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Reimagining the Liberal Arts in an Age of Technoscientific Progress

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REIMAGINING THE LIBERAL ARTS IN AN AGE OF TECHNOSCIENTIFIC PROGRESS

by

MELANIE MOORE WATSON

(Under the Direction of John A. Weaver)

ABSTRACT

The following study will investigate the impact of dismantling liberal arts curriculum during an era of dramatic technoscientific progress. I will explore the development of the posthuman focusing specifically on the areas of virtual reality and biomedicine. As I unravel the implications that virtual reality and biomedicine will have on society in the coming decades, I will describe how a new liberal arts curriculum must be entertained by educators in order to maintain innovation, play, and ethical considerations in posthuman developments. In order for our students to become contributing members of a global community, they must be given the opportunity to learn how to think critically through an immersion in a new curriculum that will focus on modern/postmodern art, literature, and film productions. This study will explore how the disciplines of the sciences and those of the liberal arts might coalesce for the betterment of our students and our society.

INDEX WORDS: Curriculum Studies, Liberal arts, Sciences, Posthuman, Technoscience, Virtual Reality, Biomedicine

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DEDICATION

To Jamey—
My everything.
Words have never been enough.

To Ella, Campbell, and Sadie Beth—
You fill me up.
You bring me more joy and happiness than I ever thought possible.

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I would like to thank several educators that have truly inspired me throughout my education. Dr. Michael Drake showed me the amazing story of our past while I was in high school and led me to the realization that I wanted to share that history with future generations. Dr. Lynn Gatlin helped me on numerous occasions during my first tumultuous year as an educator in the public school system. The department of Curriculum Studies at Georgia Southern University opened my eyes to a new way of being in education. Many discussions with Dr. John Weaver led me to the topic of my dissertation. His support and encouragement has helped me overcome challenges I sometimes thought insurmountable during this process.

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My husband, Jamey, has been my sounding board throughout this process. I would never have reached the end of this journey without his constant help and encouragement. I will never be able to express my love for the man who completes my thoughts, gives me strength, and holds my heart.

My amazing daughters Ella, Campbell, and Sadie Beth have shown me the true nature of love. I did this for them.

Most of all, I thank my Lord and Savior, Jesus Christ. I am grateful for His mercy and humbled by His grace.

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CHAPTER 1

PREPARING FOR THE MIDDLE

"In a third place in the middle of the others, the third person can find himself in a delicate and ambiguous position…." (Serres, 1997, p. 43).

As a high school teacher of American History, I am seeking a third space for the curriculum that I teach. This third space would allow me to bring curriculum theory into my standardized public school curriculum. Because of my role as a teacher in a public high school bound by the constraints of standardization and Annual Yearly Progress (AYP) mandates, I feel compelled to teach as I am told. This typically means that I teach students how to take two standardized tests in American History during March and April of their Eleventh Grade year. I am also a student of Curriculum Theory. My passion in this area goes against everything that I am asked to do in practice. Curriculum theorists see education and schooling differently. Education should promote dialogue. It should require critically assessing one's life and place in society. Education should consider one's experiences. Schooling should allow spaces for lives to develop rather than cubicles that stifle play and creativity. Education and schooling in this light are necessary for the advancement of an empowered society. "Critical capacities are needed to keep our society dynamic; hence schools should teach students to be critical" (Apple, 1995, p. 13). I find myself living two lives, one as a public school teacher, one as a student of curriculum theory. I seek to explore how I might become a third person that would bring passion, thought, and life back into the public school classroom.

As I am becoming a newer version of my professional self (Melanie 4.0?), I am discovering that the classical schoolroom is one of boredom, harshness, and inactivity. How might this dull blanket be lifted from our students? I believe that a third place of schooling might be created. Serres (1997) contends that the third place is not supposed to exist. When there are two extremes, they will push against one another in eternal argument unless one is eventually determined to outweigh the other and thus will encompass the entire space. Serres holds, however, that a third place is possible. I believe the third place can be created in the school. Currently, I see a dichotomy between the classroom and the hallways as my students enter a room, escape from that room into the sanctuary of the halls, and reenter another room in another location within the school. The hallways give students a brief reprieve as they move through their education. When the bells ring to end class, I observe students flooding into the hallways. Teachers are required to stand outside their classroom doors to monitor students' behaviors. From this vantage point, I am privy to the private conversations of students as they congregate by blue metal lockers. During the six minutes between classes, students cast off the expectations of the standardized, sterile classroom. There is an obvious transformation in facial expressions and body language. They carry themselves with more confidence…they laugh. There are two groups that congregate near my classroom. One group is comprised of middle-class African American students—four or five boys and one or two girls. The other group is from very wealthy families. They are predominately white students and equal in number of girls and boys. The conversations of the groups are similar although the backgrounds are a bit different. I overhear these groups of students discussing their plans for the afternoon or weekend. They exchange good-natured insults, give hugs, and slowly begin to move away towards their next classes. I have learned which classes the students look forward to attending and which classes they dread. They linger a little longer at the lockers, with their friends before leaving to go to the "bad" classes with the teachers that "don't teach" and "don't listen." I recently had to cover a class for one of the "worst" teachers during my planning period because she was absent and no substitute was available. When the students walked into the room, they were somber. Once they realized that the teacher wasn't there, they brightened. They still had to do the work she left but a weight seemed to have been lifted. I spoke to some of the students that this teacher and I share. I asked them why they disliked some classes and not others. The resounding responses centered on the fact that some teachers allow outside experiences and individuality to be explored—others simply refuse to entertain discussions that stray from the Standards. In order to educate our students, we have to recognize and embrace the people that they are in the hallways. We should not allow them to move through education, but we should entice them to explore an individual education that allows a deeper understanding of their authentic selves. Educators are foolish to believe that a hidden curriculum is not taking place in these hallways. Webber states, "Curriculum is not just in books and lesson plans; it is every conceivable message transmitted to students in schools, either through linguistic or nonlinguistic means" (2003, p. 37). Although Webber focuses on the dangerous messages within the hidden curriculum, I believe there are also vitally important lessons that might be learned by educators about play, fantasy, creativity, and stimulation. Examining the hidden curriculum is what curriculum theorists do according to Pinar: "The educational task is to take the cover stories we as Americans tell ourselves and look to the back pages. We must teach what the cover stories hide, exposing and problematizing the 'hidden curriculum'" (2004, p.39). Although the traditional classroom is now laden with standardization, I seek to find a way to bring the energy of the hallway into this place. Conversations of literature, science, history, and technology fused with autobiographical understandings will allow a new classroom to become a third place between the extremes of the halls and the antiquated classroom.

Reimagining the liberal arts curriculum is essential to allowing this conversation. The Arts, in this third space, will remember its roots in technē.

> Technē…is a deliberate application of human intelligence to some part of the world…it is concerned with the management of need and with prediction and control concerning future contingencies. The person who lives by technē does not come to each new experience without foresight or resource. He possesses some sort of systematic grasp, some way of ordering the subject matter, that will take him to the new situation well prepared, removed from blind dependence on what happens (Nussbaum, 2001, p. 95).

Technē was born in ancient Greece where technology and art were viewed as part of the same sphere. Heidegger (1977) and Rutsky (1999) maintain that this bond between art and technology remains. "…the relationship between art and technology, so visible in the Greek *technē*, has always been basic to technology, to its 'essence,' even when the *conception* of technology has been explicitly posed…in contrast to art, to the aesthetic sphere" (Rutsky, 1999, p. 4). I submit that a reimagined liberal arts curriculum might be fused with a technoscientific curriculum in order to advance both fields as equal and important to society. Students should explore how technologies' hold on our lives as individuals and consumers is both harmful and life affirming. Britzman challenged curriculum scholars to "…imagine the call of the ethical as that which obligates us to education" (2003, p. 31). A liberal arts education will prepare adolescents for encountering technoscientific advancements in an ethical manner.

My study will advance a conversation already begun by several curriculum studies scholars in the areas of technological advancement, literary theory, and popular culture. Pinar

(2004) explores the figure of the cyborg, a figure often examined in posthuman literature. He asserts that the cyborg student will manifest herself in response to increased exposure to and enfleshment of cyberspace. The biomedical posthuman student will enter the classroom genetically altered or chemically reimagined. The technologies that have created these students need to be explored through the lens of curriculum theory. Will technology be used to further democratization or simply continue the reproductive tendencies of standardized curricula? I will show that technology does pose extremely dangerous scenarios for a democratic future, but it also opens the way to more honest discussions of Self through juxtaposition with the Arts.

I suggest that the traditional role of Arts in education be reexamined. Mary Aswell Doll writes of the impact of fiction. "…fiction disturbs the status quo….One learns about one's self. One learns about living….fiction—more than fact—teaches wisdoms about the human condition precisely because fiction connects readers to what courses within themselves" (2000, p. xi). I will examine what modern fiction and other liberal arts might add to our classrooms. Drawing on Doll's expertise, I will examine how we might incorporate fiction more effectively into our curriculum. Maxine Greene also writes of using the arts in more provocative ways. In order to experience the renewal of art, educators must force students out of the stasis condition prevalent in our schools.

> Mere exposure to a work of art is not sufficient to occasion an aesthetic experience. There must be conscious participation in a work, a going out of energy, an ability to notice what is there to be noticed in the play, the poem, the quartet. "Knowing about," even in the most formal academic manner, is entirely

different from creating an unreal world imaginatively and entering it perceptually, affectively, and cognitively (Greene, 1995, ¶ 2).

I believe that there must be a relaxing of standardization in order for students to experience the arts in this way. The current atmosphere in public education only allows for a brief exposure to a work that feels stale and uninspiring.

Destabilizing the Standardized Curriculum

It becomes important for educators to accept what curriculum scholars have long believed—curriculum must be about creating experiences (Apple, 1995; Macdonald, 1995; Pinar, 1994). Curriculum is not about developing a lesson plan based on current standardized testing. "Such practices have little to do with teaching students to develop critical skills…and an awareness of the operations of power that would enable them to both locate themselves in the world and to effectively intervene in and shape it" (Giroux, 2003, p. 89-90). Curriculum is everything one experiences inside and outside the classroom. To simply try to eliminate that which is outside of the classroom is to deny a student access to her Self. In order to allow these experiences to develop, the educator must bring to the classroom opportunities to explore the culture beyond the concrete holding pens of public education institutions. Madeline Grumet states, "curriculum is the child of culture….Curriculum transmits culture….Curriculum modifies culture…" (2004a, p. 24).

If we accept that Grumet is correct, then we must allow conversations of the posthuman to develop within our field. Weaver argues, "Curriculum scholars should not opt out of the posthuman discussions and the debates over the uses of the biosciences because the price of denial and erasure are too high. Ignoring (bio)technology or constructing it as an intrusion or threat to humanity prevents all of humanity to become who we are" (2010, p. 144). By incorporating discussions of technological progress, the advancement of the liberal arts curriculum, and the inclusion of culture in the classroom, I am contributing to the discussions already begun in the field of curriculum studies.

In order to bring about a change to traditional classrooms, educators must destabilize the learning environment. Michel Serres (1995) argues that we seek to break everything in our society down into its most elemental parts. He does not see this as beneficial or even possible. I associate this with the standardization of our curricula. The first Unites States History standard outlined by the Georgia Department of Education (2008b) states that "the student will describe European settlement in North America during the 17^{th} century." This is further broken down into five subsections each with key events that the student must be able to explain. The first subsection states "Explain Virginia's development; include the Virginia Company, tobacco cultivation, relationships with Native Americans such as Powhatan, development of the House of Burgesses, Bacon's Rebellion, and the development of slavery." From this, I am to pull out the events, brief the students on when these events occurred and which historical figures were present, and then test them on these facts. I am not to stray to other events that might give more information or encourage discussion because I am to teach these things in the course of one to two fifty minute class periods. I do not understand how instructing students to "break down" the history of our nation into little more than isolated events gives any indication as to the narrative of how our country has risen to great heights and pulled itself up from despair time and again! What we find, however, is that when we as a society attempt to simplify people, places, events, and ideas into small, understandable units, the unit demands we ask more questions about its existence. Thus, the unit becomes complex again and we, in turn, attempt to simplify it. Serres believes this attempt to atomize everything is a major fault of society.

> We are fascinated by the unit: only a unity seems rational to us…We want a principle, a system, an integration, and we want elements, atoms, numbers. We want them, and we make them….We think only in monadologies. Nevertheless, we are as little sure of the one as of the multiple. We've never hit upon truly atomic, ultimate, indivisible terms that were not themselves, once again, composite. Not in the pure sciences and not in the worldly ones (1995, p. 2-3).

Yet, we continue to educate our children in the simplest terms possible and when they offer a question that might complicate and breathe new life into the unit, it is often avoided and left in the space between the teacher and student to gasp for breath, falter, and die without receiving an answer.

Standardization will be difficult to eliminate from education because it allows those in positions of authority and power to maintain a mirage of control. Through testing, reports, and weekly evaluations of educators, administrators and politicians are able to show the public that children are watched closely, instructional time is being efficiently monitored, and that high school graduates are knowledgeable, contributing members of society. Students and teachers alike feel the watchful eyes of the public. Michel Foucault examines the gaze in a discussion of Bentham's Panopticon and its relation to schools.

> The panoptic mechanism arranges spatial unities that make it possible to see constantly and to recognize immediately….If the inmates…are schoolchildren, there is no copying, no noise, no chatter, no waste of time….it makes it possible to observe performances…to map aptitudes, to assess characters….the director may spy on all the employees that he has under his orders…he will be able to judge them continuously, alter their behaviour, impose upon them methods he thinks best…. (1995, p. 200-204).

Not all schools are structured in the same circular architectural form that Bentham imagined, but the gaze of the director is felt persistently. The door of my classroom, for example, has a rectangular window. I am not allowed to cover this window at any time. I am told this is for security reasons…persons on the outside need to be able to see in the room in case there is a security problem. This also establishes a power structure. I may be peered upon to ensure that I am leading a standardized classroom without my knowledge of being watched. This is a direct example of how my students and I might be assessed on a regular, daily basis. We also feel the gaze of politicians and others in society through standardized testing. The scores of our students are studied to determine whether we are doing an adequate job and whether our students are educated to certain standards. The results are often published in local newspapers. Adequate Yearly Progress as defined by No Child Left Behind legislation determines where monies will be distributed, where students will be bussed, and which teachers will be held in high esteem and which will be terminated.

Stability of curriculum through standardized classrooms also allows for power structures in society to reproduce themselves within the walls of public education (Apple, 1995; Delpit, 2006; Gilmore, 2003; Giroux, 2006; hooks, 1994). Students from disadvantaged backgrounds due to class, race, or gender, often encounter the classroom as a space that relishes the status quo and discourages any voice that would question the traditional classroom's norms. The classroom often seems a microcosm of society, where politicians and others in traditional positions of power seek to silence voices that challenge long held beliefs of curriculum and bodies in education. bell hooks finds that "silencing enforced by the bourgeois values is sanctioned in the classroom by everyone" (1994, p. 180) including those being silenced as they feel their status is fixed. Afraid to speak up and be heard in an unwelcoming environment, they accept their fate and continue through the educational system. A new curriculum might allow more people to feel as Angela Gilmore eloquently expresses:

> There are still times when I am silent, most often because I am afraid, sometimes justifiably, sometimes not. Yet usually I do not achieve anything as a result of my silence. Silence does not cause fear to disappear. Silence does not make me feel more secure. Silence does not dispel ignorance (2003, p. 116).

In order to push education to a more equitable, imaginative forum, it is necessary to plug into voices of minorities. In the very near future, we will encounter not only human minorities within the classroom, but also posthuman hybrids. What will their voices sound like and will we be prepared to receive them? A forced instability within the standardized curriculum will launch us towards a new examination of bodies and technoscience through the liberal arts.

I have argued the many faults of today's standardized classroom. I want to imagine what a new destabilized classroom might be like. Education is a going forth. Serres (1997) examines the journey that a swimmer takes as he leaves the bank of a river carefully in his quest for the opposite shore. He feels for the earth and finds it for awhile under his feet as he leaves and again as he approaches the other side. This is security, stability. This is standardization in schooling. Serres is most interested in the middle part of this journey as am I. This is where education occurs. The crossing where there is no security of earth beneath feet. It is playful and laden with anxiety.

> Departure requires a rending that rips a part of the body from the part that still adheres to the shore where it was born, to the neighborhood of its kinfolk, to the house and the village…to the rigidity of habit. Whoever does not get moving learns nothing. Yes, depart….Learning launches wandering….Above all: never take the easy road, swim the river instead (Serres, 1997, p. 7-8).

In an environment that seeks to incorporate ethical discussions of technoscientific advancements through a revitalized liberal arts curriculum, we must challenge students to begin to think differently. At home, on the shore, our students think simply with standardized memorization. A new curriculum should push them towards the opposite shore and let them gasp for air in the middle of this journey. I picture a child crossing the river and realizing that he has no safety net there in the middle. Arms and legs failing, gasping for breath, he suddenly begins to kick his legs and pump his arms through the water. Here, in the middle, alone, he has worked to learn to swim. Once learned, he easily makes it to shore. "This is the point in labor when, suddenly, everything becomes easy …Right in the middle, the work is over" (Serres, 1997, p. 11).

In the third place of education, the middle is sought. Technology and art are embraced, and new ideas launch the student into the middle to grapple with the possibilities of the future. The school should meet them here. Standardization, however, pushes art and technology to their opposing corners. Each is required to meet the standard of pure repetition. "Pure repetition" stops progress from occurring. According to John Caputo (1987) "pure repetition" is a cycle that occurs within the flux, within chaos. Drawing on a Platonic view of Being, Caputo argues that the ancient Greeks sought pure repetition as a way to return Being to its previous truth. By being in the world, we are fallen creatures. Our destiny lies in returning to the truth that was ours prior to being cast down. This repetition seeks to go back not to move forward. This is what I see in education today. By standardizing curriculum, elitists submit that they know best what students should learn in a classroom. "Pure repetition" in schools occurs every day in the following scenario. The teacher arrives at school and enters her classroom. She writes the standard on the board so that the students know what they are expected to learn during the day's lesson. She will write an "essential question" near the standard that encourages the students to think about the standard. This question should guide the student in *how* to think about the standard. At the beginning of the lesson, the teacher will reference the standard and tell students to think about the question. The material that she covers will only link to the standard. Extra information is superfluous and should not be covered. Trying to expand the standard will only distract students and will force the teacher to get behind the pacing guide that has been distributed to make sure she will cover all material prior to the standardized test. Once the material has been covered, students will be given a standardized quiz. Each question references the standard and substandard from which the question was drawn to ensure that only the standards are covered.

Students begin with the standards and end with the standards. There has been no attempt to push students out of the comfortable cycle of repetition; no encouragement to think independently. Caputo argues that philosophers have been grappling with movement for centuries. In pure repetition, students and teachers are caught running in a vicious circle where there is no movement forward. Kierkegaard was the first to explore a way to progress *through* the flux by repetition as movement. Drawing on Kierkegaard, Heidegger, and Derrida to name a few, Caputo submits that "Repetition …is not the repetition of the same…but a creative production which pushes ahead, which produces *as* it repeats, which produces *what* it repeats, which makes a life for itself in the midst of the difficulties of the flux" (Caputo, 1987, p. 3). Caputo's repetition should be modeled in the classroom. "Repetition starts at the beginning, not at the end. It means to produce something, not to reproduce a prior presence" (Caputo, 1987, p. 15). Repetition then encourages students to move through the flux, to struggle through the anxiety of encountering new information. Exploring Caputo's repetition is mimetic of Serres' journey across the river. "Pure repetition" returns the swimmer to the original shore preventing an experience of the new shore.

In order to bring together art and technology that have been divorced through pure repetition in an attempt to standardize the curricula, we should incorporate mimesis into education. Mimesis allows technology and art to wed once again in technē. Lacoue-Labarthe describes mimesis this way:

> …mimesis, which reproduces nothing given…, but which *supplements* a certain deficiency in nature, its incapacity to do everything, organize everything, make everything its work—*produce* everything. It is a productive mimesis, that is, an

> imitation of *phusis* as a productive force….It accomplishes, carries out, *finishes* natural production as such. "Perfects it," Diderot says (1998, p. 255-256).

I propose that we seek a mimetic curriculum for the liberal arts that will allow us to study the advances of technoscience with a more expressive dialogue than that allowed through pure repetition. Weaver believes that "Mimesis needs to replace pure repetition as a core concept in the development of the mind" (2010, p. 118). Mimesis will allow a liberal arts curriculum that will explore the timeline of science through literary readings of classical novels and modern science fiction. The liberal arts will also inquire about the role technology plays in our medical and social lives. Finally, the liberal arts allow autobiographical considerations as students will acknowledge that technology has shaped their lives thus far and will understand that they are the stewards of tomorrow's technological advancements.

Technē exposed

I believe that technoscientific advancements are moving so quickly that unless society is grounded in a liberal arts education that forces one to think critically, ethically, and creatively, global mistakes might be made in the name of progress. A reemergence of technē would allow us to embrace what the sciences and the arts have to offer humanity. C.P. Snow's well-known book, *The Two Cultures and the Scientific Revolution*, expressed his belief that the sciences and the arts were at odds. In 1959 Britain, Snow found himself enjoying the company of both scientists and literary intellectuals. He realized that the two cultures knew very little about one another and that they had no interest in rectifying the situation. Snow blamed this on the education in Britain stating that, "Nearly everyone will agree that our school education is too specialised" (1959, p.19). Today, Mary Midgley makes the same argument: "Different academic disciplines…should not behave as if they each owned their own private universe. Physics, literary criticism, political theory, geology, and ethics should all notice that they share a world" (2006, p. 193). I believe the focus on standardization is forcing a polarization of the two disciplines in American education. Snow argued that the alienation of one culture from the other would impoverish society. Creativity and progress is only attainable at the "clashing point of two subjects, two disciplines, two cultures" (Snow, 1959, p. 17). The solution to the problem would lie with an education firmly committed to reintroducing technē.

Almost forty years after Snow's examination of the two cultures, Bruno Latour investigated how these two cultures have become so polarized in society through the lens of Nature and Society. Latour (1993) argues that although society may believe in the polarization of Nature, that which encompasses the sciences, and Society, that which encompasses the arts including politics, in fact, they have never been fully separated. The ancient Greeks realized this connection. Although Humanity believes that we have moved far beyond the Grecian understanding of the Arts and Sciences, the truth is that they have never been disjointed. The union has only been hidden by those that suggest the superiority of one over the other. Latour believes that in the Modern Era where Nature and Society are pushed to their respective corners, the hybrid objects of their union have simply been pushed underground and ignored. He suggests a Middle Kingdom exists as the place between the extremes where they are allowed to mingle and produce quasi-objects. Latour's big announcement is that Humanity has never entered the Modern Era, much less a Post-Modern Era, because we have never truly been able to purify the two poles. The quasi-objects that reek of Nature and Society have always already been present but simply ignored by those seeking a Modern Era. Once Humanity is willing to embrace hybrids that are conceived with traits of Nature and Society, progress within the technosciences can advance without fear of Frankenstein monster's sneaking up from behind. Technē is searching for a voice. Within the new classrooms of educational institutions, we can allow that voice to emerge. We can explore the Middle Kingdom. "The work of mediation becomes the very centre of the double power, natural and social. The networks come out of hiding. The Middle Kingdom is represented. The third estate, which was nothing, becomes everything" (Latour, 1993, p. 139-140).

Many of the hybrids that Latour references are found in today's technoscientific culture. Organ transplantation, pharmacogenomics, and virtual realities are advanced because of a fundamental concern for the welfare of humankind. The development of each belongs to the realm of Science. The concern that spurs the creation is the domain of the Arts. Erwin Schrödinger examines this dichotomy in his lecture entitled *Mind and Matter* (1992). After examining the mutations and evolutionary history of mankind, he concludes that "…our biological future…must not be taken to be an unalterable destiny that is decided in advance by any Law of Nature" (Schrödinger, 1992, p. 115). This basic understanding gives humanity hope that the body might be pushed to un-natural limits with the aid of technoscience. When the question arises, however, "from whence does technoscientific progress come?" the scientist is stumped. We cannot scientifically explain the mind because science comes *from* the mind. "All science however is a function of the soul, in which all knowledge is rooted" (Jung quoted in Schrödinger, 1992, p. 119). The mind and its mysteries have been questioned by philosophers for centuries. This is why I maintain that the Sciences are necessary for technoscientific advancements, but the Arts are critical for the creation of Science.

I am proposing that technē has always already been present in our society and that it is the driving force behind our achievements in both the Arts and Sciences. The fact that it has been undervalued and ignored particularly in education has led us to a crossroads where ethical decisions on further advancements will either be made or cast aside. Two areas of immediate concern in a discussion of ethics in technoscience appear in the domain of biomedicine. I offer pharmacogenomics and organ transplantation as examples of how issues in technoscience arise as progress ensues.

Organ Transplants and Pharmacogenomics

The dissecting of the human anatomy dates back to ancient Greece. Although little is known about the original autopsies, accurate testimony has been obtained from Renaissance Italy proving that Italian doctors were taking part in the practice of dissection as early as the 13^{th} Century. The first recorded autopsy was done by Andreas Vesalius in the 16^{th} Century (Park, 1994). It is not surprising that once the body became an open frame, scientists began to consider the possibilities of organ transplant. As with Victor Frankenstein's monster, an uncontrollable technology, such as a used organ giving new life to another body, may be viewed with hatred, wrath, and fear. "Unlike human life, the life of Frankenstein's creature cannot be figured as organic or whole. He is an uncanny assemblage of spare parts, the result of a mixed, 'unnatural' reproduction, a kind of technological miscegenation" (Rutsky, 1999, p. 133).

The first organ transplants in North America occurred in the 1950s (Caplan & Coelho, 1998). Initially a rare and miraculous life-saving technique, this process has fallen under scrutiny recently from those intimately familiar with the process. Ethical questions arise from the families of donors as well as the recipients of the donors' organs. Lesley Sharp (2006) provides an anthropological record of organ transplant in *Strange Harvest*. Through interviews, she found that the shortage of organs in the United States may be due to the dehumanization of the patients by those in the corporate medical profession. In an attempt to help patients deal with the "Frankenstein syndrome," a fear held by many recipients contemplating taking the survival organs of a "dead" donor into their own bodies, some doctors may inadvertently be accountable for aiding to this dehumanization. Sharp describes the problem this way: "In an effort to quell the potential unease associated with the hybrid body, transplant professionals regularly describe the body parts as inert objects. In this way, the surgeon's craft centers on the repair of a complex and fragile *machine*" (2006, p. 24).

Another fear surrounding the realm of organ transplantation is that of body commodification. Many issues surrounding the "cost" of the American body have arisen in the past few decades. In regards to organs, we must contemplate how much each American organ is worth. (It is worth pointing out here that I use the term "American organs." The cost of organs in other countries would surely be tied to that country's ranking as technologically advanced or third-world.) In 1999, ebay pulled an advertisement for a "fully functional kidney" located in Sunrise, Florida from its site, but not before bids reached $5.7 million" (Online Shoppers Bid Millions for Human Kidney, 1999). How should we view the organs of the deceased? Is the dead body merely a "treasure trove of reusable parts" as suggested by Sharp (2006, p. 11)?

Perhaps, the way to dispose of this manner of thinking is to refuse the proposition of compensation for organ donation. One position is that to compensate families for the organs of the deceased is "out of step with the rest of the culture" (Joralemon & Cox, 2003, p. 27). The body is still seen by most in western society as one's own property. To turn it into an object for trade would be to dehumanize the living body. Others argue that the shortage of organs calls for compensation in order to increase the supply to meet demand.

The "Frankenstein syndrome" is not likely to fade from the medical community. In fact, it is likely to increase as new advancements in artificial organ replacements occur. Science fiction novels aid in suspicion of doctors as most depict the "mad doctor" or the "mad scientist" as one "devoted to overcoming the body, not improving the body" (Westfahl, 2002, p. 4). Our views of transplantation and technological advances have gone from awestruck to mundane. Willard Gaylin is worth quoting at length:

> Now as we approach the end of the twentieth century we find that the myth of Frankenstein has become an everyday reality….The inconceivable has become conceivable. Dr. Frankenstein is at work in every major city of the modern world. We honor, we revere, we respect and need him. We wish him well and urge him to go further. An artificial heart, a brain transplant, go further—an artificial placenta; go further (1990, p.17).

The dilemma in organ transplantation does not simply center around human-to-human transfer, but also in discussions of artificial organ transfer and xenotranplantation between humans and animals. The lack of supply in available organ transplants has led some scientists to consider the possibilities of using other sources of organs to meet the demand (Sharp, 2007). Xenotransplantation raises issues of ethicality when considering the possibilities of killing animals for their organs (Caplan & Coelho, 1998). Other issues will include the "Frankenstein syndrome" in another, more complex dimension. The reality of accepting an organ from a "lesser" species will cause many suffering from debilitating and possibility fatal illness to think twice before agreeing to a xenotransplant. At one time, this discussion would have only taken place in science fiction novels, but the unbelievable is now within reach. To alleviate the drain on supply, xenotransplants may offer a viable option.

Another futuristic, although tragic, transplantation issue comes with the potential use of anencephalic neonatal organs for donation to children. The number of children that die annually from lack of organ transplants continues to rise (Caplan and Coelho, 1998). Due to most state laws that require a patient to be brain-dead prior to organ harvesting, the donation of these organs does not happen as readily as many parents would like. The ethical dilemma is real and must be weighed carefully.

The Human Genome Project (HGP) represents a crossing in biotechnology from studying the field of genetics to using the science of genomics to determine the possible quality of life of populations. The possibilities to improving health are virtually endless. "Within 10-15 years, we will have identified hundreds, if not thousands of genes that predispose to disease" (Institute for Systems Biology quoted in Rose, 2007, p. 87). In examining the creation and advancements in pharmacogenomics, it is useful to understand the relationship between biotechnical start-up companies and the larger pharmaceutical companies involved in the production of a drug. Rajan describes this as the upstream-downstream cycle of development: "…with a few exceptions, biotech companies tend to focus on upstream drug discovery, but do not always have the capital to take molecules through downstream clinical trials processes" (2006, p. 23). This creates a dichotomy between the two industries as it becomes imperative for the biotech companies to give license to pharmaceutical industries, but then disallows those start-up companies to realize the potential capital to be gained from its discovery. "Drug development is such a capital-intensive process that very few companies have the muscle to actually take a drug to market" (Rajan, 2006, p. 45). We also find in studying these advancements that there are disputes between public and private corporations as to the potential patentability of genomic discoveries. Naturally, public corporations would like for genomic identifications to remain legally open to all public use, whereas, private enterprises like that of Craig Venter's Celera Genomics (Davies, 2001) object. "This competition, after all, has not been about finishing first and getting the credit for it—who generates information first has always had huge implications for whether that information goes automatically into the public domain or becomes the property of particular companies" (Rajan, 2006, p. 49).

Pharmacogenomics is a field ripe with potential for life saving medicines. A simplistic description of the process of developing pharmecogenomic drugs states that it is the "effort to (1) emulate the strategies of the HGP and (2) utilize the fruits of the HGP to reduce the incidence of disease and improve the practice of medicine, while reducing health care costs" (Mohrenweiser, 2003, p. 31). A more complex understanding involves the description of target markers within a given population. Pharmacogenomics is after all "a commercially driven, industrialized, high-throughput science that has emerged consequent to the genomics revolution" (Rajan, 2006, p.

154). Understanding how individuals may be targeted for potential drug therapies will allow us to determine what is considered to be a target market within a studied group.

The genomic revolution allowed for scientists to discover SNPs, single nucleotide polymorphisms, which allow genomists to view the different variations within a single gene. Once the SNPs are discovered, it is possible to determine the drug reaction of an individual or a single population (Rajan, 2006). Attempting to market a drug to a specific population based on DNA homogeneity is difficult and would include several different phases. First, variations must be targeted within genetic makeup. These variations will be determined in the population through genomic sequencing in target populations known to exhibit particular susceptibility to disease. Next, variations have to be tested to determine drug responsiveness. It has been determined that genomic sequences may impact the responsiveness to certain drugs amongst individuals, as well as different levels of toxicity. It is important, therefore, that drugs are clinically tested in order to find the maximum efficacy toward a particular sequence. Finally, target markers are determined to ensure maximum success for pharmaceutical prescriptions (Rajan, 2006). As genes determine our physical appearance, they also "determine our susceptibility to disease and how we respond to medicine" (Meadows, 2005). This is the understanding behind personalized medicine.

One aspect of pharmacogenomics that has the potential to target specific genomic sequences in the attempt to find susceptibility patterns to certain genetic inferiorities is the aforementioned DNA biochip. "DNA biochips will allow testing for hundreds of conditions at a time" (Knoppers, 1999, p. 40). This amazing technology allows for "10,000-50,000 different unique sequences [to be] attached to a surface of less than the area of a coin" (Mohrenweiser, 2003, p. 43). The chip works through a single sample of DNA that is passed through to this chip to determine any matches to a sequence on the biochip. The sequences search predominately for SNPs. It has been discovered that most genetic variations occur due to the difference of one nucleotide in a sequence. When that nucleotide is pinpointed, it becomes possible to isolate it in order to change it or provide medication targeted specifically to that SNP (Hood, 2003). As this technology improves, we will see more genomic sequences applied. Today, most focus is placed on markers to detect cancerous tumors, breast cancer, and the onset of Alzheimer's disease (Rothstein & Hornung, 2003).

Big PhARMA must consider the potential value of individualized medicine. The group of pharmaceutical companies that make up "Big PhARMA" consist of major corporations that "transform [information] into an array of products, services, and practical techniques" (Thacker, 2006, p. 186). The importance of these companies cannot be understated. They have the ability to delay the production of genomic medications if it is determined that the drugs are of little capital value. At the present time, Big PhARMA is producing mass quantities of drugs based on symptoms. The same drug is prescribed to a wide variety of people with no knowledge of the responsiveness based on individual genomics. This is profitable for Big PhARMA. As a society attempting to find a third space of humanity, we must ask, "What is value?" Perhaps our answer will change with the advancements of pharmacogenomics. Heidegger states that, "Value is value inasmuch as it counts. It counts inasmuch as it is posited as that which matters" (1977, p. 72). As a society, it is important to put forth that which is valuable to humanity.

A popular example of the promise of pharmacogenomics may be found in the company PXE International founded by the Terry family. Pat Terry and his wife, Sharon, learned that their children suffered from a rare disease (PXE) that causes cells to age rapidly. Due to the rarity of this disease, many members of Big PhARMA had not attempted to create medication for those suffering from PXE. With the help of the University of Hawaii, the Terrys were able to locate the specific gene that causes PXE in their children. At this stage, they obtained a patent on the cell line and created PXE International (Waldby & Mitchell, 2006). Through PXE International, they allow access to the cell line to researchers interested in finding a cure for the disease. This has brought attention to their cause and has given them a sense of hopefulness in a future for their children. Without the Terrys' willingness to pursue a cure for their children's illness, it is likely that scientists would have discarded it due to the rarity of the disease. This perhaps is one of the most difficult deficiencies of individualized medicines, those that suffer from rare diseases will be overlooked as pharmaceutical companies pursue drug interventions that will help a large percentage of the population. This is part of deciding which human is worth saving.

More recently, Pat Terry has co-founded a biotechnology company, Genomic Health, in the pursuit of pharmacogenomic aid for his children. Co-founder of Genomic Health, Randy Scott has said

> Genomic Health's mission is to one day provide physicians and patients with an individualized molecular analysis that enables the treatment team to utilize relevant treatment guides for all diseases. Our ultimate goal is to make personalized medicine a reality and to dramatically improve patient care (Rajan, 2006, 194).

The Terry's pursuit of a biotechnological cure for their children gives credence to Nietzsche's insistence on a human "will to power." Rather than putting their fate in the hands of experts, they took a personal role in the medicinal community that had the power to care for their children. The mission of Genomic Health is personal for the Terrys. The possibilities for increased quality of life should be personal to all of us. We must take heed not to fear the possibilities of man to the extent that we lose the potential of man (Nietzsche, 1989).

In order to advance the intrinsic value of personalized medicine, a marketing campaign must be carried out in order to build trust amongst the public. Mark Rothstein and Carlton Hornung (2003) did an interesting study in order to assess the willingness of the public to support pharmacogenomic research and development. Their findings allow us to gauge the weariness and interest of society. There is a wide disparity in levels of trust towards medical professionals and federal government operations amongst racial populations. For example, Rothstein and Hornung found that the White population had a great deal of trust in medical institutions and health organizations, but African Americans did not place much faith in those groups. The Hispanic population greatly trusts health organizations, but not medical institutions. The Asian population surveyed hit the mean on both groups with some trust in both groups. Interestingly, all populations were severely mistrustful of drug companies. The survey also found that those with a higher education were more likely to take part in genomic research. Remarkably, those with the most faith in health organizations were those with only some college education. Those least likely to trust health organizations based on the education criteria were participants with less than a high school education and those with post graduate education. Finally, all of those surveyed said they would be much less likely to undergo genetic testing if the information were to be made available to insurance companies, life insurance companies, and employers (Rothstein & Hornung, 2003). In order to fully realize the benefits of pharmacogenomics, it is vital that those in Power realize these and other concerns of the public in relation to biotechnical fields of health and that those concerns are ethically addressed. Technoscience is about more than biomedicines, however. I will focus most of my discussion on how technology interecepts the biological realm.

Virtual Realities and Cyborgs

Many in society are uncertain about the benefits of VR as it challenges our traditional perception of the here-body. “One does not take one’s body into VR, one leaves it at the door while the mind goes wandering, unhindered by a physical body, inhabiting an ethereal virtual body in pristine virtual space, itself a ‘pure’ Platonic space, free of farts, dirt and untidy bodily fluids…” (Penny as quoted in Hansen, 2004, p. 165). When one enters into this space it can initially feel surreal, eerie. I recently entered the virtual realm of SecondLife[1]. I created an avatar and walked through a business district, party area, and even a space set aside for educational purposes! I immediately felt a personal connection with my avatar and found that I was very protective of her/me. The experience was strange. The avatar was me but not me. I felt like I was being stalked, watched even though I was physically in my house at 3 AM on my computer. Much of what makes these sites seem so strange is that they have developed so

[1] SecondLife is a virtual world where members can meet, shop, work, and learn. It has attracted business members like IBM and popular celebrities like Jay-Z. SecondLife is also being used by universities like MIT for distance learning and virtual classes. This website is free to join, but members are asked to pay in real money for clothes, homes, cars, and other luxuries. As virtual worlds grow in number, SecondLife will likely be the standard to which all others are compared.

rapidly. In fact, technological progress is outdating sites before they can get off the ground. Sadie Plant says of cyberspace: "Like all varieties of cultural change, technological development was supposed to proceed step after step and one at a time….But cyberspace changed all this" (1997, p. 13). Sites like secondlife.com are bound to become more a part of our daily space. A new culture has emerged. In the realm of VR, "we are witnessing the emergence of a new cultural metalanguage, something that will be at least as significant as the printed word and cinema before it" (Manovich, 2001, p. 93).

The desire for a virtual realm is not a recent phenomenon. In fact, one might argue that man has been manipulating technology for centuries in order to create new spaces. The common denominator, however, in each attempt has been the presence of a screen. From Renaissance paintings on canvas screens to digital interfaces on a computer screen, technological progress has revolved around screens encased in a frame made of various materials. "In each of these, reality is cut by the rectangle of a screen…." (Manovich, 2001, p. 104). The overriding difference, however, between the classic space of the screen in paintings, photography, and cinema and the new space of virtual reality centers on the act of perceiving. "…whereas photography and cinema present…images for subsequent perception by the spectator's simulational consciousness, in VR the image is literally created in the process of 'perception' (simulation)" (Hansen, 2004, p.170). So, we learn that previous forms of images were created and then perceived at a later date while new technologies allow us to perceive images as they are developing. Hansen refers to this as a "mutation" of images from classical images to digital images in a VR space (2004). Where will the screen lead us in the future? Manovich suggests that instead of simply entering virtual reality predominantly through a visual experience with a computer screen, the future may witness the merging of the retina and the screen. "Eventually, the VR apparatus may be reduced to a chip implanted in the retina and connected by wireless transmission to the Net" (Manovich, 2001, p. 114).

As we move within a technoscientific space, we must accept our bodily dependence on new technologies. Donna Haraway invokes the term cyborg to describe the relationship between technology and humanity.

> The offspring of these technoscientific wombs are cyborgs—imploded germinal entities, densely packed condensations of worlds, shocked into being from the force of the implosion of the natural and the artificial, nature and culture, subject and object, machine and organic body, money and lives, narrative and reality (Haraway, 1997a, p. 14).

Katherine Hayles also offers a review of the cyborg:

> Fusing cybernetic device and biological organism, the cyborg violates the human/machine distinction: replacing cognition with neural feedback, it challenges the human-animal difference, explaining the behavior of thermostats and people through theories of feedback, hierarchical structure, and control, it erases the animate/inanimate distinction (1999, p. 84).

Because our lives have become so infused with technological machines that help us to communicate easily, consume rapidly, and live longer, we must accept that Haraway and Hayles are correct in their characterization of today's global citizen as a half machine, half human cyborg.

There are many in society that may believe that these definitions are alarming. The fast pace of technoscientific advancements may cause some to feel that progress should be stunted until ethical reviews might be done. Questions may arise: If we are becoming cyborgs, if the animate/inanimate distinction is becoming ambiguous, are we actually experiencing progress or are we experiencing the extinction of humanity as we have known it? It is necessary to recognize the cyborg in another light before drawing a conclusion. Rutsky informs us that the definition of a cyborg may not be that of a dehumanized machine, but of a person with a strong identity having a relationship with a machine in order to create a more functional life.

Rutsky's definition allows for a less permanent relationship between humanity and technology. Scientists invoke the term fyborg to characterize the part of the population that only relies on technology from time to time. A fyborg is a functional cyborg. We often "plug into" technology, but may "unplug" and continue life. A true cyborg cannot live without technological help. Perhaps, we are beginning to realize that we are all cyborgs/fyborgs at some level. Why, then, are we still reluctant to acknowledge our dependence on technology? Maybe we do not want to lose control, in a Frankensteinian manner, of the tools that we have created.

"It has long been assumed in the Western world that technologies are basically tools, means to ends decided in advance by those who make them and put them to use" (Plant, 1997, p. 77). This assumption is now being tested. With the creation of true cyborgs, we must consider that our technologies are no longer controllable. What becomes of the machine once it becomes part of the human is unknown and, therefore, causes much anxiety. "Nothing can guarantee a system's immunity to these runaway effects" (Plant, 1997, p.162). The idea that cyborgs may take unplanned turns is further iterated by Don Ihde. "Part of their nature…is the degree to which the unintended and unplanned results occur without intentions entirely. If we 'dance' with the nonhumans, the steps that occur are often different from and often out of tune with the music played" (Ihde, 2002, p. 100).

The Role of Curriculum

Curriculum theorists have already begun a conversation about the role of education in society. I seek to further that discussion by examining how the arts and technologies work in conjunction to allow education to "...be about human beings making sense of their lives" (Doll, 2000, p. 59). As educators, it is our responsibility to provide a space within the classroom that encourages conversations of classical writings, contemporary works, and technological progress spurred by autobiographical investigations into lived experiences of the students that surround us (Pinar, 1994; Smith, 1999; Springgay and Freedman, 2007). I find it almost impossible in today's climate to allow students to have these discussions. Standardization places certain outcomes on learning and outlines what is appropriate to discuss within the school. Curriculum theorists believe that the outcome of learning will never be the same for two people. "The obvious yet evidently generally unknown fact is that one cannot predict human response, except in trivial matters and in artificially circumscribed circumstances" (Pinar, 1994, p. 124).

The importance of the work of curriculum scholars cannot be overlooked. History has never seen a moment of such intense technological progress. In Chapter Two, I plan to examine the emergence of the posthuman in society. I will rely on the work of Donna Haraway and Katherine Hayles to define the posthuman. In a posthuman society, the issue of biopolitics and biopower arises. Curriculum scholars have the opportunity to address these critical issues in order to expand democracy rather than limit it to those with power. Giroux has already begun to address this issue. "Its [biopolitics] policies avidly attack critical education at all levels of cultural production in an all out effort to undermine critical thought, imagination, and substantive agency (Giroux, 2006, p. 71).

Chapter Three exposes how the liberal arts need to face an unsettling in order to become relevant in a technoscientific culture. Historically, the liberal arts have been rooted in the past and have focused on classical works of art to examine the nature of being. I offer a review of the history of the liberal arts in order to examine how they might be reconfigured in today's classroom. Heidegger discusses the necessity for a rootedness in tradition in his writings and lectures of the 1920s and 1930s[2] (Bambach, 2003). Heidegger's rootedness, however, is not an obvious relation to the past. In 1924, Heidegger "announced to his students that 'we need to win back rootedness and autochthony as it was alive in Greek science'" (Bambach, 2003, p. 17). Autochthony "signifies something concealed, mysterious, and chthonic whose meaning lies hidden beneath the surface…, or rather whose meaning needs to be worked out in a confrontation with this concealment in order to grant one an authentic identity" (Bambach, 2003, 19). I agree with Heidegger's assessment that a rootedness in tradition, in the classics, is necessary to develop identity, but I would argue that Heidegger should be unsettled in his rootedness. Nontraditional modes of art might further an exploration of authentic identity by allowing

[2] Heidegger's views on the necessity of autochthony served to further his relationship with the National Socialist Party. Although I use his arguments of autochthony and rootedness to situate the study of liberal arts, I do not believe that a classic curriculum and a study of the past should be used to further a political agenda as was seemingly done by Heidegger and the National Socialist Party during the 1930s.

students to play and explore more recent works. Just as the classics lend insight into our past, so too might new forms of liberal arts lend insight into whom we might become.

I will follow my examination of the history of liberal arts with a discussion of how instability is created in the human existence as a result of technological progress. Within instability comes the opportunity for knowledge. Noted Austrian poet Ranier Maria Rilke sought to understand the transience of life's experiences. His *Duino Elegies* (1923/2001) is a compilation of ten elegies, or lamentations, written over the course of several years as inspiration captured his imagination. I will use Rilke's "The Eighth Elegy" to explore the need for a liberal arts curriculum to force a new understanding of Being. In this elegy, Rilke focuses on a space called the "Open" that seems to be beyond the reach of humans as we are blinded by worldly issues. The Open allows us to capture life at its fullest. I will argue that the liberal arts teach us how to embrace the freedom of the Open.

As Chapter Three traces the progression of the liberal arts, Chapter Four explores the history of science from ancient Greece to the modern era. It is vitally important to understand how the study of science developed in order to fully appreciate the speed of advancements that technology has lent to the field of science. I argue that the progress of the twentieth century is exponentially faster than previous centuries due to the use of a variety of new technologies. I believe that the future of technoscience will continue to progress at a faster and faster pace thus underscoring the need for the critical thinking skills that may be developed through a liberal arts education. A second important aspect exposed by tracing the history of science to modern day is the number of paradigm shifts in science that have occurred over the centuries. We should be aware that science itself is constantly shifting so that we do not take current scientific theories as absolute truths but as part of the greater narrative encompassing the timeless mysteries of humanity and the universe. It is also fascinating to note how Western society has at times embraced scientific advancement and at other times shunned it. At all times, however, there has been an amount of fear and awe circling any new discovery. Linking the past to the present will allow a fuller understanding of how we might encourage the positive elements of technoscientific advancements while allowing a moderate amount of fear of the unknown to force us to question the negative applications of new innovations.

"The human mind works with images, and even its most subtle ideas have to be composed from images" (Bronowski, 1993c, p. 28). Because we see in images and use those images to make sense of the world around us, I will explore metaphor in works of science fiction in Chapter Five. I will begin by analyzing the science fiction literature of young adult author Nancy Farmer. Through *The Eye, The Ear, and the Arm* (1994), Farmer draws the young reader into a futuristic world where three young children have been kidnapped. Detectives born with sensory genetic mutations that allow them to feel, see, and hear more than the average person are hired to find the children. Her most recent and perhaps most acclaimed work is *The House of the Scorpion* (2002). This work of science fiction focuses on the moral and ethical implications of cloning. Nancy Farmer attempts to write science fiction for young adults that does not have a dystopic tone that she accuses adult science fiction of embracing. I will then focus on adult science fiction literature including Philip K. Dick's *Do Androids Dream of Electronic Sheep?* (1966), Neal Stephenson's *Snow Crash* (1992), and Michael Chricton's *Next* (2006). I have chosen these three works because I feel like the issues surrounding science fiction changes almost as quickly as technoscience itself. By examining authors of different decades, we get a better sense of the concerns with technoscientific progress through the years. I also hope to show that variety of topics covered by science fiction. I believe that many times science fiction writers are lumped together by those that do not fully understand the genre. Rather than fitting a certain mold, a scifi author typically carve out new paths and ways of imagining the world that is particular only to him. This is one of the most interesting aspects of science fiction works. One thing, however, that all three of these works share is the "dual fascination with and suspicion of the power of things" (Roberts, 2000, p. 151).

I will not stop my investigation of science fiction with literature. In today's society, it is important to acknowledge the role of film in popular culture. For this reason, I will also explore the way that metaphors are used in the original *Star Wars* trilogy, the millennial movie *Gattaca*, and the recent 3-D phenomenon *Avatar*. Looking at the issues of the posthuman in these films allows a more comprehensive understanding of how the science fiction genre may be used to study technoscientific progresss.

In my concluding chapter, I will take a closer look at how public universities are becoming more like trade schools rather than places for introspection and critical thinking. By discouraging liberal arts programs, universities are denying students the opportunity to have ethical discussions about technoscientific progress that can only be pondered with a sound liberal arts education. Throughout this dissertation, I will keep as my focus the necessity of creating instability in education as a means to promote a third space for dialogue in education. Wexler offers this:

> The work of reintellectualization—education for the mind, of disciplined thought with wider cultural resources—points to the other side of narcissism, to why a self-centered education opens a third way, an alternative ‘way out,’…as the bases for educational thought and practice (1996, p. 77).

I am seeking this way out of the current educational system.

CHAPTER 2

THE CHALLENGING OF THE POSTHUMAN

"It remains true, nonetheless, that man in the technological age is, in a particularly striking way, challenged forth into revealing" (Heidegger, 1977, p. 21).

Technological progress has always been at the forefront of human development. In creating fire, in cave drawings, in cinematic production, and in life-saving medicines, humanity's reliance on technology is evident. By the early-twentieth century, Martin Heidegger was questioning the undeniable influence of technological progress on mankind by exposing the possible dangers and saving powers of technology. By the mid-twentieth century, Philip K. Dick was theorizing future societies that revolved around fusion of technology and humanity. Today, we teeter on the precipice of a new era—one that will include the posthuman. Due to the fast rate of technoscientific innovation, more questions are being asked by the public about the dangers of moving too rapidly into a new era, the ethics involved in experimentation, and the possible implications for future generations. These questions have entered into pop culture in the guise of popular films such as *Gattaca,* and most recently, *Avatar.* Today's science fiction writers are also focusing on answering the question of where technology ends and humanity begins in a newly envisioned, cyberpunk future reality. Through differing lenses the directors and authors of new science fiction dance around the notion of the posthuman, sometimes exalting its emergence, sometimes damning it.

The confusion over the role of the posthuman is amplified by the varying definitions of what exactly constitutes a posthuman. Sadie Plant describes the evolving body as "complicating, replicating, escaping its formal organization...." (1997, p. 177). She does not go much further in describing the posthuman except to say that the posthuman is evident in "the indelible markings of brands and scars, the emergence of neural and viral networks,…neural jacks, vast numbers of wandering matrices" (Plant, 1997, p. 177). Don Ihde and Donna Haraway prefer to discuss the "human/nonhuman hybrid under the sign of the cyborg" (Ihde, 2002, p. 89). The posthuman era is also referred to as the moment in history when the machine has taken over the body in Pepperell's *The Posthuman Condition* (2003). Finally, there is the concise view of Katherine Hayles: "In the posthuman, there are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanism and biological organism, robot teleology and human goals" (1999, p.3). Each theorist holds great insight into our question of the posthuman. I intend to look closely at all proposed posthuman examples to determine the possibility of the posthuman as the embodiment of technoscientific progress.

I believe that the best way to investigate the posthuman is through Heidegger's *Question Concerning Technology,* (1977). Heidegger offers us a way to reveal the untarnished truth of the posthuman through an exploration of the essence of technology. I propose that although the posthuman has come to mean different things to different theorists, the essence of the posthuman is the same throughout. Once we have determined the essence of the posthuman, we, as curriculum scholars, will be in a better position to analyze the implications of this technoscientific hybrid for society and education. The dangers of biopolitics and biopower will not be ignored as any discussion of technoscientific advancements ultimately will face scrutiny from critics afraid of unleashing technology's force. I submit, however, that by uncovering the essence of the posthuman, we will escape its danger, find its truth, and embrace its difference.

The Essence of Technology

Before we can analyze the implications of the posthuman, we must first understand the impact of technology on our lives. Heidegger maintains that the essence of technology is wholly separate from technology. Generally speaking, two definitions of technology hold sway in the mind of the public. "One says: Technology is a means to an end. The other says: Technology is a human activity" (1977, p. 4). Although correct, these are not the definitions that interest Heidegger. Heidegger's focus is not the taken-for-granted definition. Instead, he challenges us to look deeper than the surface of the issue to "consider for a moment…the possibility that technology is precisely something that is *not* of our own design and is not ours to control" (O'Brien, 2004, p. 7). The essence of technology forces us to delve into the causality of technology rather than its instrumentality. Heidegger's patience with his reader is illustrated as he explores the essence of a chalice as an example of how the essence of technology may be reached. The chalice would not be the tool of the church if it were not for the silver from whence it is carved. Without the church endowing the chalice with sacrificial meaning, it could not be used as the tool for church members to accept Christ's sacrificial offering. The parishioner that accepts the religious and sacred meaning of the chalice is also responsible for exhuming the essence of the chalice. Heidegger seeks to simplify the way to causality, the way to truth, which is the essence of technology, through this example.

Although an "instrumental definition serves to conceal more than it reveals," (O'Brien, 2004, p. 6) the instrumental definition is necessary in our discussions if for no other reason than it distinguishes older technologies from modern technologies. These definitions do not help to reveal the essence of technology, however, because in investigating them we are lured into a false sense of believing that technology is ours to control. If we can define it, we can control it. The problem with this mentality is that if we continue to believe this, then we will never have a free relationship with technology. "Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it" (Heidegger, 1977, p. 4). To fully embrace the modern technologies that allow the posthuman to exist, we need to understand the role that Man plays in the coming-to-presence of technology.

Heidegger states that the technologies that we adopt are always already present and are waiting to be revealed. Man is called to reveal this technology though we do not always recognize our calling. The calling occurs at the moment of inquiry and investigation. This is when we are challenged to bring-forth technology. We are able to bring-forth the unconcealment of the essence of technology through technē. "*Technē* belongs to bringing-forth, to *poiēsis;* it is something poietic" (Heidegger, 1977, p. 13). Technē is the handiwork of the artisan as well as the intellectual craft of the individual. It is concerned with creation hence it is present in the bringing-forth. We are at the point where the revealing of modern technologies takes place. Heidegger makes sure to point out that technē in this sense also means "to be entirely at home in something, to understand and be expert in it. Such knowing provides an opening up" (1977, p. 13). At the moment of opening up, the essence of technology is revealed. At the moment of revealing, the alētheia, the truth is unconcealed and the essence of technology is revealed. "It is to the happening of revealing, i.e., of truth, that freedom stands in the closest and most intimate kinship" (O'Brien, 2004, p. 27). This is the most important moment for the posthuman, society, and education. In the revealing, the essence of technology shows itself to an impatient world.

In order to embrace a free relationship with technology, we must find the essence of our Being in order that we are not imprisoned by technology. Heidegger addresses this by warning that Man must become more than simply a standing reserve whose only purpose is to wait idly by for the challenging of bringing-forth technology's essence. "Everywhere everything is ordered to stand by, to be immediately at hand, indeed to stand there just so that it may be on call for a further ordering" (Heidegger, 1977, p. 17). Modern technology seeks to order everything to achieve ease and flexibility. The danger is that we become part of the ordering. Humans become used as a resource serving technology. I believe that we must get past thinking of ourselves and our environment in an ordered way. As long as we continue to follow this ordered pattern, we stand as reserves to technology. As standing-reserves we risk allowing technological progress to overtake our sensibilities. Issues of biopower and biopolitics arise. Heidegger states, "For man becomes truly free only insofar as he belongs to the realm of destining, and so becomes one who listens and hears, and not one who is simply constrained to obey" (1977, p. 25). I submit that a free relationship occurs where there is disorder and room for chaos. The exploration of a liberal arts curriculum becomes vital to freedom with technology. Only with a liberal arts education will Man become "one who listens and hears" (Heidegger, 1977, p. 25) and so refrains from an existence as a standing-reserve. In the next chapter, I will explore how the Liberal Arts are exposed in this chaos at the moment of revealing. At this point, however, I will turn my attention to how this discussion of technology lends itself to the emergence of the posthuman and the dangers that are present with its unconcealment.

The Posthuman

The essence of the posthuman is not as readily examined as is the instrumental definition of the posthuman that generally consists of a man-human hybridization of sorts. I believe that the essence of the posthuman is intricately interwoven with the Self. Unless we delve into a discussion of how the posthuman influences and shapes the Self, we will not fully realize the implications of the posthuman on society. My analysis of the posthuman incorporates the views of feminists, scientists, curriculum scholars, philosophers, and social theorists. Each discipline has a legitimate interest in the posthuman and each has a contribution to make as we continue in this rapidly accelerating era of technoscience. As Heidegger suggests, the instrumental definition of the posthuman (there are several) does not embrace the essence of the posthuman itself. I explore the idea that as the posthuman develops there is a danger of losing Self. The posthuman that emerges from humanity's connection to information through virtual reality, the posthuman that is created from mechanical and organic prosthesis, and the posthuman that is invented in a laboratory that specializes in genetic manipulations, all focus on informational patterns of zeroes and ones. As we embrace the technosciences that will enhance life, we must be cautious not to exclude the uniqueness of our humanity. Katherine Hayles explains it this way:

> …becoming a posthuman means much more than having prosthetic devices grafted onto one's body. It means envisioning humans as information-processing machines with fundamental similarities to other kinds of information-processing machines, especially intelligent computers. Because of how information has been defined, many people holding this view tend to put materiality on one side of a

> divide and information on the other side, making it possible to think of information as a kind of immaterial fluid that circulates effortlessly around the globe while still retaining the solidity of a reified concept. Yet this is not the only view….Other voices insist that the body cannot be left behind (1999, p. 246).

The purity of the body is not vital to this argument. Posthuman grafts may have reshaped the vessal. My argument is that the body as the container for the Self must remain even as informatics attempts to loosen the constraints of its medium. As I trace the evolution of the posthuman in its different forms, I will be mindful of the importance of Self.

In order to examine the posthuman, it is important to trace the emergence of this phenomenon. Hayles (1999) describes three waves of technoscientific advancements that culminate with the arrival of the posthuman in current forms. "The first, from 1945 to 1960, took homeostasis as a central concept; the second, going roughly from 1960 to 1980, revolved around reflexivity; and the third, stretching from 1980 to the present, highlights virtuality" (Hayles, 1999, p. 7). Homeostasis typically has been used to explain the physiological makeup of humans as able to maintain a stable state in changing environmental conditions. During the period from 1945 to 1960 great strides were made in cybernetic informatics that allowed machines to become homeostatic. Feedback loops were used for immediate communication with the system in the form of a signal from the output. This signal was used to communicate back to the system so that the system is able to read the environment and incorporate the output signals from the environment with the current signals to maintain a stable communication. At this moment in history, "cybernetics signaled three powerful actors—information, control, and communication—were now operating jointly to bring about unprecedented synthesis of the organic and the mechanical" (Hayles, 1999, p.8). Reflexivity is the logical next step in the evolution of cybernetics. If information is being communicated back into a system, it begs consideration that the information that may be sent to the system is in fact about the observer. In this period of development the observer becomes the observed. In other words, "reflexivity is the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates" (Hayles, 1999, p. 8). Finally, the third wave of cybernetics that pushes us towards the posthuman occurs when the machine begins to change codes, to evolve spontaneously, in unexpected ways. Each step in the evolution of the machine has been critical to the development of the posthuman. Hayles ends this discussion by exploring our reliance on modern machines and defining the condition of virtuality. The condition of virtuality occurs when we perceive information as permeating all parts of our world, and we become reliant on that information. "From ATMs to the Internet,…to the sophisticated visualization programs used to guide microsurgeries, information is increasingly perceived as interpenetrating material forms" (Hayles, 1999, p. 19). In this age of virtuality, we are more than biological organisms. Our codes are intertwined with zeros and ones of cyberspace. I am interested in the impact of this dependence and the forms of power that emerge as a result of our dependence on technology.

The Value of the Thing is…

Technoscientific progress has ensured that the human body can be sustained for a longer period of time through organic manipulations and mechanical and cybernetic innovations. Technoscience has also allowed us to conceive of the possibility that our genetic makeup might be decoded into a pattern that can be entered into a computer, manipulated, and reconfigured in new, better genetic codes. All of the progress that has been made begs the questions…What is the value of this information and who will be able to access it? Has life become a commodity? It is important to understand that posthuman technologies are not available to everyone. "With information, the constraining factor separating the haves from the have-nots is not so much possession as access" (Hayles, 1999, p. 39). A biocapitalistic economy, does not follow all of the rules of the free market.

Within a capitalist economy, access to this information should be available through competitive pricing and the fulfillment of self-interest by the consumer. In explaining how capitalism works, Adam Smith (1776/2003) posits that two factors are always present in society. The first is self-interest. Self-interest motivates the individual to purchase commodities that satisfy her needs and desires. The second factor is competition. In a competitive marketplace, entrepreneurs seek to make a profit from a commodity. In order for the economy to function properly, there has to be a voluntary exchange between the consumer and the entrepreneur. By pursuing self-interest, the individual is also promoting the good of society. The introduction of the posthuman has wrinkled Smith's capitalistic theory. Exchanges in the market of body parts are not always voluntary: "Even though the mother may never have authorized (or known about) the sale of the placenta, she is presumed to have given her consent" (Rabinow, 1999, p. 87). The competition that is required between entrepreneurs to keep prices low does not occur as technoscientific corporations seek to patent information in the name of intellectual property rights: "…current intellectual property laws tend to hinder access to the basic layer of information and tissues, and fear of lawsuits deters people from making innovative use of these ‘raw materials’” (Waldby & Mitchell, 2006, p. 147). Finally, access to this technoscientific information and biomedical research is not open to everyone. Rajan points to the competition between publicly and privately funded industries in the field of biotechnology. “…who generates information first has always had huge implications for whether that information goes automatically into the public domain or becomes the property of particular companies” (2006, p. 49). Furthermore, “It is a useful corrective to remember that 70 percent of the world’s population has never made a telephone call” (Hayles, 1999, p. 20). For this group of people, the saving power of technoscience is far out of reach. They will, however, play a role in the advancement of the posthuman.

“We live in a world of rapid changes, many of which force us to ask afresh what we mean by words that are an integral part of our lexicon, words like ‘life,’ ‘capital,’ ‘fact,’ ‘exchange,’ and ‘value’” (Rajan, 2006, p. 3). In examining the era of the posthuman and the commodification of the body, I want to look closely at how these words and others have shaped the way that we view the posthuman. I will focus my attention on what the terms “biopower,” “biovalue,” “biopolitics,” and “bioeconomics” have come to mean. Each term, although centered in the realm of biology, relies on technoscientific achievements. The new lexicon will allow us to explore our relationship with technology in a third space between traditional definitions and those that conjure images of the posthuman. Foucault has referred to the space of biopower and biopolitics as “the space in which a series of uncertain elements unfold is…roughly what one can call the milieu” (2004, p. 20). The uncertainty of the milieu will cause many in society and in education to proclaim the dangers of technology and the posthuman. In the near future, however, educators will be forced to consider the posthuman in the classroom.

For some teachers, the posthuman has already arrived at school. Smith states, "As a teacher, the question of 'what is to be done' with respect to Others…depends on who I think the Other is, and who I think I am in relation to them" (1999, p. 11). The language that we use to discuss the posthuman Other does offer understandings into how society currently perceives the posthuman and also into what society currently deems as valuable.

Biopower

Simply put, biopower refers to the power over life. In *The History of Sexuality, Volume One*, Michel Foucault describes the power over life that traditional systems of government have held over their subjects.

> Starting in the seventeenth century, this power over life evolved in two basic forms….One of these poles…centered on the body as a machine….The second, formed somewhat later, focused on the species body, the body imbued with the mechanics of life and serving as the basis of the biological processes….Hence there was an explosion of numerous and diverse techniques for achieving the subjugation of bodies and the control of populations, marking the beginning of the era of "biopower" (Foucault, 1978, p. 139-140).

According to Foucault, prior to the seventeenth century, the focus of life was death because the span of life was so short. The sovereign, whether earthly or heavenly, determined the time of that death. Due to advances in technoscience that allowed for the extension of life, there was a paradigm shift in the following centuries that changed this focus of death not only to life, but to the extension of life.

Robert Boyle's experiments in England during this period were responsible in part for this change. Shapin and Shaeffer explain:

> The power of new scientific instruments, the microscope and telescope as well as the air-pump, resided in their capacity to enhance perception and to constitute new perceptual objects….Hooke detailed the means by which scientific instruments *enlarged* the senses:…his design was rather improve and increase the distinguishing faculties of the senses, not only in order to reduce these things, which are already sensible to our organs unassisted, to number weight, and measure, but also in order to enlarge the limits of their power, so as to be able to do the same things in regions of matter hitherto inaccessible, impenetrable, and imperceptible by the senses unassisted….Scientific instruments therefore imposed both a correction and a discipline upon the senses
> (as quoted in Ihde, 2002, p. 91).

Many scholars that pursue the posthuman (Hayles, Haraway, Ihde, Latour) point to Boyle's laboratory experiments as the catalyst for discussions about the contributions of the non-human—arguably the ancestor of the posthuman. By the early twentieth century, the theory of evolution advanced by Charles Darwin had emerged bringing new speculations and inquiries into what it means to be human.

The theory of evolution is a critical turning point in the history of mankind. Although initially dependent on Platonic ideals of typing and classifying objects, Darwin's theory has led modern biologists to believe that the evolution of the species is based on the innate differences in organisms at the molecular level (Lewontin, 2000). Shrödinger (1992) takes the conversation further in evaluating the progress of evolution. Have we reached our evolutionary potential? In *Mind and Matter,* Shrödinger's primary concern is that we may have no control over the deterioration of our bodies. Is there a way to prevent this deterioration? If we have reached the end of our evolutionary progress, it would appear that the future of our species is doomed to decline. Shrödinger finds a way out of this malaise. He argues that although it may appear that we have reached our biological apex, there may still be room for evolutionary progress. Progress may be achieved through intended behaviors towards new environments, including new technologies that prolong and protect life. It comes to pass, however, that those that hold the knowledge of these technologies and sciences, could also have the power to determine access.

It is necessary to recognize the implication of biopower in the emergence of the posthuman. For example, the manipulation of the human genome will lead to increased life expectancy, freedom from disease, and individualized medicine. "In that sense the 'human genome' in current biotechnical narratives regularly functions as a figure in a salvation drama that promises the fulfillment and restoration of human nature" (Haraway, 1997a, p. 44). The hope of many scientists is that in the very near future, scientists will have the capability to diagnose and treat medical conditions at the very basest level through the manipulation of genomes (Rose, 2007). Much of the research, however, on genomes and stem cell lines is done without the consent of the people. There are numerous examples of databases around the world that store the DNA of citizens. "…human nature is embodied, literally, in an odd thing called a genetic database" (Haraway, 1996, p. 365). The largest banks are found in Sweden, the United Kingdom, Estonia, Japan, and Iceland (Cohen, 2005; Pálsson and Rabinow, 2005). In the northern part of Sweden, heart and cardiovascular disease runs in families. The government took blood samples from a majority of the families in this area and stored them in a database for research. The government later signed a contract with the biotechnological firm, UmanGenomics, in order to advance research. A scandal erupted, however, due to the fact that the agreement gave "the exclusive right to exploit for commercial purposes genetic information obtained from blood samples….in the absence of debate from the public" (Cohen, 2005, p. 96). This is the power that the government has assumed over the lives of its citizens. In entering an arrangement with UmanGenomics, the Swedish government proposed a helpful solution to the population suffering from heart and cardiovascular disease, but was this a solution that the citizens were willing to accept? We are set back on a path of asking who has authority over genetic material? Is it ethical for a government to assume this biopower if it is for the good of the society? One could argue that the citizens of northern Sweden have become the standing-reserves for the technoscientists at UmanGenomics?

Biovalue

The biovalue of a standing-reserve is very high. Heidegger's warnings have become our reality. The profit motive of capitalism is an intense driving force behind technoscientific advancements. Unfortunately, without biological material, many of these advancements must cease. As mentioned, many governments are banking the genetic materials of their citizens with the interest of protecting the good of the society. In any discussion of the ethics surrounding technoscientific advancements, we must acknowledge the biopiracy that is taking place in many areas of the world. "We have found almost everywhere a new form of globalized 'apartheid medicine' that privileges one class of patients, organ recipients, over another class of invisible and unrecognized 'nonpatients,' about whom almost nothing is known…" (Scheper-Hughes, 2005, p. 149).

Apartheid medicine is an interesting pairing of words and in itself represents an ethical dilemma. The word apartheid originates from the Dutch *apart* meaning "separate" and *heid* meaning "hood" (Soanes & Stevenson, 2006, p. 59). Medicine derives from the Latin *medicina* from *medicus* meaning "physician" (Soanes and Stevenson, 2006, p. 887). If we consider the objective of those practicing medicine as stated in the Hippocratic Oath, we find that there is no provision for a separate-hood in medical practice. In fact, the classical version of the oath states only "I will apply dietetic measures for the benefit of the sick according to my ability and judgment; I will keep them from harm and injustice" (Edelstein as quoted in Tyson, 2001, ¶ 10). Although newer versions of the antiquated oath are still used, the basic tenant of protecting life remains. Who then is responsible for the apartheid medicine now being practiced globally? Is it the patients, doctors, or living donors? Perhaps more than one group is at fault.

Scheper-Hughes is a leading medical anthropologist seeking to understand the motivation of the nonpatient, organ-donor in the transnational organ market. The term "nonpatient" is often used in medical circles to refer to "the scientifically sick person who does not seek medical help" or "the well person who does not seek medical help" (Szasz, 2001, p. 32). Scheper-Hughes' nonpatient, however, is the person that does not have a medical record and travels easily as a carrier of healthy organs to an undisclosed location to offer life to a stranger for a fee. This nonpatient is valuable to the global market for "medical consumption" (Scheper-Hughes, 2005, p. 149). Is there outrage among those populations or satisfaction with new found wealth? These emotions and others have been experienced by the organ donors that have agreed to interviews. A nonpatient in Brazil agreed to sell his kidney to an elderly African-American woman in New York City for US$6000. Scheper-Hughes (2006) interviewed this Brazilian about his experience. She reports that he initially agreed to sell his kidney because he needed money to help support his children and their mothers. Once the transaction took place, he was returned to the slums of Brazil to continue his life. After a short time, the money was gone…taken by the mothers of his children. He had hoped that his donor recipient in New York City might send him some money. He learned, through Scheper-Hughes, that she was in difficult economic trouble and could not help him. He reported that he felt shame within his community due to selling his kidney because people taunted him. This shame is also found in other donor s' stories. Vladimir, of a small village in Moldova, became an organ donor in Istanbul (Scheper-Hughes, 2005). As a nonpatient, he gave up his kidney for US$3000. He now finds it difficult to get work in his village because of the stigma attached to organ donors. He is ashamed of his sacrifice. Although some nonpatients feel outrage and some probably do enjoy the benefits of the money they earn, the majority of nonpatients seem to feel shame and confusion after their procedures. The Brazilian and Moldovian donors are just two actors in this globalized drama.

Due to the shortage of organs for donation, there has been a rise in the black market organ trade. The ebay kidney was voluntary auctioned in the American market and brought attention to the consumer demand for organs. More unsettling, however, is the rise of "transplant tourism" (Scheper-Hughes, 2005, p. 150). In this new type of tourism, wealthy recipients seek healthy organs, usually kidneys, from healthy recipients for a large sum of money. Typically, these organs are obtained from the very poor citizens of underdeveloped nations. Sheper-Hughes (2005) interviewed a recipient of a kidney from an anonymous peasant in an eastern European hospital room. How he arrived at the decision to risk his life to obtain this transplant is worth quoting at length:

> Why should I have to wait years for a kidney from somebody who was in a traffic accident, pinned under a car from many hours, then in miserable condition in the I.C.U. for days and only then, after all that trauma, have that same organ put inside me? That organ isn't going to be any good! Or worse, I could get the organ of an old person, or an alcoholic, or someone who died of a stroke. That kidney has already done its work! No, obviously, it's much better to get a kidney from a healthy person who can also benefit from the money I can afford to pay. Believe me, where I went the people were so poor they didn't even have bread to eat. Do you have any idea of what one, let alone five thousand dollars, means to a peasant? The money I paid him was 'a gift of life' equal to what I received (2005, p. 151)

There are many ethical questions that arise in situations like this one. This Israeli grandfather had been on a transplant list and was undergoing dialysis prior to making the arrangements to travel to another country to purchase a kidney on the black market. His concerns of receiving an organ from someone elderly or that died of neurological failures are legitimate concerns. It is ironic, however, that he would not gratefully accept a kidney from someone that died of causes unrelated to kidney failure under the rationale that the kidney may have been sitting in a traumatized body for several days. I believe that this patient may also have been concerned about the likelihood that he would receive a kidney at the age of 70. His doctors told him that continued dialysis was the best option. How old is too old to receive an organ transplant? This argument arose in our own country recently when former Vice President Dick Cheney received a heart transplant at age 71. Some argued that the heart should have gone to a younger person. A high school friend of mine informed me recently that his father had a heart transplant a year ago. We had this conversation as we watched his father tee off on the 18th green in very good health. His father was 69 at the time of the surgery. Would we argue that he should have been passed by as well? Because of the tragically large numbers of people on organ waiting lists, some have argued, like this Israeli grandfather, for the legalization of the sale of body parts for economic gain. Why shouldn't people be able to offer up their bodies? Would we consider these transactions to be acts of biopiracy if the donors willingly contributed to the depleted organ supply? Perhaps in reading of this scenario, you have begun to make your own judgments about whether this was a legitimate transaction. Would it change your mind if you knew that Vladimir of Moldova, that can no longer find work and feels shame daily, is the donor to the grandfather?

A final issue of ethics brings us back to Heidegger's notion of a standing reserve. Do we constitute the organ donor in this eastern European nation as a standing reserve of body parts waiting to be poached by wealthy citizens fortunate enough to have the means to extend life? If the paid donor is part of the standing reserve, are voluntary donors whose organs are not procured until death is pronounced not also a form of standing reserve? Does it make a difference if the donor is alive and volunteers as opposed to dead having volunteered during life? And is it possible that the citizens be considered "willing" if this appears the only option available to them for economic independence? Many ethical dilemmas appear in scenarios like the one described. What are we as a global population doing to stop transplant tourism and other problems associated with organ donation? What we know is evident is that the citizen populations often do not participate in answering these questions. I believe that a global conversation should take place that would afford citizens impacted by organ shortages the opportunity to speak. Without an adequate education system that has prepared citizens for such ethical quandries, however, I fear that these conversations cannot take place. If citizens are not shaping these types of policies through democratic means, then who is shaping policy? According to Haraway (1997a), the Pentagon, the scientific research community, and businesses are the leaders in technoscientific policy shaping in the United States. Other developed nations likely follow similar patterns.

Nonpatients are also consumed as research targets in pharmacogenomics research. Andrew Lakoff (2005) exposes the role globalization plays in creating this group of nonpatients in *Pharmaceutical Reason*. Through ethnographic research in Argentina, Lakoff reports that pharmacogenomic medicines are being developed to target psychological disorders in Buenos Aires. The question of biopiracy arises when Lakoff exposes the quest of a French genomic corporation for bipolar SNPs. The source for these valuable SNPs came from patients in an institution in Buenos Aires, Argentina. A western, technologically advanced nation seeking resources from a lesser advanced nation is reminiscent of the colonialism of the nineteenth and early twentieth centuries. The marriage of Genset's vice-president to the molecular biologist gathering DNA in Buenos Aires should alert researchers to a possible breach of ethics. The close friendship of this couple to a doctor at the institution mining for DNA is arguably an attempt at biopiracy, at the very least an overt attempt by this French corporation at biocolonizing patients in Argentina for the purpose of extracting their genetic materials. Ultimately, there is a fine line that should be observed in this era of technoscience. Are we comfortable subjugating one population for the potential health and economic benefits of another population? At what point do we determine that the benefits of doing so outweigh the costs?

An increase in globalization exacerbates the differences between the haves and the have-nots of our world. Technoscience advancements in the area of virtual reality and artificial intelligence allow information mined from the have-nots to be almost immediately accessible to those with technological access. Converting bioinformation into zeroes and ones allows DNA codes and genetic manipulations to occur through computer processes. "In this timescape, species being is technically and literally brought into being by trans-national, multibillion-dollar, interdisciplinary, long-term projects…" (Haraway, 1997a, p. 58-59). Those with biopower understand biovalue. In the posthuman era, civilizations will emerge dominant that hold the most access to technoscientific information. It is imperative that a strong ethical base instilled through a critical education be instilled in the populations of the nations with this biopower. Rose (2007) warns "Once each life has a value that may be calculated, and some lives have less value than others, such a politics has the obligation to exercise this judgment in the name of the race or the nation. All of the eugenics, projects of selective reproduction, sterilization, and incarceration follow" (p. 57). Before this global practice becomes so entrenched that we cannot extrapolate ourselves from these discriminatory practices, we must recognize the biopolitical narratives being used to justify the unethical manipulations of the body politic.

Biopolitics

The terms "biopower," "biovalue," and "biopolitics" overlap and intertwine in the technoscientific era, but perhaps "biopolitics" is the farthest reaching in terms of redefining what is human. It is within the realm of biopolitics that the social definition of life is compared to the biological, where philosophers, scientists, and politicians determine the course of technoscientific advancements in regards to/in spite of what is thought to be best for society. Biopolitical regimes are determining who will have access to these advancements and who will give up life in order to maintain the rate of these advancements. Although some of the topics that I will broach in this section have already been examined, I want to look more closely at the justifications of those involved in the decision making process

As previously mentioned, Estonia, the United Kingdom, Iceland, and Sweden have developed government databases to store genetic material. In a report offered by the British House of Lords in February of 2002, the House argued that a "thorough consideration of stem cell research" had been conducted and that the recommendation had been made for "the establishment of a British stem cell bank to be 'responsible for the custody of stem cell lines, ensuring their purity and provenance'…" (Franklin, 2005, p. 68). The implications of these banks are startling. Stem cells have the potential to repair and recreate any part of the human body. Stem cell research is being used in cancer studies, studies to prevent or reverse birth defects, and in experimentation in organ and muscle creation (U.S. Department of Health and Human Services, 2001). Because governments are harnessing this power for themselves, the potential for abuse is very present particularly since the decisions to keep this power were made without public discourse.

In Iceland, the creation of a Health Sector Database has aroused concern amongst the public. deCode Genetics was given exclusive rights by the Icelandic Parliament to obtain genetic materials of everyone in the population and to access clinical records of those deceased as far back as 1915. Although similar to the Swedish database, the Icelandic database seems to have emerged as the fastest growing database and is opposed internationally as well as among the local populations for what is seen as ethical violations. The issue that most concerns bioethicists is presumed consent (Pálsson and Rabinow, 2005). Health care professionals have the right to access the medical information of every citizen of Iceland under the notion that the people agree unless they expressly state that the information should not be shared. The justification of the Icelandic Parliament focuses on the "potential genetic bases for 12 common diseases" (Pálsson and Rabinow, 2005, p. 94). The biopower and the bioeconomic potential that stands to be obtained through knowledge of these diseases is exponential. Of course, the bioethical arguments arise as many opponents warn that genetic information will be used to discriminate against those deemed to have inferior genetic material than others (Rose, 2007).

In light of biopolitical advances within developed nation's governments, it is the responsibility of citizens to acquire what Rose and Novas (2005) refer to as biological citizenship. As biological citizens, it behooves us to participate in "a range of struggles over individual identities, forms of collectivization, demands for recognition, access to knowledge, and claims to expertise" (Rose and Novas, 2005, p. 442). In order to take part in these debates, we must have an educated citizenry that understands the necessity of taking part in discussions of technological advancements. The education that is offered must shake off the restraints of standardization and embrace the liberal arts tradition of asking questions, analyzing and considering information, and debating the merits of an outcome. We must also begin to reassess science education in our public schools and universities.

Science Studies Curriculum and the Posthuman

In 1999, Katherine Hayles reported that 10 percent of the US population were cyborgs. Considering that cyborgs make up a portion of our posthuman population, we should expect that the actual numbers of posthuman living among us are much higher in 2012. Having examined the role that technoscience plays in our societies, we must as educators "prepare for a future when the school is returned to us and we can teach, not manipulate for test scores" (Pinar, 2004, p. 127). This future will contain classrooms of posthumans, discussions of technoscientific progress, and critical lessons that allow for debate and discussions. Of course, we face barriers to these enlightened classrooms. Science classrooms allow little creative thought and liberal arts classrooms are rote with regurgitated facts. A science studies curriculum is desired.

A science studies curriculum seeks to create new spaces in science classrooms. The tragedy of the current science curriculum is that it resists pathways toward experiential learning. Experiential learning not only allows students to draw on their own curiosities derived from lived experiences, but it propels them towards a discovery of Self in relation to the natural world. Unfortunately, as is the case in many disciplines, standardization snuffs out the students' sense of wonder at an early age. Upon entering school, students are exposed to a "bulimic pedagogy" (Blades, 2001, p. 71). A bulimic pedagogy does not encourage students to engage in the mysteries of science.

> Rather than being taught to challenge the authority of "facts" and to explore through experience, children begin early a careful march toward a death of their desire to know as facts are presented with authority in their science textbooks and

> teachers dictate notes to children that will be tested in a few weeks. This pathological, bulimic pedagogy is all the more a crime as it claims the sign of science, when there is really nothing scientific at all in the mass accumulation of facts that bear little or no meaning (Blades, 2001, p. 74).

All science curricula in Georgia contain the same first three standards. These standards provide an example of how science is currently presented to students. The first standard sounds promising.

> **SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.**
>
> a. Exhibit the above traits in their own scientific activities.
>
> b. Recognize that different explanations often can be given for the same evidence.
>
> c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations (Georgia Department of Education, 2008a, p. 3).

In first encountering this standard, one might believe that the student in this classroom will be challenged to form his own opinion about a scientific inquiry. He may test a hypothesis and have it succeed or fail based on how well he researched and performed his experiments! He might learn how to think, plan, analyze and draw on his own experiences! Standards 2 and 3 in this classroom read:

> **SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.**
>
> a. Follow correct procedures for use of scientific apparatus.
>
> b. Demonstrate appropriate technique in all laboratory situations.
>
> c. Follow correct protocol for identifying and reporting safety problems and violations.
>
> (Georgia Department of Education, 2008a, p. 3).
>
> **SCSh3. Students will identify and investigate problems scientifically.**
>
> a. Suggest reasonable hypotheses for identified problems.
>
> b. Develop procedures for solving scientific problems.
>
> c. Collect, organize and record appropriate data.
>
> d. Graphically compare and analyze data points and/or summary statistics.
>
> e. Develop reasonable conclusions based on data collected.
>
> f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information
>
> (Georgia Department of Education, 2008a, p. 3-4).

Standard 2 of the curriculum simply requires students to learn lab safety rules and the names of the materials that will be used in scientific experiments. This is necessary, of course, if students are going to spend any time in the lab. Standard 3 explains the step by step process students will use to reach conclusions that are predetermined at the start of the lesson. The bulimic pedagogy rears its ugly head when students aren't asked to reach their own conclusions…conclusions that might challenge preconceived notions.

Noel Gough's essay, 'If This Were Played Upon a Stage,' argues that "school science should represent the reality of out-of-school science in some intellectually and morally defensible fashion" (1998, p. 71). Sadly, there is very little correlation between the two. Gough gives a script of an exchange that takes place between students and a teacher in a science classroom preparing to do a laboratory experiment. In this script, the teacher explains to students that they will be testing a hypothesis by participating in a step-by-step procedure that will offer a known conclusion. If students do not follow the steps, they will arrive at the wrong conclusion. If they follow the correct steps, they will reach the same conclusions drawn by scientists in the real world. They will have been successful without drawing any conclusions of their own. Gough explains that this type of school science "distorts the interrelationships between theory, method and data by representing data generation as part of an invariable sequence of activities that can be rationalized as 'the scientific method' of producing 'scientific knowledge'" (1998, p. 73).

The path to the discovery of the double helix structure of DNA by Francis Crick and James Watson provides an excellent out-of-school science example. Watson was drawn to the sciences at an early age by his father who would often take him on bird-watching hikes. In studying animals, Watson naturally found Darwin to be a powerful influence but notes that Darwin only "explained life after it got started" (Watson, 2005, 2:28). While attending the University of Chicago, he read Schrödinger's *What is Life?* (1992) and found that he was drawn to Schrödinger's assertion that "the essence was information present in our chromosomes, and it had to be present on a molecule…and somehow all the information was probably present in some digital form" (Watson, 2005, 2:32). This is what led him to Cambridge University to study

DNA. Francis Crick was also drawn to science very early in life. His father was a businessman and his mother a teacher. He studied physics as an undergraduate at University College in London. Perhaps he would have continued his studies in physics rather than moving into the field of biology had it not been for the outbreak of World War II. Between his undergraduate and graduate studies, Crick like Watson was inspired by Shrödinger's essay (National Health Museum, 1989). He determined to follow his newfound interest in living organisms. I point out the background of these men and briefly describe how they both came to be at the Cavendish Laboratory seeking the DNA structure for two reasons. First, this background is left out of school science. The function of DNA in heredity is the focus, not how the workings of DNA were discovered. By not exposing students to the life map of scientists, we prevent them from understanding how their own lives might take them on a journey of great discovery and adventure. Secondly, it is obvious that Watson and Crick drew from their experiences with nature as children and later on their curiosities tweaked by Schrödinger in ultimately focusing their attentions on discovering the structure of DNA. By encouraging experiential learning through a science studies curriculum, we will allow students to discover their own passions. Had Watson and Crick been forced to follow a standardized school science curriculum, would they have been interested in pursuing a deeper understanding of biology as adults?

Watson has stated, "…science seldom proceeds in the straightforward logical manner imagined by outsiders" (1968/1996, p. xi). This was certainly true in the double helix discovery. It was a fierce competition between scientists representing different research institutions, universities, and countries. In a 2005 lecture, John Watson explained how he and Crick struggled their way towards their understanding of the double helix structure. Watson states that the men thought that perhaps they would "take a shortcut to finding the structure of DNA" (Watson, 2005, 5:31). School science was not the sort of science being done by these men. The two men began by building a model. They looked at x-rays, compared their ideas to papers published by other notable scientists at the time, and hoped that they would find the answer before someone else. There were many false starts and tense discussions in the months leading up to the discovery. There was certainly no straightforward path. A science studies curriculum expects students to explore the cultural, political, and historical movements that allow scientific discoveries (Weaver, Morris, & Appelbaum, 2001). When students in Georgia study DNA, the standard states:

> **SB2. Students will analyze how biological traits are passed on to successive generations.**
>
> a. Distinguish between DNA and RNA.
>
> b. Explain the role of DNA in storing and transmitting cellular information.
>
> c. Using Mendel's laws, explain the role of meiosis in reproductive variability.
>
> d. Describe the relationships between changes in DNA and potential appearance of new traits including
>
> - Alterations during replication.
>   - Insertions
>   - Deletions
>   - Substitutions
> - Mutagenic factors that can alter DNA.
> - High energy radiation (x-rays and ultraviolet)
> - Chemical

e. Compare the advantages of sexual reproduction and asexual reproduction in different situations.

f. Examine the use of DNA technology in forensics, medicine, and agriculture.

(Georgia Department of Education, 2008a, p. 6-7).

Simply stating the fact that DNA is important in heredity as standardization expects only allows students to glimpse a fragment of this life altering discovery. By allowing students to understand the events occurring during the lives of these men, we allow them a more realistic understanding of Science.

The final problem that I would point out in school science curricula is the lack of discussion of paradigm shifts. Interestingly, the resistance to discuss the importance of paradigm shifts may be the one area that school science and out-of-school science are similar. Thomas Kuhn explains the way these shifts occur:

> In science…novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation. Initially, only the anticipated and usual are experienced even under circumstances where anomaly is later to be observed. Further acquaintance, however, does result in awareness of something wrong or does relate the effect to something that has gone wrong before. That awareness of anomaly opens a period in which conceptual categories are adjusted until the initially anomalous has become the anticipated. At this point the discovery has been completed (1962/1996, p. 64).

James Watson even acknowledged the resistance to acknowledge paradigm shifts among the scientific community when he said, "Most scientists are really rather dull. They said, we won't think about it till we know it's right" (Watson, 2005, 11:25). So rather than finding an anomaly in the work and setting forth to remove it or explain it, many scientists will just continue with the pervading belief until someone proves the initial theory to be short-sighted and forces a paradigm shift. Kuhn notices that the people usually responsible for paradigm shifts are young scientists (1962/1996). Something in their experiences with science has caused them to question, to play with ideas. A science studies curriculum will encourage students to learn the history of science, the shifting of paradigms and how they occur, and to develop their own ways of questioning.

> Science educators have consistently argued since the 1970s that the focus of school science on recruitment has been counterproductive and that more philosophically valid and engaging science education would consider the societal issues presented by interactions of science, technology, society, and the environment (Blades, 2001, p. 77).

A paradigm shift in school science curricula is necessary for the thoughtful and productive future of science. Schools will be places that foster scientific thought through a science studies curriculum rather than places that stifle it.

Weaver (2010) points out the need to consider Haraway's "modest witness" when determining truth in science. When preparing for a science studies curriculum, we should be sensitive to the modest witness in scientific discovery. In every scientific breakthrough there are those people/instruments whose contributions are glossed over or completely ignored. The stories of these nonhumans and quasi-objects are critical to determining the cause of paradigm shifts, the ethics behind them, and the legitimacy of science. In science, we will find those with biopolitical power determining the way science should be taught. Shifting the focus of science curricula to more critical science studies curricula may face resistance from those in power. Giroux (2006) states that biopolitic's "policies avidly attack critical education at all levels of cultural production in an all-out effort to undermine critical thought, imagination, and substantive agency" (p. 71).

Ultimately, we will have to drop our focus on standards-driven education and adopt a new curriculum that joins science, critical theory, and poetics. "The three methods are contributory methodologies to a larger hermeneutic circle of continual search for greater understanding, and for a more satisfying interpretation of what *is*" (Block, 1997, p. 180). Who we are as a species demands reconsideration. What *is* human? What *is* posthuman? Hayles (1999) is correct in her assertion that the best time to determine what we will be as posthumans is now "before the trains of thought it embodies have been laid down so firmly that it would take dynamite to change them" (p. 291). Curriculum scholars (Giroux, 2003; Smith, 1999; Weaver, Morris, & Applebaum, 2001; Wexler, 1996) maintain that education should offer students the opportunity to participate in the critical conversations of a democratic culture. Science education as practiced offers facts about the methods of science. Very little conversation about the context and paradigms of science are offered. If we are to escape the becoming of standing-reserves for scientific experiments, then we will have to develop a free relationship with technology as Heidegger suggests. This relationship will only occur when a critical conversation begins within our schools. Once we have engaged with technology in this way, we are exposed to its saving powers.

CHAPTER 3

THE LOSS OF ART

"For us, responsibility always begins with a rootedness in the past, and the authority it exerts, even if our chief responsibility is to improve on this past in the best way that we can" (Kronman, 2007, p. 171).

The liberal arts in the United States are rapidly becoming obsolete. Citizens may observe this in the lack of funding for theatre, the decline in art exhibits[3], and the lack of regard for humanities' curriculums in public education. Many view this decimation as legitimate, if they view it at all. Funding should be placed elsewhere, they say, in places like national defense, technological innovation, or standardization of curriculums to ensure a "smarter" citizenry. Recent examples of this can be found in Kansas and Florida. Governor Sam Brownback proposed phasing out state funding of the arts in 2011 (Peterson, 2011). He estimates a savings to the state of $575,000 if the Kansas Art Commission were to become a private, non-profit organization. Former Florida Governor Charlie Crist cut state funding to the arts by 90 percent during his tenure (Handelman, 2010). As an educator, my questions are, "What is our responsibility as educators to future generations? Do we owe them the opportunity to be exposed to the Arts?"

[3] The decline of funding for art exhibits and for theatre productions began in the 1980s when avant-garde art began to draw funding from the National Endowment of the Arts. Congressional outrage over government monies being used to fund art exhibits featuring works such as *Piss Christ* led to a slashing of the NEA's budget. The decrease in funding is chronicled by Alice Goldfarb Marquis (1995).

A History of the Liberal Arts

Ancient Greece

The liberal arts tradition dates back to the ancient Greece trivium and quadrivium. The trivium included an education in the arts of grammar, rhetoric, and logic. The quadrivium was developed later and includes the numerical arts of arithmetic, music, geometry, and astronomy. During the Hellenic Age, which dates from the eighth century B.C. to the end of the reign of Alexander the Great in 323 B.C., reasoning and oratory skills became the foundations of education for the free citizen. Oratory skills were important as a means to continue the cultural insights of Homeric poetry and as a means of political participation in the assembly. Reason allowed a way for the advancing republic of Greece to draw patterns between language and the world around them (Wagner, 1983). Beginning in the fifth century B.C., "rhetoric emerged as the cornerstone of secondary education and vied with philosophy as the focus of advanced education" (Wagner, 1983, p. 6). This art may best be defined as the spoken art of persuasion. Rhetoric allowed masters of the art to sway a group to believe that what he was speaking was truth—a necessary skill for anyone hoping to sway voters. In describing the art of rhetoric, Camargo states

> Rhetoric originated, according to Aristotle, at Syracuse early in the fifth century, with arrangement and delivery as its essential core. Aristotle himself added invention. Hermagoras then incorporated these three topics into what was presumably a complete system, rounding off the canon with style and memory (1983, p. 96).

The second and third arts of the trivium are logic and grammar. Both disciplines arose during the Hellenistic period, the beginning of which is marked by the death of Alexander the Great (Wagner, 1983). Logic was necessary according to thirteenth century theologian, Robert Kilwardby. He explains:

> Since in connection with philosophical matters there were many contrary opinions and thus many errors (because contraries are not true at the same time regarding the same thing), thoughtful people saw that this stemmed from a lack of training in reasoning, and that there could be no certainty in knowledge without training in reasoning. (Kilwardby, 1988, p. 265).

The study of logic led ancient scholars to ask questions about the nature of being in the world. This questioning led to the first branch of philosophical inquiry known as metaphysics. Aristotle argues the need for logic.

> We must…set the apparent facts before us and, after first discussing the difficulties, go on to prove, if possible , the truth of all the common opinions about these affections of the mind…for if we both resolve the difficulties and leave the common opinions undisturbed, we shall have proved the case sufficiently (1998, p.160).

Grammar, although perhaps, the last of the three to develop, is often viewed as the foundation of both rhetoric and logic (Huntsman, 1983). "Grammar as a subject supplied the body of information about the forms of language and the ways those forms might be combined into meaningful constructions" (Huntsman, 1983, p. 60). Without grammar, patterns of language could not have been developed, communications would cease. Grammar, therefore, becomes the underpinning for rhetoric, as the persuasive sister, and logic, as the method of understanding and communicating patterns. After Alexander the Great's death, wars were fought to determine who would rule this great empire. Greek tradition remained strong in the territories that would ultimately be held by Rome (Butts, 1955).

The quadrivium can also be traced back to the Hellenic Age of Greece. The numerical arts are typically thought to originate with the Pythagoreans "since they were the first to link the four arts of the quadrivium" (Wagner, 1983, p. 3). The four arts of the quadrivium—arithmetic, music, geometry, and astronomy—were considered essential curricula for the educated citizen because they "revealed the order of the universe" (Wagner, 1983, p. 4). Because the relationship between beings and the universe could be calculated and patterned through numerical theory, Plato included a study of the quadrivium arts in his curriculum (Kren, 1983).

The Middle Ages to the Enlightenment

The Middle Ages are critical to the life of the liberal arts. I focus on the work of two scholars of this era to show how their influence ensured the longevity of the seven arts begun by the Greeks. Boethius was a scholar and functionary in the court of the Roman Consul, Theodoric. His largest contribution to the liberal arts of the Middle Ages was the translations of the ancient works of Aristotle into Latin. Having studied the trivium and quadrivium in the original Greek, he is often seen as the link between the ancient texts and the Latin texts that ultimately allowed for the transmission of the great works through the centuries (Marenbon, 2003). The second great scholar to give aid to the liberal arts during the Middle Ages was a

Christian theologian, Cassiodorus. Christian teachers of the Early Middle Ages were concerned about teaching what they considered pagan arts. Butts notes Cassiodorus' argument

> the seven liberal arts were specifically justified by the Scriptures….He quoted to such good effect the text 'Wisdom hath builded her house, she hath hewn out her seven pillars' (Prov. 9:1) that he church eventually accepted all seven liberal arts for use in the monastic and cathedral schools. The medieval limitation of the liberal arts was thereupon established in fixed form as early as the beginning of the seventh century (1955, p. 148).

A new era for the liberal arts began in the fourteenth century when the period of the Renaissance began. Although the culture and educational traditions of the Middle Ages permeated the Renaissance, there were several significant changes to the liberal arts. First, the rising middle class began to spend money on local schools for the education of their children. This meant that a liberal arts education previously attainable by only the elite classes of society would now be available to more people leading to a more educated populace (Butts, 1955). Secondly, the power of the church over education was beginning to weaken. The Humanist tradition began due to "a new interest in human nature and in freeing human individuality from the restricting demands of church, guild, manor, and monastery" (Butts, 1955, p. 180). Humanism gives the liberal arts new focus. Because of the belief that the individual is responsible for his own destiny, there evolved the belief that an in-depth study of the *studia humanitatis* was necessary. The humanities studies that developed from this belief focused on grammar, rhetoric, oratory, poetry, history, and moral philosophy (Roest, 2003). The third significant change to the liberal arts is the exclusion of the quadrivium arts from the humanities.

This marks a major shift in the study of the liberal arts. Because of the division between the trivium and quadrivium in the teaching of the humanitites, I will distinguish between the liberal arts and the humanities from this point. When discussing the liberal arts, I will be including the sciences with the verbal arts, as this is their rightful place. Any use of the term, Humanities, will be referring to the disciplines that take root solely in the trivium. Although the quadrivium arts made promising advances in astronomy and mathematics, these arts were now considered part of the scientific realm (Hudson, 1912).

The Renaissance gave way to the Enlightenment in the eighteenth century. The monarchical political structure of the Renaissance period encouraged a backlash against absolutism in any form. From this, Enlightenment thinkers such as John Locke touted the rights of man and encouraged citizens to resist the authority of absolute governments while Jean-Jacques Rousseau encouraged a reformation in education. "Never has a generation been so confident that knowledge could improve society as were the scholars and intellectuals of the late seventeenth and eighteenth centuries" (Butts, 1955, p. 286). The importance of the humanities reached a fevered pitch in education. The concept of *Bildung* increased the belief that an education in the virtues of reason was of the highest priority. Vondung is worth quoting at length on the complexities of *Bildung*:

> *Bildung* is an extremely complex and particularly "German" concept, which makes it impossible to translate into foreign languages. Among the English terms the dictionary lists for *Bildung* are: formation, education, constitution, cultivation, culture, personality development, learning, knowledge, good breeding, and refinement. *Bildung* indeed can mean all this—and it most often

> means all this together—but it means still more….*Bildung* meant a process of self-realization and perfection of all one's capabilities into a harmonious whole (2000, p. 134-135).

For Immanuel Kant, *Bildung* was the "formation of character" (Munzel, 2003, ¶ 7). Kant's most notable contribution to humanity during the Enlightenment was his critic of the metaphysical philosophies that had held sway for centuries. As a result of his belief that we sense the truth of objects *a priori* to the actual experience of the object, he argued that a strong instruction in the arts of reason was tantamount to the current instruction of youth in instrumental sciences. True to the spirit of the Enlightenment, Kant did not dissuade studies in any discipline, but he felt that to focus on one area of knowledge to the exclusion of another was a grave mistake (Munzel, 2003, ¶12).

American Education to the Cold War

During the age of the Enlightenment, a new nation was formed from the British colonies in America. In 1776, the Americans declared their independence from Great Britain, establishing the United States of America. The influence of British education and culture lingered in the new nation, however. The education of the earliest colonists revolved around religion and rested largely with the local governments (Spring, 2005). Three colleges had been founded during the colonial era: Harvard College in 1636, William and Mary in 1693, and Yale in 1701 (Butts, 1955). In order to gain acceptance into these colleges, students had to comply with certain entrance requirements which included the "ability to read Cicero at sight, ability to speak Latin prose and poetry, and ability to decline Greek nouns and conjugate Greek verbs" (Butts, 1955, p. 263). The influence of the trivium is obvious in these entrance requirements.

The 1800s brought about controversy within the education system as opposing groups argued the purpose of education. Education reformer Horace Mann argued that the role of education was to create a good society. In bringing schools under the supervision of state governments, Mann streamlined curriculum. "Children in the common school were to receive a common moral education based on the general principles of the Bible and on common virtues, and such education was to eliminate crime and corruption in society" (Spring, 2005, p. 80). Although a aspects of a liberal arts curriculum may be seen in common schools in the teaching of virtue and basic mathematics, there is little to suggest that a strong immersion into the trivium and quadrivium, or the humanities of the Renaissance, was present. In colleges, where the humanities maintained a strong presence, there were debates centering on the language of instruction of the classics. Modernists urged that the Greek and Latin languages be dropped in favor of more modern languages (Butts, 1955). Although colleges continued to educate students in the humanities curriculum, the scientific revolutions of Europe and the United States began to show influence in the rise of science courses and in legislation such as the Morrill Act of 1862 This act allowed the use of federal funds to be used by colleges for the advancement of agricultural and mechanical understandings (Campbell, 1995).

By the beginning of the 1900s, a nationalizing of the United States curriculum in elementary and high schools had formed through the use of common textbooks like the McGuffy reader and recommendations of national committees such as the Committee of Ten and the Committee of Fifteen. The recommendations of the Committee of Fifteen in 1895 provide insight into the general trend in education below the college level. William Torrey Harris, as leader of the committee, "maintained that a curriculum constructed around the finest resources of Western civilization was still the most appropriate and desirable for America's schools" (Kliebard, 2004, p. 15). Although this position influenced the curriculum in the early 1900s, a new group of reformers had been formed in reaction to the Committee of Fifteen. Amongst them was John Dewey (Kliebard, 2004).

Dewey's small group of progressive educators began to gain traction in curriculum circles. Dewey's educational philosophy became known as experimentalism and was based on his belief that the scientific method could be applied to the thought processes of children to help order their experiences in and out of the school. From experimentalism came three new tenents on learning. First, students' learning is impacted by the culture outside of school. Students should participate in examining the problems of society. Secondly, students should play a role in planning the path of their education and experiencing education. Students will learn more by experimentation with new material rather than rote memorization. Thirdly, students learn emotionally, physically, and mentally. Any experience with education will impact the entirety of the child. Positive experiences will translate to success outside of the school while negative experiences may lead to an inability to adjust to new environments or respond correctly to new situations (Butts, 1955).

Coinciding with Dewey's experimentalism in education was another reform movement that would change the American educational system by creating the vocational school. Based on the German educational system, proponents of vocational school, like Union leader Samuel Gompers, pointed to the ways a trained industrial and agricultural base could benefit a democratic society (Kliebard, 2004). Dewey was critical. He maintained that training workers for a trade did not satisfy the need for knowledge. Here Dewey can be seen defending the humanities curricula. Perhaps for the first time, practical knowledge is seen as gaining popularity over a liberal arts curriculum.

The humanities curricula had held their place as superior disciplines to this point. The shift in political power that resulted from World War II ultimately served to knock the humanities from their perch. The impact of the Cold War between the Soviet Union and the United States infiltrated the American curriculum. When the Soviets launched the Sputniks in the 1950s, a charge to increase the math and science standards in the United States was given. A Space Race had begun between the two super-powers. The fact that the Soviets launched a satellite first "…signified failings in America's educational system" (Clowse, 1981, p.105). Congress acted swiftly by passing the National Education Defense Act. President Eisenhower said of this piece of legislation:

> We should…have a system of nationwide testing of high school students; a system of incentives for high-aptitude students to pursue scientific or professional studies; a program to stimulate good-quality teaching of mathematics and science; provision of more laboratory facilities; and measures, including fellowships, to increase the output of qualified teachers (Clowse, 1981, p.57).

The president eloquently began to squeeze the life from humanities education with this statement. The decline of humanities in education would continue for the next four decades as math and science took a dominant role as the disciplines for strong national (Detels, 1999).

The influence of the federal government over education continued to grow as politicians used either the guise of national defense interests or the elimination of poverty from society to intervene in the states' right to govern education. President Lyndon Johnson signed into law the Elementary and Secondary Education Act in 1965. This act was to provide federal funding to schools to ensure equal access to education for students in all areas of the country. The ESEA was the first education legislation to be passed that was not for purposes of national security (McCluskey, 2008). The most recent update to the ESEA was the No Child Left Behind Act of 2001. During the 1960s there were also a growing number of educators, represented by the National Education Association, and members of Congress that desired a national Department of Education. After facing resistance through the Nixon and Ford administrations, the NEA threw its support behind presidential candidate Jimmy Carter. Upon being elected president, Carter kept his word and created the Department of Education (Stallings, 2002). Not much was accomplished by the Department of Education during Carter's one term as president. It was widely assumed that it would be a short lived part of cabinet politics as newly elected President Ronald Reagan had campaigned to end both the Department of Education and Department of Energy. Although he entered office prepared to eliminate the position, he thoughtfully reconsidered when he realized he did not have the support of Senate Republicans that enjoyed the amount of federal funding they could acquire for their states through Department of Education grants (Stallings, 2002). Under Education Secretary Terrell Bell, a study of the educational climate in the United States took place. The document that emerged from this study in 1983, A Nation at Risk: The Imperative for National Reform, was the impetus for changes in education policies in many states (Cannon, 2000).

In 1987, another report on education was given. This time it was in the form of Allan Bloom's national bestseller, *The Closing of the American Mind.* The book relays the problems that Bloom found in the modern university—the lack of intellectual passion by students and the lack of intellectual stimulation from the professors. The lack of instruction in the great books of Western civilization was a major concern. He found that the liberal anti-war movements of the 1960s were partially to blame as professors of the era were found

> publicly confessing their guilt and apologizing for not having understood the most important moral issues, the proper response to which they were learning from the mob; expressing their willingness to change the university's goals and the content of what they taught (Bloom, 1987, p. 313).

Bloom belongs to a group of political theorists that hail from the teachings of Leo Strauss and refer to themselves as Straussians. Strauss, by all accounts, was a captivating teacher and a champion of liberal education. He brought with him from Germany the lessons of Greek philosophical foundations and he taught his students what it was to read a text for the first time and how to let the text speak to you (Norton, 2004). Strauss urged a liberal education that would continue to build upon the classics. "Liberal education is concerned with the souls of men and…. consists in learning to listen to still and small voices" (Strauss, 1968, p. 25).

Straussians have become very influential in American politics. The powerful figures espousing to be followers of Strauss' teachings are politically Republican and socially conservative. They taut the virtues of a liberal education and read the great books of ancient Greece, but this is where the similarities between Straussians and Strauss end. Whereas the nature of man was always a source of philosophical debate and curiosity for Strauss, for Straussians, "nature…has but one form. That form is simple and certain and self-evident truths" (Norton, 2004, p. 76). The power that the Straussians found in the George W. Bush administration combined with the belief that there are certain foundational truths has led to an educational policy, No Child Left Behind, that pushes a curriculum of conformity along the lines of a particular political ideology. Although conservative Republican principles are not blatantly espoused throughout the curriculum, the standardization of the national curriculum through statewide testing assumes that one will be proficient in a discipline if they learn a particular standard. This is in direct contradiction to what Strauss taught as the basis for liberal education. In discussing what works might be taught in Departments of Political Science, Strauss states "whatever broadens and deepens the understanding should be more encouraged than what in the best case cannot as such produce more than narrow and unprincipled efficiency" (Strauss, 1968, p. 19). A standardized curriculum will not allow students to engage with a text and experience the wonder of what that text holds.

The Purpose of Liberal Arts

In examining the purpose of a liberal arts curriculum, I will use *The Eighth Elegy* of Ranier Maria Rilke's *Duino Elegies* (1922/1989). The poetic insight gives weight to my argument for a strong liberal arts curriculum while helping trace the need and desire for insight into Self in a technoscientific age. Rilke's masterpiece, *Duino Elegies*, began in 1912 after a quarrel with a lover that left him in a state of depression. During a walk on the beach he claims that he heard a voice cry out "Who, if I cried out, would hear me among the angelic orders?" (Victor, 2010). This inspired ten poems over the span of ten years. The language of the Eighth

Elegy is magnificent as one feels the struggle to expose Self in an environment of inauthenticity. Holthusen believed that Rilke's poetry captured the imagination of an audience in the 1950s because they could relate to the isolation of one "who has not yet lost himself in the scramble for material comforts and in pleasure-seeking, in the din of small-talk and rhetoric and in the enthrallment of naked instincts" (Holthusen, 1952, p. 8). How much more does this pertain to society today?

The Eighth Elegy

With all its eyes the natural world looks out
into the Open. Only our *eyes are turned*
backward, and surround plant, animal, child
like traps, as they emerge into their freedom.
We know what is really out there only from
the animal's gaze; for we take the very young
child and force it around, so that it sees
objects—not the Open, which is so
deep in animals' faces. Free from death.
We, only, can see death; the free animal
has its decline in back of it, forever,
and God in front, and when it moves, it moves
already in eternity, like a fountain. (Rilke, 1922/1989, p.193).

Rilke describes humanity's inability to find the Open in the introduction of *The Eighth Elegy.* The Open is an integral part of this poem. It is the place where Self, our authentic being, resides. It is the space between this tangible world and the transcendence of the unconscious mind. It is the soul of humanity. I believe that our discovery of Self is prevented in a world caught in the snares of technology. I am in awe of Rilke's insight into society's ability to "take the very young child and force it around" (Rilke, 1989, p.193). I can envision the hands of an adult on the narrow shoulders of a child forcibly turning that child away from the truth of Being. The young child would have been born facing that truth in her innocence. Clouding her vision now are the things of this world: television, ipods, virtual realities, missiles, biomedicines. Her back effectively turned toward the Open, she will grow into adulthood without Self. Rilke goes on to argue that animals may be the only living force capable of seeing the true essence of life because they are unhindered by humanity's drive toward progress. Exposing students and society to the liberal arts may allow humanity to come close to turning our eyes forward toward "the Open" (Rilke, 1989, p.193), toward the essence of living. I believe that the liberal arts that are comprised of arts and sciences are necessary for society to turn back towards the Open.

I believe that humanity gave up a strong liberal arts tradition without so much as a whisper of protest. During the periods of the Renaissance and the Enlightenment, strong advances were made in the realms of the trivium and quadrivium. Rather than continuing the tradition of celebrating the seven arts in education, a division was created that cast the arts of the quadrivium into a separate sphere. This division remains. Michel Serres notes "…the questions fomented since the dawn of time by what we call the humanities help rethink those asked today, about and because of the sciences" and continues, speaking of a meeting between the students of the divided disciplines, by stating "The scientific experts were uncultured, and the so-called cultured were ignorant" (Serres with Latour, 1995, p. 27-28). I hold that the disciplines as technē will have to be taught as equally important in a new liberal arts curriculum for the advancement of society in our technoscientific era.

Never, not for a single day, do we *have*
before us that pure space into which flowers
endlessly open. Always there is World
and never Nowhere without the No: that pure
unseparated element which one breathes
without desire and endlessly knows. *A child*
may wander there for hours, through the timeless
stillness, may get lost in it and be
shaken back. Or someone dies and is *it.*
For, nearing death, one doesn't see death; but stares
beyond, perhaps with an animal's vast gaze.
Lovers, if the beloved were not there
blocking the view, are close to it, and marvel…
As if by some mistake, it opens for them
behind each other…But neither can move past
the other, and it changes back to World.
Forever turned toward objects, we see in them
the mere reflection of the realm of freedom,
which we have dimmed. Or when some animal

mutely, serenely, looks us through and through.

That is what fate means: to be opposite,

to be opposite and nothing else, forever.

If the animal moving toward us so securely

in a different direction had our kind of

consciousness--,it would wrench us around and drag us

along its path. But it feels its life as boundless,

unfathomable, and without regard

to its own condition: pure, like its outward gaze.

And where we see the future, it sees all time

and itself within all time, forever healed. (Rilke, 1989, p.194-195).

Rilke continues his magnificent exposé of humankind. He alludes to the possible moments when humanity almost grasps the Open, at death, in love. Is the Open unattainable? I do not believe that it is completely unattainable, nor do I feel that it is a place that we obtain to roam there forever with the animal. I argue that the way to bring forth the Open in the Heideggeran sense is through an in-depth study and appreciation for the liberal arts. This education should start in the schools.

Educational institutions today equip students with the tools needed to produce economically for the nation rather than instilling within them a deep sense of Self that will transcend their occupational worth. Freidrich Schiller, writing more than one hundred years before Rilke, asserts that an aesthetic education, an experience of what is beautiful, is necessary to push mankind towards a place where the Open may be considered. Schiller believes that when man accepts the world around him as it is, he is bowing to the overbearing hand of Nature.

“Contemplation (reflection) is Man’s first free relation to the universe which surrounds him” (Schiller, 1795/2004, p. 120). In contemplating Nature, we transcend it, look down atit, and come to understand our place in it. Contemplation occurs in aesthetic experiences and , therefore, an aesthetic education is desirable. Schiller’s arguments for a deeper understanding of the beauty surrounding this world do not suggest that what is natural, of science, is unimportant. Instead, he argues that because of the division between the sciences and the aesthetic arts, “the essential bond of human nature was torn apart” (Schiller, 1795/2004, p. 39). Schiller’s arguments align with Rilke’s expression that “Forever turned toward objects, we see in them/ the mere reflection of the realm of freedom” (1989, p. 194). The realm of education is one that focuses on the utility of the sciences and encourages analytical skills without embracing aesthetic experiences. According to Schiller, excluding aesthetic experience prevented a person from achieving “a sense of wholeness in life” (Kimball, 2002, p. 12). Unless, we rejoin the arts and sciences exalting the power of all technē, we will be unable to find the Open, will obtain a reflection of Self rather than experiencing it authentically.

Liberal arts programs in public high schools particularly should be viewed as essential to a democratic nation. Without a deep understanding of Self and Place in society, how will citizens be able to make intelligent, ethical decisions about the future of the nation? The liberal arts programs are imperative to the advancement of education because they have been designed to be “a means to acquaint…students with a wide range of human pursuits and to equip them with a general knowledge of themselves and of the world that will prepare them to meet the personal, ethical, and social challenges of life, regardless of the career they eventually choose” (Kronman, 2007, p.41). Part of any liberal arts curriculum will naturally focus on a traditional humanities curriculum with emphasis on literature, history, and philosophy. Currently, Humanities classes are only offered to the "gifted" students. Although it is certain that philosophical conversations are intrinsically complicated, students of all backgrounds should be given the opportunity to learn from the great voices of the past. Why send students into life with no experience when they might benefit from the experience of those that have roamed the Open? Kronman argues that the humanities are vital to an educated society because they give students the skills required to "put themselves—their values and commitments—into a critical perspective" (2007, p.147).

The humanities push students to look for answers to questions such as "How do things come into existence, have their being, and then pass away?" (Perkins, 1991, p.129). In reading poetry, such as that of Rilke, one is able to acknowledge what one does not have and may ponder how to obtain it. Adrienne Rich discusses the impact that poetry had on her life, "But poetry soon became more….I thought it could offer clues, intimations, keys to questions that already stalked me, questions I could not even frame yet: What is possible in this life?...How am I going to live my life?" (2001, p.43). By denying students the right to ask these questions and the mental agility with which to answer them, I believe we are denying them a natural right to identify the Self. Poetry is one means used to afford students access to the experiences of previous generations (Bronowski, 1993a).

When students read poetry and literature, an innate "referential function" allows them to make connections between the language on the page and their daily lives. According to J. Hillis Miller, that referential function is constant in every reader and is an inevitable consequence of language (2002). Unfortunately, many students have lost the ability to read and recall information. Reading is not valued in the educational institution because it is seen as a passive act. Students feel that to sit and read a book is to waste time. They want to do an assignment in order to get a grade. Anything that is ungraded is wasteful in their opinions. Giving students a passage to read for discussion is at present an attempt in futility. Not only are many unable to read anything that is not written in modern language, they cannot recall what they read minutes after finishing, and certainly cannot critically analyze its implications for their lives. This is the true shortcoming of the educational establishment.

> If a man or woman has not read the great thoughts of the ages, cannot put his or her ideas down in a written form for others to peruse and profit therefrom, cannot see relationships among discrete bodies of knowledge, is that person really educated? (Perkins, 1991, p.130)

The obvious answer to this question is a resounding no. A strong liberal arts education, steeped in science and art, will encourage students to think critically about their experiences in relation to the world around them.

The need for literary understanding surpasses the referential opportunities for students. Literary knowledge is also directly associated with our democracy. In J. Hillis Miller's analysis of Jacques Derrida, the connection of literature and democracy is apparent: literature is allowed "freedom of speech, the freedom, in principle, though never quite in fact, to say or write anything, or to perform any symbolic act" (2002, p. 63). In what other avenue are we so uninhibited? The artful prose and reflection found in literature and poetry allows all of humanity to put aside the monotony of daily experience in an attempt to glimpse the Open with "the animals' gaze" (Rilke, 1989).

Yet in the alert, warm animal there lies
the pain and burden of an enormous sadness.
For it too feels the presence of what often
overwhelms us: a memory, as if
the element we keep pressing toward was once
more intimate, more true, and our communion
infinitely tender. Her all is distance:
there it was breath. After that first home,
the second seems ambiguous and drafty. (Rilke, 1989, p.195)

Rilke's emotion transcends the years and provokes in me an enormous reaction. I understand "the presence of what often/ overwhelms us: a memory" (Rilke, 1989, p. 195) as the memory of Self. Remember, that as a young child we were "forced" away from the Open and our gaze set backwards. The memory that burdens us is the memory of Self unencumbered by the world. The Self was our "first home." The world without understanding of Self is a poor substitute… "ambiguous and drafty."

The way to recapture the "element we keep pressing toward" is through an experience with a new curriculum that offers students "the ability to conceive of things which are not present to the senses" (Bronowski, 1993b, p. 9). This ability requires the student to play using imagination. The art of imagination has been snuffed out by standardized curricula. I argue that this art must be returned to schools through a new liberal arts curriculum. Bronowski argues that imagination is the "common quality in science and poetry" (1993d, p. 5). I encourage the coexistence of the descendents of the trivium and quadrivium in a modern liberal arts curriculum that investigates the classics and entertains new works that tickle the imagination and encourage innovation and play.

If we are to imagine our place in this world, in the great conversation of civilization, we must use artistic impulses to play with the possibilities. This leads us to the question, "What should we consider appropriate disciplines to be studied in liberal arts courses?" I believe that we can no longer confine the liberal arts to the traditional arenas of painting, sculpture, and poetry often emphasized in Humanities courses. Perhaps we can begin to expand the borders to include technology and science. Adrienne Rich maintains that, "…truth is not one thing, or even a system. It is a complexty" (2001, p. 32). The liberal arts curriculum, like truth, should be a complexity.

Oh bliss of the tiny creature which remains
forever inside the womb that was its shelter;
joy of the gnat which, still within, leaps up
even at its marriage: for everything is womb.
And look at the half-assurance of the bird,
which knows both inner and outer, from its source,
as if it were the soul of an Etruscan,
flown out of a dead man received inside a space,
but with his reclining image as he lid.
And how bewildered is any womb-born creature

That has to fly. As if terrified and fleeing
from itself, it zigzags through the air, the way
a crack run through a teacup. So the bat
quivers across the porcelain evening. (Rilke, 1989, p. 195)

"…the tiny creature which remains forever inside the womb" (Rilke, 1989, p.195) is beyond reach of the objectification of the World. In an age of technoscientific progress, it is easy for society to embrace a science curriculum that proclaims to advance innovation and invention in technoscience. The utilitarian curricula that permeate the current education system do nothing to reintroduce the bewildered creature to the Open. It is critical that we attempt to secure the Open for future generations by allowing discovery of Self through scientific inquiry and aesthetic expression.

Scientific inquiry is necessary to sustain a vital, competitive nation in a globalized economy. The future of science lies in technoscientific advancements. With knowledge, however, comes great responsibility. "For the most important thing about technology is not what it *does*, but what it *aspires* to do" (Kronman, 2007, p. 233). There are ethical considerations to be weighted when discussing the possibilities of technoscience. I believe that it is a critical perspective afforded through an understanding of the arts that will allow ethical reasoning to prevail in the new age of technoscience.

I am reminded of Heidegger's warnings: "Even this, that man becomes the subject and the world the object, is a consequence of technology's nature establishing itself, and not the other way around" (2001, p.110). Technology need not arouse such suspicion. If our future depends on technology and we equip our children with the tools to implement innovation responsibly, then we might reap the rewards without becoming the object of technology as Heidegger fears. In 1981, the National Endowment for the Humanities acknowledged that "A democracy demands wisdom and vision in its citizens….It must therefore foster and support a form of education designed to make men masters of their technology and not its unthinking servants" (Perkins, 1991, p.128). This is the defense of the Humanities and it is the defense of liberal arts.

And we: spectators, always, everywhere,
turned toward the world of objects, never outward.
It fills us. We arrange it. It breaks down.
We rearrange it, then break down ourselves.
Who has twisted us around like this, so that
no matter what we do, we are in the posture
of someone going away? Just as, upon
the farthest hill, which shows him his whole valley
one last time, he turns, stops, lingers—,
so we live here, forever taking leave. (Rilke,1989, p. 196-197)

Let us not be, as Rilke suggests, constantly "in the posture of someone going away" (1989, p.196). In order to twist ourselves forward toward Art, toward humanity, we must restructure ourselves in a technoscientific age. In the turning, we must finally consider the implications of Science and Art in education. "Science is today the greatest authority in our lives—greater than any political or religious ideal, any cultural tradition, any legal system" (Kronman, 2007,p. 207).

CHAPTER 4

THE RISE OF SCIENCE

"It is easy to see how the very passion of the desire for truth
might interfere with finding truth.
Seeking to be god tends to get in the way of being a god"
(Davis, 1988, p. 44).

"What men make, men may unmake;
but what nature makes no man may dispute"
(Shapin & Shaffer, 2011, p. 23).

Technoscientific advancements are challenging the prevailing notions of what constitutes as human. Exposure to virtual realities and the hybridization of human bodies has made us more dependent than ever on our inventions and innovations of what once was left to nature. Examples of the important role of technoscience are frequently cited in academic journals as well as in popular culture publications like *Wired* magazine. In the June 10, 2011 issue of Wired, a short article reported on the newest experimentations of the Defense Advance Research Projects Agency (DARPA). DARPA is the sometimes controversial research arm of the Pentagon. According to its website, DARPA was created in 1958 to ensure the technological supremacy of the U.S. military. "As the DoD's primary innovation engine, DARPA undertakes projects that are finite in duration but that create lasting revolutionary change" (Defense Advance Research Projects Agency, n.d.). Recently, DARPA has begun seeking ways to enhance biological engineering in the fields of agriculture, industry, and therapeutic devices. Simply put, the Pentagon is engaging in the business of biological building blocks that could be used in a variety of ways. Think of Eli Whitney's invention of the interchangeable parts in technoscientific, modern terms. Imagine if we could remove faulty cell lines or change them at the atomic level by inserting new building blocks of coded biological material. The program for creating synthetic biology is referred to as Living Foundaries. According to the federal government's website, fbo.gov, DARPA is hoping to entice creative agencies or individuals outside of the government's agencies to offer new approaches for its Living Foundries programs. "Living Foundries aims to enable on-demand production of new and high-value materials, devices and capabilities for the Department of Defense and establish a new manufacturing capability for the United States" (Defense Advance Research Projects Agency, n.d.). The Pentagon is not the first agency to work in the area of synthetic biology, but it hopes to increase the rate of production of DNA and perhaps use it in the field of biosecurity (Pennisi, 2010).

DARPA's successes will be closely monitored by the Biological and Toxin Weapons Convention (BWC). The progress made in technosciences was the focus of the 2011 BWC. The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxin Weapons and on their Destruction, typically referred to as the Biological and Toxin Weapons Convention, was the first disarmament treaty of its kind because it banned an entire class of weapons (UNOG, 2009). Since its enforcement in 1975, participating nations have met every five years to address concerns and areas of positive advancement and cooperation. Of particular interest to the states involved at the Seventh Review Conference held in Geneva, Switzerland, were the "rapid pace of relevant advances in science and technology; the global diffusion of science and technology research and its applications; and the breadth of fields now engaged in the 'life sciences'" (Bowman, Hughes, & Husbands, 2011, p. 16).
Understanding that the pace of technological advancements is increasing rapidly, the BWC has considered reviewing the treaty more frequently to keep up with the challenges and opportunities

revealed by these advancements. The desire of the convention would be to continue to share internationally the discoveries in biological synthesis that may lead to vaccines, cures for disease, and data management through rapid computer systems. At the same time, the members of the BWC seek to maintain the promise of Article I of the treaty that prohibits any state from producing or maintaining threatening amounts of harmful biological agents that could be used to target another state. If our Pentagon is engaged in studying and formulating biological building blocks for manufacture, we can be certain that other nations' militaries are doing the same. Are there intentions peaceful or malicious?

In this chapter, I will explore how the United States arrived at this point in technoscientific development. To make this determination, I will explore the history of science beginning in antiquity. The journey from ancient Greece to the United States of America in the year 2013 is full of paradigm shifts and discoveries that propel societies forward. It is an awesome journey full of scientific revolutions. Thomas Kuhn found that the history of science was non-linear and that this was due to the characteristics of the scientific revolutions that establish new paradigms for the scientific community.

> Each of them [scientific revolutions] necessitated the community's rejection of one time-honored scientific theory in favor of another incompatible with it. Each produced a consequent shift in the problems available for scientific scrutiny and in the standards by which the profession determined what should count as an admissible problem or as a legitimate problem-solution. And each transformed the scientific imagination in ways that we shall ultimately need to describe as a transformation of the world within which scientific work was

> done. Such changes, together with the controversies that almost always accompany them, are the defining characteristics of scientific revolutions (Kuhn, 1996, p. 6).

This chapter also seeks to understand how entrenched paradigm shifts based on the Cartesian-Newtonian view of the universe might be altered by embracing a new paradigm that revolves around quantum theory, string theory, and chaos theory. According to an article by Robert Tremmel (2006), the current state of education in our country is largely a result of the Cartesian belief that the mind is separate from and master of our world. This theory seemed to be backed up when Sir Isaac Newton developed mathematical theories to explain the working of the universe. In the early 1900s, Fredrick Taylor would use Cartesian-Newtonian worldview to create a precise, efficient scientific practice for maximum efficiency in industry. These ideas would soon translate to the way curriculum is created in schools. "The Taylor System proceeded from the heartland of the Cartesian-Newtonian paradigm and is a leading example of how linear, mechanical approaches to business management, industrial efficiency, and scientific method became central to school reform in the period 1910-1950" (Tremmel, 2006, p. 14). When the Taylor System began to be used by educators to develop curriculum, the first standards were developed. What students should learn, the amount of time that should be spent on topics, and how to break down large ideas into smaller parts to be used as building blocks for understanding resulted. After a review of scientific discovery, I will conclude this chapter by exploring how the Cartesian-Newtonian paradigm might be unseated in order to allow the newer paradigm of quantum, string, and chaos theories to permeate society's outdated understanding of how parts of the universe are “continuously unfolding and enfolding” (Tremmel, 2006, p. 21) in relation to one another.

Ancient Greece

The largest contribution given to modern science by the ancient Greeks is the intense desire for knowledge (Bertman, 2012; Crombie, 1952; Renn, Damerow, & McLaughlin, 2002). This desire led the Greek philosophers to question why we exist as individuals and as a human collective. By exploring these ideas, some of the great minds of the ages were forced to consider astronomy, mathematics, anatomy, and mechanics. Although, these natural philosophers did not label the culmination of these interests as “science,” we trace our scientific heritage to these ideas and discoveries. The ancient Greeks’, “special gift to us was the scientific attitude, the methodical investigation of the physical universe and the living beings within it. This attitude, along with the technologies it came to generate, is the most visible contribution of antiquity ….” (Bertman, 2012, p. 233).

Greek science may be traced to the philosopher Thales in 585 B.C. Thales seems to be the first Greek to promote the belief that nature derives from certain laws that interact with one another in a predictable way rather than the prevailing notion of the time that gods were determining the course of nature based on unpredictable whims (Fowler, 2008). By promoting a dialogue with other philosophers in the city of Miletus, a town close to present day Turkey, Thales and other philosophers began to dissect issues of geometry, geology, and astronomy. A fellow Milesian, Anixamander, leaves us more information about the formulation of these lines of inquiry as some of his writings have endured.

Perhaps the most amazing postulation of Anixamander was his theory of the earth's location in the universe. He believed that "The earth…is cylindrical like a drum, and rests unsupported at the centre of a spherical universe" (Guthrie, 1950, p. 28). When questioned as to why the earth does not fall in one direction or another, he explained that the spherical nature of the universe is such that all points are equidistant and therefore support the earth in its position. This theory is evidence of critical and intelligible thinking in the sixth century B.C. Although these first natural philosophers were without modern tools of research and observation, they were able to formulate answers to difficult, timeless questions without a single nod to the gods of ancient Greece. Their critical observations may have given rise to more astute inquiries of later philosophers like Pythagoras, Aristotle, Euclid, and Archimedes.

Pythagoras, who left no written books of his own, is known like many great thinkers of antiquity only by the works of his students. The earliest Pythagorean book was written in the fifth century B.C. by the student, Philolaus. From his text, we can determine that the Milesian thought of a rationale universe had been adopted by Pythagoras. This is not surprising in light of the fact that Pythagoras is believed to have studied on the island of Miletus with the aged Thales and to be a contemporary of Anaximander, a renowned student of Thales (Hakim, 2004). Philolaus' work deals primarily with establishing order for the kosmos, the world and all things in the world (Kahn, 2001). According to Pythagoreans, this order was established through mathematics. In fact, "they believed devoutly that numbers are the essence of the universe and that they are real and tangible" (Hakim, 2004, p. 75). This belief, though shaken a bit by the discovery of irrational numbers, led the Pythagoreans to make great strides in the field of mathematics, astronomy, and music. Perhaps the contributions of the Pythagoreans are best explained by Sangalli:

> For the Pythagoreans, “number” was a living reality whose nature was to be discovered. Their study of number was divided into four branches: Arithmetic, number in itself; Geometry, number in space; Music or Harmonies, number in tie; and Astronomy, number in space and time. They believed that only through numbers may we achieve comprehension of things that would otherwise remain unknown… (2009, p. xiv).

In the fifth century B.C., Aristotle, the great pupil of Plato, made his contribution to future generations by seeking to prove order existed in the universe by to studying and categorizing all things. He is often viewed as the first great thinker to outline and attempt to solve a problem through a carefully planned and systemic process of logic (Hakim, 2004). Although he is not credited with developing a scientific method, we do know that he did many experiments in attempting to expose the inner workings of nature. The term “experiment” used today derives from the Greek word “empeiria” which means experience. Aristotle writes of this often in his personal papers (Jaroszynski, 2007). He hoped that by examining the intricacies in the makeup of all things in nature, he could reveal the grand design of the whole universe.

A well-known theory developed by Aristotle deals with the problem of mechanics. We see the obvious transition from belief in ancient gods as the source of all unexplainable phenomena (the question raised by the Milesians) to Aristotle’s attempt to produce a rational theory based on practical knowledge (possible through the mathematical contributions of the

Pythagoreans) in his development of the theory of the lever. Aristotle sought to determine how "small forces can move great weights by means of a lever" (Renn, Damerow, & McLaughlin, 2002, p. 47). By examining weights on an equal-arms balance, Aristotle concluded that if the balance is unequal, equality may be achieved by moving the weights or the suspension point. Essentially, "the weight moved is to the moving weight inversely as the length to the length" (Renn, Damerow, & McLaughlin, 2002, p. 47). Aristotle's theory of the lever allowed natural philosophers, mathematicians, and early physicists the means to understand how a small force can be used to move a large object if a lever is employed. This led to improvements in "ships (oars, rudder-oars, masts), the sling, the wedge, the pulley, and even tooth-extraction" (Irby-Massie, 2002, p. 51).

To this point, I have focused on contributions from antiquity through the classic period of Greek history. Aristotle is arguably the last great mind of this period. His extraordinary intellect may have been the catalyst that ended the classic period of Greece and ushered in the Hellenistic Era. Aristotle was hired by Philip of Macedon to tutor his son, Alexander. Aristotle spent eight years with the royal family during Alexander's formative years and likely had a significant impact on him. When Philip died, Alexander began to expand the territory of the Macedonians. As Alexander the Great, he sent scholars throughout his empire to collect specimens of plants and animals to study. He also sent live animals back to his former teacher who kept them enclosed in what may have been the first zoo on record (Hakim, 2004). Alexander the Great, like Aristotle, was a man of many talents. He had a great intellect, he was a military genius, and he put both to use in becoming a formidable and ambitious opponent. When he died, his great empire was split into three parts. The event of his death and the subsequent division of his empire begins the Hellenistic period of Greek history.

The Hellenistic era is important in the history of science because it ushers in a period of time characterized by intense interest kosmos and the desire by each of Alexander's successors to contain the best minds of the age within the territory of their rule. Alexander the Great's successor in Egypt, Ptolemy I, may have been the most successful in continuing the scholastic tradition of Alexander and Aristotle. Ptolemy I is often credited with beginning construction on the Great Library in Alexandria, "a library whose aim was to contain a copy of every book ever written" (Phillips, 2010, p. 1). Close to the Great Library was the Mouseion, a well-known university that hosted lectures by some many natural philosophers, astronomers, mathematicians, and doctors of the era. The fact that the Mouseion and the Great Library were located in Alexandria made it the "cultural hub of the Greek empire, and a melting pot of Greek and Egyptian knowledge" (Pearson, 2006, p. 2). As impressive as this cite was, the library itself was reported to hold at least half a million original scrolls, it was not a place that allowed much personal freedom to those who lived and worked there (Phillips, 2010). After all, Ptolemy's objective was to secure the best intellectuals in Alexandria. Once they were part of the Mouseion, the Ptolemies did not make it easy for them to leave. This was not a problem for most scholars, however, as most of the Ptolemies gave handsome stipends to those working at the Mouseion and the proximity to the Great Library was quite an alluring incentive to stay in Alexandria.

One of the most influential mathematicians to have worked at the Mouseion was Euclid. A century after Aristotle began to write of the necessity of personal experience along with practical knowledge to explain the natural world and humanity's place in it, Euclid adopted these principles of logic, to explain whether mathematical theory could coincide with real world problems (Jaroszynski, 2007). Euclid is most widely known as the author of the mathematical text Elements. In this text, he outlines geometrical theorems including algorithms for finding area and volume of three-dimensional objects (Pearson, 2006). Elements combines many postulates from previous generations with his own improvements to the study of mathematics. This text was the seminal work in geometry for the next millennia and had a significant impact on Archimedes, Galileo, Newton, and Einstein (Magill, 1998).

Another Hellenistic thinker to influence the progression of science was Archimedes. Archimedes is often linked with Newton as one of the two greatest mathematicians to have every lived (Adler, 2002; Magill, 1998; Sarton, 1948). Archimedes lived in the third century B.C. in Greece. It is believed that he studied in Alexandria, however, and had a wide understanding of the advances in mathematics made by his predecessors. Archimedes, though a pure mathematician at heart, understood the need for practical applications of his knowledge. He drew on Aristotle's theory of the lever and Euclid's geometrical theorems to expose how the center of gravity keeps weights in balance (Renn, Damerow, & McLaughlin, 2002). This principle is fundamental in the history of mechanics as all simple machines work according to the formula By proving the ratios necessary for the lever to balance are directly influenced by finding the center of gravity on an object, Archimedes was able to create many machines that advanced society. He became one of the most widely respected inventors of this age offering advances in "statics, hydrostatics, astronomy, and engineering" (Magill, 1998, p. 77).

The end of Archimedes life coincided with and was a result of the Roman conquest of Greece. When Archimedes was 75 years old, the Roman army invaded his coastal city Syracuse. Archimedes helped stop the army several of his inventions. One way that he stopped the advance of Roman ships was with the invention of Archimedes' claw. This device was essentially an enormous pulley that consisted of a claw on one side and a weight on the other. The claw would lift the bow of the advancing Roman ship high into the air and then drop it back into the sea. (Hakim, 2004). Although, the Greeks won several battles with the help of this great man, they ultimately lost the war. Legend says that the Roman emperor had commanded that Archimedes not be harmed in the invasion of Syracuse. Unfortunately, a Roman soldier went against those orders and killed the great scholar while he sat in his home working on a theorem (Adler, 2002).

The Roman Empire had taken over all of the former Greek Empire by the first century A.D. For approximately, 200 years the conquered Roman territories continued to function as individual and essentially self-governing commonwealths of the Roman Empire. This changes, however, during the second century. Historians note that under the rule of Emperor Trajan all independent territories under the Roman umbrella were eliminated and all people were given Roman citizenship (Irby-Massie & Keyser, 2002). It was in this climate that the last of the Hellenistic scientists was born.

Galen must be included in any discussion on the history of science. Born in 129 A.D., he is most notable for his advancements in the field of medicine. Galen, like many of the other notable scientists discussed, was born into a prominent family in an area that thrived with diversity, entertainment, and scholarship (Mason, 1962). In his life, he studied with some of the top doctors in Alexandria, had a career as a physician to gladiators, and became the doctor to the court of Marcus Aurelius (Magill, 1998). Galen followed the teachings of Aristotle feeling strongly that the nature of man was exhibited by growth or lack of growth in one or all of the three souls. After dissecting and closely studying the anatomy of many animals including a Barbary ape, he determined that the three souls were based in the digestive, respiratory, and nervous systems (Mason, 1962). His writings have been passed down through the ages because of their useful nature. Magill writes:

> Galen can be credited for several things: setting a high ideal for the medical profession; insisting on contact with nature as a condition for treating disease; stressing the unity of an organism and the interdependence of its parts; and realizing that a living organism can be understood only in relation to its environment (1998, p. 340).

While other notable men contributed to scholarship in the sciences after Galen, their works were watched closely by the growing Christian church. Most of the contributions of men from second century to fifth century A.D. came in the form of preservation of the classical works previously discussed (Jaroszynski, 2007). Ultimately, the emperor Justinian closed Plato's Academy in 529 A.D. in an attempt to extinguish any lasting pagan religions thus ending an era of inquisition into the natural workings of the kosmos.

The advancements in science, math, and medicine made by Greeks from the classic period through the end of the Hellenistic era are extraordinary. Philosophical inquiry went through several stages from the introduction of rational thought by Thales to the anatomical investigation of the body by Galen in response to socio-political events that brought new regimes to the forefront while eliminating others.

> The human tendency to assimilate our thinking to our environment is well known…and could even be said to be an essential part of the human condition….that human tendency seems to have directed the overall course of ancient Greek science. Political monopoly promoted intellectual synthesis, while political pluralism promoted intellectual debate and productivity. And in the end, the pinnacle of political uniformity fostered the creation of a hyper-synthesis which promised a view of the body and the universe as an ordered and meaningful whole….(Irby-Massie & Keyser, 2002, p. 16-17).

In a close inspection of Greek contribution, it can be determined that the classic period of Greece fostered like-minded thinking as most city-states were only in contact with others in Greece. Very little outside thought penetrated the realm of the Greek Empire until Alexander the Great began to expand the borders of his empire to encompass new lands. Upon his death, his empire was divided ushering in the Hellenistic era. During this time, competition between the three successors of Alexander intensified the competition between the great minds of the respective territories. Competition always pushes men to greater achievements. This competition lasts until the Roman Empire enveloped the Greeks once again ushering in a period of synthesis in thought directly impacted by the Christian church.

The Middle Ages

The era of history marked by the fall of the Roman Empire in 476 A.D. through the beginning of the Renaissance in Europe in the fourteenth century is referred to often as the Middle Ages. Carl Sagan believed that nothing significant happened to advance science during this era due to the heavy-handedness of the Christian church (Sagan, 1980). Is he correct? Is there reason to simply skip mention of this era and move directly into the Renaissance to complete our study of science? Although, I believe that Sagan is correct in his assertion that Western Europe had little to offer in the way of scientific progress, it is worth mentioning how the ancient works did survive to be reinvigorated during the Renaissance. This survival is mostly credited to the Islamic world, but there were some in monasteries in the West that held classical teachings invaluable.

The debate over scientific progress in the Middle Ages can be categorized into two categories: those like Sagan, whom I will refer to as the Traditionalists, who believe that there was a significant decline during this period, and the Continuists, those who believe that the Middle Ages were instrumental to the beginning of the Scientific Revolution of the Renaissance. Those who argue that antiquity's scientific progress was decimated during the Middle Ages often point to the reported conflict between the church and natural philosophers. This traditional argument states that "In the long struggle of the Christian church to hold the western world together during its centuries of turmoil, the church had gained much power over the minds of most western thinkers" (Spangenburg & Moser, 1993a, p. 24). Most Traditionalists point to the criticism of Copernicus and the trial of Galileo by the Roman Catholic Church (Blackwell, 1999). Both Copernicus and Galileo advanced the heliocentric theory stating that the Sun, not the earth, sits at the center of the universe. These ideas were thought to directly contradict the Bible. Copernicus found his writings banned by the Church and Galileo suffered a trial, the banning of his writings, and a burial outside of Church grounds typically signifying excommunication. Copernicus and Galileo lived during the fifteenth century. By this point, the Renaissance had begun and the feudal era of the Middle Ages had given way new systems of government allowing for a rise in wealth, education, and culture throughout Europe. I am not sure that these examples are the best to use in arguing that the Middle Ages were fraught with a domineering Church seeking to stamp out progress. While there are instances during the Middle Ages when the Church takes a firm stand against the advancements of science, there is also ample evidence to prove that the Church not only consented to inquiry by natural philosophers but that many church leaders encouraged it.

Most Traditionalists argue that the rise of the Islamic Empire saved many of the great works of antiquity from complete destruction. After the prophet Mohammed's death in 632, the religion of Islam spread quickly throughout the Middle East and northern Africa reaching at one point to Spain in the west and central Asia in the east (Ronan, 1982). During the sixth and seventh centuries, Christians in the conquered territories of eastern Persia worked to translated Greek texts into Syriac. From Syriac, it was translated into Arabic by many scholars of Jewish, Christian, and Islamic faith (Crombie, 1952, p. 19). Within two centuries, most of the important works of Greek scholarship had been translated into Arabic (Grant, 2008). These works were the catalyst to the golden age of Islam that lasted from the eighty century to the eleventh century (Ronan, 1982). Scholars agree on these points, but begin to differ on the role of Islam on natural philosophy and mathematics once the ancient works had sufficiently been translated and studied.

Traditionalists argue that during the golden age of Islam, the Roman Catholic Church denied progressive inquiry into ancient texts therefore ending progress in the West. Continualists dispute these claims arguing that Islam simply became a holding area for Greek texts, particularly in natural philosophy. Continualists point to evidence that religious leaders prohibited madrasas from studying the "foreign sciences" (Grant, 2008, p. 509). Additionally, the writings of the Arabic thinker, al-Ghazali, indicates that religious leaders were concerned that the teachings of natural philosophy would so impress Muslims that they would turn from religion due to arguments of logic, nature, and mathematics. Al-Ghazali writes that man "draws the conclusion that the truth is the denial and rejection of religion. How many have I seen who err from the truth because of this high opinion of the philosophers and without any other basis" (Grant, 2008, p. 507).

Although arguments may be made as to the extent that natural philosophy progressed in the Islamic world, there is little evidence that can dispute the advances in mathematics. Al-Khwarzmi began to use algebraic formulas in the modern sense. Although he is not the first to use these formulas, he is the first to make them understandable through written language (Ronan, 1982). Perhaps the area that Islam contributed to most was the area of medicine. Stark differences may be made between medical practices in the Islamic world and the practices of the Western Medieval world. The greatest Arabic medical writer was al-Rāzi who wrote books combining Greek and Syriac medicinal practices along with his own contributions (Artz, 1954). During this era, western European medicine did more harm than good typically, while Arabic medicinal practices were finding cures and developing surgical methods that healed patients. A

Muslim medical practitioner is worth quoting at length as he describes the differences between the two cultures in relation to medicine.

> They brought to me a knight with an abscess in his leg, and a woman troubled with fever. I applied to the knight a little cataplasm; his abscess opened and took a favorable turn. As for the woman I forbade her to eat certain foods, and I lowered her temperature. I was there when a Frankish doctor arrived, who said, "This man cannot cure them." Then, addressing the knight, he asked, "which do you prefer, to live with a single leg, or to die with both legs?" "I prefer," replied the knight, "to live with a single leg." "Then bring," said the doctor, "a strong knight with a sharp axe." The doctor stretched the leg of the patient on a block of wood, and then said, "cut off the leg with the axe, detach it with a single blow." Under my eyes the knight gave a violent blow. He gave the unfortunate man a second blow, which caused the marrow to flow from the bone, and the patient died immediately. As for the woman, the doctor examined her and said, She is a woman with a devil in her head. Shave her hair." They did so; she began to eat again—like her compatriots—garlic and mustard. Her fever grew worse. The doctor then said, "the devil has gone into her head." Seizing the razor he cut into her head in the form of a cross. Then he rubbed her head with salt. The woman expired immediately (von Grunebaum quoted in Artz, 1954, p. 164-165).

This explanation of medical practices shows the vast improvements in medicine in the Islamic world. Unfortunately, competing schools of thought regarding religion and science led to the decline of progress in this part of the world. Throughout the Golden Age of Islam, religious leaders had allowed scientific inquiry because it was determined to complement religion. When great thinkers like al-Ghazili began to condemn these inquiries as fundamentally dangerous to religion, the erosion of scientific advancements began in the Middle East (Ronan, 1982).

Whereas, the Traditionalists' arguments that Islamic science preserved and advanced Greek contributions with little aid from western Europe during the Medieval era, Continualists disagree arguing that "It was Greco-Islamic-Latin science and natural philosophy that unquestionably set the stage for the Scientific Revolution of the seventeenth century" (Grant, 2008, p. 503). Without denying the contributions of other civilizations, the Continualists insist that much was going on in Western Europe between the fifth century and the fourteenth century that aided scientific progress.

The Christian religion does play a role in academic studies during this era. The Continualists argue, however, that religious leaders did not try to extinguish scientific inquiry but expected natural philosophy and mathematics to be studied in universities as a way to show the existence of God. By this point in history, the Quadrivium, discussed in detail in Chapter Three, was being taught in universities throughout Europe. The focus on astronomy and mathematics exposes the universities' belief that educated people should possess great skill in these areas. The question then arises as to whether the study of natural philosophy was also encouraged by church leaders. Continualists point to St. Augustine's writings from the fourth century as evidence that scholastic investigations in natural philosophy were encouraged. "In the hands of Augustine, science had a part to play in the Christian religion….The universe…must be good. Its study could only be good and would lead to a greater appreciation of God's wisdom" (Ronan, 1982, p. 250). Other scientific contributions of the early Middle Ages came in the form of technological inventions. New systems of agriculture were developed between the sixth and ninth centuries, a harness developed during the eighth century, and a nailed horseshoe in the ninth century. In addition to these developments, great progress was made in armaments for war between the sixth and eleventh centuries (White, 1963). The practical side of science is obvious in technical progress. Once western Europe advanced to the point of meetings its most basic needs of survival, more progress in scientific theory and experiment was evident.

Continualists have a better argument for advancement of scientific thought in the late Middle Ages. Robert Grosseteste, Thomas Aquinas, and Roger Bacon made great strides in scientific and mathematical thought during the thirteenth century. Some of their advancements may have been due to the conquest of Spain by Christians in 1236. From Spain came new information about the ancient Greeks as well as Islamic math and medicinal practices (Hakim, 2004). Grosseteste was a leading lecturer in theology at the University in Oxford prior to being named Bishop of Lincoln. Aristotle's methods of inquiry influenced Grosseteste leading him to device his own methods for scientific experimentation (Ronan, 1982; Beaujouan, 1963; Crombie, 1963; Southern, 1963). Although these methods were revolutionary in a sense, there is little evidence that Grosseteste actually put them into practice. It seems that his primary interest was in examining ancient texts and writing commentaries on them (Southern, 1963). Through these commentaries, however, we do find original thought on experimentation that is influential in the works of his student, Roger Bacon (Crombie, 1963). Not long after Grosseteste's work on Aristotle, the Roman Catholic Church banned any works by Aristotle from being read and studied. This ban in the mid-1200s was a result of several key points in Aristotle's writings.

> It denied the immortality of the individual human soul. It denied human free will and gave scope for the interpretation of all human behavior in terms of astrology. It was rigidly determinist, denying that God could have acted in any way except that indicated by Aristotle (Crombie, 1952, p. 40).

This ban did not last long thanks in large part to Roger Bacon and Thomas Aquinas.

Roger Bacon lectured at the two largest and most influential university in Medieval Europe, the University of Oxford and the University of Paris. He was greatly influenced by the writings of Aristotle, but he believed that "scientific truth is not something that you blindly accept from authorities….Rather, it is the fruit of observation and experimentation" (Hakim, 2004, p. 234). A strong supporter of reason and critical thought, Bacon was jailed for several years for heresy, but his contributions to a scientific method of studying nature influence Thomas Aquinas who heard his lectures at the University of Paris.

Aquinas studied Aristotle during the ban on his works as they were funneled to him by his teacher at the University of Paris. There is some thought among scholars that the ban on Aristotle allowed his works to be questioned in a way that had previously not been considered (Hannan, 2007). This is perhaps the reason that Aquinas concludes that Aristotle is not the final authority on matters, but rather a "guide to reason" (Crombie, 1952, p. 42). Due to this belief, Aquinas is able to reconcile Aristotle's views with Christian theology to show that they can be studied together. Aquinas put forth the notion that "Christians need have nothing to fear from pagan philosophy. When it came to science, the Greeks revealed God's world; when it came to matters of salvation then the Church and the scriptures were the revealing authority" (Ronan, 1982, p. 260). Aquinas did not live to see the ban on Aristotle's work lifted, but there is no doubt that Greek philosophical thought was allowed to continue its advanced throughout Europe in large part due to his endeavors.

The arguments between the Traditionalists and the Continualists about the impact of the contributions of Medieval Europe on the Scientific Revolution of the Renaissance Era will continue. The early Middle Ages in Europe obviously focus on the most basic needs of the people, while advancements in technology and agriculture allow for greater intellectual progress during the late Middle Ages. I believe that Beaujouan says it best: "We are bound to recognize that medieval science was not revolutionary. But it believed in progress, and indeed progressed" (1963, p. 236).

Renaissance

The Renaissance marks the period between the fourteenth and sixteenth centuries when major changes in society, government, and religion gave way to new conceptions of humanity and the kosmos. The Renaissance began in Italy in part because of its proclivity to trade and commerce (Artz, 1954). The infusion of ideas from other cultures pushed Italian citizens to consider the inventions of Arabic and Asian citizens and to desire a deeper understanding of ancient Greek texts. In the universities of Italy, a significant shift in ideas about the works of antiquity began to take place. This interest led to the rise of humanism, the focus on the "immensely rich literature in Latin and Greek…which demanded study for the better understanding of the power of the human spirit" (Wightman, 1962, p. 12). This movement was encouraged by Francesco Petrarch an Italian writer and poet of the fourteenth century (Drees, 2001). Because of his immense fame throughout Italy, his insistence that ancient works be studied and embraced was entertained by universities. Humanism, however, was not just about studying the ancient texts. It was also about being critical of those texts and improving them when inaccuracies were found. Several of the great Renaissance thinkers were trained in the humanist tradition: Andreas Vesalius, Galileo, and Martin Luther (Grendler, 2004). The advancements in science, mathematics, astronomy, and medicine by these men and others paved the way for the Scientific Revolution.

The Renaissance was critical to the advancement of medicine. The two most influential figures in this area are Leonardo da Vinci and Andreas Vesalius. Da Vinci is historically significant because of his wide range of interests. He was an inventor, an artist, a scientist, and a mechanical genius (Artz, 1954; Ronan, 1982). Although the sketches he left in all of these areas influenced men of the Scientific Revolution, his drawings of anatomical dissections may have influenced a later Renaissance physician, Andreas Vesalius, whose works would put the incorrect theories of Galen to rest permanently. As a teacher at the most famous medical school in Europe, the university at Padua, Vesalius would make advancements in human dissections, anatomical drawings, and ultimately publish an immense medieval text, *The Fabric of the Human Body* (Ronan, 1982).

The most noted mathematician of the Renaissance was Fraņcois Viète. Viète, however, was not allowed to spend his time consumed in mathematical contradictions and formulas. Instead, he was a employed by Kings Henri III and Henri IV to decode letters from foreign enemies (Nahin, 2010). In spite of his duties to the royal court, Viète was able to clarify complex mathematic concepts in trigonometry and algebra. His contributions would allow these mathematical operations to be more accessible for generations to come (Ronan, 1982).

Nicolas Copernicus and Galileo made great leaps in astronomy during the Renaissance. Their contributions to heliocentric theory and planetary rotations debunked the long-held belief that the earth was at the center of the universe. Copernicus was a true Renaissance man receiving degrees in law, medicine, and philosophy (Spangenburg & Moser, 1993a). Once receiving a canonry, an appointment to a cathedral chapter, Copernicus set about building an observatory from which he developed his heliocentric theory outlined in his book *De Revolutionius Orbis Coelestium* (Ronan, 1982). Interestingly, there was little condemnation on the part of the Pope. Criticisms did arise by some of his contemporaries, but Copernicus' theories, it was decided, were helpful in determining the placement of the planets but his heliocentric theory was discarded as a ridiculous notion (Gingerich, 2011). Galileo was not as fortunate as his predecessor in posing the heliocentric theory. Perhaps it is because he was able to mathematically prove the theory about which Copernicus had only speculated. "Instead of just reasoning his ideas through logically, in the manner of…his contemporaries…he measured time and distance and *introduced mathematics into physics*. Then he tested and proved his point by experiment" (Spangenburg & Moser, 1993a, p. 53). This made Galileo dangerous to the Roman Catholic Church which had launched a Counter-Reformation in response to Martin Luther's Protestant movement. Ultimately, Galileo was put on trial by the church and imprisoned for his views because he refused to recant them. Galileo's contributions to mathematics, science, physics, and astronomy would be the springboard for many great scientists of the seventeenth century.

A discussion of Renaissance science is not complete without recognizing the impact the Protestant Reformation and the Age of Exploration on society. The Protestant Reformation began in 1517 when Martin Luther nailed 95 Theses to a cathedral door in Germany. Meant as a proposition for debate, the criticisms listed therein began a maelstrom of activity as the Roman Catholic Church was fractured from within. The response of the Catholic Church was swift and harsh. Anyone believed to speak or write against the teachings of the Church was put on trial for heresy. This is the movement in which Galileo finds himself embroiled. Ronan writes of the impact of the Protestant Reformation and the Counter-Reformation:

> All this…was to have a profound effect on the growth and practice of science during the Renaissance and for long after….the Protestant attitude…stimulated scientific research. The scientific stimulus was caused by the wish to use discovery to create an orderly and coherent picture of the universe, with a view to uncovering more of Gods handiwork (1982, p. 273).

The political and religious uproar of the Reformations occurred as the Age of Exploration was reaching its height. The new lands found by the explorers along with the advancements in geography, cartography, and astronomy led people to consider that theories long held about the kosmos could be wrong. The splintering of the Church coupled with the Age of Exploration impacted the world exponentially as Gutenberg's printing press sent information of new theories and ideas around the world. It was in this climate that the Scientific Revolution began.

Scientific Revolution

The Scientific Revolution of the seventeenth century is marked not only by new insights in the fields of astronomy, physics, and mathematics by René Descartes, Robert Hooke, Robert Boyle, and Isaac Newton, but also by the great shift in scientific inquiry implemented by Francis Bacon. This is also the century when scientific communities move away from their historic homes in the universities allowing educated citizens of Europe to participate in the validation of laboratory science through institutions like the Royal Society in England and the Académie Royale in France. The advances in thought, method, and technologies during the Scientific Revolution ultimately end the domination of the natural philosophers of ancient Greece and usher in the era of modern science.

Francis Bacon was a philosopher in the early seventeenth century largely credited with moving scientific inquiry away from the Aristotelian method of deductive reasoning characteristic of the Greeks (Spangenburg & Moser, 1993a). Bacon believed that scientific progress had slowed due to the obsession by scholars with the works of ancient Greece. "Bacon's view of scientific method was essentially experimental, qualitative, and inductive" (Mason, 1962, p. 145). To this end, Bacon was known to create Tables of Incidents (Henry, 2002) that would allow him to study small elements of a larger problem to draw a conclusion based on the holistic evidence gathered. Although, Bacon's greatest contribution was his belief that science began with experimentation rather than theory leading to today's scientific method, he also contributed to the advancement of science with his notion that heat is caused by motion and that time is measureable (Hakim, 2005). These theories would gain momentum and be expounded upon and proven by Isaac Newton a few decades later.

René Descartes disagreed with Bacon's method of inductive inquiry preferring instead to stay true to the deductive reasoning of Aristotle. Perhaps most known for his contributions to philosophical thought with his works on mind-body dualism, Descartes also played a significant role in the advancement of mathematical concepts. Descartes argued that there must be order to the universe (Davis, 1988). This argument was not new, and Descartes wondered at the slowness of scientific progress in solving the mysteries of this order. He concluded that "the shortness of life and the slowness of thought" (Davis, 1988, p. 38) led to a lack of continuity in scientific inquiry. Descartes latches onto the idea of a uniform scientific method that would allow scientific progress to transfer from one generation to the next without interruption. To this end, he developed mathematical formulas that could be used in scientific experiments to prove the order of the universe (Spangenburg & Moser, 1993a).

The attempt to validate the experimental methods of science occurred largely under the supervision of Robert Hooke and Robert Boyle of the Royal Society in London. Robert Hooke was a co-founder of the Royal Society and an early assistant to Robert Boyle. Hooke believed that many of the problems of experimental science were a direct result of the small capacity of human senses for adequate observation. His solution to this problem was the invention of new and better instruments for observation (Shapin & Shaffer, 2011). Micrographia, published in 1665, outlined new theories of light waves and exposed the need to enlarge the senses "with Instruments, and, as it were, the adding of artificial Organs to the natural" (Hooke quoted in Shapin & Shaffer, 2011, p. 36). To this end, Hooke built an air-pump for Robert Boyle that became the symbol for experimental science.

Robert Boyle uses the air-pump to experiment with the elemental nature of air. The Greeks had determined that air was one of the four ancient elements. By using the air-pump, Boyle is able to show that air must be made up of smaller elements. His recordings of experiments expose his belief in small particles that he called corpuscles, we call them atoms (Hakim, 2005). The air-pump also proved the elasticity of air and allowed for the creation of a vacuum (Shapin & Shaffer, 2011). A pneumatic experiment with a bird proved that the bird would die without air. The bird was placed inside the air-pump, and the air was slowly pulled out. The bird expired shortly thereafter. The elasticity of air was proven by dropping a coin and a feather into the air-pump after air had been removed. The two fell at the same rate of speed much to the amazement of witnesses (Hakim, 2005; Shapin & Shaffer, 2011).

It is at this point in history, that validation of scientific theories began to be questioned. For example, the long-standing rivalry that led to theoretical challenges by Thomas Hobbes to Robert Boyle based on the integrity of instrumental experimentation led to Boyle validating his findings before groups of witnesses (Shapin & Shaffer, 2011). Witnessing became instrumental if one hoped to advance his theories to the public. The novelty of performing experiments in a public space was questioned by many. "Nevertheless, what Boyle was proposing, and what the Royal Society was endorsing, was a crucially important move towards the public constitution and validation of knowledge (Shapin & Shaffer, 2011, p. 78).

It is in the midst of the debates between Boyle and Hobbes and the influential works of Hooke on the use of instruments that the greatest mind of the seventeenth century developed. Sir Isaac Newton was a contemporary of Hooke and Boyle. He was a loner and often difficult to contend with even under the best of circumstances (Hakim, 2005). Newton was a mathematician and a physicist. He combined both the inductive reasoning of Bacon, the deductive reasoning of Descartes, and mathematical formulas for use in the natural world to formulate a scientific method that exposed solutions to problems of gravitational pull, laws of motion, and the elemental design of nature. Perhaps the most fundamental advancement made by Isaac Newton was his postulate that "nature has basic laws that are the same everywhere in the universe" (Hakim, 2005, p. 181). The paradigm shift known as the Scientific Revolution led to intense investigations into the natural world and the solar system. Newton's discoveries proved that there was much more to be learned about ourselves and our universe. Newtonian theories were seldom questioned until another paradigm shift in the scientific world almost three centuries later advanced Einstein's theory of relativity disproving the absoluteness of time and space proposed by Newton.

The Enlightenment

The era of the Enlightenment is often marked as the period of time from the late seventeenth century to the late eighteenth century. Some historians date its ending with the United States' Declaration of Independence in 1776 while others mark the ending at the storming of the Bastille marking the beginning of the French Revolution in 1789 (Spangenburg & Moser, 1993b). This era of history is noted for its reliance on reason and the experimental method to determine truth. It is also an era that struggled for intellectual freedoms from political and religious authorities. Kant defined the Enlightenment as

> …man's release from his self-incurred tutelage. Tutelage is man's inability to make use of his understanding without direction from another. Self-incurred is

> this tutelage when its cause lies not in lack of reason but in lack of resolution and courage to use it without direction from another (1784, p. 1).

Kant believed that men should seize upon the explanations of the universe provided by the Scientific Revolution and publicly debate new ideas of order and efficiency in all areas of life. By largely eliminating emotions and imagination from the quest for knowledge, Enlightenment thinkers would attempt to promote science as the absolute authority of the universe.

François Marie Arouet, most well-known by his pen name, Voltaire, was a champion of the Enlightenment. After spending his early years in service to the French court, Voltaire moved to England where his ideas about freedom, liberty, and reason were nurtured. He returned to France and began his first work as a French philosophe (Shank, 2010). Seeking to show that progress, or human enlightenment, could be achieved through scientific reasoning applied in all areas of society, Voltaire penned two works praising Newtonian science. The first was *Letters Philosophique* published without Voltaire's permission in 1733 and expounded upon the following year in another, more legitimate publication. These letters on the English culture witnessed by Voltaire, ultimately inspired Frenchmen to abandon the mistaken notions of their countryman Descartes for the improved theories of the Englishman, Sir Isaac Newton. To smooth the transition, Voltaire wrote

> I indeed believe, that very few will presume to compare his [Descartes] Philosophy in any respect with that of Sir Isaac Newton. The former is an Essay, the latter a Master-Piece: But then the Man who first brought us to the Path of

> Truth, was perhaps as great a Genius as he who afterwards conducted us through it (1734/1999).

By allowing the French to maintain their respect for the genius of Descartes by placing him as the precursor to Newton, Voltaire opened the way for Newton's ideas in a country previously inclined to disregard an Englishman as more enlightened than one of their own.

Following Voltaire to the alter of scientific reasoning and discovery were Denis Diderot, Jean le Rond d'Alembert, Joseph Priestly, Henry Cavendish, and a host of Parisian intellectuals debating in the homes of salonnières. Diderot and D'Alembert are most influential in recording the scientific, mathematic, and technological progress made during the era in an exhaustive volume of work known as *Encyclopédie* (Spangenburg & Moser, 1993b). Joseph Priestly was an English chemist that is notable for several studies including those on electricity and on air. He is perhaps most famous for discovering the components of oxygen (Hakim, 2005). "Henry Cavendish has been called the greatest experimental scientist of the eighteenth century" (Hakim, 2005, p. 250). Through multiple experiments, Cavendish showed that hydrogen will become liquid when burned thus proving that water itself was not a fundamental element as had been believed by the Greeks (Spangenburg & Moser, 1993b). The salonnières, intellectual women of wealth in France, opened their homes to philosophes and others for open debates on topics of science, mathematics, technology, religion, and politics. The role of these women in the progression of ideas through the Enlightenment has long been debated. The philosophes of the era, however, recognized the intelligence of these women and the need to have their governance in debates so that they would not decline into argumentative chatter (Goodman, 1994).

The impact of the Enlightenment on religion and politics must be along with the advancement of rational thought. Voltaire envisioned a future era when enlightened citizens would have complete intellectual freedoms and have no fear of retaliation by authoritarian figures whether they be of the church or of the state. “With the triumph of science came a sort of intellectual prestige that made it a model of what rationality should be. The Enlightenment of the eighteenth century took scientific thought as the basis for human progress” (Sutton, 1995, p. 5). Now that science was fully recognized as the essential ingredient for progress, the church and the governments began to be challenged. This challenge will allow scientists in the nineteenth century to ask controversial questions about the origins of life and creation of the universe.

Romantic Science

Perhaps as a reaction to the instrumentalism of Enlightenment science, a new approach to scientific research emerged coined Romantic science. Richard Holmes marks James Cooks’ voyage around the world in 1768 as the beginning of this movement and the voyage of the 1831 *HMS Beagle* carrying the naturalist Charles Darwin as the end point (Holmes, 2008). Amazing progress was made during this era by many scientists in the areas of chemistry, physics, astronomy, and biology, but the scientist that embodied the spirit of the Romantic Movement was the German naturalist Alexander von Humboldt.

The Romantic scientists, referred to most often as naturalists, rebuked the Newtonian science that sought to weigh and measure everything as individual elements of nature. Naturalists intended to explore and understand nature in a holistic sense. “In Humboldt’s view, the science the naturalist was aiming at was a picture from multiple angles, each one opening new paths to the discovery of nature's laws, serving the pleasure of both the intellect and the senses" (Bourguet, Licoppe, & Sibum, 2002, p. 120). This attempt to view nature through the senses meant that naturalists needed to experience nature not just read and study small parts.

The voyage of the *HMS Endeavor* in 1768 and the voyage of the Spanish vessel Pizarro in 1799 contained amongst the crews naturalists. Being a member of the crew was a privilege for naturalists and was a highly sought after appointment. Joseph Banks became famous after travelling around the world with Lieutenant James Cook. The crew embarked on a fabulous exploration of the island of Tahiti where Banks collected many specimens for observation and measurement. True to the Romantic spirit, the collection offered Europeans an ephemeral glimpse into the world of the indigenous Pacific islanders. It combined "natural history with ethnology and human artifacts" (Holmes, 2008). This expedition and another by Cook in 1777-1778 heavily influenced Alexander von Humboldt who set sail aboard the *Pizzaro* to study the Americas. Humboldt would spend five years in the Americas measuring, mapping, drawing, and exposing the culture and the natural environment of the new continent. As part of the narrative of his experiences, Humboldt lamented the annihilation of many of the indigenous peoples and their lands. In addressing Europeans, he hoped "to 'witness' experience to those who never left, to ask what it means, what is happening to the larger human community" (Walls, 2009, p. 155).

In Europe, scientists were building on the advances of the Scientific Revolution. By 1800, Humphry Davy was a well-known chemist in England. He was mesmerized by the change in the field of chemistry which had finally shrugged off the vestiges of alchemy. The task for chemists was to determine the elemental components of compound substances. Davy's contribution to this field was the discovery of six new elements (Hakim, 2005). He and other

Romantic scientists believed that “chemistry needed to be applied to the human condition itself: the workings of the human body and mind, medicine, the cure for diseases, and …these would provide the key to life on earth itself” (Holmes, 2008, p. 247). John Dalton advanced the field of physics in 1808 when he published his theory on the composition of elements. Dalton determined that the twenty-one elements that had been discovered differed due to varying small particles. His atomic theory posits that “each atom has a characteristic mass and that atoms of the elements remained unchanged by chemical processes” (Spangenburg & Moser, 1993c, p. 11).

Darwin created a paradigm shift in biology and sent shock waves throughout science. When Darwin set sail on the *HMS Beagle*, he took Humboldt’s accounts of his South American exploration with him (Spangenburg & Moser, 1993c). The five year voyage allowed him to experience nature, as it had with Humboldt, which ultimately advanced his original notions of geology and human biological progress over time. When visiting the Galapagos Islands, he found evidence of extinct tortoise fossils that were similar to but not identical to living tortoises on the island (Ronan, 1982). This revelation was the catalyst for his theory of evolution that was published in his seminal work *On the Origin of Species*. Darwin’s argument explained how differences among species could become so pronounced that the differences ultimately created a new species that was unable to breed with the original species (Spangenburg & Moser, 1993c).

Following the line of thought of the Cartesian-Newtonian paradigm, Frederick Taylor outlined a philosophy for a more efficient process for industrial production. *The Principles of Scientific Management* (2006/1911) examined the role of workers and management in relation to the rate of productivity. He proposed that workers should be given small, individualized tasks and should be taught to be expert and most efficient in those areas for maximum productivity rates. The management was to ensure that the top rates of productivity were accomplished. Taylorism, as it came to be called, flooded the workplace and was soon seized upon by educators as a way to advance American curricula. This assured the position of supremacy of the Cartesian-Newtonian paradigm even as new research paved the way for a more radical view of the universe.

Modern Science

The advances that continued through the 1800s launched an era of unimaginable discoveries in the 1900s. Dmitry Mendeleyev proved the existence of more elements and began the compilation of the periodic table. Hermann von Helmholtz advanced the First Law of Thermodynamics insisting that energy cannot be destroyed. Rudolf Clausius and William Thomson went further with the Second Law of Thermodynamics proving that processes move from order to chaos and never the other way in nature. Gregor Mendel discovered more proof to support Darwin in his study of pea plants offering that traits are passed from one generation to the next (Spangenburg & Moser, 1993c; Ronan, 1982, Hakim, 2007). Building on the great work of these men, scientists of the twentieth century were able to determine the makeup of the human species, harness energy for peaceful and destructive purposes, and launch men into outer space. The science of this most recent century moved quickly culminating in biotechnologies and posthuman hybrids by the 1990s. I will create a timeline of the most spectacular advances in science in the 1900s, but I most hope to show that this century made the most advances in the most fields of science at the most rapid rate ever experienced in human history.

At the turn of the century, JJ Thompson made a discovery that advanced Dalton's atomic theory. He found that atoms have an internal structure. After studying newly discovered x-rays in his laboratory, he began to speculate that something smaller than an atom could exist. After multiple experiments, Thompson was able to determine the electric charge of the particles and the mass was soon found proving that these electrons were indeed the smallest particles in the universe (Ronan, 1982). Soon after, Rutherford discovered the existence of the nucleus and the movement of the electrons (Spangenburg & Moser, 1994a). Once the structure of the atom had been established, the path was open for a discovery that would change the field of physics.

Max Planck is credited with the discovery of quanta, packets of energy. In a paper published in 1900, he explained that energy was divisible much the same way that matter is divisible. He came to this belief after studying light and discovering that "it is emitted and absorbed in discrete packets of energy called 'quanta'" (Malin, 2003, p. 3). This was a revolutionary thought. It meant that Newtonian physics would have to be reevaluated. Although Planck is credited with quantum theory, it is Albert Einstein that changes our perception of the universe through application of the quantum theory in arguing the existence of a fourth dimension, time.

Einstein's space-time continuum is outlined in his General Theory of Relativity published in 1905. Basically, Einstein argued that time is relative meaning that it is not constant for all people at all times. This was a mind-blowing theory and the basis for his Law of Relativity. Einstein began his work studying light beams. He determined that nothing is faster than light beams and so that would mean that light is constant in our universe and all perceptions of light are relative. This means that I may observe events occurring simultaneously, but you may observe the same events differently. Time and space are not different as Newton had believed, but they form a continuum that allows events in the past, present, and future to all be perceived as real in that time by that observer. Einstein wrote, “ For us believing physicists the distinction between past, present, and future is only a stubbornly persistent illusion” (quoted in Malin, 2003, p. 23).

In 1927, as Einstein was continuing his work, Werner Heisenberg outlined his unpredictability principle. By this point it was becoming clear that quantum theory was able to explain many more aspects of the universe than Newtonian physics. Those things too fast or too small to be observed by human senses could be understood through quantum theory. Heisneberg’s theory, however, was controversial within the realm of quantum mechanics because it proposed that scientists only had the ability to predict the outcome of an experiment at the subatomic level. Heisenberg noted that when an electron moves, it does not move in a predictable pattern. Because we cannot be certain what an electron will do when it moves, we cannot be certain about any outcomes but can only predict what we think will occur based on what we believe the electron will do (Spangenberg & Moser, 1994a). This theory bothered many scientists including Einstein who was more interested in finding certain principles that could link the universe.

In 1937, quantum theory had allowed great strides to be made in understanding the universe at the subatomic level. Two scientists, Otto Hahn and Fritz Strassman made an amazing discovery as they bombarded a uranium atom with protons. They split the nucleus of the atom which produced large amounts of energy (Spangenberg & Moser, 1994a). It was soon determined that the energy given off could be used to split another nucleus causing a chain reaction. If all of this energy could be harnessed, it could be used to create the most power bomb in any nation's arsenal. The United States would be the first nation to successfully detonate an atomic bomb effectively ending WWII. Before detonation, some scientists, including Einstein , raised moral and ethical questions about the lethal power of this bomb. Although science had caused people to question its ability to hurt or heal throughout time, the creation of such a deadly weapon made people question the authority of science.

As developments in quantum physics advanced through the early 1900s, so did the advancements in the new fields of molecular biology and genetics. The invention of better technologies allowed scientists to look closer at the basic building blocks of humans and to begin manipulations of those building blocks. Many discoveries about the structure and functions of human chromosomes led to the ultimate discovery of the double helix structure of DNA in 1951 (Ronan, 1982; Spangenberg & Moser, 1994b). Once this discovery was announced, scientists began to manipulate the structure of DNA and to wonder at the potential of genetically engineering species to certain specifications. It only took 16 years after the discovery of the DNA structure for the first cloning on record to take place. In 1967, the vertebrate of a South African clawed tree frog was successfully cloned by a British scientist (Spangenberg & Moser, 1994b). By 1973, two scientists had been successful in splicing a gene to insert preferred material into it leading to the gene copying the new material rather than the original material (Judge, 2003). This experiment is viewed as the first success in the field of genetic engineering. Just as the atomic bomb led to serious discussions about the authority of science, so did this new ability of genetic scientists to alter the organic composition of a living being. In 1974, the first conference on genetic engineering was held to outline guidelines on how to proceed with this new understanding (Spangenberger & Moser, 1994b).

In the era of modern science, a new way of gathering and understanding information began. In 1938, Claude Shannon was asked by his employer Bell Laboratories to determine how many conversations could be carried across a phone wire at any given time. Shannon analyzed phone messages using Boolean logic (a system of coding information using 0s and 1s developed by British mathematician George Boole). Binary codes allowed the conversation across a phone wire to be translated into binary code, mathematically processed, and then translated back into phone messages (Hakim, 2007). This was the beginning of classic information theory and the end of information gathering simply through natural observation or cultural text. According to Albert Borgmann (1999), natural, cultural, and technological information gathering exist today simultaneously, but technological information gathering threatens to overtake the others simply because of the amount of information available. He states, "…clearly technological information is the most prominent layer of the contemporary cultural landscape, and increasingly it is more of a flood than a layer, a deluge that threatens to erode, suspend, and dissolve its predecessors" (1999, p. 2).

As information theory races forward, quantum informational theory is now being formulated by computer scientists seeking to apply the principles of quantum mechanics to digitization. This would allow a computer to process multiple computations much faster than traditional computers (Raisinghani, 2001). In quantum informational theory, the observer will likely play a role in the outcome of the probability computations. This is strikingly different from classic information theory where we were simply observers of the computations done by the computers (Hakim, 2007). What will this mean for our relationship with computers in the future? It is difficult, if not impossible to predict. The unpredictability theory postulated by Heisenberg would apply to digitization only allowing us to predict a human-computer dynamic but not allowing us to know with certainty the outcome of such collaboration.

Impact of Paradigm Shift on Curriculum

Even as the scientific community seeks to understand the theories postulated in the past century, society seems unable or unwilling to break from the Cartesian-Newtonian paradigm of the Nineteenth Century. David Bohm, noted physicist and philosopher, examined two reasons that explain society's reluctance to embrace a more relevant paradigm. Fragmentation refers to humanity's desire to break all things down into smallest parts in order to analyze and understand them. According to Bohm, the problem with fragmentation is that it gives "rise to a reality that is constantly breaking up into disorderly, disharmonious, and destructive partial activities" (Bohm quoted in Tremmel, 2006, p. 19). In schools, this translates to breaking down ideas and taking information out of context in order to push understanding of specific standards rather than examining the whole of idea. The second problem is referred to by Bohm as "program thinking" and explains that humans are always tempted to hold onto paradigms even if it is understood that they are outdated. Essentially, it is difficult for humans to step out of their comfort-zones even if stepping out would lead to progress. Holding onto paradigms and comfortable ways of thinking gives a sense of security to the person clinging to it.

According to Tremmel, the way to push a new curriculum is to expose society to the necessity of a new paradigm. The introduction of quantum, string, and chaos theories should encourage a new paradigm shift in our thinking and in school curricula specifically. Tremmel (2006) argues that there are four ways to push this new paradigm that would force a disruption in the Cartesian-Newtonian paradigm perpetuated by Taylorism. First, people must be encouraged to pursue alternative point-of-view. I have also argued this point. It is imperative that people be pushed to consider ideas that cause discomfort. After exposure to new ideas, people may still hold onto previously held notions, but the only way to encourage a paradigm change is to expose as many people as possible to other ways of viewing the world. Secondly, educators should encourage ways of thinking based on connectedness as seen in new scientific theories, rather than thinking in fragments as the older paradigms suggest. The third way to encourage a new paradigm is through activity theory which "requires that educators think in terms of interconnected activity systems that take into account not just the doer and what is to be done, but the doing itself as well in all its manifold connections" (Tremmel, 2006, p. 33). Finally, Tremmel notes that literary studies will play a role in a paradigm shift. Literacy studies allow students to explore "non-traditional and non-verbal literacies" (2006, p. 35) in order to take up a discussion of the interconnectedness prevalent in our world. This interconnectedness is imperative in this age of technoscientific progress. A deeper understanding of how the technosciences and liberal arts complement one another will only give more weight to Tremmel's arguments of interconnectedness drawn directly from the new theories of science of the last century.

Progress of science

In this brief history of science, I have attempted to show how humanity has progressed from an ancient era that believed that all things in nature are determined by the whims of gods to an era of supercomputers, digitization, and posthuman hybrids. While this progression took hundreds of years, most of the progress occurred in the twentieth century with the aid of technology. Now, through advances in quantum theory, molecular biology, and information theory of the 1900s, we embark on a new century where advances in technosciences will only increase in an exponential manner. Our interactions and our dependency on technology appear to be a permanent reality. The questions posed by atomic theorists, molecular biologists, and informational theorists throughout the last century have yet to be answered. Is it possible to advance the technosciences in a way that will advance humanity without the risk of doing irreparable harm? This question has pushed the literary imagination of the last century to take up the dark possibilities of a technoscientific world left unchecked.

CHAPTER 5

SCIENCE FICTION IN THE CLASSROOM

"All fiction is metaphor. Science fiction is metaphor"
(Le Guin, 1976, p. 5).

"No other genre is so free to imagine the possibilities
of other worlds, societies, and times as science fiction"
(Sullivan, 1999, p. 1).

The creation of artificial intelligence during the 1920s and 1930s thrust innovative societies into a new era to be characterized by the use of technologies rather than industry. The technology revolution that held the remainder of the 20th Century in a firm grasp demanded the development of machines that could replace human labor.

> Farmers used personal computers; manufacturing firms installed programmable robots; home-based businesses relied on the Internet to go global. The examples are everywhere and endless: computer-based training of first-graders; computer-driven rockets and smart bombs; computerized data collection on factory floors and at supermarket registers; software-based simulation models for economists, astronomers, consultants, political pundits, and all our weather forecasters (Cortada, 2004, p. 4).

By 1960, it seemed that computers were becoming common place in American factories and corporations. They were, however, still relatively new and continued to cause frustration amongst programmers (Cortada, 2004). This began to change in the latter part of the 1960s due to a surge of computer-literate graduates. "…in the early 1970s, at a time when computer was synonymous with mainframe, with large centralized units," (Stone, 1996, p. 100) technological institutions like Massachusetts Institute of Technology began graduating students with the ability to increase society's interactions with the computer. This understanding of classic information theory was imperative to the introduction of creative interfaces like ATARI during the 1980s. The next two decades saw the surge of personal computers as the internet introduced day-to-day society to globalization.

At the turn of the century, developed countries began to look for ways that technology could complement and help nature. This meant that scientists were beginning to seek ways to enhance human life by using technologically advanced methods of healing and prolonging a quality life. Because society has become so dependent on personal computers, the newest interactions between technology and people are not alarming. We fully expect technological advances to make life easier, better. Little discussion is given to negative consequences of biotechnologies as the focus is solely on progress. With this advent, we may be convinced that Katherine Hayles is correct in admonishing, "Henceforth, humans were to be seen primarily as information-processing entities who are essentially similar to intelligent machines" (Hayles, 1999, p. 7).

The advances in technoscience in the past century has created a society that is one of artificial intelligence, artificial organs, artificial limbs, and artificial knowledge. It is with this understanding that I began to wonder about the future of the United States populace, specifically the students that I will encounter in my classroom. As an educator, it is imperative that I contemplate the future of the students that I teach. In attempting to craft an understanding of posthumanity for the next generation, I find that an interrogative look at classical and popular science fiction can give many answers to the uncertainty of our future.

Science fiction has historically been viewed as a low-culture genre of literature (Higgins, 2001) unworthy of study in any formal educational institution. I challenge this outdated notion. I believe that science fiction will advance the twenty-first century classroom in two ways. First, by studying science fiction, students will be presented with the potential of scientific advancements. Higgins states, "but SF retains a strong influence upon how we engage with the present and anticipate the day after tomorrow" (2001, p. 1-2), Appelbaum promotes "science fiction's premise that the present is a history of possible futures" (2008, p. 175), and Jones writes that science fiction literature is "news from nowhere, not a report from the future but a parable of our times: a vision and a daydream and a warning" (1999, p. 15). In studying science fiction, students are faced with the challenges posed by technscientific advancements in terms of how they may be viewed by tomorrow's society. Children will be asked the question: What is your responsibility to future generations? Secondly, science fiction may be read as a metaphor for the hidden curriculum of students' lives (Appelbaum, 2008). Using science fiction to read the cultural text of the society that our students are engaged in outside of the classroom will allow educators to explore lessons within the classroom that meet the curriculum needs of students. In this sense, I refer to the curriculum not of content, but the curriculum of lived experience. "Curriculum is an event. It happens and it passes" (Grumet, 2004b, p. 240). If she is correct, then we should encounter curriculum, live it, and walk away from it changed in some way by our encounter. If reading science fiction text is allowed to be an encounter with curriculum, we will be enveloped by a new, metaphorical understanding of a world with which our students enjoy an intimate relationship. By allowing science fiction text to cross the boundary from the low-culture masses to the high-culture of academia, teachers and students together will be allowed to explore the vision, daydream, and warning that Jones explains is within SF text. In this chapter, I want to explore the works of adult and young adult science fiction writers. Some of these authors have found themselves locked into the scifi genre while others have moved into mainstream literature circles. I will also explore scifi film to engage the text of this medium that is often embraced by students.

Science Fiction Literature

Do Androids Dream of Electronic Sheep?

"She must think she's human, he decided. Obviously she doesn't know"(Dick, 1966, p. 510).

I begin my investigation into scifi texts with Philip K. Dick who wrote the majority of his works in the midst of the enormous political and social upheaval of the 1960s. Critical readings of Dick's work usually show several common themes: "the current state of humanity's self-alienation; our cultural and personal paranoia; the failure of humans to empathize; the ontological despair of living within an industrial and politicized culture that manufactures "reality"; and so forth" (Easterbrook, 1995, p. 20). In reading one of his most popular works, *Do Androids Dream of Electronic Sheep?* (1966), one would encounter all of these themes. What might they tell us about our current and future societies?

Dick's work often includes the question of life. In this particular story, he examines his curiosity about the blurring of the human and technology by investigating how a human, Rick Deckard, interacts with his environment, specifically the androids that he encounters. This work investigates a future society in which androids have escaped from a colonized planet and returned to Earth. Deckard is charged with finding and eliminating these androids, but upon an encounter with a beautiful android, Rachel, he begins to struggle with the possibility that the organic has merged with the inorganic. Androids are separated from humans by their lack of empathy. Deckard begins to wonder if the androids that he is charged with retiring have actually begun to have human emotions. What implications should this have on his job? Prior to meeting Rachel, Deckard had gone about his work with little compassion for the androids, they were after all unfeeling machines. He questions whether he can continue with his career. He fears that his new moral quarrel will be detected by his superiors and have dire consequences for him.

This story also explores the manufactured reality of this futuristic (?) society. Deckard is desperate to hold onto the last vestiges of society prior to the nuclear war that made much of the earth uninhabitable. The dial up religion on the Mercer box gives him some semblance of connection to the rest of the human race while the electronic sheep on his roof provides him with the ability to show that he is distinct from the android race through the simple task of taking care of a pet. Throughout this book, we see the protagonist Deckard continue to struggle with the question, "What makes me human and, therefore, different from an android?"

In reading this classic work of science fiction in the classroom, students would be encouraged to consider that very question. There are several ways to investigate humanity in the classroom. Raham suggests a courtroom simulation that would put an android on trial. If the android can prove his/her humanity to the court, then they will be afforded the rights of humans, if not, they will suffer punishment (2004). Students would have to understand the biological components of humans, but for curriculum theorists, much more would be gleaned from this reading. Power relationships of society could be a primary focus. Students bring a hidden curriculum into the classroom that may be partially exposed in understanding the power relationships that they contend with on a daily basis both inside and outside the school. Power struggles are ingrained in our democratic culture. Giroux points out that cultural texts “would be analyzed as part of a ‘social vocabulary of culture’ that points to how power names, shapes, defines, and constrains relationships between individuals and their society” (2003, p. 126). With an understanding of power structure in society, the struggles faced by androids and bounty-hunters become metaphors for the daily interactions of students and society as students struggle with understanding their own identity much as Decker does in Dick’s classic work.

Snow Crash

“Da5id Meier…founding father of the Metaverse protocol…has just suffered from a system crash” (Stephenson, 1992, p. 77).

The cyberpunk era exploded with the release of William Gibson’s Neuromancer in 1984. Cyberspace and all of its possibility was exposed to the public launching Gibson onto the stage of elite sci-fi authors. In many cyberpunk fantasies, the use of drugs to slip into alternate realities is common although not necessary. Virtual reality plays a major role as human consciousness is transmitted into a utopian society free from the inadequacies of the physical body. In these societies, one can be whomever he chooses. Might we attempt to prevent aging? Sickness? Death? Within the virtual worlds created by sci-fi authors anything is possible including a drug villain that turns a utopic village in cyberspace into a dangerous realm that warns of new dangers that will attack the very wiring of the brain resulting in death.

Snow Crash is the title of the book, but also the name of a drug in Stephenson’s Metaverse. He explains that a snow crash is the complete destruction of a computer system. Amazingly, a snow crash has been found to work on computer literate humans by sending a virus into the brain through the optical nerve. When trying to determine how Da5id, who is not a computer, could be infected by the virus, Hiro, the protagonist, is told that Da5id is " '…a hacker. He messes with binary code for a living. That ability is firm-wired into the deep structures of his brain. So he's susceptible to that form of information'" (Stephenson, 1992, p. 200). Although the story centers on Hiro's search for the creator of snow crash, another part of the novel enthralled me.

Outside of the Metaverse, the wealthiest citizens have guard dogs, called Rat Things, that have an ability to attack quickly and viciously when they perceive a threat. After one attack, the heroine, Y.T., approaches an injured Rat Thing that appears to be burning itself up from the inside because its technology has been damaged. This is when we discover that the organic has been used to create an inorganic machine. "The black glass windshield—or facemask, or whatever you call it—has a hole blown through it. Big enough that Y.T. could put her hand through. On the other side of that hole, she can't see much….But she can see that red stuff is coming out from inside….The Rat Thing is hurt and it's bleeding" (Stephenson, 1992, p. 96). Amazingly we learn that dogs have been used to make these machines. They feel and communicate. In this futuristic society, android animals are created for protection. These androids, however, unlike those in Dick's work do have feelings. In reading a second scifi novel, we have reencountered the question of the android.

In a classroom, several current issues might be explored after a reading of Stephenson's book. First, an examination of cyberspace and the prosecutions of crimes committed in that space by real world officials could be discussed. Many have argued that there should not be outside regulation of cyberspace opting instead to allow the users of virtual communities to set their own standards of behavior (Smyth, 2009). Avatars in Stephenson's Metaverse can cut people off from access to certain areas by killing them. A social contract exists in the Metaverse, perhaps it should exist is any virtual community. Students may also be asked to create an avatar and community of their own for cyberspace. In creating an alternate reality, students may expose more of themselves and be more outspoken.

In pushing students to explore cyberspace, educators may use avatars to serve as metaphors for gender and racial political text in society. Students may embrace the ability to explore gender and race as they create themselves anew in a virtual world. How might they be treated differently in different skin? Donna Haraway seeks a world where gender has disappeared completely. Blaming the western culture for the bodily focus of women, she embraces the future of the flesh/machine duality that would erase vestiges of gender permanently (1991). In reading racial text in cyberspace, students may encounter a more difficult time shedding what Margaret Chon refers to as “material race” (2003). Although racial identities may be altered in cyberspace, white continues to dominant the technology. Chon (2003) gives two reasons for this. First, “the default setting for virtual race is White” (p. 238) and secondly, because white people tend to be more populous in online communities, “social norms, and technologies are in fact racially precoded and prearranged” (p. 240) pushing racial minorities to accept the norms of the dominant race. Understanding the socio-political text that encompasses race and gender, will allow students to seek change and demand power in the formation of their own identities.

Next

“Genes are facts of nature….Facts of nature can’t be owned” (Crichton, 2006, p. 529).

A fascinating twist in the realm of science fiction is encompassed in the biomanipulations tracked in Michael Crichton's novel, *Next*. In a speech given at a conference in Chicago on "The Legal and Ethical Issues in Michael Crichton's *Next*," Crichton concluded by stating, "…what I find is that people really do live in the past. They don't understand what is going on now. They focus on the future, which is absolutely unknowable. As a result, the change, which is happening right now in the present, is happening where no one is really looking" (2007, ¶23). He writes this book as multiple tales coalesced into one warning of the dangers of a society that does not have an adequate knowledge of technoscientific progress. Articles in publications ranging from prestigious journals to internet magazines were used to compile multiple scenarios that just skirt the edges of today's innovations. Everything from a transgenic human/chimpanzee, to kidnappings for genetic material, to custody cases being determined based on the genetic diseases possibly passed from parent to child are part of this tale. I was mesmerized by this novel after researching biomedical advances such as the DNA chip, gene patenting, and wet art. Unfortunately, I had to seek out this information. The general public may not know of these advances until it is too late to express an opinion. So, which way shall we go in biomedical research? Do we seek to defy death? To create a posthuman that fuses humanity with technology indefinitely? How do we teach our students to be critical citizens in the advancing technoscientific era?

"*Next*…serves its purpose as a first literary effort to map and chart the complex and emerging societal landscape of genomics" (Zwart, 2009, p. 172). In examining the field of genomics, students will become increasingly aware of the impact of the Human Genome Project. The joint press conference by President Bill Clinton and Prime Minister Tony Blair in 2000 announced the completion of the HGP. In this setting, Prime Minister Blair referred to the human genomic map as “a working blueprint of the human race” (Office of the Press Secretary, 2000, ¶ 28). Unfortunately, the metaphorical use of the blueprint to describe the genome project is misleading. The genome will not lead to a perfect replica for several reasons including basic evolutionary changes (Avise, 2001; Zwart, 2009). The once held belief that one could clone a human or animal exactly based on the DNA of the original organism is false. The blueprint metaphor does not take into account technological or environmental influences on the replicated organism that might change its behaviors or characteristics. This undoubtedly unintentional mistake is indicative of the misunderstanding by the public about what is actually happening in genomic research and what the public perceives to be happening (Zwart, 2009). Rather than the metaphor of blueprint, many scientists refer to the advances in the HGP as a map to be explored (Avise, 2001). This is closer to the way the completion of the HGP was presented by President Clinton in the press conference with the Prime Minister. The media and notable dignitaries were gathered in the East Room of the White House where President Thomas Jefferson had studied the map of the Louisiana Territory brought back by his aide Meriwether Lewis after his great journey to the Pacific Ocean (Office of the Press Secretary, 2000). Zwart refers to the map metaphor this way:

> Indeed the map metaphor is multi-dimensional, it involves multiple layers. It defines the HGP as a large-scale mapping endeavor, funded and coordinated by governmental bodies, supported by heads of state, and directed towards charting (as a more or less inevitable consequence, claiming and annexing) unknown territory (2009, p. 156).

In studying *Next,* students may begin a discussion about the problems that might arise as a result of technoscientific authority left unchecked by the populace. It may be equally important, however, to expose how the actions of powerful forces influence the creation of a multi-dimensional map.

Educators and students would benefit from exploring the way that human knowledge unfolds much the same way as a journey into an unknown territory in a multi-dimensional map metaphor. George Lakoff and Mark Johnson (2003) explain that "Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature" (p. 17). Their work in this area exposes how we use metaphors in all areas of our lives from work, to play, to money, to war. I believe that educators could play with the notion that "argument is a journey" (Lakoff and Johnson, 2003, p. 89) after reading Crichton's fictional account about the dangers of biomanipulations that may occur after the completion of a genomic map. To explain how an "argument is a journey" relates to our everyday speech habits, Lakoff and Johnson offer this: "One thing we know about journeys is that a JOURNEY DE-FINES A PATH….He *strayed from* the path. He's *gone off in the wrong direction*. They're *following us*. I'm *lost*" (2003, p. 91). The working map of the HGP sets the path for scientists to follow to determine the origins of disease, sickness, and other genomic markers. They will note when they have taken a wrong turn and they will consult the map again to make corrections. I believe that educators may use this same metaphor in determining the future of education. I differ with Lakoff and Johnson, however, on one main point in their explanation of the journey. They point out that the "journey de-fines a path" (2003, p. 91). I believe that the journey defines a path that is laid out on a map by one or more original explorers. I do not believe that in education we should show students this path as the only one worth taking. I believe it would be beneficial for our students to go "off in a wrong direction," to get "lost" (Lakoff & Johnson, 2003, p. 91).

I return now to the idea of the map as a metaphor for the classroom and show how the journey might be successful when viewed in an alternate way. Before we begin on this journey, we must realize certain characteristics that pertain to all maps. "Maps are unique. They show you things you cannot see….Maps see around corners. Maps banish horizons" (General Drafting Company, 1959, p. 8). Understanding the unique qualities of a map helps us to understand why genomists prefer this metaphor to that of a blueprint. It should also help us to realize that this metaphor is just as relevant for education as it is for the HGP. As educators, we must seek to give students the tools to be confident in following the maps laid out for them. Students should understand that their journey will be unique. Students will bring to the classroom their own set of experiences and must be allowed to use their skills and knowledge to explore the new terrains, to embrace the gift of sight that the maps offer. Our classrooms need to be places where students are encouraged to take this journey.

The Ear, the Eye, and the Arm

"How—how did you happen?" she asked.
Arm replied, "We all come from the village of Hwange, near the nuclear power plant."
"Oh, yes," said Mother. "That's where the plutonium got into the drinking water."
"Our mothers drank it."
(Farmer, 1994, p. 50).

The Ear, the Eye and the Arm (1994) is a young adult science fiction novel that explores the coming of age of three young siblings in a future Zimbabwe. The siblings, having been sheltered their entire lives by their father, determine to go on an adventure that would have them home before their parents could realize they had gone. Soon after leaving their home, they are drawn to a genetically-engineered monkey that helps trick them into a back room where they are kidnapped by a gang seeking to destroy Zimbabwe's power structure. The frantic parents hire three detectives that have special powers due to genetic mutations that occurred during gestation. The detectives follow the children throughout Zimbabwe trying to rescue them from the dangerous situations they encounter, but they always arrive just as the children have managed to slip away.

The children encounter danger in several places. Dead Man's Vlei is a toxic waste dump. Amazingly, the children are taken to this place after they have been kidnapped. The people living here fade into the waste so that it is difficult for the children to see them. Does this mean that the people there are no better than the toxic waste they pilfer through daily? These people live in despair without morals. The danger in Dead Man's Vlei is perceived and understood quickly by the children. They will ultimately escape to Resthaven, a wall-off area of Zimbabwe that the population is unable to enter. The children are allowed access, however, and initially believe this place to be utopic. "Tendai thought he had never seen anything so peaceful" (Farmer, 1994, p. 100). The people of Resthaven live according to traditional ways of their ancestors without technology or any modern conveniences. The children soon find out that life in Resthaven is not all that they had been led to believe. Children are separated and given specific gender roles, witchcraft is thought to be real, and disobedience is not tolerated. Dead Man's Vlei may serve as a metaphor for the toxicity of the moral corruptness of today's society. The toxicity began at the end of the twenty-first century when toxic waste was dumped in the area. Because toxic waste is a by-product of the advancement of technology, students may conclude that technoscientific progress is dangerous. Resthaven, however, should contradict that notion. Progress is not something to be feared. Instead, students may determine that the controlling and dominating nature of the elders in Resthaven poses much more of a danger because they refuse to allow any advancement that might diminish their power over the people of Resthaven.

The House of the Scorpion

"Matt's a clone," said Steven.
Emilia gasped. "He can't be! He doesn't—I've seen clones. They're horrible!..."
(Farmer, 2002, p.26)

The House of the Scorpion (2002) is one of Farmer's most read and discussed novels. I include a second work from Nancy Farmer because her books have been recognized by the Association for the Library Service of Children and have been given the prestigious Newberry Honor award. This puts her young adult science fiction work at the forefront of children's literature encouraging more interest in this genre among young readers. This work deals deeply with the complex issue of cloning. The story follows, Matt as he develops from a young child to a teenager of 14. Early in the story, the reader understands that Matt is being hidden by his caretaker, Cecilia. It is soon revealed that Matt is a clone whose purpose is to produce organs for his owner, a drug lord named El Patron. Matt learns of his purpose and runs away only to be captured when he crosses the border and forced into a labor camp. He is ultimately able to escape with some of the other boys. The story ends when El Patron dies after being poisoned by his trusted bodyguard. This frees Matt from his fate and, as El Patron's clone, makes him the successor to El Patron's fortune.

The obvious issue to address is the bioethics of cloning. Although cloning began in the 1960s, it wasn't until 1997 that the US Congress attempted to pass legislation to prevent any attempts to clone a human (Bonnicksen, 2002). This novel would certainly allow students to explore the ethical issues of biotechnology. Clones meet the requirements outlined for "being" human, but how would we determine where their rights begin and the original beings rights end? Realizing that the US Congress' legislation only bans cloning on humans and not on animals or plants may cause additional concerns. The Cartesian belief that animals are separate from humans because they lack a soul may cause a lot of discussion among animal lovers in the classroom.

Metaphorically, students may look around the cloning issue at the geographic space that lies between the United States and Mexico where Matt and his family live. This space is a new country given over to drug lords situated between two dominant countries. Are there third spaces like this in our society? As an educator, I hope to create a third space in my classroom to study curriculum as *currere*. Appelbaum relies on Pinar's description of *currere* as,

> a shift from analyzing the content of the curriculum …toward the experience…; it is a systematic and self-reflective study, using youth culture texts to interrogate the relations between academic knowledge and one's own life history, in the interest of both self-confirmation and social reconstruction (2008, p. 3).

A space that would exist between the dominant federal education standards and the school culture that seeks to push only a content curriculum. In this space, students will not be given predetermined learning objectives, but will be allowed to let texts speak to them in ways that will encourage self-reflection and self-understanding.

Science Fiction Film

Before investigating how science fiction film might be used in the classroom, we must understand how cinematic productions differ from literary works and how they might influence popular culture. Differentiating between science fiction literature and science fiction film is no different from differentiating between the two mediums as they relate to other genres. Perhaps one of the most striking differences between literature and film is the ability of film to "isolate and dissect a specific behavioral pattern" (Gilgen, 2003, p. 58). This does not pertain to literature. In literary works, one perceives "pictures, signs, or symbols" (Eidsvik, 1974, p. 16) as the printed word is heard by the reader whether internally if the work is read silently or externally if the work is read aloud. Literary works implore the reader to examine the entirety of the work even as images are promoted sequentially. The author does not allow the reader to proceed ahead of his timetable but encourages the reader to keep an eye ever on the horizon while reminding the reader of the memory of pages just turned. Serres explains it metaphorically. The reader is referred to as a sailor approaching land. He is worth quoting at length:

> The sailor is lost in the Bay of Kekova with its multiple inlets, rocky promontories, small islands, straits, outlets and narrow beaches, strange branchings, harbor basins and walls; all he sees of the bay are scenes, he can only comprehend it in its totality at the table of the watch and dreams of a great work, each book of which would describe or illustrate a total, beautiful and sufficient perspective of the bay, opening up and hiding the neighbouring vista, showing and covering its global geometry, longed for as a divine surprise or rejected as too

> great a task. But the constant level of the water condemns the sailor to rely on abstract thought or the stars, in order to see. He proceeds horizontally. The time of this great work, both unexpected and expected, percolates along the whole length of the navigation route or ramble, as it could be called, up and down, adventurous, but a knot in the volume of space, with repetitions, rediscoveries, novelties, and sudden grandiose visions (2008, p.238).

Philip Dick, Neal Stephenson, Michael Chricton, and Nancy Farmer allow the reader to discover the human-machine android, the animal-machine hybrid, the cyberspace reality, and the "biocybernetic reproduction" (Mitchell, 2005) of organic material into digital code in order to create new or replicated organic materials by inviting the reader on a journey much like that of Serres' sailor. What then of science fiction film?

Walter Benjamin's seminal essay, "The Work of Art in the Age of Mechanical Reproduction" (1935) outlines Benjamin's fear that the authenticity of art, what he refers to as the "aura," would be destroyed by photography and film. "The presence of the original is the prerequisite to the concept of authenticity" (Benjamin,1935, p. 3). When in the presence of an original work of art such as a Rembrandt's painting *Christ in the Storm* or, my favorite piece of art, the sculpture *Pietà* by Michelangelo, one contemplates the work alone or in the presence of only a few people. Benjamin worries, however, that this intimate contemplation dies with the advent of the replicated work of art (1935). In movie theaters, Benjamin observed masses of people distracted by the barrage of images removed from the art before them. He theorized that this distraction would encourage the masses to sit submissive to the cinematic production, mesmerized by what the cameraman chose to show them (Gilgen, 2003). Perception is fragmented preventing the audience from viewing the work in its totality.

> Distraction as provided by art presents a covert control of the extent to which new tasks have become soluble by apperception. Since, moreover, individuals are tempted to avoid such tasks, art will tackle the most difficult and most important ones where it is able to mobilize the masses. Today it does so in film (Benjamin, 1935, p. 14).

Benjamin was most concerned about how this persuasive art might be used in the wrong hands. In 1935, Hitler was Führer in Germany and Mussolini had imposed his Fascist regime in Italy. Benjamin worried that the loss of "aura" in art would open art to politicization (1935).

In hindsight, I believe that Benjamin's fears appear exaggerated though art and film historians still debate the points made in his essay. Surely, any work of art can be politicized. Film is no different. Film, however, does not destroy art. It instead allows us to view our reality through a different lens, from a different angle. While the mechanical reproduction of film does cut and splice images causing fragmentation, this allows "normally neglected details, individual body parts, and stage props…ephemeral things among the waste of history" (Gilgen, 2003, p. 59) to be discovered and analyzed.

In reviewing science fiction film, I want to focus on how the images onscreen are reflective of today's society and a promise of tomorrow's technoscience. George Lucas' original Star Wars film, *A New Hope*, was the largest grossing film of all time when it was released in 1977 (Silvio & Vinci, 2007). The complex issues surrounding one's search for Self are addressed by Lucas as is the issue of a technoscientific society. *Gattaca* was released 1997 investigating a near-future class structure divided between genetically-altered superior humans and the inferior "faith-birth" population conceived with no technoscientific intervention. The central focus is the genome and its potentially unethical uses. A final film that stirred society because of its special effects and new 3D camera model, *Avatar*, will be examined as it brought a new virtual reality experience to viewers while exposing racial prejudices and the attempted destruction of the "Other." Science fiction film is perhaps best summed up this way: "From the image of reality came the reality of the image" (Schmidt, 2003, p. 81).

Star Wars, Episodes 4-6

"Your overconfidence is your weakness."
--Luke Skywalder
(Lucas & Marquand, 1983)

George Lucas's first Star Wars trilogy exploded onto movie screens in 1977 introducing society to the ongoing fight between good and evil in the Galactic Empire. A popular culture following commenced making the *Star Wars* trilogies some of the highest grossing films of all time. There are many issues to be examined in these films and many authors have happily accepted the task of dissecting Lucas' scripts, choice of actors and actresses, inclusions and exclusions of people, ideas, and things. I want to look more closely, however, at how the *Star Wars* trilogies can be used in the classroom to encourage students to discover a stronger sense of Self in a globalized, technoscientific world. I believe this can be accomplished by examining the metaphorical personhood given to the Galactic Empire and the Republic in the first trilogy and by questioning how viewing these movies through this metaphorical framework has implications on how we view the journeys of the characters in the films in relation to our own search for identity.

In 1977, the world was introduced to Luke Skywalker, Princess Leia, and their dark nemesis, Darth Vader, for the first time. We were immediately captivated by the galaxy created in the imagination of George Lucas. Between 1977 and 1983, Lucas dazzled audiences with the epic battles fought between the evil Galactic Empire controlled by the Emperor and the Rebels seeking to maintain a free Republic. The first movie, *A New Hope,* begins with a message from Princess Leia of the planet Alderaan. She has been captured by Darth Vader and is being held on the battle ship, Death Star. She sends an SOS to the Jedi Obi-Wan Kenobi via the droid, R2-D2, asking for help in saving her planet. R2-D2 and C-3PO, a second droid, encounter Luke Skywalker on the planet Tatooine. Skywalker is ultimately convinced to help them find Obi-Wan Kenobi who will take him on as a Jedi apprentice. In order to help Princess Leia, Obi-Wan and his small group set out to find transportation to Alderaan. Han Solo, a smuggler, and his first mate, the Wookie Chewbaca, agree to take them for a fee. The Imperial forces of the evil Empire chase the group now aboard Solo's Millenium Falcon. After finding the planet Alderaan destroyed, the Rebels aboard the Millenium Falcon find themselves pulled towards the gigantic space station of the Empire, the Death Star. Here, they will encounter Darth Vader for the first time, rescue Princess Leia, and lose their comrade Obi-Wan to the light saber of Darth Vader. This first film ends when Solo and Skywalker are able to destroy the Death Star much to the appreciation of the Rebels and Princess Leia.

The second film, *The Empire Strikes back* (1980), continues the fight between the Empire and the Rebellion. Darth Vader was able to escape the annihilation of the Death Star and is determined to overtake the Rebel base on the ice planet Hoth. Luke Skywalker leaves the planet to seek the Jedi Master Yoda. He improves his abilities to use The Force (an energy produced by all living things in the galaxy) to fight the Dark Side. When Solo is captured by a bounty hunter and turned over to Darth Vader, Luke leaves Yoda to help his friend promising to return to finish his training. Darth Vader has used Solo's capture to bring Skywalker Cloud City where the two engage in a fierce battle. During this battle, Vader cuts off Skywalker's hand. Skywalker accuses Vader of killing his father when Vader reveals that in fact he is Luke Skywalker's father. Luke is rescued from Sky City by Princess Leia, fitted with a new hand, and the small group heads off to attempt to rescue Han Solo.

In 1983, the last film of the original trilogy was released. *The Return of the Jedi* launches the last battle between the evil Galactic Empire and the Rebellion. Having freed Han Solo and allied with the Ewoks on the forest planet, the Rebellion is poised for a final showdown with the Empire. Luke Skywalker decides to allow himself to be taken prisoner in an attempt to convince his father to turn from the Dark Side. Darth Vader has welcomed the Emperor of the Galactic Empire aboard a new and improved Death Star. When Vader and Skywalker meet, they are embroiled in a fierce battle during which the Emperor attempts to turn Luke to the Dark Side by pushing Luke to embrace the anger he feels towards his father. Realizing that Luke is gaining the upper hand in the battle against Vader, the Emperor begins to torture and kill Skywalker. Vader turns on the Emperor to save his son. In killing the Emperor, however, Vader is himself wounded and dies having finally turned from the Dark Side in the last moments of his life. The Empire is ultimately destroyed and the Rebellion celebrates its victory in what was thought to be the last *Star Wars* film.

Although I focus my analysis for classroom use on the first trilogy, it is important to note that the second trilogy has spawned as much discussion, criticism, and debate as the first trilogy. The first of the prequel trilogy was released in 1999. This second trilogy exposes the early life of Anakin Skywalker, his relationship with Padme (the mother of Luke and Leia), and his turn to the Dark Side. Recently, George Lucas sold his company Lucasfilm to Disney for $4.05 billion. Soon after, Disney announced a third trilogy would be released with *Star Wars: Episode 7* scheduled for a 2015 box office opening (Watercutter, 2012). It seems that the Star Wars saga will continue. We will finally learn what happens to the Republic after the defeat of the Empire. Exciting as the prospects for another trilogy may be, I do not believe that anything following the release of *The Return of the Jedi* (1983), can equal the cinematic revolution or the intergalactic richness of characters. With that being said, I want to take a closer look at the metaphors created in a galaxy far, far away.

George Lakoff maintains that we need to begin to see reason as embodied, removed from the traditional, Western mind-body duality (Slavestorms, 2010). He and Mark Johnson outline reason this way:

> Reason is not disembodied, as the tradition has largely held, but arises from the nature of our brains, bodies, and bodily experience. This is not just the innocuous and obvious claim that we need a body to reason; rather, it is the striking claim that the very structure of reason itself comes from the details of our embodiment….Reason is not completely conscious, but mostly unconscious….Reason is not purely literal, but largely metaphorical and imaginative (1999, p.3).

Based on this new approach to reason, I argue that in viewing the first trilogy of the *Star Wars* films, we give personhood to the Galactic Empire and the Rebellion to frame the battle in ways that make sense to us based on our conceptual frameworks. Lakoff states that the metaphor of countries as persons is something that society does on a regular basis. For example, we refer to developed nations in terms of being more adult nations, third-world nations as child-like nations, bad nations as rogue nations, or allies as friendly nations (Slavestorms, 2010). In the Star Wars trilogy, the Galactic Empire is evil and menacing. It pursues the Rebels throughout the galaxy (Galipeau, 2001). The Rebellion, on the other hand, is viewed as good, friendly, and honest. By giving these personal qualities to abstract governmental systems, we are able to make sense of those systems within our own conceptual frameworks.

Students may be urged to question how living in an evil Empire verses an honest Republic may impact an individual's identity formation. In the original trilogy, we learn that Darth Vader was once a great Jedi Knight, but when we are introduced to him he is an obvious cyborg. Obi-Wan Kenobi explains to Luke: "He's more machine now than man, twisted and evil" (Lucas & Marquand, 1983). In order to survive burns and injuries, Anakin Skywalker underwent intensive surgeries where his human system was linked to machines to keep him alive. By joining the dark side, he gives up his previous identity becoming Darth Vader and an integral part of the Emperor's dictatorial regime. "Hence, Vader's appearance…becomes an ultimate cautionary image of the dangers of conformity and how the lack of pure individual agency can lead to a perilous dependency that quickly becomes necessary for survival" (Vinci, 2007, p. 14). It is apparent that Vader's survival depends on the Empire and his compliance with the Emperor's wishes. Once he attempts to save Luke, a chain of events quickly unfurls. Darth

Vader kills the Emperor but does irreparable damage to the wiring that controls his own breathing in the process. Understanding that his death is imminent, he asks Luke to remove his mask symbolizing his turn back to the light side of the Force and his desire to reclaim his identity as Anakin. Now, looking at Luke without the mask of Darth Vader, Anakin tells him to leave the Death Star.

Anakin: Now... go, my son. Leave me.

Luke: No. You're coming with me. I'll not leave you here, I've got to save you.

Anakin: You already... have, Luke. (Lucas & Marquand, 1983).

Luke faces his own struggle as he grows as a Jedi. He understands the lure of the dark side and battles within himself to maintain control of the anger and hatred that threaten to consume him. An interesting insight into Luke's journey, however, occurs in the conversation that he has with Leia on Endor just before he goes to confront Darth Vader. He acknowledges that he has no recollections of his mother. Leia remembers her vaguely and mainly just in images. Although Padme dies just after giving birth to Luke and Leia, it is possible for Leia to have memories of her. "Most of the words we use in our inner speech, before speaking or writing a sentence, exist as auditory and visual images in our consciousness" (Damasio, 1994, p.106). Perhaps having this connection to her mother allows Leia to develop an identity without enduring the strong inner conflict found in Luke. The fact that Luke has absolutely no memory of Padme may be partially responsible for the fact that his identity formation develops more slowly and with setbacks at times. The absence of the maternal parent can cause problems in identity formation. "Without close maternal contact the nascent personality is directly exposed to archetypal realities and may be easily overwhelmed by them" (Galipeau, 2001, p.221). Many students will relate to the seemingly absent parents and the crisis in identity that may develop as a result.

Princess Leia serves as the sole heroine in the original trilogy. Her character has also been the source of much debate. Was she a victim of her sexuality or an independent woman? While initially presented as a strong character in *A New Hope*, the image of Leia shackled, wearing a metal bikini, and waiting to be rescued in *Return of the Jedi* has been said to lend credence to the argument that the Star Wars galaxy is male-dominated and Lucas' female characters while "young, beautiful, headstrong, and titled…are not active presences in the way the men are" (Wetmore, 2005, p. 72). I was a little girl when this trilogy was released in theatres. I remember Princess Leia differently. Sure, she wore a metal bikini and was ogled at by Jabba and his minions, but I wanted to be Princess Leia. I wanted her strength and her independence and her confidence. She is the only woman in films that I was allowed to watch that I remember having those qualities in the late 1970s and early 1980s. I saw her as Diana Dominguez describes her:

> "…she transcends all of the stereotypes and archetypes: she is a princess, but not a damsel in distress; she is a warrior, but does not live solely by the sword or gun; she is a sister and, eventually, a wife and mother, but she never stops being a rebel; and, she exemplifies both traditional and feminist qualities of the hero, fighting dragons (or storm troopers) bravely and treating others equally" (2007, p. 120)

Princess Leia is marginalized only by the lack of literature about her influence in the movies. Google Star Wars, Darth Vader, or Luke Skywalker and hundreds of articles and books will be at your fingertips. Google Princess Leia and you will find online stores to purchase a costume or information about a possible upcoming role in *Episode VII*. For a character that had such a profound impact on young girls in my generation, it is telling that more has not been written about her. Educators must not allow a gendered curriculum to continue. One way to prevent this is to acknowledge the role that women like Princess Leia play in popular culture (Mayes-Elma, 2004). Understanding "children's popular culture grants insights into childhood consciousness and provides new pictures of culture in general" (Steinberg & Kincheloe, 2004, p. 20). It is only by opening this dialogue that we will empower the women of the next generation.

Gattaca

"Consider God's handiwork; who can straighten what He hath made crooked?"
Ecclesiastes 7:13

In 1997, a futuristic movie entitled *Gattaca* received very poor reviews from critics despite its all-star cast including Ethan Hawke, Jude Law, and Uma Thurman. The movie begins with the tagline from Ecclesiastes that forces the audience to ponder the ethics of genetic manipulation. As the movie progresses, we are shown the realities of a dystopic society arisen from the pursuit of genetic excellence. Those, like Ethan Hawke's character, that are not part of the genetic elite face "genoism," the prejudice against humans not genetically pre-ordered by their parents. Writer/Director Niccol pushes the audience to consider its own humanity by coining words like "de-gene-erate" and "in-valid" to describe the inferior population of *Gattaca's* milieu. The haunting thought is that today's human will be far inferior to the post-human portrayed in the film.

Scientists, politicians, and economists are seeking many of the genetic-identifying techniques that *Gattaca* exposes but not necessarily for the same usages. For example, when Vincent (Ethan Hawke) is born, a nurse immediately takes blood from his heel and reads his genetic sequence foretelling his susceptibility to disease, addiction, and violence. This sequence leads to his (in)ability to be educated, to work, and even to find a mate. Today's geneticists in the field of pharmacogenomics hope to read the genetic sequence of the population not to determine his/her potential abilities, but simply to prevent the onset of disease through proactive measures. Kaushik Rajan describes the invention of the Affymetrix chips, or DNA chips: "…the chip itself maps clusters of genes to provide broad views of gene expression" (Rajan, 2006, p. 139). I compare the future possibilities of this DNA chip to the type of device shown in this scene of *Gattaca*. It is not only the creation of DNA chips but the entire realm of personalized medicine that must be addressed in order to study the ethical implications of the post-human future.

The family of Jack and Lisa Nash provide an example of the moral and ethical dilemma brought to the forefront by the ability to manipulate our genetic makeup before egg implantation in the uterus. They were given the devastating news that their daughter, Molly, suffered from a rare and fatal genetic disorder. The best chance for survival for Molly was a cell transfer from an unaffected sibling. Jack and Lisa Nash made the decision to undergo IVF treatments in order to genetically test embryos for the disorder prior to implanting them in Lisa's uterus. The couple had a little boy that did not have the genetic disorder. The blood from his umbilical cord was taken at birth to provide the needed cell transfer. The Nashes have been criticized by some people for their actions (Rose, 2007). Although many people feel sympathy for the family and the horrible plight Molly faces, there is a deep concern about the precedent this type of embryonic selection creates. “The problem for many is that the frontiers of what is now genetically possible are being pushed back far quicker than the ethical debate can keep up with” (Oliver, 2000, ¶ 3). Is this the top of the slippery slope that bioethicists have warned us about? Will we soon be choosing the sex, hair color, eye color, and talents of our children? More in line with the Nash case, will we soon produce children for much more invasive procedures that may be needed to save those already living?

The designer baby metaphor causes us to pause and consider the consequences of paying to genetically alter our children. *Gattaca* underscores the complications of a society that allows designer babies to be conceived. Of course, designer babies will come at a cost. It is understood that only the wealthiest citizens of the world will be able to afford to genetically alter their fetuses. If this happens, a genetically superior population would assume a more powerful position in society, a position only available to the wealthiest among us. *Gattaca* is “a parable on racism and classism” (Dinello, 2005, p. 195). After viewing the film and discussing the creation of designer babies, students may explore science through a more ethical lens. While we may not want to ban the use of biotechnologies like those used to help choose the Nash’s son, we must always be aware of what a future based on genetic technologies may look like. By glimpsing the worst case scenario in *Gattaca* juxtaposed with the best case scenario of the Nash case, students may think critically about the advancing sciences while examining their own experiences with racism in classism in society.

Avatar

"Me and Norm were out here to drive these remotely controlled bodies called avatars. They're grown from human DNA mixed with DNA from the natives here" (Cameron, 2007, p.11).

An amazing accomplishment in cinemographic technology emerges in James Cameron's recently released movie, *Avatar*. On the science fiction planet, Pandora, James Sully fuses his consciousness with the grown body of his avatar. Although Sully is paralyzed from an injury received in the armed services, he finds he is able to walk through his avatar. Part posthuman and part jacked in avatar, Sully infiltrates the Na'vi that inhabit Pandora. His initial mission is to find the weakness of this people in order to move them away from the land that the "sky people" want to mine for a valuable mineral. Sully will eventually learn the ways of the Na'vi with the help of Neytiri, the warrior daughter of the leader of the Na'vi. What impressed me about this movie, aside from the dramatic storyline, was the possibility that we might do more in the future than simply slip through our consciousness into a virtual world, we might actually move and live in a different body. Embodiment begins to take on another meaning literally outside of the flesh, blood, and muscles of our physical bodies. Embodiment becomes 0s and 1s recreated into another body that is part human/part other…the lines blur between species, between machines and humans. In this way, embodiment loses itself to code becoming disembodied only to be embodied once more in a different physicality.

After watching this film, I kept wondering, "How could Sully keep his Self intact when he embodied his avatar?" In the skin of his avatar, he was able to retain his memories, thoughts, and emotions from his previous body. In discussing this with my husband, I kept using the metaphor of vision. Sully *sees* things in Pandora through the eyes of the soldier he was before accepting this mission. As he *watches* the Na'vi and *studies* their culture, he *views* them differently…with more compassion and understanding. Donna Haraway believes that vision allows us to claim the "doctrine of objectivity" (1997b, p. 254). She goes on to say that

> We need to learn in our bodies, endowed with primate color and stereoscopic vision, how to attach the objective…in order to name where we are and are not, in dimensions of mental and physical space we hardly know how to name (Haraway, 1997b, p. 254).

The experiences that we embrace throughout our lives are based on our five senses. Sight is arguably one of the strongest senses used to string connections between ourselves and our world. In Cameron's *Avatar*, Sully was able to embody his avatar after his thoughts, memories, and emotions were transcribed into binary code and transferred into an Other being. He opened his new eyes in a new body but remained the embodiment of what he had always been.

Binary codes have been used to transfer data digitally from one source to another but the type of transmission occurring in the film would only be possible through quantum mechanics. According to Plant (1997), quantum mechanics makes it possible for "an atomic particle…[to] be in two places at one time" (p. 254). In this way, Sully is able to embody his avatar and experience the world of Pandora while his body lies in waiting for him to return. If this were to be possible, however, if the atomic particle was changed in Pandora, it would also be changed in his waiting body, thus his waiting body would be forever altered by the experiences in the avatar. In the film, this does occur as Sully becomes more and more at one with the Na'vi people.

In a classroom, the metaphor of vision as it relates to embodiment may be explored. Haraway (1997b) believes that view the world through the lens of subjugated knowledge are best suited to see the possibilities afforded by new technologies because they see from below the power structure of technoscience and so are not blinded by its ability to transform embodiment but can bring the objectivity of situated knowledge to bear on any advancements. Many students may understand how their own situated knowledge forces them/allows them to explore the world through a different framework than that of their peers. Encouraging students to embrace their experiences will allow them to work through the ways that technoscientific advancements have changed and will continue to alter identity formation. I defer again to Haraway:

> These technologies are ways of life, social orders, practices of visualization…How to see? Where to see from? What limits to vision? What to see for? Whom to see with? Who gets to have more than one point of view? Who gets blinded? Who wears blinders? Who interprets the visual field? (1997b, p. 289).

Those who might critically consider these questions will enjoy the possibilities of technoscience secure in spite of the changes to embodiment that it might desire.

My Vision

Although science fiction fantasies are entertaining, I do not believe that we will ever travel in hover crafts or live in a house like the Jetsons. In the next fifty years, however, I do believe that we will encounter more and more citizens that have become posthuman through biomedical research and technoscientific innovations. Specifically, I believe that genetic testing will become commonplace. It will be used to determine the best form of treatment for various diseases. We will see genetic testing used to manipulate embryonic life in order to relieve a future person of genetic predispositions.

> …susceptibility promises, in the age of genomics,…more than risk assessment and risk management—more, that is to say, than intervention based on a correlation between factors such as age, weight, or diet whose link to the disease process may be unknown or distant. Susceptibility, it is claimed, is something that can be defined at the level of the individual's genome that predispose that person to the development of a particular disease or disorder (Rose, 2007, p. 87).

I also believe that we will move further into the use of virtual realities. There are already virtual sites that allow the creation of avatars that can shop, date, eat, and even go to classes. Technologies are being created that allow us to enter these virtual realms using more than just sight. Through screen technology, we will free our consciousness from physical embodiment and allow our senses to perceive sound, smell, and touch in the virtual realm. We will be "jacked in."

> Most remarkable of all, however, are the electronic dreams of down-loading human consciousness onto computers, dreams which take it for granted that he personality is a kind of software that does not need the body because it can be run with equal ease on any kind of hardware (Midgley, 2006, p. 123).

The outrageous situations outlined in sci-fi may allow us the opportunity to present technoscience advancements to our students in public education classrooms in order for them to research and contemplate the ethical questions that will arise as we move forward.

CHAPTER 6

A PLACE FOR ART IN A TECHNOSCIENTIFIC ERA

"…the teacher has, first of all, to be alive, not dead"
(Wexler, 1996, p. 147).

"It is a preparation for the 'job' of living,
which of course is not a job at all"
(Kronman, 2007, p. 14).

There is little dispute among scholars that technological progress to-date has changed our perceptions of place, time, language, information, and the intricacies of the human body. Unfortunately, there continues to be much debate about which academic disciplines, the sciences or the liberal arts, are most equipped to deliver progress in a technoscientific society. This hostility between the liberal arts and the study and practice of science has led to a fissure that has long forced a tense dance between the academic fields. I propose a cease-fire between the two camps. I believe that the liberal arts, while holding tight to their roots, have evolved and should not be viewed solely in a confined, historical capacity. Art, philosophy, and literature have always lent vision to science. To ignore this contribution is to endanger the technoscientific progress of the future. A new scholarly pursuit must be undertaken by curriculum theorists. One that at once gives credence to the introspection of the humanities while allowing for the future advances in technoscience. The focus of this final chapter lies here at the intersection of competing disciplines and in the literature that will shape the lives, both figuratively and literally, of future generations.

I believe that the current spaces occupied by the liberal arts and technosciences might meet, coalesce, and complement one another in an entirely new space in the university. Don

Ihde's discussion of the phenomena of the here-body and the virtual-body in his work *Bodies in Technology* will aid my discussion as I analyze embodiment within these spaces. The here-body is comprised of body one which encompasses our sense of space literally and body two which refers to the body that we encapsulate based on our experiences related to our sex, gender, ethnicity, or religion. The here-body is that which has been traditionally exposed to the liberal arts in society and within the walls of public schools and universities. It is the body most discussed by modernist. Postmodernists, however, may be more interested in the virtual-body referred to by Ihde or in the human-machine cyborg developed by Donna Haraway. These bodies are bound in the space of technoscience. An understanding of each is instrumental in understanding the classroom for the posthuman. Ultimately, I hope to show that the liberal artsand technosciences need not be relegated to polarities in academic discussion, but can merge for the advancement of students and society.

The University Today

The university structure of 2013 is dramatically different from the university structure three hundred years ago. When the first colleges began in the United States, they were based primarily on Christian teachings and the desire to promote a moral and conscientious class to lead the country (Eliot, 1923). There was an easy progression from this type of university to the liberal arts university. The liberal arts university drew on works of philosophy, literature, and art to provide students a way to answer the questions that we all strive to understand about the nature of life and the meaning of life (Kronman, 2007). By the mid-1900s, the university structure had changed dramatically. The research university took the place of the liberal arts university. "Education consequently had new aims….the pedagogical aim was not to develop the capacity for different kinds of understanding…but to transmit new knowledge and to give students the ability to do independent research" (Arndt, 2008, ¶33). This new structure slowly removed the liberal arts from its perch in the university and replaced it with more vocational centered interest.

The current "multiversity" is one of inflated grades and lower expectations. The term multiversity refers to the current university system that is run by administrators rather than educators. Under their control are educational departments, athletic programs, university medical facilities, contracts with corporations, shopping centers and restaurants, and a myriad of other services (Lasch, 1979). Having changed the purpose of the university has perhaps led to a lack of pedagogical focus by administrators. The fact that federal legislation such as NCLB has reduced educational rigor and stamina in the public school system only compounds the problem at the university level. Students are accustomed to demanding high grades for little work and multiversity administrators are more interested in the monetary bottom line than with actual academic instruction. It is in this environment that we must encourage a resurgence of humanities education that complements the technoscience field.

The challenge facing the university today is to link cultural reproduction and technological production. In the university as in the wider society these two forces are disengaged. On the one side are battles of cultural identity and on the other a market-driven capitalism is pervading the university, shaping the university in the image of technoscience (Delanty, 2001, p. 157). As I mentioned in my introductory chapter, I am seeking a third space for education. In order to accommodate that space, I will describe the current spaces of the humanities and the technosciences then push forward to where a mixed reality of the two might exist. I will also point to places in society where the two spaces have already merged in hopes of showing the university a way forward.

Space for Humanities (LR) vs. Space for Technoscience (VR)

"…we live not only in but also through and with space, it affects every area of human existence." (Benesch, 2005, p.15)

I define space as an intrinsic understanding of our plenary surroundings with the notion that those surroundings change according to modifications in lived experience and technological advancements. Accordingly, I base my discussion of space on the two realities, lived reality (LR) which defines our daily lives in our biological environment and is perceived through the here-body and and virtual reality (VR) which refers to computer-simulated environments that we may enter in a technological dimension with our virtual bodies. The cyborg fits between these two dimensions as it incorporates technologically simulated additions to basic biological functions. To begin, we must realize that for centuries LR was the only reality and any discussion of our embodied place was held in dialogues pertaining to classical liberal arts teachings. Conversely, current analysis of VR is held in light of postmodern theory. It is between the space of lived reality and virtual reality that current discussions of liberal arts may get displaced as liberal arts as a discipline is seen as belonging to an older, dated curriculum that has outlived its purpose in today's technology-driven society. It is necessary then to start a discussion of embodiment in space by focusing on the state of the humanities as they are encountered by students in today's schools. An understanding of the problems faced by the liberal arts in its current realm of education may present a solution to the question of where these studies fit in a technoscientific future.

Anthony Kronman explains that students should be exposed to liberal arts in the university:

> It [liberal arts] can help them meet the challenge of gaining a deeper insight into their own commitments, of refining for themselves the pictures of a life that has purpose and value, of a life that is worth living and not just successful in the narrower sense of achievement in a career (2007, p. 39).

As a teacher of history and student of curriculum studies I see the logic and truth of Kronman's statement. We all need exposure to those lessons of the past that help to root us in who we are as individuals and communities. I am also able to understand the desire of those outside academia to drive a vocational-centered curriculum for students within the university so that society will deem the child a success. The question then is how might educators play a role in reminding society of the critical role the liberal arts play in any education and in a successful life? How do we allow for the liberal arts to continue to occupy a space in the vocational-centered university? I believe that one way is by answering the charges of those that criticize liberal arts classes and departments in education. Frank Donoghue argues in his book *The Last Professors* that charges have been made against the liberal arts by members of the private sector of society. For example, "Figures such as Carnegie, Crane, and Birdseye asked what was the use of traditional academic studies to business?" (Donoghue, 2008, p.20) and some of these same critics argued "that the university professors are no different from other workers and should be managed accordingly" (Donoghue, 2008, p. 21). Why are we afraid to address these allegations? To cast them aside is to appear arrogant and elitist or worse incompetent and desperate to hold to a dying field of knowledge. In order to adequately address these questions, it is imperative that curriculum theorists interested in the survival of liberal arts education understand the space we as educators and students in public schools and universities move through in the technoscientific era of education.

The space that has been created for students in the lived reality of public schools is cramped by standardization and a push for performance driven data that will prove excellence. Bill Readings witnessed this same phenomenon in the universities. Writing of the tradition of the university he states, "intellectual activity and the culture it revived are being replaced by the pursuit of excellence and performance indicators" (Readings, 1996, p. 55). Any attempt by students to question the great works of the past is stifled as teachers push students to learn the facts that will be tested on state examinations at the end of the school year. A critical examination of the humanities is pushed further to the side in an attempt to expose students to maximum amounts of information in what is considered the important areas of education. There are no open spaces situated for the pursuit of intellectual growth. "From the first early-morning meetings of the administrative staff to the close of the school day, the students are managed, at worst as a potentially dangerous population, and at best, as a deficit self, to be classified, guided, or uplifted" (Wexler, 1996, p. 33). Perhaps some would argue that managing students and assessing student ability is necessary in determining future leaders, but these people are misled if they believe standardized tests and strict adherence to traditional modes of teaching are adequate forms of education and assessment that can truly show student ability. High stakes testing does not measure a student's knowledge but instead "undermines teacher autonomy, imposes harsh restrictions on academic labor, disables critical approaches to teaching,…and promotes pedagogical practices that supposedly 'measure' student progress while reproducing a tracking system that parallels the deep racial and economic inequalities of society as a whole" (Giroux, 2003, p. 90). Because the test must be uniform in nature and does not take into account differences in student ability, background, or interest, an atmosphere of intellectual conformity exists. Those who are capable of conforming to expectations will have an easier time moving through the suffocating space of public school hallways. Those that are unable or unwilling to conform will find that the Panopticon power structure of schools does not offer freedom of discovery through knowledge.

"I fear that national and state academic standards and tests will place a stranglehold on free thought" (Spring, 2005, p. 114). Like Spring, I question the motivations of a society that insists on creating intellectual conformity inside the classroom. I determined to look for the spaces that our bodies move through in order to account for this conformity/uniformity among the citizens we graduate. President Clinton's Secretary of Labor Robert Reich at the signing of the School-to-Work Act said, "There should not be a barrier between education and work. We're talking about a new economy in which lifelong learning is a necessity for every single member of the American workforce" (Reich quoted in Spring, 2005, p. 75). Although all scholars would agree that lifelong learning is important, Reich linked the economic superiority of the United States to the country's ability to produce excellent workers not knowledgeable citizens. By tearing down barriers between education and work, the government is systematically removing from society that hallowed space of academia where critical investigations and debate may freely take place. In its place, the government and big industrialists are seeking educational experiences for children that consist of vocational training for the highest paying jobs in a globalized economy. We now realize that the questions about the utility of the liberal arts posed by Carnegie, Crane, and the like are still being asked by modern members of the industrial sector. Our students are being taught to focus on skill sets needed for a vocation rather than on acquiring an education.

In this lived reality, the study of liberal arts is deemed irrelevant as bodies are situated to fit into spaces to be filled by worker, producer, and consumer. Science education has been promoted in schools for this purpose while liberal arts curricula are being pushed aside. It is at this critical juncture and with this understanding that scholars must face the charges of the private sector and give them the answers they have been seeking in regards to the liberal arts. We may do this by showing that the liberal arts programs are designed to be "a means to acquaint…students with a wide range of human pursuits and to equip them with a general knowledge of themselves and of the world that will prepare them to meet the personal, ethical, and social challenges of life, regardless of the career they eventually choose" (Kronman, 2007, p. 41). We should recreate this traditional definition, however, in light of a technoscientific future. This is the place for a third space in education.

A Third Space

"Different academic disciplines, therefore, should not behave as if they each owned their own private universe. Physics, literary criticism, political theory, geology, and ethics should all notice that they share a world" (Midgley, 2006, p. 193).

"I seek a middle path…" (Serres, p. 90, 1997).

Mary Midgley encourages university disciplines to understand their interconnectedness. In this technoscientific era, the technoscience have come to believe that they now control the future of the university. They have the support of the government, of corporations, and parents

(International Society for Technology in Education, 2000). I submit that a technoscientific future without the liberal arts will flounder and decline. A fallacy in many intelligent people is their belief that "science does not need imagination" (Bronowski, 1993c, p. 20). This fallacy gains momentum in a technoscientific era because all focus is on improving and sustaining life. Why would the liberal arts be important in light of the life lengthening and enhancing potential of the sciences? Universities must have the capacity and the courage to weigh the moral costs of advancing technoscience without humanities education. "Our visions—our ways of imagining the world—determine the direction of our thoughts…" (Midley, 2006, p. 2) Because technoscience is advancing at speeds never before seen, we must encourage ethical visions of technoscientific progress. Without universities requiring students to have a secure education in the liberal arts, what might we envision for our future?

In order to develop a space in the university in which the humanities hold equal importance with new technologies, I suggest a third space that will once again combine the arts and technologies into the single sphere of technē. Micheal Serres' explores this third space for instruction and education in *Troubadour of Knowledge*. His quest for understanding leads to the realization that Science and Literature influence one another and should not be seen as separate entities.

> Literature speaks science, which reencounters narrative, which, suddenly, anticipates science. This middle case thus returns to the first in lightening fashion so that knowledge is never cut up into…strongly defined solids….No history of science or history in general, no instruction is possible, no transformation without this fluid whirlpool (Serres, 1997, p. 90).

According to Serres' then, the liberal arts and the sciences cannot be relegated to opposite domains and hope to survive. It requires a constant mingling of the two domains in order for students to garner a true knowledge of each. This third space has been achieved by artists through technological reproducibility.

Art and Technology in Culture

"Technological reproducibility becomes…an ongoing process of representation or production that both depends on a continual unsecuring and continually unsecures its own representations" (Rutsky, 1999, p. 106).

Technological reproducibility is seen often in art forms. It is important to note that technoscience is already at work in many art forms thus giving hope that a third space might be created for the university where the two fields might mingle in the same way they have in works of art in society. The work of Walter Benjamin has been discussed, but it is worth mentioning again the importance of film in society. Film breaks apart space and time in order to rearrange images into a new aesthetic.

> Benjamin detailed a shift in the function and ontology of art in the age of technical reproducibility. Once it had become reproducible through mechanical procedures such as photography, he claimed, art underwent a fundamental metamorphosis, losing its status as a unique object tied to a single time and place (its "aura"), but gaining in return a newfound flexibility, a capacity to reach a larger, indeed mass audience, and to effect a hitherto unimagined political impact (Hansen, 2004, p. 1).

We have also seen how technological reproducibility is used to break down works of digital art. Some artists have begun to experiment with reproducibility in order to allow visitors to their exhibits to interact with their art. One of the more fascinating examples of this is Miroslaw Rogagla's *Lovers Leap*. Hansen describes this exhibit in *New Philosophy for New Media* (2004). Two large images are facing one another across a large space. The viewers' movements trigger sensors in the floor that change the pictures on the screens making the art seen reliant on technology triggered by the viewer. In this way, technology breaks apart art in order to provide greater insight into specific frames of the work. Universities might consider how the liberal arts can be used in a similar breaking apart to enhance technoscience in a similar way. The possibility that a critical eye afforded the student by a liberal arts curriculum might encourage a more ethical progress of technoscience should be the goal of today's university.

The Role of Curriculum Theorists

"In studying the politics of identity, we find that who we are is invariably related to who others are, as well as to who we have been and want to become" (Pinar, 1994, p. 243-244).

I strive to create spaces of honesty in my classroom. In this protected space, I hope to encourage students to examine critical issues of Self and the Other through a reimagining of the liberal arts that incorporates film, fiction, and scientific exploration. Clifford and Friesen explain it this way: "We wanted questions that were more true to that in-between space: questions that required conversation; questions that demanded both a careful attention to the text, an exploration of self, and attentive listening to the voices of others" (Clifford & Friesen, 2003, p. 183). The reconceptualization of curriculum allows for a more authentic journey as my students and I traverse this new terrain. It is only through the discovery of curriculum theory, however, that I have imagined this type of space for my students. This is not something that I studied in my undergraduate education classes or when I returned to graduate school to obtain my Masters Degree. In most teacher education programs, teacher candidates are required to take a few liberal arts classes, concentrate their studies in one main area, take pedagogical classes that focus on classroom management procedures and how to write a lesson plan, and practice what they have learned in a real-world classroom (Finn, Ravitch, & Fancher, 1984).

For other teachers to embrace the space that I seek, new methods should be introduced to teacher candidates. "…teacher preparation informed by contemporary curriculum theory would explicitly occupy the intersections between undergraduate study of liberal arts and institutional demands of practitioner performance" (Pinar, 1994, p. 228). The cohesion of liberal arts studies and curriculum theory is easily understood. The liberal arts traditionally sought to answer the resounding ageless question, "Why are we here?" Embracing the liberal arts once more will allow educators to encourage students to seek answers to this question. The foundation of curriculum theory is necessary in this pursuit as it allows teachers to introduce their students to the necessity of autobiography in searching for identity and understanding Self. Autobiography forces us to examine the experiences of our past in order to embrace our futures. In uprooting our ghosts, we find the answers that help us to know our authentic Selves.

I believe that my job is similar to that of an artist. Bronowski asserts that "The artist provides a skeleton; he provides guiding lines; he provides enough to engage your interest and to touch you emotionally. But there is no picture and no poem unless you yourself enter it and fill it out" (1993b, p. 14). If I might provide the lines for my students and allow them to determine the picture or poem that they create, then I will have been a great success as an educator. If I show them a completed picture or poem and tell them to replicate it with no interpretation or deviation, then I have only taught them the standardized curriculum that others have deemed important. I want to lead them on a path of discovery in a technoscientific era that seeks to define them before they have a chance to define themselves. I conclude with a quote from Bill Readings: "…the aim of pedagogy should not be to produce autonomous subjects who are supposedly made free by the information they learn—teaching is a question of justice not a search for truth" (1996, p. 14). If we are to give rise to the voices of our students, we need to offer them a way to grapple with the questions of justice and ethics promised in a posthuman society. By teaching them how to see the world in a new way, by allowing them to speak with their own voices, we will be able to embrace the third space where the sciences and arts mingle to further the ethical advancement of the posthuman in a rapid paced, technoscentific era.

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