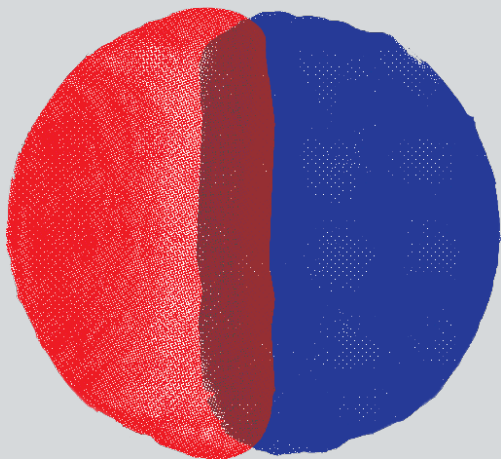


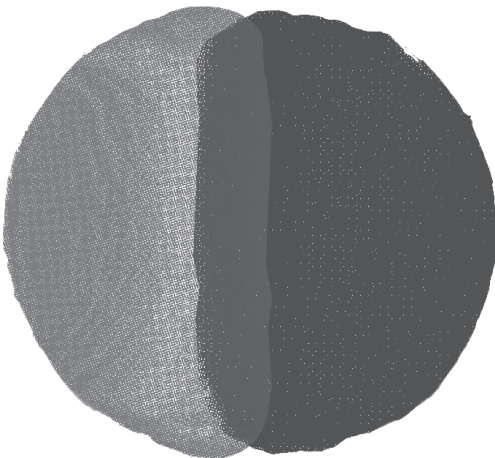
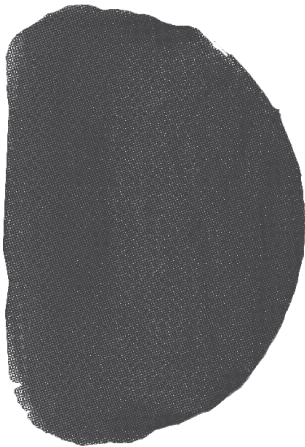
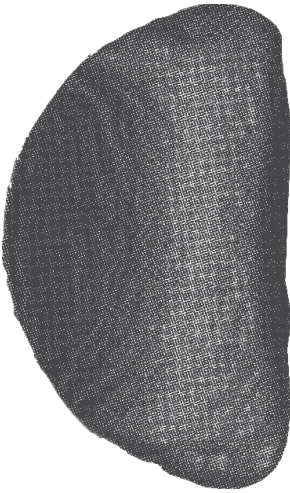
When Art
Education



Meets
Environmental
Issues



The Interconnectedness
of Art and Science



A Thesis

Presented in partial fulfillment of the requirements for the degree Master of Arts (MA) Art + Design Education in the Department of Teaching + Learning in Art + Design of the Rhode Island School of Design

By Eunhyung (Julie) Chung
Rhode Island School of Design, 2021



When Art Education

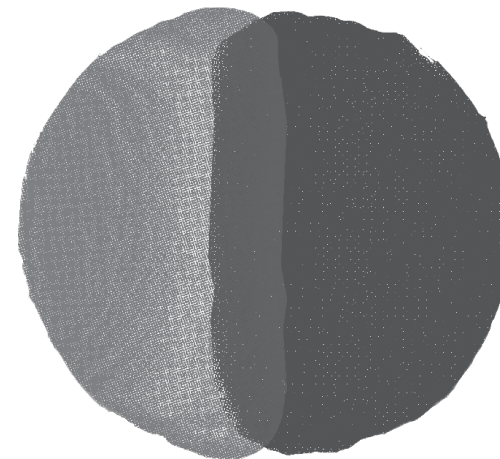


Meets Environmental Issues

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The Interconnectedness
of Art and Science

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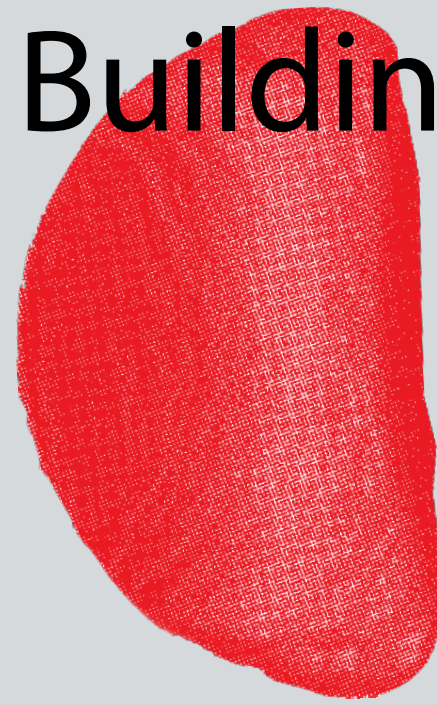
Thank you to Shiqi Wu for giving me a lot of help to finish my projects and always providing me with helpful feedback to develop my thoughts even further through fruitful conversations.

Abstract

In recent years, we have come to understand that the environmental crisis is no longer what we see in books or screens but it is what we are facing now. Along with the public's increasing interest in the environment post-COVID, this thesis explores the role of art in enhancing awareness of critical environmental issues. Through a literature review, the author examines theoretical concepts at the core of the history of art and science in search of ideas about the interconnectedness of science and art. The review explores why an interdisciplinary approach to education is vital to learning about environmental issues and the unique and non-subsidiary role art can play in understanding science. The author reviews current pedagogical models in settings outside of classrooms, where there is an integration of art and science. And through an analysis of these models, the author identifies promising practices and areas they argue are in need greater consideration.

In this thesis, the author focuses on various new approaches to environmental issues through art education that move beyond traditional concepts of environmental arts education and emphasizes the role of the "media as an art teacher." The thesis presents the author's interdisciplinary experiences while in graduate school at the Rhode Island School of Design (RISD), where writing and research are incorporated into art practice as a possible conceptual foundation for integrated teaching and learning pedagogy. The author argues that environmental issues do not exist apart from us but are closely linked to us in various ways. However, they further claim there is still a significant gap in educational contexts between learners' awareness and a deeper understanding of environmental issues. The author concludes that art education has considerable potential in regard to creativity development and empowerment which they argue can bridge this gap and lead to change.

Building



Solid Ground

Statement of Research Question

How can art education fill in the gaps between awareness and understanding of environmental issues?

The advent of new viruses, rising sea levels due to global warming, frequent wildfires, air pollution, the amount of trash growing at an uncontrollable rate, animals going extinct due to anthropogenic impacts are no longer the stories of distant countries or the distant future. These are the real issues that we are facing now. Although some movements were to preserve the environment, most people still ignore this environmental crisis and continue to postpone our tasks. Why are we so insensitive to the environmental crisis? What has paralyzed our thoughts on the environment? How can we make people feel that when they see glaciers melting, it's not something that is only happening on the screen, but it's something that's closely related to us? There is "a big gap between awareness and understanding" (Wilson, Forister, Carril, 2017, p.1) of environmental issues.

For too long, we have turned away from the crisis that nature faces, and we are in a state that we can no longer postpone. In my thesis, I explore how art and science are interconnected and how art education can fill in the gaps between awareness and understanding of environmental issues. I look at how environmental education has been neglected in the curriculum. By reflecting on existing teaching models related to the environment and my experiences at RISD, I analyze how science and art worked together and find directions to take a step further.

Why has environmental education through art lost its vitality?

Eco-art first began with the practice of artists. From late 1960, artists became aware of the seriousness of environmental problems and offered creative solutions to them. Then, in the 1970s and 80s, this movement actively proceeded to environmental art education. At that time, the creativity of art-based environmental education drew its attention, and people started to acknowledge the effectiveness of the interdisciplinary approach in developing ecological literacy.

But why has environmental education through art lost its vitality? Why is the world changing so rapidly while art education remains unchanged? I have noticed that the diversity of arts education dealing with environmental issues was very limited. For example, the activities like upcycling plastic bottles and transforming them into artwork or creating artwork in nature using fallen leaves or tree branches, like Andy Goldsworthy's land art, have frequently emerged in the K-12 environmental art curriculum. It is definitely invaluable since it allowed students to discover the beauty of nature and create new meanings from the trash that had been thrown away. However, I believe we have repeated this type of activity for too long in the same way. We need new teaching models that can significantly impact changing students' behavior toward the environment beyond recognizing the values of nature.

As environmental issues become more diverse and severe, we need more various and developed approaches to understand how closely and intricately they are intertwined with our lives. And the methods that I am proposing are as follows: Animal and Human Relationships / Human Health / Social Equity / Identity & Building Community.

Through the Covid-19 pandemic, we have learned that we share our planet with animals and how we humans are part of nature. Thinking about the relationship between humans and animals could be one way to think about nature. In 1975, biologist Hans Krebs introduced "August Krogh's Principle." Contending that "For many problems, there is an animal on which it can be most conveniently studied," this principle "has attained great popularity in the biological literature" (Jørgensen, 2001, p.59). And here I saw the possibility that learning about the animals that one is interested in and building emotional connections to animals could be the first step to get involved in environmental issues. In addition to this, environmental issues can impact our health and cause social equity issues such as environmental refugees. Nature plays an essential role in forming children's identity and community building. Through a review of related scholarly literature, I examine how the environment is related to us in many different ways.

If we integrate environmental education with arts education, what synergy will it bring?

What is the artist's role in society? Does art have an impact on the world? By questioning what art can do in the face of global environmental issues, I investigate how art and creative production can raise the awareness of ecological problems and lead to change in people's behavior. And I found that environmental education often occurs outside of the classroom. More and more, our curriculum is changing into interdisciplinary. By combining these two different fields, art and environment, I explore what synergy that art can bring.

Background & Setting

Art as a Gift, Art as a Present

Whenever I ask myself, "Why am I here? What does art mean to me?" such questions always bring me back to the moment when I was a child.

When I was nine years old, there was a small street food truck nearby my house. They sold chicken sticks, and their chicken sticks were so delicious that I drew a picture of them and gave it to the food truck's owner as a gift. The owner was so grateful to receive my drawing that she put the drawing in front of the truck and gave me seven chicken sticks for free. That was the first moment that I realized how rewarding it is to please others through my artwork. And since I was such a shy girl, it was always easier to speak through art. Art was another language for me. I expressed my love, gratitude, and all the feelings through art. For me as a child, art was something that gave pleasure to others. I liked art because people liked my art and wanted to satisfy their expectations, not disappoint them. Art was precious to me because of its altruism, consideration, and positive influence. I was gifted, and I wanted to share that gift with others. While I was making art, I was able to be in this moment, be present. However, unfortunately, this wasn't always the case.

Can art change the world?

A considerable number of things happened in 2020: From "more than 13,000sq km (5,019sq miles) of the Brazilian Amazon burned" (Church, 2020), the wildfires in Australia, the red sky in California, the advent of coronavirus, to protests against racism. Nature was sick, and as well as humans. The virus has killed

countless lives of people and animals. Everything stopped as if implying that it was time for the earth to take a break and recover. During this long period of isolation, I came to think more deeply about the value of art and the artist's role in this situation. I wanted to share my gift with nature and make artwork that is meaningful and influential to more people, not just for my satisfaction. Then I asked myself, 'Can art change the world?'



Figure 1. A sea turtle with straw up its nostril. A still from a film by marine conservation biologist Christine Figgenger, 2015.t

I remember seeing this photograph of a turtle bleeding with the straw stuck in its nostrils. It was first time that I realized what was happening under the ocean and how animals suffered due to humans' selfishness. Even though it was just a photograph, it quickly spread to the Internet. It touched people and played a crucial role in the expulsion of plastic straws and the commercialization of paper straws. This photograph has remained in my mind for a long time and sparked my pledge thesis on environmental education through art.

We don't understand others until we see and experience with our own eyes. If art and science are combined to solve these environmental issues, I firmly believe we can make a difference, changing people's notions and actions. I thought art could be a crucial key connecting the environment and the public. As an artist and an art teacher, what we create and

teach can change and shape the way people see the world without being too didactic. I think the influence of art on people is far more significant than we think. Thus, we should always have to take responsibility and think about what potential and power we can create through art.

New approaches to art-based environmental education

I firmly believe we need new and broader approaches toward environmental education. Although public awareness of environmental issues has developed, people still separate themselves and treat them as irrelevant to their lives. We're alarmed when we read an article saying that the discarded disposables created a garbage island called the "Great Pacific Garbage Patch (GPGP)," which consists of about 80,000 tons of garbage. We feel sad when we watch videos of children playing in a river covered with waste. But the sadness lasts only for a moment. As we turn around, we go back to our daily routine as if nothing had happened. We bother to take our reusable water bottle to the cafe, so we drink coffee in a plastic cup, use a plastic bag instead of a reusable shopping bag. We know that methane gas released from cattle exacerbates global warming, but we often eat steak for every special occasion. Now we need to go beyond the perception of the problem, truly understand it, and change our behavior. Awareness, not premised on deep understanding, is temporary and can be changed easily.

To move beyond the awareness of environmental issues to a fundamental understanding of them, we must contend change how we learn about the environment. Due to reckless development and urbanization, we have pushed nature further away from us. As a result, the young and the older generation have lost

opportunities to be in nature. And, unfortunately, arts and environmental education are losing their place in the K-12 curriculum. To address these issues, I argue that we must approach environmental education differently from the uniform environmental arts education of the past according to the rapidly changing environment.

Methodology

In the thesis, I use various qualitative research methods, which involved a critical analysis of scholarly literature, interviews, my role as participant observer during academic coursework, research symposium and workshops and informed by autobiographical experiences while studying as a graduate student at the Rhode Island School of Design (RISD).

Literature

The Literature consulted included: Journals / Interview Script / Scientific Article / Art Education Journal / Poem. Since art-based environmental education integrates art and science, art education journals or scientific articles were covered. I mostly used qualitative research methods to reflect on the interconnectedness of art and science, its value, and existing teaching models.

Different types of Media

Media includes: Documentary film / TED Talk / Documentary Video

When it comes to environmental education, the Media plays a critical role in raising public awareness and interest in environmental issues. The media also has negative aspects such as excessive exposure and misinformation. While considering the strengths and weaknesses of media, the thesis examines the role of the Media as an art teacher.

Research Symposium & Workshop

The thesis references a Research Symposium and workshop held by the North American Association for Environmental Education. This workshop examines how environmental issues are deeply related to human equity and justice and proposes various arts-based educational research models.

My experiences in RISD

The thesis is informed by my journey at RISD. I immersed myself as an artist in the topic of environmental education through art, using myself as a case study.

Interview

I interviewed representatives from two non-profit organizations to look deeper into what educational models currently exist outside of the school settings and what difficulties they face. The organizations include Creature Conserve and the Rhode Island Natural History Survey (RINHS), both of which work at the intersection of art and science.

Scope & Limitation

I have attempted in this thesis to clarify that the topic is not broadly about nature but art-based curriculum and instruction that explores matters related to climate change or environmental issues. In this thesis, I identify the environmental issues related to our lives in various ways as concerning: Animal and Human Relationships / Human Health / Social Equity / Forming Identity & Building Community. Although "Humans and the environment" is a broad topic, I focused on these four approaches as an opportunity to examine art-based environmental education.

When examining existing educational models, I decided to narrow my research of art education journals and media sources to those published within the last five to ten years or which contained visual evidence of students' works. It was important to find more experimental, progressive, and new art-based environment educational models that integrate science and art, so I decided not to include examples that represented the typical conventional environmental assignments, such as upcycling plastics. While I tried to limit the scope of my review to contemporary literature, I have also referenced some of the older texts in order to make the case for enduring ideas like the interconnectedness of science and art, the role of art in dealing with environmental issues, and the educational role of the media.

In regard to the age groups covered in the literature, my focus was from the lower elementary school grades to youth. However, since few journals dealt with environmental education through the arts for higher education, I positioned myself as a case study within the context of my experiences at RISD. I fully recognize in regard to the latter that since this is reflective of a personal experience while at RISD, there are significant limitations to any generalization of that experience.

Structure & Content

In Chapter 1: Introduction, I begin my thesis by raising research issues and questions and set the context for my interest in the intersection of art and ecology, the methodologies used, and scope, and limitations that I established for the study.

In Chapter 2: Learning from Precedents,

I look at a variety of scholarly literature, including media and journals, and each analysis is presented as an abstract accompanied by a brief reflection. I categorize the literature into two sections; in the first section, I define the role of art in the face of the environmental crisis, discussing why integrating art and science is so important. I also diagnose the current scene of why we should learn about the ecological crisis. In the second section, I examine existing teaching models. Places of learning are not limited to schools but include museums, site visits, galleries, and media. By investigating various forms of art-based environmental education, we can gain insights that can inform future directions.

In Chapter 3: Creating a Constellation,

I re-examine three courses and a workshop that I have taken at RISD. I, as an artist, immerse myself in environmental education through art and figure out the relationship between art and science. I evaluate the impact and the effectiveness of them and rethink how we can improve them. And through the interviews with professionals currently working across the boundary of art and science, we discover the unique power that only art possesses when combined with science.

In Chapter 4: So that My Light Shines on You,

I discuss what this journey has meant to me and how it has changed my life. By diagnosing the effects and limitations of environmental education through the arts of the past and looking at the recent educational models of the past five years, I propose a possible direction for arts-based environmental education, what we might learn, and what we need to unlearn. The

thesis concludes with a number of questions about the direction for the future, hoping that my light might shine on more people and more exciting forms of art-based environmental education might emerge.

Learning

From
Precedents

This chapter presents my responses to a select number of sources that include articles published in academic journals, symposia proceedings, documentary films, and talks. In my review of this material, I summarize key findings as well as describe the impact of the material on my own thinking. The review is organized in two parts; the first covers sources that explore how art and science are interconnected and why it's important to integrate the two, the benefits art can bring, and how media can act as art teachers. In the second part, which is limited to contemporary literature published within five years (2015-2021) I review and respond to material dealing with a range curricular and teaching practices designed to engage youth with environmental issues, rather than a broad concept of nature.

Why Integrating Art and Science is Important?

Spelman, L. (2015, June). *Art Can Save A Panda* [Video]. TED Conferences. <https://www.youtube.com/watch?v=F05ZMfZUnEO>



Fig. 2. Art Can Save a Panda (TED Talk) by Lucy Spelman, (Image retrieved from <https://creature-conserve.com/events>), 2015.2017, p.2.

In this TED Talk Lucy Spelman, a biologist and wildlife veterinarian, she talked about how integrating art and science can save species and make a difference in conservation. Although humans are striving for conservation through de-extinction or rewilding, the efforts of scientists alone are not enough to save animals. While mentioning that Leonardo da Vinci and Charles Darwin were both scientist artists (Spelman, 2015), she said we could find a solution in the interrelatedness of art and science.

Spelman continued the story highlighting examples of three endangered animals, the Sumatran tiger, giant panda, and mountain gorilla. First, she explained how real-world experiences of interacting with animals, such as touching a Sumatran tiger, could play a vital role in changing people's perceptions of the conservation of animal species. And the speaker criticized the reality of how we invest little money in preserving species while willing to spend \$800 billion on war, pointing out that nature reserves for pandas in China do not have bamboos which are most important for pandas' habitat. Lastly, while referring to the fact that many mountain gorillas are endangered due to the infection of human disease and habitat destruction, she said as followed:

We have to understand that humans and gorillas and environmental health are connected. The conservation is about embracing that idea of health, both as physical health (well-being) and economic health, but also the big idea of health. (Spelman, 2015)

As a scientist, she realized her ability to reach a broad audience was limited; few people listen to scientists. Then, she began to teach classes that combined art and science at Rhode Island School of Design. In the video Spelman showed examples of work made by her students. While talking about how art can elicit people's subconscious emotions when combined with science, Spelman argued that these changes in people's perceptions could eventually preserve the environment.

This lecture was the starting point realizing the unique value and influence of art and the synergies that arise when art is combined with other fields. On the surface, art might seem it couldn't change anything. However, I firmly believe that the

Wilson, J. S., Forister, M. L., Carril, O. M. (2017). Interest Exceeds Understanding in Public Support of Bee Conservation. *Biology Faculty Publications*, 1570, 1-7, doi:10.1002/fee.1531

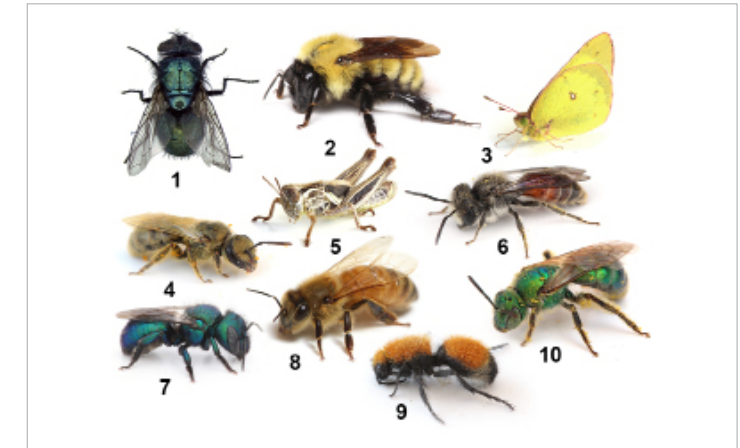


Fig. 3. Images of bees and non-bees. Published in www.frontiersin ecology.org. JS Wilson et al., 2017, p.2.

This article's author points out that there is a significant gap between people's awareness and understanding of bees. Although research and financial support for the conservation of bee species have increased as the number of bees has sharply decreased, a recent survey has revealed that the public were aware of the importance of bees but were ignorant about the richness of US bee species.

The issues of the conservation of bees cannot be solved by awareness alone but by an accurate understanding and education. However, public and media attention seems to be focused only on the honey bee, not wild bees, which are the main contributors to the pollination of our crops. People were unaware that there was a difference between the plants that honey bees liked and wild bees liked and that a mono plantation would put certain bee species on the brink of extinction. Although some acts started with good intentions, this unintentionally led to negative consequences. The writer says, "Without effective outreach and education about native bees, the efforts of those concerned about bee declines may in some cases do more harm than good." (Wilson, Forister, Carril, 2017, p. 5)

While mentioning various citizen-science programs about birds which were successful in that it raised the public's awareness of birds, the authors claim that similar success could occur with native bees. The authors urge biologists and educators to work together to educate people about the diversity and the importance of native bees.

Throughout this article, I became increasingly aware of the importance of education in transforming people's awareness of

animals and nature into a real understanding, which will in turn lead to an actual environmental movement for change. Funding only invested for scientific research of native bees would not be enough to change people's behavior. However, I argue that we must go several steps further. What if for instance art programs were developed where learners engaged in the creative art-making process as a means to develop a deeper understanding about the diversity of bees and especially native bees.



Fig. 4. Woodcut of Galileo using his telescope. Published in Country Life Magazine. Martin Fone, 2018 (Picture: Chronicle / Alamy Stock Photo).

This article explores how science education and the history of science (HoS) can be taught in the context of the history of art, taking Galileo's telescope as an example. It is because science and art share many similarities historically and epistemologically. When we look at the origin of "art," it comes from the Latin word "ars and artis," which in turn stemmed from the Greek word "techne." (p. 7) And the historical philosophers, such as Aristotle, "defined art as a permanent disposition to produce things rationally," and Quintilian noted that "art is based on a method and an order (pg. 7)." In the past, people viewed art as not very different from science, such as technique or logical rule. Art and science are epistemologically similar as well. They value creativity and imagination, produce physical outcomes through the intellectual process, and satisfy human needs. As the authors argue (2020), "Beauty does not dwell only in the fine arts" (pg. 9), both art and science bring great pleasure when inventing something new.

For a long time, science has provided tools and technologies that can inspire art. Conversely, art has become a great communication tool in conveying complicated ideas of science in a more accessible way. The richness brought by art was of great

help to the development of science. But ironically, subjects are increasingly separated in the curriculum, and art and science are now considered two distinct fields. However, the article's authors claim that art and science share many similarities and argue that science education can take place in art history. Learning about the history of science humanizes science, and through art history that depicted science, we can see how science has been embedded in and influenced our lives. The writers explain the social and cultural atmosphere of the time through examples of paintings that depicted Galileo's telescope. Finally, the authors propose a pedagogical model that combines science and art to show how they can be applied to teaching in practice through the 7Es model (Eisenkraft, 2003), including Extract-Elicit, Engage, Explore, Explain, Elaborate, Extend.

This text was invaluable in helping me realize how much science and art are intrinsically and historically similar. In so much of the educational environment disciplines are increasingly divided, so the movement to integrate art and science appears to me to have significant potential since it leads many would argue to more comprehensive understanding and more open-minded and creative thinking.

Wardrip-Fruin, N. (2003). The Medium is Message. In N. Montfort (Ed.), *The New Media Reader* (pp.203-209). The MIT Press.

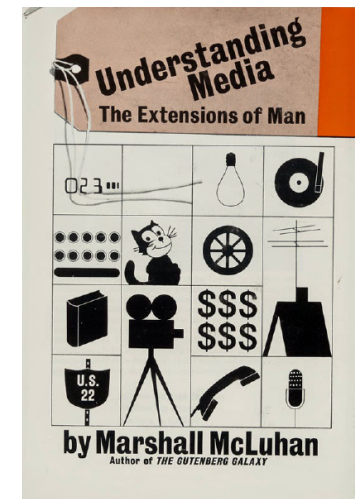


Fig. 5. The book, "Understanding Media: The Extensions of Man" (first edition). Marshall McLuhan, 1964 (Picture: WIKIPEDIA).

"The Medium Is the Message" is the first chapter of the book "Understanding Media: The Extensions of Man," written by a Canadian philosopher, Marshall McLuhan. In the book, he declares (1964), "the media itself is a fundamental message" (p.203) while pointing out that we are paying too much attention to the content of the medium, not the characteristics of the medium itself. And taking it even further, he published a book, "The Medium is the

Message: An Inventory of Effects" (1967), since it can change people's thinking and behavior in specific ways. Medium is powerful because it uses another medium as its content, not because it contains powerful content. He also compares the media to electric light and stating, "The message of the electric light is like the message of electric power in the industry, totally radical, pervasive, and decentralized." (p. 203)

And through the examples of the paradox of mechanization, film, and cubism, he strengthens his idea. In the West, continuity, and uniformity have been regarded as rational. However, mechanization was not a causal sequence but a sequence of fragmented parts. The movie "carried us from the world of sequence and connections into the world of creative configuration and structure" (p.205), and Cubism allowed people to look at the structure where the three-dimensional and the plane conflict, not the world of continuous illusion dominated by perspectives.

Lastly, the writer talks about our attitude toward media as follows: "The products of modern science are not in themselves good or bad; it is the way they are used that determines their value." (McLuhan, 1964, p. 204) And McLuhan (1964) warns us that we must not forget that there is a risk of being numb in the media, saying that all media is an extension of the human senses, shaping each person's conscious experience (p.209).

This article provided a new perspective on the power of the media itself. Although I don't entirely agree that medium is more important than the content because some media that contain biased or wrong content can mislead or antagonize the public. Thus, it seems crucial to recognize the potential danger of the media itself and the content and take it critically.

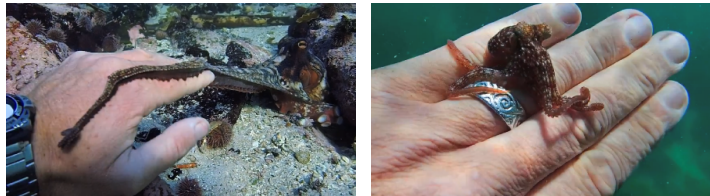


Fig. 6. The cover of the book, "Understanding Media: The Extensions of Man" (first edition). Marshall McLuhan, 1964 (Picture: WIKEPEDIA).

This documentary (2010) was filmed in a kelp forest off the coast of South Africa. The film depicts a diver Craig Foster overcoming depression and slump through building a deep emotional bond with the octopus. At the time of filming, he was going through an emotional breakdown, and the following is what he felt like when he was going into the sea:

In the beginning, it's a hard thing to get in the water. It's one of the wildest, most scary places to swim on the

planet. The cold takes your breath away, and you just have to relax. And then you'll get this beautiful window of time pr 10 or 15 minutes. Suddenly, everything feels okay. (Craig Foster, 2020)

However, in the sea, he met one octopus full of curiosity. This octopus rekindled his passion, and he began to capture the beautiful moments of the sea with his camera. At first, the octopus was afraid of him and ran away, and since it was so shy, the octopus hid in the seaweed, peeking out its eyes and observing him. However, after a few days passed, the octopus gradually built trust in him and began to attach its body to his hand and swam freely with him. Sometimes, the octopus disguised itself like a stone or a seaweed and covered up its whole body with many shells to defend itself from predators. One moment, the octopus was losing its energy after a shark attacked some of its arms. By watching the octopus regenerating its arm gradually, viewers could be immersed the emotional journey of the octopus. And the documentary ends with the old octopus slowly dying while the newborn babies are coming into the hands of the diver's son and forming a new bond.

Before watching this documentary, I never had any emotional attachment to a creature such as an octopus, and ever realized the existence of a beautiful underwater world, a sea forest. However, this documentary film completely changed my perception of marine life. The tight bond, trust, and emotional connection between this little creature and the diver were fascinating and truly moved my heart. Through this documentary, I realized the influence of the media that evoked a deeper resonance and started to see the potential of media as an art teacher. And I thought that having people's emotional connections to animals could be the first step in getting them to think about and care about nature. When Craig said (2020), "What she taught me was to feel that you are a part of this planet, not a visitor. That's a huge difference," it reminded me of our responsibility as part of this planet that shares life with all other living things.

Reed, J., Ehrlich, P. (Directors). (2020). *My Octopus Teacher* [Film]. Netflix.



Fig. 7. Shark fins trade in Hong Kong 2013. (Picture: Antony Dickson / AFP / Getty Images).

This article reports on an interview with David Shiffman, a marine conservation biologist. The interview examines people's misunderstandings surrounding shark conservation and the detrimental impact that a biased media could bring about. While media can play an essential role in raising people's awareness of ecological threats, distorted media obscures the most important causes, concerns, and solutions by other collateral factors, making the most critical issues unrecognizable. Taking sharks as an example, Shiffman argues that the media's attention has long been focused on shark fins and has repeatedly depicted fins as the only significant source of shark death. However, the impact of shark finning on global shark conservation is a small part compared to other factors such as overfishing.

Another misconception that the public had about sharks was about the term "shark finning." It has been universally thought that a complete ban on shark finning and shark product trade could solve shark populations' declining issues. However, Shiffman argues that it is crucial to acknowledge that bans are not always the perfect answer and are not always supported by scientific evidence. Here, Jimmy says (2020) "Shark finning means catching a shark, removing its fins at sea, and discarding the carcass at sea" (Thomson, 2020, p.5). Thus, banning shark finning doesn't necessarily mean banning the sale of shark fins. Shark fins can still be sold even after shark finning is prohibited. As a solution, he contends that it could be more effective to devise a way to develop the biological sustainability of shark fisheries rather

than completely banning fishing for sharks or prohibiting shark finning.

The article reports that such biased and misleading media coverage could be extraordinarily dangerous because if the public cannot understand the most critical threats and problems that species face, they may not support practical solutions that can be a real help. And eventually, Thompson warns (2020) that this could lead to the spread of misinformation on a global scale in a way that can harm the whole conservation and management policy (p.9). Based on these public misunderstandings, the author argues that there is a disconnection in the opinions of non-experts and experts on shark conservation threats and solutions and hoped that the media would more cover scientific experts' voices.

This article was significant for me to realize that viral environmentalism in the media doesn't always have a positive impact and that sometimes biased media can be misleading and unintentionally have adverse effects on the environment.

"Unnamed Dragonfly Species" is one of the collections of poems in the book "Well Then There Now" (2011). In this poem, the writer shares stories of the environmental crises we are facing and how indifferent people are towards those issues. In this poem, the list of endangered species appears intermittently in alphabetical order in bold in the middle of the story. At first, those species stand out, but as we gradually get used to them, they become invisible.

Since 1988, the rate of glaciers melting has accelerated, and over the past decades, 36 miles of glaciers in West Antarctica have melted, raising the Earth's sea level by one-sixtieth of an inch. This little inch of sea level rise seems to be nothing, but the sea level rise of just three feet in Bangladesh will immerse half of the country, displacing more than one hundred million people. However, we are still indifferent to what is happening in nature, and it's often thought to have nothing to do with our lives. We have a sense of awareness and agree that we are responsible for the issues, but we don't know what to do next. People don't want to be paralyzed by excessive information. But the truth is that glaciers, which make up 66% of the world's clean water, are, to the author's words, melting at an uncontrollable rate like zombies and we can't stop it. The poem ends with a species called Yellow-Breasted Chat, which is on the verge of permanent extinction, implying that environmental crisis is an on-going conversation. The following are the last few sentences of the poem:

Vesper Sparrow The systems of relation between living things of all sorts seemed to have become in recent centuries so hierarchically human that things not human were dying at an unprecedented rate. Wacy-rayed Lampmussel And the systems of human governments and

Spahr, J. (2011). Well then there now. *Unnamed Dragonfly Species* (pp.72-94). Black Sparrow Books.

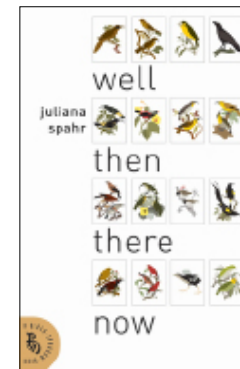


Fig. 8. The book, "well then there now" Juliana Spahr, 2011 (Picture: Google Books).

corporations felt so large and unchangeable and so connected and so immediate to what was happening. Whip-poor-will They knew this but didn't know what else to do. Wood turtle And so they just went on living while talking loudly. Worm snake Living and watching on a screen things far away from them melting. Yellow-breasted Chat. (Juliana Spahr, 2011, p.93)

This poem showed the potential of how great the impact of the environmental problem of endangered species can be when combined with the artistic form of poetry. I was really impressed with the powerful format of the poem because the way we gradually overlooked endangered species resembled our attitude of being paralyzed by repeated exposure to the media. Also, the writer recalls a story of a person who sheds tears while sharing the experience of seeing and touching an actual glacier. This example showed how important it is to have an emotional relationship with nature by experiencing the beauty of nature. This poem illustrated our lethargic attitude toward environmental problems and suggested alternatives to build emotional connections towards ecological issues that seemed alienated from our lives.



Fig. 9. Ice Watch London, Olafur Eliasson and Minik Rosing, Tate Modern, 2018 (Picture: dezeen).

Current Teaching Models of Learning Environment through Art

Francis, M., Paige, K., & Lloyd, D. (2013). Middle years students' experiences in nature: A case study on nature-play. *Teachingscience*, 59 (2), 20-30.



Fig. 10. Lachlan's drawing of a park setting. Students were asked to draw a place in nature. Published in *teaching science*, Francis, M., Paige, K., & Lloyd, D., 2013, p.25.

This article describes a case study conducted with 25 students in grades 6-7 at an elementary school. It examines how nature has been alienated from children's lives and why children need to experience nature firsthand. Mainly focusing on the playful experience in free time, the article delves into children's thoughts, attitudes, and concerns on nature and presents solutions for playful nature interaction.

More and more children have lost their connection to nature, which has led to problems such as 'natural deficit disorder' and 'biophobia,' which regard nature as fearful or far from life. However, the author explains why the relationship between children and nature is so significant through the following quotation "Producing a world of people disconnected to life, and nature and the world [because] it is going to have a profound impact on who we are and what we become." (Levin, 2010)

This suggests that emotional affection and connection to one's living environment can develop environmental identity. In addition, the nature play experience gives children the opportunity to take risks so that they are not afraid of failure and keep challenging themselves. Also, it tends to accompany the sensory experience, which has been found to have a positive effect on children's creativity development, thinking ability, learning pattern, and more profound social relationship development.

This case study focused on "Citizen Science: Urban Ecology Network", which consisted of a two-part program. In the first, all students participated in a drawing activity and completed a short survey, and in the second, seven students were selected as the focus group for in-depth interviews. The program asked students to draw a place in nature, and the resulting drawings produced two types of drawings - those that illustrated domesticated nature and others that illustrated the wildness nature. The study reported that among the 25 students, 60% preferred to draw wild nature over domesticated nature as their subjects for drawings, and some of the 40% were reluctant to include the domesticated nature when sharing their experiences with their friends. Among them, three students said they had no experience in nature, and through

this, we could see how lacking, and absent nature is in children's surroundings. Paige & Lloyd (2013) reported that the students' statement of 'I haven't been to nature' revealed that nature was recognized as no longer a place 'to be' but a place to 'go to' (p.24).

The authors reported they could see the emphasis on "greenness" in many children's drawings. Trees and water were the main subjects that appeared in students' drawings, and we could also see that their first-hand experiences in nature had a considerable influence on the students' paintings. However, most of the nature experiences were either with family or under adult supervision. Only three children drew a free nature-play experience. While looking at one drawing of a person riding a swing placed on a lonely dirt floor, the writer pointed out the following problem.

Possible other explanations for the overall lack of nature-play in local public spaces may have been due to fewer preferred 'wild' nature features and poor design of nature spaces available within neighborhood and local environments where playgrounds have a minimum of standardized equipment. (Woods & Martin, 2010)

Charles Jordan, the director of Documentary Play Again (2010), said "What they don't know, they will not protect; and what they do not protect, they will lose" (p.28). The writer found that the fears and threats children have about nature mainly came from not knowing well about nature and animals, namely, inexperience and ignorance. However, they also argued that children's attachment to nature could naturally lead to an interest in preserving the environment by experiencing nature, not through media.

Lastly, the writer suggested the following solution to resolve the disconnection between children and nature: 1. We should reconsider nature-play areas, such as playgrounds and parks, and include children's voices when designing them. 2. Parents or teachers should give agency to children and let them freely experience nature, not under parental supervision. 3. Educators can explore several interactive wild nature play methods that connect place-based learning and local community education to empower students as informed citizens and potential leaders.

As a result of this article, I became more aware of the fact that a child's lack of interaction with nature could have a lifelong impact on identity formation. The article also introduced me to a number of new terms used in environmental education, such as environmental identity, natural deficit, natural disorder, and bio-phobia. But perhaps most valuable was hearing thoughts about nature from the eyes of children, not through the eyes of adults. This developed my understanding of the underlying reason behind many adults being so insensitive to environmental issues.

Schlemmer, R. H., Stephen Carpenter, II, B., & Hitchcock. (2017). Socially engaged art education: Practice processes, and possibilities. *Art Education*, (70) 4, 56-59.



Fig. 11. Students' filter-making process, students sieve saw dust to mix with clay. Published in *Art Education*, RH Schlemmer et al., 2017, p.57.

The authors of this article demonstrate how socially engaged art education can creatively respond to the social inequality issues. The project was designed to raise awareness about the water crisis and social inequity starting at Edinboro University in 2014 by Stephen Carpenter, II, the chief executive artist of Reservoir Studio. The project consisted of four 90-minute sessions. Students, faculty, artists, and community members learned to build ceramic filters and thought about the role of art as a catalyst for change during the project.

In this project, the art classroom was transformed into a water filter production center and public participatory learning space. Students were divided into small groups and tasked with filtering the sawdust or kneading clay for ceramic filters. They used a "hydraulic ram press," which was similar to the actual filter production facilities. What's important is that performance didn't introduce the filters as art objects. Instead, it emphasized the role of art as a forum for recognizing problems, exchanging opinions, and suggesting solutions. This conversation extended to social media and outside of the classroom.

The project did not stop at making 150 handmade water filters. Students researched issues related to the global water crisis through texts and visual materials. Based on the research, 9th-grade students participated in a socially engaged art-making process, and their work was exhibited at the Virginia Museum of Contemporary Art and Old Dominion University. This project has demonstrated the potential of art's role as socially engaged responses. It has also shown how creative participation in arts education can have a lasting impact beyond school by supporting students' "rights as learners, creative beings, and concerned citizens of the world" (Schlemmer, Stephen & Hitchcock, 2-17, p.59).



Fig. 12. The Burning of the Houses of Parliament. J.M.W. Turner, 1834. (Photo: Creative Common)

The authors of this article argue that in order to confront environmental crises, artists and educators can and should play an important role in dealing with environmental responsibility and ecologically literature culture. The relationship between art and nature has been around for a long time. A long time ago, humans used visual materials to invoke the forces of nature for practical and spiritual purposes. Art enables us to rethink and reimagine where humans are placed in nature. When European colonists first came to North America, they considered nature to conquer and couldn't see its beauty. In the 19th century when painters, photographers, and poets began to recreate the world around nature through art. However, people in the 19th century undervalued nature, encouraging people to think of it as "out there" in the world. Nature was separated and distanced from our daily lives. We can achieve the change in people's awareness of nature through internal intellectual change. Thus, Hicks & Roger emphasize the importance of students experiencing the proximate nature around them to understand it truly. In addition, the authors pointed out "how threats to the natural world intersect with issues of social injustice and disempowered communities" (Hicks & Roger, 2007, p.334). These authors argued that ecological harm done to the natural world has a great deal to do with the social and political impacts of those harms and artistic visions and narrative-based understanding of environmental issues can make these issues as real things that are happening in our world (p.335).

This article provided important information for understanding the perception of nature and the relationship between art and nature in a historical context. It was also significant to realize how ecological problems are deeply connected with social inequality and political issues. Although the history of colonialism was an

Jacobson, S. K., Seavey, J. R. and Mueller, R. C. (2016). Integrated science and art education for creative climate change communication. *Ecology and Society*, (21) 3, 1-7.



Fig. 13. 5E learning cycle. Published in San Diego County Office of Education, (Image retrieved from <https://ngss.sdcoc.net/Evidence-Based-Practices/5E-Model-of-Instruction>).

obstacle for people to see and enjoy nature, art enabled people to reimagine the world of nature. I strongly agree that the narrative aspect of art can call attention and preserve and restore our natural environment.

An interdisciplinary field trip to a remote marine lab showed possibilities of creating public communication about climate change through art. This trip included two artists, two biological scientists, and two courses one with nine art major students and the other comprising of nine students from a natural resource management class. The authors believe that environmental issues have been neglected in the curriculum and propose ways in which an interdisciplinary approach that integrate art and science, can be helpful in dealing with environmental crises. The authors contend that science focuses far too much on conveying accurate information, while creating the disconnection with the public. They argue that it's time to find an emotional connection to the environmental issues by bringing art into science. Additionally, rather than restricting the environmental issues to ecological issues, authors suggest an expansion of such matters to the field of arts and humanities.

The visits activities follow the "5E learning cycle", which includes Engage / Explore / Explain / Elaborate / Evaluate. During the "Engage" stage, learners are asked motivating questions to arouse curiosity through the discussion. In the second stage of "Explore," students go on a field trip to a marine lab. Students pick up found objects during this process, which they will use later for the artistic-led collage project. In the "Explain" stage, scientists provide knowledge and information about the concepts through discussion, lecture, and reading. Students will think about how to convey the idea of environmental crisis through the form of collage. In the "Elaborate" stage, students brainstorm and exchange ideas and create collages, following the description of the project suggested by an environmental artist. Associative thinking can be aroused through peer-peer learning. In the last stage, "Evaluate," instructors monitor and quantify learner's progress and feedback on the success. Pre- and post-surveys and group discussions were considered for the assessment. As a result, they found out that students' grades about the knowledge of environmental issues increased after the project. When Jacobson (2016) evaluated the effectiveness of the informal field trip, he got many positive feedbacks, which proved that the field trip was especially effective in that it increased students' motivation and interest (p.5).

Since science and art are different in many ways, teachers in various fields had to face many challenges when integrating other disciplines. The author said about the difference as follows:

Scientific disciplines have very different cultures, languages, and standards than the arts. We found that many aspects of planning, implementing, and evaluating our module faced challenges. The need to balance systematic procedures with spontaneity and quantitative accountability with subjective appraisal by the science versus art faculty created tension. The scientists had to modify their dependence on focusing on knowledge acquisition through lectures and demonstrations, while the artists had to modify their desire to simply “turn the students loose” for personal exploration. This tension was productive: “creativity and achievement often flourish in the presence of antagonists” (Jacobson, Seavey and Mueller, 2016, p.6)



Fig. 14. Pigments ground from creek rocks. Students created a drawing using the pigments. Published by *Artizein: Arts and Teaching Journal*, Seeman, L. and Dickey, J., 2017, p.6.

This article reports on the Strawtown Studio and introduces and describes some of its education models. Strawtown Studio is an art-based environmental education nonprofit organization comprising of artists, naturalists, and educators, and is located at the lower Hudson River Valley of New York. This journal talks about what Strawtown Studio pursues and introduces some of its education models. Their programs are rooted in place and designed primarily for children aged 7-12 and local communities. Seeman & Dickey (2017) discuss how experiences in nature in early childhood can have a lifelong impact and how learning about nature can strengthen the roots of our communities. Strawtown has partnerships with many other organizations, such as regional science institutes, alliances,

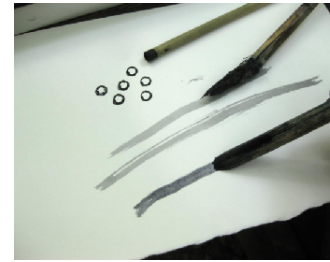


Fig. 15. Ink brushes made from two types of reed, cattail and phragmites grasses. Seeman, L. and Dickey, J., 2017, p.9.

and citizen science programs, which play a crucial role in demonstrating that their actions do not end within a class but have a real impact. Sometimes they develop place-based experiences with students as future programs, which can empower students by showing them what they are doing matters and can bring changes in the real world.

This article’s authors introduced three programs. One was painting with color pigments made by grinding creek stones in nature; another was a ceremonial art project, which used trees with exposed roots due to stormwater erosion. And the third program was “Marsh Grass Painting at Hudson River Marsh.” Here, the students went on a field trip to the marsh, harvested two types of reeds, and made them into brushes. Through the stroke of ink brushes, students were able to infer the vegetation and characteristics of plants. For example, they found that one reed was tolerant to pollution due to its dryness, while the other was very susceptible to water pollution since it absorbed a lot of water. Seeman and Dickey (2017) said “scientific inquiry informed art, and conversely, art informed science” (p.3), and they called the experience of feeling the answer through tactile experiences as “felt perception” (p.10). The findings later affected modifications to the actual Piermont Marsh restoration plan

Here Seeman & Dickey (2018) describe “how artistic perception, the ability to imagine beyond the obvious, can lead to greater knowledge and relating” (p.9). What was in my opinion so impressive about this program was that it did not end up simply in an art class but brought about a change by reaching out to professionals or institutions working on environmental issues. I think showing students that even one or two people can change the world by taking action can have a tremendous positive impact on students’ attitudes.

Hauk, M., Leetch, M., Wood, M., and Kippen, R. (2017, October 18). Liberating Diverse Creatives: The Future of Arts-Based Environmental Education Research [NAAEE Research Symposium Session and General Conference Interactive Symposium]. Retrieved from <https://naaee.org/our-work/programs/conference/past-conferences/sessions/liberating-diverse-creativities-future>.

Affirmation	Lens	Motivation	Approach	Suggested Application
1 Art is Activism	Environmental Justice	Critical Inquiry	Socially Conscious and Socially Engaged Art	Bring your surroundings (places or communities) to art practice / Mural
2 We are creative because we are connected.	Gaian Lens	Inclusion, Equity, and Justice (Multiple ways of knowing)	Just Sustainability Arts	Use the method of collage, montage, or assemblage to compose multilayers of imagery.
3 Science and art are in me in equal measure as harmonious partners.	Feminist materialist lens	According to Tbilisi Accord (1977), art can empower people in understanding and improving multi-layered environmental issues.	STEAM	Creative Design Process (drafting research questions, designing permaculture gardens, or imagining creative solutions)
4 Dance	"Dance as a fluid counter action that disrupts violence perpetuated within structures of society."	Creating brave research spaces	Art as a spiritual practice	Extend the deep engagements to your work

Table 1. Recommended practices in Arts-Based Environmental Education Research, Marna Hauk et al., NAAEE, 2017, p.7-8.

This review is based on the briefing paper of a 2017 symposium convened by the North American Association for Environmental Education (NAAEE). The purpose of the symposiums was to introduce arts-based educational research to environmental education researchers. Although one can apply arts-informed approaches to various research processes, many researchers experienced significant challenges in incorporating art into the academic research process. Thus, NAAEE proposed a compilation of arts-based educational research under four headings; Affirmation, Lens, Motivation, and Approach (p.7-8).



Fig. 16. Climate change themed, socially engaged and socially conscious mural-making, 2017, p. 13. (Photo by Rachel Kippen).

Since art allows us to be more open to various voices and feel emotionally connected to ecological crises, incorporating art into environmental education can bridge the gap between the public and environmental issues. Through this reading, I learned how environmental injustice is deeply related to the history of suppression and domination and how "liberating creativity" through art can be "an act of resistance, resilience, and regeneration." I also learned that when art-based environmental education is dealt with within a community context, it empowers the community by bringing their collective memories together. Lastly, as the authors recommended, teachers should move away from traditional art and introduce contemporary art and visual

Conkey, April A. T., Green, M. (2018). Using Place-Based Art Education to Engage Students in Learning about Food Webs, *Journal of Instructional Pedagogies*, (21), 1-17.



Fig. 17. A field trip to a serpentarium. (Image retrieved from Cape Fear Serpentarium / Destimap)

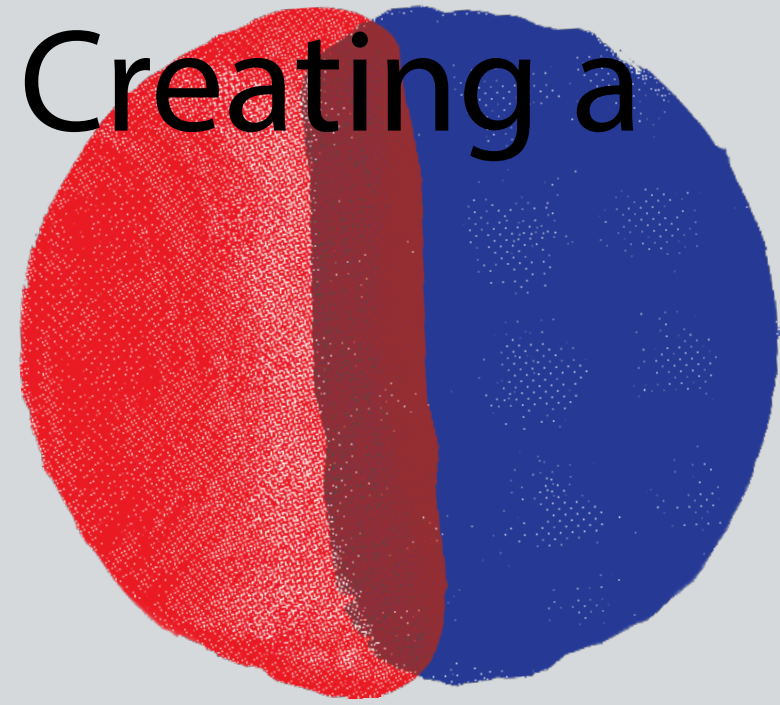
culture to students so that students can see things in the contemporary context and build connections to what is currently happening.

This article describes research that aimed to evaluate the impact of place-based art education on students' understanding of local rattlesnake food webs. The focus of the article was a collaborative project where faculties from various disciplines, including art, wildlife science, and instructional technology, participated. The project was designed for 4th and 5th-grade students at rural school, who were introduced to trophic levels through reviews, a field trip to the serpentarium and a native plant garden, creating a painting, and writing a script. The professional transformed the students' artwork into augmented reality, so when people placed their smart device near their paintings, they could watch a video of students explaining their works. The artwork was later displayed in galleries of schools and universities. Evaluators compared students' drawings and descriptions created before and after the project and evaluated any changes in the level of understanding using the students' art as the assessment tool. The researchers also collected qualitative data through conversations with children's parents and teachers.

Somewhat surprisingly, the grade level students made significant progress in understanding the trophic levels and found connections by applying what they learned to other animals. Integrating art into the curriculum created engaging environments, which led the authors argued to students' greater understanding and higher satisfaction. Since arts-integrated learning involved emotion, it stimulated students' excitement and curiosity, and they were able to build empathy towards nature. In addition, art gave students more agency and freedom, enabling students to transform what they learned and make it entirely their own. The authors claimed this also has to do with the way our brain works because our brain remembers things by creating narratives relevant to what we already know. Here, visuals became an excellent platform for children to think of stories, which resulted in long-lasting knowledge. Finally, place-based learning enabled students to develop deeper interests and attachments to the local ecosystem by building connections with their real world.

What impressed me most was when April and Marybeth (2018) said that emotional learning could arouse intellectual curiosity, leading to a "precursor to cognitive engagement" (p.4). Art played an invaluable role in empowering students not as passive receivers who simply accepted information but as active receivers and distributors who translated their thoughts in their way and delivered them to others in a creative way.

Creating a



Constellation

In this Chapter, I re-examine three courses and a workshop that I took while at RISD and interview two non-profit organizations that combine art and science to drive a meaningful change. I curated my studies during one year of the MA program, using myself as a participant observer within what could be considered a set of case studies. I approached the courses with various lenses - as an artist, researcher, student, and educator. I examined how each course was structured and how each was located at a variety of intersections of art and science. Along with my writings and visual examples that I produced for the courses, I evaluate in this chapter how these experiences have influenced my interests and thoughts about environmental issues and figure out the value of art in scientific inquiry. I acknowledge that there are limits to any generalization of my finding since I focused on only one or two assignments for each class, however it is my hope that others interested in curricular practices at the intersection of art and science will find my observations of some value.

The Emergence of Eco-Art

Before examining each course in which I was a participant, it's important to provide the context for the integration of art and environment within education. As was mentioned in Chapter 1, eco-art first began as a form of artists' practices. From the late 1960s, artists recognized the seriousness of environmental problems and proposed original solutions, which led to ecological art education in the 1970s and 80s. Education that combines art and the environment became increasingly popular, and there was growing support for the idea that creativity in art can facilitate our understanding of ecology.

From STEM to STEAM

More and more fields are encouraging educators and indeed companies to work across disciplines. For instance, in 2013, STEM transitioned to STEAM, adding Art to Science, Technology, Engineering, and Mathematics. In Jen's (2018) journal, *Gathering STE(A)M: Policy, curricular, and programmatic developments in arts-based science, technology, engineering, and mathematics education* Introduction to the special issue of *Arts Education Policy Review*, STEAM education is defined as "an approach to teaching where students demonstrate critical thinking and creative problem-solving at the intersection of science, technology, engineering, arts, and math" (p.73). Although STEAM has similarities to Arts Integration, they are different since they pursue different goals. In the journal, "Preparing Students for Learning, Work, and Life Through STEAM Education," Mary (2019) articulated that arts integration pursues "a deeper understanding of both the arts and at least one other subject area." On the other hand, STEAM embraces that but also "focuses on the process of learning and problem-solving" (p.4).

Interrelatedness of Art and Science

According to the journal "The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree," the author argues that they all share the roots. For example, Leonardo Davinci was a



Fig. 18. Vitruvian Man Drawing by Leonardo da Vinci, Ink on paper, c.1490 (Image retrieved from <https://fromthegreennotebook.com/2019/06/02/how-to-unlock-your-creativity-like-da-vinci/>).



Fig. 19. The first realistic Moon Drawings through a telescope by Galileo Galilei, Watercolors on paper, c.1609 (Image retrieved from <https://ourplnt.com/moon-drawings-galileo-galilei/#ax-zz6uwGOaH00>).

painter, theorist, engineer, scientist, sculptor, and architect. And Galileo Galilei was an Italian astronomer who proved Copernicus's "Heliocentrism" through his drawings. Galileo's interest in art and deep knowledge about "Contrast" enabled him to figure out that the sun is the center of the planet. We often mention them as historical figures who seamlessly integrated arts and science.

Multidisciplinary, Interdisciplinary, and Transdisciplinary Integration

However, when combining different disciplines, a lot more tension and difficulties are created. Therefore, it is essential to define the relationship between these fields clearly. Ashley (2018) makes a clear distinction among Multidisciplinary, Interdisciplinary, and Transdisciplinary.

Multi-disciplinary involves “the process by which investigators from more than one discipline work from their own disciplinary-specific bases to solve a common problem.” This approach is “considered the least integrative of the three, and has been criticized as temporary, often weak, and superficial.” (p.63)

In Interdisciplinary approaches, “scholars work jointly from their disciplinary perspectives to address a common problem.” (p.64)

“Transdisciplinary research strategies require not only the integration of discipline-specific approaches but also the extension of these approaches to generate fundamentally new conceptual frameworks.” (p.64)

Using these definitions, I created a diagram of each course in which I enrolled to illustrate what I saw as the various relationships between art and science. Understanding the dynamic relationship between art and science was in my view crucial to discover the value of each discipline, without being diluted or conquered in meaning by each other.

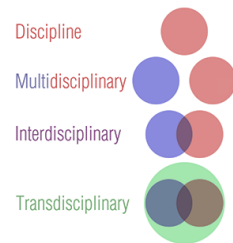


Fig. 20. Diagrams explaining combinations of different fields (Image retrieved from <https://thedailyomnivore.net/2012/12/12/transdisciplinarity/>).

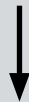
	Art and Science Relationship	Course Name	Structure
Science led Art		Biology: Animal-Human Interact	It is a lecture taught by a biologist. Every week, students learn about different species and their relationships with humans.
Art of Communicating Science		Art of Communicating Science	It is a Studio/Seminar course that combines Illustration and Science. Students learn about the Sixth Mass Extinction and make artwork based on lectures, readings, discussions, and research.
Data Visualization		Vis-A-Thon (Nature Lab)	It is a collaborative project between scientists and artists. Participants work together to create an art piece that visualizes scientific issues related to climate change.
Trans-disciplinary Collaboration		Interdisciplinary Collaboration	It is a studio course that facilitates collaboration with people working in different fields. Students make connections for their art projects.

Table 2. The relationship between art and science in each class, 2020.

Overview of the course
&
Structure
showing how art and science
were intertwined in the
course



Project images
as the result of each class
&
Project Description

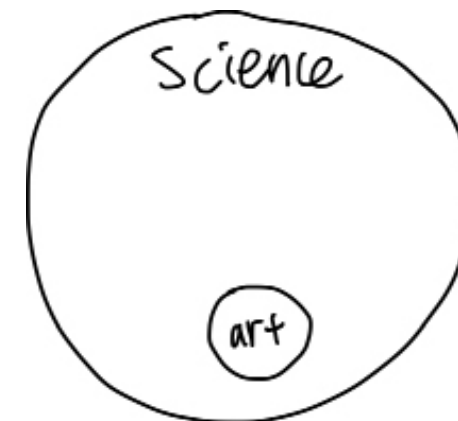


Detailed contents for
the structure
&
Process Description

Table 3. The relationship between art and science in each class, 2020.

1. Science led Art

In 2020, I enrolled in a course, Biology: Animal-Human Interact. It was a seminar course taught by zoological medicine veterinarian Dr. Lucy Spelman and different species were introduced each week. Through lectures, readings, and discussions, students learned about the ecology, zoology, biology, natural history, and values of the animals and their relation to humans' life. The class also covered anthropogenic threats that animals are facing and possible solutions. Students produced written responses and visual reflections about each week's reading and lecture. At the end of the semester, students chose one animal to research, wrote a literature review, and made artwork.



Project Description

For this project, "Shake & Change to save a Koala" (Fig. 14.), I researched koalas and made a proposal video for a koala ash globe. In 2019-20, there was a severe bush fire in Australia, which led many koalas to death. In the picture (Fig. 15), a koala is mourning in grief next to his friend that died from the fire. After I learned that koalas don't need to drink water, the fact that the koala died while heading for the water to cool off its burnt body was so heartbreaking. While researching, I also discovered that most of the causes that drove koalas to death were due to humans. I came to think a lot about the ripple effect and how our small acts can have a significant impact. So, I made an ash globe that changes its color triggered by humans' actions. If people are indifferent, leaving this globe alone, its color will remain red. However, when you shake it and warms it up, it gradually changes its color into green. On the



Fig. 21 . Shake & Change to Save a Koala, Eunhyung Chung, A video of an ash globe, 5 x 5 x 6", 2020.

bottom part of the globe, I included basic information about koalas, such as what threats they are facing and how the proceeds from product sales will be donated to save koalas. I proposed that Australian aboriginal people made this globe, and eco-friendly materials are used, such as ashes or charcoals left in Australia dyed with thermal paint.

Fig. 22. A photo of an injured koala mourning next to the one dead in the bushfire. A photo by Kelly Donithan from the Humane Society International (HSI) Disaster Response team, 2020 (Photo: Getty Images).



Literature Review

Students chose one topic related to animals for the final project and wrote a literature review based on the ten reading lists they picked. I researched koalas, and the title of my thesis was "Koalas, on the verge of functional extinction?". I focused on multiple threats that koalas face and ways to reduce the impact of climate change and habitat loss on koalas to reverse their population decline. I referred to scientific articles and reports, a general article, and a video.

While doing research, I was shocked that most factors that are threatening koalas were due to humans, such as climate change, habitat destruction, weakened immunity due to high stress, wildlife predation, car crashes, and diseases. Also, there were numerous misconceptions around koalas, which had to do with their physiology, how the media depicted them, and global warming. We acknowledge that the media can improve the public's consciousness of the crisis that koalas were confronting and save koalas. Thus, in this thesis, I addressed the positive and negative sides of the media. Although I wrote this thesis in a purely objective scientific manner, it truly deepened my understanding of environmental issues by going further from ecological awareness. By learning about this single animal, I learned how anthropogenic factors affect animals and us, humans, as well.

Eco-friendly materials are used
The ash from the bush fire flew into Sydney's waters, amplifying local people's anxiety about drinking water. The bottom of the ash globe is made of charcoal and ash collected near Sydney beaches.



The ash will be collected from Australia's bushfire and dyed with thermal paint and dust. "Thermal Dust & Paint" change their color from RED to GREEN (86F) / (31C). The color changes by the temperature of surroundings. The color is red when cold but changes into green when warm. This ash globe is covered with red ash when we leave it indifferent, but the red forest will reveal nature's original green color when we shake it.



Environmental issues are deeply related to the problem of inequity. It is because when an ecological crisis occurs, the ones who suffer most are the people who are marginalized or economically poor. Therefore, I tried to include Australian local artists as producers so that this ash globe could raise the public's environmental awareness, support koalas, and provide an opportunity for neglected aboriginals to engage with the movement to restore the destroyed nature.

What was invaluable about this assignment was that it empowered students by making them aware of the problem and treating them as big people more than students, who could influence society by making them come up with practical solutions. In addition, this research-based art project enabled more in-depth consideration in many aspects, including sustainable materials, work ethics as an artist, and how art can be socially engaged, which motivated me to grow as a more mature artist.

2. Art of Communicating Science

"Art of Communicating Science" is a studio/seminar course that combines two illustration and biology classes. Throughout the course, students learn about "major drivers of extinction today: Agriculture / Hunting / Fishing / Habitat Destruction (Urbanization, pollution, resource extraction) / Climate Change" and think about solutions. Based on the lectures, readings, discussions, or videos, students create illustrations. Sometimes they have to work as a group to brainstorm ideas together and make a collaborative art piece. There were many in-class improvisatory activities where students drew thumbnails after watching articles or videos related to extinction, and they were able to get feedback on drawings. For the final project, students chose one animal or topic related to extinction, wrote a literature review, and inserted their illustration images into the texts they wrote. All of the students' writings and illustrations were collected and published online as a book <SOLUTIONS Human-Centered Approach to Conversation>.

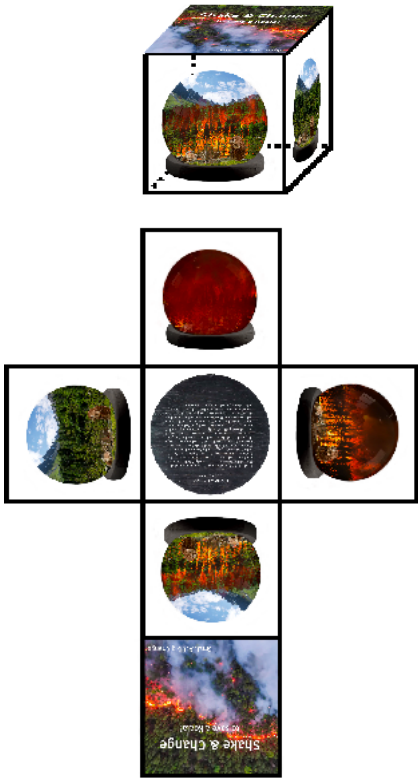


Fig. 23. Shake & Change Package Design. Eunhyung Chung, 2020.

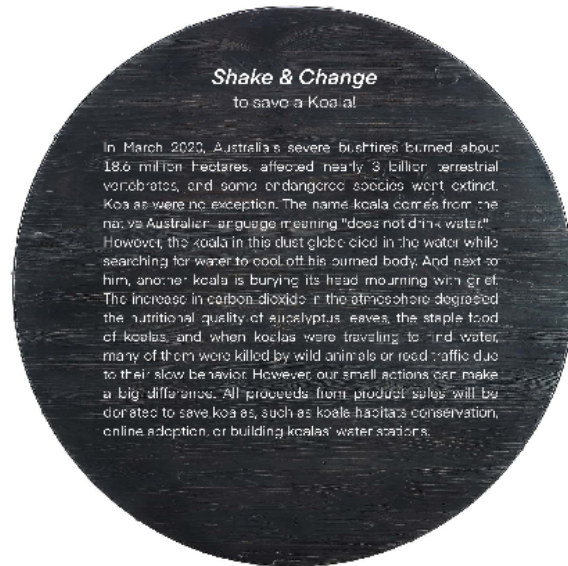
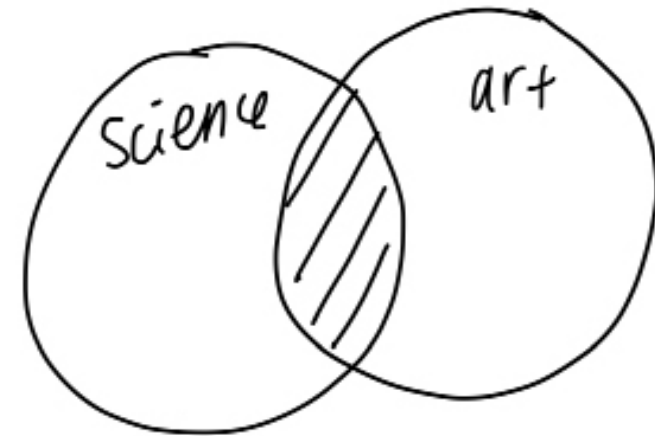


Fig. 24. The bottom part of the ash globe, Eunhyung Chung, 2020.



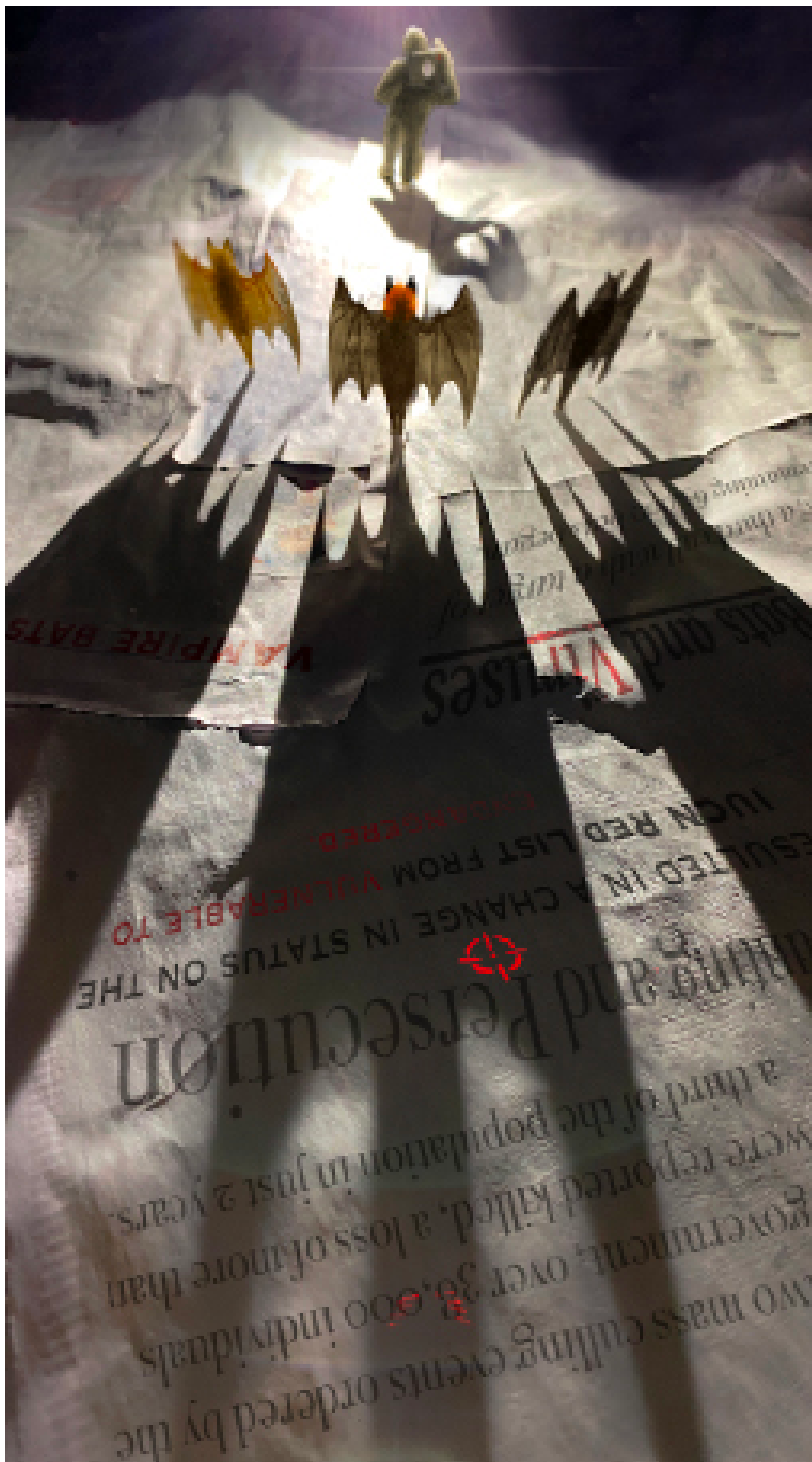


Fig. 25. Bats = Viruses?, Eunhyung Chung, Mixed media (color pencil, acrylic paint, newspaper, paper cuts, photoshop), 11.1 x 19.8", 2021.

Project Description

For the final project, I wrote about "WHY BLAME BATS FOR EVERY DISEASE?". Throughout our history, we've always struggled with fighting zoonotic diseases, from HIV/AIDS originated from higher apes (the 1980s), bird flu (2004 and 2007), SARS (2009) caused by musk cats and bats, to Ebola virus and COVID-19 from bats. And in the cover image on the left, I depicted how negative images planted by the media can result in misleading information that all bats carry viruses and more severe persecution of bats, making them endangered. Although some bat species indeed have a high risk of a viral host, bats also have tremendous ecological and economic values as pollinators or as powerful insecticides in nature. And actually, many bats are going extinct and suffering from diseases due to various anthropogenic factors. Killing all bats just because some species can carry viruses cannot be a fundamental solution. We should be aware of what factors can increase the risk of infection of animal-borne viruses, not blaming bats for all the diseases. The writer figures out ways to minimize the risk of new infectious diseases by proposing bat conservation to reduce the new human virus.

Science

In this group assignment, students had to read New Yorker's article THE SIXTH EXTINCTION? by Elizabeth Kolbert, and take out all the original comics and put our spot illustrations into the writing instead. It was New Yorker's practice to sprinkle unrelated cartoons through the editorial content. This article was about the link between the extinction of animals and the emergence of humans. Frogs were dying of fungus due to human pollution, and bats were dying of white-nose syndrome. Four to five students were in one group, and through discussions, they decided what they thought were essential or impressive in the text that they would like to express in pictures.

Art

I was particularly impressed with the following passage. "Unfortunately, we are losing all these amphibians before we even know they exist" (Elizabeth, 2009, p. 54). So I decided to introduce various fascinating frogs to the public, such as a horned marsupial frog whose call sounded like opening a champagne bottle cork, a glass frog with translucent skin, and frogs that could survive in various environments.



Fig. 26. Introducing frog species, Eunhyung Chung, 2021.

Science + Art

Although mine was simple informational drawings, I could make the scientific facts more intriguing by maximizing what I wanted to emphasize. Our illustrations made the text more immersive by delivering the content more vividly. We saw how art could bring vitality to science and act as a communication window for the public.



Fig. 27. Final Essay about Bats, Eunhyung Chung, 2021.

Science

For the final, I explored how the media flatten the images of bats. According to IUCN RED LIST, bats are listed as vulnerable to endangered. Although bats have significant ecological and economic values, they are commonly simplified as negative images that carry viruses. However, many other anthropogenic factors can increase the risk of spreading the virus, such as dense breeding of livestock (factory farming), habitat destruction, hunting and killing, and ingestion of wild animals. We should rethink the causes that spread viruses and find solutions there, not blaming bats for all viruses.

Art

The image on the left above was the initial thumbnail for the cover design. And my professor suggested that I use the close-up shot and focus on just a few bats. In the studio class, we learned how cropping could be a helpful tool that can strengthen the concept by capturing the essence.

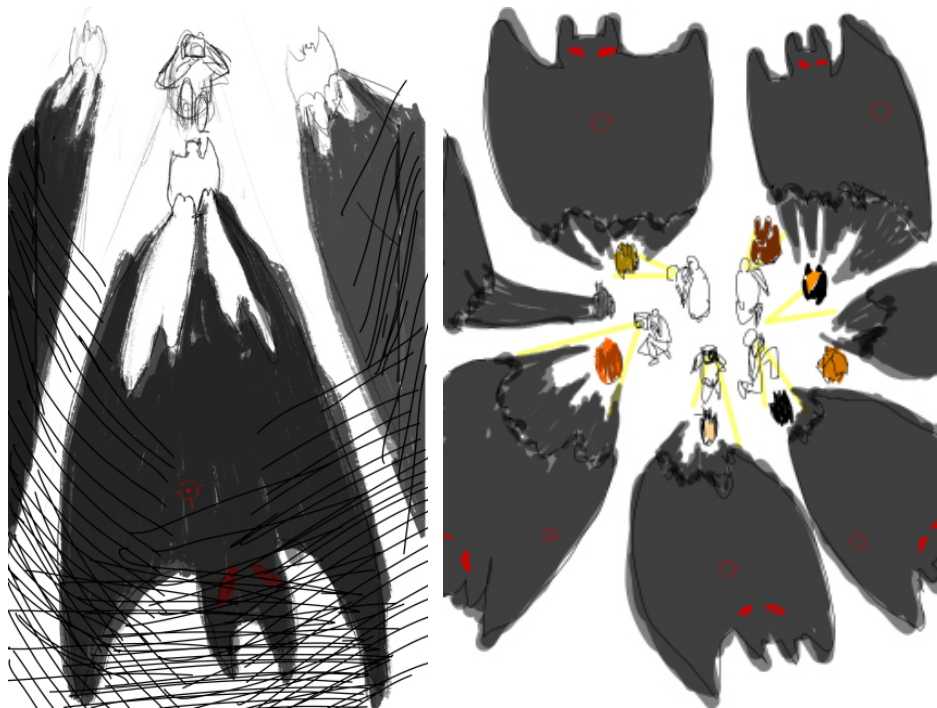


Fig. 28. Thumbnails for the cover design, Eunhyung Chung, 2021.

Science + Art

The most important thing I've learned was the value of hand drawing instead of using digital tools. My illustration professor Susan Doyle once said, "In the digital world, it is hard to make mistakes." You can control everything and can fix it anytime. However, hand-drawing allows you to be open to experiments and failures, and this is where creativity can grow.

In this journey of making my book, including texts and drawings, art played a crucial role in making me more committed to learning science to communicate with the readers in a more inspiring and exciting way.



Fig. 29. Final Essay about Bats, Eunhyung Chung, 2021.

One of the most important lessons I've learned here was that "Art doesn't have to be didactic." I was struggling with what art can provide in the context of science, and at first, I thought art should be educational or informative to validate its value. So when I drew the spot illustration for my writing, as you can see from the Fig. 30., I made it as informative and as possible. Since I wanted to show how factory farming can act as a viral reservoir, I listed all the environments that can spread the virus.

However, one thing I overlooked was that I didn't leave spaces for the viewers to ponder. Unlike science, whose purpose is to convey accurate information, art can inspire people and stimulate their imagination by leaving more room for them to think. Art can open people's minds and broaden their perspectives. If it can lead to a further discussion or linger in their mind and influence them somehow, it is meaningful. Art and science have their unique value, and sometimes, in art, the less can be more impactful.



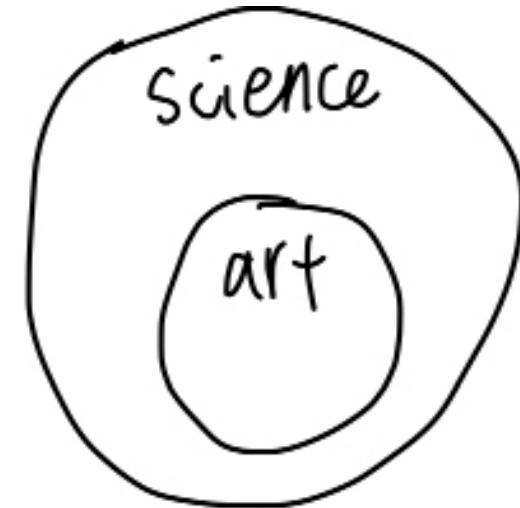
Fig. 30. A Recipe for a Deadly Virulent Virus (Spot Illustration for the final essay- Before revised), Eunhyung Chung, 2021.



Fig. 31. A Recipe for a Deadly Virulent Virus (Spot Illustration for the final essay- After revised), Eunhyung Chung, 2021.

3. Data Visualization

In 2021, I joined a program called Vis-a-thon, an interdisciplinary collaborative project run by RISD Nature Lab. It was a month-long program for graduate students where art students in Rhode Island School of Design could work with students at the University of Rhode Island who studied climate change in coastal communities. Participants in the program had to design a science visualization project based on their research and shared it at the end of the month.



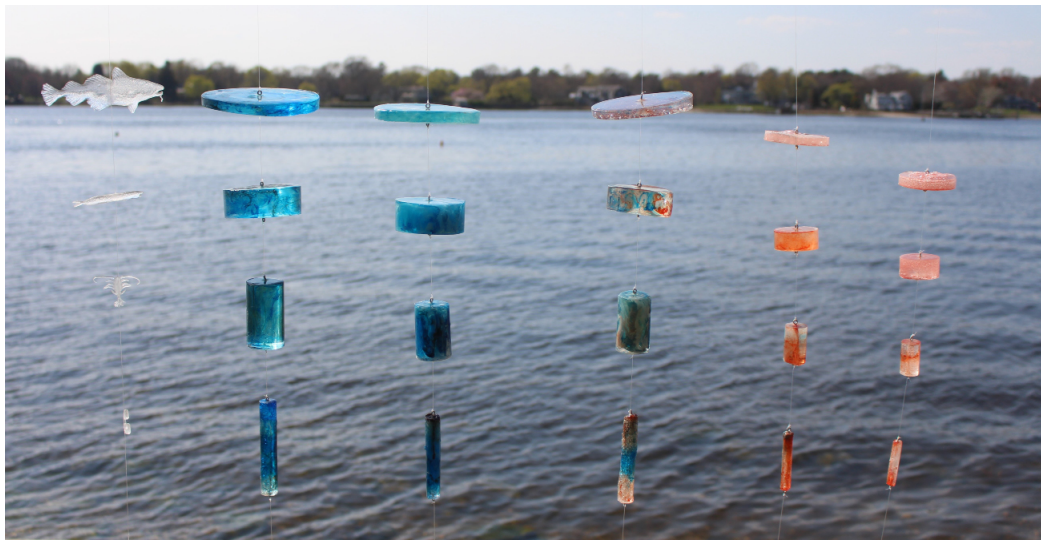


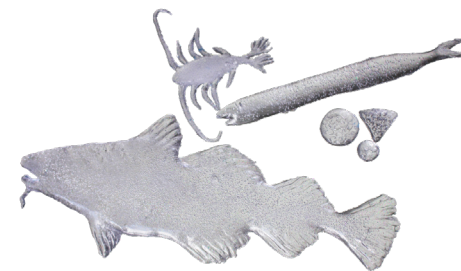
Fig. 32. The Transition, Catherine (Catrina) Nowakowski & Eunhyung Chung, Mixed Media (Ink, Resin, Fishing line), 36 x 6 x 14', 2021.

Project Description

“Inverted Triangle” is a 36 X 14” sized site-specific sculpture made out of resin. It was a research-based collaborative project between arts and sciences, and I worked with Catherine (Catrina) Nowakowski, majoring in Biological Oceanography at the University of Rhode Island. This project showed how much the marine food web depends on the small animals located at the bottom of the food web and how climate change affects marine life. Our goal was to show the public the importance of planktons in sustaining the system and the interconnectedness between humans and nature.

My team focused on four marine animals and three central concepts around the marine food web system: ENERGY / SIZE / TEMPERATURE. The animals included codfish, sand lance, copepods (zooplankton), and phytoplankton. In the Biomass Pyramid, the bigger the animal is, the smaller the energy is transferred. We used an inverted triangle shape to show the inverse relationship between the size of the animals and the energy transmitted. And we assigned three visual languages to the five columns that we made based on the scientific data from 2004 to 2016.

We’ve noticed that ocean temperatures increased over the last decade, and the size of the plankton became smaller, making them less efficient at transferring energy. It led to a decrease in the number of large animals. So, in our model, we made the upper part of the food web disappear and become transparent as the temperature goes up.



Color: ocean temperature

Width: the size of the animals

Height & Density of the Ink: Energy saved as Biomass

Science

Come up with Ideas and Research Topic

Students from the University of Rhode Island (URI) and RISD faculty critics each made presentations on their research and artwork during the first two weeks. Program facilitators from Nature Lab also led a museum workshop to exchange ideas on artwork through various lenses and introduced artists who successfully integrated science into their art practices.

Find the Common Interest to decide the topic

Based on each student's research presentation, they matched me with Catrina, a Ph.D. candidate at URI studying Biological Oceanography. Since we both were interested in the idea of "communicating science with the general public" through the "interaction of art," I enjoyed the whole process of sharing opinions and coming up with ideas together.

The only difficulty was that since I didn't have much background knowledge in science, it took a while to understand how the marine food web works. Although the process of coordinating ideas was challenging, this gap was meaningful and inspiring because it pushed the limits of our thoughts further, which led us to come up with more original ideas. Finally, we decided to focus on the inverted relationship between the size of the marine animals and their energy transferred to the higher food web.

We inverted the ecological pyramid, which seems stable, to show how these tiny plankton located at the bottom of the food web sustain the whole marine system and how climate change affects them.

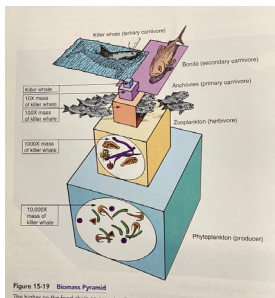


Fig. 33. Biomass Pyramid, Published in INTRODUCTORY OCEANOGRAPHY (10th Edition), Harold V. Thurman & Alan P. Trujillo, 2004.

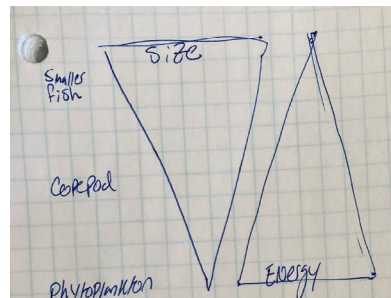


Fig. 34. Inverted Relationship, Sketch by Catrina, 2021.

Art

Think about various ways to visualize the idea

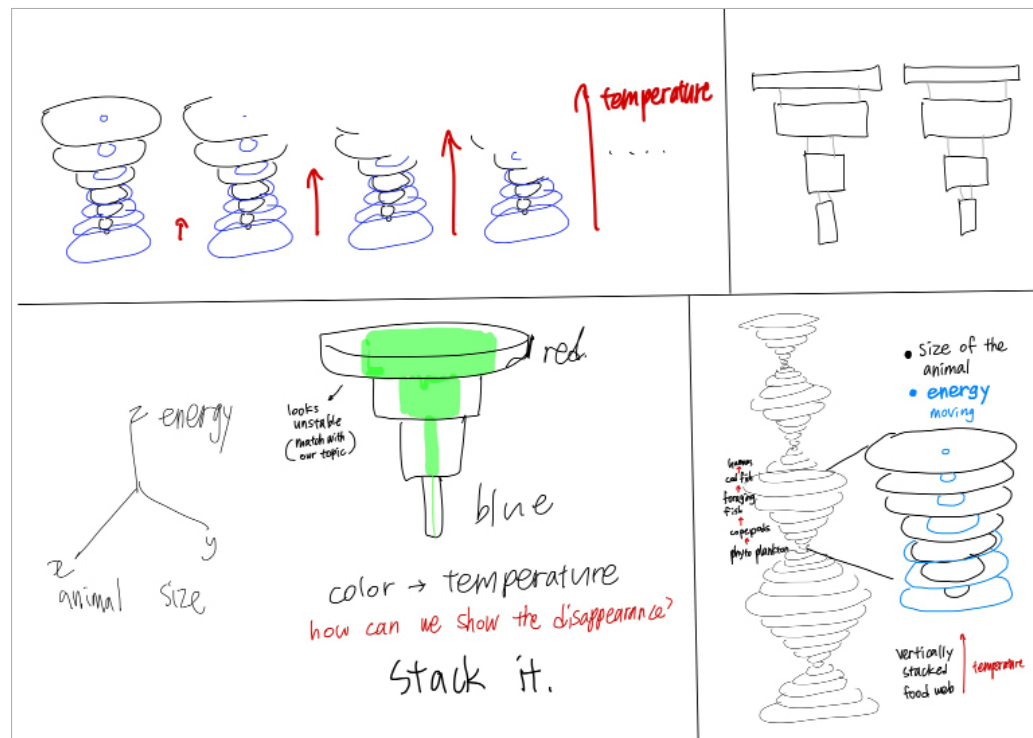


Fig. 35. Visualizing the concept of "Inverted Relationship", Sketch by Eunhyung Chung, 2021.

Material Experiments

While my scientist collaborator came up with the topics and brought scientific data, I figured out what materials we can use to show "change" and "disappearance." The table below explores various ways to show the idea of loss.

Temperature	Thermochromic pigment changes its color by the temperature.
Transparency	Transparency can show the presence or absence. / Resin
Wind	Different layers stacked on top of each other
Light (Reflection)	Hot foil mirrored papers can change their appearance by the reflection
Fluorescent	Fluorescent paints are invisible in the light but visible in the darkness.
Soluble	Melting ice
Perspectives	Sculptures that look different from different angles / Lenticular Lens
Sound	On / Off
Biodegradable	Naturally disappear

We chose resin as our primary material since we found that the appearance of ink spreading through the resin resembled energy flow and the ocean current.

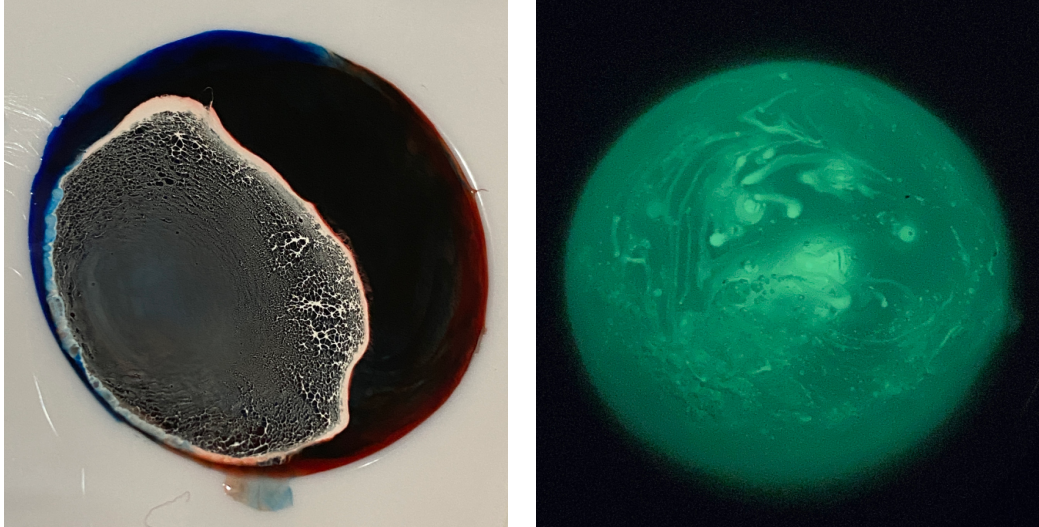


Fig. 36. Material Experiments, Eunhyung Chung, 2021.

Science
Collect Data and Measurements
(Marine Animals' Size and Energy relationship)

My collaborator made these measurements of the size of marine animals and the energy relationship based on the actual data from 2004 to 2016. Based on the scientific data, we made five columns instead of seven to grasp the essential ideas.

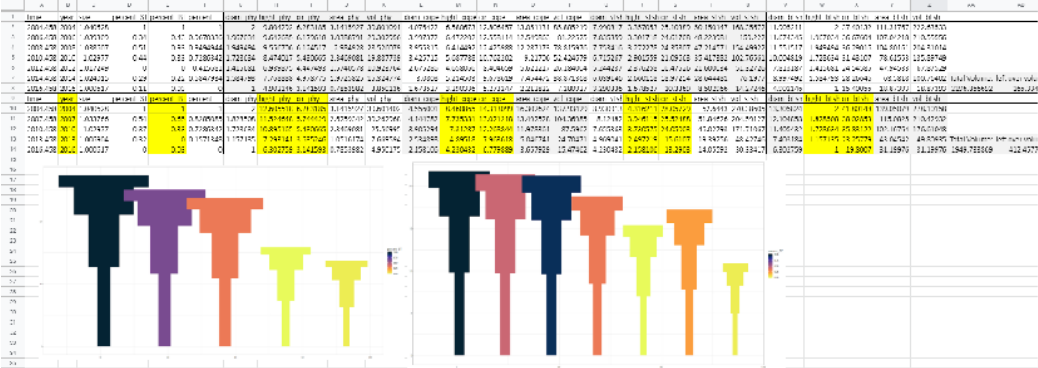


Fig. 37. Collecting Data and Measurements, Catherine (Catrina) Nowakowski, 2021.

Art

In science, most of everything is under control. But in art, sometimes you have to be open to unexpectedness, which can lead you to more exciting outcomes. We were very careful to match the amount of ink (energy) with the actual data, but soon after, we realized that the less we feared experiments and failures, the more interesting results came out. And in science, it is crucial to convey as accurate and detailed information as possible. However, in art, it is essential to give impactful ideas to viewers. During the process, we have noticed that science and art can lead to results far more creative and beyond imagination when we can fill the gap while respecting each other's differences rather than one subordinated to the other.



Fig. 38. Process Photos, Catherine (Catrina) Nowakowski & Eunhyung Chung, 2021.

4. Transdisciplinary Collaboration

In this course, "Interdisciplinary Collaboration," students build connections to possible collaborators who could work together or contribute to their work somehow. Based on the contacts, students create a collaborative art piece. Through readings, videos, presentations, and guest critics, we looked at contemporary artists who developed their content in collaboration with scientists, engineers, writers, artists, and other professionals. David Brooks, Harriet Salmon (craftmanship podcast), Charlotte McCurdy, Eduardo Kac, and Mary Miss came as guest critics. Jill Magid's (2018) "Proposal" and Katie Paterson's (2014) "Future Library" were introduced as successful collaborative works.





Fig. 39. Swimming in the Deep Sky, Eunhyung Chung, Hot foil paper, fishing line, and kite frameworks, Variable Installation, 2021.

Project Description

The sea is one of the most sensitive and vulnerable to climate change. Although the Deep Sea plays a significant role in climate change mitigation and its biodiversity changes very quickly as soon as available resources from the surface waters are modified, we don't know much about the sea. And there is a severe disconnection between the public and the sea. So, to minimize this gap, I thought learning about animals could be the first step for people to appreciate nature's value and understand how we humans are part of nature.

In this project, "Swimming in the Deep Sky," I made flags of deep-sea creatures, most of which have a transparent body and survived in the harsh environment using bioluminescence from their bodies. I used the sky as the deep sea, making invisible visible to show the beauty of the biodiversity in the deep-sea, and hopefully, fill in the gaps between people's insensitivity to the loss of biodiversity and the genuine understanding of nature. For the materials, I used mirrored paper that reflected the surroundings, and some parts of their body gradually disappeared by the time blending with the sky. Eventually, the animals engraved on the flags vanished without a trace, leaving only the transparent flags. Near the flags, I put flyers that contained images of the deep-sea animals and quotes that explained how they are susceptible to climate change.

Science

In this project, I reached out to many professionals in different fields, such as scientists, one kite company, Pell Marine Science Library, and an artist. Table 3 shows the contact lists that I made throughout the course and the questions I had. It took me a while to figure out what topic I am interested in, so I mostly contacted with scientists, especially biologists. Although it was stressful and anxious to reach out to them at first, later, I was surprised that many people were open to having a conversation and willing to help. It was valuable to hear scientists talking about what they think matters and what environmental topics are hard to communicate with the public. The conversations I had with various professionals and a field trip to the marine science library were genuinely inspiring and gave me ideas that I couldn't have thought of by myself. It truly pushed my limitations. Then, I finally decided to focus on deep-sea animals and came up with these questions below.

How can I build an emotional connection between deep-sea animals and the public?

How can we make the term "Biodiversity" more "real," not abstract?

How can we make people feel that we are part of nature?

List of contacts	Position	Result	Purpose
Sunshine Menezes	Clinical Associate Professor of Environmental Communication in University of Rhode Island	O Email	Ask questions about Why Communicating Science through art is important / What matters in science Get feedback on the projects
Roger Williams Park Zoo	Roger Williams Park Zoo Education Department	X	Ask if they are interested in developing the idea of revitalizing the pandemic zoo through art
David W. Gregg	Executive Director of Rhode Island Natural History Survey (RINHS)	O Zoom	Ask questions about the organization itself / their programs / When ecology is combined with art, what benefit that only art can bring? (Interview)
Lucy Spelman	Biologist / Wildlife Veterinarian / Professor in RISD	O Zoom	Ask questions about What topics are hard to communicate in science? / What can art do when combined with science? / Endangered Species in RI
Catherine Nowakowski	PhD student in Oceanography in URI	O Zoom	Gain experience on interdisciplinary collaboration (Visualizing Science through Art) Ask questions about How Climate Change is affecting the Marine Ecosystem / Deep sea animals
Julie Cerrito	Staff member in Pell Marine Science Library in URI	O Visit	Research on marine creatures / How Climate Change is affecting the Rhode Island's Coasts
Ron Kitt	Owner of Kittkites (Newport Kite Festival)	O Visit	Get technical help for making kites

Table 3. List of Contacts, Eunhyung Chung, 2021.



Fig. 40. Proposal Images for "Flying in the Deep Sky", Eunhyung Chung, 2021.

While researching deep-sea, I found so many beautiful marine animals I didn't even know that they existed. So, I chose deep-sea creatures, which have survived in the harsh environment, which achieve invisibility via transparency to disguise, and most of which use bioluminescence to live in the darkness.

Art + Science

I ended up making flags, but my initial idea was to make deep-sea animals into kites and fly them in the sky, using the night sky as the deep sea. At first, I wanted to make giant kites imitating their movements and bodies as realistically as possible. However, I found that it needs more time to develop this project, so I had to consider new ways to make this long-term project more feasible. Although I couldn't achieve this project within this short period, starting from an impossible and limitless idea and talking to various people without having a final concrete plan was meaningful in opening up my imagination and possibilities.

Art

While trying different materials, I finally decided to use hot foil paper (Fig.41). I liked how it disappears by the background through the reflection and transparency and how it casts ghostly shadows on the ground. And the beautiful wrinkles that it made by the wind weren't something that I had planned but worked out well with the concept of "loss." In the process, I learned how not being afraid of experimentation and being flexible enough to adapt to the situation can lead to unexpected beauty.



Fig. 41. Material Experiment (Translucent Species), Eunhyung Chung, 2021.

Art + Science

The biggest question I struggled with throughout the whole process was how much my work should be informative. While researching deep-sea and having conversations with my peers, professors, artists, and scientists, it was essential to realize how art can spark people's interest in environmental issues even in a poetic way without necessarily being informative or didactic. So, I decided to make flyers (Fig. 42 and 44) and put them near the flags, making it optional for viewers to pick them up. In just one day, all of the flyers were gone. Although I might not be able to see how my work can change people right away, as an artist Mary Miss said, "Change is long-term" and "Change takes time."



Fig. 42. Close-up images of flyers, Eunhyung Chung, 2021.

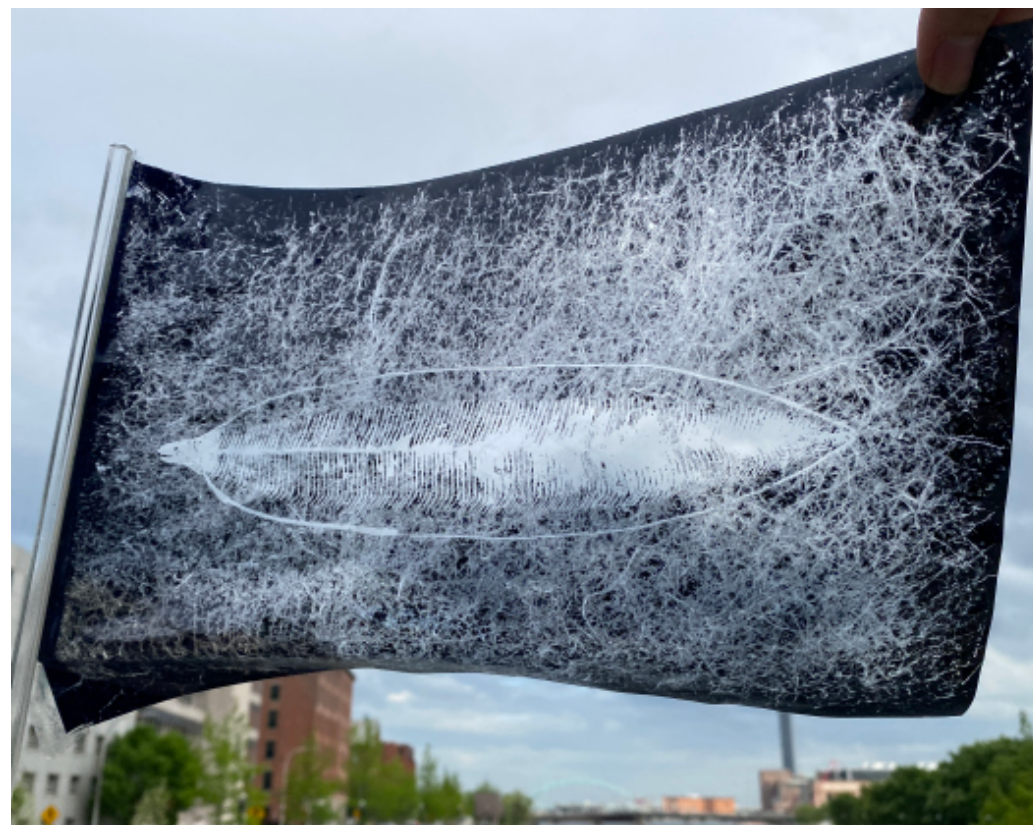


Fig. 43. Process photos showing how the animals gradually disappear, Eunhyung Chung, 2021.



Fig. 44. Installation photo of a flag and flyers, Eunhyung Chung, 2021.



Fig. 45. Installation photo of a flag, Eunhyung Chung, 2021.



Photo retrieved from University of Rhode Island (URI) website: <https://web.uri.edu/nrs/faculty/>

The Executive Director of Rhode Island Natural History Survey

David W. Gregg is an executive director of Rhode Island Natural History Survey that aims to collect and disseminate information on Rhode Island's geology, animals, and plants and make people develop a more profound interest in RI ecosystems. He has published books, articles and hosted documentary videos and many public events such as the annual RI BioBlitz. Before RINHS, David directed the Spellman Museum of Stamps & Postal History. Also, he worked as an associate curator and project manager at Brown University's Haffenreffer Museum of Anthropology. David received his Ph.D. in anthropology from Brown University and is a fellow of the Coastal Institute at the University of Rhode Island. He is an archaeologist and has excavated in Britain, Italy, Rhode Island, and Alaska for his practice.



Photo retrieved from Dr. Lucy's website: <http://drlucyspelman.com/doctoring-the-ark/wildlife.htm>

The founder of Creature Conserve

Lucy Spelman has worked as a zoo and wildlife vet, zoo director, media consultant, writer, public speaker, and educator. She has taught biology courses combined with art at RISD since 2010 and continues her practice as a biologist and veterinarian. In 2015, Lucy founded the Creature Conserve, a non-profit organization that invites artists, scientists, and writers to help people learn about and support animal conservation. In her TEDx talk (2015), "Art Can Save a Panda," she talked about how science combined with art can save species. Lucy worked as a media consultant for Discovery Communications (2005) and as a vet and director at the Smithsonian Institution's National Zoo (1995–2004). She completed her bachelor's degree in biology from Brown University (1985) and veterinary degree from the University of California \at Davis (1990).

5. At the Intersection of Art and Science

I interviewed two non-profit organizations in Rhode Island that are working at the intersection of art and science. It was interesting to hear how they came up with combining art and science and what they thought about the role of art.

Q1: What does your organization aim for?

DG: When Rhode Island Natural History Survey was founded in 1994, the original purpose was to create an organization that would help break down barriers between different scientists and agencies and encourage communication among scientists. When I joined the natural history survey in 2000, the organization was still focused primarily on communication among scientists and didn't acknowledge art's role. When I became the director in 2004, there was a great deal of interest from the general public who enjoyed science as a hobby. As they joined the Survey, we started to get more programs that served amateur scientists and began to meet artists interested in natural history or used some aspect of nature as a subject.

LS: At first, Creature Conserve began with stipends to help students or local artists study abroad. But now, the scholarships are open to anybody who wants to combine science with art or writing. We also give them options to take a workshop or teach a workshop or post a theme week on social media. We supported collaboration for mainly emerging artists or young artists who wanted to do something collaborative but didn't know how to use science in their work, talk to a scientist, or what matters in science. By making those connections, we wanted our nonprofit to become an inspiration for networking. It's really about the process, not so much about a final product, just like my teaching.

Q2: Was there a specific event that prompted you to combine art and science? How has your background influenced you currently working for a non-profit organization?

DG: To talk about my background, I am an archaeologist by training. I trained at the Haffenreffer Museum at Brown University, where a lot of the work I did was exhibit design, object conservation, collections management. Many anthropological or ethnographic objects are valued, both as objects of science and as art. I never really saw much difference between seeing an object for its artistic content or its scientific content.

And my dissertation was about the early history of European contact in Alaska. Most of the earliest contact was whale or whaling ships that went to Alaska and met native people. But there were also Natural History expeditions that went to Alaska starting in the 1870s. These expeditions took all the scientists, including botanists, zoologists, ornithologists, geographers, and geologists, but also brought artists, such as photographers and watercolorists. After they came back from the expedition, they got all the stuff they've collected and displayed them all together in New York. Each one contributed something unique to the overall picture of the place they visited.

I think that the artistic contribution is significant to communicating all the other possible layers of discovery when you go to a place that no one's ever been before. And, of course, the artistic interpretation. Art is essential to learn about these natural history expeditions in the past because you need to know what they focused on and how they perceived what they saw. We think of our little organization here in Rhode Island as an expedition to Alaska in 1890.

LS: I made my first decision when I was working with mountain gorillas. I have had many experiences, and I came to think, 'why only a few of us are responsible for the world's mountain gorillas?'

In science, there is difficulty in helping people feel connected. So I approached conservation differently. I wanted to work with young people in an academic setting who loved nature and animals but were not studying science. In 2009, I taught science to non-science majors at Brown University, and in 2010, I began teaching at RISD. What was great about working with students was that they're early in their career and getting the sensitization that science can be useful to them as a prompt.

Conservation is multi-layered and complicated. It only works when we work together. While teaching at RISD, I saw that people could get across my complex ideas much faster when artists visualized them. People want to keep looking at an art piece because it's something subconscious that's grabbing us. That power was missing in science. I realized that art is a way of making abstract things relevant and lively.

The news in the conservation world isn't positive. There's always sad news. But when I taught the students, they were not too tainted by history. As my teaching informed them, they inspired me through their artworks. I started to see my teaching as a collaborative work between scientists and artists, and I found it compelling, challenging, and enjoyable. I wanted to create a community for like-minded artists and scientists, planting the seeds to accelerate that idea.

Q3: Can you tell me about your process of designing a workshop, lecture, or exhibition?

DG: Well, since our organization is quite small, the program manager and I work together on everything. The way we come up with programs has to do with people that we know. We know that they are good speakers, and the subject matter they bring has to be intriguing to our members.

We also try to push the boundaries. I've had organized programs where the speaker is working on a complicated and demanding science. But most people who come to these lectures are not professional scientists, so they might not understand what the scientists are saying. It might challenge

either way, but it's okay. If you challenge scientists, they will think harder and learn more. It also applies to artists speaking about their work to a group that's expecting science. Artists see things differently, and it will challenge the audience, pushing them to grow and learn. I want people to understand that art has a lot to contribute to science, and science also contributes to artists.

LS: Previously, I mainly curated and decided on the exhibition. But for our next exhibit, we decided to invite an artist as our curator and chose not to theme it. Before, we were theming the exhibitions on the major drivers of extinction, such as global trade, farming, hunting, habitat loss or urban development, agriculture. But that opposes what we want to do with Creature Conserve, which captures what people are already doing. And what we are trying to do is find those connections and share them with the public.

We are thinking about curating a biennial show and sharing the state of art and science of conservation with the public. The biennial will be the best of the best pieces from our first two exhibits, open call, and submissions from these workshops and other events. Again, it is planting those seeds as far and wide as we can. We want people to come and look at art, and it will connect them to nature in a way that they haven't been able to connect.

Q4: What should we remember when we are working or teaching with people in different fields?

DG: It's tough to connect with some scientists, partly because today's scientists work very differently from the traditional natural, historical approach. Conventionally, scientists were studying a system that is essentially static in time. Many scientists think what we do is not relevant to their research, and I think that's because they're trying to answer a complicated question that's very narrow.

So you have to find the right people who understand or work in a similar way to what you do. And I think, today, younger

scientists better understand the importance of communicating their research with people and the community. And there's a lot more opportunity for art to become engaged with people who aren't scientists.

Reaching out to artists can also be challenging because some artists aren't interested in nature as a subject. Interestingly, there is a tendency that artists look down on natural history artists, essentially illustrators. There's that sort of pejorative connotation that tries to distinguish "pure artist" and "scientific illustrator." In the scientific illustration, you try to show an objective truth, not new things. Well, that's not true. However, there is a tendency that both traditional scientists and artists look down on the people working across the boundary.

LS: I think the most important thing for the future educators, who are considering teaching a collaborative course, is to be clear about why you're co-teaching and not confuse students. You have to talk about what's happening and what you meant, and your endpoint should be a genuine agreement between the two of you. I've seen people co-teach, and it's just two people teaching their courses, where there's no cross-fertilization. I was lucky that I've co-taught with some super talented people. They could figure me out, and I could also figure them out and get the students to respond to both of us.

Another thing is that you should be planned and flexible. You can have some thoughts or prompts, but they should be flexible according to others because you don't know what they're thinking. And when you co-teach, you should let the class know that it's a work in progress to some extent. Let students understand that you'd never done this kind of assignment and that it might not work. I think co-teaching is much more of a field of art like you have to sort of navigate it. It's also important to hear what your students think. Find a way to check in with the students if they are on the right track and balance the workload.

Q5: Can you tell me about one of the workshops or courses that you think was successful?

DG: There was a workshop called “The Insect Orchestra” by Melissa Guillet. She compared insect sounds to everyday objects. When she came out with her work, people were amazed that they had never thought of the sounds before. Her interest in nature and her artistic ears enabled scientists and amateur scientists to think about things they wouldn’t think about otherwise.

We also have some connections with Hera Gallery in Wakefield. We work together on the program called The Green Stitch. They hold a workshop a month and invite a scientist to talk about their research or work in which they are interested. They also invite the gallery’s public members, who are not primarily artists but interested in art. Participants make arts and crafts inspired by the speaker scientists. They then put together all the different artworks made by people to create an artistic impression of a particular scientific subject. It’s like creating an ecosystem based on arts and crafts. And you have these exciting opportunities for ‘cross pollination’ between people. We, Natural History Survey, help the gallery come up with the subjects for each month and then find the scientists who could talk about different things.

LS: I would pick an art exchange course that went abroad with students and met local animals and people. We hosted a couple of artists who stayed with us at the camp, went through the course, and made a final art piece. They studied one of the animals related to the research topics. In South Africa, we’ve also set up these artists to teach art to many kids at school. On the art exchange day, we had the whole community see the artworks and exchange thoughts. There was a little greeting ceremony, and RISD students and South African students put up all the artwork. They saw art and love for the nature of where they live in a way they don’t see. I think of it as the entire cycle of collaboration among art, science, writing, journaling, and the whole conversation around them. It’s

not only about art but also about the shared experience. Students felt a little forced to begin the conversation at first, but all of a sudden, art was connecting people. It’s fascinating to see and feel these young artists make connections that change their perspectives and bring life to how we live with nature. And every piece from the courses is meaningful because it’s a life-long personal journey of all of the artists, the students.

Q6: What do you think is most important to encourage young people to develop an interest in wild animals and plants?

DG: I think that a lot of interest in young people comes from seeing how adults relate to these things. If kids grow up watching adults spraying their garden with chemicals to kill all the insects and all the wrong plants, being scared of spiders, and not letting them walk in the bushes because of ticks, then the kids take those values up. They will become afraid of nature and lose curiosity about the things around them. But if you show them interest and excitement with the things around them, they would want to explore and have adventures to decode secrets all around them.

Adults could model the right attitude towards nature for kids. For example, at Bioblitz, I often lead a bug walk for kids. Let’s say I take ten kids into a meadow with tall grass. I’m standing with tall grass, saying, “How many insects can you see?” They would say “None” because they’re not used to looking. Then I let everyone sit down for a minute. And after about 30 seconds, somebody would go, “Hey, there’s an ant. There’s a grasshopper over here. I just saw a fly.” As soon as they sit down on the ground and stay still for a moment, they suddenly see all this stuff. I think that’s what art can do as well. Art brings these fascinating little things of nature to life, allowing children to appreciate their value.

Q7: How do you define the collaboration between art and science?

LS: In many cases of collaboration between art and science, art is in the service of science. Of course, artists can make science understandable by visualizing scientific data. But that's art for science. I'm interested in the opposite. I think the difference between scientists and artists is that while scientists add to the great understanding of the world, artists make artwork to understand their place in the world.

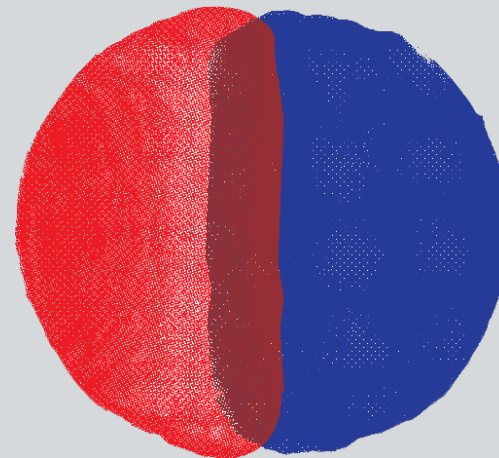
There is a difference between the scientists giving topics to artists versus the inspiration from the artists' creative spirit. They can be informed but not necessarily informative, and that's what I see as collaboration.

When teaching kids about conservation through art, it is essential to break down barriers between art and science so that kids can see the world through both lenses. I target older people because kids know what to do. But when they grow up, they start consuming, and nobody wants to be taught when you're out of school. So, I see it as awareness, inspiration, thought-provoking, not as teaching. Conservation has been run by relatively few, mostly white, mostly men, declaring what needs to be saved and going out to do it on their own, in other words with a larger group that defines their conservation "organization" rather than bringing in everyone and anyone into the effort. Conservation only works if we all do it. We have to change how we work, and it has to be more bottom-up to create a desire for that.

So That



My Light
Shines on You



Art and Science Share Roots

Before I began this journey, I felt disconnected from science and never thought I would be interested in it. My art educational background didn't fully appreciate the interconnectedness of art and science, so after my art middle school in Korea, I felt I couldn't be interested in science. However, after taking biology courses at RISD and carrying out the research for this thesis during the MA program, I became surprised at just how much art and science share roots historically and intrinsically - from both disciplines valuing of creativity and imagination to discovering joy from creating something new. Also, I now see how much art and science exist in complementary relationships while creating synergies. Artists have been informed and inspired by science, and art has in my view on numerous occasions bridged the gap between the public and science, making it more accessible. It has been important for me to realize that creativity and imagination can spring up when two seemingly conflicting disciplines meet, which can then enable students to develop a more comprehensive understanding of concepts when viewed through more open-minded and expansive perspectives.

Emotional and Experiential Learning through Art

Through the selected literature of current teaching models of learning about environmental issues through art, I discovered that many valued field trips or place-based learning that connect students to the real world. In such venues, education wasn't limited to the brick and mortar classroom, it reached out to environmental groups and communities, and many classes took an interdisciplinary approach which involved art educators and scientists. Such an approach led learners to a deeper understanding of ecological issues and empowered both the community and the students. Such a pedagogical approach played a vital role planting in students the idea that their actions can be impactful, nurturing them into influential adults. Also, such place-based learning entailed knowledge, reasoning, and very importantly integrated bodily experiences and emotions. It is argued that emotional and experiential learning can increase

creativity, making the one-way learning process a more "inclusive" and "lively" experience, leading ultimately to "true" and "long-lasting" knowledge.

Taking courses at RISD that focused on the relationship between animals and humans and working with scientists have greatly influenced my interest in this subject. By reading numerous scientific articles in addition to the courses I have taken has led to my realization of the significant gap that exists between the public's awareness and genuine understanding of environmental issues. There is a saying that "You can see as much as you know." However, the ecological crisis has become a reality, not a distant future, so it's no longer tenable just to recognize that a problem exists. In my view now is the time to take translate recognition into action. The research that has supported this thesis has led to my own realization that environmental issues are not just ecological issues but also closely related to human health, social equity, identity formation, and community building. When this deeper understanding meets the creativity of art, I believe that knowledge is no longer superficial and temporary, which all too easily evaporates, but becomes authentic and life-long. As Lucy Spelman contended, environmental problems can be solved when we work together, and art can make this collective effort possible. Despite their importance, matters related to the environmental crisis have generally been neglected not only in the in the visual arts curriculum but I would argue in education generally. Although ecological issues change rapidly and become more and more severe, environmental education through the arts still seems to remain located in the past. For students to better understand the importance of how closely they are intertwined with our lives, I believe environmental education must also be more developed and importantly diversified.

The Role of Art in Engaging in Environmental Issues

As a result of this thesis investigation, I have come to more fully appreciate that art creates tremendous synergies when combined with other disciplines in that it conveys emotions and provides a firm narrative base that makes learning more memorable. Since art is not simply about passively accepting information but actively reinterpreting it in one's own way and recreating it with their senses, learning combined with art can be sustained. For environmental issues that seem too broad and ambiguous can get closer to people as they are more concrete and tangible when combined with art.

Art makes invisible things visible.

The most important thing to remember was that when art becomes didactic, it is less effective. If science is a one-directional conversation. Art is in my view a multi-directional conversation among artists, collaborators, artworks, and viewers. Science constantly adds data to be more accurate, but art continues to remove elements to get as close to the essence as possible. The blank space left by art provides more room for thought to the audience and induces change by arousing curiosity rather than forcing change. I fully appreciate that it is no easy task to measure the impact of art in solving environmental problems. It may seem like nothing has changed for now. But we should give a chance for the audience so that the contents could seep into them. As an artist, Mary Miss declares, "Change is long-term" and "Change takes time." Further, she also said that "Your generation is living in a time where it is probably easier to make changes through culture than policy. You might not be able to understand the impact of art at first glance, but it indeed has an impact in the long term."

Art and science each have distinctive strengths, and I have come to see as a result of this year long thesis investigation that interdisciplinary approaches through science and art are crucial in learning about environmental issues. Therefore, if we can develop curricula that value the parallels between artists and scientists, rather than seeing art as a subsidiary tool for understanding science, I firmly believe it will lead to a more meaningful change. I hope the ideas I present in this thesis will encourage more educators, artists, and scientists to rethink the importance of art to drive change in environmental issues, and by doing so to propose and implement new and more diverse forms of art education at the intersections of art and science.

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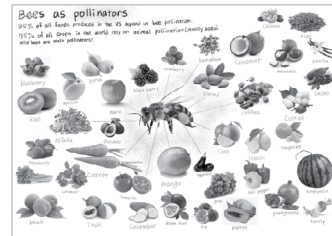
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ASSIGNMENT PORTFOLIO

This appendix consists of a portfolio of assignments I completed during two courses Biology: Animal-Human Interact and Art of Communicating Science. In addition to studio-based reflections both courses also required students to produce written responses to weekly readings and lectures.



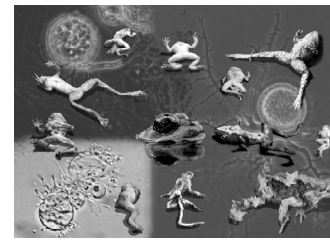
The Impact of Monoculture Farming on Bees, Eunhyung Chung (2020)



The Importance of Bees as Pollinators, Eunhyung Chung (2020)



DDT - Bioaccumulation, Eunhyung Chung (2020)



Frogs are undergoing the Sixth Mass Extinction due to the Invisible Killer, Chytrid Fungus, Eunhyung Chung (2020)



Meat Paradox, Eunhyung Chung (2020)



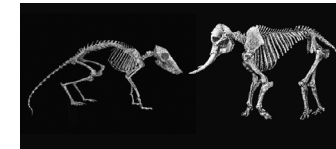
Our Actions Impact the Health of the Animal and its Health Affects Ours, Eunhyung Chung (2020)



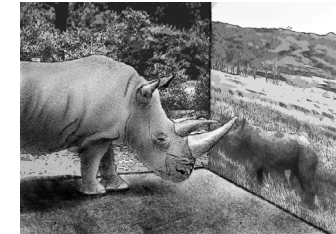
Shark Finning, Eunhyung Chung (2020)



Overfishing, the Major Threat to Declining Sharks, Eunhyung Chung (2020)



Somalia Sengi & Elephant, Eunhyung Chung (2020)



The Habitats of Zoos, are they really Considering Animals?, Eunhyung Chung (2020)



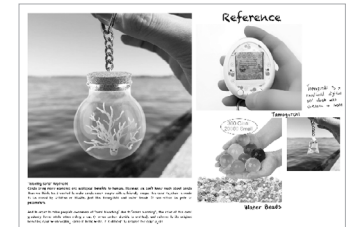
Leaving Food Outside can lead to More Coyotes, Eunhyung Chung (2020)



Companion Animals can Fill the Gap of the Loneliness that Humans can't Fill, Eunhyung Chung (2020)



Coral Model Bleached by Vehicle Mileage (CO2 Emissions). (If you ride less, the coral color will recover to its original color over a long period of time.), Eunhyung Chung (2020)



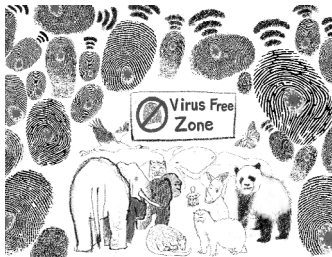
Growing Coral Keychains, Eunhyung Chung (2020)



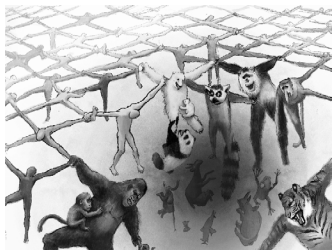
Anybody else who owns an Animal is Responsible for their Waste, Eunhyung Chung (2020)



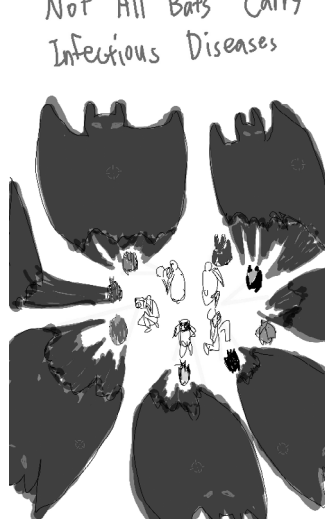
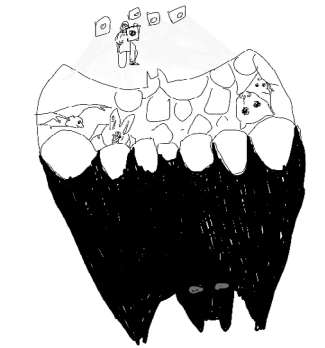
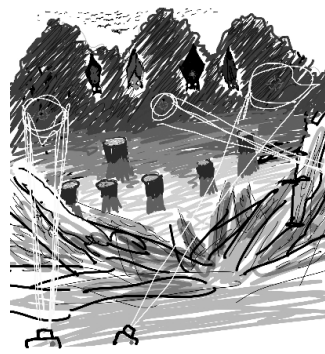
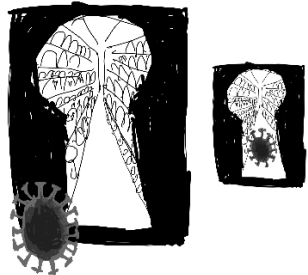
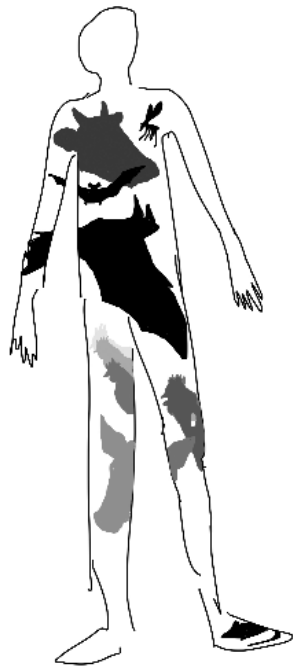
Ethical Consumerism can Save a Luwak (Package Design), Eunhyung Chung (2021)



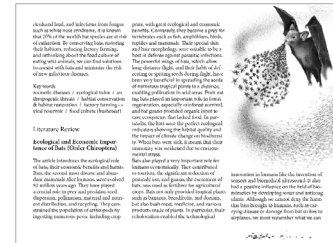
Global Safety Net (Thumbnails), Eunhyung Chung (2021)



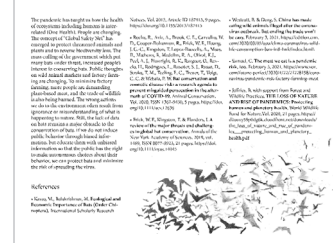
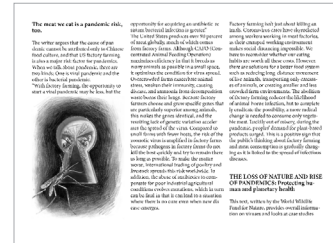
Not only for them but also us, Eunhyung Chung (2021)



Thumbnail Images for the Final Essay about Bats, Eunhyung Chung (2021)



Why Blame Bats for Every Disease? (Final Essay), Eunhyung Chung (2021)



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