

THE IMPACT OF SCIENCE FICTION MEDIA ON STUDENT INTEREST AND
LEARNING

by

Michael Tang

A professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2014

STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

Michael Tang

July 2014

ACKNOWLEDGEMENTS

I would like to thank my advisor, John Graves, for encouraging all of the Capstone students to contact him via phone call to talk about our projects. These conversations helped me to narrow down my research topic and clarified my goals. He has been such an encouraging and thoughtful professor and the Capstone process could not have been any smoother without his help. My science reader, Ritchie Boyd, was also a tremendous help in taking the time to look over my virtual poster and my paper and offering helpful feedback.

I also would like to thank my wife, Cheryl, for being such a great support and encouragement for me as I pursued my Master's degree in Science Education. She has helped proofread my paper and gave me pointers on how to clearly communicate the content of my research. Most of all, she has spent countless hours watching movies and TV shows with me and has learned to share in my joy of science fiction.

Finally, I would like to thank J.P. Mathot, my master teacher from Sierra Vista Middle School who also went through the MSSE program and presented his Capstone project years ago. It was because of his referral to this program that I got started on this journey, so without him, I wouldn't be here today.

TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND	1
CONCEPTUAL FRAMEWORK.....	4
METHODOLOGY	7
DATA AND ANALYSIS.....	10
INTERPRETATION AND CONCLUSION	17
VALUE.....	19
REFERENCES CITED.....	23
APPENDICES	25
APPENDIX A: MSU Institutional Review Board Exemption	26
APPENDIX B: Science Subject Survey (Pre-treatment).....	29
APPENDIX C: Movie Review Questions	33
APPENDIX D: Science Subject Survey (Post-treatment	40
APPENDIX E: Post-Treatment Interview Questions	44
APPENDIX F: Teacher Journal Reflection	46

LIST OF TABLES

1. Data Triangulation Matrix	10
2. Science Subject Survey Pre-Treatment & Treatment Scores: Male vs. Female.....	14
3. Average Science Subject Survey Scores for Science Fiction: Male vs. Female	16

LIST OF FIGURES

1. Average Assessment Scores - Pre-Treatment Unit vs. Treatment Unit.....	11
2. Average Pre-Treatment Unit Assessment Scores	11
3. Average Treatment Unit Assessment Scores	12
4. Average Science Subject Survey Scores: Pre-Treatment vs. Treatment	14
5. Average Science Subject Survey Scores for Science Fiction	16

ABSTRACT

The purpose of this research project was to determine if the use of science fiction media in the classroom can impact student learning and interest in science. Students were shown clips from various science fiction films such as *Gattaca* and *Spider-Man* throughout each unit. The class then discussed different aspects of the plot, how the movies used science, and how science concepts played a role in the movies. Student learning was gauged by the assessments in each unit while student interest in science was assessed through the Science Subject Survey and the Post-Treatment Interview.

INTRODUCTION AND BACKGROUND

I teach high school science at a private Christian school in Southern California. Southlands Christian School is located in the southern part of Los Angeles County in the city of Walnut, a middle income community with a population of 30,011 consisting of 23.7% White, 2.8% African American, 0.2% Native American, 63.6% Asian, 0.1% Pacific Islander and 19.1% Hispanic or Latino (US Census Bureau, 2010). Southlands has not listed its demographics on its school website or in any official documentation. According to the school administration, the population of the school is composed of 576 K-12 students with about 76% of the entire student body consisting of I-20 foreign exchange students from Taiwan, China, South Korea, Vietnam, Thailand, and Japan (Stacey Nunez, personal communication, October 24th, 2013). Most of the international students come with a high proficiency in reading and writing English while 19% of students are placed in specialized English Language Learner courses for language arts, history, math, and science. The remaining 24% of the student body is comprised of local students from the Los Angeles County area.

I have been teaching science at Southlands Christian Schools for the last three years after I received my teaching credential in 2010. As a part of my job interview in the spring of 2010, I was required to teach a “demo lesson” in a high school biology class with the school administrators observing. The students were learning about genetic mutations at the time, so I decided to start my lesson by showing them pictures of the X-Men to introduce the topic and to engage the students. Immediately, their faces lit up and I could tell that they were instantly attentive to the lesson. I started by asking them who these characters were and what kind of powers they had. Surely enough, the students had

no problems participating in our discussion. I then transitioned the discussion to the lesson on mutations by explaining how the X-Men were able to have these amazing powers because of genetic mutations in their DNA. I then lectured on the different types of mutations and how they occur in DNA. I showed students slides of actual cases of genetic mutation such as sickle-cell anemia and trisomy 21 where the changes in the DNA caused abnormalities in people's physiology and physical appearance. The lesson was an overall success and the school administrators were delighted by my use of a popular movie and how I was able to connect the science content to the students' interests.

Unfortunately, I was not able to create that kind of lesson during my first year of teaching. I was overwhelmed and struggled with lesson planning and trying to gather resources for my classes. I was given three different subjects to teach, so I wasn't able to concentrate my time and energy to one specific class. My curriculum was based on a strict routine in which I lectured one day and the following day students worked on a worksheet. Occasionally, I would give the students group work or a lab experiment. As time went on, I could tell that my students were getting tired of the mundane routine of my class. Science clearly was not very interesting to them. I also became bored with my style of teaching and frustrated with not knowing any resources that would be fun and engaging with the students.

I am currently in my fourth year and I am teaching an AP Biology class of seven students and three biology classes of ninety students total. The school has a daily schedule of eight periods with each class being forty-five minutes long on Mondays, Thursdays, and Fridays and a block schedule of alternating four periods on Tuesdays and

Wednesdays. I currently feel that I have more freedom to explore other methods of teaching since I have taught my curriculum several times already. My long term teaching goal is for my students to have fun while learning biology so that science becomes interesting to them. I also want them to be able to see how relevant and applicable science is to everyday life.

I look back to my demo lesson and I desire to use the same teaching methods throughout my curriculum. I want to be able to use science fiction movies as a means to introduce concepts in biology in a fun and engaging way and to reference them as way of reviewing general concepts with students. Many of the students are already familiar with the stories and characters of many famous science fiction franchises such as *Star Wars*, *Spider-Man*, *Jurassic Park*, and even the hit TV show *Breaking Bad*. In addition to being an introductory tool for different units, science fiction media can also be used in leading the class into a discussion on how the biological concepts relate to concepts that we see in movies and TV shows.

I believe that this teaching strategy aligns with my long term teaching goal. In my action research, I want to answer the question: *will the use of science fiction media in the classroom have positive effects on my students?* I will investigate the following sub-questions that are related to my overall focus:

- Does the use of science fiction media in the classroom increase student interest in science?
- Does the use of science fiction media in the classroom increase student learning in science?

- Does the use of science fiction media impact male students differently from female students?

CONCEPTUAL FRAMEWORK

Entertainment and media have become so easily accessible with tablets and smart phones that people don't even have to leave their beds to watch a movie or television show. American youth from the ages of 8-18 spend an average of two hours daily engaging in various forms of entertainment including video games, television, movies, and social media (Vahlberg, 2010). Many of the more popular television shows and movies contain scientific concepts in some form. Twenty-two out of the sixty highest grossing movies of all time can be classified as science fiction, with James Cameron's *Avatar* being the record holder at \$2.8 billion (Perkowitz, 2013). The original *Spider-Man* movie, which grossed \$821 million worldwide in 2002, heavily emphasizes concepts from genetics by showing how an ordinary high school student's DNA is radically transformed after being bit by a radioactive spider, which enables his body to produce spider webs and climb walls (Bumbray, 2012). Popular television shows like *Breaking Bad* feature science as an integral part of its narrative and even goes as far as to explain intricate concepts in chemistry such as the combustion of mercury fulminate, the dissolving ability of hydrofluoric acid, and poisonous nature of phosphine gas (Harnisch, 2013). Science is prevalent in many forms of contemporary media and the youth in America are constantly exposed to it as they consume and enjoy entertainment with such frequency.

The downside of the extensive use of science in contemporary media is that it often blurs the line between scientific fact and science fiction. As a result, this can

influence the average viewers' understanding of science depending on their level of science literacy and can have a negative impact if the concepts presented in science fiction are actually false (Dhingra, 2003). The 2011 film *Limitless* is based on the myth that humans only use 10% of their brains but presents this as a scientific fact all throughout the movie. In order for the story of the movie to work, the science facts must be twisted or exaggerated to serve the story of the film. The goals of the filmmakers of movies like this are not to educate the public about science or to aim for accuracy but to simply portray science in an entertaining and engaging manner (Logan, 2001). Audiences also watch films and TV shows primarily to be entertained, so it is understandable that the films they watch address the entertainment aspect first and foremost. However, when this mixture of science and fiction takes place in media, the public's understanding of science and critical thinking skills can be hindered (National Science Foundation, 2000). One study assessed the kind of impact that science fiction had on middle school students' understanding of Earth science concepts (Barnett, 2006). An experimental group of students viewed the 2003 science fiction film *The Core* while the control group did not view the film. The students were first assessed with a pre-test that indicated a similar level of understanding of Earth science between the two respective groups. Both groups were then assessed again after the viewing of the movie. The study discovered that the students who viewed the film had more misunderstandings about earth science from the single viewing than those who did not watch it. While some scientific facts were presented accurately by the scientist characters in the film, most of the science presented was based on unscientific ideas that were used to advance the story. Surveys and questionnaires from the study also indicated that students viewing the film trusted the

science presented in the film because they were explained by characters who were scientists (Barnett, 2006).

Educators can address the fallacies of science fiction media by using them as opportunities to teach students how to extract and analyze the science that is portrayed. A good strategy would be to show these films so that students can be engaged and then to teach them how to critique the science in science fiction (Barnett, 2006). It is inevitable that students will be exposed to the flawed science of science fiction films, so educators should attempt to teach them how to compare what they watch to what they actually learn in the science classroom. Another method in using science fiction in the classroom is to discuss how specific scientific concepts are used in the narrative of a story (Smith, 1990). Some science fiction films present science in a manner that is based on reality and grounded in sound concepts so that it is plausible to the audience (Kirby, 2003). Films like these can help teachers demonstrate concepts in science and connect it to the world. Students already consume hours of entertainment every week and so connecting their personal interests to the classroom can be an effective way to engage them in learning and thinking about science. These discussions about science with students can lead them to not only understand concepts but to develop within them the ability to critically think about and analyze the world (Settlage, 2007). Science fiction can also plant a seed of curiosity and inspire them to investigate scientific issues on their own (Wall, 2010).

Most movies that contain science fiction elements are typically geared toward males rather than females. Three of the highest grossing movies of 2013 were *Iron Man 3*, *Man of Steel*, and *Star Trek Into Darkness*, all of which had audiences that skewed heavily in male attendance over female attendance during their respective opening

weekends (Subers, 2013). Male preference for movies that contain science fiction elements is further evidenced in the demographics of overall box office sales and surveys of male and female movie goers (Fischhoff, 1998).

METHODOLOGY

I used 90 students in my 3 biology classes for this research project. The pre-treatment and treatment units were administered in the fall semester and spring semesters. The research methodology for this project received an exemption by Montana State University's Institutional Review Board, and compliance for working with human subjects was maintained (Appendix A).

In the fall semester, the pre-treatment unit began in mid-August 2013 with the Introduction to Science and Biology unit and ended with the Cell Biology unit. Afterwards, students were given the Science Subject Survey which assessed their attitudes and interest towards science and science fiction (Appendix B).

The Science Subject Survey consisted of three different sections. The first section was comprised of 13 questions based on a Likert scale with five responses: *Strongly Agree* (5), *Agree* (4), *Neutral* (3), *Disagree* (2), and *Strongly Disagree* (1). The questions from this section gauged the students' attitudes and interests towards science prior to any exposure to the treatment. The second section determined the students' thoughts towards various classroom activities such as lectures, group work, and labs. This portion of the survey was also based on a Likert scale with three responses: *Helpful* (3), *Neutral* (2), and *Not Helpful* (1). The responses in the two Likert surveys were converted to numerical values and then averaged in order to analyze the data and draw trends and connections.

The third section consisted of open-ended questions which gave students the opportunity to express their opinions in their own words.

The fall semester treatment unit then started in October 2013 with the Photosynthesis and Cellular Respiration unit. The unit lasted six weeks and ended with the Genetics unit in mid-November 2013.

For the treatment units, students were shown ten minute clips from various science fiction movies as a way to introduce science concepts during lectures. The content of the clips corresponded to what was being taught during a particular lesson. The science fiction films shown were *Sunshine* (2007), *The Incredible Hulk* (2008), *Gattaca* (1998), *Spider-Man* (2002), *Spider-Man 2* (2004), and *Osmosis Jones* (2001). After viewing the clips, students answered Movie Reflection Questions about the plot of the films and the science concepts that were portrayed (Appendix C). Students wrote down the answers in their notes and participated in discussions in their groups and then with the entire class. The class discussions and reflection questions contributed to my journal reflections in which I wrote about my feelings towards the success of each lesson. I also used the discussions of the Movie Reflection Questions to determine how I could adjust my lessons to better present the concepts through the movies.

In the spring semester, the pre-treatment unit began in mid-January 2014 with the Nervous System unit and ended with the Digestive System unit. The treatment unit then started in mid-February 2014 where the pre-treatment left off in the Digestive System unit and continued until the Immune System unit. At the end of this treatment unit, all the students were given the Science Subject Survey again in order to assess changes in their attitudes towards science. The results of this survey also determined if the treatment was

successful in helping the students appreciate science more as a result of viewing science fiction films. Two additional statements (*Watching sci-fi movies in class has made me more interested in science* and *Watching sci-fi movies in class has helped me learn science concepts*) were added to this post-treatment Science Subject Survey in order to gauge student opinions on how watching the movies in class has impacted their interest and learning in science (Appendix D).

The Post-Treatment Reflection was also conducted at the end of the spring semester treatment unit (Appendix E). Six different students across the three periods of biology were selected based on their grade range (from high performing to average to low performing) and different genders. Students answered questions about their experiences with science and how they felt about watching science fiction films alongside the lessons. The Post-Treatment Reflection allowed the students to explain the effectiveness of the treatment in greater and more personal detail.

I also wrote in a Teacher Reflection Journal throughout the treatment unit to document the progress of each unit and my own feelings towards the use of science fiction in the classroom (Appendix F). I partly determined the success of a lesson by how the students responded to it in class with their attentiveness and participation. Their responses to the Movie Reflection Questions showed me if they were able to follow along and analyze the portrayal of science in the films. I also took notes on what went well with my presentation of the science fiction clips and what I needed to modify in the future. This method of instruction was new to me and so I wanted to chart my progress in implementing it in my lessons. I felt that it would be helpful to look back on my journal once the treatment units were all completed.

Table 1
Triangulation Matrix

Action Research Subquestions	Data Source 1	Data Source 2	Data Source 3
Does the use of science fiction media in the classroom increase student interest in science?	Science Subject Survey (Pre-treatment and Post-treatment)	Teacher Journal Reflection	Post-treatment Reflection
Does the use of science fiction media in the classroom increase student learning in science?	Science Subject Survey (Pre-treatment and Post-treatment)	Summative Assessments	Movie Reflection Questions
Does the use of science fiction media impact male students differently from female students?	Science Subject Survey (Pre-treatment and Post-treatment)	Summative Assessments	Post-treatment Reflection

DATA AND ANALYSIS

The average assessment scores on chapter quizzes and unit tests from the fall and spring semesters indicated a 2.0% decrease from pre-treatment units to treatment units ($N=90$). The average score for the pre-treatment assessments was a 75.1% while the treatment assessments had a 73.1% average (Figure 1).

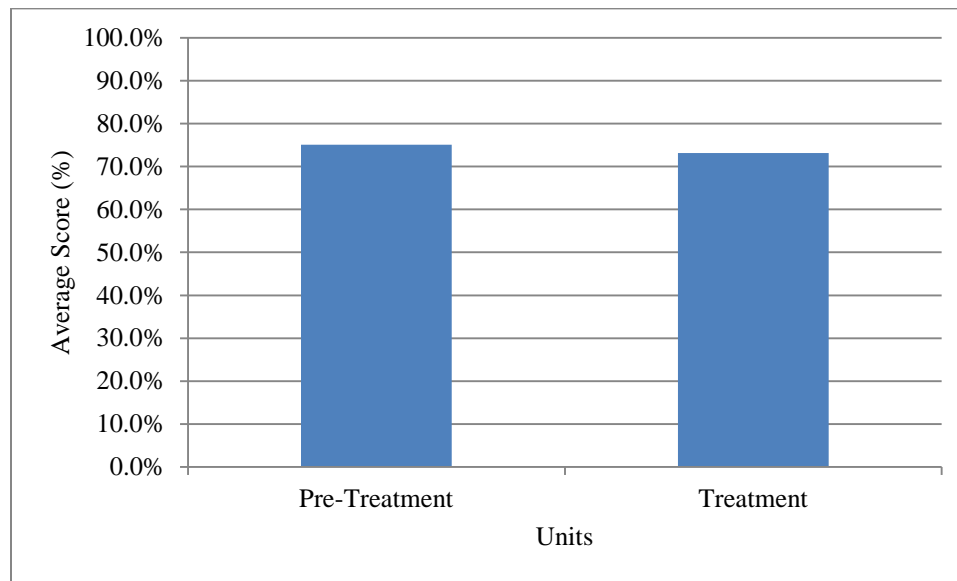


Figure 1. Average Assessment Scores - Pre-treatment Unit vs. Treatment Unit, ($N = 90$).

The average pre-treatment assessment scores stayed consistently within the 70% to 79% range across the fall and spring semesters. The average scores were 77.1% for the Intro to Science quiz, a 77.0% for the Biochemistry test, a 75.0% for The Cell quiz, a 71.6% for the Nervous/Muscle quiz, and a 74.8% for the Cardiovascular test (Figure 2).

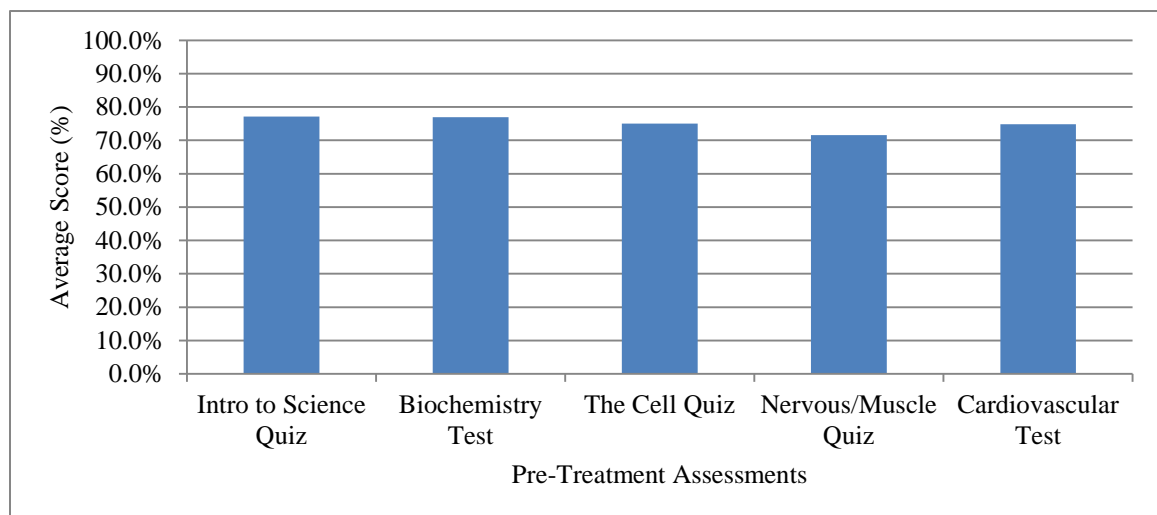


Figure 2. Average Pre-treatment Unit Assessment Scores, ($N = 90$).

Like the pre-treatment assessment averages, treatment unit assessment scores also fell within the 70% to 80% range. Students averaged a 76.1% on the Cellular Respiration test, 68.3% on the Photosynthesis test, a 73.0% on the Digestive/Endocrine quiz, and a 75.2% on the Immune System test (Figure 3).

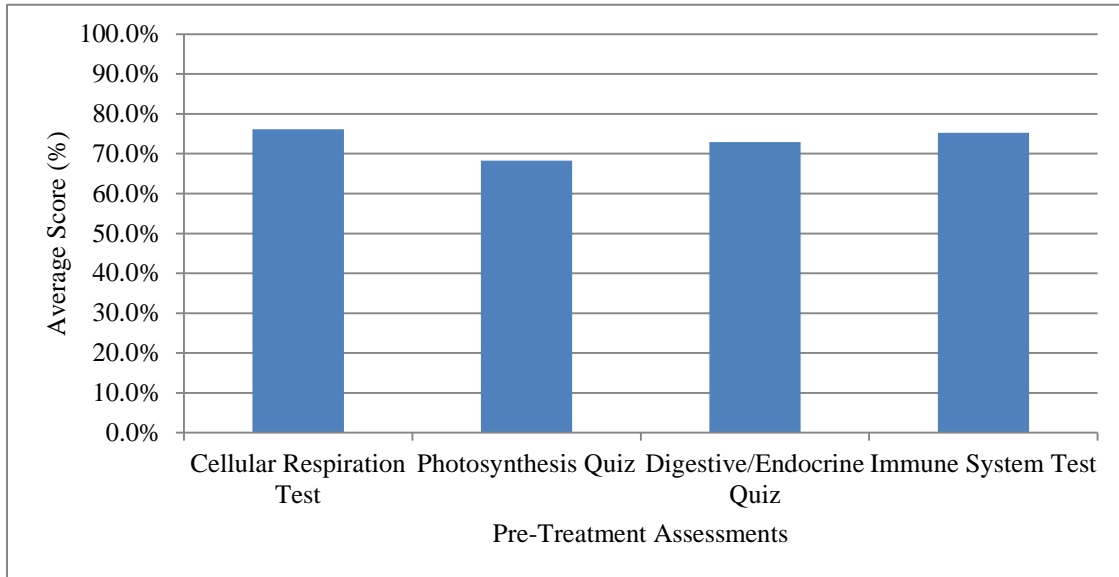


Figure 3. Average Treatment Unit Assessment Scores, ($N = 90$).

The average Likert responses from the pre-treatment Science Subject Survey indicated that students' attitudes toward science were in the neutral range. Students responded slightly higher to the statements about science as a subject such as *Science is interesting* and *I can see how science relates to the real world* than statements about their own personal abilities such as *I am good at science* and *I can see how science relates to my own life* (Figure 4). The open-ended questions from the pre-treatment Science Subject Survey indicated that there was a wide range of student attitudes towards science. In response to a question about what they enjoyed most about science and what they disliked, one student had a very positive view towards science, explaining that she enjoys

“learning about how cells work and about the human body’s organ systems.” Another student expressed the opposite view, finding science to be “really hard to study for because there are so many terms” and that “the concepts are difficult for me to understand.” Some students presented a more moderate response. One student simply wrote “I’m indifferent” in her response.

The post-treatment Science Subject Survey showed a slight decrease from the pre-treatment results for each of the statements. The most notable drop was for the statement *I am good at science* which fell to an average score of 2.8 (Figure 4). One student explained that “it is hard to memorize many scientific words and their definitions,” while another student explained that “the vocabulary is the most difficult part of biology and it is very hard to remember the concepts.” Many other students echoed similar sentiments about the difficulty of biology. One student added the point that “many of the concepts build on each other, so it is hard to keep up after learning so many things.” However, some students still noted that they enjoyed “learning about the human body and the processes that go on inside [their] body” and that “I always enjoyed science since middle school, so I still like it now.”

In the Teacher Journal Reflection, I noted that students’ faces lit up when I announced that they would be watching clips from *Spider-Man*. They were engaged throughout the viewing and participated enthusiastically throughout our class discussion, even more so than when we discuss daily warm-up questions at the beginning of class. However, I also noted that the longer the Powerpoint lectures progressed from the viewing of the clips, the less the students seemed to be engaged.

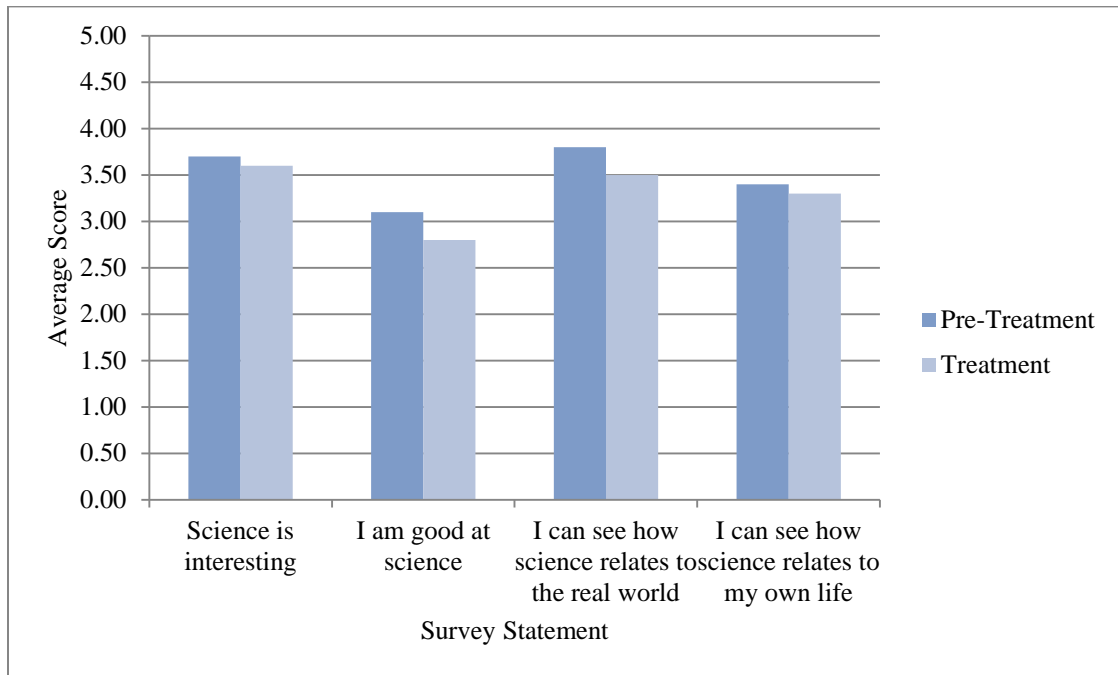


Figure 4. Average Science Subject Survey Scores: Pre-treatment vs. Treatment, (N=90).

Male and female students had close average scores in the pre-treatment and post-treatment Science Subject Surveys. The average scores for each of the statements were in the neutral range and did not change significantly from the pre-treatment survey to the post-treatment survey (Table 2). The most notable drop was for the statement “I am good at science” for both male and female students.

Table 2
Science Subject Survey Pre-Treatment & Treatment Average Scores: Male vs. Female, (N=90)

Survey Statements	Male Average (Pre-Treatment)	Female Average (Pre-Treatment)	Male Average (Post-Treatment)	Female Average (Post-Treatment)
Science is interesting.	3.8	3.6	3.5	3.7
I am good at science.	3.1	3.2	2.8	2.8
I can see how science relates to the real world.	3.8	3.8	3.4	3.6
I can see how science relates to my own life.	3.3	3.5	3.2	3.4

The additional two statements about science fiction in the post-treatment Science Subject Survey showed a rise in average Likert scores when compared to the statements about student attitudes towards science. The statement *Watching sci-fi movies in class has made me more interested in science* had an average score of 4.2 while *watching sci-fi movies in class has helped me learn science concepts* had an average score of 4.0 (Figure 5). These scores fell in the *Agree* range of the Likert scale. In response to the Post-Treatment Interview Questions, one selected student explained that viewing and discussing the science fiction films “helped [her] understand the concept more with several creative examples” and that she would “like to continue watching because a lot of science fiction films are interesting to watch.” Another selected student said, “Personally,

I learn better when I see something actually happening, so watching a movie and then discussing it gives me a better understanding of what was happening.”

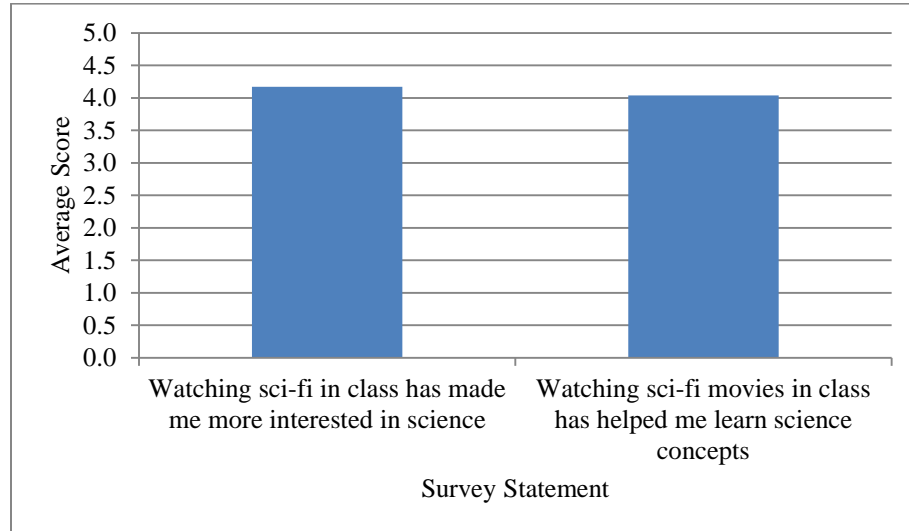


Figure 5. Average Science Subject Survey Scores for Science Fiction, (N=90).

The average score for female students were slightly higher than male students for the additional statements about science fiction in the post-treatment survey. The average score for male students was a 3.9 for both statements while the average score for female students was a 4.4 and 4.2, respectively (Table 3). The female scores fell within the *Agree* range of the Likert scale while the male scores were in the higher end of the *Neutral* range.

Table 3
Average Science Subject Survey Scores for Science Fiction: Male vs. Female, (N=90).

Survey Statements	Male Average Score	Female Average Score
Watching sci-fi has made me more interested in science	3.9	4.4
Watching sci-fi movies has helped me learn science concepts	3.9	4.2

INTERPRETATION AND CONCLUSION

Biology has been a difficult science subject for many of my students. Each new unit has required students to retain prior knowledge as newer concepts continually build upon older concepts. The breadth of scientific terminology has also overwhelmed and affected their motivation towards the subject. This was evidenced by the average assessment scores across the pre-treatment and treatment units in both semesters were consistently in the 70% to 79% range. The overall assessment averages of the pre-treatment and treatment units were also fairly close at 75.1% and 73.1%. The slight 2.0% decrease may be attributed to the outlying lower average of the Photosynthesis test. This was a cumulative assessment which included concepts from the previous Cellular Respiration chapter and consisted of some of the longest and most difficult concepts in biology. Future studies that compare average scores of assessments should take into account the different levels of difficulty that students have with different concepts.

The assessment averages throughout the school year were reflective of student attitudes towards science. This was apparent as the average Likert response scores in the pre-treatment and post-treatment Science Subject Surveys consistently fell within the

neutral range (3.0 to 3.9). Many of the student responses to the open-ended questions in the two surveys indicated that while they found some of the concepts in biology to be interesting, there was a large amount of scientific concepts and terminology that made it difficult for them to study. The most significant decrease between the two surveys was for the statement *I am good at science* which fell from a 3.1 in the pre-treatment to a 2.8 average in the post-treatment. Student confidence levels toward science declined throughout the school year as more concepts were covered.

Given the consistent average assessment scores in the 70-79% range and the neutral responses in the Science Subject Surveys, I concluded that the viewing and discussion of science fiction movies in class did not increase or impact student learning in any way. I noted in the Teacher Journal Reflection that students seemed to lose interest the longer the Powerpoint lectures lasted. Student attitudes definitely seemed to be lifted when viewing clips of movies and discussing the science in the clips, but the longer we talked about science, the more disengaged they became. For the *Spider-Man* clip, I referred back to the clip multiple times during the lecture and this seemed to hold their attention a little bit longer throughout the lesson. I did not do this for the other science fiction movies and felt that this method would have helped.

Students did indicate in the post-treatment Science Subject Survey that viewing science fiction clips in class has helped them become more interested in science. I noted in each of the Teacher Journal Reflections that students would light up whenever we viewed the clips and discussed them in class. When asked if they want to continue to view science fiction movies in class, the response was overwhelmingly positive as it makes the content more fun and relatable. Ironically, students also indicated that viewing

the clips helped them with learning science. Their claims were not supported by the data from the pre-treatment and treatment assessments. I believe that students did not differentiate their overall excitement with watching movies in class with the actual learning of science.

Contrary to box office and movie survey statistics, female students scored higher than male students to statements about viewing science fiction in class. I did not expect this result due to science fiction audiences typically skewing heavily towards males. Possible factors that could have contributed to this result are female students performing better than male students in biology, thus having a more positive opinion of science. Further students could examine the psychology of male and female attitudes and performance in science classes. Other students could also assess male and female scores and attitudes in not only biology, but also the other core science classes like chemistry, physics, and earth science.

VALUE

Movies have an significant place in youth culture today. As the summer season approaches, thousands of theaters across the world prepare to embrace the crowds of teenagers who will in turn embrace stories of superheroes endowed with powers that stem from some kind of scientific phenomenon. Science fiction has taken ahold of the movie industry and the interests of many young people. These movies can provide a bridge for students' personal interests and the classroom. Many biology teachers already choose to show the sci-fi film *Gattaca* during the genetics units of their classes because of how it accurately illustrates the concepts in a real world setting and draws out many bioethical

issues. This practice can extend to many other movies like *Spider-Man* which are not overtly sci-fi like *Gattaca* but still contain many sci-fi elements in their stories.

Viewing movie clips in class is not unusual for teachers in most subjects like history, literature, and science. Many students benefit from visual aids and so movies can be an effective tool in illustrating various concepts. The practice and methodology of utilizing movies in the classroom, however, has been a rare topic of research. It is my hope that this project would encourage other teachers to assess their methods in showing movies in their classrooms and develop effective ways in facilitating student learning through movies.

I've realized from this project that my students don't have the most positive attitudes toward science and are hindered in their motivation by how overwhelming the content can be. The consistently mediocre test scores also show that they are not achieving a level of mastery of the subject which can be due to a variety of reasons such as poor or lack of study habits, varying English language levels, or even my own teaching methodology. While the purpose of the project was to find out how the treatment would impact student learning and interest in science, I've learned about how my students struggled throughout the school year with biology and how they felt towards my class. It has made me aware that this is a problem in my classroom and it is something that I need to address in subsequent school years.

As a teacher, I have learned how to reflect on my own teaching practices throughout the school year as well as how to address areas of concern in my classroom. When I saw the data for the class averages on the assessments, I realized I may not have been giving enough resources for my students to succeed. I began to think of ways in

how to better prepare students. One adjustment I made was to provide my classes with a list of review questions that reflect the content of what will be assessed on the exam. I am also trying to develop a concepts overview sheet that I would pass out to the students at the beginning of each unit so that students know what to focus on when they review and study.

The results of this project have helped me develop further questions that can be answered through action research:

- Will greater integration of science fiction media in the classroom in classwork and homework impact student learning and interest in science?
- Which particular science fiction movies and TV shows can benefit student learning and interest in science?
- What are effective teaching methods that can help students who struggle with the breadth of science concepts and terminology?
- Do male and female students differ in their learning and interest in biology, chemistry, and physics?

I have been a fan of movies since I was in middle school and I have a particular affinity for science fiction. I believe that one of the reasons why I chose to study science in college and teach science as a profession is because of how science fiction has aided my fascination with the subject. I have also heard many stories of how scientists and engineers were inspired by classic sci-fi movies like *2001: A Space Odyssey* which pushed their imaginations to make fiction into reality. Space X CEO Elon Musk has the goal of eventually sending people to the planet Mars, an idea that has roots in many classic science fiction stories. I believe that future scientists, engineers, and educators sit

in my classroom everyday and that one important key to inspiring them is to open their imaginations to the endless possibilities that science can accomplish. Science fiction may play a very important role in helping my quest to inspire students in the same ways as it has inspired me. I will continue to show science fiction movies in my classroom to support the lessons. Most importantly, I will seek ways in refining my methodology and improving how I support the students in learning science and developing an interest in it.

REFERENCES CITED

- Barnett, M., Wagner, H., Gatling, A., Anderson, J., Houle, M., & Kafka, A. (2006). The impact of science fiction film on student understanding of science. *Journal of Science Education and Technology*, 15(2): 179-191.
- Bumbray, C. (2012, June 26). Flashback review: Spider-Man. *JoBlo*. Retrieved December 3, 2013 from <http://www.joblo.com/movie-news/spider-man-retro-reviews-spider-man>
- Dhingra, K. (2003). Thinking about television science: How students understand the nature of science from different program genres. *Journal of Research in Science Teaching*, 40(2): 234–256.
- Fischhoff, S., Antonio, J., Lewis, D. (1998). Favorite films and film genres as a function of race, age, and gender. *Journal of Media Psychology*, 3(1).
- Folch, C. (2013, June 13). Why the west loves sci-Fi and fantasy: a cultural explanation. *The Atlantic*. Retrieved December 3, 2013, from <http://www.theatlantic.com/entertainment/archive/2013/06/why-the-west-loves-sci-fi-and-fantasy-a-cultural-explanation/276816/>
- Harnisch, F., Salthammer, T. (2013). Die Chemie bei Breaking Bad. *Chem Unserer Zeit*, 47, 214-221.
- Kirby, D. A. (2003). Science consultants, fictional films, and scientific practice. *Social Studies of Science*, 33(2): 231–268.
- Logan, R. A. (2001). Science mass communication. *Science Communication*, 23(2): 135–163.
- National Science Foundation. (2000). Indicators: Science and Engineering 2000. Washington, DC: National Science Foundation.
- Perkowitz, S. (2013, October 4). Watch My Shorts. *The Science & Entertainment Exchange*. Retrieved March 12, 2014, from <http://www.scienceandentertainmentexchange.org/blog/watch-my-shorts>
- Roberts, D. F., Foehr, U. G., Rideout, V. J., and Brodie, M. (1999). Kids and media at the new millennium: The Henry J. Kaiser Family Foundation.

- Settlage, J., Southerland, S. (2007). *Teaching Science to Every Child: Using Culture as a Starting Point*. Taylor & Francis Group, LLC.
- Smith, V., Scott, J., & Coskrey, W. (1990). *Teaching the Science in Science Fiction*. Annual Meeting of the American Association for the Advancement of Science. New Orleans, LA, February 15-20.
- Subers, R. (2013, May 5). Weekend report: 'Iron Man 3' takes off with second-highest opening ever. *Boxoffice Mojo*. Retrieved December 4, 2013, from <http://boxofficemojo.com/news/?id=3682&p=.htm>
- Subers, R. (2013, May 19). Weekend report: 'Into Darkness' boldly goes where 2009's 'Trek' went before. *Boxoffice Mojo*. Retrieved December 4, 2013, from <http://boxofficemojo.com/news/?id=3686&p=.htm>
- Subers, R. (2013, June 16). Weekend report: 'Man of Steel' soars, scores new June record. *Boxoffice Mojo*. Retrieved December 4, 2013, from <http://www.boxofficemojo.com/news/?id=3693&p=.htm>
- U.S. Census Bureau State & County Quick Facts: Walnut (city), California. (n.d.) Retrieved December 4, 2013, from <http://quickfacts.census.gov/qfd/states/06/0683332.html>
- Vahlberg, V. (2010). *Fitting into Their Lives: A Survey of Three Studies About Youth Media Usage*. Newspaper Association of America Foundation.
- Wall, M. (2010, December 28). Far flung movies may inspire future scientists. *NBC News*. Retrieved March 12, 2014, from http://www.nbcnews.com/id/40829505/ns/technology_and_science-science/t/far-flung-movies-may-inspire-future-scientists/#.UyCG-_ldWSo

APPENDICES

APPENDIX A

MSU INSTITUTIONAL REVIEW BOARD EXEMPTION

MONTANA STATE UNIVERSITY
Request for Designation of Research as Exempt
MSSE Research Projects Only
(10/14/11)

THIS AREA IS FOR INSTITUTIONAL REVIEW BOARD USE ONLY. DO NOT WRITE IN THIS AREA.

Confirmation Date:

Application Number:

DATE of SUBMISSION: 12/2/13

Address each section - do not leave any section blank.

I. INVESTIGATOR:

Name: **Michael Tang**

Home or School Mailing Address: **9 Woodland Dr, Irvine, CA 92604**

Telephone Number: **9499811181**

E-Mail Address: **leyown@gmail.com**

DATE TRAINING COMPLETED: 3/11/12 [Required training: *CITI*

training; see website for link]

Investigator Signature Michael Tang

Name of Project Advisor: **Carl Graves**

E-Mail Address of Project Advisor: **carl.graves@ecat.montana.edu**

II. TITLE OF RESEARCH PROJECT: The Impact of Science Fiction Media on Student Interest and Learning

III. BRIEF DESCRIPTION OF RESEARCH METHODS (If using a survey/questionnaire, provide a copy).

Pre-treatment surveys will be given to the students. In the treatment unit, I will begin new lessons by showing 10-15 minute clips from various science fiction movies such as Spider-Man (2002) and Sunshine (2007). These clips will introduce the topics to students and will provide a connection between the content and student interests. Review question worksheets will be given to the students after each viewing which they will answer individually. The class will then discuss how the science concepts were used

in the movie. I will then transition into the lecture. Post-treatment interview questions will be given to 5 students of different achievement levels.

APPENDIX B
SCIENCE SUBJECT SURVEY (PRE-TREATMENT)

Name: _____ (first name only)

SCIENCE SUBJECT SURVEY

Circle the answer choice that best reflects your attitude and opinion.

1. I think that science is interesting.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

2. I feel that I am good at science.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

3. Taking notes in class and reading the textbook at home helps me understand science.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

4. It is easy for me to understand the concepts that we learn in science class.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

5. It is easy for me to remember the concepts we learned after we move on to a new chapter.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

6. I can see how science is related to everyday life and to the real world.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

7. I can see how science is related to my own personal life.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

8. I enjoy watching movies and TV shows in my free time.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

9. I spend at least one hour a day watching movies and/or TV shows.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

10. I enjoy movies and TV shows that have some elements of science (i.e. Spider-Man, Breaking Bad, X-Men Jurassic Park, etc).

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

11. I notice when science concepts appear in movies and TV shows.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

12. I think about the science concepts in movies and TV shows when they are mentioned or used in the story.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

13. I think about whether or not the science in movies and TV shows is accurate.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

Circle the answer choice for the following class activities that best reflects your attitude and opinion on whether or not they are helpful in your learning of science.

Warm-Up	Helpful	Neutral	Not Helpful
Powerpoint Notes	Helpful	Neutral	Not Helpful
Science Youtube Videos	Helpful	Neutral	Not Helpful
Textbook	Helpful	Neutral	Not Helpful
Workbook	Helpful	Neutral	Not Helpful
Worksheets	Helpful	Neutral	Not Helpful
Labs	Helpful	Neutral	Not Helpful
Chapter Review Questions	Helpful	Neutral	Not Helpful

Answer the following questions.

1. What do you find most challenging about science?
2. How do you study and remember the material covered in this class?
3. What do you like most about science? What don't you like about science?

APPENDIX C
MOVIE REVIEW QUESTIONS

Photosynthesis - SUNSHINE Movie Review Questions

- (1) What was the goal of the scientists aboard the Icarus II?

- (2) What happened to the Icarus I?

- (3) What is the purpose of having the garden in the Icarus II?

- (4) How do you think the spaceship obtains sunlight, water, and carbon dioxide to sustain the garden?

- (5) How does the destruction of the garden affect their mission?

- (6) In what biological ways is oxygen so necessary for the survival of the crew members?

Cellular Respiration - SUNSHINE Movie Review Questions

(1) Where does the garden in Icarus II get carbon dioxide to produce oxygen and high energy sugars?

(2) How does the oxygen garden obtain light and water to go through photosynthesis?

(3) What moral dilemma does the crew of Icarus II face after the oxygen garden is destroyed?

(4) Why do Mace and Capa collapse to the ground in their brief brawl?

(5) Why do humans need oxygen to survive? (Explain using cellular respiration)

Mitosis - THE INCREDIBLE HULK Review Questions

(1) In the opening title sequence, what happened to Bruce Banner that radically mutated his cells?

(2) What new physical traits does Bruce Banner show after his transformation?

(3) What happened to Bruce's red blood cells as he viewed them under the microscope?

(4) In order for Bruce to transform into the enormous Hulk, what must his cells have to do first?

(5) Which type of cell do you think Bruce's body has to mostly produce when he transforms? Why?

(6) After he becomes the Hulk, what do you think Bruce's cells are doing to keep up with all his energy demands? What must his body continually take in, in order for him to continue as the Hulk?

(1) How did the movie use DNA in its story?

(2) Did the changes in Peter's DNA alter his genotype, phenotype, or both?

(3) How do the changes in Peter's DNA affect his phenotypic traits? List all the things you observed in the movie.

Transcription/Translation – SPIDER-MAN 2 Review Questions

(1) How does a change in DNA affect phenotypic traits? Explain on the cellular level.

(2) What in the movie doesn't make sense given what we know about transcription and translation?

Genetics – GATTACA Movie Review Questions

- (1) What are all the ways in which Vincent disguises himself (genetically) as Jerome?

- (2) How do corporations discriminate against Vincent in the interview process?

- (3) Why did Irene have Vincent's DNA sequenced? What did she use to sequence his DNA?

- (4) Why are In-Valids discriminated against? What particular phenotypic traits does Vincent have that makes him an obvious In-Valid?

- (5) What genetic trait did the parents of the pianist engineer for him?

- (6) How did Vincent beat his brother in the game of chicken? How does this relate to the overall theme of the movie?

- (7) Do you believe this type of genetic engineering in society would benefit us or cause serious social disorder? Explain your position.

Human Physiology – OSMOSIS JONES Movie Review Questions

Explain how the movie represents the following types of cells, organs and organ systems and contrast them with how they actually function in the real world.

Cell/ Organ / Organ System	Osmosis Jones	Real World
White Blood Cells		
Immune System		
Circulatory System		
Neurons		
Viruses		
The Brain		
The Stomach		
Digestive System		
Bacteria		

APPENDIX D

SCIENCE SUBJECT SURVEY (POST-TREATMENT)

Name: _____ (first name only)

SCIENCE SUBJECT SURVEY

Circle the answer choice that best reflects your attitude and opinion.

1. I think that science is interesting.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

2. I feel that I am good at science.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

3. Taking notes in class and reading the textbook at home helps me understand science.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

4. It is easy for me to understand the concepts that we learn in science class.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

5. It is easy for me to remember the concepts we learned after we move on to a new chapter.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

6. I can see how science is related to everyday life and to the real world.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

7. I can see how science is related to my own personal life.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

8. I enjoy watching movies and TV shows in my free time.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.....	2.....	3.....	4.....	5.....

9. I spend at least one hour a day watching movies and/or TV shows.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

10. I enjoy movies and TV shows that have some elements of science (i.e. Spider-Man, Breaking Bad, X-Men Jurassic Park, etc).

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

11. I notice when science concepts appear in movies and TV shows.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

12. I think about the science concepts in movies and TV shows when they are mentioned or used in the story.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

13. I think about whether or not the science in movies and TV shows is accurate.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

14. Watching science fiction movies in class (i.e. Gattaca, Spider-Man) has made me more interested in science.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

15. Watching science fiction movies in class has helped me learn science concepts.

Strongly Disagree Disagree Neutral Agree Strongly Agree
 1.....2.....3.....4.....5

Circle the answer choice for the following class activities that best reflects your attitude and opinion on whether or not they are helpful in your learning of science.

Warm-Up	Helpful	Neutral	Not
Helpful			

Powerpoint Notes	Helpful	Neutral	Not
Helpful			

Science Youtube Videos Helpful	Helpful	Neutral	Not
Textbook Helpful	Helpful	Neutral	Not
Workbook Helpful	Helpful	Neutral	Not
Worksheets Helpful	Helpful	Neutral	Not
Labs Helpful	Helpful	Neutral	Not
Chapter Review Questions Helpful	Helpful	Neutral	Not

Answer the following questions.

1. What do you find most challenging about science?
2. How do you study and remember the material covered in this class?
3. What do you like most about science? What don't you like about science?

APPENDIX E
POST-TREATMENT INTERVIEW QUESTIONS

Post-Treatment Interview Questions

- (1) Did you enjoy watching the science fiction films in class throughout each unit?

- (2) Do you enjoy watching science fiction movies and TV shows outside of class?

- (3) Do you ever think about the science in these movies and shows when you watch them?

- (4) How did the viewing and discussion of these films help you in being more interested in science?

- (3) How did the viewing and discussion of these films help you learn the content taught in class?

- (5) What ways do you feel like this practice of viewing science fiction films can be improved in the future?

- (6) Would you like to continue watching and discussing clips from science fiction films?

APPENDIX F
TEACHER REFLECTION JOURNAL

Teacher Reflection Journal

10/9/13 – I showed the students *Sunshine* today. The film is about how the sun is dying and how a group of scientists are sent on a mission to re-ignite the sun with a large payload bomb. Aboard the spaceship is an oxygen garden that produces and circulates oxygen. It also becomes a major plot device when it is destroyed by an accident, causing desperation in the scientists. The students were very excited to watch the movie as many of them have never seen it before. They were engaged in discussing how the concepts of photosynthesis were used in the movie. I noticed that once I led into the Powerpoint lecture, students continued to volunteer and participate. This was very encouraging. However, they seemed to be less engaged towards the end of the lecture. The concepts for the Light Reactions and the Calvin Cycle of photosynthesis are very dense and long, so it's easy to lose focus.

11/5/13 – Today the students watched *The Incredible Hulk*. They were excited and surprised because they didn't see how it related to cell division at first. The students had trouble connecting some of the ideas of the movie to the general concepts we learned in class. I also felt like some of it was a stretch as I tried to connect the movie to cell division. While it is true that transforming into the Hulk would require rapid mitotic divisions, there is not much else to draw from the movie. Despite the weak connection, students enjoyed watching the movie.

12/2/13 – The viewing and discussion of *Spider-Man* was a huge success. Students laughed as Peter Parker discovered his powers after being bitten by a radioactive spider. The science in the movie was absolutely clear and led perfectly into the lesson on DNA. Students were engaged throughout the entire lesson and even the quiet ones participated during the class discussion. Showing this movie was a total success!

12/6/13 – *Spider-Man* seems to be an incredibly accessible superhero because students loved the *Spider-Man 2* viewing. Students showed the same level of interest during this lesson as the previous one.

12/9/13 – Students watched the first 20 minutes of *Gattaca*. This was a strictly sci-fi movie which lacked explosions, action sequences, and CGI and focused more on the drama of the story. As I observed students during the viewing, I could tell that some of them were not as interested in the movie. A couple of students had put their heads down and I had to tell them to sit up. The more vocal students participated well in the discussions while other students were quiet. The connection to the lesson was very strong, though, and it was a great segway into the topics of genetics.

2/24/14 – Students reacted well to *Osmosis Jones* and laughed at the humor even though it was slightly below their age level.