alternate opinions on animal-human interactions. As Percival asserts (2011) "using these media...to display the similarities in snake and human, and although people fear them, they fear us as equally: They have personalities just as we do so a human and snake bond is extraordinarily possible" (p. 15).

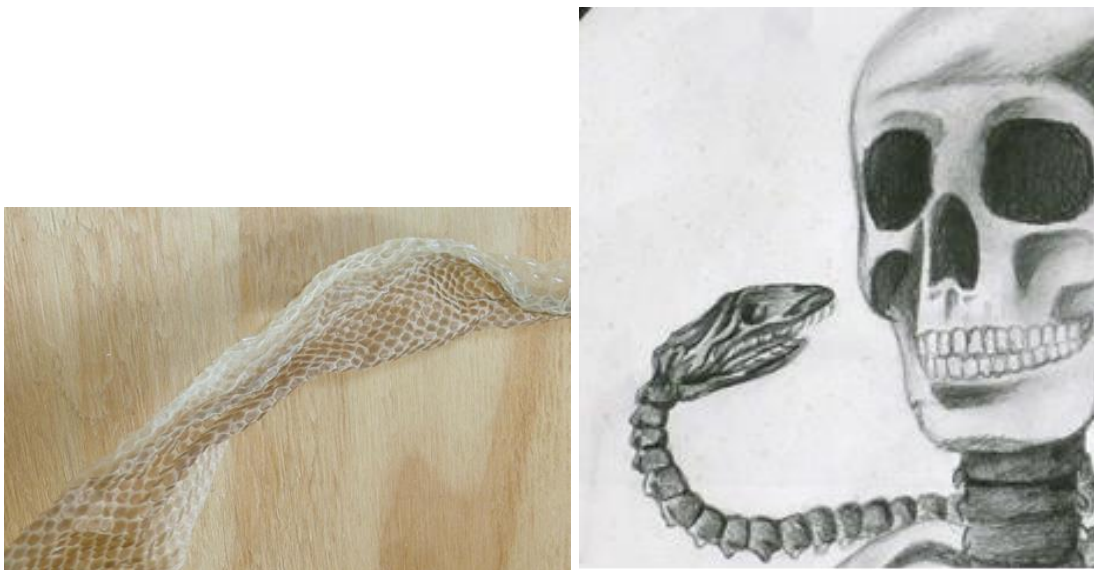


Figure 45: Madeline Percival, (2011), *Skin and Bones* (detail), (from: *BioTech Evolution* exhibition), pencil illustration 21cm x 24cm and sculpture, shed snake skin, wood, 26cm x 12cm x 11cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

I argue that these communicative agendas illustrated through these artworks follow some of the benefits outlined by the Animal Ethics Committee (ANHMRC), as a way to "[increase] our understanding of animals...and [promote] environmental objectives"

("Proposals", 2004). However, Percival and Hutt's artworks also highlight the complexities of animals bred for commodification in the pet industry as each species has been sourced from a store. In the case of Percival the purchase of the snake would have required certification and licensing permits. By relocating the actual animals or evidence of (shed-skin) within a gallery/education context the works also bring into question the complicit nature of bioarts practice.

Artworks that examine a potential biotechnological future

During the wet lab session of DNA extractions Cass described a hypothetical situation in the future. He asks the students to consider; "What if an insurance company could access all the genetic information of your DNA, and find out everything health wise that could potentially happen to you? For example, your pre-disposition to an inherited disease and decide not to provide you with insurance due to the financial risk?" (G. A. Cass, personal communication, June 24, 2011). This hypothetical future and the actual process of extracting his own DNA greatly affected Lozanovski. In response to this, he produced the work *Keep Safe Your Identity*, a piece that contained his own DNA, sound and selection of projected images. This film consisted of news articles and reports extracted from scientific publications taken from the internet debating biotech futures, cloning and the human genome. This indicates that the student, like most in Gen Y, engage with the world via the internet. Through this compilation of images and journal articles Lozanovski demonstrated a reflexive engagement with his lifeworld and the mass media. In addition, his action reinforced the strength of the research in setting up opportunities for participants to consider the role and relationship of their practice to the social realm/public sphere. This projection placed opposite a specially constructed safe that housed his extensive sample of DNA of which he became an expert in extracting. (Figures 46-47) Lozanovski states (2011):

Scientists of today's world have been able to accomplish many things over the past decades and one of those things is the Human Genome Project...It has benefits such as being able to help cure certain diseases, but just imagine if a person had hold of another beings DNA and cloning was a possibility. Dehumanization or more commonly referred to as 'identity theft' comes into play. Disputes and debates over human cloning have risen over the years and have always concluded that it violates human dignity. Therefore my piece I have created was to state my opinion that is we should all keep safe our identity. (p. 11)

Since the completion of *Bio-Tech Evolution* in 2011, this work has been exhibited in a number of locations across Perth as a representation of the GATE program and talent at Balcatta SHS. These exhibitions included a Young Talent Awards (*Metamorphosis*) night hosted by Central TAFE, Perth.

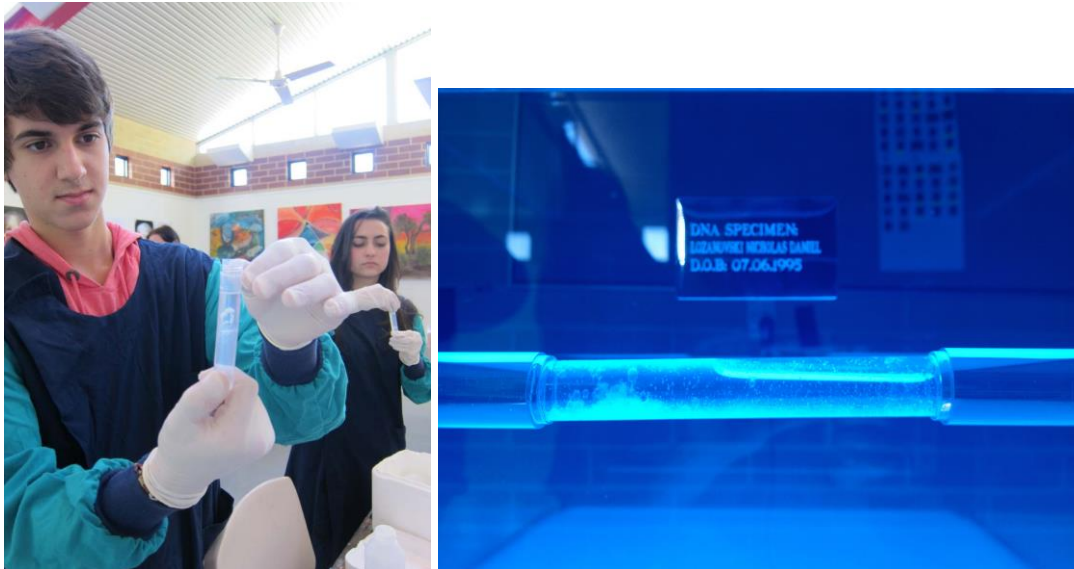


Figure 46: Nicholas Lozanovski, (2011), *Keep Safe Your Identity* (from: *BioTech Evolution* exhibition), DNA, sound, Perspex, projection, 1m x 40cm x 40cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

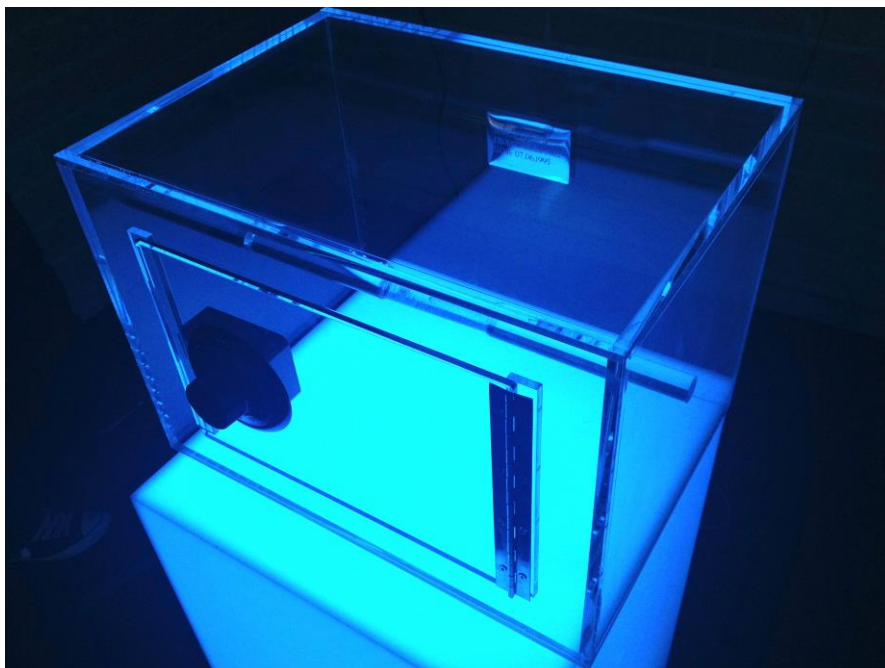


Figure 47: Nicholas Lozanovski, (2011), *Keep Safe Your Identity* (from: *BioTech Evolution* exhibition), DNA, sound, Perspex, projection, 1m x 40cm x 40cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Combining graphic design, painting and DNA collected from fellow students the piece *Nosam*, (Figure 48) by Foster explores the “potential advantages and disadvantages of cloning. [Foster suggests] “That perhaps our DNA will be taken from us, and then our identity will be passed onto generations after we have gone...what would happen if you just ate a strawberry before your DNA was taken? What would you become?” (2011, p. 7)



Figure 48: Christine Foster, (2011), *Nosam* (includes detail), (from: *BioTech Evolution* exhibition), human DNA, acrylic, MDF, 30cm x 40cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The work by Fogliani *They Are Not You* (Figure 49) depicts a potential future of human cloning, where individual identity is lost. As shown by the detail, within the illustration Fogliani provides the viewer with scientific excerpts, questions and debates on human cloning, its possibilities and potential problems.

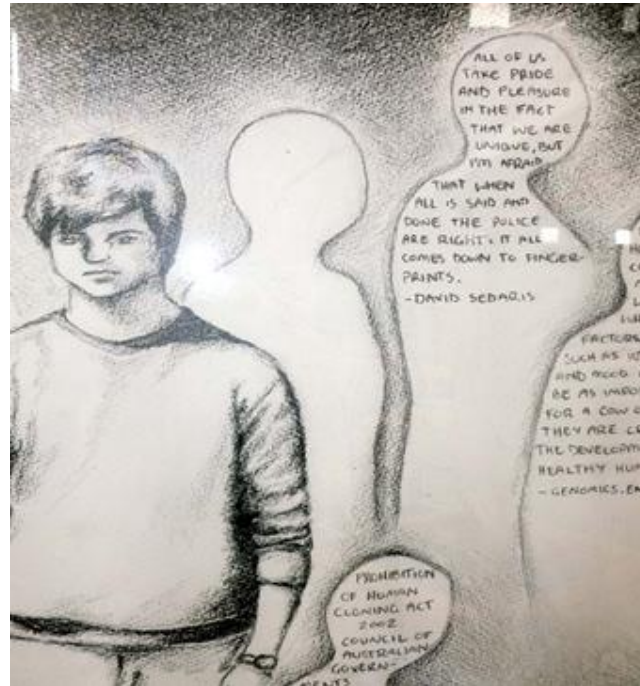


Figure 49: Madeline Fogliani, (2011), *They Are Not You*, (detail), (from: *BioTech Evolution* exhibition), pencil illustration on paper, 48cm x 34cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Brown explores the future possibilities of a cyborgian animal/man. Inspired by the lectures on GMO debates, he produced a sculpture entitled “*CMCM1* (Cellular Mutated Cyborg Man) (Figure 50) “to grasp the understanding of and how they will affect our lifestyles in the future...The work reflects on the conception of a new understanding of life as we know it [based on]...evolutionary genetics” (Brown, 2011, p. 3). Brown asks the viewer to contemplate and reflect on current debates surrounding biotechnological developments the potential benefits “metal is used on its limbs to allow the viewer to fantasise and imagine fully automated prosthetic limbs that will enable people to walk again” (ibid) and problems where:

The idea that the future animal DNA will be intertwined with Human DNA to create sustainable life was interesting to me, so I designed my Cyborg with wings like a bat to show both what the future has in store but also the dangers these creations can cause: Both socially in society and physically at war. (Brown, 2011, p. 3)



Figure 50: Jesse Brown, (2011), *CMCM1 (Cellular Mutated Cyborg Man)* (from: *BioTech Evolution* exhibition), microbiological skin, wine, wire, glass, clay, 50cm x 43cm x 26cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

It is important to note that with all of these pieces, the artists do not claim to be scientists (Bunt, 2008), but aim to question and debate potential futures through the public forum of an art exhibition. The students who produced artwork using a form of 'wet biology' or a life science taught during the course, understood that the processes involved were just a section of scientific knowledge and by no means stood in for the whole complexity of scientific research and what it entails (Bunt, 2008) particularly in relation to the production of an artwork. To further their education, I encouraged students to enrol in double art and science degrees.

Additional artworks

Other concepts discussed by students which were not part of the final exhibition, as their artworks were not realised due to external commitments, covered a number of topics raised during the lessons. In response to my lecture on invertebrates and biodiversity: One student considered the construction of a sculptural invertebrate using recycled materials, mainly waste products as a representation of increasing urbanisation and potential future animal adaptations in such environments. This artist also produced a number of anatomically correct illustrations during the 'wet laboratory' session, through her observation of live invertebrates, however did not want to show these works publically.

Another student inspired by the *WA Birds of Prey Centre Workshop* developed a sculpture that represented the Mayan legend of the Quetzal Bird. The bird is the "spiritual protector of Mayan chiefs" (Flannery, & Schouten, 2004, p. 8). During invasion in 1524 the bird attacked the Spanish army, and when the chief was killed placed its body upon his chest forever changing its appearance from green splashed with red (Rothwell, 2012).

The final work that unfortunately did not develop in time for exhibition was a series of jewellery pieces containing exotic and native flora encased in resin. The intention behind this work for the artist was an aesthetic exploration of the diverse structures, colours and textures of flowers. The concept developed as a response to increased urbanisation replacing biodiversity, the jewellery becoming a pledge to save the plant tissue for the future. The diverse interpretation of what constitutes bioart praxis reflects the range of possibilities the medium has. As established in the literature review, by definition the genre is fluid and changeable actively responding to contemporary cultural conditions and/or developments in biotechnology. By including students in this arts context, the exclusivity of the field opens to incorporate young artists.

6.5 Survey Questions for Participants (de-identified)

To examine and record the social and cultural impact of the course a series of survey questions developed for the participants to provide feedback at the end of the nine

weeks. These questions aimed to identify whether the participants had made connections between the topic discussed and their own lived experience to establish whether the combination of art-science is a productive way to examine biotechnologies and generate an engagement with nonhuman life, and to establish whether the participants had considered crossing disciplines before. This links directly to the research question in that it reaffirms the potential ways in which an interdisciplinary approach between art and science can offer an additional platform to engage with nonhuman life.

The following questions and answers used to determine the success/failure of the course in relation to the research question and key agendas behind the research. The survey initially determined the participant's previous understanding of/engagement with nonhuman life. Secondly, to identify whether the students gained any creative and critically reflexive benefits from participating in the course, and whether the experience changed how they thought about science and art practices. The results reinforce Robinson (2006; 2010; 2013) and Sullivan's (2010) arguments in specialist pedagogies and art as a form of critical inquiry.

Questions

1. How often and in what ways do you think about the natural world or other living things in it. How has this project changed how you think about the natural world and other living things?
2. In what ways has this project challenged your view of art and science?
3. In what ways do you think this cross-disciplinary art and science project has been useful in understanding the impact technology has on everyday life? List some technological examples that are relevant to you, both positive and negative.
4. We have been discussing many ethical aspects throughout this project, what are some ethical issues that you consider important concerning biotechnologies and art/science projects?
5. What are some productive aspects of combining art and science?
6. Do you consider this cross-disciplinary approach to art and science is a productive way to learn or not? Explain why.
7. What aspects of this project could have been changed or improved?

Please write a short paragraph on what you have gained from this project.

Question 2: In what ways has this project challenged your view of art and science?

“Because its new experience in which the two have been combined which is something I have never really thought about as a possibility before” (22/10/11).

“I had always thought of art and science as two separate fields. I can now see that art can be used to explore science” (17/9/11).

These responses indicate that their understanding of art and science as separate disciplines is completely established reflecting the current educational context. The course shifts this perception and encourages the participants to investigate knowledge or creative research in a cross-disciplinary manner. It also however raises the question of whether it is appropriate for the arts to question the sciences.

“It’s challenged my view of art and science by combining the two, which is something I’d never done before. I previously thought that the two had nothing to do with each other, but then I learnt that they can work well together to educate people” (22/10/2011). This response reinforces the educational possibilities of the course in terms of presenting hands-on scientific activities in a different context. It also talks about the communicative capacity of the praxis in terms of its outreach via public exhibition.

“This project has made me realise how science can be used in art to portray issues in the world” (22/10/2011). This response reinforces one of the key aims of the praxis in that the combination of art-science activities can be used to reflexively engage with an individual’s lifeworld through the act of communication and arts praxis. It also demonstrates that the course has encouraged the participant to consider the role of their arts praxis in relation to broader cultural contexts.

Question 5: What are some productive aspects of combining art and science?

“It can explore ethical issues in science, art and climatic issues. It gives science an imaginative edge to explore the passion and infinite wonder of science. It also gives art a larger range of materials and opens a whole new door of possibilities” (20/9/2011). This response further identifies the educational and reflexive attributes engendered through the course.

“Art is free and you can create anything so combining science techniques gave us endless possibilities to create something new and out of the box” (18/9/2011) This comment raises a number of issues in relation to the potential un-reflexive hype that surrounds the production and consumption of bioarts. As Hauser (2008) suggests, is this

art form using the “hottest biological sciences” as a way to promote newness / uniqueness in the arts community? I would also argue that art in this context and defined by this research, is still bound by the ethical considerations of using ‘wet biological’ practices. This methodology was considered seriously by all participants who produced artworks using biological materials, from production, exhibition and after exhibition.

“Some productive aspects are innovative solutions that help cure common problems, the creation of questionable art work and the ability to see things from a different perspective” (24/9/2011). The participant response indicates that the course has established the complicit nature of bioarts practice in relation to the implications of using ‘wet biology’ in an arts context. A number of established interdisciplinary arts practitioners (Svenja J. Kratz, Kirsten Hudson and Tarsh Bates) address this issue further in *Creatures of the Future Garden*. The participant has also highlighted the problem-solving potential that can occur when two separate disciplines and ways of thinking are brought together. This approach concurs with Cass (2011) and Levins (2008), debate on contributions to scientific research beyond established institutions and the innovation that can take place in such interdisciplinary actions.

The following response from this participant demonstrates the communicative capacity of the course in terms of providing a forum to debate, discuss potential biotechnological futures. It demonstrates the importance of public exhibition as an alternative voice in the lifeworld. “..Producing art that is also related to science to educate people on current issues or future issues. You also get introduced to using different media such as sculpture with wine skin” (22/10/2011).

“That art will always be used to keep science in check and judge it so neither becomes too radical” (17/9/2011). This is a particularly interesting response. It relates directly to Bunt’s (2012) concerns where negative preconceptions develop through arts communication. In order to engage critically with science, the arts needs to acknowledge potential assumptions made and focus on the importance of “opening up rational debate” (Bunt, 2012, p. 6). This required from the students an analysis that encompassed multiple voices and positions from both fields. The course encouraged students to consider reflexively the potential impact their artistic statements could have on public understandings of scientific practice. During the development phase of their artworks, each individual investigated the technologies they intended to use by researching scientific work to gain an understanding of the methodologies and aspirations of the field. For those students that developed works relating to the human genome project and DNA technologies, these outcomes were founded on the scientific

lectures presented by Cass, which included the history, applications and implications of such research. The lectures also incorporated potential future implications of such research illustrated by the artworks of Alexis Rockman *The Farm* (2000) and Patricia Piccinini *The Young Family*, (2005).

“You get a new outlook on both subjects you can find new ways to make social comments by using both art and science. You’ve got more interesting media” (22/10/11). This comment again highlights the function of the course, in providing a space where the infrastructures and ideologies of art and science are reflexively and critically examined via interdisciplinary activities.

Question 6: Do you consider this cross-disciplinary approach to art and science a productive way to learn or not? Explain why.

“I think that this is a fantastic way to learn, especially for younger students. It has the capability of capturing their imagination, teaching them about the world and application as well as giving them a foundation of science, which can lead them into an interesting future. It is also good for older students to mix all that they have learned with the perspective of developing an open mind” (20/9/2011).

Questions for Teachers

1. If you were to repeat the course yourself, what would you use and what would you change?

“The birds of prey were fascinating” (17/2/2012). This response indicates how significant the introduction of the live birds of prey was in this context. The lasting impact this has had on the educators and in this case her child, demonstrates the potential long-term outreach such activities can have.

“Crossing over into science and using the technology for the sake of it. Why do this? Questioned how playing with science is art?” (20/9/2011). This response echoes the critiques of bioarts as cited in the literature review concerning the complicity of working with life science for artistic ends. In particular the concerns identified by Hauser (2008) and Bunt (2012) regarding the importance of keeping the methodologies from each discipline distinct. In the case of Hauser (2008), the reliance on aura and popularity of the biological sciences to promote artistic endeavour.

2. *How has the course changed your working knowledge of:*

a) *Education pedagogies – teaching methods*

“Actual physical involvement with techniques and biology, and hands-on experience. This should be incorporated more into teaching, including other areas of teaching” (21/2/2012). This statement indicates how the course has potentially opened up new ways of teaching through hands-on experience. This hands-on experience with the natural world is often presented in schools through the development of vegetable patches actively contributing to biology education and home economics. What the course has provided is another way to generate real-time interactions with broader applications.

b) *Science education*

When you see a change in something, that is often a catalyst moment in art and science. There is a certain magic in science and the art making process, each has similar elements of discovery that can cross-over. Cross-over and hands-on biology should be used in science teaching. (17/2/2012)

This answer indicates that the experience for the educator has reminded him/her of the way art and science can be used to understand the world, either physical or cultural. It also indicates that the experience has captured his/her creative imagination. What is most significant about this statement is the acknowledgment that there needs to be more hands-on science in science teaching contexts as well.

c) *Art education*

“It is an interesting approach to deal with and develop a certain perception of contemporary art. Students still think of art as framed by the realms of modernism as this is what is in the curriculum” (21/2/2012). This indicates that the course offered a new consideration to extend the types of art movement examples taught in secondary education curriculum. As Giddens (1990) suggests our lived experience framed by cultural conditions of late modernity or even postmodernity, therefore it is crucial that the education of arts incorporates this visual language. By introducing the students to the genre of bioarts, they can further access their contemporaries.

3. *What aspects of the course were useful and why?*

“Able to look at technique in relation to own concepts and experience. The course showed how people work in a post-modernist framework” (21/2/2012). This response echoes the previous comment in that the course offered an alternate approach to current arts curriculum.

“Self-directed projects opened up students artistic capabilities, built their confidence” (14/2/2012). This acknowledges the importance of developing the student’s critical reflexivity. This technique was applied to decisions made in their projects and the consideration of their artist statement. By providing a number of choices of subject matter, materials and contemporary issues to explore, the students were free to select what they considered the most significant idea for communication and representation.

By crossing the disciplines and using real engagements with biology and life, it provided a much richer experience. Much bigger picture of how things are in the world. They [students] are actually doing the discovery for themselves through hands-on engagement [life science workshops]. This has a long lasting impact (17/2/2012).

This again demonstrates the importance of including real-time interactions with non-human life in this context. The statement also reinforces the educational agenda for the course to further interdisciplinary thinking and consideration for the natural world.

4. What is your view of the natural world and biotechnologies?

“People don’t necessarily think of the impact of these things” (17/2/2012). This shows how the unfamiliarity of biotechnologies can lead to complacency. It also indicates a number of issues raised by our increased urbanisation and distancing from the natural world because of capitalist hegemonic contexts. The course brought these issues into the foreground for students and educators.

How do you think about these things?

“We are living in a secular society – science helps us understand how the world works and how we change and alter it. The course explored this relationship” (17/2/2012). This comment shows how the course encouraged students to consider the relationships between the system and the lifeworld.

5. *Where do you usually gather your information from to develop an understanding of the natural world and biotechnologies?*

“On-line, Radio such as the debate on GM crops, mass media, news, education section in newspapers, David Attenborough documentaries. In my own garden, watching and being aware of my surroundings” (21/2/2012). This reinforces the reach of the mass media in determining the first point of reference for many; however, this individual actively seeks out multiple perspectives on information.

6. *What were your expectations of the outcomes of the projects? Were these met?*

“Quite successful and satisfying to see students develop self-directed works” (22/9/2011). The emphasis on “self-directed works” indicates how the course provided more freedom for students to communicate their own ideas, rather than a curriculum brief. It also indicates the important aspect of the special arts GATE program in offering additional opportunities for artists to develop their practice.

7. *What future applications do you think such cross-disciplinary projects have?*

“Cross-overs should happen a lot more. Have a project that involves even more areas” (22/9/2011). This shows how the interdisciplinary approach to the course could be extended into other areas of education, echoing Robinson’s (2010) assertions on creativity in schools.

6.6 Projected outcomes: Creative thinking applied to education in negotiating the specialisation of curriculum.

The purpose of this course was to provide students with an opportunity to explore the potential cultural and ethical consequences of biotechnologies and foster community engagement with nonhuman life. Through the conception of this course, I aimed to set up a site within a secondary school context to encourage students to think about art-science cross-disciplinary models, as a way to debate biotechnological futures at an earlier stage in the education curriculum, rather than in a tertiary, gallery or conference context. Another aim was that through the experience of this course and consequent exhibition of artworks, the students would develop an application of participatory action (McTaggart, 1997) and engender environmental consciousness to be applied to their individual lifeworld. Each student chose a self-directed project with the option of using

'wet biological material' in their art piece, considering the responsibilities of this. They were also encouraged to examine critically a potential question raised by biotech futures or an environmental issue.

Art has the potential to act as a form of public communication: the students' final works demonstrated this capacity, which is to be commended. Throughout the program the students developed a reflexive ethically mindful approach to topics raised, showing that they were considerate citizens and actively participate in local and global contexts. Interdisciplinarity according to Drake (1998) is where "subjects are interconnected beyond a theme or issue and the connections are made explicit to the pupils...A topic such as 'water' could be examined considering the influence of social, political, economic, media, global, environmental and technological aspects" (cited in Venville et al, 2002). The curriculum includes aspects of this model as outlined by Drake. Each class combined science and art curriculum, and drew attention to particular issues located within the contexts of the students' lifeworld: Biotechnologies, local/national environments and eco-systems.

According to the studies by De Brabander (2000), cited in Venville et al (2002), there are two modes of knowledge dissemination in the lifeworld: "Everyday knowledge...as subjective, open to debate, not easily testable...and academic and specialised knowledge". The latter usually stemming from classical education curriculum such as "biology and chemistry". De Brander critiques the process of interdisciplinary education and as Venville, et al, (2002) terms "integration", in that it generates a form of knowledge that is soft, difficult to test and is "weakly classified and weakly framed" (2000, cited in Venville et al, 2002). I argue through a combination of classical curriculum and art-based form of inquiry framed by reflexive analysis *Bio-Tech Evolution* avoids falling into this trap.

The course draws on established curriculum in the arts and sciences, while also being open enough to allow the student to direct the outcome. The creative outcomes, although not assessed formally, contribute to the students' repertoire of knowledge and arts practice through the GATE program. This contributes to their overall extra-curricular activity points, which can lead to an entrance into further studies at tertiary levels.

Of the different forms of curricular integration highlighted by Venville, et al, (2002), the complimentary education model of the "harmonisation of different skills, concepts, attitudes across separately taught elements [critical thinking]" and in the case of *Bio-*

Tech Evolution the integration of scientific practices with the critical examination models found in the arts is the most applicable to this course.

This course aimed to establish the merit cross-disciplinary art/science activities have in generating an additional form of education curriculum to add to the current context of / breakdown institutional specialisation (Robinson, 2010). Current education systems in the wealthy minority world are based on an industrial model in which subjects are conducted separately and curriculum and testing produces a standardisation of thinking and a consequent loss in creative thought (Robinson, 2010). With its origin stemming from the period of Enlightenment currently a model based on industrial output rather than creative thinking; this approach is no longer sufficient in the 21st century (ibid).

Secondly, the course introduced interdisciplinary curricula and, in so doing, challenges the standardization and separate disciplinary specialism practices of current education systems (Robinson, 2010). The course aimed to encourage students to think about science in terms of how it frames our understanding of the natural world, and in combining art and science practices through their projects they set up a way to engage with contemporary cultural conditions and locate their arts practice within broader contexts through its communication, exhibition and topics of investigation.

Through the combination of scientific laboratory sessions with art-based reflexive interrogation, this course re-framed the biotechnological debate via a cultural analysis point of view. The application of Habermas' (1987) communicative action can also be used in this context as a way to develop understanding of the systems that frame the lifeworld through cross-disciplinary thinking. By using a combination of art and science practices, a learning experience was set up for students to critically engage with contemporary contexts through production and communication of an arts piece, the outcome of which used scientific technologies and visual arts aesthetics /concepts.

The course also provided another point of access for the students to knowledge that might not necessarily be available, due to curriculum constraints. For example the laboratory sessions and lectures provided students with an insight into the life science of mycology, based on current research in the field conducted by established scientists. In providing access to this information it is hoped that the experience will encourage the next generation to take these practices on board.

6.7 Generating a site to examine developing biotechnologies' impact on contemporary cultural conditions through arts praxis.

This course aimed to establish the merit interdisciplinary art/science activities have in generating an additional form of education curriculum to breakdown institutional specialisation. As discussed in the Literature Review (Chapter, 3.0), Robinson (2010) asserts that current education systems in the wealthy minority world are based on an industrial model in which subjects are specialised and conducted separately and curriculum and testing produces a standardisation of thinking and a consequent loss in creative thought. As Robinson (2010) maintains with its origin stemming from the Industrial Revolution education models based on output rather than creative thinking. To problem solve for a technological future that is yet to be culturally understood, as the literature review established is also a concern of Catts and Cass (2008). The current secondary curriculum also acknowledges the shifting contexts that shape the lifeworld:

Changes confront students in a number of contexts – local, national, regional and global and include increasing interdependence as a result of globalisation; the use and impact of new technologies; the dynamic nature of social, economic and political structures...increasing demand for declining natural resources and the emergence of sustainable management practices; and the acquisition and application of new knowledge. (1998, p. 250)

This context includes the potential role biotechnologies will have on the students understanding of and engagement with the nonhuman. Through combining science and art practices, this can be achieved. The course encouraged cross-disciplinary modes of thinking, creating and acting. The students were shown examples of artworks that demonstrated collaboration between art and science, either through the collaborative projects, conceptual development, or through application of the finished outcome. When deciding on a topic of investigation, the students were asked to research its relationship to scientific and artistic ideologies, applications and debates. This process allowed the students to critically examine how each context operates, and how to locate their practice in-between the two through the presentation and communication of ideas in a public exhibition.

As a participatory hands-on model of education, the students have learnt the potential communicative role their art practice can have and how this form of creative research (Barrett and Bolt, 2007) can be used to question aspects of the lifeworld. The students situated their artworks within broader contexts operating in the lifeworld through the

topics and issues they addressed, and as such developed an understanding of their relationship to the field of arts practice as a form of cultural production and communication. This process was reinforced through the addition of a public exhibition of the artworks where the viewer could consider their position in relation to the bioartworks, life sciences and environmental issues put on display (Hauser, 2008).

6.8 Summary

This approach to the praxis developed the research question in a number of ways. Firstly, it provided a site of direct real-time engagement with nonhuman life. Through this hands-on approach, students were required to deal with the ethical implications of care and responsibility for the other life form and its associated environmental needs. This offered a renewed site of contact with the natural world, within a contemporary situation of “environmental generational amnesia” (McKinney, 2002) where such experiences are becoming rare, due to the time spent engaging with mass media technologies and increasing urbanisation (Jones, 2011).

Secondly, the topics provided direct access to information on specific life sciences for the public via an arts practice. The works also implicated the viewer in various ways through the use of wet biological practices, metaphor and symbolism exploring interfaces between humans, technology, biology and the environment. By using ‘wet’ biological practices as a part of the artwork, the aim was to provide a direct real-time experience of wet biological components for the viewer. This experience aimed to enhance and provoke discussions on existing issues raised by the inter-relationships between humans, technology and the environment.

The course aimed to foster life science activities beyond a traditional scientific context in an arts context, and by consequence into the lifeworld. This cross- disciplinary and collaborative act (where art and science information and philosophies are presented simultaneously) in an educational context has been used to define my position within the bioarts field.

This art-science education model provided alternative levels of engagement with biotechnology beyond hegemonic institutions such as the mass media and corporate industry. The overall premise for this activity aimed to provide students with an opportunity to engage critically with biotechnologies through the creation of an arts

project. In combining established science and art practices, students had the opportunity to examine the mechanisms of both in terms of how they operate and contribute to an understanding of their lifeworld and contemporary contexts (Habermas, 1987).

The learning outcomes of the course contributed to current science and art education, as framed by the Australian Curriculum. This included responsible scientific practices, laboratory methods, critical thinking and problem solving skills, understanding ethics, considering environmental sustainability and developing communication skills.

This was achieved through a relocation of scientific laboratory practicals within an arts context and via the introduction of multiple teachers into the program from the fields of science and conservation. Both guest presenters (Yvonne Sitko – *WA Birds of Prey Centre* and Gary Cass – *Scientific Creativity Initiative*) actively operate and communicate across multiple contexts, including schools, exhibitions, fairs, public arenas, locally, nationally and internationally. Each educator brought a new level of engagement to the topics in the course, due to their personal contextual influences, agenda and lifeworld.

Thirdly, the praxis created a site where a relationship between the individual and broader contexts could be examined, through the subject matter of each class and a reference to local and global contexts. For each session there was a particular focus on local and global environmental issues or biotechnological futures. Through this students could consider a direct correlation between contemporary local and global contexts; and their role within this, either through day-to-day decisions and activities (Giddens, 1991) or through the communication and production of an art piece. This process developed a framework for the students to build on ideas of communicative action and ethical citizenry in society.

7.0 Curatorial Exhibition: *Creatures of the Future Garden* Exhibition

D. Documentation of exhibition, electronic catalogue, facebook link, and workshop (refer to the DVD)

The research so far has established the multiple ways in which the bioarts praxis has been applied through the development and exhibition of individual artworks across various contexts and the creation of the secondary education art-science course *Bio-Tech Evolution*. This chapter reflexively analyses the third research aspect of my bioarts praxis – a curated group exhibition *Creatures of the Future Garden*, held at *Spectrum Project Space*, Edith Cowan University, in Perth, Western Australia. The exhibition included a symposium and *WA Birds of Prey Centre Workshop*.

As an introduction, the first section of this chapter presents historical and contemporary precedents to the curatorial exhibition. There is a particular focus on contexts that combine science, education and public participation, relating to a couple of relevant examples, such as the *Great Exhibition* at *The Crystal Palace* in London, U.K. in 1851 and Melbourne Museum in Victoria, Australia. I then identify key bioart exhibitions that act as conceptual precedents to *Creatures of the Future Garden*, reflexively drawing on my experiences as a participating exhibitor.

Following this is a reflexive analysis of the space in which the curatorial exhibition was held and how this context adds to its communicative efficacy. The fourth section identifies curatorial decisions for *Creatures of the Future Garden*. This includes the selection of artists, and a reflexive analysis of how the artworks explore the research agenda. There is a particular focus on the relationship between the art object, its communicative capacity and viewer engagement with nonhuman life.

The final section identifies viewer/participant responses to the exhibition/artworks and workshop. This section shows how this experience aids in drawing associations between the biological material, the lifeworld and a reflexive methodology. It is through the interaction with objects that we make sense of the world around us; culture, history, identity and the environments we inhabit (Williams, 1976, cited in Inglis, 2007, p. 6). This is an important element of the bioarts praxis as it advocates the communicative and sociological agenda behind the multi-method approach. Through this interaction the concepts articulated by the artists or cultural commentators are translated into everyday life with the intention that the viewer gains a longer lasting impression of the artwork

through their direct interaction with nonhuman life. The aim being that this can have a transformative potential for the viewer to apply this knowledge to their actions in the lifeworld. The process is particularly enhanced with the addition of the symposium and hands-on *WA Birds of Prey Centre Workshop* that deals with local environmental issues and everyday contexts.

7.1 Science communication, education and developing community engagement: The changing nature of gallery and museum spaces.

This section draws on a number of historical and contemporary theories behind the public exhibition of nonhuman life for educational and communicative purposes. There is a brief discussion on the history of the scientific exhibition in relation to its role as a reflection of the lifeworld and the influence of hegemonic institutions on the generation of cultural and economic capital (Bourdieu, 1995, cited in Fensham, 2002, p. 174). This leads into a reflexive examination on the shifting approaches to museums and galleries that foster multi-purpose activities. This contextual information used to locate *Creatures of the Future Garden* within the bioart field.

Historical ideologies of the museum as a framework for how we engage with nonhuman life: Politics, power and economics behind the construction of meaning

“In the modern age, the function of the museum is to research and demonstrate the social and cultural context of artefacts and to foster relationships between objects and people”

(Hooper-Greenhill, 1992, p. 18).

Although there have been many interactive changes implemented in museum contexts since this statement by Hooper-Greenhill (1992), the quote still demonstrates the influence that public exhibitions, museums and galleries can have in shaping our understanding of the world, lived experience and knowledge. Implicit within this is a power and responsibility that can be held by such institutions as voices of authority and objective information.

The public exhibition of nonhuman life carries with it a number of historical precedents, which sets up ideologies that have become the foundations for current museum spaces. The origin of nonhuman collections exhibited in museums has developed from the history of the urban or civic scientist who would collect specimens as curiosities and as a

way to understand the natural world (Patterson, 2008). As highlighted in the Literature Review 3.0, within the history of the wealthy minority world one of the best-known contexts is the *Great Exhibition* at the Crystal Palace in London, UK. Klingender describes: “This exhibition was founded in 18th and 19th century...by wealthy members of society...to exhibit the latest technological invention” (2010, p. 290). At this stage there was a focus on presenting a “glorification of science and technology” (ibid), a reflection of the ideologies from the modern industrial context at the time. These experiences were initially exclusively for friends “eventually the working classes were allowed entrance with the hope that a visit might further their education” (ibid). This shift from private collecting as a curiosity and private science education/entertainment to public education and the generation of cultural capital developed over a number of years.

The ideology of an ivory tower however still remained through the aura of the institution as a figure of authority, such as the *Natural History Museum* 1881, London and early forms of exotic menageries housed in the grounds of royal residencies, such as Versailles (O’Doherty, 1986). Contemporary takes on this formula combine specimen collections from the natural world, IMAX theatres and interactive exhibits. For example *Maryland Science Center*, created in 1976, Baltimore, U.S. Museum approaches and themes have also extended to include: Living History Museums: Representations of different cultural histories through artefacts, Maritime, Military and War, Open-Air Ethnographic Museums: Large scale replication of historical sites especially villages, and the Pop-up Museum (1990): A short-term installation of an institution, Science, Virtual and Natural History.

Of particular interest to the motivations for this research and as a framework for *Creatures of the Future Garden*, museums and public galleries became a place where the viewer’s position in relation to the natural environment, history, time, and culture were constructed, measured and portrayed. As such museums and galleries can be used to reflect the lifeworld and generate cultural capital (Bourdieu, 1995, cited in Fensham, 2002). As reiterated in an article from *The Independent* “Knowledge is now well understood as the commodity that museums offer...the opportunity to change one’s perception or knowledge of the world through a visit to an art gallery is offered by those whose funding makes exhibitions possible” (Anonymous, 6 September 1990, cited in Hooper-Greenhill, 1992, p. 4).

Museums have been fundamental in creating “specific intellectual environments [through the] assembly of objects [and become] storehouses of knowledge” as a way to

understand the world (Cannon-Brookes 1984, cited in Hooper-Greenhill, 1992, p. 2). This construction of knowledge based on scientific methodologies, the rational ordering and classification of specimens, and representation of culture through artefacts led to the status of museums to be according to Klingender (2010) “a trusted source of unbiased information” (p. 291). This methodology is in opposition to how artworks/humanities based communications are usually seen by the public, which is often considered as a form of personal expression (Holcombe, 2013).

In relation to the curatorial exhibition, where the intention is to communicate scientific information through various practices, *Creatures of the Future Garden* provided an alternative approach to generating such bodies of knowledge. By combining the practices of art with science in this way, the exhibition sits between this objective stance on information dissemination positioned by Klingender (2010) and the sociological role of artistic communication. This position creates a tension in relation to the effective communication of science via a bioarts exhibition. As the pieces are conceived and framed by artistic discourse and intention, the works cannot be considered unbiased. This situation draws attention to a gap between the curatorial aims to communicate scientific information and the actual outcomes demonstrated by viewer feedback. Notwithstanding, the exhibition opened up a platform to multiple levels of engagement with developing technologies and scientific practices. This is reflexively addressed later in the chapter through the subject matter provided by the exhibiting artists and through the inclusion of a symposium and *WA Birds of Prey Centre Workshop*.

21st Century museums and exhibition spaces dealing with nonhuman life and science

In contemporary contexts across the globe, “hard questions are now being asked about the justification of museums, about their role in the community, and their functions and potentials” (Hooper-Greenhill, 1992, p. 1). Is the established model of museums and galleries now outdated? Traditional museum displays (dioramas) have constantly to compete or update with other forms of knowledge/information gathering (Internet, iPhone, tablets, interactive touch screens et al) and as a consequence the shifting interests of the public that demands a quick educational experience that fits in with other daily demands.

For example, the *Museum of Science and Technology of Islam* in Saudi Arabia provides the visitor with multiple levels of engagement with the artefacts through the introduction

of interactive digital display tables. These displays set up a visual narrative of cultural and scientific history for the viewer to engage with alongside actual artefacts traditionally displayed in cabinets. The content with each digital display allows the viewer to select information autonomously, “provides information on the technological and scientific advances of the Muslim world from 700BC-1700BC, in the fields of maths, medicine, astronomy arts, architecture, botany, chemistry” (2013). During the conceptual development of each display, designers ensured that the subject matter and visuals were appropriate for the target audience and culturally sensitive to the context (2012). The interactive display also allows the viewer to generate connections across the timeline, illustrating the history of global interactions between culture through commerce and exchange of ideas.

Alternatively the ability that technologies such as iPhone, YouTube and the Internet have in extending the access to the museum is also noted through the action taken by individual visitors recording their experience of exhibitions and creating a blog / YouTube, opens the opportunity up to the global community, as illustrated by *British Museum and Victoria and Albert Favourites*, produced by the alias ‘leadinglady19’. Through this process the individual mediates the knowledge made available by the museum, which can lead to misinformation, however the process of placing the film on the web, creates a greater outreach for the institution beyond geographic location, culture and demographic.

To understand the impact developing technologies have on the educational approach, contemporary museums are now conducting research on the relationship between individual learning methods and the application/development of “interactive on-line web learning” Schaller et al (2007). They identified that individuals have social, intellectual, practical, and creative modes of learning, specific to their individual context and personality. The researchers conducted a series of hands-on workshops with *The Franklin Institute Science Museum* and local schoolchildren and adults, observing how the participants interact with electronic games, puzzles and creative web-based activities centred on the museum’s invertebrate exhibits. They concluded, in order to design successful, interactive educational experiences as an adjunct to visiting the museum itself, web resources needed to cover the different learning styles.⁴⁶

To open up a broader audience, as raised by Cummins (1997); Museums now have to choose between maintaining the aura of an ivory tower or invest in various popular forms of “community outreach”. The infrastructures that support the museum determine its

approach, as Hooper-Greenhill (1992) elaborates; “Museums have always had to modify how they worked, and what they did, according to the context, the plays of power, and the social, economic, and political imperatives that surrounded them” (p. 1). This is also applicable to the bioarts field. The influence of such contexts on the production, execution and selection of exhibits in a gallery or museum has in some part determined the associated values and ideologies that come with it. These ideologies are then disseminated into the lifeworld of the viewer.

Another context that is shaping how museums and gallery spaces are positioned in the public sphere and by consequence what the public expects of these institutions is identified by Hooper-Greenhill (1992): They are “...no longer built in the image of that nationalistic temple of culture,...found in farms, boats, coal mines, warehouses, prisons, castles, or cottages...going to the museum is often closer to that of a theme park or a funfair” (p. 1).

This sets up an exciting precedent for *Creatures of the Future Garden*, with its agenda of creating spaces that have multiple uses and opening access to arts/sciences to varied demographics or even the potential future location of the exhibition in multiple contexts within the lifeworld (farms, boats, coal mines, warehouses, prisons, castles, cottages). This approach is also of interest to science communities through the relocation of science centres and “children’s museums” into shopping complexes. As Thomas (2010) proposes: “It represents a determined effort to present science as something for everyone and part of everyday life” (p. 280). In this way the ivory tower is broken down, and hands-on experiences of science are introduced into day-to-day lived experience of a cross-section of the population.

These forms of interactive museums are now occurring more frequently. As described in the Literature Review 3.3 *Eureka!* in the U.K. and Scitech in W.A. This method could aid in developing social change at a grass roots level. The workshops and scientific displays presented in *Technebiotics*, organised by artist Phil Ross also demonstrate how the cross-over between arts and science can encourage the viewer to implement sustainable practices through scientific education in their daily life (section 7.2).

The hands-on experience of interacting with nonhuman life in an institution is not a new phenomenon as established in the Literature Review, 3.0, and by examples such as AQWA: *Aquarium of Western Australia*⁴⁷ in Perth, where the marine touch pools were

established in 1982. However, what the exhibition brings is an alternative position to such established nonhuman interaction through the framework of critical arts discourse.

Melbourne Museum: Real-time interactions with nonhuman life

In terms of precedents for the introduction of live animals into a gallery or museum space as has been done in *Creatures of the Future Garden*, the most relevant example within the context of Australia demonstrated by the Melbourne Museum in Victoria. This institution actively sets up live interactions with animals and invertebrates for public education. This is illustrated through the creation of the *Forest Gallery* and *BugsAlive!* interactive exhibit. As picturesquely described on the Museum's webpage (2013):

Step through the glass doors into a living verdant fern gully complete with waterfall and cool temperate rainforest plants.

Follow the pathway that leads under the creek and discover how water shapes the landscape and creates the conditions for forest life - take a close up view of small fish, frogs and skinks.

Emerge from the dark rainforest into the sunlight and smell the eucalypt trees while learning how plant species have evolved. In the creek, you may see native fish and spiny crayfish that inhabit the water, and the elusive water dragon may be basking nearby.

Forest Secrets is alive with seasonal change - birds nest, flowers bloom and berries ripen. The local Kulin Aboriginal people have seven seasons marked by the life cycles of plants and animals. Have a privileged view of some forest animals inside a log, in the foliage or basking on the ground. Somewhere up in the trees is the Tawny Frogmouth, while tiny wrens and finches flit across the path and among the bushes. Listen carefully for the call of the male Satin Bowerbird trying to tempt the female into his blue decorated bower.

In a clearing huge, timber poles come into view representing the impact of fire. Fire is a destructive force yet it is essential to regenerate the forest. A lone chimney reconstructed here following Black Saturday stands as a symbol of the devastation bushfire can cause, and a video display set within one of the blackened poles illustrates both the destructive and regenerative effects of bushfire. Seating platforms double as displays exploring human attitudes and impacts on the forest. Understanding how people think of and use the bush is central to managing it wisely.

Enjoy this refreshingly different exhibition and gain a new appreciation of our mountain forests.

As a form of communication, this description covers a number of cultural, educational, scientific and environmental conservation agendas for the museum. It draws attention to

specific plant and animal species endemic to the local visitor's environment. It provides an insight into historical and contemporary Indigenous cultural interaction and knowledge of the local environment. It also makes connections with contemporary events in the visitor's recent lived experience (extensive bush fires in Victoria in 2009), remembered as Black Saturday). The living exhibition space also creates the wilderness that Gessert (2008) refers to: "The Forest Gallery covers 1,485 square metres and is 27m wide and 55m long...Both the plants and animals replicate very accurately the habitat and ecology from that region" (Discovery Centre, 2012).

The Melbourne Museum⁴⁸ as an institution has a multi-method approach and transcends boundaries of the ivory tower traditional museum model. In addition to collections, scientific displays and educational packages familiar in most museums, there is also a blog linked to each exhibition that provides an opportunity for the public to ask questions of museum curators and scientists: known collectively as the 'Discovery Team.' The public and the researchers upload photographs from their experiences with nonhuman life (Community Photo Gallery on Flickr) and contribute information through civic science activities (photographic records of species, contributions of specimens to the collections). In this way, the museum has made an active connection with the viewer's lifeworld and can use this information as a resource to map current cultural and ecological interests. The blog shares the experiences of researchers at the museum – opening the laboratory doors.

BugsAlive! in particular provides on-going links between the living invertebrate exhibitions, conservation and educational activities of the zoologists and entomologists with the intention of generating on-going viewer participation. As posted by Jessie Sinclair 1st August 2011 *BugsAlive!* 'Bug of the Month' on the Museum Victoria BlogSpot: "Green Diving Beetles (*Onychohydrus scutellaris*)...store air and dive underwater to hunt food and find mates...found Australia-wide and on warm nights are attracted to lights...on the Gold Coast...thousands...coming into the lights on the foreshore" (2011).

This method creates a situation where the viewer / participant can traverse between the educational displays in the institution – the knowledge this provides – and their own lifeworld. The viewer / participant as such can become an active contributor to the institution through the blog, while also developing a greater awareness of the environment and its invertebrates. The process therefore ideally develops reflexive and responsible 'civic scientists.' The experiences shared between entomologists and the public crosses the boundaries of the 'ivory tower.' By allowing visitors to touch, this

almost entirely knocks down the existing idea of a 'museum' as a temple of cultural elitism which as an idea still exists in most traditional art galleries.

This hands-on participatory process as established by Klingender (2010) is a successful way to develop long-lasting educational experiences. Based on extensive thirty-year research into the behaviour and "learning styles" of people who visit museums, Klingender (2010) identifies that "a significant number of our visitors learn best by doing...they only truly comprehend as a result of what has come to be called hands-on learning" (p. 294). This process of hands-on learning and real-time engagement with nonhuman life provides a formula that has the potential to shift an individual's relationship to the environment and become a part of the on-going lifeworld.

Exhibitions and Museums as sites for social agency through collaboration with the public

There has been on-going discussion by academics in the field of museum studies on the way museums and galleries consider their educational relationship to the public (Bitgood, et al 1990; Raben, 2013, Russell, 1994). As Screven (2002) states: "Learning is voluntary...self-directed...driven by curiosity, discovery...sharing of experiences with companions... [and generates] divergent thinking, critical analysis, better understanding of the past, the complexity of the natural world and critical environment issues".

To address this, a number of spaces have initiated workshops and hands-on activities for the public to participate with. Within the context of Perth, Western Australia, where the *Creatures of the Future Garden* was based, galleries such as the Fremantle Arts Centre, Mundaring Arts Centre, Artspace, PICA, the Art Gallery of Western Australia (AGWA), and the WA Museum encourages exhibiting artists or artists in residence to engage actively with the public. This is done by providing workshops to teach techniques, floor talks and children's art activities. As WA Museum curator Rosemary Fitzgerald replied in response to my question: 'Has there been any discussion on a need for museums to make changes to their displays, educational programs and events in response to public demand or technological competition (internet / iPhone)?' Fitzgerald replied, "Many museums are picking up on new media trends, such as hand-held devices with apps and interactive on-line content" (personal communication, May 20, 2013). This response shows the changes museums need to undergo to encourage viewer attendance. It further indicates that contemporary spaces are required to have multiple educational methods, activities and facilities.

This is not a new concept, however I argue that the approach used in *Creatures of the Future Garden* could be a useful addition to such contexts in creating a space that facilitates collaborations between art and science, education and conservation and provides an opportunity for young people to produce, respond and exhibit artworks that deal with current contemporary biotechnological futures with established artists. This is increasingly important in light of McKinney’s concerns about “environmental generational amnesia” (2002). Making such connections between established practitioners and emerging artists offers a point of knowledge exchange to prompt further research and interdisciplinary problem solving methodologies.

The *WA Museum* in particular has a large section of the space dedicated to educational hands-on activities for primary and secondary school students. This includes access to collections, and live display of native frogs, insects and snakes, Figures 51-52.



Figure 51: Donna Franklin, (2014), Photograph taken at *Discovery Centre*, WA Museum.



Figure 52: Donna Franklin, (2014), Photograph taken at *Discovery Centre*, WA Museum.

The Discovery Centre is set up to provide access to specimens in an interactive way. Through hands-on engagement with the nonhuman, there is the potential to increase greater awareness of local ecosystems, in this case particularly fauna. These interactions at the *WA Museum* bring collections to life, and have the potential to encourage young children to engage more readily with the natural world.

In using this method of audience participation these contexts set up a precedent for *Creatures of the Future Garden* through the application of spaces that have a multi-purpose outcome (gallery, art exhibition, collections, scientific research, cultural and scientific education). This process also aids in the generation of cultural capital for the viewer and community. In this way museums/galleries that aim “to engage the public in educational endeavours can move visitors towards greater social change at local levels” (Wood, 2009, p. 26). This was a particular aim behind the inclusion of the *WA Birds of Prey Centre Workshop* as a part of *Creatures of the Future Garden*, detailed in section 7.6. I believe that the more individual participants know about their local environment and the nonhuman life that co-exists in these spaces, coupled with a hands-on experience of these animals, the more likely it is that individuals will act in a more environmentally conscientious manner and as such aid in developing “social change at local levels” (ibid). This approach is made explicit through the work done at the *Osservatorio ecomusei* in

Barcelona, Spain, “The exhibition content that reflects localized interests and multiple perspectives aids museums in promoting visitor-orientated meaning-making” (Wood, 2009, p. 37). In this example interdisciplinary models are being applied to exhibition spaces via the integration of artworks.

By using this method of selecting artworks that are concerned with specific contemporary issues of interest and relevance to the individual viewers, the process can potentially lead directly into a renewed reflexive engagement with lifeworld. As Jarratt explains: “If you can connect people up to their educational community, to their local political community...or to their museum community, they feel and act in more participatory ways” (1997, p. 26). In this way the *Osservatorio ecomusei* space becomes a hub as Wood states (2009) where there is a determined “focus on community empowerment and to incorporate shared decision making in the development of exhibitions” (2005, p. 37).

This activity supports my agenda in creating spaces that have a multiplicity of uses: education, communication and art exhibition, with most activities invested in empowering the individual lifeworld. I argue that it is these sorts of events, spaces and points of dialogue that offer the participant / viewer a greater opportunity to understand the bigger picture or the relationships between their lived experience and the systems that govern them. As Oppenheimer states “If people feel they understand the world around them...then and only then are they also able to feel that they can *make a difference through their decisions and activities*” (cited in Rodari and Merzagora, 2010, p. 2). This I argue is achieved through the introduction of a hands-on educational workshop (*WA Birds of Prey Centre*) within art contexts that provide an additional point of reference to the viewer’s own lived experience, giving the viewer the opportunity to consider their participatory role in the future engagements with nonhuman life.

7.2 Bioart Exhibition, workshop, symposia precedents

This section reflexively analyses key examples of curation agendas in the bioarts field, most relevant to the practical and conceptual precedents for *Creatures of the Future Garden*. The section provides a framework for my curatorial decisions in relation to the social role of arts praxis. Within this section I identify key issues raised by these precedents and demonstrate how specific artists selected for *Creatures of the Future Garden* develop this discourse.

Selected precedents to the exhibition include:

BioFeel BEAP 02 Aesthetics of Care? Symposium and *VIVO ARTS* (2002) course run by Adam Zaretsky at *SymbioticA*. These examples are built on through the inclusion of students from *Bio-Tech Evolution* (Brown and Lozanovski) course and *Abiogenesis* (Whittle) opening up the discourse to include the next generation.

Art of the Biotech Era and the follow up exhibition in 2009 *Bio-Tech Art Revisited* of which I was an exhibiting participant hosted by the Australian Experimental Arts Foundation (AEAF) in Adelaide, South Australia. This example provides a contextual background to the location of *Creatures of the Future Garden*, its location in Perth, W.A, but also its relevance to global contexts.

The workshop event *Technebiotics* in California, USA. The inclusion of the *WA Birds of Prey Workshop* sets up a premise for further site-specific / local environmental discourse at bioart exhibitions.

These particular examples were selected to provide an insight into some of the events happening between the primary bioart exhibition in *BioFeel BEAP* 2002, to 2009, and prior to the commencement of this research in 2010. This process is used to identify how *Creatures of the Future Garden* can be situated in the field of bioart exhibitions and how this event expands upon previous models in the bioarts field. Within each case in point I identify precedents that are either built on through *Creatures of the Future Garden*, or are an influence to curatorial decisions.

BioFeel BEAP 02 Aesthetics of Care? Symposium and VIVO ARTS (2002)

The selection of themes each artist explores in *Creatures of the Future Garden* builds on the premise that was of particular concern for the artists, academics and scientists that presented papers and artworks at the *BioFeel* exhibition and *Aesthetics of Care?* Symposium. The complimentary symposium for *BioFeel BEAP02* (Literature Review 3.0), also foregrounds the agenda behind my symposium in that it provides a forum to debate the complicit nature of bioarts practices, and sets up a dialogue between artists, scientists, academics and the public. *Aesthetics of Care?* debated concerns at the time of an increasing hegemonic focus on manipulating living systems for “profit driven research” (Catts, 2002, n.p.).

These issues are specifically examined in a number of works selected for *Creatures of the Future Garden*, namely *Keep Safe your Identity* (2011-2012) (Lozanovski), *The Synthetic Kingdom* (2009) (Ginsberg) and *Definition* (2012) (Whittle). As I have included students in the exhibition (Brown, Lozanovski and Whittle) from *Bio-Tech Evolution*, these debates are taken on board by the next generation.

This approach also sets up the premise of a critical reflexive discourse around developing an arts practice and biotechnologies. The continual state of flux (Hauser, 2008) of ideas and bioartworks is indicative of the close relationship between such arts practices and the lifeworld and is representative of the impact of the post-modern conditions that frame it (Giddens, 1991).

Artworks were being produced in response to current biotechnological developments and cultural positions in regards to nonhuman life and art-science dichotomies. This reinforces my argument, that such practices are vital in developing ways to reflexively and critically question contemporary contexts. This is an ideological position echoed by Sullivan (2010) and Shanken (2011). As established in the introduction, the term bioart constantly changes in light of new interpretations, artworks and biotechnologies (Hauser, 2008). This provided scope for the selection process during curation of *Creatures of the Future Garden*. It also reflects the sociological role this art genre can have in generating reflexive engagements with contemporary cultural conditions to better understand the lifeworld. Due to its reference and use of life science mediums / technologies and subject matter the genre also easily traverses geological space, time and cultural contexts.

Through my selection of established artists, local and international, for *Creatures of the Future Garden*, I aimed to demonstrate that this art form – its agenda and methodology – is applicable across local and global contexts. The themes that each artist critically engaged with through their practice covered many aspects of our historical and contemporary understanding of nonhuman life. In addition some works communicated ideas surrounding current global environmental issues. As a result these works raised epistemological questions about the lifeworld, new technologies and existing hegemonic systems.

The exhibition *BioFeel* also introduced tertiary student artworks as a result of the art-science workshop *VIVOARTS* run by resident Adam Zaretsky.⁴⁹ *VIVOARTS* was the first hands-on art-biology workshop run at *SymbioticA*. As a course *VIVOARTS* included

theory and practical sessions on GFP transfers, molecular biology, tissue culture and rigorous discussions on the ethical considerations of manipulating life (2002, Catts, n.p.). This workshop was modelled on art and biology courses developed by Adam Zaretsky (then a research fellow at *SymbioticA*) at The School of The Art Institute of Chicago, San-Francisco State University (ibid). The class work was represented by a photographic collage of individual student artworks documented during the foundational art-biology course *VIVOARTS*.

This activity and the undergraduate units in *SymbioticA* (Chapter 6.0) and consequent exhibition of artworks influenced – in addition to the *Bio-Tech Evolution* course – the inclusion of secondary students in my curated exhibition. By including Year Eleven and Twelve students in the exhibition *Creatures of the Future Garden* puts the focus on generating connections between secondary educational institutions and bioarts practices thereby bridging a gap between current art-science activities in this context. Building on the *VIVOARTS* precedent, the students participating in *Creatures of the Future Garden* (Brown, Lozanovski, Whittle) presented ‘wet biological’ artworks.

Art of the Biotech Era 2004 and Biotech Art Revisited 2009

Curator Pandilovski identified, *Art of the Biotech Era* 2004 had an intention of “[dealing] with artistic and cultural issues, in which artists, activists, theorists, demonstrate something of the plurality of approaches to biotechnology” (2004, p. 4). This ideology sets a premise for *Creatures of the Future Garden* in terms of the selection of artists that explore alternative cultural positions to biotechnologies and the life sciences beyond hegemonic structures and corporate bodies. Likewise as a part of *Art of the Biotech Era* show the *Biotech Culture Symposium*⁵⁰: “addressed...the politics of the discipline of biotechnology, the ethical implications of genetic engineering, the relationship between ethics and biotechnology, the essence, spectacle and background of scientific processes, the complex relationships of science and culture” (Pandilovski, 2004, p. 4).

The follow up exhibition and symposium five years later *Biotech Art Revisited* in which Cass and I exhibited *Micro 'be'*, demonstrated that these exhibitions were still reliant on new media based institutions and funding bodies (AEAF) and that the theoretical and philosophical discourse had begun to develop in a number of key directions. As Pandilovski identified (2009) these included: A systematic approach which traverses across scientific methodologies and process based outcomes, art practices that dealt with cross-discipline collaboration and practices that examined the manipulation of life for

artistic ends from a critical postmodern position. Also at this stage as evidenced in the Literature Review 3.0, was the development of a number of key texts, bodies of knowledge and ideas developed by cultural theorists, practitioners and critics.

Biotech Art Revisited included a number of works created from the previous exhibitor's in *Art of a Biotech Era*. Curator Pandilovski points out at this stage (2009), five years after *Art of a Biotech Era* there were a growing number of arts practitioners in the field whose praxis and interest in bioarts had developed as a result of multiple workshops held locally, nationally and internationally, "There are currently eighteen workshops running Asia, Europe and the U.S." (2009, Pandilovski). Most were based on the model set up by *SymbioticA* from 2000 onwards.⁵¹ Also developing at this time, was the increasing interest and support by universities "scientific labs [that] have opened their doors" (ibid) and institutions such as AEF to host bioarts exhibitions.

Pandilovski argues that Australia is one of the key contexts behind the development of such bio-political discourse and practices in the field, with artists gaining international awards. He (2009) states that this: "signified that Australian arts...in the field of biotechnology...is one of the leading countries...because we also have these specialised labs which deal with art-science collaborations...so you have many artists from around the world spending time in Perth [e.g. ORLAN artist in residence⁵²]."

Reporter Williamson (2009) from the Australian Broadcasting Commission, Adelaide asked Pandilovski: "How do you broach traditional arts audiences?" (Williamson, 2009), who responded: "The AEF...already has a premise of contemporary arts and unusual practices...so audiences expect this. I would not underestimate audience interest in finding new art of the day...it's time now for bigger institutions to take these practices on board" (2009, Pandilovski).

The themes presented in *Creatures of the Future Garden* adds another position to the discourse surrounding such bioarts works and reinforces the importance such practices have as a way to develop an understanding of contemporary contexts in the viewer's lifeworld. This puts into practice the theoretical framework established by Sullivan (2010) regarding art as a form of social agency. Curator Pandilovski (2009) reiterates: "Art is used to better understand the changing world of the 21st Century". This level of critical engagement and communication is taken further in the research by its multi-method approach; also situated in the *Bio-Tech Evolution* course (Chapter 6.0), and through the public exhibition of specific creative works (Chapter 5.0). This statement also

underpins the research agenda and intentions behind the central question in that my praxis is used to develop an understanding of nonhuman life in a contemporary biotechnological context.

Workshop Precedent: Technebiotics

Often bioart exhibitions also present workshops for the public to engage directly with life science beyond the laboratory doors. The addition of life science workshops offers a way for the public to experience first-hand these interactions with nonhuman life and in doing so provides a site of debate, exchange and education. As a result, the viewer not only sees an artwork, but also directly engages with the contexts, artists and scientists that frame the work.. For example as a part of the exhibition *Biotechnique*, there followed the workshop *Technebiotics*: "...featured artists, scientists and educators who engage with biological processes and techniques. There were demonstrations of cutting-edge laboratory equipment...alongside traditional horticultural methods and everyday bioreactors" (Ross, 2007, n.p.).

This event included workshops on sustainable practices in the garden, zoology from the University of California, DNA spooling, fermentation, composting, how to create your own bio-reactor, cell-tissue culture for beginners, hydroponics, and a SPF Prevention of Animal Cruelty display. This provides an opportunity for cultural communicators to demonstrate the viewer's everyday engagement with these technologies through the food, pets, plants, clothes, and medicines they consume. This agenda is another way in which this interdisciplinary context provides "an opportunity for scientists" to communicate/demonstrate research in a new way to a different audience (Skilton, 2005, p. 283). I argue, by opening laboratory doors; art / science workshops and events offer a site for the scientific practices to step outside of the often confining circumstances set up by traditional institutions, providing a site for cultural reflexivity (Giddens, 1999). If access to scientific technology breaks out of the institution, could this public activity lead to a different approach in the conducting and generation of knowledge? As Dumit suggests (2008), "[expertise] confines problems as much as it defines them" (p. xii), including the generation of knowledge not only for those involved in the life sciences and arts, but for the public as well. Levins (2008) argues "Commodification of science [and arts] and...institutional organization works against self-reflection [reflexivity]...Scientists [and artists]...evaluated mostly by their contributions within the bounds of their department definitions" (p. 37).

The *Technebiotics* workshop⁵³ covered a lot of different areas that currently operate in the individual's lifeworld. It drew attention to the systems that shape how we engage with nonhuman life in a contemporary context across a number of scientific fields: tissue culture, conservation and animal welfare. In contrast the inclusion of the *WA Birds of Prey Workshop* in my exhibition placed an emphasis on local contexts, particularly in relation to specific ecosystems, urban environments and native fauna.

7.3 Locating Creatures of the Future Garden: Spectrum Project Space, Edith Cowan University

Exhibition Spaces in Tertiary Institutions

This section looks at the agenda behind the location of the exhibition within a tertiary institution at *Spectrum Project Space (Spectrum)*. I provide an overview of this space and identify how its context follows my aims for *Creatures of the Future Garden*, determines the audience demographic and reinforces my multi-method approach to the praxis. What *Creatures of the Future Garden* brings to this space is the first exhibition of nonhuman biological life / bioart and live birds of prey workshop (a scientific and conservation based demonstration). This action extends the concept of the space as a site that has multi-purpose outcomes and forms of communication beyond the field of the humanities (music, visual arts, performing arts, cultural studies) which has historically been the focus of the space. It is hoped that this exhibition will spark further experimentation in the field of bioart and exhibition of nonhuman life in an ethical and educational manner and therefore add to the cultural communication, value and awareness of nonhuman life.

This space is an important context to house the exhibition for a number of reasons. The most significant of these relate to its encouragement of artistic experimentation, educational focus and the physical versatility of the space. There was also a pragmatic decision in locating the exhibition in a space that was close to my residence and place of study. This is mainly due to the physicality of the works (large pieces and works containing living nonhuman elements / wet biology) that require regular maintenance / feeding as outlined in the ethics and methodology (Chapter 4.0). Being in close proximity, the daily feeding, cleaning, and up keep of the space could easily be conducted by me. This also provided the opportunity to gallery sit the space and talk with viewers to gather feedback on the exhibition and the artworks. *Spectrum* purposely

promotes itself as a 'space' rather than a commercial venture, or traditional exhibition gallery.

This model leaves the door open for public presentation of all aspects of artistic research while also disrupting the traditional ideologies of commercial gallery spaces as places of exclusivity and as another form of the ivory tower. *Spectrum* was also chosen for its policy of exhibiting "both emerging and established artists" (2012). This is particularly important for *Creatures of the Future Garden* which exhibits the works of internationally recognised artists and high school students on an equal footing. This included participants from *Bio-Tech Evolution*; Jesse Brown, Nicholas Lozanovski and Sasha Whittle participant in *Abiogenesis*. Established artists included; Trish Adams, Tarsh Bates, Gary Cass in collaboration with Suzanne Cass, Kirsten Hudson, George Gessert, Alexandra Daisy Ginsberg, Svenja Kratz, and Angela Singer. This is an important distinction from precedents as it opens discourse to traverse into educational contexts.

As *Spectrum* is located within a tertiary institution and within the official 'Gallery Circuit,' the audience demographic of the space spans across the university community from varied disciplines (staff and students), educational institutions (primary secondary), other tertiary institutions (UWA, Curtin, Murdoch, Notre Dame and TAFE) and public interested in the visual arts. This indicates that the context could be rather specialised and is problematic to the multi-disciplinary outreach approach to this research. This is precisely why I use multiple contexts; it is not my intention to dismiss the important cultural role of exhibits within art institutions, but rather to encourage greater participation within these specialised contexts. To extend the audience demographic further I organised a media release via the University and publishing advertising within the dominant local paper *The West Australian*. *Spectrum* also advertised the exhibition on their website and Facebook page.

7.4 Curatorial Praxis: *Creatures of the Future Garden*

This section critically and reflexively examines the artists and artworks selected for the exhibition and the curatorial decisions made. The selection process was initially determined in relation to how each artwork deals with various issues surrounding our contemporary engagement with nonhuman life. I also provide a background to each of the artists to contextualise how their practice adds to the field of bioart: complete biographies are available in Appendix C. This is followed by an analysis of the viewer/participant feedback. I identify how the workshop and symposium effectively adds to the viewer's engagement with nonhuman life and biotechnologies.

As an introduction to the curatorial process, I provide a brief overview of current debates surrounding the concept of artist as curator. This situates the curatorial praxis in relation to broader contexts in the fields of arts, art theory and museum studies. Historically the role of the curator was the discerning influence on the legitimisation of artworks – as demonstrated by the aura around the 1737 Salon in Paris. Historically the precedents to this form of public exhibition trace back to the 16th Century. Prior to this time, private collectors would exhibit their treasures in domestic spaces. The selection and exhibition of academically trained artists by jury introduced 1748 “after the success of the Exposition de jeunesse in the Place Dauphine” (Currie, 2007). This selection process sparked the development of unofficial salons “by progressive artists” (Currie, 2007). The themes, presentation and selection process sets up a narrative that can to an extent shape how the audience engages with the works. “Cultural confinement occurs when a curator thematically limits an art exhibition instead of asking the artists to set their own limits...In the gallery space a work of art...becomes a portable object cut off from the outside world” (Smithson, cited in Richter, 2013, p.46). This statement echoes Weiss’ (2004) concerns on the reductive quality of curating and its impact on the production and determination of artworks.

In relation to the curatorial approach for *Creatures of the Future Garden*, this process is counter-acted in two ways. Firstly, the selection process for artworks based on existing bodies of work, although thematically framed by contemporary engagements with nonhuman life. This approach ensures that the artist’s individual intentions are realised without complete curatorial intervention. However by contradiction, it is also important to note within the ‘call for works’ some artists proposed new pieces in response to the topics or thematic questions I set up. The process of initiating a ‘call for works’ also created a more adaptable curatorial process as it allowed artists to choose whether they wanted to participate or not. Secondly, the exhibition tenet itself diversified by the inclusion of multiple activities in the space.

The popularisation of curation has led to the development of specific tertiary courses across the globe. Stürzl (2013) suggests that this phenomenon is a result of the influence of artistic approach to the presentation of artworks beyond a museum tenet, while also reflecting the tensions between new media arts and the art market. “Power relations...raise questions of whether artists as curators could make a different contribution to “traditional” exhibition-makers or whether curators were perhaps making use of artistic strategies in their work that had led to their rise in the first place” (p. 7).

Rather than a single voice dictating the narrative of display, scholars in the field of arts, arts theory and museology have recently discussed a change in approach.

There has long been a debate surrounding the role of authorship between the curator and artist in this field. Models in the 21st Century focus on collaboration between artists and curators or collectives, or call to remove these binaries to focus on the process of curating itself (von Bismarck, Marchart and Roelstraete cited in Stürzl, 2013, p. 7). Art historian Adamopoulou and museum curator Solomon (2013) argue, "...artistic knowledge and practice can illuminate aspects of historical and museum practices, aspects which are rendered invisible when working in their own academic field" (p. 26). Two artists in the exhibition demonstrate this approach.

Angela Singer and Svenja J. Kratz exhibited existing artworks based on established on-going research into the re-appropriation of taxidermy remains. The artistic display of these remains opened up discourse to extend the form's communicative possibilities and express "...unquestioned meaning, purpose and authority of museum practices and processes, i.e. documentation, collection, taxonomy, display, visual perception and, of course, curating" in an arts context (Adamopoulou and Solomon, 2013, p. 27).

To reinforce my collaborative and interdisciplinary approach as an artist, I decided to develop a curated exhibition as opposed to a solo exhibition. By opening up the discourse beyond my creative works, the curatorial praxis extends the communicative possibilities of the research to encompass other voices in the field of bioarts. This action echoes Paul's (2006) argument that these changes indicate, "A clear defection from the model of a single creator or "star" that still predominates in the art world" (p. 6).

Curatorial Process: Selection of artists/artworks to establish the narrative

The title *Creatures of the Future Garden* was chosen to allude to a number of artworks in the exhibition that examine concepts of control and/or nurture of nonhuman life and biotechnological futures. It was also used to ask the viewer to consider their role in the development of future 'gardens' as to whether they will destroy, co-exist, cultivate or innovate to solve problems. The word creature defined as a "living thing, being, animal, beast" (2004, p. 123) and "thing created, dependent" (1991, p. 121) sets up a number of points of view regarding how the viewer will interpret each work and engage with the nonhuman life on display. These associations reference a number of issues raised by the selected artworks and reinforce the historical and contemporary relationships that

have developed between human and nonhuman life. This includes, domestication, industrial production and consumption and potential outcomes that can occur as a result of advances in biotechnology.

The overarching premise for the exhibition firstly aimed to represent a diversity of living nonhuman life in real-time: bacteria, invertebrates, plants, fish, birds, animals (including human DNA), to draw attention to their existence in the viewer's lifeworld. I also wanted the viewer to experience the multiple forms of life sciences from the past, present and into the potential future. The intention was to encourage the viewer to consider their complicit role in the current biotechnological contexts, nonhuman welfare and co-existence with nonhuman life. This has been achieved through the selection of artwork content that for the most part deals with real-time engagements with nonhuman life and artists that follow the physical and conceptual applications of bioart as established by Catts & Zurr, 2008; Gessert, 1994; Hauser, 2008; Patterson, 2010; and Ross, 2010. This approach allows the viewer to make connections between the artwork and their own lived experience. This reflexive process was reinforced through the multiple uses of the space with the addition of artist talks within the *Creatures of the Future Garden* symposium and the *WA Birds of Prey Centre Workshop*. The arts praxis is then not restricted to art objects within the 'gallery space', but extends into a form of participatory action, developing the communicative capacity of the artworks in relation to other contexts within the fields of science, biology, and environmental conservation within the lifeworld.

Another premise that framed decisions for the exhibition was the non-hierarchical choices made for the selection of artists. *Creatures of the Future Garden* also presented a series of artworks generated by 'The Made Generation' Collective. This group, organised by Cass, includes a selection of young contemporary artists whose practice has a focus on a biotechnologically created future. For details on the conceptual agenda behind this group see Appendix C.

This group is a result of the school unit *Abiogenesis*, run by Cass: *The Scientific Creativity Initiative*, and the secondary educational praxis which is a part of this research: *Bio-Tech Evolution: Future Engagement With Nonhuman Life* run at Balcatta Senior High School (BSHS), Perth (previously addressed in Chapter 6.0).

As previously discussed in Chapter 6.0, Brown, and Lozanovski chose a self-directed project with the option of using 'wet biological material' in their art piece, and considered

the responsibilities of doing this. They were also encouraged to examine critically a potential question raised by biotech futures or an environmental issue. The students chose to explore the future of the human body and consequently human identity in light of developing biotechnologies. For Lozanovski, these works built on the original piece shown at BSHS as a part of *Bio-Tech Evolution*. Cass & Cass, Brown and Whittle produced new works specifically for the exhibition.

As a curatorial decision to *Creatures of the Future Garden*, the inclusion of emerging artists with established artists is a deliberate act. This non-hierarchical agenda stems from a personal interest I have in generating opportunities for young people to experience the life sciences in a hands-on way in conjunction with the practice of art as a form of cultural analysis. As with most technologies that develop rapidly, it is the youth of today who will have to deal with the biotech consequences of tomorrow, this issue also raised by the artwork of George Gessert. In addition, this decision reiterates my agenda to breakdown systemic colonisation and lead to an empowerment of the lifeworld through arts communication, reflexive analysis and individual participation.

The exhibition has been used to highlight various “biological art” practices. Each artist selected in some way examines interactions between humans, technology, and biology. Each artist aims to either re-invigorate the social, cultural and environmental value of nonhuman life or draw attention to current biotechnologies.

To begin the curatorial process I initially placed a “call for works” on the *SymbioticA* mail-list. This email list is used to announce activities at *SymbioticA*, current local, national and international exhibitions and conferences and provide links to resources from the life sciences, cultural theories, and bioart practices. The mail-list is not limited to but most commonly reaches scientists, social theorists and cultural practitioners. I placed this call for works also out of curiosity to see what the responses would be and determine to an extent the global reach of this particular context.

The original title posted as a part of this call out to the exhibition was: *Biotech Future Engagement with the Nonhuman*, with this I also included information on the agenda behind the exhibition as follows: This exhibition will be used to examine interactions between humans, technology, and biology, with the aim of re-invigorating the social, cultural and environmental value of nonhuman life. Artworks that contain / deal with “wet biology” are encouraged. Ethics /quarantine clearance must also be confirmed if this is required.

As Gessert (2000) states:

New technologies often make old problems worse. No one should be surprised if biotechnology benefits primarily the rich, or favours forms of expression that do not intrinsically challenge old, [human]-centred views of the world. And yet biotechnology, and the kinds of art that it is strengthening, present unique opportunities to leave anthropocentrism behind.

I inserted this quote from Gessert into the 'call for artworks' to set up an initial ideological position for the theme of the exhibition. Through this quote, I wanted to draw attention to the political role arts praxis can have as a way to communicate ideas surrounding the development of biotechnologies. What was also significant within this quote is the concept that such forms of bioart can be used to break down the idea of human / nonhuman separation and human as dominant to nonhuman. This position became influential towards the final selection of artworks for the exhibition.

However, as a result of this first call out for artworks, a number of proposals had a strong technological focus (computers connected to bacteria, pictorial representations of biological life) the visual outcome centered on the exhibition of electronic devices rather than a consideration for the actual physical use of a living nonhuman element. On reflection the emphasis on a nonhuman element and definition of "wet biology" should have been made more explicit. This technological aesthetic also illustrates the issues raised by Pandilovski (2009) that has often been a consequence of earlier bioarts practices that stem from information arts practices that use the technology as a material for the art.

Responses came from a number of global communities including Europe (France, Belgium), Japan, United States and Australia. This again indicates the global outreach and application this form of arts praxis can have, but also that there are a number of countries that are on the periphery due to access, infrastructure, or Internet policing (Bauman, 1998). During this process it became clear that the description for calls of works needed to be reconsidered. At this stage I had not formulated a specific theme for the exhibition beyond the agenda of providing a survey across different life sciences.

Re-framing the criteria, I researched a number of artists in the bioart field and organised a call out that had a focus on artworks that deal directly with nonhuman life as the material. This illustrates my reflexive methodology which is central to the overall research focus. Implicit within this needed to be the artist's recognition and prior experience of the

ethical, cultural and environmental implications of using / manipulating nonhuman life through bioarts praxis.

Another key influence to the final selection process was the need for the artworks to be contemporaneously produced. I argue that such works would as a result, reflexively examine and respond to current cultural mechanisms and institutions (current debates on biotechnologies, the environment and nonhuman life). These frame the individual artist's lifeworld and as a consequence encourage the viewer to make connections within their own lived experience. This is particularly evident with Gessert's artwork *The Fern Age* (2012) Figures 58-59 and the works of the following three artists.

Three artists responded to this call from Australia: Trish Adams (VIC), Svenja J. Kratz (QU) and Kirsten Hudson (WA). Adams and Kratz already had an affiliation with *SymbioticA* as past artists-in-residents and were therefore familiar with the praxis of bioart as defined in this research. Both Adams and Kratz actively collaborate with scientists to produce artworks or conduct the related life science themselves (cell-tissue culture).

Adams proposed a film installation work *HOST* (2011). This piece was produced during her artist residency in collaboration with scientists in the bee house at Queensland Brain Institute, The University of Queensland Australia. The work explores a number of issues the most pertinent being how the work draws attention to the current ecological concerns of dying bee populations across the globe. I selected three artworks by Kratz that deal with human/nonhuman relationships. The most relevant artwork that provides a communicative alternative and illustrates the relationship between the art object and the lifeworld is the piece *The Remains of Algernon and the Poetry Orchids* (2011), Figure 65. In using a mummified fetal-calf and a fixed flask of HeLa cells: The artwork negates the relationship between the meat industry and human cell-tissue culture for medical research both an implicit part of our lifeworld.

By contrast to the artists above, Hudson however, has a praxis history of body performance, installation and film. Hudson often uses sugar in all of its forms (fairy floss, cubes, plastic icing) as a metaphor for beauty, femininity, and commodification of the body, see Appendix C. She approached me with a keen interest to develop a work that deals with the ethical, cultural and environmental complexities of her ongoing day-to-day experience with ants that continually consume her artworks and 'invade'/co-habit with her in domestic spaces.

The others invited for exhibition were directly contacted via email, with specific artists or artwork/s in mind. These included Tarsh Bates (WA), Jesse Brown (WA), Gary and Suzanne Cass (SC-WA), Alexandra Daisy Ginsberg (UK), George Gessert (US), Nicholas Lozanovski (WA), Angela Singer (NZ) and Sasha Whittle (WA). As a part of the curation this selection process started with questions such as: How can I bring as many diverse, real-time experiences of nonhuman life into the space as possible? And how can I create a space that has multiple uses as described by Gessert (2008) – educational, hands-on workshops, housing nonhuman life and wet biological processes?

During correspondence and discussion on the overall theme of the exhibition with the artists, a number of other questions were raised in response to my exposure to these individual artist's agendas, particular artworks and their positions on what constitutes bioarts praxis. These points of reference included: Links between the art object and the viewer's lifeworld, local environment and site specific nonhuman life (examined in my own artwork *Diaspora Monopoly* (2012) Figures 54-56. And questions such as: How do the artists responsibly consider the implications of their manipulation of nonhuman life for artistic purposes? (Addressed in selected artworks by Tarsh Bates, Kirsten Hudson and Svenja J. Kratz section 6.5). What types of cross-overs occur between art and science and is there a collaborative potential inherent within this? (Addressed through *WA Birds of Prey Centre Workshop* shown in exhibition space. See section 7.6).

7.5 Artists and Artworks

This section reflexively analyses the specific artworks within the exhibition and how each adds to an understanding of nonhuman life in a contemporary context. This process is used to establish the communicative role of the artworks in relation to their contribution to contexts of bioart and in generating various levels of engagement with nonhuman life. Where possible the following sub-sections are organised according to the themes each artist examines, however the communicative capacity of several artworks traverse across a number of issues identified in the proceeding sections. Environmental issues: Local and global environments and constructed environments, human – nonhuman interactions, animal welfare, animal activism, and real-time engagement. Biotechnologies, genetics, human-nonhuman identity and body politics; these sections expand on why these particular topics are relevant to our contemporary engagement

with the nonhuman. Followed by how the artwork aids in this understanding, building associations between the artwork and the viewer's lifeworld.

Artworks dealing with environmental issues: Local, global environments and urban environments:

Donna Franklin, Tarsh Bates and George Gessert

Diaspora Monopoly (Figures 54-56) presents a re-location of my suburban garden, containing exotic and native flora and fauna. The title alludes to the disruption of biodiversity through increasing urbanisation driven by the demands for properties that have a capitalistic value to the detriment of quality of life and sustainable planning.

The garden installation contains plant species that are currently quite popular, therefore common, and easily recognisable with other species that are rare, heritage-listed and have been passed down through the generations within my family. Pink coloured plants in the garden reference the standardisation of species based on consumer demand in the horticultural industry. Plants are given certain aesthetic enhancements or features in response to popularity as presented by Gessert through his hybridised iris series (Figure 12). This use of colour also created a visual connection / link with other works in the space in particular Alexandra Daisy Ginsberg's animated film *The Synthetic Kingdom* (2009) and Kirsten Hudson's native ant sculpture *under/mine* (2012). The domestic goldfish were included in the work to reference subtly the controversial bioart piece *Helena* (2000), where strategic and politically motivated Danish artist Marco Evaristi puts the onus on the audience to determine the life or death of fish housed in blenders, where viewers clearly had the option of pressing the button or not (Figure 53).



Figure 53: Marco Evaristti, (2000), *Helena*, installation, goldfish and blenders. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Shown at Trapholt Art Museum in Kolding (2000) and Kunstraum Dornbirn, Austria (2006) his approach to arts practice as a provocateur and sensationalist is akin to Eduardo Kac and Damien Hirst.⁵⁴ This form of artwork reflexively engages with the systems that frame nonhuman life in society. This piece resulted in much publicity and a three-year trial where the curator (Meyer) was accused of animal cruelty, and later acquitted due to the ‘fast’ death of goldfish killed by viewers during the exhibition. This artwork by Evaristti draws attention to the complicit nature of bioart practices and responsibilities of the artist, ethical and moral, and most significantly systems and institutions that govern the lifeworld of the viewer/participant.

Dieter Buchhart explains by exposing the “media filter...the viewer changes...into active or passive accomplices...The role of the media is ambivalent since through encouraging the pressing of the button they are also complicit. They use the art project in order to provide...another scandal (2013).⁵⁵⁻⁵⁶ This work also crosses the spaces domestic and commoditised environments. The goldfish, a purchased item for individual collection and display is most readily associated with the pet industry. By placing the animal within a blender in a public space the work also raises uneasy issues of co-existence, animal consumption and breeding for design.

Diaspora Monopoly (2012) also conceptually reflects upon the current complexities of co-existence. With a focus on shifting ecologies due to urbanisation and mega cities.⁵⁷ Through this work, I wanted the viewer to make connections with their own lived

experience, also encourage a level of participatory action by presenting an example of a garden containing endemic plant species that provides habitat for local fauna, which could be reproduced within the viewer's own context.

The installation was located in two different areas of the space, at the front entrance and along the hidden 'window space', which faces a university garden and walkway. Placing the garden at the entrance aimed to lead the viewer into the space with something potentially familiar.

Within this window space, I deliberately selected plants that were the same species as the ones visible through the windows. This enabled the viewer to experience the work in relation to the garden and environment outside playing with concepts of interior / exterior. This binary refers to the Crystal Palace and its housing of mature oak trees through the *Great Exhibition* in 1851. In this confined space, the viewer also gets a physical sense of their own bodies in between the walls, and placement of the plants on either side and can see outside the window while in the corridor.

I used a layered recording of native birds and insects within this space; some species endemic to Western Australia and others introduced or from other parts of Australia. The intention of the sound was to communicate dislocation, re-location and migration of animals due to the impact of human activity or in response to instinctual behaviour. The link to migrating birds using sound in this work also talks about the close relationships between ecosystems, climate change and animal dependency, as birds' migrate/re-locate in response to breeding cycles and food availability. It has also been discovered that noise pollution in urban areas impacts upon the songs local birds produce who adapt their pitch, frequency and loudness of calls to compensate in comparison to birds living in less built up areas.⁵⁸



Figure 54: Donna Franklin, (2012), *Diaspora Monopoly* Recycled materials, native and exotic plants, fish, sound, dimensions variable. Photographer: Kelsey Diamond.



Figure 55: Donna Franklin, (2012), *Diaspora Monopoly* (detail), Recycled materials, native and exotic plants, fish, sound, dimensions variable. Photographer: Alexandra Engels



Figure 56: Donna Franklin, (2012), *Diaspora Monopoly* (detail), Recycled materials, native and exotic plants, fish, sound, dimensions variable. Photographer: Donna Franklin

The sound in the space was deliberately loud and heard from outside the building through the glass windows and as a result, the sound of real birds blended in with the recorded birds. The intention was that the viewer would make connections between the recorded sounds and the resident birds on campus. However, it has been unclear whether this was the case for all viewers. One individual discussed his experience with the sound in detail and made connections between the space and the outside environment. Being such a loud recording, it also had an impact on the other works in the space. This effect is discussed in further detail in relation to other key works in the space that have also used sound; Narration by Ginsberg in the film *The Synthetic Kingdom*, (2009) soundscapes by soundtrack in the film *HOST*, (2011) Trish Adams.

The capuchin monkey from *Humanatis* series was shown a second time in *Creatures of the Future Garden* by way of introduction to the space to frame an engagement with nonhuman life from a historical point of view. The books *Origin of the Species*, *The Expression of Emotions in Man and Animals* were used to set up the context of human beings as a part of the animal kingdom. This was also explored in Alexandra Daisy Ginsberg's piece *The Synthetic Kingdom* (2009) through the hypothetical use of human tissue alongside animal tissue in the generation of new biological products.



Figure 57: Donna Franklin & Peter Minson, (2011), *Humanatis Series Red Chested Capuchin Monkey* (from: *Creatures of Future Garden* exhibition). Glass, Metal, Microbiological Skin (by-product from *Acetobacter* bacteria), wood, 36cm x 30 cm x 23cm. Photographer: Kelsey Diamond.

I have exhibited with George Gessert a couple of times (2004 *BEAP Bio-Difference*, Lawrence Wilson Art Gallery, Western Australia and 2006 *Second Skin*, ENTRY 06, Essen, Germany). During these exhibitions, Gessert and I have often discussed the use of biological sciences in art and the relationship in particular between culture and nature. As presented in the Literature Review, 3.0 Gessert has always had an interest in critiquing the control and anthropomorphism of nonhuman life producing works that deal with these issues through an established practice of plant hybridisation.

I sent a request for a series of these works to be sent from the United States, with the development of the living element to be grown by myself. The intention behind this request was to initiate links for the viewer with a history of nonhuman manipulation through plant cultivation or a 'cultured nature', while also drawing attention to current commodification, and standardisation of plants for industry. Gessert replied however, with a keen interest to produce a completely new work in response to his on-going

experiences with extreme weather conditions and current debates on global-warming. Gessert proposed the artwork *The Fern Age* (2012) (Figures 58-59):

Paper, ink, plants, coal: I trust materials. Over time, they can be relied on to speak for themselves. Coal is carbonized tree ferns. Humans began to burn coal on a large scale only at the dawn of the Industrial Revolution. Today much of the world's electricity is generated by burning coal. Cheap energy is supposed to bring happiness to the greatest number. Maybe it does, but some scientists say that if we continue to rely on coal to generate electricity, and go on to exploit the rich deposits of fossil fuels beneath the North Sea, temperatures on earth will eventually climb above the boiling point of water. We too will become coal. (Gessert, 2012)

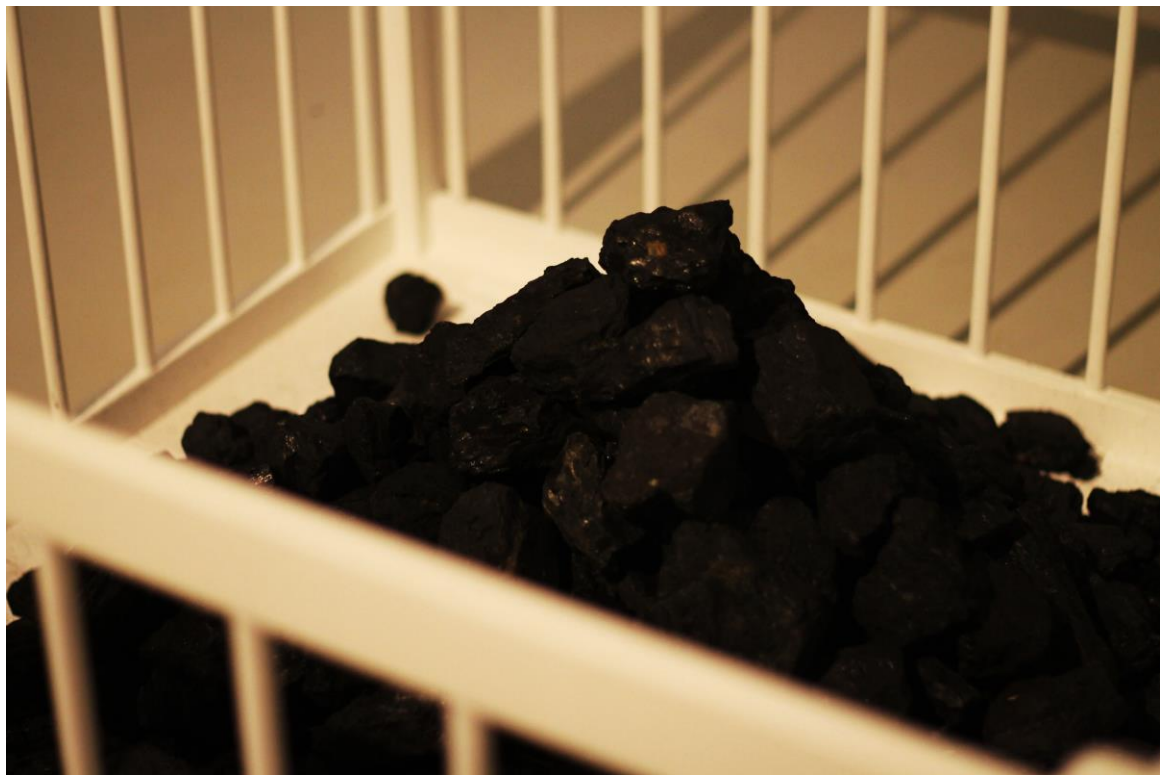


Figure 58: George Gessert, (2012), *The Fern Age* (detail) coal, recycled playpen, 137cm x 137cm 80cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)



Figure 59: George Gessert, (2012), *The Fern Age*, coal, recycled playpen, 137cm x 137cm x 80cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The inclusion of this work breaks outside of my 'traditional' and specialist framework of bioart in that the living elements or nonhuman 'wet biology' aspects are well and truly dead. The work however, added another angle to the exhibition. It situated the activities of the past, or it is argued that they continue (Industrial Revolution), in relation to the activities of the present (biotechnology) evidenced by other artworks in the exhibition. It also drew attention to current environmental debates surrounding global-warming, and energy consumption within the context of the viewer's lived experience. This relationship between art object – biological material and lifeworld became a key driving force in a number of interpretations of artworks across the exhibition as discussed in the viewer feedback in section 7.6. The location of Gessert's piece was chosen to generate associations with Bate's work, the play-pen referencing new life (young children) or in Gessert's statement, the threat we pose to the next generation. Furthermore, the glass vessel containing fruit-fly is a metaphor for a womb, and is discussed shortly.

To broaden the communicative possibilities available to me I decided that the selection process should not only be based on the artist's use of materials, but also on what the artist intends to communicate about how we engage with nonhuman life, historically, contemporaneously and into the potential future. This influenced my decision to invite

Angela Singer to exhibit her series of recycled/re-appropriated taxidermy animals that deal with historical and contemporary animal hunting practices, detailed in the following section. Through this process I also became aware of the complicit nature of bioart as defined through the use of nonhuman life / wet biological practices; that through this methodology the artist who speaks against the manipulation of nonhuman life for human-centric ends, is also a part of this process through the production of an artwork.

To engage reflexively with this complicity I invited Tarsh Bates to exhibit the work *in vitro node* (*Drosophila melanogaster*) common name fruit-fly (Figures 60-61). Placed adjacent to Angela Singer's *Catch/Caught* (2007) taxidermy rabbit (Figure 63), the glass vessel on a museum display/domestic table, for some was considered to be aesthetically pleasing until they realised that the work contained living organisms; fruit-flies. The narrative between these works aimed to draw an association between the visceral 'internal body' of the rabbit and the 'vessel' in which the flies were contained. As the flies moved in response to the viewer's presence there was an immediate association developed between the viewer's own body and the artwork.

The use of a scientific vessel is integral to Bates' concerns in that it represents a womb. Within the work, Bates cultured and cared for species, including some that has historically been used within reproductive sciences. She asks the viewer to consider "What does it mean to care for fruit flies, slime mould, daphnia, hydra or soil nematodes in a gallery?" (Bates, 2011). As such, this re-location of everyday scientific equipment usually unseen by the general-public into the context of a gallery space changes the meaning of the object and opens up the discourse surrounding nonhuman life to encompass broader implications beyond the scientific community; Particularly in relation to human-nonhuman interaction.



Figure 60: Tarsh Bates, (2011), *in vitro* node (*Drosophila melanogaster*), card invitation, 15cm x 18cm, Photographer: Bo Wong. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)



Figure 61: Tarsh Bates, (2011), *in vitro* node (*Drosophila melanogaster*) fruit fly, glass vessel, table, 103cm x 34cm x 34cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)

As Bates describes, “part of a broader experiment in the aesthetics of care, which investigates the potential that sustained proximity and care can offer in exploring the relationship between the carer and cared-for...through prolonged engagement with living organisms” (2012). Through this philosophy and methodology, Bates unpacks the complicity and complexity of producing artwork that uses nonhuman life while also questioning this application. She asks, “Is it appropriate – or ethical – to contain organisms in glass terrariums and keep them for our own purposes, aesthetic, cultural, educational, and scientific?” (Bates, 2012, p. 6). Bates’ artwork and *Creatures of the Future Garden* do not claim to provide a definitive answer to this question, it aims to generate an awareness of the many ways in which we interact and understand nonhuman life within contemporary contexts.

Another agenda behind her work shown in *Creatures of the Future Garden* alludes to the relationship between the nonhuman as a subject in the laboratory, as Bates states, “Fruit flies epitomise technological evolution of the nonhuman as an animal that has been used as a model scientific organism for over 100 years. It has co-evolved with humans in laboratory environments. It could be argued that the laboratory is now its natural environment” (T. Bates, personal communication, April 20, 2011). This statement became a significant marker through a number of works within the exhibition and introduced the viewer to the ethical and moral positions that creative practitioners take in the field of bioart. In the scientific field Bates identifies that “*D. melanogaster* [fruit-fly] has provided vital contributions to our understanding of biology, especially in the fields of genetics and developmental biology since Thomas Hunt Morgan discovered sex-linked inheritance studying *Drosophila* between 1910 and 1917” (2012, p. 20). What is also indicated within the work is the evidence of the complete two-week life cycle of the fly (one of the reasons for its extensive use in science), from egg-maggot-adult-death. This real-time experience provided a metaphorical link to a number of other works that deal with immortality, life and death.

The artwork *in vitro* node (*Drosophila melanogaster*) also raises questions of the human influence on the natural world and problematic future environments for biotechnological outcomes. Alexandra Daisy Ginsberg and Svenja J. Kratz, another two artists selected for the exhibition who examined later in this section, develop this idea further.

Artworks that examine human – nonhuman interactions including animal welfare and animal activism, real-time engagement, cultural construction and binaries:

Angela Singer, Svenja J. Kratz, Trish Adams and Kirsten Hudson

I was first introduced to the work of British born-New Zealand based artist Angela Singer at the conference *Animals, People - A Shared Environment* (2011) hosted by The Australian Animal Studies Group, at Griffith University, Queensland (discussed in section 5.2). Her work was shown during the paper presentation *Reconstructing the Animal – contemporary artists interrogating human-animal relationships* by Yvette Watt as a part of an exhibition *Reconstructing the Animal* shown at the Plimsoll Gallery, Tasmanian School of Art, also curated by Yvette Watt. Watt's intention behind this exhibition aimed to counter-act what she considered a recurring theme behind the production of artworks that deal only with the use of "animals as a means to think through issues surrounding ideas of nature, or as metaphors, signifiers, or representations of the human or Other." Rather "than...making work which honoured the animals themselves" (Watts, 2011, p. 1).

Watt's curatorial agenda supports my own argument in that "the key consideration in the selection of artists was that there should be an avoidance of the use of animals as symbol or metaphors, and an emphasis on the animals as individuals and/or a questioning of the nature of human/animal relations" (2011, p. 1). This is particularly evident in the works by Singer, Kratz, Adams and Hudson. The biological artworks selected for *Creatures of a Future Garden*, takes this idea a step further through the incorporation of artworks that actually contain nonhuman life, compelling the viewer to experience an animal/human relationship in the space as they engage with the work itself in real-time. This is enhanced by the introduction of a live *WA Birds of Prey Workshop*, where the focus of discussion is based around each individual animal – its biology, personal history and future.

Three taxidermy artworks of Singer's were selected for exhibition including; *Hedge Row, Red Fox (*Vulpes vulpes*) (2010)*, *Catch / Caught (2007)* and *Tear (2005-2010)* (Figures 62-64).



Figure 62: Angela Singer, (2010) *Hedge Row, Red Fox (Vulpes vulpes)*, Vintage taxidermy red fox and mixed media ceramic, 40cm x 30cm x 15cm. Photographer: Angela Singer. (Copyright permission courtesy of Angela Singer.)



Figure 63: Angela Singer, (2007), *Catch/Caught*, Taxidermy rabbit, mixed media (buttons), 36cm x 16cm x 8cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 64: Angela Singer, (2005-2010), *Tear*, wax, glass, resin, dimensions variable.
Photographer: Angela Singer. (Copyright permission courtesy of Angela Singer.)

Singer reminds us that too often the welfare of an animal is dependent on its cultural and symbolic value in this case through contemporary hunting culture in New Zealand and abroad, rather than as a form of sentient life. Singer, who has a history of animal activism, disrupts this process by re-appropriating discarded taxidermy animals and as she states using a process of “Working with the history of each particular animal...I aim to recreate something of its death by hunt” (Singer, 2012, p. 41). As stated by Aloi, Singer “does not work with living animals, nor have living creatures killed or otherwise harmed for her art. All the animal materials used in her art are old, donated and/or discarded as refuse” (cited in Singer, 2012, p. 41). Singer asserts: “old home taxidermy is donated...other times hunters [donate]...trophies so I get to hear how they were hunted and how the animal was killed...find...wound scars that the taxidermist hid...holes of bullets and parts missing of the skull” (cited in Watts, 2011, p. 4).

These three works ask the viewer to consider what has happened to the animal and draws on a historical cultural ideology that frames our engagement with nonhuman life as a trophy, collector’s item and resource to be commodified – fur trade (Singer, 2011). The subject matter of Singer’s work and on-going career as an artist demonstrates the close relationship between arts praxis and the individual lifeworld. Growing up in the

United Kingdom, the practice of hunting is historically a part of British culture and identity. This is also mirrored in her current lived experience residing in New Zealand, and as such ultimately influenced her animal activism. I argue that this process enables her to generate an art praxis to challenge and empower her lifeworld through the communicative act of art making and therefore becomes not only a reflexive act for the artist but also the viewer. This connection was particularly noted, in viewer's responses drawing associations between the fox and rabbit as introduced species within Australia – a legacy of colonisation.

The placement of Singer's artworks was decisively arranged in relation to other works in the space. In particular the glass and wax entrails/animal faces of *Tear* (2005-2010) were placed on a wall that led into a darker room which housed *The Made Generation Collective* (Brown, 2012, Cass and Cass, 2012, Lozanovski, 2011-12, and Whittle, 2012) and films by Trish Adams *HOST* (2011) and Alexandra Daisy Ginsberg *The Synthetic Kingdom* (2009). The use of animals as a resource and associations with the raw abstract and visceral quality of Singer's piece provided an introduction to the tissue, flesh, and wet biological materials examined in the works and collective group above.

As previously mentioned one of the three artworks presented by Svenja J. Kratz, *The Remains of Algernon and the Poetry Orchids* (2011) (Figures 65-66) also deals with the complexities of cell-tissue culturing and animals as a resource. The sculpture "consists of the mummified body of the fetal calf 'Algernon' with a live orchid growing out from within the remains. Within the table drawer there is a flask of fixed HeLa cells (the first human cell line established in 1951 from patient Henrietta Lacks).⁵⁹



Figure 65: Svenja J. Kratz, (2011), *The Remains of Algernon and the Poetry Orchids*, mummified fetal calf containing a living orchid with painted text, 92.5cm x 60cm x 40cm. Photographer: Dan Cole. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)



Figure 66: Svenja J. Kratz, (2011), *The Remains of Algernon and the Poetry Orchids*, (detail), mummified fetal calf containing a living orchid with painted text, 92.5cm x 60cm x 40cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)

These cells were originally grown in a liquid nutrient medium containing fetal calf serum [FCS]" (Kratz, 2012, p. 38). As Kratz illuminates within the meat industry "The practice of

slaughtering pregnant cows and subsequent availability of fetal calf blood has enabled great advancements in cell and tissue culture and contributed to the development of new medical technologies and treatments for humans and other organisms” (2012). The unborn calves’ “blood is harvested to produce serum, their bodies are discarded, deemed unfit for consumption” (ibid). Kratz stresses that intention behind the artwork “does not aim to criticise...rather comments that there are victims at every level of consumption...the boundaries between good and bad, benefit and harm are always blurred...the death of one organism can give rise to new life and possibilities” (2012, p. 38).

This work was selected for exhibition to provide connections between the art object / bodily remains of ‘Algernon’ and the systems within the viewer’s lived experience that might not be immediately apparent or known about. Kratz is also in a similar position to Bates and Adams as she practices life science. In this case, cell-tissue culture on a daily basis through her work and research over the last six years at the Institute of Health and Biomedical Innovation, Queensland University of Technology. The knowledge required in this context reinforces the importance of understanding the science behind the production of ‘wet biology’ in bioarts. Through Kratz’ work her arts praxis offers a way to unpack, question and debate the complexities of animal consumption, production and medical research. In this way her research offers another approach to understanding the various nonhuman interactions that take place in the lifeworld, while also providing illumination on the processes of systemic colonisation. The inclusion of this piece reinforces the potency of a multi-method approach to the curatorial praxis to encompass many aspects of nonhuman exchange in a contemporary biotechnological context.

The placement in relation to surrounding works in the space was critical to the reading of *The Remains of Algernon and the Poetry Orchids* (2011). This decision was not finalised until I had spent time looking at the works in the space. As the viewer walks around the ‘object’ the eye takes in the visual fleshy associations of Singer’s *Tear* (2005-2010), whilst simultaneously hearing the narrative provided by Ginsberg on the synthetic kingdom, whilst smelling the pungent, sweet odour wafting from the liquid in Brown’s cyborg. These levels of experience for the viewer generate associations between the artworks materiality – the fetal calf’s life and death. Ginsberg’s animation details hypothetical futures of drawing from biology to form the basis of future product design. She also discusses how such futures will change how we classify life. This concept and method of classification is echoed in another work by Kratz, which is also framed by the visuals provided in Ginsberg’s animation.

Another piece by Kratz, *Life and Death Vessels: a collection of curiosities* (2011) (Figures 67-69) is an installation of living and preserved plants and animals that “explores the complex relationships between humans and other organisms and engages with the human endeavour to understand and control the world around us...vessels are engraved with poems and a variety of philosophical and scientific texts” (Kratz, 2012, p. 39).



Figure 67: Svenja J. Kratz, (2011), *Life and Death Vessels: A Collection of Curiosities*, collection of curiosities and glass vessels containing animal and plant specimens and engraved with poetry, 90cm x 122cm x 60cm. Photographer: Dan Cole. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 68: Svenja J. Kratz, (2011), *Life and Death Vessels: A Collection of Curiosities* (detail), collection of curiosities and glass vessels containing animal and plant specimens and engraved with poetry, 90cm x 122cm x 60cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 69: Svenja J. Kratz, (2011), *Life and Death Vessels: A Collection of Curiosities* (detail), collection of curiosities and glass vessels containing animal and plant specimens and engraved with poetry, 90cm x 122cm x 60cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The work poetically plays with the aesthetics of museum exhibits and the expectations of the viewer when she constructs chimera-like specimens from multiple organisms (Figure 69). Kratz constructs her own specimens/chimeras using bones from multiple sources (fish, amphibians, birds). Kratz uses this method to comment on anthropocentrism or “the human need to categorise and create the illusion of order and certainty and also reference the Western tendency to view ourselves as central beings” (Kratz, 2012, p. 37). This approach not considered ‘authentic science’ on one level talks of the tension that can take place when science and art combine. This often occurs in the field of bioarts where artists play with the ideas of hoaxes to illuminate on the mass media systems and processes of colonisation. These works are sometimes initially misconstrued by the public as ‘real science’ such as Eduardo Kac’s *Alba the fluorescent bunny* (2000) and Laura Cinti’s *The Cactus Project* (2002).⁶⁰ Kratz does not claim to be a scientist, however practices cell-tissue culture in a scientific manner. Kratz acknowledged the ethical methodologies inherent in science combining it with the philosophical thinking of a cultural communicator. This was clearly made evident during the exhibition’s complimentary symposium in which she presented her research, experience / knowledge of cell-tissue culture and philosophies as an artist – discussed further in section 7.6.

Kratz’s final piece selected for exhibition is entitled *A Turtle Fondly in Imaginary Worlds and the Desire for Certainty and Control* (2011) (Figure 70). Like the previous artwork, this piece consisting of an antique taxidermy turtle with living bonsai tree on its back. This also refers to the concepts of control and human dominance and the philosophy of the World Turtle. The World Turtle is a concept where the earth is a disc that sits atop four elephants on a turtle flying through the cosmos associated with the cult novels of Sir Terry Pratchett.

Kratz states, “The bonsai tree represents the earth, but...also... [symbolises]...human desire to control and shape the world to suit particular desires” (2012, p. 38). This artwork was included in the exhibition to allude to the James Lovelock’s Gaia hypothesis (1979), as a reminder that we are in fact living in an interconnected system that has finite resources, environments and ecosystems.

This work becomes a political act in relation to the cultural context in which this exhibition takes place: Perth, Western Australia – a city dependent on resources and mining industries for financial stability. Over-looking the space between Kratz’ *Life and Death*

Vessels (2011) and Gessert's *The Fern Age* (2012) this piece created a fitting link to the concepts behind and materiality of Gessert's work.

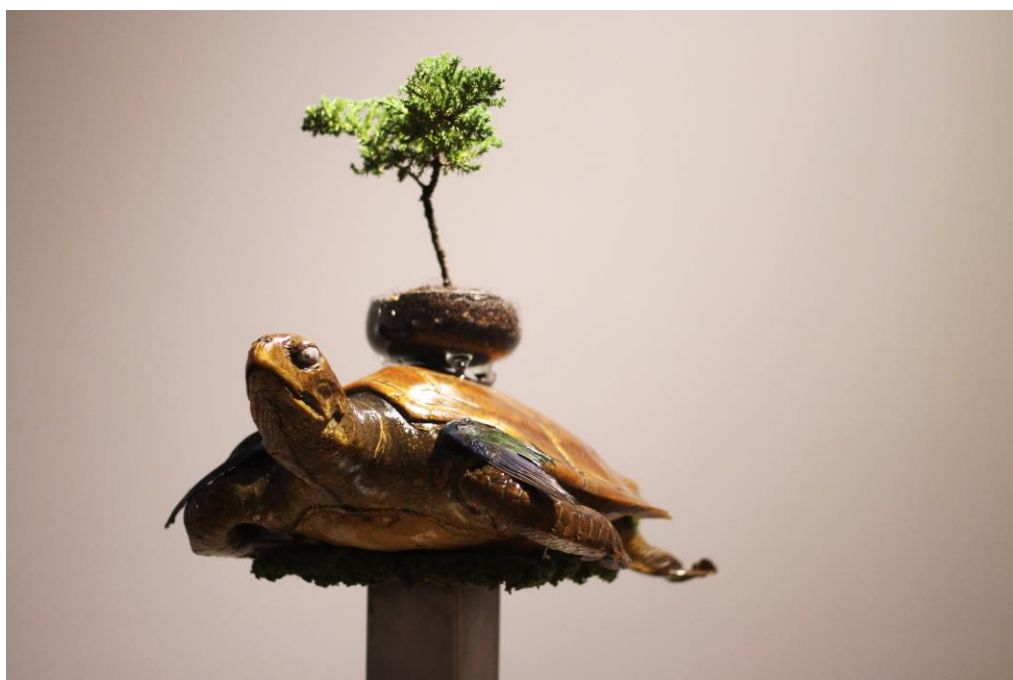


Figure 70: Svenja J. Kratz, (2011), *A Turtle Fondly in Imaginary Worlds and the Desire for Certainty and Control*, antique taxidermy turtle with living bonsai tree and bird wings, 148cm x 63cm x 40cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Trish Adams' video installation *HOST* (2011) (Figures 71-72) is a response to her art/science collaborative residency at the 'bee house' located within the Brain Institute, The University of Queensland. In this work and her other research into stem cell tissue culture (Appendix B), Adams explores the "shivering boundaries between contemporary biomedical cellular research and current enquiries into nonhuman 'others' such as honeybees" (Adams, 2012, p. 23).

It is important to note that this work does not adhere to the definition of 'bioart' as framed by this research. However, it provides an intimate record of the interactive experience sought out by the artist. As Adams describes, "It revealed not only the bee's flying and navigational skills but also rare moments of nuanced inter-species intimacy between human being and bee...[and to] feel the delicate vibrations of their wings as they hovered over my hands" (ibid).

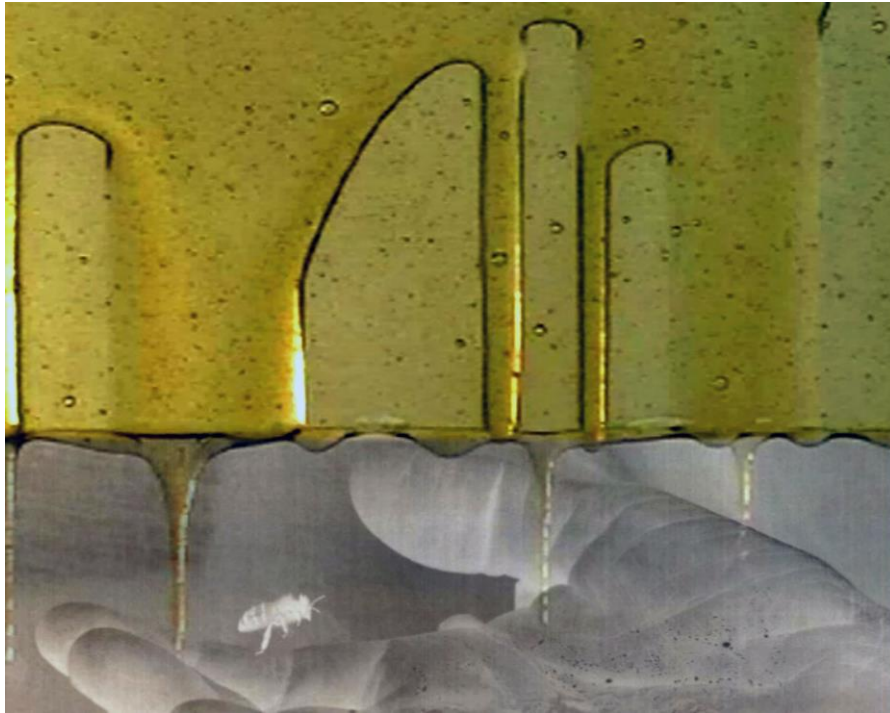


Figure 71: Trish Adams, (2011), *HOST*, (still from film), cinematography: Carla Evangelista & Peter Kraft, Indoor Honeybee Facility, Visual & Sensory Neuroscience Group, Queensland Brain Institute, The University of Queensland. (Copyright permission courtesy of Trish Adams.)



Figure 72: Trish Adams, (2011), *HOST*, (still from film), cinematography: Carla Evangelista & Peter Kraft, Indoor Honeybee Facility, Visual & Sensory Neuroscience Group, Queensland Brain Institute, The University of Queensland. (Copyright permission courtesy of Trish Adams.)

The piece provided a poetic intimate representation of a real-time experience with a form of nonhuman life that is usually associated with industries such as agriculture, food production, and beauty products and through an insect feared due to its ability to sting and swarm. In addition to the film installation, Adams also provided the honey scent of a specially designed perfume to fill the space. This adds another sensory level of experience for the viewer and draws associations to our usual day-to-day engagement with bees – honey.

The soundscape by roundhouse created a multi-layered experience for the viewer. Sources of sound were subtly blended together to encourage the viewer to make connections with the imagery and various other technological interventions in the world relating to nonhuman – human interactions, communication, and living in the 21st Century. These included; recordings of the insects buzzing during flight and take-off, the sound of a modem connecting, mobile phones tones, communications between NASA and space stations or Tibetan monks in prayer.

In addition to the sounds of birdcalls from *Diaspora Monopoly* (2012), this sound scape inevitably had an effect on the reading of other works on the space. Both these sounds provided a link to the outside environment and reinforced the viewer's experience of nonhuman life in real-time in the space. The mechanical/organic sounds in *HOST* (2011) also echoed the tension created through the containment of nonhuman life within 'man-made' vessels as seen in artworks by Bates, Hudson, and Kratz. It also encouraged the viewer to consider their ideological position in relation to the objects and life put on display, this position further reinforced through Ginsberg's narrative on synthetic biology, which followed the film *HOST* (2011). The suggestions of electronic equipment, modems, phones, pilots and astronauts communicating to NASA merged through this soundscape and alluded to our reliance on such technologies since the Industrial Revolution. This represented how we frame/filter our experience and understanding of the world via technology. The work as a whole indicates how such technologies have affected and changed the lifeworld to become a sequestered experience, which creates a disassociation from or filters out the natural environment.

Giddens (1991) defines this sequestration of experience as the processes by which "day-to-day social life tends to become separated from its 'original' nature and from a variety of experiences bearing on existential questions and dilemmas" (p. 8). Furthermore, Giddens (1990) suggests, "direct contact with events and situations that link the individual lifespan to broad issues of morality and finitude are rare and fleeting" (ibid).

This condition directly links to the way in which we conduct ourselves in a wealthy minority world context. In this context as consumers, we are encouraged to only focus on the product (animal, plant, or technological), rather than an ethical consideration for its production and disposal or as a form of sentient life.

HOST (2011) asks the viewer to reconsider the nonhuman life we co-exist with and offers a renewed point of contact. This piece makes connections to the current on-going demand for bio-secure disease free bees from Western Australia, exported to the U.S. and Canada. These bees are bred by apiarists to increase populations and provide pollination services to agriculture in places where colonies are dying from exotic diseases such as “European foulbrood, small hive beetle and varrea mite” infestations (Thompson, 2013, p. 1). The work becomes a poignant reminder of the fragile relationship and dependence we have on bees in the industry and as a crucial part of the health of ecosystems around the globe.

In discussion with a number of viewers, the connection between current ecological issues and bee health was evident (section 7.6). This indicates that the viewer made links between the art object’s content and associated issues within their current lifeworld (Hauser, 2008). I argue that this demonstrates one of the communicative actions crucial to my contemporary bioarts praxis.

Western Australian artist Kirsten Hudson proposed the artwork *under/mine* (2012). The intention with this piece aimed to disrupt categorisation of the ‘other’ alluding to our own history of ‘othering’ within Australia. A term coined by Edward Said in his work *Orientalism* (1979), he states that it is a: “psychological dynamic of power that allows those who occupy a position of Western dominance to imagine a racial or ethnic other, against whom he or she may more clearly elaborate his or her own self” (Sturken and Cartwright, 2009, n.p.). The concept refers to the exoticism of cultures and consequent power struggles and inequalities that then ensue as a result. There is a particular focus on Western paradigms of self-identity as dominant to all others. This is particularly relevant in the historical context of colonisation. Australian artists that explore these issues include: Richard Bell, Tracey Moffatt and Fiona Foley.⁶¹

In the work Hudson creates an ant farm environment from ant chow (gelatin/sugar mix), reproducing floral patterns found in Victorian wall-paper designs connected to colonisation. Particularly evident in this work is the associated symbolic power struggle

between indigenous ants and Australian historical events, (Figures 73-74). Hudson (2012) states:

Recognising that resistance is contextually bound to the structures that are being resisted, *under/mine* materialises the western human desire to contain and control that which is deemed “other”... Producing new visual patterns as a result of their embodied negotiation of the alien system in which they find themselves, *under/mine* is a collaborative work (between artist and ants) that explores how rather than falling into the trap of “either/or” dichotomies, encounters with “otherness” can instead produce new hybrid forms that both recognise alterity and refuse assimilation. (p. 35)

Through collaboration with native sugar ants the piece examines the constructed binaries of “Human/Nonhuman, Coloniser/Colonised, and Male/Female” (Hudson, 2012, p. 35). Haraway cited in Pratt (2008) adds another dimension to the experience of the artwork as a viewer. The tension created between the disruptions of the colonial wallpaper patterning by indigenous ants, suggests a “contact language...the interactive, improvisational dimensions of colonial encounters...emphasizes how subjects are constituted in and by their relations to each other...It treats the relations...in terms of co-presence, interaction, interlocking understandings and practices often within radically asymmetrical relations to power” (p. 449).

Hudson aims to embody this process of becoming (Deleuze, cited in Stagoll, 2005) as an alternative approach through her collaboration with the nonhuman life. This process also makes evident the complicated power relationships between the artist and the biological material put on display (Bates, 2012 and Hauser, 2008); where the artist is manipulating life for artistic ends and communicative possibilities. Hudson’s work also questions of what other dominant ideologies shape the ways in which culture and the environment is understood.



Figure 73: Kristen Hudson, (2012), *under/mine*, Native Australian sugar ants, acrylic, ant chow (gelatin/sugar mix), 1.5m x 1m x 15cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section*: ss40, 103C. *Exception*: Research or study.)



Figure 74: Kristen Hudson, (2012), *under/mine*, (detail) Native Australian sugar ants, acrylic, ant chow (gelatin/sugar mix), 1.5m x 1m x 15cm. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

This piece also raises a number of issues in relation to bioarts practices as defined by this research. Like Kratz and Bates, Hudson identified the problematic and complicit actions raised by the practice of bioarts that contain living nonhuman life as the actual medium itself. Through the act of removing ants from their natural environment to be relocated within an artificial temporary context for artistic purposes a number of ethical and environmental concerns develop.

Hudson engaged with this process during her presentation at the complimentary symposium. As Hudson (2012) identified “Despite being removed from their natural habitat and manipulated into performing for *human entertainment*, the native Australian Sugar Ants within *under/mine* silently resist all efforts to pre-determine their movements” (p. 35). The process of collecting the ants and transferring them to the constructed environment for a period of nine days raised ethical concerns for couple of viewers who were angered and confronted by the physicality of the work, relocation and consequent death of some ants. Hudson was completely aware of the complicit impact of her actions and the consequences of which were debated during the symposium. This artwork like the pieces by Bates and Kratz again raises the issue of “whether it is appropriate for

artists” (Bartlem, 2005, p.43) to use nonhuman life in this context. As Sperou (2008) argues:

Critics of biotech art claim that the use of living tissue [nonhuman life] is only justifiable if it can be of benefit in some tangible way. Some artists argue that they are not scientists and that therefore the intention of their work is not necessarily to produce either a utilitarian good or to gain acceptance for biotechnological innovations. (p. 95)

The quote by Sperou (2008) identifies one of the criticisms of the art form in the field. The potency of the praxis for me lies in its ability to draw attention to the way we frame our interactions with nonhuman life. The strength of the art form lies in its experiential and symbolic qualities. Through the viewer’s engagement with ‘wet biology’, an individual can pause and reflect on their biology, mortality and place in the natural or biotechnological world.

I argue that in this case Hudson’s work becomes a response to everyday actions and consequences that occur when humans interact with nonhuman life and when shown in this context this situation is intensified. The fact that such works re-contextualise elements of lived experience into symbols for arts communication can only lead to a broader discussion of such issues and the complicit part we all play in continued environmental degradation through developing urban spaces that replace biodiversity (and as a result native ant colonies being disrupted or annihilated). As Hudson (2012) explained during the symposium: “When engaged in practice-led research there is a commitment to the belief that creative practice leads to new conceptual spaces and relationships as well as new ways of thinking about seeing and being in the world”. Hudson has identified that it is through the production and dissemination of arts praxis that the individual can generate an informed position on the systems that govern lived experience as cited in the Literature Review 3.0, by (Giddens, 1990; Habermas, 1987; and Sullivan; 2008).

Artworks examining future biotechnologies, genetics, human-nonhuman identity, body politics: Alexandra Daisy Ginsberg, Gary and Suzanne Cass, Jesse Brown, Nicholas Lozanovski, and Sasha Whittle

Also selected for the exhibition were a number of artists that examined the potential future of biotechnologies. This included synthetic biology and the human creature: encompassing body politics and ethics, gene sequencing and technological enhancement. These series of artists chosen to encourage the viewer to consider the

potential directions new biotechnologies may take us. The artworks examine the implications of this on the environment and human sense of self in relation to technology and other forms of life.

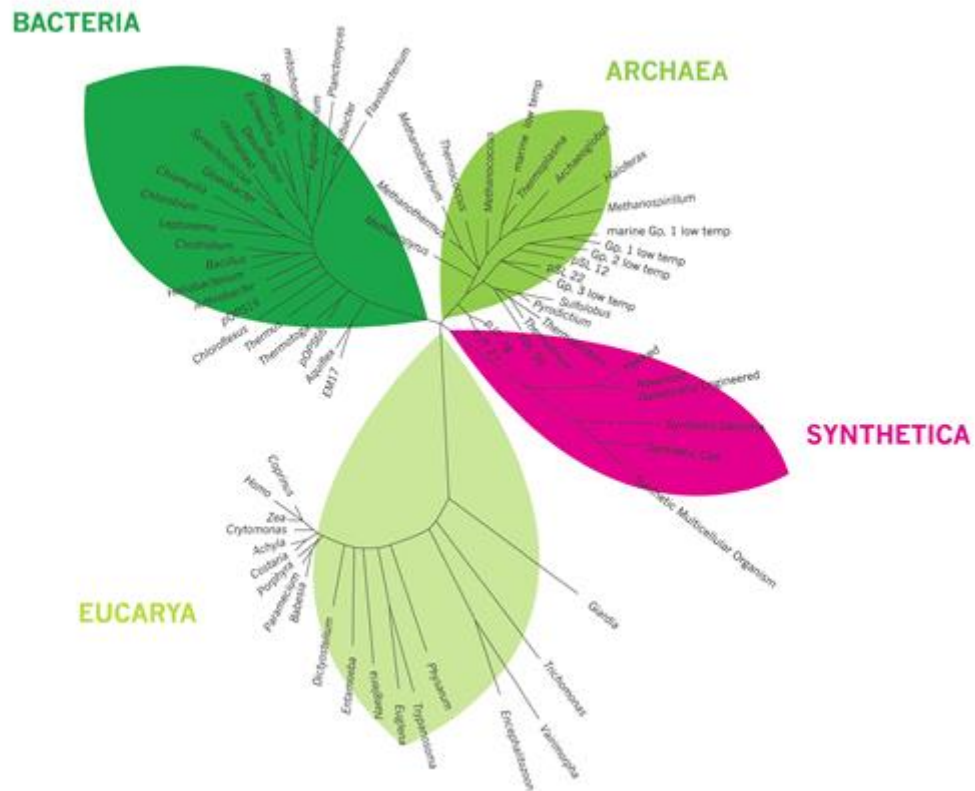


Figure 75: Alexandra Daisy Ginsberg, (2009). *The Synthetic Kingdom*, (still from film), Animation: Cath Elliot. Little Giant Pictures. (Copyright permission courtesy of Alexandra Daisy Ginsberg.)

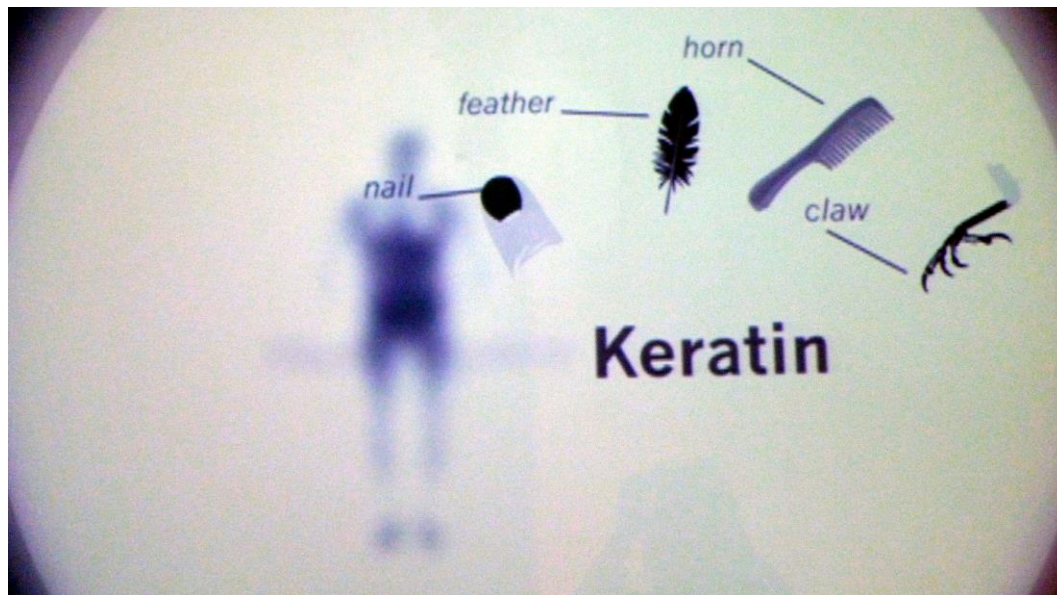


Figure 76: Alexandra Daisy Ginsberg, (2009). *The Synthetic Kingdom* (still from film), Animation: Cath Elliot. Little Giant Pictures. Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

In the work *The Synthetic Kingdom: A Natural History of the Synthetic Future* (2009) (Figures 75-76) Ginsberg presents an animated film that visualises a hypothetical future in response to actual current research and debates into the development of synthetic biology. This artwork draws attention to the relationships between biotechnologies, commerce and human-centric ideologies reflecting a potential future of nonhuman life. The film narrated by Ginsberg visually represents scientific processes required to add a new branch to the Tree of Life:

Synthetic Biology is turning to the living kingdoms for its materials library. No more petrochemicals: instead, pick a feature from an existing organism, locate its DNA code and insert it into a biological chassis. From DIY hacked bacteria to entirely artificial, corporate life-forms, engineered life will compute, produce energy, clean up pollution, make self-healing materials, kill pathogens and even do the housework. (Ginsberg, 2012, p. 33)

Although presented as product promotion the narrative alludes to its artistic questioning through statements such as:

Biotech promises us control over the natural world, but living machines need controlling. Biology doesn't respect boundaries or patents. And in simplifying life to its molecular interactions, might we accidentally degrade our sense of self? Are promises of sustainability and unparalleled good health seductive enough to accept such compromise? (Ginsberg, 2012, p. 33)

The questions raised by the artwork illustrate the agenda behind many of the forms of bioart cited in this research. Sperou (2008) points out that by working with these topics in

the way Ginsberg does: “Artists engage in the ethical, ecological, political and commercial implications of biotechnology” (p. 95). This process in some measure counteracts the gap between “these [technologies that] are rapidly developing before we have time to understand their potential or significance” (ibid) and as a result Cass and Catts (2008) concern that individuals are ideologically unprepared to understand the implications within the timeframe from research development and product consumption.

This method employed by cultural practitioners in the field is an attempt to set up a critical and reflexive discourse surrounding these developing technologies so that the viewer who engages with the works can develop a reflexive attitude towards their lifeworld and question “the expected and unexpected implications of emerging technologies on everyday life” (Ginsberg, 2009). In a way the collaborations Ginsberg seeks out through her praxis (design technologies, symposiums and workshops) intersects the hegemonic processes that usually frame biotechnological innovation (industry, corporatisation and mass media). As Ginsberg states (2009), “Biotechnology is unapproachable, yet it promises to change our lives...design can work with technology...bringing...skills of function, synthesis, collaboration and tangibility to allow us - biotech’s ultimate consumers - better access to question and consider our alternative futures” (n.p.).

Another element that added to the narrative of the exhibition through inclusion of this work is the influence of Ginsberg’s verbal statements on the reading of other artworks in the space. Ginsberg asks the viewer to consider: “How will we classify what is natural or unnatural when life is built from scratch?” (2012, p. 33). This statement becomes a touchstone for a number of pieces in the exhibition such as Svenja J. Kratz’ *Life and Death Vessels: A Collection of Curiosities* (2011) where nonhuman life is understood through scientific classifications, and Tarsh Bates *in vitro* node (*Drosophila melanogaster*) (2011), which exhibits the fruit-fly, a principal life form used in genetic research.

The Human Bio-Tech Face of Perth (2012) (Figure 77) presented by Gary and Suzanne Cass consists of merged photographic images – and collected DNA samples from their family aims to draw attention to the impact gene patenting will have on our sense of self, privacy and individual freedom.

The Cass’ state that, “The future identity of the human species will be carefully a controlled experiment, only perfection will be tolerated” (Cass, G. and Cass, S. 2012, p.

47). According to Stuart Hall, the ideology of race is a social-political construction, a process often used for exploitation and economic gain (1997). *The Human Biotech Face of Perth* (2012) a family self-portrait merged with the faces of the Perth community, aims to shatter this process. In stripping each participant to their “molecular nudity” (ibid) removing all cultural constructions of their self-identity, status and individuality reduced into a series of chemical molecules.



Figure 77: Gary and Suzanne Cass, (2012), *The Human Biotech Face of Perth*, (still from film), Town folk’s DNA, photography, mixed media, dimensions variable. (Copyright permission courtesy of Gary Cass and Suzanne Cass.)

By mapping Perth’s identity in this way (through the collection of the participants own DNA) a cultural hybridisation occurs. However, as a chemical code that has the potential to be manipulated, reproduced and sold, also raises the question of who owns one’s identity? Student Sasha Whittle in her work entitled *Definition* (2012) also examines these ideas (Figure 78-79). As Whittle (2012) states:

This self-portrait illustrating the code from a homo-sapiens chromosome X [and containing human DNA represents] the potential future of how humans will be defined by what their DNA says rather than what sort of person they are. As DNA makes up our structural self, our face won’t identify us, our DNA will. (p. 51)

This work selected as a part of the *Made Generation Collective*, reflects the current concerns young people have in relation to developing biotechnological futures. Whittle

has also created the first DNA portrait of Rosalind Franklin which now hangs in the Franklin-Wilkins Wing of Kings College, London (U.K.). See Appendix C.

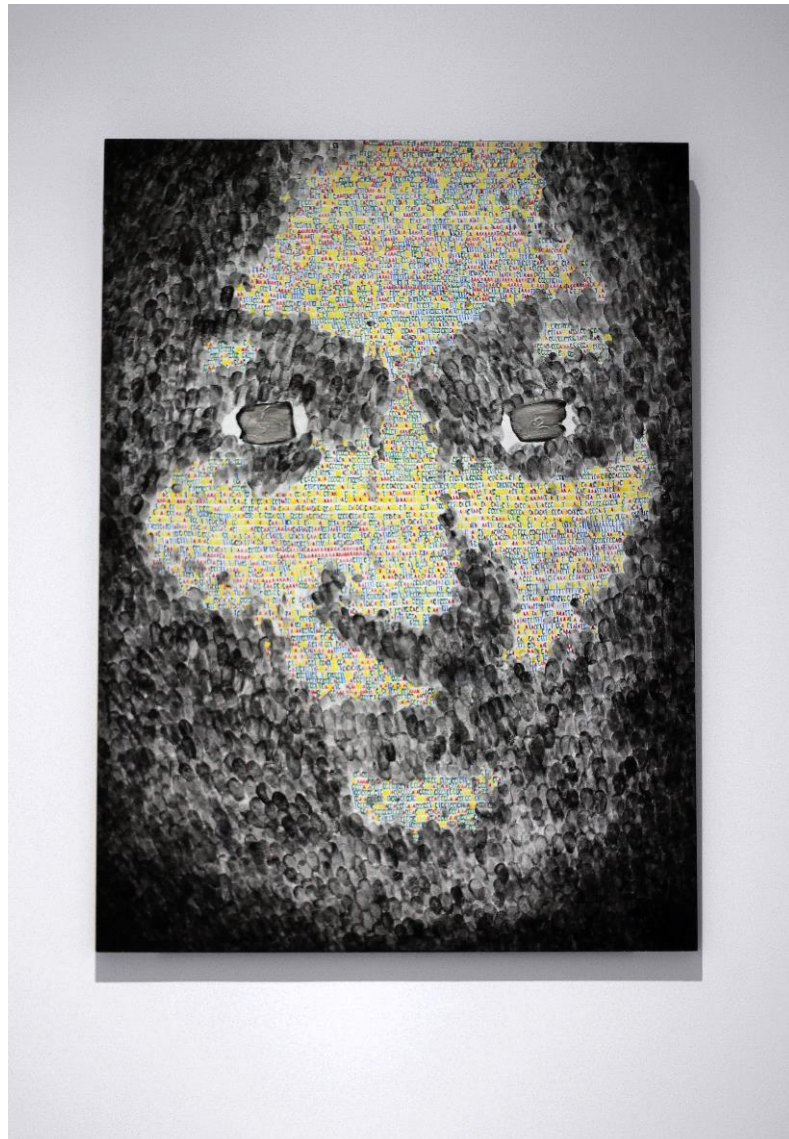


Figure 78: Sasha Whittle, (2012), *Definition*, acrylic on MDF board, DNA, 40cm x 30cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 79: Sasha Whittle, (2012), *Definition*, (detail), acrylic on MDF board, DNA, 40cm x 30cm. Photographer: Alexandra Engels. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Lozanovski as a participating student re-exhibited his work *Keep Safe Your Identity* (2011-2012) from *Bio-Tech Evolution* with an addition of a sculptural relief self-portrait piece representing “the possible visual consequences of human cloning” (Lozanovski, 2012, p. 49), Figures 80-81. The work raises the issue of who has access to your body tissue, and genetic information, with reference to the developments in the Human Genome Project and “disputes and debates” raised by human cloning (Lozanovski, 2012, p. 49). He states “we should keep safe our identity” (ibid) concerned that DNA mapping may become another form of surveillance and control, a resource for corporations to access and further categorise the individual.

Lozanovski encouraged his friends to interact with the work, enjoying the attempts to break into the safe and steal his identity. The inclusion of this piece adds a different dimension (not based in the nonhuman) and becomes a springboard for other pieces in that part of the exhibition space that deals with human identity. This shows the scope of bioart and hence the multiple outcomes of the practice.



Figure 80: Nicholas Lozanovski, (2011- 2012), *Keep Safe Your Identity*, DNA, Perspex, light, sound, 1m x 40cm x 40cm, acrylic paint, pencil, plaster and wooden panel, 1m x 40cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)

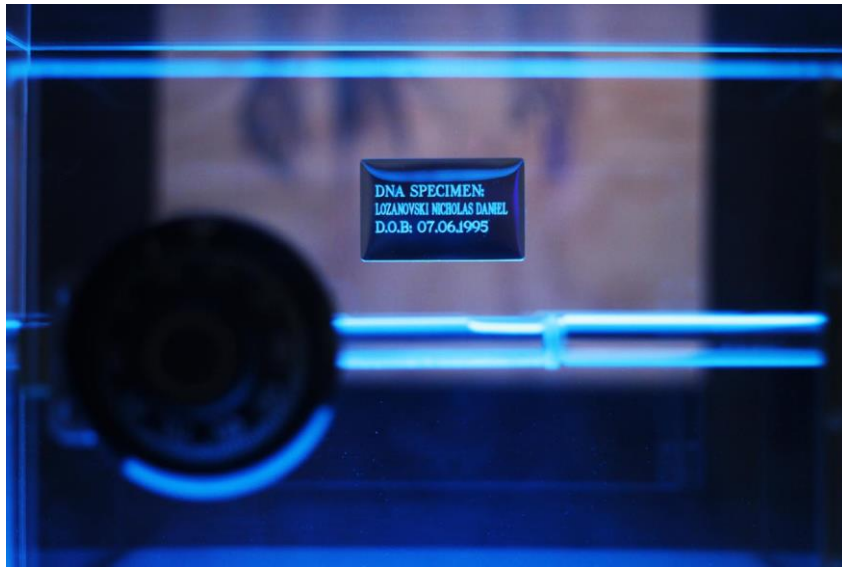


Figure 81: Nicholas Lozanovski, (2011- 2012), *Keep Safe Your Identity*, DNA, Perspex, light, sound, 1m x 40cm x 40cm acrylic paint, pencil, plaster and wooden panel, 1m x 40cm. Photographer: Kelsey Diamond. (Exception to copyright. *Section: ss40, 103C. Exception: Research or study.*)

In the piece *Imperfections of immortality* (2012), (Figures 82-83) Jesse Brown also built on his work from *Bio-Tech Evolution* and questioning “the need for the human to remain a soft machine!” (Brown, 2012, p. 45). He posits that in order “To survive a future world that may be environmentally hostile, the human will require an upgrade; the merger of the soft machine with the hard machine. Birth of the Cyborgian Being” (ibid). The work physically manifests the post-modern human condition in the context of a technologically driven society. The human, that is over-dependent on the machine, now has *become* the machine. Based on “the quote from Isaac Asimov’s (1999) ‘Bicentennial Man’: “*Andrew, society can tolerate an immortal robot. But we will never tolerate an immortal human.*” As the court declared Andrew a robot. “*A mechanical machine, nothing more*” (cited in Brown, 2012, p. 45).

We as a society are developing technologically and with change arises conflict. Will the future be characterized by segregation much like our past? Will the development of machines, an essential part of progressing into the future, be bound by the necessity to maintain “control”? Will the combination of soft and hard machines create a Cyborg that thinks, breathes, and bleeds? My artwork is a statement of the changes that will arise when we consider the limitations in which human life is formed. (ibid)



Figure 82: Jesse Brown, (2012), *Imperfections of immortality*, mannequin, aluminium, paper-mâché, *Acetobacter* and wine. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 83: Jesse Brown, (2012), *Imperfections of immortality*, (detail), mannequin, aluminium, paper-mâché, *Acetobacter* and wine, 1.2m x 40cm x 40cm. Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The inclusion of these three student artworks illustrate that many of the issues the artists in the exhibition are commenting on will ultimately influence the lifeworld of these young individuals. These individuals will therefore need to resolve the future outcomes and deal with the consequences of current biotechnological research. Their generation will be responsible for the future welfare of nonhuman life, the environment and development of future biotechnologies. I argue that this exhibition through its multiple method approach and non-hierarchical agenda sets up an infrastructure that encourages youth to engage with biotechnologies in a critical manner and generates the empowerment of their lifeworld as a result of this opportunity.

This was made most evident when I observed the three emerging artists during public interviews and artist floor talks, where each clearly demonstrated their knowledge/understanding of the life sciences they had applied to produce the artworks. Each individual spoke confidently about their intentions for the communicative outcomes of the artworks and demonstrated an understanding of their role as cultural producers and active participants in the lifeworld.

Since graduation, it is also significant to note that both Lozanovski and Whittle are currently undertaking a Double Bachelor Degree in Art and Science. Lozanovski studying across two campuses (Mount Lawley and Joondalup) at Edith Cowan University (ECU) and Whittle, awarded a Centenary Scholarship, studies at the Australian National

University in Canberra, New South Wales. In this way, they are able to develop their interdisciplinary praxis, and as an unprecedented act at ECU, Lozanovski is breaking new ground within the institution.

Situated in the Faculty of Education and Arts (EA) in the School of Communications and Arts (SCA), the intention of the Double Degree in Art and Science initiated in 2011, as described by Course Coordinator Professor Jill Durey (personal communication, April 9, 2014) aims:

To provide a broader opportunity for employment, and intellectual inspiration for students by combining areas that do not usually combine. To add a different string to their [graduates] bow. [The Double Degree lets graduates] start out with a foundation for future applications that might not exist now.

Durey (2014) argues, "Technology enables these approaches to happen." This reflects the close relationship between new media arts and contemporary cultural conditions. It also demonstrates the need for education systems to be dynamic in approach to respond to new cultural conditions in contemporary contexts (Giddens, 1990; Robinson, 2006; 2010; 2013). In terms of the mechanisms that facilitate this Double Degree, Durey (2014) stresses that each unit taught separately to ensure "substance in discrete subjects". The aim is to develop core knowledge in both areas, specialist areas taught separately. This indicates that the course has adopted a cross-disciplinary methodology.

The research however, builds on this model by offering interdisciplinary pedagogies, particularly in relation to the theoretical analysis of such cross-disciplinary acts. The way in which the Double Bachelor is organised allows the student to combine units in multiple ways. As each specialist unit is situated in an established course either humanities or science based, the possibilities of elective combinations is endless and can be created based on the student's particular interests. As evidenced so far, the majority of enrolments come from students with a background in aviation, engineering, psychology and humanities. The support of this Double Degree by SCA and Edith Cowan University also indicates its flexibility as an institution.

7.6 Symposium and WA Birds of Prey Centre Workshop

As previously established, I set out on this curatorial praxis with the intention of creating Gessert's (2008) concept of a space that has multiple uses and outcomes: housing nonhuman life, a place wilderness and education. This multi-method approach allows the viewer to make connections between the artwork and their own lived experience, a process reinforced by the inclusion of the *WA Birds of Prey Centre Workshop* and symposium presentations by a number of the exhibiting artists.

Creatures of the Future Garden Symposium 20th June 2012, CREATEC presentation, Edith Cowan University

As a part of the multi-method approach to the praxis, I invited exhibiting artists to present a fifteen-minute talk on their research/creative practice methodologies and their piece in the show. Of the twelve artists/collectives in the exhibition local artists Gary Cass, Kirsten Hudson and inter-state visitor Svenja Kratz were able to participate. In terms of the brief for this symposium, the aim was to demonstrate that each artist actively practices the science relevant to the artwork and understands the implications of doing so. For Hudson in particular the processes and production of creating the artwork became a site of ethical dilemma.

What became evident in each of these presentations was the way in which each individual engaged with the contexts they operate. There was a clear crossover between the contexts of science and art, with a focus on the role arts practice has in generating alternative understandings of the lifeworld. Each presentation drew attention to aspects of the systems that shape our engagement with nonhuman life in relation to technology and daily-lived experience.

This is particularly the case in Kratz' work as established in section 7.5 where it crosses the spaces between cell-tissue culture, the meat industry and ethical arts practices. What also became clear through the inclusion of this symposium was the communicative value of multi-method approaches to this research. With the addition of a symposium, the viewer could then experience the artworks with a broader understanding of the role each piece has in illuminating aspects of lived experience. It also demonstrated the importance of art as research to engage reflexively with the lifeworld and systems that control it (Barrett & Bolt, 2007; and Sullivan, 2010). This becomes particularly significant

in relation to enhancing a cultural understanding of developing biotechnologies and relationships to nonhuman life.

WA Birds of Prey Centre Workshop, Spectrum Project Space 26th June 2012. (Refer to DVD)

The inclusion of the birds of prey workshop was an integral part of *Creatures of the Future Garden*. The intention was initially to generate the idea of an ‘exhibition space’ that has multiple uses, as described by Gessert (2008). I also wanted to create an opportunity for the viewer to have a hands-on experience with nonhuman life as done in the secondary art-science education course *Bio-Tech Evolution* (Chapter 6.0). The third aim for the inclusion of this workshop was to encourage the viewer/participant to make connections between the animals and their day-to-day lived experience: Achieved through Sitko’s pedagogical approach. In her presentation, she placed a strong emphasis on how we can lessen our environmental impact through daily activities. For additional documentation of all species represented during the workshop see DVD.

To establish the communicative impact of this workshop in relation to the agendas highlighted, I asked participants to provide feedback on what they experienced, especially in relation to the hands-on engagement with nonhuman life in this context. I have listed a few to demonstrate the variety of feedback.

“So informative and loved the ‘hands on’ participation from the audience” (J. Maher, personal communication, June 26, 2012).

I felt it was quite a privilege to be so close and spend time with these birds, to touch them and interact with them is something that would never normally happen” (J. Monks, personal communication, June 26, 2012).

“Excellent show with a fascinating subject and point of view. Birds of prey workshop is an excellent (and totally fun) way to involve the public. More exhibitions like this!” (M. Schlipalius, personal communication, June 26, 2012).

“I learnt so much about owls. She [Sitko] is so knowledgeable. I was lucky that I could come that day” (personal communication, June 27, 2012).

The addition of the workshop also broadened the outreach of the exhibition. As it was held in the same space, those individuals who had not heard of, or intended to see the exhibition, could engage with the artworks.

The workshop experience also in part inspired a colleague to develop an exhibition based on endangered birds (L. Maruffo, personal communication, June 12, 2014). This exhibition also held at *Spectrum* included local, national and international artists. See Appendix C.

7.7 Viewer Feedback on the exhibition

Creatures of the Future Garden had an emphasis placed on the physicality of the artworks to generate an experience of the nonhuman life in real-time – a key element of bioart as defined by this research. Each piece containing nonhuman life would carry with it various earthy, pungent smells and subtle changes over time or the movement of organisms in response to the viewer's presence that occurs through this form of 'wet biological arts'. The following responses in some instances capture these elements and with additional detailed documentation including key moments within the *WA Birds of Prey Centre Workshop* documented by Kesley Diamond and Alexandra Engels provides an insight into the overall experience of the exhibition, (refer to DVD).

As a part of this exhibition, I also invited high school students and teachers from art and science backgrounds. The inclusion of secondary schools on the mail-list reinforces the crossover between my multi-method approaches to the research. The viewer demographic also included public, horticulturalists, scientists, and other individuals from the campus community including administrators, nurses and gardening staff.

The method used for collecting the data included a 'comments book' and through a verbal communication with individuals as they engaged with the artworks. As a part of this process I allowed the individual to make the decision on whether to provide feedback or not, without leading the conversations. This technique left the discussion open and consequently, the participant ultimately directed the content. The decision to either be identified or de-identified was also decided by the participants. As before this process required clearance from the Human Ethics Committee, Edith Cowan University.

The viewer feedback is organised into three main sections based on my aims for the exhibition. These sections include responses from other artists, responses to the real-

time engagements with nonhuman life and how this shifts audience perceptions of a 'gallery space' and evidence of viewers making connections between the art objects and their own lived experience.

As a Bioart exhibition

"Where is the science?" (personal communication, July 20, 2012). This viewer was concerned that the works were confusing the public's perception of authentic scientific practices. She pointed out that the artistic element to the works with the use of symbolism, metaphor, personal communicative agendas, ethical positioning – clouds the reading of true science in the pieces. As Pandilovski states, bioarts "return to concepts of beauty or aesthetical values in presentation, shift from previous approach in information arts" (2009). The viewer also stated that the closest representation of science in this exhibition was the animated film by Ginsberg *The Synthetic Kingdom* (2009) as it described and visualised potential future scientific techniques.

As a hypothetical piece Ginsberg uses the language of science and identified how we might extract bio-materials to create synthetic biological products for example keratin from hair and nails. In producing this work Ginsberg like the other artists does not claim to replace years of scientific research and the qualifications required to do this (Bunt, 2008). However, if I consider this statement "Where is the science?" in relation to my argument for an exhibition that contributes to an understanding of the life sciences there is space for confusion. This I would argue is counter-acted through the addition of an exhibition catalogue and didactic panels that explain the life sciences used by the artists.

The hands-on educational aspect of the exhibition was mainly focused around the inclusion of the *WA Birds of Prey Centre Workshop*. In contrast to this response another individual in the field of interdisciplinary bioarts stated:

The captions allow space for you to enter the work, if you come in a bit cold they offer a way to engage, without being too long. Often with these types of shows they rely too much on the technology, this one is more friendly and gentle in its approach. (personal communication, June 27, 2012)

This comment positions the exhibition in relation to other forms of bioart / bio-tech shows, where the weight of the selection process is reinforced as one that has a focus mainly on the nonhuman as a theme, rather than critical examinations of biotechnology as established in section 7.2. The agenda behind these exhibitions is to generate reflexive critical discourse. As O. Catts emphasises: "The intention in developing such

artworks is not about the promotion of science” (personal communication, November 30, 2012). Although the projects aim to encourage further studies in science or consider how science is used to understand the world. The outcomes of each creative work do not claim to replace the function of science communication.

Creatures of the Future Garden traverses between these disparate positions through its multi-method approach. The exhibition and symposium offered a forum for critical discourse around nonhuman and human interactions, while the *WA Birds of Prey Centre Workshop* provided an educational platform. The selection of works that contained familiar living / non-living objects (scientific and domestic vessels, table, domesticated plants, the bees, fox, and rabbit) was also used to “encourage the [viewer] to make connections between the [artwork] content” and their lived experience (Vanderbilt, 2008, p. 141).

The intention was to encourage the viewer to consider the nonhuman inhabitants within their lifeworld. As indicated through this viewer’s response, “The direct relationship the works had on my lifeworld was most insightful and made me question my role, and complicity within our contemporary context” (personal communication, March 16, 2013). This interplay between the art objects, subject matter and ‘wet biology’ in the lifeworld was also identified by these viewers from the bioarts field as indicated below:

The show has a positive outlook and depth to it that is often in contrast to other shows of this theme [bioart], the elements of each work have serious and confronting messages but also contain hope through the living – especially that one [points to Kratz’ *Life and Death Vessels*] and the garden at the front. (personal communication, June 26, 2012)

As a preface to the following statement, it is important to note Schilpalius was Bates’ curator for *In Vitero* at PICA, as previously mentioned, and therefore adds professional experience and knowledge to the viewer feedback. Schilpalius has a background in anthropology and museum studies. She has also worked extensively in the bioarts field and arts community as a curator:

Plants, insects, taxidermy and all the things that make you think about humanity’s place in the living world. We need shows like this that make you think. Too many art shows are visually pleasing without a lot of depth. When you stop and take time with this exhibition, it has depth and substance. (M. Schilpalius, personal communication, June 26, 2012)

One viewer pointed out that the exhibition provided a reflexive discourse on developing biotechnologies and its impact on nonhuman life. He commented on the way in which the public often responds to innovations and his concern that these creations will become a substitute for the real or at least change our appreciation of the natural world. "I have observed when people hear about new technologies or an invention, for example robotic animals - The response is often 'Wow that's cool!' Without pause and reflection as to whether this will have an impact on the future values of *real* nonhuman life" (A. Simionato, personal communication, June 28, 2012). These statements underpin aspects that the research question aims to address in that they demonstrate how cultural contexts frame our engagement with nonhuman life.

Real-time interactions with nonhuman life: shifting expectations of exhibition spaces

The following response was received by email. This individual has a background in science, however currently coordinates Higher Degrees by Research at the School of Communications and Arts, Edith Cowan University. What this response indicates is the way in which the exhibition works as a complete narrative. It also illustrates how the multi-method approaches to the role of the exhibition: artworks, symposium and workshop add a new dimension to the space. This response reinforces the potency of including secondary students as a way to extend the communicative possibilities. Particularly significant is the acknowledgment of the 'outreach' of the exhibition through artwork content and audience participation.

I did not turn up with expectations about science education. However, I realised I turned up with expectations about Spectrum gallery. Your exhibition was so clearly different from everything that has been there previously. There have been plenty of group shows, but none where the individual components were so easily connected in a whole theme. I am considering now that this partly due to the effort in organisation and collaboration rather than some intrinsic cohesiveness of the science/art stuff. It is also partly your connectedness within the community of science/art practitioners that added to the richness of the final exhibition.

While there are plenty of art exhibitions that aim to instruct, criticise or illuminate, they do not necessarily succeed because they are not outward looking. I have been to a couple of shows recently where the total effort went into the production and very little on advertising/organisation or outside connections [invitations beyond art community circuit, addition of artist talks and symposium, collaboration with the *WA Birds of Prey Centre*]. Yet true collaboration is an indicator of art, which goes beyond a personal perspective. However, we tend to reward individuals so it is tough to get this kind of work happening (D. Brady, personal communication, April 2, 2013).

The following response indicates the lasting effect the inclusion of live animals had on a young viewer. This links to Cherriman (2011) and Sitko's (2012) aims as environmental conservationists and educators; that the next generation will have a greater appreciation of the nonhuman through direct experience. As Malina states: "Childhood determines your reactions" (cited in Popper, 2000). "The first thing my son said this morning was 'Do you remember at the exhibition last night there was an owl and goldfish! They're my favourite'" (personal communication, June 22, 2012). Further reactions from this child detailed in upcoming sections and in response to the *WA Birds of Prey Centre Workshop*.

As highlighted in Chapter 5.0, viewers often expect artworks to fall into the category of painting et al, rather than 'wet biological' arts. Bioarts therefore can provide new ways of engaging with works in a gallery context, as made evident through this response: "Good use of space never seen living things in a gallery space before; biological parts are gross and intriguing at the same time" (personal communication, June 29, 2012). *Spectrum* as a space in this context, offers a platform through which such expectations or boundaries are extended.

Physical Reactions

There were a number of visceral experiences for the viewers, which some secondary students found confronting. This was particularly evident when viewers identified the live specimens in Kratz' *Life and Death Vessels: A Collection of Curiosities* (2011) "It is intriguing and repulsive at the same time – these opposite elements [art-science and living-dead] put together" (personal communication, June 27, 2012). Another response "The worms creep me out" (personal communication, June 30, 2012), and in Bates' *in vitro* node (*Drosophila melanogaster*) (2011) "Are they real bugs? Oh that is disgusting!" (personal communication, June 30, 2012). These responses demonstrate that an individual's real-time engagement with nonhuman life, is often framed by culturally constructed associations and assumptions such as all 'bugs' are bad.

As the exhibition brings these animals, invertebrates and microbes into the space in an unexpected way, it is 'normal' for individuals to have such reactions. This process reinforces my argument that there needs to be more opportunities for human – nonhuman, and art-science interactions to take place to counter-balance the disassociations with the natural environment. This is particularly pertinent to the location of the exhibition in Australia – a country famed for its population of insects. These

reactions demonstrate how urbanisation continues to influence cultural conditioning. In addition, I observed an adolescent boy looking at *The Remains of Algernon and the Poetry Orchids* (2011): He asked his family “What is that?” His father replied reading the didactic panel: “It’s a fetal calf” This individual is then physically repulsed by the work and moves back from the piece (Figure 84).



Figure 84: Svenja J. Kratz, (2012), *The Remains of Algernon and the Poetry Orchids* (detail), (from: *Creatures of the Future Garden*), Photographer: Donna Franklin. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Unreal or real?

Over the duration of the exhibition, several viewers believed that the plants were plastic imitations. In particular the orchid in *The Remains of Algernon and the Poetry Orchids*

(2011) by Kratz and plants in *Diaspora Monopoly* (2012). These viewers were surprised to hear that there are only real plants in the exhibition and that living things are a part of a 'gallery context' (personal communication, June 29, 2012).⁶²

In response to the presence of Oskar the owl, who was at the opening night event with Sitko, one viewer reflected: "When the bird was in the space, it could have been mistaken for an animatronic robotic bird, as we are used to artificial life, especially in this context [exhibition space]. It's good to play with people's expectations of what is real and authentic" (personal communication, June 28, 2012), (Figure 85).



Figure 85: Oskar the barking owl. *WA Birds of Prey Centre* (from: *Creatures of the Future Garden*) Opening night 21 June 2012, Photographer: Kelsey Diamond. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

This response highlighted the way the exhibition of nonhuman life in such contexts is not a common practice in the arts field. It also demonstrates the impact developing technologies are having on people's perceptions of what constitutes a real life form and a constructed one (animatronic). There were also other responses that emphasised the educational importance of generating spaces that house nonhuman life (Gessert, 2008), and the way these experiences can enhance the viewer's appreciation and interest in the environment.

This was particularly significant in relation to the following example, which focuses the attention on the potential this form of exhibition can have in generating a lasting interest for the next generation. A child (five year-old) asked if the plants are real; "Is that real?" I answered yes. The child still disbelieves that the plants are actually real, exclaiming/laughing "No they're not!" His father then said, "Touch it and find out" (personal communication, June 28, 2012). After touching the leaves, the child then realises that they are in fact real living plants. A discussion then followed between father and son on the different types of plants in the installation. As an added experience for the child, I suggested he could feed the goldfish. This family visited the exhibition a number of times so that the child could feed the goldfish in the pond and later that week attended the *WA Birds of Prey Centre Workshop*.

The impact this experience had on the child in particular, was immediately apparent as he frequently asked Sitko questions about the birds, which in response Sitko would pause her demonstration to make sure the child gained the most from his curiosity, answering his questions in detail. Later during the hands-on session in the workshop the child recalled specific details about their names, biology and behaviour – such as the brown falcon (*Falco berigora berigora*) whose feet are armoured with scales to protect it from snake bites (a source of prey) (Figures 86-88).



Figure 86: *WA Birds of Prey Centre Workshop*, (Participant interacting in sequence), Spectrum Project Space. (26th June, 2012). Photographer: Alexandra Engels. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

The mother of the child later informed me: “After the birds of prey workshop my son wanted us all to pretend to be birds. I was an owl, my husband was the wedge-tail eagle and he was the barking owl” (personal communication, June 28, 2012). This shows the educational value such activities can have in conjunction with a family foundation that supports a child’s development in the formative years. Environmental educator Cherriman (2012) asserts, “Education as a child begins in the backyard and if you pay attention to the animals that are around you, you can learn a hell of a lot about the natural environment” (cited in Moore, p. 38).

Sitko reinforced Cherriman’s idea on the environmental benefits of learning about your own context by drawing attention to some of these animals in the Perth region. This provides tools for individuals to apply this knowledge within their own lifeworld, such as identifying species, and taking actions that consider the welfare of the animals. For example educating participants of the avoidance of certain rat poisons can potentially blind the owls that consume the sick prey.



Figure 87: *WA Birds of Prey Centre Workshop. Creatures of the Future Garden.* Spectrum Project Space. (26th June, 2012) Photographer: Alexandra Engels. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)



Figure 88: *WA Birds of Prey Centre Workshop. Creatures of the Future Garden.* Spectrum Project Space. (26th June, 2012) Photographer: Alexandra Engels. (Exception to copyright. Section: ss40, 103C. Exception: Research or study.)

Generating relationships between bioart objects and lifeworld

As previously cited the exhibition as a bioart show had already started to generate connections for the viewer between the art objects and their lived experience. It was also noted that the viewers' experience of the artworks provoked memories of animal encounters. People would talk about their own interactions with animals, plants and nature, particularly those experiences, which directly related to the nonhuman life represented in the exhibition such as the bees, fox and rabbit.

In response to Kratz' piece *A Turtle Fondly in Imaginary Worlds and the Desire for Certainty and Control* (2011) one viewer remarked: "It reminds me of the time when I lived in Darwin in the 1950's, when we used to give stuffed turtles as gifts all the time. We didn't think anything of it they were exotic tourist souvenirs – wouldn't do it now, values have changed" (personal communication, June 22, 2012). This demonstrates the close relationship between cultural perceptions of nonhuman life and the impact on its welfare, an issue also raised by Singer (2012) and Jones (2011). In reference to Kratz' other piece *The Remains of Algernon and the Poetry Orchids*, (2011) one viewer made a direct connection between the biological material (fetal calf - Algernon's mummified body and Henrietta Lack's cell-line) in the work and the circumstances that frame it in the lifeworld. "It makes you think that we just take all these things for granted: That our lived experience contains all these things that take place on a daily basis, life and death that we don't notice or know about" (personal communication, June 30, 2012):

It really makes you think [gestures to artworks and text in the exhibition]. All the living things which are confined by the space [framed by science also within glass vessels], but also are allowed room to play and experiment [via an arts praxis]. Just to think. Then to stand next to the garden, it soothes your consciousness. It replenishes you, the sound, water and living things. It needs to be more of a part of life, otherwise you are just rushing and you do not see. (personal communication, June 30, 2012).

This response emphasised the technological impact on the speed of 21st century lifestyles in a wealthy minority world context, highlighting the significance of this exhibition in its ability to encourage viewer contemplation and reflexive pause.

The following comment identifies that the exhibition helped this viewer make direct associations between the works and human impacts on environment. It also demonstrates the communicative capacity of the works and the use of the space,

offering an alternative way to consider lived experience through co-habitation and sustainable design:

Environmental changes, what we do not see, when transferred into this space transported into urban spaces we choose what we want in these urban spaces. How do we transfer the whole environment, especially in relation to zoos, and constructed spaces. How do you consider all living things sustainably in terms of human and environment in terms of human and urban spaces. Do we include the whole existence of what is in nature? This show brings us back to what was before, co-existence especially the corridor [window space]. Reminds me how important this connection is for future existence. Installation so important in understanding where you belong. To create architecture that includes these experiences (sound all a good way to remind us of other spaces through sound). The viewer as actors and the artists as actors that engage with materials. People coming into the exhibition question at another level of engagement: To question whether you have forgotten this movement between human and nonhuman. Sounds of water reminds us that we are all connected a part of life, science, culture. Inspires you in so many ways: Life, art and communication (A. Simionato, personal communication, June 28, 2012).

In relation to the *Hedge Row, Red Fox (Vulpes vulpes)* (2010) “The flowers remind me of the flowers at grave sites, the ceramic flowers under glass domes” (D. Pepper, personal communication, June 27, 2012). This comment indicates the associations drawn from the specific use of materials, in this case, hand-made ceramic flowers. Singer deliberately chooses evocative materials to reinforce her requiem to the life of the animal.

In response to *Diaspora Monopoly* (2012) “You could do that in your own garden Imagine that it’s something my mother would do – plants everywhere” [garden installation at the front of the space] (personal communication, June 26, 2012). This comment indicates the shift in lifestyle activities for some out of necessity or lack of opportunity and reinforces Jones’ (2011) position that Australia is increasingly urbanised. In densely populated areas, there is little room for traditionally landscaped gardens of the 1950s. This then influences the individual’s interest in creating green spaces or not. However, as demonstrated in the installation, even small spaces can contain ecosystems.

[Window space] “Reminds me of driving down south, looking at trees on either side of the road, just assume that there is bush all the way back, but actually it’s just a corridor” (personal communication, June 27, 2012). This statement demonstrates another issue pertinent to the Western Australian context; In that we grow up with a concept of being

surrounded by bush and use it as a marker of Australian identity – however due to increased urbanisation, and extensive farming and mining, most bushland is separated into corridors and isolated pockets (Smele, 2013).

Comments Book:

“Wonderfully thought provoking and it pulls you gently to uncomfortable places you don’t normally go” (M. Lum, personal communication, June 21, 2012). This response reinforces how the exhibition’s inclusion of nonhuman life and particularly confronting subject matter has been an important tool in generating a reflexive engagement with the lifeworld of the viewer.

“Amazing exhibition. Both morbid and provoking” (Aman, personal communication, June 21, 2012).

I have included the following comment from the Principal at Balcatta SHS to demonstrate the on-going connection between *Creatures of the Future Garden* and *Bio-Tech Evolution* through the direct inclusion of the secondary students. This reinforces my multi-method approach to the praxis and research. “Amazing exhibition. Congratulations Donna. Congratulations all artists. A huge thank you to Gary and Donna for their work with Balcatta SHS. We are very proud of all our students – Jesse and Nick and the G & T Art Program” (A. Kristancic, June 22, 2012). This comment also indicates that the secondary institution has an on-going support of student participation in the broader community.

The following includes feedback from student assignments designed around the exhibition by a staff member at a secondary education institution. These Year 10 and 11 students also participated in Cass’ *Abiogenesis* Unit (Terms 3-4 2012):

Going to the *Creatures of the Future Garden* exhibition was very confronting. It was in your face and challenged what you thought about things such as global warming, animal cruelty [hunting] and the idea of DNA and genetic mutation...The fact that other people took so much time to look into these ideas of people creating things that are not in existence presently...is crazy. I disagree with doing it for pure entertainment, but I can see the value of doing it in order to understand more about science. Although it was really confronting and had so much meaning behind it, I was surprisingly not too overwhelmed. I think one of the worst things was the smell. (Year 10 student, assignment reflection, November 8, 2012)

This response identifies a number of key issues regarding the exhibition. It draws attention to the complicit nature of bioart practices as addressed by (Bates, 2011; Hudson 2012; and Kratz; 2012) in that there is a fine balance between the manipulation of nonhuman life for artistic and communicative means and the consideration of the ethical problems or confusion about science that could potentially arise by doing so. This student also remarked on the physicality of the artworks in terms of the 'wet biology' and was like other students repulsed by the smell. A couple of students were so disgusted by the smell and taxidermy animals that they did not want to pursue their engagement with the works in any detail and misunderstood the artists' intentions. One student remarked:

I do not like spooky thing [sic] [refers to Brown's *Imperfections of immortality* 2012], and I will never accept the way these artist [sic] treat dead animals. I know there was a reason and something they want to tell us by seeing display. But I couldn't understand deep story from almost everything...piecing different animals' body parts...It's [sic] means 'Blasphemy to the lives' (Year Ten student, assignment reflection, November 8, 2012).

However, the student had also identified the complicit nature of working with biological material for artistic ends, an issue raised by both Bates (2012) and Kratz (2012). This response, although emotive reinforces that the practice of bioarts must continue to acknowledge the ethical implications of engaging with nonhuman life.

7.8 Summary

The exhibition aimed to set up a site where the viewer can reflect on and consider their own lived experience in relation to their engagement with nonhuman life, biotechnologies and the environment. The exhibition set up multiple forms of engagement with the nonhuman as defined by Gessert (2008). The space developed varied uses beyond the direct experience of art and arts practices. This included the addition of educational workshops, talks, and the housing of the living components of the artworks. It aimed to offer a space where educational activities took place, art-science dialogues occurred, and sections of the area transformed into a temporary wilderness space.

The intention behind the exhibition aimed firstly to develop real-time interactions with nonhuman life. Secondly, it set up a space to debate the future of biotechnology from an artistic and through the symposium scientific perspective. The purpose was to develop an awareness of the implications, politics and ethics of such futures. These outcomes were reinforced with the addition of a workshop event and symposium actively to engage with the broader community. Through this approach I aimed to develop a greater

appreciation for the natural world, through education and direct hands-on experience, in an attempt to counteract “environmental generational amnesia” (McKinney, 2002), in an increasingly urbanised cultural context. I also sought to bring this work and these ideas to a wider audience – the public and especially to schoolchildren, and to break down notions of exclusivity in the gallery by introducing emerging artists into the field.

The praxis set up a physical space especially for the exhibition of bioart, including protocols and facilities to house nonhuman life, sites for wilderness, and opportunities for education via the *WA Birds of Prey Centre Workshop* (Gessert, 2008). The presentation of a locally specific workshop could also begin to foster Jarratt’s (1997) concept of community orientated education and participation. This exhibition further illustrated the unique position of the research in that it builds a multi-method approach and extends the possibilities and definition of bioarts.

8.0 Conclusion

This research has demonstrated ways to reinvigorate community engagement with nonhuman life and the environment through bioarts praxis. I have argued the reasons why this is increasingly important in our contemporary context where the value of nonhuman life is framed by new biotechnologies and a lifeworld shaped by commodity culture and dense urbanisation. The research has acknowledged the complexity of the term bioart. I have argued its slippery nature by definition directly responds to the changes in contemporary cultural conditions and developing biotechnologies. Using wet biology as the practical and conceptual anchor for my working definition of bioarts, the research covered various forms of nonhuman life, from bacteria to live birds of prey. The literature review and subsequent case study chapters have provided a comprehensive overview of the field specifically examining how the research adds or differs to established practices. Traversing art, science communication, and education, the research determined the advocacy of dealing with 'wet biology' in a critical and ethical manner across these contexts.

In order to establish how bioarts praxis can provide an alternate communicative position to navigate these paradigms, the research built on the genre by the development of a multi-method approach, a model that encompassed three major projects. Namely, the exhibition of bioartworks, a secondary education art-science course and the curation of a group exhibition.

A crucial aspect of the research identified how it is culturally important that bioarts praxis offer a real-time experience with nonhuman life via wet biology, while also critically engaging with the implications of doing so. This was theoretically and practically addressed across each project using a reflexive praxis methodology (Barrett and Bolt, 2007; Gramsci, 1975) underpinned by ethical protocols. The research has shown how reflexive analysis is a necessary tool to examine critically the bioarts field from within. In using this methodology I ensured that the outcomes of the research militates against bioarts as being yet another ivory tower (Shapin, 2012). The multi-method approach demonstrates how the research extends beyond the academic specialist domain into secondary and public contexts. By strategically placing the bioarts praxis across these cultural realms, the research mediates the processes of systemic colonisation in the lifeworld.

The bioarts praxis, sourced representations of nonhuman life from mass media in the public sphere to offer a point of critical reflection for the viewer. This was exemplified by

the *Humanatis Series* (2011) shown at *Animals-People at Shared Environment* (2011), Queensland, *Creatures of the Future Garden* (2012), *Becoming*, USST, Shanghai (2013), and the post-graduate exhibition *Becomings* (2014), Perth. These artworks combined microbiological skin, significant evolutionary and sociological texts and visual representations of current biotechnological research. Most significantly, these artworks *Guam Flying Fox*, *Red Chested Capuchin Monkey* and *GFP Marmosets (Kei and Kou)* drew attention to the physical connections between humans and animals, our impact on the environment and continued manipulation of life. The other body of work *Mycotroph* and *Systemic Network for Social Darwinism* (2010), Perth, shown in *Signs of Change, Posted, Out of the Shadows*, and *The Christmas Show*, examined aspects of the research question involving the construction of sculptures specifically related to our Australian context. This included the incorporation of living fungi with recycled metal and laboratory glass to represent the mycorrhizal fungus endemic to Western Australia and the mycelium that provides nutrients to plant and animal life. The contextually specific nature of this work aimed to communicate hidden aspects of the environment in the viewers' immediate present. These collaborative bioart pieces were exhibited in a number of diverse contexts such as across the arts, science and in the public sphere to develop the potential outreach of bioarts praxis.

To advance connections between bioarts and education the second project situated in a secondary school special arts context. In the interdisciplinary course, I directed life science laboratory practicals that covered multiple forms of nonhuman life including bacteria, invertebrates, plants and fungi. In addition, the course introduced a hands-on local birds of prey workshop by Yvonne Sitko, and lectures and workshops on plant and human DNA extraction conducted by collaborator Gary Cass. This hands-on engagement with the life sciences offered a fresh and unique approach to current curriculum restrictions. After this laboratory experience students exhibited a self-directed artistic wet biological work that expressed their views on nonhuman-human life in a biotechnological context. The agenda behind this course aimed to encourage students to reconsider their day-to-day participation with the nonhuman in the lifeworld, local environments and biotechnology. During this project, the research significantly demonstrated how such encounters provided a lasting cultural impact on individual participants. This was especially evident from student and teacher feedback and individuals who have continued to develop their art-science praxis by enrolling into equivalent tertiary studies.

Demonstrating the breadth of the research the final project culminated in the curation of a group exhibition. This exhibition made an assertion that gallery space is enriched by the

introduction of wet biological art, sites for wilderness ecosystems and local environmental workshops and symposium. *Creatures of the Future Garden* built on the previous knowledge and experience gained from the first two projects. A comprehensive exhibition of internationally recognised bioartists, national and local artists was exhibited alongside emerging secondary school art students. This action pushed the boundaries of exhibition expectations, declaring that the voice and ideas of young people should be considered equally significant to the works by established practitioners in our contemporary understanding of nonhuman life and future biotechnologies.

The three projects have provided a deeper understanding and layered experience of our contemporary engagements with nonhuman life. Of particular significance is the way each aspect of the creative praxis was built on using the multi-method approach. The research questioned whether our contemporary participation with biotechnologies and the nonhuman can be critically examined through the intersection of bioarts, education and greater public involvement. This was reflexively demonstrated by the communicative outcomes of student artworks in *Bio-Tech Evolution*, the subject matter chosen for the artworks exhibited in the public sphere and through the curation of *Creatures of the Future Garden*.

9.0 Glossary of Terms

Aerobic Fermentation

“In the presence of free oxygen, where one carbon is converted to another carbon source” (VanDemark and Batzing, 1987, G-10).

Anaerobic Fermentation

“The anaerobic utilization of an organic molecule in which organic molecules serves as both electron donors and electron acceptors” (VanDemark and Batzing, 1987, G-10).

Anthropocentrism

To view the world from a human-centric position, consider human beings as the ultimate outcome of the universe or evolution. To consider all engagements in the world based on human experience and values.

Anthropomorphism

“Attribution of a human form or personality to a god, animal or thing” (Moore, 2009, p. 56).

Bacteria

Unicellular prokaryotic organisms.

Biology

The science that deals with the study of living organisms or systems.

Biotechnology

The application of the principles of engineering and technology to the life sciences...The use of microorganisms, such as bacteria or yeasts, or biological substances...enzymes, to perform industrial or manufacturing processes. Applications include production of certain drugs, synthetic hormones and bulk foodstuffs. (2007)

Civic Science

We define citizen science programs as those that involve citizens (K-Life) as decision-makers in scientific initiatives outside of formal educational initiatives. In environmental issues, research has shown citizen science initiatives to be successful in promoting civic engagement. Because of their involvement, citizen groups have played a role in shaping environmental policy. Involvement in citizen science programs can also promote scientific literacy. (n.a., 2009)

Environmental Justice

The monitoring and research into the distribution of environmental harms and benefits in society, and the rights to recognition and participation by citizens and communities in decisions affecting their health, amenity and well-being. This term applied to the process of monitoring corporate, and/or government actions to maintain accountability in relation to environmental conservation, policies and protection acts by third parties. (Lindsay, 2009) Retrieved from <http://edovic.org.au/current-projects>

Genetically Modified Organisms (GMOs)

“An organism whose genetic characteristics have been altered by the insertion of a modified gene or a gene from another organism using the techniques of genetic engineering” (2007).

In-vitro culture

“Of processes or reactions taking place in a test-tube or other laboratory environment [in glass]” (1987, Hughes; Michell & Ramson, 1987, p. 595).

Ivory Tower

Etymologically derived from a number of sources in Greek, Latin, Old English and French languages pertaining to strongholds to keep out, watch, “gain knowledge by experience” (Harper, 2001-2014), dominion, and associated with wealth. “As a symbol of artistic or intellectual aloofness (1889) from French *tour d’ivoire*, used in 1837 by critic Charles-Augustin Sainte-Beuve (1804-1869) with reference to the poet Alfred de Vigny, whom he accused of excessive aloofness” (ibid).

Life Science

“The study of the laws of living matter... [for example] anatomy, bacteriology, biology” (2007).

Lifeworld

Every-day pre-reflective (Adams, 2006) lived experience in which the actions, realities of day-to-day life taken for granted and considered normal. Containing circumstances that shape structure and familiarise the individual with the cultural norms and codes expected in that particular cultural context. Often shared by groups, the lifeworld carries with it dominant ideologies that maintains its stability. However, the lifeworld is subject to change, dependant on its relationships to governing systems and global events.

Marshall McLuhan and Raymond Williams debate on media

It is often implicit for Williams that a medium is a particular use of a technology; a harnessing of a technology to an intention or purpose to communicate or express...Williams is also wary about the theoretical implications that the term ‘medium’ has come to carry. First, he criticizes and virtually dismisses it as always being a misleading reification of a social process. Second, he sees that it is also a term that is used to recognise the part that materials play in a practice or process of production, as in artistic processes where the very nature of paint, ink, or a certain kind of camera will play a part in shaping the nature of an artistic product (Lister et. al. p. 88, cited by Vanes, 2009). *New Media: determining or determined?* Lister et al. (2008). *New Media: A Critical Introduction* (2nd Edition). New York: Routledge.

See also: *Understanding Media: The Extensions of Man*. (1964), by Marshall McLuhan, and *Television: Technology and Cultural Form* (1974), by Raymond Williams.

Mass Media

In the sphere of the mass media, dominant ideologies are reproduced and communicated through cultural production. Blockbuster movies in particular can influence the social realm by perpetuating stereotypes of the human behaviour, cultural identities and ideologies. In a consumer context, these films can to an extent influence how we consider and engage with developing biotechnologies.

Mega Cities

A single metropolitan area that has a population over ten million people or more, often where two or more areas join. There are currently 24 mega cities on record examples include Shanghai, New York, Mexico City and Tokyo.

Microbiology

“The branch of biology that is concerned with the study of microorganisms, including bacteria, archaea, viruses, algae, protozoa and fungi and their effects on humans” (2009).

Mycelium

(plural mycelia) is the vegetative part of a fungus, consisting of a mass of branching, thread-like hyphae. Fungal colonies composed of mycelia found in soil and on or in many other substrates. Typically, a single spore germinates into a monokaryotic mycelium, which cannot reproduce sexually; when two compatible monokaryotic mycelia join and form a dikaryotic mycelium, that mycelium may form fruiting bodies such as mushrooms. A mycelium may be minute, forming a colony that is too small to see, or it may be extensive: It is through the mycelium that a fungus absorbs nutrients from its environment. It does this in a two-stage process. Firstly, the hyphae secrete enzymes onto the food source, which breaks down polymers into monomers. These monomers are then absorbed into the mycelium by facilitated diffusion and active transport. (n.d.)

Mycelium is vital in terrestrial and aquatic ecosystems for its role in the decomposition of plant material. It contributes to the organic fraction of soil and its growth releases carbon dioxide back into the atmosphere. The mycelium of mycorrhizal fungi increases the efficiency of water and nutrient absorption of most plants and confers resistance to some plant pathogens. Mycelium is an important food source for many soil invertebrates. (n.d.)

Mycology

Mycology (from the Greek *μύκης*, meaning "fungus") is the branch of biology concerned with the study of fungi, including their genetic and biochemical properties, their taxonomy, and their use to humans as a source for tinder, medicinal (e.g., penicillin), food (e.g., beer, wine, cheese, edible mushrooms) and entheogens, as well as their dangers, such as poisoning or infection. From mycology arose the field of phytopathology, the study of plant diseases, and the two disciplines remain closely related because the vast majority of plant pathogens are fungi. (n.d.)

Historically, mycology was a branch of botany (in an evolutionary sense fungi are more closely related to animals than to plants but this was not recognized until a few decades ago). Pioneer *mycologists* included Elias Magnus Fries, Christian Hendrik Persoon, Anton de Bary and Lewis David von Schweinitz. (n.d.)

Synthetic Biology

Synthetic biology is the engineering of biology: the synthesis of complex, biologically based (or inspired) systems, which display functions that do exist in nature. This engineering perspective may be applied at all levels of the hierarchy of biological structures—from individual molecules to whole cells, tissues and organisms. In essence, synthetic biology will enable the design of ‘biological systems’ in a rational and systematic way (Synthetic Biology: Applying Engineering to Biology: Report of a NEST High Level Expert Group cited by Serrano, 2005, p.1-2).

10.0 Notes

¹ Andrews, D. (Producer). (2012). *Bindi's Boot Camp* [Television series]. Australia: FremantleMedia and Bradshaw F. & Negus, P. (2008). *The Tale of Two Honey Possums*. Hamilton Hill: Western Australia.

² Rayner's concepts of "Natural Inclusion" are similar to my own ambitions for the research. Through "Natural Inclusion" Rayner argues that: "In reality, there can be no separation of 'Nature' from 'Nurture' because 'organisms' and 'environment' inescapably include each other. In this light, there is a need for radical re-interpretation of many of the most widely accepted but simplistic models of biological structure and function. These models demean rather than enrich our understanding of life in all its depth, complexity and diversity". (Rayner & Tesson, 2003). See Biological Science and Ecology: *Inclusion Research Forum & Learning Space*. Retrieved from <http://www.inclusional-research.org/biology.php> See also: Rayner, A.D.M. (2003). Inclusivity – an immersive philosophy of environmental relationships. In *Towards an Environment Research Agenda – a second collection of papers* (A. Winnett and A. Warhurst, eds.), pp. 5-20. London: Palgrave Macmillan.

³ *SymbioticA: Centre for Excellence in Biological Arts*.
<http://www.symbiotica.uwa.edu.au>. Funded by UWA and the government organisation - Department of Culture and the Arts.

⁴ As well as the release of spores from the fruiting body (mushroom, bracket): fungi also spread through networks they put underground (mycelium/hyphae). These hair-like filaments can travel vast distances and are crucial to the health of complete ecosystems – breaking down nutrients for plants and trees, insects, animals (e.g. Potaroos exclusively eat truffles and have evolved special fork-like claws to dig). There are even some rare orchids unique to Western Australia that are entirely dependent on specific mycorrhizal fungi to germinate. Mycorrhizal fungi also have a symbiotic relationship to Australian trees providing a greater surface area for roots even on a cellular level to gather nutrients and supplying additional nutrition in our sandy soils through an exchange of chemicals.

⁵ BEAP04: <http://mass.nomad.net.au/wp-content/uploads/beap/beap2004/>

⁶ George Gessert is an invited artist in *Creatures of the Future Garden*, exhibiting a new artwork. See Chapter 7.0.

⁷ Many pieces were re-exhibited in *ENTRY06* and can be found in the accompanying texts: Lupton, E. (Ed.). (2002). *Skin Surface Substance and Design*. Cooper-Hewitt, National Design Museum, Smithsonian Institution, Princeton Architectural Press. New York. Seltmann, G. & Lippert, W. (Eds.). (2006). *Entry Paradise. New Worlds of Design*. ENTRY 2006, Birkhauser, Switzerland.

⁸ Information and publications about *ENTRY06* and Zeche Zollverein can be found at <http://oma.eu/projects/2002/zollverein-masterplan> and http://www.zollverein.de/uploads/assets/4f8592606954981f70000015/31_8_2010.pdf And <http://www.zollverein.de/#/service/english-page>

⁹ *Biojewellery* <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1352073/>
<http://www.design-interactions.rca.ac.uk/tobie-kerridge/biojewellery>

¹⁰ *Perth Urban Bushland Fungi Group* www.fungiperth.org.au

¹¹ Commencing in 2006, and awarded a *Young People and the Arts, New Concepts* research grant from the Department of Culture and the Arts - the project began at the Faculty of Agricultural and Natural Sciences, UWA, in conjunction with an artist residency at *SymbioticA*. Project website: <http://www.bioalloy.org>

¹² For further information on this see books: *No Logo*, 1999, Knopf Press, by cultural theorist, Naomi Klein, *Growth Fetish*, 2003, Allen & Unwin by Australian political theorist Clive Hamilton, *Take it Personally: How Globalisation affects you and powerful ways to challenge it*, 2001, Harper Collins Publishers by businesswoman, human –rights and environmental activist, original owner of *The Body Shop* Dame Anita Roddick DBE (1942-2007) and *Globalization: The Human Consequences*, 1998, Columbia University Press by Polish sociologist and cultural theorist Zygmunt Bauman.

¹³ The first patent on life was passed by the U.S. patent office for *General Electric Motors* and Ananda Chakrabarty. Retrieved from http://www.todayinsci.com/6/6_16.htm

¹⁴ For example in the U.S., it was culturally acceptable for wolves to be shot by members of the public. As a result of further research into the importance of ecosystems, there has been a shift of ideology and the species is protected. It has been discovered that the wolves are needed to eat the elks to avoid their over-population and allow trees to grow back. There is now a process in which they are being replaced to restore the balance within the entire system.

¹⁵ *Leonardo* Available at: <http://www.leonardo.info/isast/leostory.html>

¹⁶ Tissue Culture & Art Project: <http://www.tca.uwa.edu.au>, Critical Art Ensemble: <http://www.critical-art.net/>, Paul Vanouse: <http://www.contrib.andrew.cmu.edu/~pv28/>, Beatriz de Costa: <http://www.beatrizdacosta.net/>, Boo Chapple: <http://residualsoup.org/boo-chapple.html> and subRosa: <http://www.cyberfeminism.net/>.

¹⁷ Adam Zaretsky *VIVOARTS* 2009 workshop
<http://www.fondation-langlois.org/html/e/page.php?NumPage=24>

¹⁸ *Artscatalyst* Available at: <http://www.artscatalyst.org/>

¹⁹ *Ectopia* Available at: <http://www.artsactive.net/en/organisers/ectopia/>

²⁰ For further examples of debate / discussion cited on Eduardo Kac's website see <http://www.ekac.org/transartbiblio.html> and <http://www.ekac.org/debates.html>

²¹ Graham, F. (1990). *The Audubon Ark: A History of the National Audubon Society*. New York: Alfred A. Knopf.

²² Final Report *Environmental Justice Report*. Policy and Law Reform. Environmental Defenders Office: Available at http://www.edovic.org.au/downloads/files/law_reform/edo_vic_environmental_justice_report.pdf

²³ Artsactive Available at: www.artsactive.net

²⁴ For video discussion see: <http://mutamorphosis.wordpress.com/videos/>

²⁵ The recently created archive 1979-2013 of *ARS Electronica* is available at <http://www.aec.at/about/en/archiv/>

²⁶ *FutureLab* Available at: <http://www.aec.at/futurelab/en/>

²⁷ We commissioned three projects in 1994 from the artists Helen Chadwick, Letizia Galli and Donald Rodney...The resulting exhibition *Body Visual* opened at the Barbican Centre in 1996...Including genetics, nuclear physics, space science, ecology, neuroscience and new materials and in hard-to-access environments, such as biotech labs, experimental reactors, space agencies, zero gravity and remote environments. (Triscott, N. & La Frenais, R., 2013)

²⁸ Both Cass and I were invited by curator Marie O'Mahony, to exhibit *Fibre Reactive* and *Micro 'be'* artworks in *Techno Threads*, 26th April – 25th July, 2008, at the Science Gallery, Trinity College, Dublin, Ireland. During this exhibition, we presented a lecture our collaborative projects.

²⁹ Synthetic life sparks debate. (2010, May 22). *The West Australian*, p. 63.

³⁰ Science Gallery: <https://dublin.sciencegallery.com/international>

³¹ *Science Education in Europe: Critical Reflections: A Report to the Nuffield Foundation*. Osborne, J. & Dillon, J. (2008). *King's College London*, January 2008: Report based on two seminars consisting of speakers from fifteen Universities. Available at: http://www.nuffieldfoundation.org/sites/default/files/Sci_Ed_in_Europe_Report_Final.pdf

³² *Scitech* webpage: www.scitech.org.au

Timeline: <http://www.scitech.org.au/about-scitech?showall=&start=1>

³³ “[With the exception of cephalopods] An application for ethics approval to the Animal Ethics Committee (AEC) is not required for projects that involve invertebrate species (AEC, 2010, p. 3).

³⁴ “As part of the University of Western Australia, SymbioticA follows the University IP guidelines as found at <http://www.legalservices.uwa.edu.au/lso/copyright/features>” (2010, n.a., n.p). “Whilst SymbioticA is able to give our support towards applications, this does not automatically mean The University of Western Australia Ethics Committee will grant approval to your project. More information about this can be found at: http://www.research.uwa.edu.au/welcome/for_researchers” (2010).

³⁵ *Pacific Community Forestry Centre*

http://www.sierrainstitute.us/PWCFC/projects/ej_participatory.htm

³⁶ *FORM* Website: <http://www.form.net.au/>

³⁷ Peter Minson Website: <http://www.minsonartglass.com/index.html>

³⁸ Text written in the shadows:

“The mycorrhizal associations between fungi and plants in Australia, is a 4000million year old relationship...92% of flowering plants have a fungal symbioses” (Brundrett, 2011).

“Globally we are in a state of human–wildlife conflict” (Stafford, 2011).

The current world population: 7, 118, 212,509. Statistics Available at: <http://www.worldometers.info/world-population/>

“83% of Australian population is urbanised” (Jones, 2011).

“*The last Child in the Woods* explores the Nature deficient disorder” (cited by Chapman, 2011).

³⁹ “The ape is seated on a loose pile of a dozen books, "DARWIN.HB" on the spine of one, "ERITIS SICUT DEUS" across the page of another. The statuette is hand-finished with the addition of a calliper which is held in the right foot, itself being clasped by its opposite...The Latin, ERITIS SICUT DEUS, is taken from the Bible (Genesis, III, 5). The serpent is enticing Eve to eat of the apple tree (against the Lord's command), promising "And ye shall be as god [knowing good and evil]". The phrase appears later in Part I of Goethe's *Faust*, which was published in 1808 and likely held it in Rheinhold's mind. Goethe (1749-1832), incidentally, spent a great deal of time in the general part of Germany where Rheinhold grew up, and it's a little known fact that he devoted much of his later years not to poetry but to natural history". (Gordon-Morgan, R. & Moore, A. 1998)

⁴⁰ *Marmoset Model takes Centre Stage*

Erika Sasaki and her colleagues at the Central Institute for Experimental Animals in Kawasaki injected viral vectors with green fluorescent protein (GFP) into 91 marmoset embryos, then transferred the 80 healthy transgenic embryos to surrogate mothers. Japanese researchers this week report the passing of a transgene from a primate to its offspring (see *Nature* 459, 515–516; 2009, and *Nature* 459, 523–527; 2009). The work could establish marmosets as a model research organism to rival the more commonly used rhesus macaque, and usher in a new era of primates as human-disease models. Published online 27 May 2009 | *Nature* 459, 492 (2009) | doi:10.1038/459492a
<http://www.nature.com/news/2009/090527/full/459492a.html>
<http://www.nature.com/nature/journal/v459/n7246/abs/nature08090.html>

⁴¹ Official Monsanto Website: www.monsanto.com
Monsanto Watch <http://monsantowatch.org/>

Monsanto Vs U.S. Farmers: Report by The Center for Food Safety:

<http://monsantowatch.org/uploads/pdfs/CFSMvF.pdf>

Suicide Seeds: <http://www.greenpeace.org/international/en/news/features/suicide-seeds/>

⁴² *Ausbiotech* website: <http://www.ausbiotech.org/>

⁴³ *Fungimap VI* will be held amid the magnificent Karri and Tingle forests in the Denmark Shire on Western Australia's south coast. The five-day event (jointly organised by Fungimap and the Western Australian Naturalists Club) includes inspirational and informative talks, workshops and forays presented by leading Australian and international educators and researchers in the fields of mycology, ecology, education and conservation (2011).

⁴⁴ Global Examples of these programs: www.artistsinschools.co.uk Arts Council England, California Arts Council, The Artists Alliance, New Zealand

⁴⁵ Other secondary institutions that facilitate the GATE program in Perth, include, Applecross SHS and Kelmscott SHS.

⁴⁶ Promotion of Digital Interactive Museum
<http://www.youtube.com/watch?v=rHxPv0Be-m8>

Victoria and Albert Museum in HD

<http://www.youtube.com/watch?v=A8M9EJ42eZQ>

British Museum and VA Favourites by 'leadinglady19'
<http://www.youtube.com/watch?v=6vBT8o3YFEc>

Interactive on-line web education
<http://www.museumsandtheweb.com/mw2007/papers/schaller/schaller.html>

⁴⁷ AQWA Website: www.aqwa.com.au

⁴⁸ *Museum Victoria BlogSpot*
<http://museumvictoria.com.au/about/mv-blog/authors/jessie-sinclair/>

BugsAlive! <http://museumvictoria.com.au/bugs/exhibition/exhibits.aspx>
<http://museumvictoria.com.au/melbournmuseum/whatson/current-exhibitions/bugs-alive/>

Forest Gallery <http://museumvictoria.com.au/melbournmuseum/whatson/current-exhibitions/forest-secrets/>

⁴⁹ Adam Zaretsky is an artist, or "bioartist," working as a research affiliate in Arnold Demain's Laboratory for Industrial Microbiology and Fermentation in the Massachusetts Institute of Technology's Department of Biology...MA Fine Arts 1999 at School of the Art Institute of Chicago, where he studied and researched with "transgenic" artist Eduardo Kac...Joe Davis, Oron Catts and Ionat Zurr [TC&A]. Artist webpage: Adam Zaretsky <http://www.emutagen.com/>

⁵⁰ *Biotech Art Symposium* Publication: *Art in the Biotech Era*. [Ed.] Pandilovski, M. Experimental Arts Foundation Inc. Adelaide, South Australia. Australia. Contributors: Miguel Amado, Roy Ascott, Andre Brodyk, Stuart Bunt, Heath Bunting, Gary Cass, Oron Catts, Boo Chapple, Melinda Cooper, Critical Art Ensemble (CAE), Gina Czarnecki, Kirsty Darlaston, Joe Davis, Nik Gaffney, George Gessert, Eduardo Kac, Maja Kuzmanovic, Diane Ludin, Marta de Menezes, Anna Munster, Melenti Pandolovski, Michalis Pichler, Liljana Simjanovska (Jankovic), Niki Sperou, Mike Stubbs, Eugene Thacker, Zoran Todorovic, Polona Tratnik, Raewyn Turner, Tanya Visosevic, Adam Zaretsky, Ionat Zurr. See also <http://www.eaf.asn.au/biotech/symposium.html> and <http://www.eaf.asn.au/biotech/biotech.html>

⁵¹ SymbioticA Workshops: <http://www.symbiotica.uwa.edu.au/activities/workshops>

⁵² ORLAN Artist Residency *SymbioticA*:
<http://www.symbiotica.uwa.edu.au/residents/orlan>

⁵³ *Technebiotics Workshop* Available at: <http://philross.org/#projects/events/technebiotics/>
<http://philross.org/#projects/critter/>

⁵⁴ Damien Hirst webpage: www.damienhirst.com

⁵⁵ <http://news.bbc.co.uk/2/hi/3040891.stm>

⁵⁶ <http://www.evaristti.com/marco/helena.html>

⁵⁷ *Diaspora Monopoly* (2012) also alludes the generation of a gallery space as a site for wilderness and conservation, such as the frog pond and city orchard set up outside the Art Gallery of Western Australia: This activity demonstrates a meeting between public

interest in sustainable practices/self-sufficient gardening and government infrastructure via Department of Culture and the Arts.

⁵⁸ <http://au.news.yahoo.com/queensland/a/-/world/13343624/humans-forcing-birds-to-sing-louder/> April 4, 2012, 1:11 pm

⁵⁹ Henrietta Lacks: <http://www.lacksfamily.com/>
<http://henrietalacksfoundation.org/#lacks-family>

⁶⁰ “English artist Laura Ciniti, engineers a hilarious hoax under the guise of respectability provided by *New Scientist* magazine” (Sperou, 2008, p. 92 citing ‘Art but not as we know it: Interview with Oron Catts, Laura Ciniti and Marta De Menezes’, 2004, *New Scientist*, 28 February, p. 44)

⁶¹ Also see: Bresner, K. (2013). *Othering, Power Relations, and Indigenous Tourism Experiences in Australia’s Northern Territory*.
http://www.academia.edu/349133/Othering_Power_Relations_and_Indigenous_Tourism_Experiences_in_Australias_Northern_Territory

⁶² This is the second misinterpretation of *Diaspora Monopoly* (2012) as being constructed using artificial plants. The other comment came from an international student, who had grown up in a city context. Is this a sign that there are fewer encounters with natural environments? It raises the question as to whether there are any authentic environments left.

11.0 Appendices A-C

Appendix A

George Gessert, Tissue Culture & Art, Stephen Wilson, Eduardo Kac, and Brandon Ballengée

George Gessert <http://www.geneart.org/gessert.htm> and http://viewingspace.com/genetics_culture/pages_genetics_culture/gc_w02/gc_w02_gessert.htm Current publication: *Green Light: Toward an Art of Evolution*. MIT Press <http://mitpress.mit.edu/authors/george-gessert>

Tissue Culture and Art (TC &A) <http://www.tca.uwa.edu.au>

Stephen Wilson <http://userwww.sfsu.edu/~swilson/>

Eduardo Kac <http://www.ekac.org/>

Brandon Ballengée <http://brandonballengee.com/>
http://www.greenmuseum.org/content/artist_index/artist_id-19.html

Additional Artists (Alphabetical Order)

Suzanne Anker <http://www.suzanneanker.com>

Guy Ben-Ary with Stuart Bunt (*Fish and Chips*) Tania Visosevic, and Bruce Murphy (*Bio-Kino*) http://www.synapse.net.au/people/guy_ben-ary, www.fishandchips.uwa.edu.au and www.biokino.net

Boo Chapple <http://residualsoup.org/boo-chapple.html>

Verena Friedrich <http://www.symbiotica.uwa.edu.au/residents/Friedrich> and <http://www.heavythinking.org/>

Beatriz Da Costa <http://www.beatrizdacosta.net/>

Nöle Giulini <http://www.ngiulini.com/index.html>

Steven Kurtz <http://www.critical-art.net/>

Kira O'Reilly <http://www.kiraoreilly.com/>, <http://kiraoreilly.com/blog/> and <http://www.animalarchitecture.org/kira-o%E2%80%99reilly/>

Perdita Phillips <http://www.perditaphillips.com/>

Julia Reodica <http://phoresis.org/> and <http://eyebeam.org/people/julia-reodica>

Ken Rinaldo <http://kenrinaldo>

David Rockeby with Eric Samakh <http://homepage.mac.com/davidrockey/pt.html>

Phillip Ross <http://www.philross.org/> CRITTER <http://philross.org/#projects/critter/>

Technebiotics Workshop <http://philross.org/#projects/events/technebiotics/>

SubRosa <http://www.cyberfeminism.net/>

Paul Thomas <http://www.visible.space.com/>, <http://crash.curtin.edu.au/> and <http://mass.nomad.net.au/>

Paul Vanouse <http://www.contrib.andrew.cmu.edu/~pv28/> and <http://www.visualstudies.buffalo.edu/graduate/mfaEP.html>

Jennifer Willet, Shawn Bailey and Jason Knight *Bioteknica*
<http://www.drunkenboat.com/db8/panlitwebart/bioteknica/bioteknicafiles/index.html> and
<http://www.symbiotica.uwa.edu.au/residents/knight>

Adam Zaretsky <http://www.fondation-langlois.org/html/e/page.php?NumPage=24>

Art-Science Spaces

ANAT <http://www.anat.org.au/>

Arts Catalyst www.artscatalyst.org

Arts Council England www.artscouncil.org.uk

Arts and Genomics Centre artsgenomics.org

Artistsinlabs <http://www.artistsinlabs.ch/>

CADRE Laboratory for New Media <http://cadre.sjsu.edu/>

C-Lab c-lab.co.uk/home.html

Disonancias <http://www.disonancias.com/en/>

Ectopia Director: Matra de Menezes <http://ectopia-lab.blogspot.com.au/>

Hexagram <http://www.hexagram.org/spip/index.html>

INCUBATOR: Director: Jennifer Willet www.incubatorartlab.com

Interactive Institute <http://w3.tii.se/>

Leonardo ISAST www.leonardo.info

Leonardo OLATS www.leonardo.info/olatsinfo.html and www.olats.org

Montalvo Arts Centre montalvoarts.org

SymbioticA: Centre for Excellence in Biological Arts <http://www.symbiotica.uwa.edu.au>

Exhibitions

BEAP02 BioFeel <http://www.symbiotica.uwa.edu.au/activities/exhibitions/biofeel> and <http://mass.nomad.net.au/biennale-of-electronic-arts-perth-beap/> and <http://mass.nomad.net.au/wp-content/uploads/beap/2002>

BEAP04 BioDifference

<http://www.symbiotica.uwa.edu.au/activities/exhibitions/biodifference>

Exhibited the work *Bioteknica* by Jennifer Willet and Jason Knight, Shawn Bailey, and <http://mass.nomad.net.au/beap-2004-catalogue/>

SymbioticA Exhibitions 2002-2014

<http://www.symbiotica.uwa.edu.au/activities/exhibitions>

SymbioticA Biotech Art Workshops locations and affiliated sites

Experimental Art Foundation (2004), Australia

The Biennale of Electronic Arts Perth BEAP2004, Perth, Australia. (20-24 September 2004)

Kings College in London with Arts Catalyst, London, UK (28 March-2 April 2005)

Wollongong University, Australia (June 20-24 2005)

The University of California Irvine, USA (10-14 October 2005)

Srishti School of Art, Design and Technology and the National Centre for Biological Sciences, in Bangalore, India, with Arts Catalyst. (10-14 March, 2008)

ARTICLE 08 - Biennale for electronic and unstable arts, Stavanger, Norway (18 - 21 November 2008)

Perth Institute of Contemporary Arts (PICA), as part of HATCHED 09 (18 April 2009)

RMIT, Melbourne, Australia (16-20 November 2009) Retrieved from:
www.symbiotica.uwa.edu.au

SymbioticA Residents

<http://www.symbiotica.uwa.edu.au/residents>

Symposiums

<http://www.symbiotica.uwa.edu.au/activities/symposiums>

Appendix B

The Scientific Creativity Initiative Program: Gary Cass



Background

“I am not creative, so I cannot be an artist!”

This is the response of myself and many other scientists in the community, young or old, when asked if they are an artist. Why? Why are artists the only ones that are perceived as the creative ones? Why can't scientists be creative? Actually, I believe that the sciences and arts are both creative and it is collaborations between these two disciplines that will produce the most extraordinary, and visionary outcomes in the future. This will generate critical thinking, originality and creativity, leading to informed decisions that will take us into a future that is fast becoming unpredictable.

“In today's rapidly changing world, people must continually come up with creative solutions to unexpected problems. Success is based not only on what you know or how much you know, but on your ability to think and act creatively” (Resnick 2007).

For many years now I have been labeled a scientist because I work in a science lab. I have a science degree and I know a bit about many of the sciences disciplines; therefore I am scientist. Well at least in the world's eye, I am scientist. But recently I have realised, I think and work differently to many other scientists, in fact, I think and work differently to many other people. Not only do I work in the sciences, I am also lucky to now work in the arts. I have collaborated with many artists in many art spaces, producing and exhibiting creative pieces¹. These pieces include everything from converting the DNA code into a musical code, human-cyborgian interactions and dress made from the bacterial ferment of wine. One has to question whether these pieces are art or science. What is art? What is science? Can one say that a piece of work is art if exhibited in an art space or a science piece if exhibited in a science space? (Cass, 2010)

Many of our pieces contain a sizable amount of science and are increasingly being exhibited in public science spaces, e.g. Science Gallery at Trinity College, Ireland; a

place where ideas meet and opinions collide². The sciences - like the arts have been doing for centuries - are finally opening their doors for public scrutiny.

When my colleagues and I exhibit our creativity pieces, the public perception is that my artist colleagues are the creative minds and I, the scientist, am just the technician. But this could not be further from the truth - both artist and scientist have an equal input into all facets of the project from original concept to finished product. Therefore the scientist expresses equally contributes much to the creative thinking about the piece. Almost always when exhibiting our creative pieces, the media requests an interview with the artist, the creative one (?), whom they believe the public wants to read about. It is time for a change; it is time to show the world that scientists are creative too. Society seems to condemn this type of scientific creative thinking, my way of thinking, as an oxymoron, unconventional and too hard to brand with a specific genre. And believe that these radical thinking types of individuals are too unpredictable and too hard to manage in a compartmentalised education system. Our schools, with their cataloguing of students into linear academic trajectories, label individuals as specialists in one area. (Cass, 2010)

It is believed those who think with the left hemisphere of the brain fall into the humanities, arts and social sciences specialty and that those who think with the right hemisphere belong to the specialty labeled, sciences, mathematics, engineering and technology. There is no box for the thinkers who combine both hemispheres, who have been unfortunately discarded by a system that until now failed to recognise cross-disciplinary and holistic thinkers Artists are aware of their feelings and emotions; where scientists, having this ability, are too blinded by intellect to allow it to materialize. These emerging emotional intellectuals may be the creativity thinkers of today that will shape tomorrow. (Cass, 2010)

Scientific creativity and diversity are crucial for the future of our educational system. With an exponential increase of technologies such as nano, bio, artificial intelligence and other emerging technologies, we need to make sense of where we are going. Let's reform our education system now, before it is too late, allowing for a more organic and diverse model to prevent schools from killing creativity (Robinson 2006). (Cass, 2010)

1. www.bioalloy.org

2. www.sciencegallery.com

The Scientific Creativity Initiative: Dana Perks, Chloe Britton and Gary Cass.

The Scientific Creativity Initiative applies boundary spanners to bridge and re-align traditional academic boundaries. It will inspire new thoughts and endeavours through art/science collaborative strategies that embrace and incorporate science, mathematics, engineering and technology, with the humanities, arts and social sciences. Scientific creativity programs must be specifically designed to encourage the cross pollination of knowledge and creativity amongst various disciplines. Partnerships of people from different disciplines are the very people which give us the most promising outcomes for the future (Metcalf *et al* 2006). A possible re-introduction of philosophy and cultural theory into the sciences makes sense, to give the practitioners the opportunity of developing new ways of thinking about the future scientific and social implications of their research. This also provides a dynamic site of exchange and encourages the application of critical thinking, creativity and originality with a multimedia approach. This educational philosophy echoes the UN's Decade of Education for Sustainable Development (2005-2014) facilitated by UNESCO. (Perks, Britton and Cass, 2010)

To integrate the traditional educational scheme with new pedagogical strategies to encourage:

- Interdisciplinary and holistic learning rather than subject-based learning
- Values-based learning
- Critical thinking rather than memorizing
- Risk taking and problem solving
- Creative and original thinking
- Good communicating
- Participatory decision-making
- Utilizing multi-method approaches: word, art, drama, debate, etc. (Perks, Britton and Cass, 2010)

The Scientific Creativity Initiative is one way of bridging the gaps between a compartmentalised educational system, allowing future students to become more interdisciplinary with a broader knowledge base. This initiative will expand student's horizons, engaging with subjects that were thought traditionally not to be complementary. We need students to recognise that there is synergy between academic disciplines, and that too much specialisation may lose sight of the big picture. We become the smallest of branches on an ever-dividing tree. And if we become too specialized we are in danger of

snapping off and falling to the ground (Osborn 2009). To reinforce in society that there are sometimes greys in a world that likes to think in black and white. Our goal is to increase wisdom by being more inclusive and open. (Perks, Britton and Cass, 2010)

“Wisdom first begins with wonder and it starts young” Socrates

Our vision is to excite and engage students in both the sciences and arts, with an outcome of creativity. The Scientific Creativity Initiative has successfully piloted one of its programs, the “Abiogenesis” unit. This initial series of lectures and labs covered the geological and organic formation of the Earth and associated arts, trying to understand the theory of abiogenesis. Two more units will be developed in the future to expand and broaden the combined sciences and arts creativity knowledge base. The second unit, teaching “Evolution” will be designed to cover organic development from single celled, to multi-cellular, to death, with associated arts. The third unit “Cyborgian Systems” will embrace one possible futuristic vision of the Earth, the organic and inorganic as one entity, with associated arts. The three units are designed to engage with the past, present and future of the Earth as a living entity. (Perks, Britton and Cass, 2010)

3. <http://www.unesco.org/en/esd>

Pilot Unit Curriculum and Feedback from students

THE SCIENTIFIC CREATIVITY INITIATIVE

“ABIOGENESIS”

Dana Perks, Chloe Britton and Gary Cass

At Shenton College & University of Western Australia

Introducing Scientific Creativity

The “Abiogenesis” program of the Scientific Creativity Initiative was piloted in early 2010 at Shenton College. The program encompassed a narrative based pedagogy, through scientific and artistic engagement, with one of the theories of abiogenesis. Abiogenesis is the theory and research on how life began on Earth; how the inorganic became organic. Students were exposed to many different cross-disciplinary subject matters and practices, encouraging critical examination. Each student critically and creatively theorised how inorganic rocks became self-maintaining, autonomous and self-replicating.

The generation of life! The outcome of the program was for students to produce a creative piece, exhibiting their scientific and artistic interpretation of abiogenesis to the public. (Perks, Britton and Cass, 2010)

Delivering the Abiogenesis Program

The schedule of the unit, running over a semester, by means of a series of science lectures and practical with accompanying art practices, allowed the students to creatively engage with abiogenesis. The sciences associated with this theory included geology, crystallography, molecular biology, bubble/cellular chemistry, microbiology and genetic engineering. The art practices incorporated crystal art, code art, bubble sculpture and painting with living organisms. (Perks, Britton and Cass, 2010)

Having immersed themselves in these science ideas, the students then faced the challenge of communicating their own interpretation of these ideas with a creative piece. With reference to some cutting edge examples of arts/science practice around the world, the students were encouraged to question the boundaries of practice in science communication. These creative works spanned the fields of poetry, rock art paintings, sculptures, a dance, living art, music and the aesthetics of life's mathematical plan! (Perks, Britton and Cass, 2010)

The project culminated in an exhibition held in the school library. The Chief Scientist of Western Australia, Professor Lyn Beazley, opened the event. The 'Dancing Crystals' performed their dance, the DNA musical pieces were performed live and then the parents, teachers and special invited guests were wowed by the visual arts on display. (Perks, Britton and Cass, 2010)

Assessing Student Work

The assessment of scientific creativity has been identified as problematic. It is easy to evaluate good science from bad science but how does one judge good art from bad art? (S. Bunt personal communication). In an attempt to overcome this problem, students had to submit a written interpretation about their creative piece (see abbreviated examples at the end of this article.) Each student to help improve his or her science communication skills also presented a five-minute speech. As the course was interdisciplinary and holistic, assessment was based on creativity, rationality and visionary ideas with multimedia approaches. An assessment guide was applied to each project regarding its

creativity and originality, risk taking and problem solving, communication skills and the ability of the project to cross-disciplinary boundaries. On the basis of these criteria students deliberately chose ideas and media they were less familiar and less confident with, which made their journey a truly rewarding challenge. The 'Dancing Crystals', for example chose to communicate their findings via dance because they had considered themselves non-dancers. (Perks, Britton and Cass, 2010)

Feedback from Students and Teachers

For the students involved the novel approach re-invigorated their interest in their science studies. This was an opportunity to think freely where flexibility and creativity was valued over concrete retention of facts. Using emotional intelligence to understand scientific theories allowed students to connect with the ideas on a different level and translate their understanding with new confidence, the 'Dancing Crystals, for example "brainstormed the emotions that went with each of the stages of abiogenesis and the movements that would match". For others the challenge of questioning the label 'scientist' and stereotypical 'scientific' thinking was the most engaging aspect of the program. (Perks, Britton and Cass, 2010)

The teachers were impressed with the passionate and ongoing commitment of their students to the course. The pilot program was run outside school hours and students made a significant time commitment to be involved. They arrived each week with new questions and exponential curiosity. Teachers commented that the course had tapped into a well of student enthusiasm that exceeded expectations. (Perks, Britton and Cass, 2010)

Teacher Resources

Future developments of the *Scientific Creativity Initiative* such as the "Abiogenesis" program will include teaching resources available as a hard copy or online. This will allow teachers to use the resource as a whole, or choose appropriate Chapters that suit individual teaching requirements. Teachers can then tailor the resources to their own timetable. By using fragments of the program, teachers can directly target appropriately linked items in the curriculum. Many high schools may find the scientific creativity program is a novel way to challenge their students and promote a rich engagement with science and other learning areas. (Perks, Britton and Cass, 2010)

Further Information:

The Scientific Creativity “Abiogenesis” program can contribute to senior secondary students' WACE completion requirement through the Curriculum Council's generic personal development program 'Recreational Pursuits'. (Perks, Britton and Cass, 2010)

Student and Teacher Testimonials:

“It was a challenge to express science artistically, but I loved that you could choose to do it however you wanted” Year 11 Student

“The art bit was a huge challenge for me - it did help me to think differently” Year 11 Student

“I had such a fantastic time because I could combine the two things I’m most passionate about in one elegant response!” Year 11 Student

“The course inspired both my intellect and my imagination. It helped me bring a new perspective to some of my class work.” Year 11 Student

“The continuing enthusiasm and commitment of the students to the course amid all their many academic and other activities was testament to the impact of this course”

Chloe Britton, Teacher, Shenton College

“The Scientific Creativity Initiative Abiogenesis Program has been a magnificent opportunity to support cross-curricular work in the senior years at Shenton College. It's important to recognise that creativity is worthwhile across the disciplines.” Chris Hill, Deputy Principal, Head of Gifted and Talented Education (2010) (Perks, Britton and Cass, 2010)

Examples of Student’s Scientific Creativity: (from 2010 pilot course)

Musical DNA

Paper, keyboard

The idea for translating genetic coding into music was appealing to me, I have played music from a young age and it has been done numerous times, as shown by the many examples on the internet. Because us humans are what we call “the most evolutionally

advanced” species at this particular moment in time, I began to think that it would be interesting to convert both the human and the *cyanobacteria*’s 16S ribosomal DNA to music and to compare the two musically. (Perks, Britton and Cass, 2010)

Abiogenesis-a crystal dance

Our art piece uses body movement to convey our ideas responding to the theory of Abiogenesis. It begins in a world of extreme atmospheric conditions, as fire and ice fight for dominance over the world leaving it an intense 200oC in the sun and - 200oC in the shade. We symbolised the two extremes with the levels we use to symbolise a power relationship between hot and cold, when one was strong the other was inferior and pushed into a small space low on the ground. The DNA entered the bubbles forming the first living cell which is when we each connect at the finale of the crystal dance. (Perks, Britton and Cass, 2010)

Living Poetry

Non-pathogenic E. Coli, agar plates, Petri dishes,
50x50 mirror, cardboard boxes

Using poetry we reflect on the key concepts covered throughout this course. This project seeks to use nature as a way to reflect on science. In this project we explore the concept of autopoiesis, when an organism is self-maintaining, autonomous and self-repeating. Autopoiesis literally translates to ‘selfpoetry’ or ‘self-making’, and that’s exactly what we’re trying to represent here. The mirror juxtaposes bacteria with human life to convey a biological then-and-now, while the cardboard boxes in different shapes and sizes show the diversity of life on Earth. (Perks, Britton and Cass, 2010)

Life is Just Peaches and Cream

Fruit puree, plastic tubing, wood

Our DNA contains the instructions that specify for every part of us and make us who we are. It codes for every breath and every heartbeat, and is the source of all life. But what makes up out DNA? Nitrogen, sugars, phosphates, all things that we obtain from food. Food, the basis of all life, giving us nutrients and energy, all the things we couldn’t live without. So if life is from DNA and DNA is essentially from food, then is life literally just peaches and cream? (Perks, Britton and Cass, 2010)

For images of artworks see:

http://www.bioalloy.org/images/the_sci/scientific_creativity_initiative.pdf

Appendix C

Curatorial Exhibition: Creatures of the Future Garden

Appendix C.1

The 'Made Generation' Collective

The 'Made Generation' installation will challenge the public's perception of a future driven by biotechnological advances. The 'Made Generation' will be a future generation of living organisms, including humans, on Earth that are created by scientific technologies. With the unravelling and understanding of the coded strands of life, a controlled print run of life will be achieved. DNA, common to all living organisms, is the strand that will allow a scientifically directed future. With increasing knowledge, sophisticated genetic engineering and the ability to cross the species boundary, the chimerical combinations of living possibilities are endless. By stripping creatures down to their molecular nudity, the rebuilding of a future biological world can begin, leading to a 'create your own' genetic future where advances in technology will control biological processes by constructing genetic mutants. One will stand in wonderment of the miraculous creepy crawlies that will creep across the world but in sadness with that, for what was lost. Can we look forward to it or backwards for it? I hope the romance of the past does not blur the possibilities of the future. (Cass, 2012, p. 43)

Appendix C.2

Trish Adams Background Research to HOST (2011); Machina carnis (2002)

When I discovered an abandoned kymograph, I traced the historical origins of this archaic machine for measuring physical and nervous impulses. [1] It inspired me to create art/science projects that referenced galvanics and nineteenth century experiments into electrical stimulation of tissue. I parodied early scientific attempts to quantify the human body that used the 'new technologies' of the day by such pioneers as Carlos Matteucci. [2] During this period, I read an article from a 1999 issue of the journal: *Science*, which declared that pluripotent adult stem cell research was the scientific 'breakthrough' of the year. [3] This article described how recent biomedical research into adult stem cells indicated that some adult stem cells had the ability to become different kinds of cells. This ground breaking research resonated with my own explorations since it suggested potentials to fundamentally change the very structure of our bodies at a

cellular level. In order to investigate this exciting theory I began my *machina carnis* project in 2002 by collaborating with an adult stem cell research scientist: Dr. Victor Nurcombe. (Adams, 2012, p. 23 -24)

The *machina carnis* scientific process began in when a doctor took a sample of my blood from which we could separate and culture the stem cells under laboratory conditions. After three days in culture the drug 5'AZT was added to induce the adult stem cells to become distinctive, muscle-forming cells. At the same time a mixture of cardiac differentiating factors, with a proprietary molecule, were also added in order to change the undifferentiated adult stem cells into cardiac cells. In response to Dr. Nurcombe's unique chemical mix the some of the adult stem cells reproduced, matured and began to develop characteristics of cardiac cells. After the laboratory experiments were completed, I reviewed the digital video micrograph scientific image data and recontextualised it in the form of an interactive installation in 2006. My aim was to create a sensual reading of the scientific experience and draw each participant into an individual relationship with the *machina carnis* artwork. The installation employed open-ended methodologies that encapsulated manipulable systems where the boundaries between the body and its environment were in a constant state of interplay and flux. (Adams, 2012, p. 23 -24)

During laboratory experiments on my adult stem cells I felt that looking at my cells through the microscope was like looking into another world where I was able to make first-hand observations in a domain of nonhuman 'others'. The characteristics of the cells, observed at a microscopic level, highlighted issues relating to corporeality, sentience and cellular 'consciousness.' With the aim of finding out more in this field, I became an artist in residence with Professor Mandyam Srinivasan at the Queensland Brain Institute. [4] I observed experiments being carried out on the 'cognitive' capacities of the European honeybee's small brain. (Adams, 2012, p. 23 -24)

Appendix C.3

DNA Portrait of Rosalind Franklin (2011) by Sasha Whittle

This portrait of Rosalind Franklin is in recognition of her direct contribution to the decoding of the structure and understanding of the molecule that carries the secrets of life, DNA (DeoxyriboNucleic Acid). Rosalind was a scientist racing in an undeclared race, and received little credit during her life. Her initial scientific contributions can now be seen to have influenced many new discoveries, not only in the sciences, but also now in the arts. Her capable, passionate and independent character made her a woman before her time, and someone I admire. This piece was made using strands of fibrous DNA, the actual molecule that Rosalind helped discover. I hope this portrait will honour Rosalind's memory and her contribution to one of the greatest biological discoveries. (Whittle, 2011)

As a contextual background to Whittle's statement above, as published by the *Science Museum Brought to Life: Exploring the History of Medicine*:

Rosalind Franklin's [1920- 1958] X-ray diffraction studies contributed to the double helix model of the molecular structure of DNA. Franklin had studied physical chemistry at Newnham College, Cambridge. She received her PhD in 1945 for research into the small-scale structures of coal and carbons. As a postdoctoral researcher in Paris, she became familiar with the use of X-ray diffraction as a method for analysing molecular structures. Working at King's College London, from 1951 to 1953, she applied this technique to DNA. Without her knowledge, one of the resulting X-ray images and a report on her work were passed on to Francis Crick and James Watson at the Cavendish Laboratory in Cambridge. This information helped the two Cambridge researchers to develop the double-helix model of DNA.

Later, Franklin investigated other structures, especially the tobacco mosaic virus. Diagnosed with cancer in 1956, Franklin did not live to see the Nobel Prize awarded to Crick, Watson and Maurice Wilkins, her former colleague at King's. Since her death, there has been debate over whether her contributions to the discovery of the double helix were properly acknowledged. Some of Franklin's friends and colleagues were particularly enraged by James Watson's portrayal of her in his 1968 account, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*. (Anonymous, 2013).



Figure 89: Sasha Whittle, (2010), *Rosalind Franklin Portrait*, DNA, Perspex, card, glue, 12cm x 12cm. (Exception to copyright. *Section:* ss40, 103C. *Exception:* Research or study.)



Figure 90: Sasha Whittle, (2010), *Rosalind Franklin Portrait*, DNA, Perspex, card, glue, 14cm x 14cm. Agent General of Australia Kerry Sanderson AO presents the Principal of Kings College, Professor Sir Richard Trainor KBE with the portrait, in Kings College London. (Exception to copyright. *Section:* ss40, 103C. *Exception:* Research or study.)

Web link to Article: <http://www.wago.co.uk/index.php/news/general-news/wa-portrait-to-hang-in-london.html>

Appendix C.4

Exhibiting Artists Biographies

Trish Adams

Trish Adams is currently a Postdoctoral Research Fellow, RMIT University School of Art, Melbourne. She has worked at the art/science nexus for over twelve years. Her doctoral research project: *machina carnis*, involved a cross-disciplinary collaboration with a biomedical scientist at The University of Queensland, during which she explored the impact of experimental techniques in biomedical engineering on expressions of corporeality. Through a controversial 'first-person' scientific methodology Trish personalised her engagement with the scientific data, and was the first artists to take unscreened adult stem cells from her blood as source material for her experiments. (Adams, 2012, p.54)

Through her research and artworks, Trish poses questions about what it means to be human in the twenty-first century, and the ways in which our understanding of ourselves will be changed by contemporary bio-technological developments. Her ongoing interest in corporeality and constructs of the "self" led her to the Visual & Sensory Neuroscience Group, Queensland Brain Institute, The University of Queensland, where she was a visiting artist from October 2007 – October 2011. During this residency she participated in experiments on cognition and navigation strategies in the European Honey bee. In the recent *mellifera* project, this honeybee research was incorporated into explorations into digital "presence" in Second Life and real-time and virtual participant interactivity. Other artworks, such as HOST, have highlighted the ecological issues faced by the endangered honeybees and contemporary explorations into inter-species proximity - topics Trish continues to explore in her upcoming projects. In addition to her artworks Trish has presented her research outcomes through publications and at conferences such as: *New Constellations: Art, Science & Society*, M.C.A. Sydney, 2006; Perth Digital Art & Culture Conference, 2007; ISEA2008, Singapore; *Eye of the Storm*, Tate Britain, U.K. 2009; *Virtual Anatomies*, The University of Queensland, 2011; ISEA2011, Istanbul, Turkey and Rewire2011, Liverpool, U.K. (Adams, 2012, p.54)

<http://www.trishadams.tv>

Tarsh Bates

Tarsh Bates studied biotechnology and environmental science at Murdoch University and contemporary sculpture and performance at Edith Cowan University. She recently completed a Master of Science (Biological Art) and is currently a PhD candidate at SymbioticA, UWA. Her 2011 solo durational installation/performance *in vitro* contributed to her MSc (BA) and was enabled by a residency at PICA. Selected group exhibitions include: *sentience*, Kurb, Perth (2012); *The Conservatorium*, Paper Mountain, Fringe Festival, Perth (2012); *books and boats*, spECtrUm Project Space, Perth (2005); *Sculpture Survey 2004*, Gomboc Gallery Sculpture Park, Perth (2004); and *String Me A Story: An exhibition of hand plied string and text*, spECtrUm project space, Perth (2004). Selected performances include *the descent of man*, SymbioticA, Perth (2010); *bare*, tripart collaborative performance with Brooke Zeligman, Claire Canham and Emma Paterson, *d&k presents*, PICA, & FreeRange Gallery, ARTopia Festival, Perth (2005); and *live art by*, collaborative live performance, *The Midland National Review of Live Art*, Perth (2003). Tarsh has also participated in workshops & performances with international artists, including Richard Layzell, lone twin, Shilpa Gupta & Sarah-Jane Pell. (Bates, 2012, p. 55)

<http://invitero.tumblr.com>

Jesse Brown

My name is Jesse Brown: I am seventeen years old and attend Balcatta Senior High School. I am a WACE student who is considering a career in the arts. I consider art as a form of expression and when considering certain social and political issues, my artworks tend to reflect upon both my identity as well as the world around me. For example, some of my artworks focus on social issues like cancer, anxiety and depression. My artworks have been featured in the first *Metamorphosis* exhibition and the *2011 Young Originals* exhibition. My friends and my life itself influence my work and my urge to create confronting artworks reflects my passion for expression. (Brown, 2012, p.55)

Gary Cass

Born 1966, Scotland. Arrived Australia 1975. Lives and works in Perth. Gary Cass has been a key scientific collaborator with numerous art and science projects based at the University of Western Australia (UWA), contributing a vast range of skills in agricultural

and biological sciences to ongoing research projects. Cass is a founding member of *Bioalloy*, an ongoing research endeavor into artistic Cyborgian systems developed in the FNAS laboratories at UWA. Beginning with the idea of designing and creating a machine that incorporates a living system that grows and nurtures its own 'skin', *Bioalloy's* research into the co-existence of a Cyborgian system and the human body led to a collaboration with performance artist S. Chandrasekaran and contemporary artist Donna Franklin. Cass' collaborative projects with Chandrasekaran have been exhibited around the world, as a fringe event at the Venice Biennale and Documenta, Biennale of Electronic Arts Perth (all inclusive 2007); Chandra and Cass were awarded the Signature Art Prize 2008 in Singapore; and ArtStays Slovenia, 2010. Cass has also coordinated and run Biosciences and Arts Workshops at festivals and universities across the world. Cass is the Director of *The Scientific Creativity Initiative*, with a vision to excite and engage students through an induction of creative thinking into the sciences. Knows a little bit about science, a little less on safety and probably nothing about art! (Cass, 2012, p. 56)

www.bioalloy.org

Suzanne Cass

Suzanne Cass was born in Canberra, Australia in 1966 and now lives in Perth, Western Australia with her husband and two boys. She graduated with a Bachelor of Science from the Australian National University and has had a varied career working mainly with Government agencies, in jobs that ranged from Laboratory Technician to Administration. Writing and art have always been her passions and have manifested as hobbies throughout the last twenty years of her life. She has been an author, or co-author on several projects, consisting of an illustrated children's book, a sci-fi thriller and most recently was prompted to write her first complete novel, an adventure romance called *Bronze The Sky* expressing her fascination of the tough resilience shown by the people and echoed in the amazing county that is outback WA. (Cass, 2012, p. 56)

George Gessert

George Gessert does visual work and writes. He has exhibited widely in North America, Europe, and Australia. His writings have been included in many reviews and books. In 2005, he was awarded a Pushcart Prize, and in 2007 was included in *Best American Essays*. *Green Light*, a collection of notes on bioart, was published by MIT Press in 2010. From 1985 to the present, his work has focused on the overlap between art and

genetics. His exhibits often involve plants that he has hybridized, or documentation of breeding projects. He is especially interested in plant aesthetics and ways that human aesthetic preferences affect evolution. He has exhibited at New Langton Arts (San Francisco), Vasarely Museum (Budapest), the San Francisco Exploratorium, the Smithsonian Institution, Exit Art (New York) and many other places. (Gessert, 2012, p. 57)

Alexandra Daisy Ginsberg

Alexandra Daisy Ginsberg is an artist, designer and writer, interrogating science, technology and new roles for design in a biotech future. As Design Fellow on Synthetic Aesthetics, an NSF/EPSRC-funded project at Stanford University and the University of Edinburgh, she is curating an international program researching synthetic biology, art and design, investigating how we might 'design nature'. (Ginsberg, 2012, p. 58)

Other works include *The Synthetic Kingdom* (2009), a proposal for a new branch of the Tree of Life; *E. chromi*, a collaboration with James King and Cambridge University's grand-prize-winning team at the 2009 International Genetically Engineered Machine competition (iGEM) and a science fiction short story – *The Well-Oiled Machine*, co-written with Oron Catts while resident at SymbioticA, Center for Excellence in Biological Arts, at The University of Western Australia in 2009. Daisy taught both the ArtScienceBangalore and Cambridge University iGEM teams in 2009. Most recently, Daisy designed 'Synthesis', a one-week, intensive synthetic biology lab workshop for artists, designers, scientists and others, in collaboration with The Arts Catalyst, UCL, SymbioticA, and Synthetic Aesthetics, funded by The Wellcome Trust. (Ginsberg, 2012, p. 58)

Daisy studied Architecture at Cambridge University, Design at Harvard University, MA Design Interactions at the Royal College of Art. Her work has been exhibited at MoMA NY, The Art Institute of Chicago, The Wellcome Trust, London's Design Museum, the Israel Museum and the National Museum of China. Daisy published, teaches and lectures internationally: recent talks include TEDglobal and PopTech. (Ginsberg, 2012, p. 58). Her work has been nominated for the Brit Insurance Designs of The Year 2011, the Index Award 2011 and she is the recipient of the World Technology Award (Design) 2011. (Ginsberg, 2012, p. 58)

www.daisyginsberg.com

Kirsten Hudson

Kirsten Hudson is a practicing artist and academic based in Western Australia. She is currently employed as a lecturer in the School of Design and Art at Curtin University. Interested in critiquing dominant paradigms and ideologies surrounding subjectivity, embodiment and sociality, Hudson's research to date has focused on disrupting and resisting historical constructs of femininity. Employing the metaphors of the baroque and the gothic, Hudson's creative practice includes performance; video and object-based works made predominantly from sugar. (Hudson, 2012, p. 59)

www.artificialsweetness.com

Svenja J. Kratz

Svenja Kratz is a contemporary Brisbane-based artist interested in interdisciplinary practice, particularly the intersections between science and art. For the past five years, she has been working in the area of cell and tissue culture at QUT's Institute of Health and Biomedical Innovation (IHBI). During this time, she has produced an evolving series of mixed media exhibitions collectively titled *The Absence of Alice*. The title refers to her early experiences culturing a cell line derived in 1973 from the bone cancer lesion of an 11-year old girl, called Alice. All subsequent exhibitions map the creative evolution and movement of this initial engagement into other areas of applied biology, including genetic engineering and primary culture of human and fetal calf cells. She is currently finishing her PhD in contemporary art and biotechnology at QUT and works professionally as a contemporary artist and laboratory/research assistant in biochemistry and microbiology. (Kratz, 2012, p. 59)

<http://svenjakratz.com/>

Nicholas Lozanovski

Born 1995, Perth, Western Australia. Nicholas Lozanovski aged 16 is currently attending Balcatta Senior High School. He is in his final year of school studying TEE, including Art. Nick plans on going to University to study in the field of the arts in the hope of pursuing a career in this area. Nick's reason for choosing this career path is simply that it is his key interest. He has won many awards over the course of high school since Year 8 and has also had his own extra-curricular artwork presented at exhibitions outside of school including the *Young Originals* in 2010. The friends, family and even teachers Nick says he has, have all played a part in helping shape this area of himself. Apart from this

interest in art, Nick is like most regular teenagers eager to finish school, go out and have some fun. (Lozanovski, 2012, p. 60)

Angela Singer

Angela Singer is a British artist based in New Zealand. From the mid-1990s onward her artworks have explored the human–animal relationship, calling into question the unnecessary violence humans subject animals too, the notion that people are superior to other species, and particularly commenting on the needless death of hunted animals. Since 1997, Singer has had nine solo exhibitions and numerous group showings. (Singer, 2012, p. 60)

Her exhibitions include *The Enchanted Palace*, Kensington Palace, London, UK; *The Enchanted Forest*, Strychnin Gallery, Berlin, Germany and *Musei Civici*, Reggio Emilia, Italy; *Idea of the Animal*, RMIT Gallery, Melbourne International Arts Festival, Australia; and *Animal Nature*, Regina Gouger Miller Gallery, Carnegie Mellon University, Pittsburgh, USA. Her exhibitions this year include *Unnatural Natural History* at the Royal West of England Academy (RWA), UK; *Rogue Taxidermy* at La Luz De Jesus Gallery, Los Angeles, and *Controversy: The power of Art* at the Mornington Peninsula Regional Gallery, Victoria. (Singer, 2012, p. 60)

Singer's work has been discussed and featured in a variety of books, magazines and journals; recent books include *The Breathless Zoo: Taxidermy and the Cultures of Longing* (2012), *Art and Animals* (2011), and *Considering Animals: Contemporary Studies in Human–Animal Relations* (2011). Singer received an MFA from the University of Auckland, New Zealand in 2002. (Singer, 2012, p. 60)

www.angelasinger.com

Sasha Whittle

Sasha is currently in Year 11 at St Mary's Anglican Girls School (2012-2013). In 2011 she created a portrait of scientist, Rosalind Franklin made with DNA, the molecule that Franklin helped discover. The DNA portrait, believed to be the first, now hangs on the walls of the Franklin-Wilkins Library, Kings College, London. Her main interests are in science and art. She enjoys discovering how our universe around us works, and finds art frustratingly enjoyable. The fusion of the two is a new territory that she looks forward to exploring further. (Whittle, 2012, p.61)

Yvonne Sitko - WA Birds of Prey Centre

My name is Yvonne Sitko Birds of Prey are my life's passion. I established the *WA Birds of Prey Centre* in 2005. I've been involved in rescue, rehabilitation and release back into the wild of birds of prey since 2000. The WA Department of Conservation and Land Management license me. I have been involved in the rescue and rehabilitation of injured birds of prey in Western Australia for over seven years now. When a bird of prey is injured or sick, my main aim is to help the bird achieve a full recovery and release him or her into the wild. In some situations, the bird's injuries are so severe they unable to be released into the wild. Some of these birds join my flight shows to help educate people about the amazing qualities of birds of prey, and the critical importance of preserving their natural habitat. (Sitko, 2012, p. 53)

My business goal is **education through entertainment**. This approach means I get to educate many people about the importance of conservation. And of course introduce them to the wonderful birds themselves. The displays educate people about the importance of conserving the natural habitat for birds of prey. The birds demonstrate a lot of their natural behaviors through flight and feeding. They don't perform tricks. (Sitko, 2012, p. 53)

Recently Aussie, a young and very proud Wedge-tail Eagle, has been flying free at Subiaco Oval with the *West Coast Eagles* (football team). Aussie is a great ambassador for Wedge-tails and birds of prey in general. It was not that long ago that Wedge-tails were shot. So it is great to have Aussie educating West Australians about conservation and habitat preservation. (Sitko, 2012, p. 53)

<http://wabirdsofprey.com/>

Appendix C.5 *Eggtooth a celebration of native birds*

Exhibition June 12-21, 2014 Spectrum Project Space, Edith Cowan University

As detailed below the curator invited artists to develop two works 2D and 3D in response to the life of an endangered Australian bird:

The exhibition will unveil a variety of works using a wide range of materials from paper and canvas to textiles and glass. The hanging works will be installed to evoke stars, in reference to the Apus, or bird constellation, and will be a moving and immersive experience for the viewer. *Egg tooth* Artist and Curator, Elizabeth Marruffo said as well as her own practice being inspired quite often by birds, she noticed many other artists are often inspired by these creatures...“I also recognise the common thread of a certain vulnerability that exists between an art practice and these threatened and endangered birds,” she said.

The 43 exhibiting artists include: Adrian Baldsing, Amy Griffiths, Andrea Wood, Anna Dunnill, Anna Richardson, Anya Brock, Ashleigh Whyte, Calliope Bridge, Campbell Whyte, Celene Bridge, Claire Bushby, Claire Krouzecky, Clare McFarlane, Clarice Yuen, Jacobus Capone, Dani Andree, Denise Pepper, Donna Franklin, Elizabeth Marruffo, Emily ten Raa, Emma Lashmar, Eva Fernandez, Greg Pryor, Jane Donlin, John Parkes, Kate-Anna St Valentine, Lex Randolph, Linzi Boyd, Marek Szyler, Mark Tweedie, Martin Thompson, Minaxi May, Nicolle Desmarchelier, Pat Thomas, Paul Uhlmann, Rebecca Atkinson, Robert Turpin, Robyn Laycock, Sharyn Egan, Sian McMillan, Stormie Mills, Sue Starcken. (“New art exhibition set to hatch,” Wednesday 28, May)

In addition, a percentage of sales went to *Bird Life WA* to help with further conservation of the species represented in the exhibition. This cross-over between art and scientific conservation was crystallised by the opening speaker: Senior Ornithologist Dr. Ron Johnstone, (WA Museum). In addition, students from Duncraig Primary School participated in the exhibition, displaying paintings of native birds from their workshops with the curator. Maruffo also toured the group through the exhibition and encouraged students to discuss the artistic intentions behind the works (L. Maruffo, personal communication, June 23, 2014).

For this exhibition I was allocated the Baudin’s Cockatoo (*Calyptorhynchus baudinii*). In preparation for these works I researched the cultural and biological histories and current statistics from a number of sources. This cockatoo is endemic to the South-west forests of Western Australia, with a specialised long beak evolved to feed on Marri nuts (Johnstone, November 2010, p. 1). The continuing threats to this species include: “Clearing of forests, fires, vehicle strikes and feral European honey “bees which take

over nesting hollows. In the past large numbers were shot by orchardists; illegal shooting is still occurring” (Johnstone, November 2010, p. 2).

With this information in mind I produced a mixed media illustration of the female cockatoo entitled *All that remains* (2014), Figure 90. This piece incorporates a disappearing bird and marri tree. The stump on which it sits is blackened from fire and the nesting hollow filled with introduced bees. The bird itself was based on taxidermy specimens from the WA Museum collection. The second work entitled *Decoy* (2014), Figure 91, represents the male cockatoo, with its distinctive pink flesh round the eye. Constructed from recycled materials and painted in matching mediums to the 2D piece. This work plummets from the sky alluding to illegal shooting. The body is also covered in bees wax to provide an additional link to introduced bees.



L-R: Figure 91: Donna Franklin, (2014), *All that remains*, ink, pencil on paper, 40cm x 40cm.

Figure 92: Donna Franklin, (2014), *Decoy*, recycled materials, ink, pencil, paint, bees wax, 76cm x 39cm x 12cm.

For additional information see:

Johnstone, R.E. and Storr, G.M. (1998). *Handbook of Western Australian Birds*. Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum pp. 278–280.

Johnstone, R.E. and Kirkby, T. (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia. *Records of the Western Australian Museum* 25: 107–118.

12.0 Exhibitions, Conferences, and Publications

Solo-Collaborative Artwork

Research Week Exhibition, (2010), Edith Cowan University, Joondalup Campus.

Animals, People a shared Environment, (2011), POP Gallery Griffith University, Brisbane, Queensland, Australia.

Posted, (2011), Spectrum Project Space, Edith Cowan University.

Blind Box Graduate Fundraising Exhibition, (2011) Polytechnic West, Perth, Australia.

Exhibition at the *Grey Door*, Greenhill Gallery, (2011) Claremont Hotel, Perth, Australia.

Fungi Map VI Conference, (2012), Agricultural Institute of Denmark, Australia.

Semipermeable(+) *A SymbioticA exhibition*, (2013) ISEA, Powerhouse Museum, Sydney, Australia.

Luminous Prints, Retrospective SymbioticA Exhibition (2013) for the Centenary Celebration of the University of Western Australia, Perth International Arts Festival, Perth, Australia.

Becomings Post-Graduate group exhibition, (2014) Spectrum Project Space, Perth, Australia.

Collaborative Artwork

Signs of Change, Jewellery Designed to make a Better World, (2010) FORM Gallery, Perth, Australia.

Green Nation An exhibition of Living Art, Craft and Design, (2011), Gallery Artisan, Fortitude Valley, Queensland, Australia.

Lille 3000, Futurotextiles, Lille and Eurometropole Tour, (2012 –2013), Paris, France.

ArtStays, (2012-2013), Ptiju, Slovenia.

Group Exhibitions

Semipermeable(+) *A SymbioticA exhibition*, (2013) ISEA, Powerhouse Museum, Sydney, Australia.

Luminous Prints, Retrospective SymbioticA Exhibition (2013) Centenary Celebration of the University of Western Australia, Perth International Arts Festival, Perth, Australia.

Becoming. (2013) Art Gallery of University of Shanghai for Science and Technology, China.

Curation

Creatures of the Future Garden, Spectrum Project Space, Edith Cowan University, Perth, Australia.

Symposium

Creatures of the Future Garden Symposium, CREATEC, Edith Cowan University, 20 June 2012, Perth, Australia.

Workshops

DNA Extraction workshop (2011), CREATEC Conference, Edith Cowan University.

WA Birds of Prey Centre Workshop, (2012) *Creatures of the Future Garden*, Spectrum Project Space, 26 June, Edith Cowan University, Perth, Australia.

Pre-Doctoral Exhibitions (selected)

Solo Artwork

2009 *Beyond Botanica*, Artspace Gallery, Nedlands, Australia.

2009 *Field Notes* Mundaring Arts Centre, Perth, Australia.

2009 *SUPER HUMAN: Revolution of the Species*, ANAT, RMIT Gallery, Melbourne, Australia.

2008 *Coded Cloth*, Samstag Museum, Adelaide, Australia.

2007 *ARS Electronica07, SymbioticA Exhibition*, OK Museum, Linz, Austria.

2007 *Second Skin*, Kaohsiung Museum of Fine Arts, Taiwan.

2006 *BEAPworks06*, John Curtin Gallery, Perth, Australia.

2006 *Second Skin Exhibition ENTRY06*, Vitra Design Museum, Zeche Zollverein, Essen, Germany.

- 2005 *Intimacy: Digital Skin*. Thailand New Media Arts Festival. Bangkok, Thailand.
- 2004 *Bio-difference*, BEAP04, Lawrence Wilson Art Gallery, UWA. Perth, Australia.

Collaborative Artwork

- 2009 *Bio-Tech Art Revisited*, 8th April – 2nd May, Experimental Arts Foundation, Adelaide, Australia.
- 2009 *Micro 'be'* Textile University, California, USA.
- 2008 *Skin to Skin* (PIAF), Fremantle Arts Centre, Perth, Australia.
- 2008 *Ultimo Science Festival, Micro 'be' Fermented Fashion*, Educational Display, MUSE Gallery, Sydney, Australia.
- *2008 *Techno Threads*, Science Gallery, Trinity College, Dublin, Ireland.
- 2008 *Micro 'be'* Publication / Exhibition of Catalogue; *Display*, ARTantide project for the 52nd Venice Biennale, Venice.

Conference Presentations/Publications

Conferences

- Franklin, D. (2011, October). Paper presented at *CREATEC* Conference, Edith Cowan University.
- Franklin, D. (2012, September), Paper presented at *CREATEC Colloquium*, Edith Cowan University.
- Franklin, D. (2012, October) *Creatures of the Future Garden: Next Generation Education for a Biotech World*. Paper presented at the Australian Council University of Art and Design Schools (ACUADS) Annual Conference, Australia.

Artist talks/guest lectures

Invited to talk on 'doctoral research' (2010, March) for Art Fashion Undergraduate Unit, at Curtin University of Technology.

Bioart: fluid, collaborative and cross-disciplinary. A site for interacting with nonhuman life through creative practice. (2011, June). School of Communications and Arts, Edith Cowan University.

Bioart: Interdisciplinary Engagement with the Nonhuman. (2011, September). Spectrum Project Space, Edith Cowan University.

Invited talk on 'doctoral research' at Polytechnic West, WA (2011, October).

Invited talk on 'doctoral research' (2011, July) at *Fungi Map VI Conference*, Agricultural Institute of Denmark, Australia.

Invited talk on curatorial exhibition *Creatures of the Future Garden* and doctoral research, (2012, June), *Art Intensive Course*, at the School of Communications and Arts, Edith Cowan University.

Invited talk on curatorial exhibition, *Creatures of the Future Garden*, (2012, August) at SymbioticA: Centre for Excellence in Biological Arts, The University of Western Australia.

Invited guest lecture, Franklin, D. (2012, November). *Nature-Nurture. Engaging with nonhuman life from the female perspective*. Paper presentation at *Look. Look Again*. Lawrence Wilson Art Gallery, The University of Western Australia.

Invited talk on curatorial exhibition *Creatures of the Future Garden* and doctoral research, (2013, June), *Art Intensive Course*, at the School of Communications and Arts, Edith Cowan University.

Refereed Publications

Franklin, D. (2012, October) *Creatures of the Future Garden: Next Generation Education for a Biotech World*. Paper presented at the Australian Council University of Art and Design Schools (ACUADS) Annual Conference <http://acuads.com.au/conference/2012-conference>.

Catalogue Essay

Creatures of the Future Garden

Publication of previous collaborative works: Fibre Reactive and Micro 'be'

Secondary Education Text Books

Nielsen, T. H. (ed.). (2007). *Workshop Engelsk Teknikk _ OG Industriell Produksjon VG2, Workshop English Textbook, Industrial Production*, Norway.

Research Books / Journals

Knowles, V. (ed.). (2007). *Textiles. The Quartley magazine of the textiles institute.* 35.2. The Textiles Institute International Headquarters. UK.

Lee, S. (2005). *Fashioning the Future. Tomorrow's Wardrobe.* Thames & Hudson. United Kingdom.

Franklin, D. (2007). Interview for *fibrefashion.com* [on-line] Journal. *Australia: Three 'Profeseers' of UWA develop wine fabrics.* (March 15 2007). Retrieved from http://fibrefashion.com/news/textile-newsdetails.aspx?news_id=32430

Seymour, S. (2008). *Fashionable Technology. The intersection of Design, Fashion, Technology and Science.* New York: Springer Publishers.

Singer, R. J. (Ed.). (2007 May). *Fashion Technology Magazine*, 4.4. 21st Century Media Ltd. Hong Kong.

13.0 References and Bibliography

- Adamopoulou, A., & Solomon, E. (2013). Artists-as-curators in museums: Observations on contemporary complexities. 26. *Proceedings of the International Symposium: Curatorial Practices Reframed: Politics and Pedagogy in Curating Contemporary Art*. Nicosia, Cyprus: European University Cyprus. Retrieved from <http://www.oncurating.org>
- Adams, N. (2006). *Habermas and Theology*. United Kingdom: Cambridge University Press.
- Adams, T. (2011). *HOST*. [Digital still]. Original cinematography: Carla Evangelista & Peter Kraft, Scientists: Indoor Honeybee Facility, Visual & Sensory Neuroscience Group, Queensland Brain Institute, The University of Queensland. Soundtrack: *roundhouse* Custom Honey Enviroma 371685: *Damask Perfumery*.
- Adams, T. (2011). *HOST*. [Digital still]. Original cinematography: Carla Evangelista & Peter Kraft, Scientists: Indoor Honeybee Facility, Visual & Sensory Neuroscience Group, Queensland Brain Institute, The University of Queensland. Soundtrack: *roundhouse* Custom Honey Enviroma 371685: *Damask Perfumery*.
- Adams, T. (2012). *HOST*. [Photograph]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Adams, T. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Adams, T. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Adorno, T. W. (1991). *The Culture Industry: Selected essays on mass culture*. London: Routledge.
- Adorno, T. (2005). *The Culture Industry: Enlightenment and Mass Deception. Dialectic of Enlightenment*. (A. Blunden, Trans.). Retrieved from <http://www.marxists.org/reference/archive/adorno/1944/culture-industry.htm>
- Adorno, T. & Horkheimer, M. (1944). *Dialectic of Enlightenment*. New York: Herder and Herder.
- Alberti, S. (2005). Objects and the Museum. *FOCUS: MUSEUMS AND THE HISTORY OF SCIENCE*. 96(4). 559-571. Retrieved from http://www2.warwick.ac.uk/fac/arts/history/students/modules/hi916/week8/alberti_objects_and_the_museum.pdf
- Aloi, G. (2008). Death of the Animal. Angela Singer: Animal Rights and Wrongs. *Antennae: Journal of Nature in Visual Culture*. (7), UK.
- Singer, A. (2012). Artist Statement: *Creatures of the Future Garden*. [Brochure]. Spectrum Project Space. Perth, Australia: School of Communications and Arts, Edith Cowan University.

- Andrews, L. B. (2004). *Life Science Art: A New Tool for Assessing Biotechnology*. In O. Catts, (Ed.). *The Aesthetics of Care?* 2nd Edition. Australia: SymbioticA Press.
- Ang, I. (1989). *Desperately Seeking the Audience*. New York: Routledge.
- Animal Ethics Committee*. (2010). Edith Cowan University. Retrieved from http://www.ecu.edu.au/GPPS/ethics/assets/Animal_Welfare_Act_Info_3.pdf
- Animal Ethics: Complying with the Australian code of practice for the care and use of animals for scientific purposes*. (2014). Department of Education. Retrieved from <http://www.det.wa.edu.au/curriculumsupport/animalethics/detcms/navigation/animal-use-decisions/?page=5&tab=Main#toc5>
- Animal Welfare Act 2002*. (2010). Edith Cowan University. Retrieved from http://www.ecu.edu.au/GPPS/ethics/assets/Animal_Welfare_Act_Info_3.pdf
- Arts Curriculum Framework learning Statement for the Arts*. (1998). Government of Western Australia Curriculum Council. Retrieved from http://www.curriculum.wa.edu.au/internet/Years_K10/Curriculum_Framework/
- Artsedge (2009). *Artists in Schools. The ArtsEdge guide for artists and teachers in Western Australia*. Department for Culture and the Arts. Department of Education and Training. Retrieved from www.artsedge.dca.wa.gov.au
- Attenborough, D. (2010). Ascension Gateway. Retrieved from <http://www.ascensiongateway.com/quotes/david-attenborough/quotes-6.htm>
- Australian code of practice for the care and use of animals for scientific purposes*. Australian Government, National Health and Medical Research Council. (7th ed.). (2004). Canberra: Australian Government.
- Bailey, S., & Willet, J. (2004). *Bioteknica Corporate Brochure*. [Brochure]. Perth, Western Australia: The University of Western Australia.
- Balcatta Senior High School*. (2009/2010). Gifted and Talented Art Scholarship Program. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Ballengée, B. (2003-2008). *Cleared and Stained Hymenochirus Metamorph: Generation 6*. [IRIS print on watercolor paper 47.5 x 36.5 inches]. Archibald Arts, NYC. *BEAP07 Stillness*. [Brochure]. Perth, Australia.
- Ballengée, B. (2010). *Artist Statement*. Retrieved April 15 2010 from http://greenmuseum.org/content/artist_index/artist_id-19.html
- Barrett, E., & Bolt, B. (Eds.). (2007). *Practice as Research. Approaches to creative arts enquiry*. London: I.B. Tauris. Retrieved from <http://books.google.com/books>
- Bauman, Z. A. (1998). *Globalization: the human consequences*. New York: Columbia University Press.
- Barnhar, C. (Ed). (1964). *The World Book Dictionary*. Field Enterprises Educational Corporation.

- Bates, T. (2011). *In vitro. Exploring an interspecies aesthetic of care*. [Brochure]. Perth, Australia: Perth Institute of Contemporary Arts.
- Bates, T. (2011). *in vitro node (Drosophila melanogaster)*. [Photograph]. *In vitro. Exploring an interspecies aesthetic of care*. [Brochure]. Perth, Australia: Perth Institute of Contemporary Arts.
- Bates, T. (2011). *in vitro node (Drosophila melanogaster)*. [Photograph detail]. In M. Schlipalius, *In vitro. Exploring an interspecies aesthetic of care*. [Brochure]. Perth, Australia: Perth Institute of Contemporary Arts.
- Bates, T. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Bates, T. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Bates, T. (2012). *in vitro node (Drosophila melanogaster)*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Bartlem, E. (2005). Immersive Artificial Life (A-Life) Art. In Addison-Smith, H., Nguyen, A., & Tallis, D. (Eds.). *Backburning: Journal of Australian Studies*. (84). (n.p.). Australia: API Network. Retrieved from <http://ekac.org/edwina.html?&session-id=30ec9d5f56186e912f1f350d905afd85>
- Barros, T. (2009, January, 28). *Hello, Dolly!* [Photograph]. [Blog post]. Retrieved from <http://flickr.com/photos/12793495@N05/3233344867>
- Berry, I. (2003). From an Interview by J. Marstine. In King, L., & Marstine, J. (Eds.). *The University Museum and Gallery: A site for Institutional Critique and focus of the Curriculum. New Museum Theory and Practice*. USA, United Kingdom and Australia: Blackwell Publishing.
- Birringer, J., & Danjoux, M. (2009). Wearable Technology for the Performing Arts. *Smart Clothes and Wearable Technology*. Woodhead Publishing Series. 388-419. Retrieved from <http://www.sciencedirect.com/science/article/pii/B9781845693572500204>
- Bitgood, S., Benefield, A., & Patterson, D. (Eds.). (1991). Visitor Studies: Theory, Research and Practice. *Proceedings of the Visitor Studies Association Conference*. Volumes 3 and 4. Jacksonville, AL: Centre for Social Design.
- Bioart Dental Technicians*. (2010). Retrieved from <http://www.bioartdental.com.au/>
- Bioart: Applied Research in Biotechnologies*. (2010). Retrieved from <http://www.bio-art.be/>
- Biotech Art Workshop Symbiotica*. (2012). Retrieved from http://www.symbiotica.uwa.edu.au/activities/workshops/Symbiotica_BioTech_art_workshop

- Boucher, G. (2011). The Politics of Aesthetic Affect - A Reconstruction of Habermas' Art Theory. *PARRHESIA* . (13). 62-78.
- Bourdieu, P. (1993). *The Field of Cultural Production*. Australia and New Zealand: Polity Press.
- Bradby, K. (2011, July). Things that matter and the things that REALLY matter. *Poster session presented at the Fungi Map VI Conference*. Denmark, Western Australia.
- Bradley, B. (2012) *A Singular Public Sphere and the Role of the Internet*. Retrieved from <http://benheis.wordpress.com/>
- Britton, C., Perks, D., & Cass, G. (2010). *THE SCIENTIFIC CREATIVITY INITIATIVE "ABIOGENESIS."* Shenton College & University of Western Australia. Retrieved from http://bioalloy.org/images/the_sci/scientific_creativity_initiative.pdf
- Brock, K. (2011). Wildlife: Engaging Communities in Conservation. *Proceedings of the Fourth Biennale Australian Animal Studies Group Conference*. Queensland, Australia: Griffith University. Retrieved from www.wildlife.org.au
- Brodyk, A. (2002). Recombinant Aesthetics (Adventures in Paradise). *BEAP02. The Aesthetics of Care?* SymbioticA Symposium. Australia: SymbioticA Press.
- Brown, J. (2011). *Bio-TechEvolution: Future Engagement with the Nonhuman*. [Brochure]. Perth, Australia: Balcatta Senior High school.
- Brown, J. (2011). *CMCM1 (Cellular Mutated Cyborg Man)*. [Sculpture]. Perth, Australia: Balcatta Senior High School.
- Brown, J. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia. Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Brown, J. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Brown, J. (2012). *Imperfections of immortality*. [Sculpture]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Brundrett, M. (2011, July). The global significance of beneficial plant-fungus associations. 7. *Proceedings from the Fungimap VI Conference*. Denmark, Western Australia.
- Buchhart, D. (2013). *The choreography of the real. Fascination of the real*. Retrieved from <http://www.evaristti.com/marco/choreography.html>
- Bunt, S. (2008). The role of the Scientist and Science in Bio-art. In M. Pandilovski (Ed.). *Art in the Biotech Era*. Australia: Experimental Arts Foundation Inc.
- Bunt, S. (2012, April). The scientist's perspective in Bio-art projects. The incompatibility of science and post-modernism.1-15.*Proceedings from the Science Art Conference*. Lomonosov: Moscow State University.

- Bunt, S., & Catts, O. (2002). *Bio-Feel: SymbioticA*. BEAP02. Biennale of Electronic Arts Perth. [Brochure]. Perth, Western Australia.
- Buttler, E. (2010). For love and money. *Signs of Change. Jewellery designed to make a better world*. FORM Gallery. [Brochure]. Perth, Western Australia.
- Buzzle Science Glossary of Terms*. (n.d.). Retrieved from <http://www.buzzle.com/articles/science-glossary-of-science-terms-and-scientific-definitions.html>
- C-Lab*. (2013). Retrieved from <http://c-lab.co.uk/resources.html> and <http://c-lab.co.uk/about.html>
- Campbell, K.H., McWhir J., Ritchie W.A., & Wilmut, I. (1996). Sheep cloned by nuclear transfer from a cultured cell line. *Nature*. 380 (6569), 64–6.
- Cao, J., Vacanti, J. P., Paige, K.T., Upton, J., Vacanti, C. (1997). Transplantation of chondrocytes utilizing a polymer-cell constructs to produce tissue-engineered cartilage in the shape of a human ear. *Plastic and Reconstructive Surgery*. 100 (2), 303-304. USA: Department of Surgery, Children's Hospital, Boston, National Center for Biotechnology Information. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/9252594>
- Cass, G. (2011, December). The Scientific Creativity Initiative. *Poster session at the Science in Schools Conference*. The University of Western Australia. Perth, Australia.
- Cass, G. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Spectrum Project Space: School of Communications and Arts, Edith Cowan University. Perth, Australia.
- Cass, G., & Catts, O. (2008). Biotech Art. *Art in the Biotech Era*. Australia: Experimental Art Foundation Inc.
- Cass G., & Franklin, D. (2008). *Alterations: Micro 'be' Fermented Fashion*. [Photograph].
- Cass G., & Franklin, D. (2008). *Decay, Micro 'be' Fermented Fashion*. [Photograph]. *Skin to Skin* [Brochure]. Perth, Australia: Fremantle Arts Centre.
- Cass G. & Franklin D. (2008). *Metamorphosis, Micro 'be' Fermented Fashion*. [Photograph]. *Skin to Skin* [Brochure]. Perth, Australia: Fremantle Arts Centre.
- Cass, G. (2010). *The Scientific Creativity Initiative*. Retrieved from http://bioalloy.org/images/the_sci/scientific_creativity_initiative.pdf
- Cass, G. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Cass, G., & Cass, S. (2012). *The Human Biotech Face of Perth*. [Film projection and DNA]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.

- Cass, G. (2012, May). Creative Science. *Poster session presented at SCC1123 Chemistry for Life Sciences*, Edith Cowan University. Perth, Western Australia.
- Cass, S. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Catts, O. (2002). BioFeel. *BEAP. Biennale of Electronic Arts of Perth. The Exhibitions*. [Brochure]. Perth, Australia: John Curtin Gallery, Curtin University of Technology.
- Catts, O. (2003). *The Art of the Semi-Living*. Retrieved from <http://www.tca.uwa.edu.au>
- Catts, O. (2003). *From Semi-living to Partial Life: Issues in Presenting Three Dimensional Living Tissues Constructs as Art*. Retrieved from <http://www.tca.uwa.edu.au>
- Catts, O., & Zurr, I. (2003). The ethical claims of Bio Art: killing the other or self-cannibalism? *Australian and New Zealand Journal of Art: Art & Ethics* 4(2), 167-188. Retrieved from <http://www.tca.uwa.edu.au/atGlance/pubMainFrames.html>
- Catts, O., & Zurr, I. (2004). *The Art of the Semi-Living and Partial Life: Extra Ear – ¼ Scale*. Retrieved from <http://www.tca.uwa.edu.au>
- Catts, O., & Zurr, I. (2004). *The Art of the Semi-Living and Partial Life: Extra Ear – ¼ Scale*. [Sculpture]. Image retrieved from <http://www.tca.uwa.edu.au>
- Catts, O., Zurr, I., & Ben Ary, G. (2002). *Semi-Living Worry Dolls*. [Sculpture]. Image retrieved from http://www.tca.uwa.edu.au/ars/main_frames.html
- Catts, O., Stelarc, & Zurr, I. (1997-2004). *Extra Ear 1/4 scale*. [Sculpture and installation]. Image retrieved from http://www.tca.uwa.edu.au/extra/extra_ear.html
- Catts, O., et al. (2004). *Life Boat*. Retrieved from www.life_boat.org
- Catts, O., Zurr, I., & Canning, M. (2007). *NoARK The Tissue Culture & Art Project - Oron Catts & Ionat Zurr*. Retrieved from <http://www.tca.uwa.edu.au/noark.html>
- Catts, O., Zurr, I., & Canning, M. (2007). *NoARK*. [Sculptural installation]. Image retrieved from <http://www.tca.uwa.edu.au/noark.html>
- Catts, O. & Zurr, I. (2008). The Ethics of Experiential Engagement with the Manipulation of Life. In Da Costa, B., & Philip, K. (Eds.). *Tactical Biopolitics, art, activism, and technoscience*. 125-142. United States of America: Massachusetts Institute of Technology: Leonardo.
- Catts, O. (2009). *Symbiotica*. [Blog post]. Retrieved from www.symbiotica.uwa.edu.au
- Catts, O. (2014, September). *Artlink Magazine Launch – Biotech Art Edition*. [Public Discussion]. Presented at the Bird, Perth, Australia.
- Chapman, R., & Jones, D. (2011, July). Could feeding wildlife be important for reconnecting with nature? Environmental Futures Centre, Griffith University. *Proceedings from the Fourth Biennial Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University.

- Citizen Science*. (2009). School of Environmental and Biological Sciences. USA: The State University of New Jersey. Retrieved from <http://sciencelearning.rutgers.edu/citizenscience.htm>
- Coakley, J. (2011). *A conversation imagined between artists, scientists, critics, philosophers and the amateur observer asking: Is this bioart?* Australia: Contradiction Press.
- Coffey, H. (2009). *Interdisciplinary Teaching Learn NC, K-12 Teaching and Learning*. The UNC School of Education. USA: The University of North Carolina. Retrieved from <http://www.learnnc.org/lp/pages/5196>
- Corpet, V. (2002). Bio (techno) logical Art. *Artpress*. (276), 37-39.
- CRASH. (2009). The School of Design and Arts Collaborative Research Group in Art, Science and Humanity. Curtin University of Technology. Retrieved from <http://crash.curtin.edu.au/>
- Crouch, C. (1999). *Modernism in Art, Design and Architecture*. Houndsmill, Basingstoke, Hampshire: Macmillian Press.
- Crouch, C. (2007). Using praxis to develop research methods into personal creativity in the visual arts. *Proceedings of Hatched 07 Arts Research Symposium*. 1-7. Perth, Australia: PICA. Retrieved from http://www.pica.org.au/downloads/141/C_Crouch.pdf
- Crouch, C. (2007). Praxis and the reflexive creative practitioner. *Journal of Visual Art Practice*. 6 (2),105-114.
- Cummins, A. (1997, September). Town Meeting. *Published proceedings from Museums for the New Millennium. A symposium for the Museum Community*. USA: Centre for Museum Studies, Smithsonian Institution, and the American Association of Museums.
- Curriculum Assessment and Reporting Authority (ACARA)*. (2012). Retrieved from National_Declaration_on_the_Educational_Goals_for_Young_Australians.pdf Australian www.acara.edu.au/default.asp/
- Currie, G. (2007, June 30). *Paris Salons Catalogues*. National Gallery of Australia. [Blog Post]. Retrieved from <http://www.nga.gov.au/Research/Salons.cfm#chron>
- David, J. (1788). *Antoine-Laurent Lavoisier and His Wife*. [Painting]. Metropolitan Museum of Art. New York, United States of America. Retrieved from <http://www.metmuseum.org/Collections/search-the-collections/436106>
- Dawkins, R. (2009). *The Greatest show on Earth. The evidence for evolution*. Great Britain: Bantam Press.
- De Bono, E. (2013). *Edward de Bono – Lateral Thinking & Parallel Thinking*. Retrieved from <http://www.edwdebono.com/debono/lateral.htm>
- De Botton, A. (2004). *Status Anxiety*. United Kingdom: Hamish Hamilton.
- De Botton, A., & Crombie, N. (Director). Ackerman, R. (Producer). (2004). *Status Anxiety*. UK: Channel 4 Television.

- De Menezes, M. (2009). Artists in Science Labs Discussion: 9th October. Mutamorphosis Conference, Prague. Retrieved from <http://mutamorphosis.wordpress.com/videos/> 1 January 2014
- Debord, G. (1983). *Society of the Spectacle*. Detroit: Black & Red.
- Devlin, M. (2009, September 16). Learning Theories and Interdisciplinary Epistemologies. *Proceedings from the 2008 International Conference on Teaching and Learning in Higher Education*. [Video file]. Singapore: TLHE. <http://www.youtube.com/watch?v=Zmq5x-ChOcY>
- Discovery Centre. (2012, December 10). *Melbourne Museum*. [Blog post]. Retrieved from <http://museumvictoria.com.au/melbournemuseum/whatson/current-exhibitions/forest-secrets/>
- Drake, S. (1998). *Creating Integrated Curriculum: Proven ways to increase student learning*. Thousand Oaks, CA: Corwin Press.
- Dressed to the nines by the vines!* (2007). [Cartoon]. No author. *Grapegrowers & Vignerons*. May Issue. South Australia: Rural Press Ltd, Unley. Fairfax Media.
- Dumit, J. (2008). Foreword: Biological Feedback. In B. Da Costa, & K. Philip, (Eds.). *Tactical Biopolitics, art, activism, and technoscience*. 11-15. United States of America: Massachusetts Institute of Technology, Leonardo.
- During, S. (Ed). (1993). *The Cultural Studies Reader*. New York: Routledge.189-201.
- During, S. (2007). *The Cultural Studies Reader*. New York: Routledge.
- Egerton J., & Fraser, D. (1990). *Wright of Derby*. Tate Gallery, London. Retrieved from <http://mezzo-mondo.com/arts/mmm/wright/wright.html>
- Elder, C. (2007). *Being Australian: narratives of national identity*. Australia: Allen & Unwin.
- Environmental Justice Final Report*. (July 2012). Environmental Defenders Office. Retrieved from <http://www.edovic.org.au/law-reform/enviromental-justice> and <http://edovic.org.au/current-projects>
- Eureka! Gallery Guide*. (2013). Retrieved from <https://www.eureka.org.uk/wp-content/uploads/2012/09/KS2-Gallery-Guide3.pdf> and <https://www.eureka.org.uk/about-us/about-the-museum/what-is-a-childrens-museum/>
- Evaristti, M. (2000). *Helena*. [Digital photograph of installation]. Retrieved from <http://www.evaristti.com/marco/helena.html>
- Ewen, S. (2011). *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brouchure]. Perth, Australia: Balcatta Senior High School.
- Ewen, S. (2011). *Modern Arachnids*. [Sculpture]. *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. Perth, Australia: Balcatta Senior High School.

- Farren, A., & A. Hutchison, (2004). Cyborgs, New Technology and the Body: The Changing Nature of Garment. *Fashion Theory: The Journal of Dress, Body and Culture*. 5.
- Fee, R. (2010). (Ed.). *Biotechmedia. Your Media resource for the Life Sciences Industries*. The Biotech Communications Group. Retrieved from <http://www.biotechmedia.com/definitions-b.html#Biotechnology> In *Nature Biotechnology 1999 Media Kit*. Retrieved from <http://biotech.nature.com>
- Fensham, R., et al (2002). *Understanding Bourdieu*. Sydney: Allen & Unwin.
- Fischer, E. (1963). *The Necessity of Art*. Harmondsworth: Penguin. 138-140.
- Fiske, J. (1983). Surfalism and Sandiotics: The Beach in OZ Culture. *Australian Journal of Cultural Studies*. 1(2).
- Fiske, J. (1989). *Reading the Popular*. London: Unwin & Hyman.
- Flannery, T., & Schouten, P. (2004). *Astonishing Animals*. Melbourne, Australia: The Text Publishing.
- Flannery, T., & Schouten, P. (2001). *Gap in Nature*. Melbourne, Australia: The Text Publishing Company.
- Fogliani, M. (2011). *Bio-TechEvolution: Future Engagement with the Nonhuman*. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Fogliani, M. (2011). *They Are Not You*. [Pencil Drawing]. *Bio-TechEvolution: Future Engagement with the Nonhuman*. Perth, Australia: Balcatta Senior High School.
- Forgan, S. (2005). Building the Museum Knowledge, Conflict, and the Power of Place. *Focus: Museums and the History of Science. Isis*. 96, (4). 572-585. The History of Science Society Article. The University of Chicago Press: DOI: 10.1086/498594 Stable URL: <http://www.jstor.org/stable/10.1086/498594>
- Foster, C. (2011). *Bio-TechEvolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Foster, C. (2011). *Nosam*. [Artwork acrylic paint, DNA]. *Bio-TechEvolution: Future Engagement with the Nonhuman*. Perth, Australia: Balcatta Senior High School.
- Franklin, D. (2004). *Fibre Reactive*. [Photograph]. *BEAP04 BioDifference: A Political Ecology*. [Brochure]. Perth, Australia: Image courtesy of *SymbioticA*. The Lawrence Wilson Art Gallery.
- Franklin, D., Hicks, S., & Minson, P. (2010). *Mycotroph*. [Sculpture]. Perth, Australia: FORM Gallery.
- Franklin, D., Hicks, S., & Minson, P. (2010). *Systemic Network of Social Darwinism (single segment) and Mycotroph* [Sculpture]. Perth, Australia: FORM Gallery.
- Franklin, D., Hicks, S., & Minson, P. (2010). *Mycotroph*. [Photograph]. *Signs of Change: Jewellery Designed to make a Better World*. [Brochure]. Perth, Australia: FORM Gallery.

- Franklin, D., Hicks, S., & Minson, P. (2010). *Systemic Network for Social Darwinism*, [Sculpture]. Perth, Australia: FORM Gallery.
- Franklin, D., Hicks, S., Minson, P. (2011). *Systemic Network for Social Darwinism*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D., Hicks, S., & Minson, P. (2011). *Systemic Network for Social Darwinism*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D., Hicks, S., & Minson, P. (2011). *Mycotroph* [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D., & Hicks, S., & Minson, P. (2011). *Systemic Network for Social Darwinism*. [Sculpture]. Perth, Australia: Claremont Hotel.
- Franklin, D., & Minson, P. (2011). *Guam-Flying Fox Humanitas Series*. [Sculpture].
- Franklin, D., & Minson, P. (2011). *Red Chested Capuchin Monkey Humanitas Series*. [Sculpture]. Queensland, Australia: POP Gallery, Griffith University.
- Franklin, D., & Minson, P. (2011). *GFP Marmosets (Kei and Kou) Humanitas Series*. [Sculpture]. Queensland, Australia: POP Gallery, Griffith University.
- Franklin, D. (2011). *ARK*. [Sculpture]. *Polytechnic West TAFE Blindbox Graduate Fundraising exhibition*. Perth, Western Australia.
- Franklin, D., & Minson, P. (2012). *Humanatis Series Red Chested Capuchin Monkey*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D. (2012). *Diaspora Monopoly*. [Installation]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D. (2014). Live Animal Display [Photograph]. Western Australian Museum Discovery Centre.
- Franklin, D. (2014). Live Animal Display [Photograph]. Western Australian Museum Discovery Centre.
- Franklin, D. (2014). *All that Remains (Female Baudin's Cockatoo)*. [Artwork, pencil, ink]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, D. (2014). *Decoy (Male Baudin's Cockatoo)*. [Sculpture recycled mixed media, bees wax]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Franklin, Rosalind. (1920-1958). *Science Museum.org.uk*. Retrieved from <http://www.sciencemuseum.org.uk/broughttolife/people/rosalindfranklin.aspx>

- Freeman, C. (2011). *Reconstructing the Animal*. Catalogue Essay. In Y. Watt, (Ed.). *Reconstructing the Animal*. [Brochure]. Tasmania, Australia: Focal Printing, Plimsoll Gallery, Tasmanian School of Art. University of Tasmania.
- Friesen, N., & Hug, T. (2009). The Mediatic Turn: Exploring Concepts for Media Pedagogy. In K. Lundby, (Ed.). *Mediatization: concept, changes, consequences*. New York: Peter Lang Publishers. Retrieved from <http://books.google.com.au/books>
- Gaffney, N., & Kuzmanovic, M. (2008). *Art in the Biotech Era*. M. Pandilovski, (Ed.). Australia: Experimental Arts Foundation Inc.
- Galitz, K. (n.d.). *The Legacy of Jacques Louis David (1748–1825)*. In Heilbrunn Timeline of Art History. New York: The Metropolitan Museum of Art. Retrieved from http://www.metmuseum.org/toah/hd/jldv/hd_jldv.htm
- Gell, A. (1998). *Art and Agency. An Anthropological Theory*. United States: Oxford University Press.
- Georgiadis C. (2013). *Gardening Australia*. Series 24: Episode 35, [Television series]. Saturday 16 November, 2013. Australian Broadcasting Commission.
- Gessert, G. (1994). *On Exhibiting Hybrids: Art and Technology*. Supplement of CICRA (90). 8-9.
- Gessert, G. (1997). Kitsch Ornamental Plants. *Design Issues*. 13, (3). 45-51.
- Gessert, G. (1997). *Natural Selection, Hybrid 487*. [Print]. Retrieved from *Design Media Arts 98T Genetics and Culture*. http://viewingspace.com/genetics_culture/pages_genetics_culture/gc_w02/gc_w02_gessert.htm
- Gessert, G. (2002). Breeding for wildness. BEAP02. *The Aesthetics of Care? Symbiotica Symposium*. Australia: Symbiotica Press.
- Gessert, G. (2004). Anthropocentrism and Genetic Art. *Art and BioTech Colloquium, Montreal*. Retrieved from <http://www.colloquebioart.org/pages/ggessert.html>
- Gessert, G. (2010). *Green Light: Toward an Art of Evolution*. US: Leonardo Book Series. The MIT Press.
- Gessert, G. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia. Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Gessert, G. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Gessert, G. (2012). *The Fern Age*. [Sculpture]. Perth, Australia: Spectrum Project Space, The School of Communications and Arts, Edith Cowan University.
- Giddens, A. (1999). *Structuration Theory*. London School of Economics and Political Science. Retrieved from <http://www.lse.ac.uk/Giddens/FAQs.htm#ModeQ1>

- Giddens, A. (1991) *Modernity and self-identity: Self and society in the late modern age*. London: Polity Press.
- Giddens, A. (1990). *Sociology*. (3rd Ed.). Cambridge: Polity Press.
- Giddens, A. (1984). *The Constitution of Society*. United States of America: University of California Press. Retrieved from <http://books.google.com.au/books>
- Giddens, A. (1972). *Emile Durkheim: Selected Writings*. Excerpt from Emile Durkheim (1933). *The Division of Labor in Society*. Cambridge: Cambridge University Press.
- Ginsberg, A. (2009). *The Synthetic Kingdom*. [Audio Podcast]. *Proceedings from the Super Human: Revolution of the Species Symposium*. The Australian Network for Art and Technology. Retrieved from <http://superhuman.anat.org.au/symposium/podcasts/alexandra-daisy-ginsberg.html>
- Ginsberg, A. (Director). (2009). *The Synthetic Kingdom*. [Animation]. Elliot, C. Little Giant Pictures.
- Ginsberg, A. (Director). (2012). *The Synthetic Kingdom*. (2009). [Still from animation]. Elliot, C. Little Giant Pictures. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Ginsberg, A. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Ginsberg, A. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Gordon-Morgan, R., & A. G. N. Moore, (1998). *Boston Medical Library*. Retrieved from <https://www.countway.harvard.edu/bml/rheinhold.htm>
- Gorman, M. (2013). *Why Grow your Own?* Interviews. Science Gallery Dublin. Retrieved from <https://dublin.sciencegallery.com/growyourown> and <https://dublin.sciencegallery.com/growyourown>
- Gramsci, A. (1975). *Prison Notebooks*. In W. Haug, (2005). *Gramsci's "Philosophy of Praxis" Camouflage or Refoundation of Marxist Thoughts?* 1-25. Retrieved from <http://www.wolfgangfritzhaug.inkrit.de/documents/Gramsci-PhilPraxis.pdf>
- Grant, E. et al. (2010). *Australian National Human Medical Research Council*. Retrieved from http://www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/ea18.pdf
- Gray, M. (2012). *Daddy-long legs and Orb Web Spider*. Retrieved from <http://www.australianmuseum.net.au/animalfinder/Spider-finder>
- Groys, B. (2009). Politics of Installation. *E-flux journal*. (2). 1-8.
- Guidelines for the care and use of animals in Western Australian schools, and agricultural TAFEWA colleges*. (2005). Retrieved from

<http://www.det.wa.edu.au/curriculumsupport/animalethics/detcms/navigation/resources/?oid=MultiPartArticle-id-2934129>

- Guidelines to Promote the Wellbeing of Animals used for scientific purposes. The assessment and alleviation of pain and distress in research animals.* (2010). Australian National Human Medical Research Council. Retrieved from http://www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/ea18.pdf
- Gunton, M. (Producer). (2010). *Life*. [Documentary]. London: BBC Earth. Discovery Channel. SKAI. Open University Co-Production.
- Habermas, J. (1979). *Communication and the Evolution of Society*. London: Heinemann.
- Habermas, J. (1981). *The Theory of Communicative Action*. London: Beacon Press.
- Habermas, J. (1987) *The Theory of Communicative Action: the Critique of Functionalist Reason: Volume 2*. Cambridge: Polity Press.
- Habermas, J. (1989). *The structural transformation of the public sphere*. Cambridge: Polity Press.
- Habermas, J. (1989). *A summary of Volume 1: Reason and the Rationalisation of Society*. Retrieved from <http://www.csudh.edu/dearhabermas/publsbm01.htm>
- Habermas, J. (1990). *Moral Consciousness and Communicative Action*. Cambridge: Polity Press.
- Habermas, J. (1996) *Between Facts and Norms*. Cambridge: Polity Press.
- Hall, S. (1997). *Race: The Floating Signifier*. [Video file]. Sut Jhally, (Producer). The Media Education Foundation. Hillside Studios. Retrieved from <http://www.youtube.com/watch?v=bMo2uiRAf30>
- Harper, D. (2001-2014). Ivory Tower. *Online Etymology Dictionary*. Retrieved from <http://etymonline.com/>
- Hauser, J. (2005). *Bio Art-Taxonomy of an Etymological Monster*. UCLA Art|Sci centre. [Lecture]. Retrieved from <http://eda.ucla.edu/?id=390>
- Hauser, J. (2008). Symbiotica presents...Still Living. *BEAP 07 Biennale of Electronic Arts Perth. Stillness Art and Science and Technology*. [Brochure]. Perth: Artrage.
- Hauser, J. (2008). *Forward/Backward. Living/Still*. Retrieved from <http://www.stillliving.symbiotica.uwa.edu.au/pages/exhibition.htm>
- Hawkins, H., Gutwill, J., Babcock, & McDougall, J. (2011). *Art/Science Collaborations and the Challenge of Public Impact*. Retrieved from <http://artscigeog.wordpress.com/2011/08/>
- Heiss, L. (2009, August 3). *Jewellery to Deliver Medicine*. Interview with Leah Heiss by Blanch, D. [Radio Blog Post]. Radio Australia. Retrieved from <http://www.radioaustralia.net.au/international/radio/onairhighlights/jewellery-to-deliver-medicine>

- Heywood, I. (1997). *Social Theories of Art: A Critique*. Houndsmills, Basingstoke, London: Macmillan Press Ltd.
- Hill, P. (2010). An Australian Curriculum to promote 21st Century Learning. *A National Curriculum: Looking Forward*. Education Services Australia. Retrieved from <http://www.eqa.edu.au/site/anaustraliancurriculumtopromote21stcentury.html>
- Holcombe, C. J. (2013). *Art as Emotive Expression*. Retrieved from <http://www.textetc.com/theory/emotive-expression.html> and <http://socialevolutionforum.com/2013/05/11/keeping-science-and-ideology-apart/>
- Hooper-Greenhill, E. (1992). *Museums and the Shaping of Knowledge*. London and New York: Routledge.
- Horkheimer, M., & Adorno, T. (1944). *Dialectic of Enlightenment*. New York: Herder and Herder.
- Horstman, M. (Producer). (2011, October 8). *Science under Siege: Catalyst*. [Television series]. Australia: Australian Broadcasting Commission. [Video Podcast]. Retrieved from <http://www.abc.net.au/catalyst/stories/3313559.htm>
- Hörtner, H. (2014). *FutureLab. ARS Electronica*. Retrieved from <http://www.aec.at/futurelab/en/aktuelles/about/>
- Howitt, C. (2009). Tree Weaving: Weaving science, art and language together. *SCIOS*. 45, (3). 9. Science and Mathematics Education Centre. Curtin University of Technology. Retrieved from: <http://stawa.net/wp/wp-content/uploads/2011/12/sciossept2009.pdf>
- Howitt, C., & Blake, E. (2009). Planting the seeds of science for early childhood pre-service teachers. *SCIOS*. 45, (3). 5. Science and Mathematics Education Centre. Curtin University of Technology. Retrieved from <http://stawa.net/wp/wp-content/uploads/2011/12/sciossept2009.pdf>
- Hudson, K. (2012). *under/mine*. [Sculpture]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Hudson, K. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia. Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Hudson, K. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Hudson, K. (2014). (2014, September). *Artlink Magazine Launch – Biotech Art Edition*. [Public Discussion]. Presented at the Bird, Perth, Australia.
- Hughes, J. M., Michell, P. A., & Ramson, W. S. (1987). *The Australian Concise Oxford Dictionary*. Oxford. Auckland. New York: Oxford University Press.
- Husserl, E. (1954). *The Crisis of European Sciences and Transcendental Phenomenology*. Evanston: Northwestern University Press. Retrieved from

http://www.archive.org/stream/HusserltheCrisisOfTheEuropeanSciencesintegralTextEnglish/Husserl-Crisis_djvu.txt

- Hutt, L. (2011). *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Hutt, L. (2011). *Genetic mutation in the future caused by events in the past*. [Installation]. Perth, Australia: Balcatta Senior High School.
- Inglis, D. (2007). *Culture and everyday life*. London: Routledge.
- Interactive Digital Museum Design. (2013, May 2). *Museum of Science and Technology of Islam*. [Video file]. Retrieved from <http://www.youtube.com/watch?v=rHxPv0Bem8>
- Irwin, A. (2001). Constructing the Science Democracy in the Biosciences. *Public Understanding of Science*. (10).1-18
- IUCN The IUCN Red List of Threatened Species 20013.1*. Retrieved from <http://www.iucnredlist.org/about/summary-statistics>
- IUCN Statistical Summary Extinction Rate 2011*. Retrieved from http://www.iucnredlist.org/about/summary-statistics#Tables_5_6
- Jarratt, J. (1997). External Factors Affecting Organizations. *Proceedings from Museums for the New Millennium. A symposium for the Museum Community*. USA: Center for Museum Studies, Smithsonian Institution, and the American Association of Museums.
- Jacques Louis David. (2002-2014). The Complete Works*. Retrieved from <http://www.jacqueslouisdavid.org/biography.html>
- Jameson, F. (1990). Postmodernism and Consumer Society. In H. Foster, (Ed.). *Postmodern Culture*. 111-125. London: Pluto Press.
- Jemison, M. (2009, October 30). *Teach the arts and sciences together*. TED Talks. [Video file]. Retrieved from http://www.ted.com/playlists/124/ken_robinson_10_talks_on_educ.html
- Jenks, C. (2005). *Culture. Second Edition*. Abingdon: Routledge.
- Jenner, Edward. (1749-1823). Science Musuem.org.uk*. Retrieved from <http://www.sciencemuseum.org.uk/broughttolife/people/edwardjenner.aspx>
- Johnstone, R. (2010). *Baudin's Cockatoo Factsheet. Department of Terrestrial Vertebrates*. West Australian Museum. [Brochure]. Retrieved from <http://museum.wa.gov.au/sites/default/files/Baudin's%20Cockatoo%20-%20English.pdf>
- Jones, D. (2011). Longing for Connection: The importance of interactions with wildlife in an urbanizing world. *Proceedings from the Fourth Biennale Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University.

- Joseph Wright of Derby. (n.a.). (n.d.). *Articulate 'An Experiment on a Bird in an Air Pump.'* National Gallery London. Retrieved from http://www.nationalgallery.org.uk/articulate/projects/ds/ds_painting.html
- Kac, E. (1999). *Genesis* [Photograph of installation]. Retrieved from <http://www.ekac.org/geninfo2.html>
- Kac, E. (2000). *Alba, the fluorescent bunny*. [Photograph]. Retrieved from <http://www.ekac.org/gfpbunny.html>
- Kac, E. (2001). *The Alba Flag*. [Photograph]. Retrieved from <http://www.ekac.org/albaflag.html>
- Kac, E. (2001). *The Alba Flag*. [cotton bunting and applique embroidery]. Verbeke Foundation, Belgium. [Digital Photograph]. Retrieved from <http://www.ekac.org/albaflag.html>
- Kac, E. (2008). Life Transformation – Art Mutation. The Postmodern Approach. In M. Pandilovski, (Ed.). *Art in the Biotech Era*. Australia: Experimental Arts Foundation Inc.
- Kac, E. (2013, December, 30). *GFP Bunny*. [Blog post]. "GFP Bunny" was first published in Dobrila, Peter, T. & Kostic, A. (Eds.). (2000). *Eduardo Kac: Telepresence, Biotelematics, and Transgenic Art*. Maribor, Slovenia: Kibla. 101-131. Retrieved from <http://www.ekac.org/gfpbunny.html>
- Kac, E. (2013, December, 20). *Information on Genes*. [Blog post]. Retrieved from <http://www.ekac.org/geninfo.html>
- Kalantis, M., & Cope, B. (2012). *Edmund Husserl on the lifeworld*. Retrieved from <http://newlearningonline.com/new-learning/chapter-5-learning-personalities/edmund-husserl-on-the-lifeworld/>
- Kalotas A. (2011, July). Fungi of the Arid lands. *Poster session at the Fungi Map VI Conference*. [Lecture notes]. Denmark, Western Australia.
- Karamuftuoglu, M. (2006). Information arts and information science: Time to unite? *Journal of the Association for Information Science and Technology*. 57, (13),1780-1793. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/asi.20381/abstract>
- Kaye, N. (2009). *Physical and Virtual Sites: Using Creative Practice to Develop Alternative Communicative Spaces*. USA & UK: VDM Verlag Dr. Muller.
- King, L., & Marstine, J. (2006). Marstine, J. (Ed.).The University Museum and Gallery: A site for Institutional Critique and focus of the Curriculum. *New Museum Theory and Practice*. USA, UK & Australia: Blackwell Publishing.
- Klein, J. (2010). *Creating Interdisciplinary Campus Cultures*. San Francisco, California: Jossey-Bass/Association of American Colleges and Universities.
- Klingender, F. (2010). Science and Technology Exhibits: The Use of Interactives. *New Thinking. Rules for the (R)evolution of Museums. A collection of essays*. Edinburgh: Museumetc.

- Kratz, S. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Kratz, S. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Kratz, S. (2012). *A Turtle Fondly in Imaginary Worlds and the Desire for Certainty and Control*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Kratz, S. (2012). *Life and Death Vessels: A Collection of Curiosities*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Kratz, S. (2012). *The Remains of Algernon and the Poetry Orchids*. [Sculpture]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Latham, C. (2004). *Survival of the Fittest: The Artist versus the Corporate World*. Australia: Platform Papers.
- Leonardo On-Line*. (2012). Retrieved from <http://www.leonardo.info/isast/isastinfo.html>
- Levins, R. (2008). Living the Eleventh Thesis. In B. Da Costa, & K. Philip, (Eds.). *Tactical Biopolitics, art, activism, and technoscience*. 25-33. United States of America: Massachusetts Institute of Technology: Leonardo.
- Lewenstein, B., Brossarda, D., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*. 27, (9). 1099–1121. DOI: 10.1080/09500690500069483. ISSN 0950-0693 (print)/ISSN 1464-5289 (online)/05/091099–23. Retrieved from http://www.csss-science.org/downloads/citizen_science.pdf
- Lindsay, B. (2013). Citizen science, community-based research and meaningful public participation in decision-making. *Environmental Defenders Office*. Retrieved from <http://www.edovic.org.au/blog/citizen-science-community-based-research-and-meaningful-public-participation-decision-making>
- Life sciences*. (n.d.). *The American Heritage Stedman's Medical Dictionary*. Retrieved from Dictionary.com <http://dictionary.reference.com/browse/lifesciences>
- Life sciences*. (n.d.). *Merriem-Webster's Medical Dictionary*. Retrieved from Dictionary.com <http://dictionary.reference.com/browse/lifesciences>
- Lister, M., & Dovey, J. et al. (Eds.). (2003). *New Media: A Critical Introduction*. London: Routledge.
- Lovelock, J. E. (1979). *Gaia: A new look at life on Earth*. United Kingdom: Oxford University Press.
- Lowe, M. (2007). Enraptured by Raptors. *The 3rd Degree*. Edith Cowan University.

- Lozanovski, N. (2011). Artist statement. *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Lozanovski, N. (2011). *Keep Safe Your Identity*. [Sculpture, DNA, film projection and sound]. Perth, Australia: Balcatta Senior High School.
- Lozanovski, N. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Lozanovski, N. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Lozanovski, N. (2012). *Keep Safe Your Identity*. [Installation and sculpture, DNA, Perspex, light, sound, acrylic paint, pencil, plaster and wooden panels]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Lynch, M. (2000). Against reflexivity as an academic virtue and source of privileged knowledge. *Theory, Culture & Society*. 17 (26). 26-50. *Creativity and Reflexivity* [Lecture]. School of Communications and Arts, Faculty of Education and Arts, Edith Cowan University.
- Machabee, A. (2011). *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brochure]. Perth, Australia. Balcatta Senior High School.
- Machabee, A. (2011). *One of the challenges in defining death is in distinguishing it from life*. [Sculpture living plants, microbiological skin, soil, and insects]. Perth, Australia: Balcatta Senior High School.
- Mader, R. (2013). How to move in/an institution. (New) Institution(alism). *On Curating*. Issue 21.35-45. Retrieved from <http://www.oncurating-journal.org/index.php/issue-21-reader/how-to-move-inan-institution.html#U2HRNRGKAeE> 29 April 2014
- Magaudda, P. (2013). *Biohackers. The Politics of Open Science. Hackers aiming at the conquest of the world of science. Design Art, design and culture*. Retrieved from http://www.digicult.it/news/biohackers-the-politics-of-open-science-gli-hacker-alla-conquista-del-mondo-della-scienza/http://leidenbioart.blogspot.com.au/2008_03_01_archive.html and <http://www.digicult.it/section/bio-art/>
- Malina, R. (2008). Series Foreword. In B. Da Costa, & K. Philip, (Eds.). *Tactical Biopolitics, art, activism, and technoscience*. 4-5. United States of America: Massachusetts Institute of Technology, Leonardo.
- Malina, R. (2011, April 17). *Is Art-Science Hogwash? A Rebuttal to Jean-Marc Levy Leblond*. [Blog post]. Retrieved from (<http://malina.diatrope.com/2011/04/17/is-art-science-hogwash-a-rebuttal-to-jean-marc-levy-leblond/>)
- Manasseh, C. (2008). In Situ The Art Museum in the 19th Century: J. J. Winckelmann's Influence on the Establishing of the Classical Paradigm of the Art Museum.

Anistoriton Journal. Volume 11. 1-9. Retrieved from
<http://www.academia.edu/385959>

Maton, K. (2003). Reflexivity, relationism, and research: Pierre Bourdieu and the epistemic conditions of social scientific knowledge. *Space & Culture*, 6 (1), 52-65. *Creativity and Reflexivity*. [Lecture]. School of Communications and Arts, Faculty of Education and Arts, Edith Cowan University.

McKnight, L. (2008). *Skin to Skin: A dialogue between art and fashion*. [Brochure]. Perth, Australia: Fremantle Arts Centre.

McLuhan, M. (1964). *Understanding Media*. New York: McGraw-Hill.

McNamara, A. (2012). Six rules for practice-led research. *Special Issue: Beyond Practice-led Research. Journal of Writing and Writing Courses*. 1-15. Queensland University of Technology. Retrieved from
www.textjournal.com.au/speciss/issue14/McNamara.pdf

McNiff, J., & Whitehead, J. (2006). *All You Need To Know About Action Research*. London: SAGE Publications. Retrieved
<http://myactionresearch.wordpress.com/category/books-jean-mcniff-jack-whitehead/>

McTaggart, R. (1997). *Participatory Action Research: International contexts and consequences*. Albany: State University of New York Press.

Moore, R., & Wong, H. (1997). *Natural Learning: Rediscovering Nature's Way of Teaching*. Berkeley, CA: MIG Communications.

Moore, B. (Ed.). (2009). *Australian Concise Oxford Dictionary. Fifth Edition*. Australia: Oxford University Press.

Moore, J. (2012). People in Profile: Environmental Educator, Simon Cherriman. *Landscape: WA's conservation, parks and wildlife magazine*. 27, (3). 32-38. ISSN 0815-4465

Mendiharat, A. (2008). Activating the Arts. *Art and Sci 4 Eva: Filter Magazine*. Issue: 68. 15-16.

Metcalfe, J., Riedlinger, M., Pisarski, A., & Gardner, J. (2006). Collaborating across the sectors. The relationships between the humanities, arts and social sciences (HASS) and science, technology, engineering and medicine (STEM) sectors. ISBN: 0-9757701-3-6
Retrieved from <http://www.chass.org.au/papers/pdf/PAP20061101EA.pdf>

Moody, H. & Powell, J. (2003). *Challenges of Modernity: Habermas and Critical Theory*. Theory and Science. Retrieved from
http://theoryandscience.icaap.org/content/vol4.1/01_powell.html

Mosby's Medical Dictionary 8th Edition. In *The Free Dictionary*. Retrieved from
<http://medical-dictionary.thefreedictionary.com/microbiology>

Munster, A. (2004). Collaboration or Complicity? *RealTime*. Issue 60. 4. Retrieved from:
<http://www.realttimearts.net/article/60/7375>

- Mycelium Definition*. (n.d.). In *Wikipedia*. Retrieved August 20, from <http://en.wikipedia.org/wiki/Mycelium#References>
- Mycology Definition*. (n.d.). In *Wikipedia*. Retrieved August 20, from <http://en.wikipedia.org/wiki/Mycology>
- New art set to hatch (2014, May 28). Latest News Edith Cowan University. Retrieved from <http://www.ecu.edu.au/news/latest-news/2014/05/new-art-exhibition-set-to-hatch>
- North Carolina Association for Biomedical Research*. (2006-2013). *About bioscience*. <http://www.aboutbioscience.org/topics/botany>
- Notes on Habermas: Lifeworld and System*. (n.a.). (n.d.). The University of Calgary, Canada. Retrieved from <http://people.ucalgary.ca/~frank/habermas.html>
- O'Doherty, B. (1986). *Inside the White Cube: The ideology of the gallery space. Expanded Edition*. Berkeley, Los Angeles, London: University of California Press.
- O'Keefe, S. (2011). Commodities & Oddities: Managing Unfamiliar Pest Animals. *Proceedings from the Fourth Biennale Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University.
- Osborn, A. (2009). A meeting place: The Science, Art and Writing Initiative. *CurrentScience*. 97, (11). Retrieved from www.sawtrust.org
- Pandilovski, M. (Ed.). (2008). *Art in the Biotech Era*. Australia: Experimental Art Foundation.
- Pandilovski, M. (2009). (Ed.). *Art in the Biotech Era*. Australia: Experimental Arts Foundation.
- Papstergiadis, N. (2006). *Spatial Aesthetics: Art, Place and the Everyday*. London: Rivers Oram Press.
- Papstergiadis, N. (2008). *The Global Need for Collaboration. Collaborative Arts. Conversations on Collaborative Arts Practise: Essays*. Retrieved from <http://collabarts.org/?p=201>
- Pasko, J. (2007). *Bio-artists use science to create art*. The Associated Press. Science on NBC News. Retrieved from <http://www.nbcnews.com/id/17387568/> and http://usatoday30.usatoday.com/tech/science/ethics/2007-03-05-bio-art_N.htm?csp=34
- Patterson, M. (2010, April 29). Biopunk a Manifesto. [Blog post]. Retrieved from <http://maradydd.livejournal.com/496085.html>
- Paul, C. (2006). *New Media Art and Institutional Critique: Networks vs. Institutions*. 1-11. Retrieved from http://intelligentagent.com/writing_samples/CP_New_Media_Art_IC.pdf
- Penslar, R. (Ed.). (1995). *Research Ethics. Cases and Materials*. Bloomington and Indianapolis: Indiana University Press.

- Pentecost, C. (2008). *Outfitting the Laboratory of the Symbolic*. In M. Pandilovski, (Ed.). *Art in the Biotech Era*. Australia: Experimental Art Foundation.
- Percival, M. (2011). *Bio-Tech Evolution: Future Engagement with the Nonhuman*. Balcatta Gifted and Talented. [Brochure]. Perth, Australia: Balcatta Senior High School.
- Percival, M. (2011). *Skin and Bones*. [Artwork pencil, wood, snakeskin]. Perth, Australia: Balcatta Senior High School.
- Polesel, J., Dulfer, N., & Turnbull, M. (2012). *The Experience of Education: The impacts of high stakes testing on school students and their families teachers and its impact on the public perception of schools*. Melbourne Graduate School of Education. Whitlam Institute, University of Western Sydney. Retrieved from http://www.whitlam.org/__data/assets/pdf_file/0008/276191/High_Stakes_Testing_Literature_Review.pdf
- Ponting, C. (1998). *The Pilimico history of the twentieth century*. London: Pimlico.
- Popper, F. (2000). *Frank Malina, Artist and Scientist: Works from 1936 to 1963*. Retrieved from <http://www.olats.org/pionniers/malina/arts/monographUS.php>
- Popper, F. (2002). L'art transgenique d'Eduardo Kac. *Biological Art. ArtPress*. Volume 276.52-54.
- Price, L. (2009). *Review of Tulipmania: Money, Honour, and Knowledge in the Dutch Golden Age*. Retrieved from <http://www.history.ac.uk/reviews/review/666>
- Pyle, R. (1993). *The thunder trees: Lessons from an urban wildland*. Boston: Houghton Mifflin.
- Raben, K. (2013). *The Evolution of Learning Theories in Museum Education Practice*. Bank Street College of Education. Retrieved from <http://www.curatetheclassroom.com/upload/The%20Evolution%20of%20Learning%20Theories%20in%20Museum%20Education%20Practice.pdf>
- RACP. (2004). *Royal Australasian College of Physicians*. Paediatricians Warn of Electronic Media Health Risks. Media Release: Monday, 12 July 2004. Retrieved from <http://www.racp.edu.au/hpu/paed/media>
- Raunig, G., & Ray, G. (Eds.). (2009). *Art and Contemporary Critical Practice Reinventing Institutional Critique*. London: MayFly Books. Retrieved from http://marceloexposito.net/pdf/transform_reinventinginstitutionalcritique.pdf?&session-id=30ec9d5f56186e912f1f350d905afd85
- Rayner, A. & Goff, S. (2010). Natural Inclusion and the Extended Epistemology: re-approaching an established action research paradigm with a new philosophy. *8th World Congress 2010 Participatory Action Research and Action Learning. 6th – 9th September, 2010*. Retrieved from <http://wc2010.alara.net.au/Formatted%20Papers/4.1.4.HEA.2.pdf>
- Reichle, I. (1998). Transgenic Bodies: Where Art and Science Meet: Genetic Engineering in Contemporary Art. *Art and Science*. Eduardo Kac, *Transgenic Art. Leonardo Electronic Almanac*. 6, (11). Retrieved from

- http://www.medienkunstnetz.de/themes/cyborg_bodies/transgenic_bodies/5/ and <http://www.medienkunstnetz.de/works/gfp-k-9/>
- Regine, (2007, April 29). *Interview with Stephen Wilson – we make money not art*. [Blog Post]. Retrieved from <http://we-make-money-not-art.com/archives/2007/04/interview-with-12.php>
- Resnick, M. (2007). Sowing the Seeds for a More Creative Society. Learning & Leading with Technology, *ISTE: International Society for Technology in Education*. December/January 2007-8, 18-22. Retrieved from <http://web.media.mit.edu/~mres/papers/Learning-Leadingfinal.pdf>
- Ritcher, D. (2013). Artists and Curators as Authors – Competitors, or team-workers? *On Artistic and Curatorial Authorship*. 43-57. Issue 19 / June 2013. ONCURATING.org Retrieved from http://www.on-curating.org/files/oc/dateverwaltung/issue-19/Print_to_download/ONCURATING_Issue19_A4.pdf 29 April 2014
- Ritter, M. (2009, May 27). Researchers Engineer Green Glowing monkeys. *The Star: The Associated Press, New York*. [Photograph]. Sasaki, E. (2009). *Kei and Kou*. Central Institute for Experimental Animals. Retrieved from: thestar_com.mht
- Ritzer, G., & Goodman, D. J. (2003). *Sociological Theory Sixth Edition*. Boston: McGraw-Hill.
- Ritzer Sociological Theory website*. (n.a.). (n.d.). Retrieved from www.mhhe.com/ritzer http://highered.mcgraw-hill.com/sites/0072817186/student_view0/chapter15/chapter_summary.html
- Roach, J. (2007, December 27). "Doomsday" Vault Will End Crop Extinction, Expert Says. *National Geographic News*. [Blog post]. Retrieved from <http://news.nationalgeographic.com/news/2007/12/071227-seed-vault.html>
- Roberts, M. (2011). Creating a Model for the development of Multispecies Community Zones. *Proceedings from the Fourth Biennale Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University
- Robertson, B. (2004). The South Kensington Museum in context: an alternative history. *Museum and Society*. March, 2004. 2, (1). 1-13. ISSN 1479-8360. Retrieved from <http://www2.le.ac.uk/departments/museumstudies/museumstudies/documents/volumes/robertson.pdf>
- Robinson, K. (2013, April). *Ken Robinson: How to escape education's death valley*. TED Talks Education. [Video file]. Retrieved from http://www.ted.com/talks/ken_robinson_how_to_escape_education_s_death_valley.html
- Robinson, K. (2010). *Changing Education Paradigms*. [Video file]. Retrieved from www.metafilter.com/100582/Ken-Robinson-Changing-Education-Paradigms Ken Robinson <http://www.youtube.com/watch?v=iG9CE55wbY>
- Robinson, K. (2010). *Homeschooling/unschooling*. [Video file]. Retrieved from http://www.youtube.com/watch?v=g5qv9Qx4jGw&feature=youtube_gdata_player

- Robinson, K. (2006). *Schools Kill Creativity*. *TED Talks*. [Video file]. Retrieved from http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html
- Rodari, P., & Merzagora, M. (2007). The role of science centers and museums in the dialogue between science and society. *Journal of Science Communication*. Article 0602. Retrieved from [http://jcom.sissa.it/archive/06/02/Jcom0602\(2007\)C01](http://jcom.sissa.it/archive/06/02/Jcom0602(2007)C01)
- Rogers, B. (1999). 'Conflicting approaches to curriculum: Recognizing how fundamental beliefs can sustain or sustain school reform'. *Peabody Journal of Education*, 74, (1). 29–67.
- Rolling, J. H. Jr. (2010). A Paradigm Analysis of Arts-Based Research and Implications for Education. *Studies in Art Education*. 51, (2).102-114. Retrieved from http://www.academia.edu/404689/A_Paradigm_Analysis_of_Arts-Based_Research_and_Implications_for_Education
- Rosenthal, E. (2010). *Serving children when parents come along. New Thinking. Rules for the (R)evolution of Museums. A collection of essays*. Edinburgh: Museumetc.
- Ross, P. (2007, February 28). *Technebiotics*. [Blog post]. Retrieved from <http://www.philross.org/>
- Rothfels, N. (2011). Elephants without History. *Proceedings from the Fourth Biennale Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University.
- Rothwell, M (2012). *Quetzal Legend*. Retrieved from <http://blog.guatemalangenesis.com/2009/03/legend-of-quetzal.html>
- Russell, T. (1994). The enquiring visitor: usable learning theory for museum contexts. *JEM 15, the Journal of Education in Museums*. No.15. Group for Education in Museums (GEM). Retrieved from <http://www.gem.org.uk/resources/russell.html>
- Salter, L. (2004) Structure and Forms of Use: A Contribution to Understanding the Effects of the Internet on Deliberative Democracy. *Information, Communication and Society*. 7, (2).185–206.
- Salter, L. (2005). Colonization tendencies in the development of the world wide web. *New Media & Society*.(7).291-309. SAGE Publications. Retrieved from <http://nms.sagepub.com/cgi/content/abstract/7/3/291>
- Schaller, D.T., et al., (2007). One Size Does Not Fit All: Learning Style, Play, and On-line Interactives. In J. Trant, & D. Bearman, (Eds.). *Museums and the Web 2007: Proceedings, Toronto: Archives & Museum Informatics*. Retrieved from <http://www.archimuse.com/mw2007/papers/schaller/schaller.html>
- Schmetz, A. (2012). *The Philosophizing Monkey*. Retrieved from http://library.uwsp.edu/aschmetz/Rheinhold's_Monkey/Rheinhold's_Monkey_Page.htm
- Science: Acting Responsibly*. (2011). *Curriculum Framework Guide – Science*. Retrieved from http://www.curriculum.wa.edu.au/internet/Years_K10/Curriculum_Resources

- Science Communication Unit. (2013). *Science for Environment Policy In-Depth Report: Environmental Citizen Science. European Commission DG Government.* The University of the West of England, Bristol. Retrieved from <http://ec.europa.eu/science-environment-policy>
- Scott, S. (2009). The MONA Manifesto. *Art Monthly*. 235, (09).17-19. Retrieved from www.artmonthly.org.au
- Screven, C. (2002 March). *Museums and Informal Education*. CMS Bulletin, Vol. 1, No. 1 (1993). Published in the informal education archives. Retrieved from <http://www.infed.org/archives/e-texts/screven-museums.htm>
- Seltmann, G. (2006). A Pause for thought before entering Paradise? In G. Seltmann, & W. Lippert. (Eds.). (2006). *Entry Paradise. New Worlds of Design*. Switzerland: Birkhauser.
- Seltmann, G., & Lippert, W. (Eds.). (2006). *Entry Paradise. New Worlds of Design*. Switzerland: Birkhauser.
- Serrano, L. (2005). Synthetic Biology: promises and challenges. *Molecular Systems Biology. The European Molecular Biology Organization and Nature Publishing Group*.3/158.1-13. Retrieved from National Centre for Biotechnology. www.ncbi.nlm.nih.gov/pmc/articles/PMC2174633/#!po=3.84615 doi: 10.1038/mbs4100202
- Shanken, E. A. (2011). *Contemporary Art and New Media: Toward a Hybrid Discourse?* Retrieved from <http://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf>
- Shapin, S. (2012).The Ivory Tower: the history of a figure of speech and its cultural uses... *British Society for the History of Science*. BJHS 45, (1).1–27. Doi: 10.1017/S0007087412000118 Retrieved from http://www.fas.harvard.edu/~hsdept/bios/docs/shapin_Ivory_Tower_BJHS.pdf
- Silverman, H. (2008). *Citizen science and Social Learning. People and Place. Ideas that Connect us*. Retrieved from http://www.peopleandplace.net/perspectives/2008/12/3/citizen_science_and_social_learning
- Singer, A. (2005 – 2010). *Tear*. [Sculpture wax, glass, resin]. Image courtesy of the artist.
- Singer, A. (2007). *Catch/Caught*. [Sculpture taxidermy rabbit, mixed media, buttons]. Image courtesy of the artist.
- Singer, A. (2010). *Hedge Row, Red Fox (Vulpes vulpes)*. [Sculpture vintage taxidermy red fox and mixed media ceramic]. Image courtesy of the artist.
- Singer, A. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Singer, A. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.

- Sitko, Y. (2011). *Birds of Prey School Incursions*. Retrieved from <http://wabirdsofprey.com/school-incursions/> and <http://wabirdsofprey.com/>
- Sklair, L. (2008). Sociology of the Global System. In F. Lechner, & J. Boli, (Eds.). *The Globalization Reader. Third Edition*. Australia: Blackwell Publishing.
- Skilton, P. F. (2005). All a periphery, all the time: what citation analysis tells us about knowledge, knowing and learning in science. 276-302. In S., Gherardi, & D. Nicolini, (Eds.). *The Passion for Learning and Knowing. Proceedings of the Sixth International Conference on Organizational Learning and Knowledge*. University of Trento Italy. Faculty of Sociology. Retrieved from http://eprints.brighton.ac.uk/821/1/Volume_I_02.pdf?&session-id=30ec9d5f56186e912f1f350d905afd85
- Snell, T. (2004). *Anatomy of an Exhibition*. VIS 3227 Professional Practice Reader. Edith Cowan University. Retrieved from <http://www.acuads.com.au/cont2004/cont2004.htm>
- Society and Environment*. (1998). *Government of Western Australia Curriculum Council*. Retrieved from http://www.curriculum.wa.edu.au/internet/Years_K10/Curriculum_Framework/16
April 2011
- Sowry, V. (2009, October 9). Artists in Science Labs. *Proceedings from the Mutamorphosis Conference*, Prague. [Video file]. Retrieved from <http://mutamorphosis.wordpress.com/videos/>
- Spectrum Project Space*. (2012). School of Communications and Arts, Edith Cowan University. Retrieved from <http://www.ecu.edu.au/schools/communications-and-arts/spectrum-project-space>
- Sperou, N. (2008). Verisimilitude: Biotechnology and Ancient Greek Narrative. In M. Pandilovski, (Ed.). *Art in the Biotech Era*. Australia: Experimental Arts Foundation.
- Stafford, K. J. (2011). Wildlife Crime. Institute of Veterinary, Animal & Biomedical Sciences, Massey University. *Proceedings from the Fourth Biennial Australian Animal Studies Group Conference*. Queensland, Australia: Griffith University.
- Stagoll, C. (2005). Becoming. In Parr, A. (Ed.). *The Deleuze Dictionary*. 21-22. Edinburgh, United Kingdom: Edinburgh University Press.
- Stein, M., McNair, S., & Butcher, J. (2001). Drawing on Student Understanding. Using illustrations to invoke deeper thinking of animals. 18-22. *Science and Children*.
- Stevens, J. (2008). Biotech Patronage and the making of Homo DNA. In B. Da Costa, & K. Philip, (Eds.). *Tactical Biopolitics, art, activism, and technoscience*. 43-59. United States of America: Massachusetts Institute of Technology: Leonardo.
- Stodden, V. (2010, March 22). Open science: policy implications for the evolving phenomenon of user-led scientific innovation. *Journal of Science Communication*, Article 0901. Retrieved from <http://jcom.sissa.it/archive/09/01/Jcom0901%282010%29A05/?searchterm=None>
- Sturcken, M. & Cartwright, L. (2001). *Practices of Looking: An Introduction to Visual Culture*. Oxford: Oxford University Press.

- Sturken, M. and Cartwright, L. (2009). *Practices of Looking. An Introduction to Visual Culture*. Oxford, New York: Oxford University Press.
- Stürzl, W. (2013). Between Hype and Attitude. Motivations, Presentation Strategies and Fields of Conflict for "Curartists". *On Artistic and Curatorial Authorship*. Issue 19 / June 2013, ONCURATING.org. 6-13. Retrieved from http://www.on-curating.org/files/oc/dateverwaltung/issue-19/Print_to_download/ONCURATING_Issue19_A4.pdf 29 April 2014
- Sullivan, G. (2001). Artistic thinking as transcognitive practice: A reconciliation of the process-product dichotomy. *Visual Arts Research*, 27(1). 2-12.
- Sullivan, G. (2004). Studio art as research practice. In E. W. Eisner, & M. D. Day, (Eds.). *Handbook of research and policy in art education*. 795-814. Mahwah, NJ: Lawrence Erlbaum Associates.
- Sullivan, G. (2005). *Art practice as research: Inquiry in the visual arts*. Thousand Oaks, CA: Sage.
- Sullivan, G. (2006). Research acts in Art Practice. *Studies in Art Education. A Journal of Issues and Research*. 48, (1).19-35: National Art Education Association. Retrieved from <http://www.jstor.org.ezproxy.ecu.edu.au/stable/1320834?seq=2>
- Sullivan, G. (2006). Research Acts in Art Practice. *Studies in Art Education*. Vol. 48, No. 1, (Fall). Arts-Based Research in Art Education. National Art Education Association.19-35.URL: <http://www.jstor.org/stable/25475803> Retrieved from <https://www.rhul.ac.uk/english/documents/pdf/pbrphd/sullivanresearchactsinarpractice.pdf>
- Sullivan, G. (2010). *Art Practice as Research: Inquiry in the Visual Arts*. SAGE. Retrieved from <http://thinkingpractices.wordpress.com/theories-of-art-practices-as-research/>
- Suzuki, D., & Taylor, R. (2010). *The Big Picture. Reflections on science, humanity and a quickly changing planet*. Australia and New Zealand: Allen and Unwin.
- Suzuki, D. (2010). *The Legacy. An Elder's vision for our Sustainable Future*. Australia: Allen and Unwin.
- SymbioticA. (2009). Retrieved from http://www.symbiotica.uwa.edu.au/welcome/about_us
- SymbioticA Workshops. (2010). Retrieved from <http://www.symbiotica.uwa.edu.au/activities/workshops>
- SymbioticA Activities. (2010). Retrieved from <http://www.symbiotica.uwa.edu.au/activities/projects>
- SymbioticA Courses. (2012). Retrieved from <http://www.symbiotica.uwa.edu.au/courses> and <http://www.symbiotica.uwa.edu.au/courses/mbiolarts>

- SymbioticA. Biological Arts.* (2013). *SymbioticA. International Centre of Excellence in Biological Arts.* [Brochure]. The University of Western Australia. A Century of Achievement. Australia: SymbioticA Press.
- Szczelkun, S. (1999). *Summary of the Theory of Communicative Action.* London: Royal College of Art. Retrieved from http://theoryandscience.icaap.org/content/vol4.1/01_powell.html
- Taylor, P., & Garcia-Barrios, R. (n.d.). The social analysis of ecological change. *Social Science Information.* (34). 5-30.
- The American Heritage Medical Dictionary.* (2007). Houghton Mifflin Company. *The Free Dictionary.* Retrieved from <http://medical-dictionary.thefreedictionary.com>
- The Bible.* (1952). Revised Standard Version Translated from Original Languages A.D. 1611. The British and Foreign Bible Society. Great Britain: Collins Clear-Type Press.
- (2009). *The Problem with National Testing in Schools. Thought control. Thinking, literacy and education in the middle years of schooling.* <http://peterolm.global2.vic.edu.au/2009/02/14/the-problem-with-national-testing-in-schools/>
- Thiele, K. (2011). Making Biodiversity information available to the public. Department of Environment and Conservation. *Proceedings from the Fungi Map VI Conference.* Denmark, Western Australia.
- Thomas, P. (n.d.). *Biennale of Electronic Art Perth.* Retrieved from <http://mass.nomad.net.au/biennale-of-electronic-art-perth/>
- Thomas, P. (2009, October 9). Artists in Science Labs Discussion. *Proceedings from the Mutamorphosis Conference, Prague.* [Video file]. Retrieved from <http://mutamorphosis.wordpress.com/videos>
- Thomas, P. (2010). *NOMAD.* Retrieved from <http://mass.nomad.net.au/>
- Thomas, G. (2010). *Crossing the Threshold.* New Thinking. Rules for the (R) evolution of Museums. A collection of essays. Edinburgh: Museumetc.
- Thompson, B. (2013). WA bees give Canadians a buzz. West Business. *The Western Australian.* May 11-12, 2013. p.1.
- Travis, J. (2000). *Genes on Display (art movement has grown out of genes).* Science News: Science Service Incorporated. Volume 158.
- Triscott, N., & La Frenais, R. (2013). *The Frontiers of Investigation.* Retrieved from <http://mutamorphosis.wordpress.com/2009/02/28/the-frontiers-of-investigation/#more-476>
- Turpeinen, O. (2006). Recombining ideas from art and cultural history museums in theory and practice. *Afhandlingar Nordisk Museologi* [The Journal of Nordic Museology]. 2(S), 83-96. Retrieved from <http://www.nordiskmuseologi.org/English/Outi%20Turpeinen.pdf>

- Vacanti, C. (1997). *ear-mouse*. [Photograph]. Advanced Tissue Sciences. PBS American Science Frontiers: The Bionic Body. [Blog post]. Retrieved from <http://www.pbs.org/saf/1107/features/body.htm>
- Vanderbilt, K. L. (2008). *Online Professional Development: An Analysis of Instructor Beliefs and Instructional Strategies for the Facilitation of Learning with Adult Educators*. [Dissertation]. College of Education, Georgia State University, Atlanta. Available at: http://etd.gsu.edu/theses/available/etd-06082008-150947/unrestricted/vanderbilt_kathi_l_200808_phd.pdf
- VanDemark, P. J., & Batzing, B. L. (1987). *The Microbes. An Introduction to their nature and Importance*. U.S.A: The Benjamin/Cummings Publishing Company Inc.
- Vanes, K. (2009). *Media and Performance Theory. Media Studies Research Master at Utrecht University*. Retrieved from <http://mandptheory.wordpress.com/2009/02/13/understanding-media-marshall-mcluhan/#comment-10>
- Vavaro, K. (2011). The relationship between the Australian white ibis (*Threskiornis molucca*) and humans in south-east Queensland. Environmental Futures Centre. *Proceedings from the Fourth Biennial Australian Animal Studies Group Conference*. [Lecture notes]. Queensland, Australia: Griffith University.
- Venville, G. J., Wallace, J., Rennie, L., & Malone, J. (2002). Curriculum Integration: Eroding the High Ground of Science as a School Subject? *Studies in Science Education*. (37). 43-84. Doi: 10.1080/03057260208560177
- Voigt, E. (2009). The Art is Alive! *Isotope* 9. (7), 2. Fall/Winter.1-8. Retrieved from <http://www.emilyvoigt.com/isotope.html#content>
- WA Birds of Prey Centre Workshop. (26 June 2012). [Photograph]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- WA Birds of Prey Centre Workshop. (26 June 2012). [Photograph]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- White, R., & Stoecklin, V. (1998). *Children's Outdoor Play & Learning Environments: Returning to Nature*. Retrieved from www.whitehutchinson.com/children/articles/outdoor.shtml
- White, R. (2004). *Interaction with Nature during the Middle Years: Its Importance to Children's Development & Nature's Future*. Retrieved from <http://www.whitehutchinson.com/children/articles/nature.shtml>

- Whittle, S. (2010). *Rosalind Franklin Portrait*. [Artwork DNA]. London, United Kingdom: Franklin-Wilkins Institute. Kings College.
- Whittle, S. (2010). *Rosalind Franklin Portrait*. [Photograph]. Agent General of Australia Kerry Sanderson AO presents the Principal of Kings College, Professor Sir Richard Trainor KBE with the portrait, in Kings College London. Retrieved from <http://www.wago.co.uk/index.php/news/general-news/wa-portrait-to-hang-in-london.html>
- Whittle, S. (2012). Artist statement. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space. School of Communications and Arts, Edith Cowan University.
- Whittle, S. (2012). Artist Biography. *Creatures of the Future Garden*. [Brochure]. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Whittle, S. (2012). *Definition*. [Painting acrylic, DNA]. Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Whittle, S. (2012). *Definition*. [Photograph detail]. *Creatures of the Future Garden*. Perth, Australia: Spectrum Project Space, School of Communications and Arts, Edith Cowan University.
- Willet, Jennifer. (n.d.). Artist Biography. *Colloque Bioart*. Retrieved from <http://www.colloquebioart.org/pages/bioteknica.html>
- Willet, J. & Bailey, S. (2009). BIOTEKNICA: TERATOGENIC STRATEGIES FOR CRITICAL BIOART PRODUCTION. *Proceedings from the Mutamorphosis: Challenging Arts and Sciences Conference*. Retrieved from <http://mutamorphosis.wordpress.com/2009/02/22/bioteknica-teratogenic-strategies-for-critical-bioart-production/>
- Willet, J. (2008). *BioArt: Contemporary Art and the Life Sciences*. Retrieved from <http://jenniferwillet.com/home/teaching/bioart-contemporary-art-and-the-life-sciences/>
- Williams, R. (2005). *Culture and Materialism. Selected Essays*. London. New York: Verso.
- Williamson, B. (2009). Science meets Art. Interview with Curator Melentie Pandilovski talks about Biotech Art and the Adelaide Display. Retrieved from: <http://www.abc.net.au/local/stories/2009/04/24/2551700.htm>
- Wilmot, I., Schnieke, A.E., McWhir, J., Kind, A. J., & Campbell, K. H. S. (1997). Viable offspring derived from fetal and adult mammalian cells. *Nature*. Vol. 385. Issue 6619. 810-813. Retrieved from <http://adsabs.harvard.edu/abs/1997Natur.385..810W>
- Wilson, S. (2000). *Myths and Confusions in thinking about Art/Science/Technology*. Retrieved from <http://online.sfsu.edu/~swilson/papers/wilson.caapaper.html>
- Wilson, S. (2003-2004). *Protozoa Games*. [Digital still from installation]. Retrieved from <http://userwww.sfsu.edu/swilson/>

- Wilson, S. (2004). *Protozoa Games: A series of Art & Biology Installations*. Retrieved from <http://userwww.sfsu.edu/swilson/art/protozoagames/protogames10.html>
- Wood, E. (2009). *Rules for the (R)evolution of Museums. Inspiring Action: Museums and Social Change: A collection of essays*. Edinburgh: Museumetc.
- Woodrow, R. (2011). *Animals, People – A Shared Environment....AN EXHIBITION*. [Brochure]. 4th Biennial Australian Animal Studies Group Conference. Queensland, Australia: Griffith University, Queensland College of Art and POP Gallery.
- Wright, J. (1768). *An Experiment on a Bird in the air pump*. [Painting]. London, United Kingdom. The National Gallery. Trafalgar Square. Retrieved from <http://www.nationalgallery.org.uk/paintings/joseph-wright-of-derby-an-experiment-on-a-bird-in-the-air-pump>
- Uglow, J. (2008, May). *Joseph Wright 'of Derby'*. [Blog post]. The National Gallery. Trafalgar Square, London, United Kingdom. Retrieved from <http://www.nationalgallery.org.uk/paintings/joseph-wright-of-derby-an-experiment-on-a-bird-in-the-air-pump>
- Wunderkammer*. (n.a.). (n.d.). Retrieved from <https://sites.google.com/site/acrossadistance/the-history-of-wunderkammer>
- Yarrow, S. (2005). *Canada Endorsing Monsanto's 'suicide seeds'. Leaked document reveals secret plans*. Retrieved from <http://www.greenpeace.org/international/en/news/features/suicide-seeds/>
- Zaretsky, A. (2000). *Eyebeam*. Retrieved from <http://eyebeam.org/people/adam-zaretsky>
- Zaretsky, A. (2009, October 9). Artists in Science Labs. *Proceedings from the Mutamorphosis Conference, Prague*. [Video podcast]. Retrieved from <http://mutamorphosis.wordpress.com/videos/>

Bibliography

- Achbar, M. (Producer/Director). (2005). *The Corporation*. [DVD]. United Kingdom: Big Picture Media Corporation.
- Allen, W.J. (2001) *Working together for environmental management: the role of information sharing and collaborative learning*. PhD (Development Studies), Massey University.
- Barker, C. (2003). *Cultural Studies. Theory and Practice. Second Edition*. London: Sage Publications.
- Bauman, Z. (1973). *Culture as Praxis*. London: Routledge & Kegan Paul.
- Beder, S. (2008). The Corporate Assault on Democracy. *The International Journal of Inclusive Democracy*. (4), 1. Retrieved from http://www.inclusivedemocracy.org/journal/vol4/vol4_no1_beder.htm

- Bennett, T. (1995). *The Birth of the Museum: History, Theory, Politics*. London: Routledge.
- Boyle, K. (n.d.). *Perspectives on Modernity: Habermas and Lyotard*. Retrieved from http://www.academia.edu/1569670/Perspectives_on_Modernity_Habermas_and_Lyotard
- Chomsky, N., & Herman, E. (1988). *Manufacturing consent: The Political Economy of the Mass Media*. New York: Pantheon Press.
- Cote, J. E., & Levine, C. G. (2002). *Identity formation, Agency and Culture. A social Psychological Synthesis*. The United States of America: Lawrence Erlbaum Associates Inc. Publishers.
- Curtis, H. (1983). *Biology Fourth Edition*. New York: Worth Publishing Inc.
- Cutter-Mackenzie, A., Payne, P., & Reid, A. (Eds.). (2011). *Experiencing Environment and Place through Children's Literature*. London: Routledge.
- Dawkins, R. (1995). *The Extended Phenotype*. Oxford: Oxford University Press.
- Dixon, D. P., Hawkins, H., & Ingram, M. (2011). Blurring the Boundaries. A review of Swiss Artists-in-Lab's exhibition *Think Art-Act Science*, at Arts Santa Monica, Barcelona. *Nature*. (472). 417. Macmillan Publishers Limited. Retrieved from http://artscigeog.files.wordpress.com/2012/07/dixonhawkinsingram_blurring-the-boundaries_nature.pdf
- Dixon, D. P., Straughan, E. R., & Hawkins, H. (2011). When Artists Enter the Laboratory, A review of SymbioticA's exhibition *Visceral*, at Science Gallery, Dublin *Science* 331.6019 (February): 860. Retrieved from <http://artscigeog.wordpress.com/publications/>
- Edwards, V. (2007). Good drop gets dressed up. *The Australian*. p.9.
- Entwistle, J. (2000). *The Fashioned Body, Fashion, Dress and Modern Social Theory*. Cambridge: Polity Press.
- Ewing, R. (2010). *Curriculum and assessment: A narrative approach*. Melbourne: Oxford University Press.
- Fantone, L., & Catts, O. (Eds.). (2002). Cute Robots. Ugly Human Parts. (A post-human aesthetics of care). *BEAP02 Symposium. The Aesthetics of Care? Second Edition*. Australia: SymbioticA Press.
- Findlen, P., & Smith, P. (Eds.). (2002). *Merchants & Marvels: Commerce, Science, and Art in Early Modern Europe*. London: Routledge.
- Forgan, S. (1994). The architecture of display: Museums, universities and objects in nineteenth century Britain. *History of Science Journal*. (6).139–162.
- Foucault, M. (1970). *The Order of Things: An Archaeology of the Human Sciences*, London: Tavistock Publications.

- Gregson, R. (Ed.) (2013). *Connecting with Science Education*. USA: Oxford University Press.
- Habermas, J. (1971). *Toward a rational society: student protest, science and politics*. London: Heinemann.
- Haraway, D. (1991). *Simians, Cyborgs & Women*. London: Routledge.
- Harley, J. (Producer). (2010). *The Vanishing*. [Documentary]. *60 Minutes*. Wednesday, 23, June, 2010. Retrieved from sixtyminutes.ninemsn.com.au/article.aspx?id=1075026
- Impey, O. R., & Macgregor, A. (Eds.). (2001). *The Origins of Museums: The Cabinet of Curiosities in Sixteenth- and Seventeenth Century Europe*. House of Stratus Incorporated.
- Kockelkoren, P. (2003). *Technology, Art, Fairground and Theatre*. Rotterdam: Nai Publishers.
- Lakoff, G. & Johnson, M. (1981). *Metaphors We Live By*. Chicago: Chicago University Press.
- Liposvetsky, G. (2006). Art and Aesthetics in the fashion society. In Brand, J., Teunissen, J., & Zwaag, A. (Eds.). *The Power of Fashion: About design and Meaning*. Netherlands: ArtEZPress.
- Lupton, E., Johnson, E., & Lamster, M., (Eds.). (2002). *Skin, surface substance and design*. Cooper-Hewitt National Design Museum, Smithsonian Institution. New York: Princeton Architectural Press.
- Mabel, K. W. H. (2003). *The Challenges of Producing a Piece of Bioart*. Cyberart Term Assignment. Unpublished manuscript. The University of Western Australia, Perth, Western Australia.
- McDonald, J.P. (1999). 'Redesigning curriculum: New conceptions and tools', *Peabody Journal of Education*. 74 (1), 12–28.
- Miele, F. (1995). *Darwin's Dangerous Disciple An Interview With Richard Dawkins Skeptic*. 3 (4), 80-85. The Skeptics Society, Altadena, Retrieved from: www.skeptic.com
- Mintz, S. L. (2011). History of Secondary Education-Current Trends, International Issues. State University. Retrieved from <http://education.stateuniversity.com/pages/2411/Secondary-Education.html>
- O'Mahony, M. (2002). *Cyborg the man-machine*. London and Hong Kong: Thames & Hudson.
- Pyle, R. (2002). Eden in a Vacant Lot: Special Places, Species and Kids in Community of Life. In P.H. Kahn, & S.R. Kellert, (Eds.). *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. Cambridge: MIT Press.
- Reodica, J. (2004). Testube Gods and Microscopic Monsters. In O. Catts, (Ed.). *BEAP02 The Aesthetics of Care? Symbiotica Symposium*. Australia: Symbiotica Press.

- Roth, W., & Van Ejick, M. (2012). *Imagination of Science in Education: From Epics to Novelization (Cultural Studies of Science Education)*. New York: London: Springer Dordrecht Heidelberg.
- Roth, W. (2010). *Re/Structuring Science Education ReUniting Sociological and Psychological Perspectives*. New York: London: Springer Dordrecht Heidelberg.
- Scaruffi, P. (1999). Book review of Lynn Margulis' *What is Life?* Retrieved from www.scaruffi.com/mind/margulis.html
- SeaJay, (n.d.). 'From Rocks to Avatars: The Phenomenology of Virtual Objects. Retrieved from: http://ourworld.compuserve.com/homepages/charles_langley/771210.htm
- Shilling, C. (1993). *The Body and Social Theory*. London: Sage.
- Singer, P. (1994). *Rethinking Life & Death: The Collapse of Our Traditional Ethics*. New York: St. Martin's Griffin.
- Sizer, T.R. (1999). 'That elusive "curriculum"', *Peabody Journal of Education*, 74 (1), 161–5.
- Smelik, A. (2006). Fashion and visual culture. In Brand, J., Teunissen, J., & Zwaag, A. (Eds.). *The Power of Fashion: About design and Meaning*. Netherlands: ArtEZPress.
- Stafford, B. M. (1994). *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education*. Cambridge, Massachusetts: MIT Press.
- Teaching Australia—Australian Institute for Teaching and School Leadership*
www.teachingaustralia.edu.au/ta/go/home/
- The Melbourne Declaration on Educational Goals for Young Australians*
www.mceetya.edu.au/verve/_resources/
- Tytler, R. (2007). Re-Imagining Science Education: Engaging students in science for Australia's future. Boosting Science Learning – What will it take? *Proceedings from the ACER Conference 2006. Australian Council for Educational Research. Australian Education Review*. Retrieved from: <http://research.acer.edu.au/aer/3>
- Virilio, P. (2004). *Art and Fear*. London: Continuum.
- Willet, J. (2003, June). *BIOTEKNICA Presentation*. Poster session presented at SymbioticA, Faculty of Anatomy, Physiology and Human Biology, The University of Western Australia. Perth, Western Australia.
- Wilson, S. (1993). *Light and Dark Visions: The Relationships of Cultural Theory to Art that uses emerging technologies*. Retrieved from <http://online.sfsu.edu/~swilson/papers/postmodern.pap.html> September 30 2005
- Wilson, S. (1999-2002). *Excerpts from the book Information Arts: Intersectionss of Art, Science and Technology by Stephen Wilson*. Retrieved from <http://userwww.sfsu.edu/~wilson/papers/wilson.body.infoarts.html>