

Science Fiction Exhibits as STEM Gateways

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Abstract

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Women continue to hold less than a quarter of all STEM jobs in the United States, prompting many museums to develop programs and exhibits with the express goal of interesting young girls in scientific fields. At the same time, a number of recent museum exhibits have harnessed the popularity of pop culture and science fiction in order to interest general audiences in STEM subject matter, as well as using the exhibits as springboards to expand or shift mission goals and focus. Because science fiction appears to be successful at raising interest in STEM fields, it may be an effective way to garner the interest of young girls in STEM in particular. This research seeks to describe the ways in which museums are currently using science fiction exhibits to interest young girls in STEM fields and careers.

Research focused on four institutions across the country hosting three separate exhibits, and included staff interviews and content analysis of exhibit descriptions, promotional materials, a summative evaluation and supplementary exhibit productions.

In some ways, science fiction exhibits do serve young girls, primarily through the inclusion of female role models, staff awareness, and prototype testing to ensure interactives are attractive to girls as well as to boys. However, STEM appears to be underutilized, which may be partly due to a concern within the field that the outcome of targeting a specific gender could be construed as “stereotyping”.

TABLE OF CONTENTS

Preface and Acknowledgements	2
Chapter One: Introduction and Problem Statement	3
Chapter Two: Review of the Literature	5
I. Women and Girls in STEM.....	5
II. Stem Identity in Informal Education.....	8
III. Women in Science Fiction.....	10
Chapter Three: Methods	15
I. Sampling.....	15
II. Methodology.....	20
III. Content Analysis.....	21
Chapter Four: Results and Discussion	23
I. Content Analysis Data Summary.....	23
II. Interviews Data Summary.....	25
III. Interview Question Themes.....	26
IV. Implications of Findings.....	39
V. Limitations and Challenges of Research.....	42
Chapter Five: Conclusions and Recommendations	44
I. Recommendations.....	44
Appendices	46
Appendix A: Interview Guide.....	46
Appendix B: Tables.....	48
Bibliography	52

PREFACE AND ACKNOWLEDGEMENTS

I was inspired to research the topic of science fiction exhibits in museums because I wanted to combine two of my passions, science fiction and museums, in an important and meaningful way that would both expand upon current trends within the museum field and the possibilities inherent in a fusion of popular culture and STEM learning. Through this research, I have become even more determined to find ways to use science fiction as a means of inspiring STEM engagement in young girls, and hope to make opportunities for such work in my future career.

I would like to thank all the people and institutions kind enough to consent to be interviewed and referenced in the course of writing and researching this thesis paper. I would also like to give a huge thank you to my thesis advisor and committee chair, Kris Morrissey, who was more than patient and consistently supportive and enthusiastic of this research throughout its inception and resolution, even when I was in despair or deep ennui, and gave me the strength to power through and write the thesis I had envisioned. Another big thank you to my other committee members, Adam Eisenberg and LeiLani Nishime, who exercised extraordinary patience in waiting for drafts and fortitude in reading those drafts quickly, and who gave excellent advice vital to the completion of this paper.

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CHAPTER ONE: INTRODUCTION AND PROBLEM STATEMENT

Women currently hold only 24 percent of all STEM (science, technology, engineering, and math) jobs, despite representing 49 percent of the total college-educated workforce. Within certain fields, the numbers are even worse, with women holding a mere 14 percent of engineering jobs, according to a published study by the U.S. Department of Commerce (2011). In response, exhibits and programs created with the goal of encouraging middle school girls to consider careers in STEM have become a trend within many museums.

Often what young girls see as representing the STEM fields is male, white, and emphasizes individual genius and workaholic dedication, traits which often discourage young girls, and especially young girls of color, from exploring these fields further. Science fiction, by providing young girls with alternative ways to view the world and strong female role models, might be the key to drawing more young girls into the exciting possibilities of STEM fields and careers.

Problem Statement

The goal of this research is to identify the ways in which museums are currently using science fiction exhibits to interest young girls in STEM fields and careers. More and more science museums are hosting blockbuster science fiction and fantasy exhibits, such as *Harry Potter: The Exhibition* and *Star Wars: Where Science Meets Imagination*. This study will describe ways museums are choosing and designing exhibits to reflect the potentially diverse nature of science fiction, especially in regards to providing young girls with inspiring female role models in science, technology, engineering and math.

This research will further inform museums, especially science museums and their exhibit developers, and may also help museums to identify what still needs to be done to engage young

girls in STEM, to what degree science fiction may be a helpful lens through which to inspire young girls in STEM careers, and what strategies will best incorporate science fiction into the STEM narrative. The results of this research may also prove enlightening to exhibit developers of large blockbuster science fiction exhibits, who may not have realized the potential for such exhibits to ignite young girls' interests in STEM fields and careers, and subsequently, may tailor future exhibits to appeal more to young girls.

CHAPTER TWO: REVIEW OF THE LITERATURE

In 2010, the National Science Board (NSB) produced a report on the status of STEM education and professions within the United States, meant to identify strategies for increasing the number of “future STEM innovators”, and recommendations for how the National Science Foundation, and similar groups, might best foster environments to encourage the development of such innovators. The NSB stated that too many of America’s most talented young people go unrecognized and never reach their full potential, causing the nation to lose many who could have become leading STEM professionals and made important breakthroughs in science or technology. The NSB stated three areas where focus should be concentrated in order to ensure more talented young people are being brought into STEM fields: high-impact educational policies and practices, a commitment to equity and diversity in order to cast a wider net, and learning environments with high expectations and a commitment to excellence. Although the study did not specifically mention women, stressing a commitment to equity and diversity encompasses the effort to include women in STEM fields. One of the Board’s conclusions was that “the U.S. education system too frequently fails to identify and develop our most talented and motivated students who will become the next generation of innovators” (p. 5), which includes girls currently not engaged in STEM.

I. Women and Girls in STEM

In 2007, “women accounted for only 22 percent of graduate students in engineering and 27 percent in computer sciences, with a 30-45 percent representation in most other science fields” (National Research Council, 2009), and undergraduate women were more likely to leave the sciences than similarly achieving men (p. 219). Some studies show that the percentage of women in the scientific workforce decreased by almost half from 1999 to 2002 (from 46 to 24

percent), according to the National Science Foundation (2002), while women are less likely to obtain tenure or achieve the rank of full professor in science and engineering fields. For women of color the numbers are even worse, as in 2008 only 3 percent of computer scientists were female and African American, 3 percent were female and Asian, and only 1 percent were female and Hispanic (including Latinas) (Subramaniam, Ahn, Fleischmann, & Druin, 2012).

One study found that “16-18-year-old girls, regardless of race or ethnicity, who had experienced several instances of academic sexism valued math and science less than those who experienced fewer such instances” (Mosatche, Matloff-Nieves, Kekelis, & Lawner, 2013). And even without instances of blatant sexism, young girls may not decide in favor of a STEM career if they cannot envision themselves as a professional in that field. Having role models, developing relationships with mentors, and gaining relevant job experience are all possible positive factors. Adversely, a lack of visible role models of the same race or gender as themselves can be discouraging to young people, though not enough to keep them from enrolling in STEM classes if they align with careers they have already chosen (Dorsen, Carlson, & Goodyear, 2006).

Within the field of computer science, one of the obstacles blocking women from remaining in the field is that women may approach the field differently than do men. In an undergraduate study done by Margolis, Fisher, & Miller (2000), women in the computer science major cited the context and connections of other areas (medicine, space, arts, etc.) to computer science as a primary reason for their interest. And while women saw the computer as primarily a means to an end, men responded to the computer as a toy enjoyed as an extracurricular activity and an extension of themselves. As a result,

Twenty percent of the female computer science majors we interviewed have questioned if they belong in computer science because they feel they do not share the same intensity of

focus and interest they see in their male peers. Women describe wanting to talk about other things besides computers, feeling estranged from those who are myopically focused on a machine (Margolis et al., 2000).

Margolis et al. (2000) recommend that computer science departments establish that there are many valid ways to be interested in computer science, and that having a balanced life is not the same as not being passionate. They also recommend being inclusive about the different ways in which women become engaged with technology, as women tend to be interested in technology through its social implications rather than through the machine itself, unlike men.

A study by the American Association of University Women (AAUW) suggests other factors that can discourage girls from pursuing STEM careers. Girls who believed that intelligence can grow with experience and practice tended to do better on math tests, and tended to want to study math in the future. Girls told by test administrators that boys and girls are equally capable in math did as well as the boys on math tests, suggesting that a change in the learning environment can drastically change girls' math performance. Girls tended to assess their own abilities lower than boys with the same mathematical achievement, while also holding themselves to a higher standard than the boys, feeling they had to be exceptional in order to succeed in a "male" field. These two factors discourage girls from aspiring to STEM fields even with perfect grades and scores. (American Association of University Women, 2010).

Even for women in STEM careers, the fight to be a woman in a STEM field continues. According to the AAUW, people often feel negatively about women in "masculine" positions such as scientists and engineers, and will judge them to be less competent than their male counterparts unless clearly successful at their work. If a woman is considered competent in her "masculine" job, she is considered less likeable, and since both likeability and competence are

important in any job, women in STEM fields often feel stuck between a rock and a hard place. (AAUW, 2010).

II. STEM Identity in Informal Education

According to the National Research Council (2009), there is evidence that “structured, nonschool science programs can feed or stimulate the science-specific interests of adults and children, may positively influence academic achievement for students, and may expand participants’ sense of future science career options” (p. 3). In studying the trend and efficacy of STEM learning in informal settings, they proposed a “strands of science learning” framework that describes science-specific capabilities supported by informal learning environments. They identify six “strands”, or aspects, of science learning most compatible with informal learning, and emphasize Strand 1 and 6 as being most relevant to informal learning.

Learners in informal environments:

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.

Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science (p. 4).

Strand 1 is what initially sparks an interest in STEM, in which the goal is simply to excite and engage the visitor in the subject matter. This is sometimes accomplished through hosting blockbuster pop culture exhibits. Strand 6 speaks to how learners view themselves with regards to science, and the ways in which individuals become comfortable with, knowledgeable about, or interested in science. This is the ultimate goal of informal education environments in regards to STEM learning, especially when targeting young girls and trying to get them to view themselves as scientists.

The National Research Council (2009), stresses the importance in informal learning environments to demonstrate accessibility to all, and cites one of the challenges of engaging “nondominant” groups in the sciences as being that “girls often do not identify strongly with science or science careers” (p. 209). However, female scientists often cite particular individuals or contexts outside school as being influential in their career choices, suggesting that early experiences or role models can have a powerful effect in supporting women’s engagement in science. In the committee’s words,

it seems imperative to understand more about the nontraditional contexts and individual instrumental in influencing young women in science, as well as the ways in which opportunities offered in nontraditional and intergenerational contexts available in informal environments can challenge the ways gendered messages about science are reproduced (p. 223).

Subramaniam et al. (2012) put forward a sociocultural theory of learning that “suggests that one’s cultural history and personal experiences greatly influences how one (*a*) engages with

STEM learning and (b) integrates STEM into future aspirations,” all of which is related to aspects of race, gender, and socioeconomic circumstances. These personal identities can either help or hinder young people in considering STEM careers, but studies of young women have found that they develop unique identities as scientists that are influenced by relationships inside and outside of the school environment. This suggests that successful STEM informal learning spaces can help students to link “formal” STEM learning with their existing experiences and culture, such as by teaching in students’ everyday language before integrating scientific language (Subramaniam et al., 2012).

Self-efficacy, belief in one’s own abilities, is necessary for young people to establish a long-term interest and connection in STEM fields and careers. Informal education activities can increase STEM self-efficacy, which is especially important for young girls, as math self-efficacy is a significant sign of whether a young girl will pursue a STEM career. In addition, young women often see STEM careers as solitary work, and therefore unattractive, which is an attitude informal STEM learning activities can combat. Applying STEM concepts to real world technology and problems can also help girls to stay engaged in STEM, even into post-secondary study (Dorsen et al., 2006).

IV. Women in Science Fiction

Reading or writing science fiction can significantly impact how young people think about and view their world, as well as changing their understanding of and attitude toward STEM fields. The influence of science fiction can go as far as inspiring young people to actively pursue STEM fields and careers (Subramaniam et al., 2012).

According to the physicist Stephen Hawking, “science fiction is useful both for stimulating the imagination and for diffusing fear of the future” (National Science Foundation,

2002). However, an interest in science fiction may also affect the way people think and feel about science. NSF reports that an “interest in science fiction may be an important factor in leading men and women to become interested in science as a career”, since many scientists report being influenced in their careers by their interest in science fiction as children. For example, one study found a relationship between preference for science fiction and support for the space program (National Science Foundation, 2002). In addition, thirty percent of those who participated in the NSF survey said they read science fiction books or magazines, and within those answers there was no real gender gap, with 31 percent of men and 28 percent of women reporting they read science fiction books or magazines. There was a slightly wider gender gap amongst participants who watched the Syfy Channel, with more men watching (55 percent) than women (45 percent), but still a significant number of women represented (NSF, 2002).

Part of the draw of science fiction is its exploration of possible futures; as novelist and poet Ursula K. Le Guin puts it, “the future is a safe sterile laboratory for trying out ideas in, a means of thinking about reality, a method” (Gunn, 2014). Le Guin famously described her novel *The Left Hand of Darkness* as just such a “thought experiment”, in this case about how society would look without the concept of gender. The thought experiment is a concept familiar to scientists, and some academics feel researchers dealing with emerging technologies should be as familiar with science fiction works pertaining to those technologies as if the science fiction were research papers. After all, sometimes the ideas of science fiction writers inspire readers who have the technical knowledge to make the idea a reality, just as Jules Verne’s light-propelled spaceships in *From the Earth to the Moon* inspired technologists to work on the creation of solar sails. Science fiction can inspire the kind of creative, flexible thinking that not only inspires, but challenges us to consider the many potential consequences of our actions, and can even be

considered insulation for the shock of inevitable technological and scientific advances to come (Gunn, 2014).

The absence of realistic female characters within science fiction has remained a substantial fault within the genre since its earliest days. Science fiction developed within “a patriarchal culture as something written chiefly by men for men” (Encyclopedia of Science Fiction, 2012).

When women do appear [in science fiction] they are usually defined by their relationship to the male characters, as objects to be desired or feared, rescued or destroyed; often, especially in recent, more sexually explicit times, women characters exist only to validate the male protagonist as acceptably masculine – that is, heterosexual” (SFE, 2012).

It is important to note that it is completely possible to write a sexist story around a central female protagonist, meaning female inclusion in science fiction stories is not enough on its own.

The real test of whether or not female characters are being written about as human beings is whether the protagonist is connected in any important way to other complex female characters, or if she is significantly connected only to males” (SFE, 2012).

Due to the stereotyped nature of many female characters, at times no female character at all is preferable to the stereotype. As novelist Gwyneth Jones remarks,

Accepting a male protagonist on the printed page does not mean accepting one’s own absence. Indeed the almost total absence of female characters makes simpler the imaginative sleight of hand whereby the teenage girl substitutes *herself* for the male initiate in these stories (SFE, 2012).

Feminist thought has been woven into science fiction since the 1970s, perhaps starting when author and academic Joanna Russ “charged sf with a failure of imagination and ‘social

speculation’, arguing that the lack of believable female characters in sf resulted from an unthinking acceptance of cultural conditioning and clichés” (Encyclopedia of Science Fiction, 2014). This meant that one of the main goals of feminist writers during that time was to write active female characters into science fiction, instead of the cardboard caricatures written by male writers. Science fiction, by its very nature as a limitless realm of possibility, appealed to female writers and their wish to depict a different kind of reality. For feminists, science fiction offered the opportunity to challenge the notion of women as “other” to men, and make women the heroes instead of men (SFE, 2014).

As SFE (2012) reminds us, the old stereotypes are still around, but women writers often give them a more subversive twist: “the Good Wife is married to a lesbian star-pilot, the Spinster Scientist has a rich and fulfilling sex life, the Amazon Queen triumphantly refuses to be tamed.” Even with these positive advances in science fiction literature, women’s roles in science fiction film are still severely limited and revolve around the men, where in action they’re often victims, robots, or prostitutes (or some combination), and otherwise they wait patiently at home. Sigourney Weaver’s role in *Alien* is a notable exception: a female hero who outfights and out-survives the rest of the mostly-male crew, but the sequel *Aliens* put her character in a more comfortable role for male viewers, that of a mother fighting to protect her child (SFE, 2012).

Recent science fiction shows such as *Fallen Skies*, *Alphas*, *Sanctuary*, and *Continuum* all fall into trope pitfalls, even while showcasing “strong” female characters. In *Fallen Skies* and *Alphas*, the female characters are few, sidelined, and without the fighting abilities of the men. In *Sanctuary*, most of the female characters are one dimensional, and the single woman of color is rarely seen and eventually written out of the show. In *Continuum*, abortion is written as always wrong and marriage is the answer to teen pregnancy, neither of which is a very positive message

to young girls (Bitch Flicks, 2012). Inclusion of female characters into media, science fiction, and museum exhibits is only the first step.

In summary, women are grossly underrepresented in STEM fields, in part due to societal gender stereotypes and misinterpretation of women's different learning styles. Informal education is ideally suited to engage both young girls and women in STEM, through accessibility, developing STEM self-efficacy, sparking initial interest through excitement and fun, and helping visitors to identify with the scientific enterprise. Science fiction has been connected with both sparking an interest in STEM, sometimes leading to careers, and inspiring the development of technologies first theorized within science fiction. Women have a history of being either underrepresented in science fiction or being represented by one-dimensional, stereotyped characters, but the involvement of female science fiction authors has helped to inject more diverse and complex female representation into the genre.

CHAPTER THREE: METHODS

The goal of this research is to identify the ways in which museums are currently using science fiction exhibits to interest young girls in STEM fields and careers.

I. Sampling

Four institutions and three exhibits were selected for their relevance to themes of science fiction, as well as for the relative variation in museum type, location, size, and approach to holding a science fiction exhibit. The museums and exhibits selected were: the EMP Museum and its exhibit *Icons of Science Fiction*, the Museum of Science in Boston and its traveling exhibit *Star Wars: Where Science Meets Imagination*, Pacific Science Center as a host site for *Star Wars*, and the Tempe Center for the Arts and its exhibition *American Pop! Comic Books to Science Fiction...and Beyond*. One museum staff member integral to the exhibit selection or creation process was interviewed from each of these sites: Brooks Peck, Curator at the EMP Museum and principal creator of *Icons of Science Fiction*; Larry Bell, Senior V.P. for Strategic Initiatives at the Museum of Science and principal investigator for *Star Wars*; Lisa Marchesio, Exhibit Operations Manager at the Pacific Science Center and hoster of *Star Wars*; and Michelle Dock, Gallery Coordinator at the Tempe Center for the Arts and co-creator of *American POP!*. These four sites when taken together include examples of science fiction and pop culture museums, science museums, and art galleries, and demonstrate how various types of institutions integrate science fiction exhibits into their programming and use those exhibits to interest young girls in STEM.

EMP Museum is a music, science fiction and pop culture museum in Seattle, Washington, and describes itself on its website as

a leading-edge, nonprofit museum, dedicated to the ideas and risk-taking that fuel contemporary popular culture. With its roots in rock ‘n’ roll, EMP serves as a gateway museum, reaching multigenerational audiences through our collections, exhibitions, and educational programs, using interactive technologies to engage and empower our visitors. At EMP, artists, audiences, and ideas converge, bringing understanding, interpretation, and scholarship to the popular culture of our time.

Originally called the Experience Music Project, EMP found its legs first as a popular music museum, and finally as a science fiction, popular music and popular culture museum.

The *Icons of Science Fiction* exhibit originated out of a project known as the Science Fiction Museum, before it was incorporated into EMP’s space as part of a move to become more pop cultural. During which time *Can’t Look Away: The Lure of Horror Film* and *Fantasy: Worlds of Myth and Magic* were also conceived and installed. The EMP website describes *Icons* as an artifact-based exhibit focusing on the diverse forms of science fiction, the pervasiveness of the genre in popular culture, and connecting science fiction’s big ideas to the artists, writers, and filmmakers who created them through six plot-central questions, each accompanied by two classic works that exemplify that question. The six questions that shape the exhibit according to EMP’s website are: What if we could explore the stars? What if we were enslaved by our machines? What if we fought a war with aliens? What if I had superpowers? What if we could design our children? What if I were the chosen one?

The Tempe Center for the Arts (TCA) is a publicly owned performing and visual arts center in Tempe, Arizona, with two theaters and a 500 sq. ft gallery. According to the gallery director, Michelle Dock, the mission statement of the Center is “to celebrate diverse arts experiences.”

As described on TCA's exhibit partner Arizona State University's website, *American POP!*

explores the transformative effects that science fiction and popular culture have on our everyday lives and the technology that surrounds us. Tempe Center for the Arts and Arizona State University have worked together to create an exhibit that will investigate the relationship between popular culture, scientific inquiry, technological innovation and cultural change. Displays will include objects and collections from local and national collectors as well as original art, high tech models and limited edition pieces from some of America's favorite pop culture icons.

Unique amongst this sampling, the *American POP!* exhibition does not have an admissions charge, though most of TCA's other programs and exhibits are ticketed.

In addition to the exhibit shown in TCA's gallery space, the institution is hosting a weekly program called Sci-Fi Fridays meant to complement the exhibit and its themes, and showcasing a different local scientific or artistic speaker each week, according to the City of Tempe's website. For those who cannot make it to the exhibit or who wish to gain a preview of the content, videos have been posted on their partner Arizona State University's website introducing the exhibit and allowing each scientific/artistic member of the community highlighted in the exhibit to explain how their interest in science fiction and pop culture influenced their career paths.

The Museum of Science (MOS) in Boston website states that its mission is "to play a leading role in transforming the nation's relationship with science and technology", to which end they

promote active citizenship informed by the world of science and technology, inspire lifelong appreciation of the importance and impact of science and engineering, and encourage young people of all backgrounds to explore and develop their interests in understanding the natural and human-made world.

As part of this initiative to interest as many people as possible in STEM fields, the Museum of Science also creates and collaborates with various traveling exhibits, one of which was *Star Wars: Where Science Meets Imagination*.

The *Star Wars* exhibit was created in partnership with LucasFilms Ltd., and made its debut in 2005. After being shown at MOS, the exhibit made an initial tour around the United States before going international with showings in Melbourne and Sydney, Australia. *Star Wars* then returned to North America and visited 20 more venues before finally finishing its eight-year tour in March of 2014. In total, more than 2.9 million visitors worldwide experienced the exhibit. The exhibit combined costumes and props from all six *Star Wars* films with interactive exhibits related to real world technologies, and in addition to the many costumes and props, was organized around two themes: “Getting Around” and “Robots and People”. “Getting Around” included protagonist Luke Skywalker’s original landspeeder from *Star Wars: Episode IV: A New Hope*, as well as scale models of X- and Y-wing starfighters, and provided interactives about how things move without touching the ground in the real world. “Robots and People” included the robotic characters C-3PO and R2-D2, and explored various sophisticated robotics in the real world. There was also a full-size replica of the cockpit of the *Millennium Falcon* ship from the first three films, in which visitors could experience a virtual jump to lightspeed, while Anthony Daniels (the voice of C-3PO) narrated a presentation on our galaxy.

According to the Pacific Science Center (PSC) website, their mission is “to inspire a lifelong interest in science, math and technology by engaging diverse communities through interactive and innovative exhibits and programs.” PSC accomplishes this in part through their practice of integrating pop culture elements into what they offer, be it by showing science fiction films in their IMAX theaters, holding pop music laser shows in their Laser Dome, or by hosting traveling exhibits such as *Harry Potter: The Exhibition* and *Star Wars*.

Tempe Center for the Arts is a rather small institution with little funding for its projects, and thus offers a useful look at how a smaller museum can successfully show a science fiction exhibit to a general audience, and how an art gallery can fulfill much the same function as a science museum, in the right hands. EMP approaches the topic from a wholly science fiction-based origin and goal, without any deliberate STEM integration. Pacific Science Center received its exhibit as a traveling exhibit, and therefore offers a slightly different perspective from the goals espoused by the originating institution. The Museum of Science has the unique position of having developed their exhibit to be a traveling exhibit. By sampling from a variety of institution types, sizes, and focuses, this research is able to take a representative look at the ways in which various institutions engage girls in science fiction and/or STEM.

		Gender of Interviewee	
		Male	Female
Museum Type	Science	Larry Bell, Museum of Science	Lisa Marchesio, Pacific Science Center
	Cultural	Brooks Peck, EMP Museum	Michelle Dock, Tempe Center for the Arts

Table A. *Diversity of sampling*

Both *Icons of Science Fiction* and *American POP!* had supplementary material to examine, since both exhibits were current at the time this research took place, making it easier to

access promotional materials, exhibit websites, and other supplementary materials that feature the exhibit to analyze the imagery and language used. *Star Wars* came to Pacific Science Center in 2011, and therefore had almost no material represented on the Pacific Science Center website.

II. Methodology

A mixed methods approach was used, interpreting semi-structured interviews with exhibit producers and selectors, and supplemented by content analysis of exhibit websites, promotional materials, and supplementary exhibit content, such as videos. This data was then analyzed for trends related to the central research question.

Interviews were conducted over the phone, with four staff members from four different museums, on three different exhibits. Interviews were recorded with the participant's permission and transcribed. Names were used with consent.

The Interview Guide and consent form are in the Appendices. The general flow and themes of interview questions asked of the participants:

- Why did your institution decide to hold this exhibit? What benefit was it felt the exhibit would present to your audience, and what is the exhibit's connection to your institution's mission?
- How is success measured in your institution and how successful do you feel this exhibit was/is in light of that measurement?
- Does your institution believe young girls need specifically targeted STEM programming and why/not?
- In developing/preparing for this exhibit, were young girls (ages 10-16) a target audience and why/not?

- Which aspects of the exhibit might appeal to young girls? Which aspects of the exhibit might be improved to appeal more strongly to young girls?
- Has your institution shown a science fiction exhibit in the past? If so, how successful was it?
- Might your institution hold another science fiction exhibit in the future? If so, what would your institution be looking for in such an exhibit?

III. Content Analysis

The content analysis searched for depictions or mentions of women or girls, exhibit descriptions reflecting mission goals, mentions of science fiction, the goals of the exhibits, how audience is identified, and finally how the museum identifies itself. This data was collated into two tables (B, D) describing how each museum represented these themes through their websites and supplementary material (such as online videos accompanying the exhibit).

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Descriptions of Museum	Website	Website	Website	Website
Descriptions of Audience	Website, promotional materials	Website	Website, promotional materials	Website
Mission Goals	Website	Website	Website	N/A
Gender Representation	Website, promotional materials	N/A	Website, promotional materials	Website, promotional and supplementary materials (videos)

Table B. *Sources of content analysis*

Descriptions of the museum were acquired primarily by examining “About” pages for descriptors such as “science center” or “cultural institution”. In looking for descriptions of the museum’s audience, key words were sought such as “children”, “family”, “youth”, or “community”, or more specific identifiers involving gender or age. Mission goals were looked

for on the museums' "About" pages, usually under the subheading "Mission Statement" or similar, and focused on mentions of "science", "science fiction", "learning", and references to audience. Gender representation was identified through images specifically portraying known or perceived male or female identified characters or real people, as well as through gendered names and pronouns within exhibit descriptions and promotional/supplementary materials.

A general survey of the interviews was conducted for common themes and issues across each interview question's answers, before extending found themes across the interviews as a whole. This data was collated into a table (D) describing how each museum reflects these themes.

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Relevance to Mission				
High Attendance				
New & Diverse Audiences				
Identifying the "Sci-Fi Audience"				
Gender in Exhibit				
Gender in Audience				
Exhibit Aspects Appealing to Girls				

Table C. *Interview themes*

CHAPTER FOUR: RESULTS AND DISCUSSION

This research looked at the ways museums are using science fiction exhibits to interest young girls in STEM fields and careers. Certain trends emerged through both the content analysis and interviews that point to both similarities of experiences and variations in approach across the three exhibits installed at the four museums.

I. Content Analysis Data Summary

Content analysis revealed certain themes that were supported by the interviews. In descriptions of their target audiences, all sample institutions had language that emphasized diversity, whether through age or “community” or geographic location, while Museum of Science was the only institution to emphasize young people and schools. Both the science museums, Museum of Science and Pacific Science Center, stressed the importance of creating a lifelong interest in STEM in their mission statements. EMP Museum had a mission statement that exemplified the goals of a typical science museum without the science, emphasizing interactive technologies, creative thinking about the world, and empowering visitors to create their own experiences. Tempe Center for the Arts did not have a mission statement on their website, but from the interview it became clear that their mission celebrates the diversity of experiences within art appreciation, thereby also encouraging visitors to shape their own experiences.

Coding for representations of gender included both the gender representation of the exhibit’s potential or current audience and gender representation within the exhibit itself. The goal of tracking this particular theme was not to determine how many men to women actually attended the exhibit, or how many male to female characters, creators, or actors were represented within the exhibit. Rather, the purpose of tracking gender representation in online media was to

determine how the institutions were interpreting and displaying these factors. The two cultural institutions, EMP Museum and the Tempe Center for the Arts, were the most gender egalitarian in both their depictions of the exhibits and their audiences. While mentions of men and male characters still outweighed those of women and female characters, the EMP made an effort to include a fair number of women and female characters in their exhibit description, and included a photo of four young girls enjoying the interactive on green screen technology. In TCA's supplementary video collection, half the videos spotlight women, and in their promotional poster, a boy and a girl reading comic books share equal prominence, pointing to a desire to equally include both boys and girls within their audience, if not an expectation.

The Museum of Science did not mention or depict any women or female characters in their exhibit description of *Star Wars*, though they did mention four male characters and actors. The Pacific Science Center also had no women in their exhibit descriptions, although they did not include any gender specifications, and had extremely limited material, due to the exhibit no longer being on display.

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Females in Exhibit	0	0	4	3
Males in Exhibit	4	0	16	3
Females in Audience	N/A	N/A	4	1
Males in Audience	N/A	N/A	0	1

Table D. *Overview of gender in online materials*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Descriptions of Museum	Science center, cultural institution	Science and technology center, public forum	Gateway museum	Performing and visual arts center
Descriptions of Audience	The nation, young people, K-12, schools	Diverse communities, all ages	Multigenerational	All ages
Mission Goals	Active citizenship informed by STEM, lifelong appreciation of STEM, young people exploring and developing interests in understanding world	Lifelong interest in STEM by through interactive and innovative exhibits and programs	Using interactive technologies to engage and empower, celebrate creative process, engage imagination, inspire personal expression	N/A (interview elaborated)
Gender Representation	4 male characters and actors mentioned; no women	No gender represented at all	Image of 4 young girls using interactive, 2 “icons” out of 5 are female, 2 out of 12 novels have female authors, only male characters mentioned (3)	3 out of 6 supplementary videos are with women, a boy and girl equally prominent on promotional poster

Table E. *Content analysis data*

II. Interviews Data Summary

All institutions cited relevance to mission as one of the determining factors in hosting their exhibit; all but the EMP cited high attendance as another factor, and all but Museum of Science cited bringing in new and/or diverse audiences as a factor. Despite the fact that all institutions except for the Pacific Science Center cited equal attendance of their exhibit of both men/boys and women/girls, there was a trend amongst all sample institutions but the EMP to refer to either potential or actual science fiction exhibit audiences as being typically male.

Examples of this include Larry Bell from the Museum of Science admitting that when planning for the *Star Wars* exhibit, they worried it “might be something more appealing to boys,” and when Lisa Marchesio from the Pacific Science Center remarked that the *Star Wars* exhibit seemed to be “dad-centric” but that “given the content, particularly the pop culture content”, it made sense.

As far as gender representation within the exhibits themselves, only the EMP and TCA attempted equal representation, with Museum of Science and TCA both claiming to have equal appeal. The difference here between “equal representation” and “equal appeal” is that equal representation denotes an actual reality of women being represented in equal numbers with men, while equal appeal refers to the attitude that an exhibit already “appeals to everyone”, negating the need for equal representation. An example of this is Michelle Dock’s answer to the question “Are there any aspects of the exhibit that could be improved to appeal more strongly to young girls?” in which she answered, “I don’t think so. I feel like we’ve done a pretty good job of making it across the board interesting for all, and for all ages...I think by serving all, that I’m serving those girls too.” Pacific Science Center was silent on the issue of gender representation within the exhibit.

III. Interview Question Themes

What follows is a breakdown and elaboration of the themes inherent in each question, by question, across the sample institutions. Included are many quotes from the interviews themselves, which offer greater insight and clarity into the issues discussed than could otherwise be maintained.

- **Question 1: “Why did your institution decide to hold this exhibit?”**

There was general consensus that the weightiest factors were meeting the museums' mission goals and attracting a large visitor count. Bell answered, "we were looking for an exhibit that both would meet museums' mission goals, number one, and number two, would attract a lot of visitors to come and see it." Marchesio had a similar answer, reporting:

We did a cost-benefit analysis into what we thought the local audience draw would be versus what we felt we could reasonably negotiate financially for it... and obviously it spoke to our mission, being very hands-on, and something that we could trust to really inspire people, to make them interested in science and technology.

Peck also had a mission-related answer, stating, "science fiction has been our core... definitely one of our areas of emphasis, has been for the last ten years." Dock had a slightly different take, referencing instead the organic conversations that arose amongst staff and others concerning how they all "grew up on popular culture, we grew up on science fiction, TV. We grew up collecting toys, whatnot, and in some ways those early loves led to the career choices that we were in today," which eventually established the basic concept for the exhibit.

- **Question 2: "What benefit did the exhibit present for your audience?"**

There was general consensus, this time around the importance of attracting a diverse as well as large visitor crowd, and assurance that the exhibit fit with what they already knew about the interests and desires of their visitors. As Marchesio said, *Star Wars* was a:

key market draw for us, and it was sort of a diversity of experience that we're looking for when we're looking for traveling exhibits... we had some anecdotal comments from visitor surveys and visitor comment boxes that mentioned being interested in seeing it come here.

Dock echoes the importance of diverse experiences, as “the overall mission statement of the art center itself is to celebrate diverse arts experiences.”

Along with attracting a diverse audience with a diversity of experience, many participants reported their institutions using the exhibit as a springboard to expand or shift mission goals and focus. Bell replied that *Star Wars* “made it a great opportunity for us to launch our new mission in engineering education within the exhibit.” Peck explained that while the EMP had previously catered solely to hardcore science fiction lovers:

we have a growing family audience coming to EMP, and we wanted to create a science fiction exhibit that was more geared toward them... A general audience coming away with a new appreciation for the value and also the excitement of science fiction... and if I am really lucky and things go really well, an interest in pursuing more.

- **Question 3: “In what ways does your institution feel the exhibit was or was not successful?”**

All interview participants, apart from EMP’s Peck, asserted that their exhibit had been successful because it had high attendance and visitors appeared to be rigorously engaging with the exhibits and material. As reported by Bell regarding *Star Wars*:

the exhibit did indeed draw lots of people to the museums where it went, and people did engage in the activities that we developed, including the specific components that focused on engineering design. And people did work collaboratively on some of those problems that were presented in the exhibit. People got a lot of the main messages that we had crafted for the exhibit, and so on. So for the most part, I would say that the exhibit did both the things we wanted it to do: it helped to communicate something about science and engineering, and it also attracted lots of visitors.

Marchesio referenced similar aspects, saying:

for something like *Star Wars*, where we're ticketing separately, one of the key metrics is always going to be profitability... for *Star Wars* we got really good attendance for it, so that was great, and it definitely paid off there. We did get good visitor response, like I said we got good membership response, and those are things we're always looking for in a traveling exhibit. We always want to make sure that we're bringing in things that are new and fresh, but are not alienating our core audience.

Dock also pointed to high visitor attendance numbers at *American POP!*, saying:

we're going to break our attendance records. Prior to this exhibition, our best attended exhibition... had about 10,000 people, and we're going to go over that. We've already in the 7 to 8,000 range and right now we still have two months left of the exhibition, so we'll go over that. I'm guessing we'll probably be in the 11-12,000 range by the end of the exhibition, so that's definitely good.

The introduction of Sci-Fi Fridays was also mentioned by Dock, and how successful they had been in bringing in an adult audience that might not have come otherwise, and averaging 20-25 people in attendance each week. Apart from Peck, Dock was the only participant who mentioned a less successful attribute, saying that she would change "a little bit of the marketing strategy" since they "don't have a big budget, so we rely a lot on social media... and I think I probably could have done more to reach out to the Comic-Con community."

Peck stood out as an outlier, as he did for many of the answers, in that he passed over attendance numbers as a marker of success in favor of talking about the strengths and weaknesses of the exhibit content and design itself. Peck found it a strength that the exhibit seemed to perform the functions he had wanted it to perform, pointing out:

it connects people to the stories by seeing things like costumes, and an understanding of behind-the-scenes, the fact that people make these things, they make these movies, they make these TV shows, and gives a realism to that... it's successful at showing people there's a wider range of science fiction than they might have thought, and trying to push those boundaries out a little by including things like superheroes.

He also pointed out one of the exhibit's design flaws, explaining:

the stark environment feels a little imposing, and not very warm and welcoming, and people don't want to spend a lot of time there, and so they cruise around and then take off. Especially compared to the fantasy and horror galleries, it doesn't feel as immersive, and thus as serious or real.

- **Question 4: “Has your institution discussed the need for young girls to be provided with specifically targeted STEM/STEAM programming?”**

All answered in the affirmative to some degree, though not always explicitly. Marchesio stated, “Not with regards to the traveling exhibit program. In general it's a conversation”, and Dock seeming to say that they did not have that exact conversation in planning the exhibit, but that it occurred to her while planning that “a lot of guys are into this kind of Comic-Con community kind of events and exhibitions”, while pointing out that women are equally represented within both the exhibit and Sci-Fi Fridays, as well as within their audience, so that TCA has “been conscious of trying to be democratic about that.”

Peck seemed to take the question to mean targeting young girls in general, not specifically for STEM, but did mention the importance of equal representation within an exhibit.

As Peck answers:

Yes, both formally and informally. I would say that more often we talk about it on the music side. But in developing things like the science fiction exhibit and programming, it comes up a lot when we're talking about representation. Because traditionally, as you well know, the creators skew male, wildly so. And honestly a straight up, proportional representation of creators in the exhibit would practically absent women entirely... girls are going to be more engaged by seeing women creators, and female characters. For that reason, I did things like including the Powerpuff Girls, and the author Octavia Butler.

Peck points out, "we have many young girls coming in", and even if they did not, he says he would still make sure women were equally represented because "it's the right thing to do."

Bell referred to STEM-based work his museum had done towards this goal, citing MOS's first foray into programming to encourage young girls into STEM, back in the eighties, when they did Camp-Ins at the museum for Girl Scout Troops to learn about science after hours. The museum also currently sponsors science curriculum programs in elementary schools, and Bell said getting girls into STEM has been a "big issue" there as well. As far as the *Star Wars* exhibit goes, he said:

at first we were a little worried that perhaps the Star Wars intellectual properties, the Star Wars world, might be something that was more appealing to boys than to girls, although LucasFilms had some kind of demographic survey they'd done, that suggested that both boys and girls were equally attracted to the Star Wars brand.

Bell went on to explain how MOS tested prototypes for the language used in *Star Wars* panels:

during the development process, we built prototypes of those activities and we tested them with visitors. Formative evaluation, a process we call formative evaluation, and specifically we looked at the question of how we would present not what the physical

activity was like, but what about the language of the panels led you to be attracted to the activity, invited you to do it, and sort of tied the activity either to Star Wars or the real world. We looked at alternate ways of presenting that, tying it into real world context, tying it into the Star Wars movies, or having a museum activity that kind of stood on its own merit as opposed to tying it in to something in particular. And one of the reasons we did that is because of some research that had suggested that boys were more interested in these kinds of activities and challenges in and of themselves; girls were more interested in seeing the real-life applications of these activities. The Star Wars exhibit was meant to be for everybody, but we wanted to make sure that, in the way we did it, we didn't fall into a trap where we were doing it in a way that was attractive only to boys and not to girls; that's why we did this kind of testing.

- **Question 5: “Which aspects of the exhibit might appeal most to girls, and which aspects could be improved upon in that regard?”**

Within this question there was also variation in response, not just because the participants' institutions and exhibits varied, but also because each participant seemed to take the question slightly differently. Overall the question of designing for girls was viewed as important, but sometimes problematic. Peck was the only participant to name aspects of his exhibit that could be improved upon to appeal more to young girls. As far as what aspects might appeal most strongly to young women in *Icons*, Peck answered:

the animation artwork for Powerpuff Girls, there's a number of female authors featured like Nancy Kress, Octavia Butler, really important set of artifacts. There's right up front and center, Nichelle Nichols's Uhura costume from the original Star Trek and earpiece. Really when folks come in, that's the first or second thing they notice. That's definitely

by design. And there's this touch table, it's like a digital catalog of a lot of other stuff, and kind of points to comics and manga and art, other art, games and all sorts of things... by including this digital catalog of theoretically up-to-the-minute games, comics, things like that, I can try to show what's happening in contemporary science fiction. And I think that contemporary science fiction has less gender bias, more open to a wider audience... sometimes it's just an easy story to tell, that science fiction is all about white males. And that's true, but it's also not entirely true, even going back to its origins.

And in addressing aspects that could be improved to appeal more to girls, Peck wanted to integrate more Doctor Who, because "current Doctor Who has some really interesting role models for girls, and the Doctor Who fandom has a large percentage of girls." He also said he would like to "do more programs. We don't do a lot of small focus programs, specifically for science fiction", because Peck feels that having more small focus programs for young people could draw in more young girls who might not come to the exhibit, or to their other events, which are typically late at night.

Although Bell had just previously answered that the MOS took the integration of girls seriously in the planning stages of *Star Wars*, he was loathe to point to any specific interactives or artifacts that might appeal, or not appeal, to young girls, lest he be accused of stereotyping the interests of young girls. As he said:

there's a part of the exhibit that was focused on "Could you do something like Luke Skywalker's landspeeder?" You know, a vehicle that hovers over the ground in some way... And we were doing activities that involved magnetic levitation as a way to do a little model of something that hovers, and so my stereotype would be, okay, so this is about vehicles, probably more attractive to boys who are into fast cars or something like

that, although girls can be into fast cars too. And there's another part of the exhibit that was about medical technologies, which was centered around the idea that Darth Vader had technologies attached to him that helped him breathe and function in other ways, and at some point Luke Skywalker gets an artificial arm, hand... So there's a section of it that was about health and medical technology and future aspects of that, and my stereotypical view might be that that part might be more attractive to girls, but if I say those things, I'm just revealing societal stereotypes.

Marchesio talked about the seeming higher ratio of dads near the opening date of the exhibit than was usual, and suggested that perhaps it was because it opened so close to Father's Day. She stressed that it was something that the staff noticed casually and not anything that was analyzed, but that "it's very possible, given the content, particularly the pop culture content in there."

Dock responded that while it was useful that two out of the five local artists and scientists highlighted in the exhibit are women, especially since one of the women is the Assistant Director of the Meteorites Lab at ASU and Earth and Space Technology is a male-dominated field, she feels that "whether you're a girl or a boy, you're going to be attracted to these things and the elements of wonder happening and 'what's out there?' kinds of things... I feel like we've done a pretty good job of making it across the board interesting for all, and for all ages... I think by serving all, that I'm serving those girls too." This suggests another type of discomfort with targeting girls, similar to Bell's in its avoidance of the question, but less focused on stereotyping and perhaps more focused on not putting girls above boys by targeting any one group.

- **Question 6: "Had your institution shown a science fiction exhibit in the past?"**

The two science centers, MOS and PSC, both had. MOS held a Star Trek exhibit decades ago. MOS also showed a Lord of the Rings exhibit in the past, and Bell said that while Lord of the Rings was more fantasy than science fiction, “LucasFilms didn’t consider Star Wars science fiction, but as a fantasy movie” because they felt it gave them more freedom to not remain scientifically plausible. The Lord of the Rings exhibit did involve discussions of technology, since it focused mostly on the special effects of the films. Marchesio gave a similar account, mentioning holding a Star Trek exhibit briefly in the late eighties or early nineties, and that they had “just prior to Star Wars finished Harry Potter, which I guess is really more of a fantasy than a science fiction exhibit.”

Peck was not asked this question, since through almost all of EMP’s existence, it has shown science fiction exhibits, and Dock answered in the negative.

- **Question 7: “Might your institution hold another science fiction themed exhibit in the future?”**

The general response to this question was a theoretical affirmative. None of the participants were adverse to the concept, as long as they were able to find a compelling and mission-relevant science fiction exhibit that would be fiscally responsible, and some of the participants had specific exhibits already in mind.

Bell mentioned plans with PIXAR to create an exhibit about animation and the animation process of PIXAR. He made connections between *Star Wars* and this potential PIXAR exhibit, in that both are based in pop culture that “has a great deal of popularity, and there’s an underlying educational theme, in this case computer science, as opposed to engineering.” Bell also specified that any future science fiction exhibits would have to be somehow “directly applicable in your

own life”, and that if there wasn’t that applicability it might not be the right choice, especially when trying to get girls involved.

Peck mentioned already having future plans for more science fiction exhibits:

a very large scale exhibition specifically about the interplay between science and science fiction, about how each inspires the other. And about how the trajectories of ideas of science fiction impact the real world. And especially how when you meet researchers or engineers...scientists, they’ll often say, I watched Star Trek...or something like that.

Peck went on to say that the planned exhibit “may never be exhibited at the EMP, because I think it’s more science center appropriate” and his role would be more the initiator and creator of this exhibit. He also mentioned that the EMP is “working on a big Avengers exhibit, which also has science hooks and is aimed at science centers.”

Dock was also very enthusiastic about holding another science fiction exhibit, though she did not yet have another in mind. As she put it, “from our attendance numbers and the interest level of people, we’ll certainly be doing popular culture, and actually I would love to work with the [ASU] School of Earth and Space Science again, because they actually had so much more that they wanted to display.”

From the perspective of showing traveling exhibits rather than creating your own, Marchesio pointed out that when trying to bring in a specific kind of exhibit, such as a science fiction exhibit, it can be very difficult to find one that will still have scientific content and interactivity, partly because the market of blockbuster traveling exhibits is very small. In addition, Marchesio brought up the issue of many blockbuster pop culture exhibits being “attached to some sort of property, like Harry Potter or Star Wars, and it comes with that additional financial risk”, making it even more of an ordeal to host such an exhibit. However “if

the opportunity presents itself”, she said PSC might consider putting on another science fiction exhibit.

Brooks Peck, of EMP, was asked an additional question concerning the display of Nichelle Nichols’s Lt. Uhura costume. The question was: **“On Nichelle Nichols’s Lt. Uhura costume in your exhibit, the uniform is missing its officer ranking stripes. She has a rank and the uniform always showed that in the show and movies, so what happened to them?”** Peck responded that he did not know what happened to the stripes, nor had he been aware that they were missing in the display. He posited that they might have fallen off or been removed for reuse at some juncture, or might even point to the uniform being a replica.

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Relevance to Mission	Yes	Yes	Yes	Yes
High Attendance	Yes	Yes	No	Yes
New & Diverse Audiences	No	Yes	Yes	Yes
Identifying the “Sci-Fi Audience”	“might be something more appealing to boys”	“dad-centric... given the content, particularly the pop culture content”	General/family audience	“a lot of guys”, “Comic-Con”
Gender in Exhibit	No information	No information	Equal representation	Equal representation
Gender in Audience	Equal attendance	Dads around Father’s Day; no other information	Equal attendance	Equal attendance
Exhibit Aspects Appealing to Girls	Example of stereotypical answer; no actual answer given	No answer given	Inclusion of female characters and creators	Inclusion of female role models

Table F. *Self-reported themes in interviews*

As far as museums using science fiction exhibits to interest general audiences in STEM, all sample institutions interviewed spoke to the effectiveness and ease of integrating science

fiction and interest in STEM, with many bringing up the subject on their own. All seemed to feel that integrating pop culture such as science fiction with STEM themes and learning is an effective way to interest a large number of people in STEM who may not have otherwise come to a STEM exhibit, hence the theme of using pop culture exhibits to garner new and diverse audiences. Even EMP Museum, whose *Icons* exhibit does not directly address STEM, has plans for two future exhibits integrating science fiction, pop culture, and STEM, and expects to have a science museum host them. All sample institutions were open to the idea of hosting another science fiction exhibit in the future, as long as it related to their mission goals and was financially feasible. As far as interesting young girls in STEM specifically, every institution except for the Pacific Science Center has explicitly stated that this is something they find important, and is an issue they either have worked on in the past, are currently addressing, or have plans to target in the future.

As far as women/girls and science fiction exhibits, despite all sample institutions reporting equal attendance rates of men and women, suggesting that both men and women find science fiction and pop culture themes appealing, there remained a tendency to refer to either their own exhibit audiences or to potential science fiction exhibit audiences as appealing more to boys or consisting of mostly men. One of the only museums that escaped this tendency was the EMP, which stressed that its audience is general and families, with plenty of girls. They were also the only institution to have on their website a photo of young girls enjoying their exhibit, although TCA's poster depicted boys and girls as equal appreciators of pop culture as well.

Museum of Science did not include female characters or audiences in promotional materials, though they did include males, and Bell was too uncomfortable with being perceived as "stereotyping" to give an answer about which aspects of the exhibit might appeal to girls.

Despite trying to include female audiences while planning the exhibit through a formative evaluation of how signage language invited visitors to participate in interactives, and whether tying the activity to a real world context or the *Star Wars* content influenced whether girls were interested in the activity, Museum of Science still found targeting girls to be an uncomfortable topic which sounded like “trying to reach girls over boys”, which as Bell pointed out, was not their aim with the exhibit. Pacific Science Center was even more removed from the discussion of integrating girls and girls’ interest in STEM with *Star Wars*; Marchesio having only an impression that targeting girls in STEM was an overall museum priority, and not connecting *Star Wars* to that concept at all. Marchesio had little to nothing to say about gender, except to say that it made sense to see so many dads at the exhibit because of the pop culture content.

With all this taken into consideration, museums appear to be aware of the importance of including both female and male characters and people in their exhibits, as well as generally wanting both boys and girls to be equally represented within their audiences. However, taking that a step further, and actively targeting young girls, is not yet universally embraced for a few possible reasons. One reason being that targeting young girls means knowing what is appealing to young girls, and without study into the subject, some museums are afraid this will necessitate real or perceived stereotyping. Another reason for the wariness is possibly that museums feel that they are doing enough, and believe that by aiming for a general audience, they are by default aiming for young girls as well. The third possible reason could be that museums are worried that by “targeting” girls they will be putting girls’ needs over boys and leaving the boys out.

V. Implications of Findings

To be unaware of the need to target young girls in STEM learning, or to be concerned designating which aspects of an exhibit might appeal to young girls for fear of stereotyping,

suggests a severe lack of understanding amongst museums. Especially in science museums, understanding the importance of making STEM appealing to young girls is essential, both in order to successfully serve their audiences and in the context of the national initiative to get more women into STEM fields. Museums cannot afford to have weak stomachs in the pursuit of targeting young girls for fear that such targeting will “put girls over boys” or reveal stereotypical gender assumptions in the process. Museums cannot hope to “appeal to everyone” or avoid gender stereotyping if the effort is never made to understand what it is that makes STEM appealing to young girls and then to *put those findings into action*.

However, the assumption within all sample institutions but the EMP that science fiction and pop culture is more appealing to men and boys, even after visitor attendance has proven this assumption to be false, *is* stereotyping, and actively works to exclude young girls and women from science fiction and pop culture exhibits, both as visitors and exhibit content, by encouraging museums not to consider women as a core audience. Beyond the simple fact that this makes it impossible for museums to successfully serve half their audience, it also makes it much more difficult to use science fiction to interest young girls in STEM.

There appears to be a perception that young girls are just as well served by a generalized approach as the rest of the museum’s audience pool makes the unspoken assumption that young girls are not currently at a disadvantage in regards to STEM learning and engagement when compared with their male peers. This assumption, that we are currently living in a post-sexist, gender equalized world, ignores the fact that women still represent under a quarter of all STEM professionals, and that young girls are still under the impression that they are not as naturally good at science and math as boys.

This assumption is in the same category as those who believe we no longer need Affirmative Action, as if we all live in a post-race world in which no one is any longer at a disadvantage because of their race. It is at best naïve, but worse, it is dangerous; it is dangerous because in ignoring the realities of inequality that still influence our society, those inequalities are allowed to continue, or even worsen. Inequalities do not go away if you ignore them. Museums must be prepared to undergo some learning and some mistakes in the mission to engage young girls in STEM.

Even when young girls are actively targeted and women included in exhibits, problems sometimes arise. Brooks Peck cites prominence of the uniform of Lt. Uhura in *Icons* as his prime example of the appeal of the exhibit to young girls. However, the uniform displayed in the exhibit is devoid of the gold officer stripes present in both *Star Trek* the series and the original *Star Trek* movies. Nor is there any reference in the signage as to the significance of the character of Uhura on television during the sixties as a visible and respected woman of color, or any acknowledgement of the absence of her visibility as a lieutenant and an officer on the bridge. These kinds of omissions take what could have been a powerful reminder of the historical presence of women of color in science fiction, a STEM and science fiction role model for young girls, and one of the most beloved characters in science fiction, and demote her to another pretty girl in a short skirt, which is arguably more harmful to young girls' empowerment and engagement in STEM than Uhura's absence would have been.

In general, and despite missed opportunities like that of Uhura's uniform, both the cultural institution sites did a more thorough and deliberate job of including women in their exhibits, noticing that female visitors were just as engaged as male visitors, and making the connection between the importance of getting young girls into STEM and integrating science

fiction with STEM themes to tell a compelling story. Whether this is because pop culture and art museums are more inclusive within their audiences, or feel less need to stay within certain boundaries of exhibit content, is unclear, but science museums need to catch up to the inclusive and STEM + science fiction exhibit traditions pop culture and art institutions have already begun to implement.

VI. Limitations and Challenges of Research

One of the most limiting aspects of this research was the inability to personally visit every exhibit, either because of museum distance from the research location or the exhibit no longer being shown at the institution. This excluded the possibility of gathering thorough and significant first-hand data of exhibit contents, forcing much of the research to rely on first-hand accounts of the exhibit, some of which may have been inaccurate or incomplete, especially considering that both *Star Wars* participants had had three to nine years between hosting the exhibit and giving their interviews to forget or misremember important details about the exhibit.

There is also an inherent limitation in the sample size. Four institutions and a total of three separate exhibits cannot be expected to represent definitively the trends of science fiction exhibits and STEM learning for girls for an entire nation. However, the variation in institution size, geographic location, type and scope of institution, creator or host site, and gender of interviewee all help make this research highly comprehensive, despite the small sample size.

The greatest challenge apart from the aforementioned limitations was many participants' unwillingness to discuss issues of gender within the context of their exhibit. As has been already said, this unwillingness to discuss "targeting" girls appeared to come from interviewees' fear that they would be accused of stereotyping or putting girls before boys. If "targeting" had been replaced with "serving" girls, in the interview questions, it is possible that the participants would

have viewed the question differently and would have been more amenable to a discussion of how their exhibit serves or served young girls in particular.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research was to discover the ways in which museums are currently using science fiction exhibits to interest young girls in STEM fields. This research suggests that some museums are certainly using science fiction exhibits as ways to introduce new audiences both to their museum and to STEM themes, although not necessarily through targeting girls.

There is awareness within museums that science fiction not only draws crowds, but can be a significant force in influencing young people's interest in STEM fields and even their decision to enter those fields as a professional. The opportunity for museums to make a difference in encouraging and engaging more young girls in STEM fields is not lost on these museums. However, there appears to be some uncertainty in how to follow through on getting girls into STEM.

Some museums, such as the Museum of Science, can reference programs from the past that were used specifically to target young girls and spark their interest in STEM fields, as in the Museum of Science's Camp-Ins during the eighties, in which young girls would come into the museum after hours and take part in activities and programs designed to make them feel like they were scientists. While no examples were given by any museum that pointed to current STEM programming targeted at girls, science fiction oriented or otherwise, suggesting a current lack of initiative within some museums to be "activists" for girls' STEM learning. Many museums appeared to be content to serve a more general audience, either expecting or hoping to incidentally engage young girls along the way.

I. Recommendations

Recommendations based upon this research would include targeted programming specifically for young girls, led by women in STEM fields. These programs could create safe and

nurturing spaces in which girls can explore STEM, and have supportive discussions about what it means to be a woman in a STEM field, or a geek girl into sci-fi, with women they can look up to and trust, who will tell them they are just as smart and capable as the boys.

Science fiction and science exhibits could also ensure they represent both male and female figures to a more or less equal degree, and especially include women in positions of authority. Including women in positions of authority may be more important than having a large number of women being represented who have little to no authority.

Museums might want to more fully explore what it means to target girls in pop culture and STEM exhibits, partly through increased positive and powerful female visibility in exhibit displays and acknowledgement of the difference in learning styles and STEM interest between boys and girls while creating interactives. This kind of awareness and targeting will create a more inclusive and welcoming environment, in which girls may feel as engaged in STEM as their male peers.

APPENDICES

Appendix A. Interview Guide

Science Fiction Exhibits and STEM Learning

University of Washington

Samantha Robie: robies2@uw.edu

Thesis Advisor: Kris Morrissey, Director of the Museology Graduate Program. Phone: 206-685-8207. Email: morriss8@uw.edu.

I am asking you to participate in an interview for a research project that is part of my Master's Thesis work at the University of Washington. The purpose of this research is to describe how science fiction exhibits are being implemented by museums as a way to interest young girls in STEM fields and careers. Your participation is voluntary, and you may discontinue participation at any time. I am going to ask you several questions in which you will be asked to represent to the best of your ability your institution's goals, reasoning, and future plans, based on your professional expertise and involvement within the institution. No question will ask you to offer your personal opinion, and you are encouraged to answer each question from a purely professional standpoint. If you are uncomfortable with answering a particular question, please feel free to abstain from answering. If you have any questions now or in the future, you may contact me through the information at the top of this form. Do you have any questions? Do you agree to participate in this interview?

1. Why did your institution decide to hold this exhibit? What benefit did it feel the exhibit would present to its audience?

2. How successful do you feel this exhibit was/is and why?
3. Has your institution discussed the need for young girls to be provided with specifically targeted STEM programming? Could you talk a bit more about that?
4. In developing/preparing for this exhibit, were young girls a targeted audience? Could you talk a bit more about that?
5. Which aspects, if any, of the exhibit might specifically appeal to young girls?
6. Which aspects of the exhibit might be improved to appeal more strongly to young girls?
7. Has your institution shown a science fiction exhibit in the past (before this exhibit)? If so, how successful was it?
8. Might your institution hold another science fiction exhibit in the future? If so, what would your institution be looking for in such an exhibit?

Appendix B. Tables

		Gender of Interviewee	
		Male	Female
Museum Type	Science	Larry Bell, Museum of Science	Lisa Marchesio, Pacific Science Center
	Cultural	Brooks Peck, EMP Museum	Michelle Dock, Tempe Center for the Arts

Table A. *Diversity of sampling*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Descriptions of Museum	Website	Website	Website	Website
Descriptions of Audience	Website, promotional materials	Website	Website, promotional materials	Website
Mission Goals	Website	Website	Website	N/A
Gender Representation	Website, promotional materials	N/A	Website, promotional materials	Website, promotional and supplementary materials (videos)

Table B. *Sources of content analysis*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Relevance to Mission				
High Attendance				
New & Diverse Audiences				
Identifying the “Sci-Fi Audience”				
Gender in Exhibit				
Gender in Audience				
Exhibit Aspects Appealing to Girls				

Table C. *Interview themes*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Females in Exhibit	0	0	4	3
Males in Exhibit	4	0	16	3
Females in Audience	N/A	N/A	4	1
Males in Audience	N/A	N/A	0	1

Table D. *Overview of gender in online materials*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Descriptions of Museum	Science center, cultural institution	Science and technology center, public forum	Gateway museum	Performing and visual arts center
Descriptions of Audience	The nation, young people, K-12, schools	Diverse communities, all ages	Multigenerational	All ages
Mission Goals	Active citizenship informed by STEM, lifelong appreciation of STEM, young people exploring and developing interests in understanding world	Lifelong interest in STEM by through interactive and innovative exhibits and programs	Using interactive technologies to engage and empower, celebrate creative process, engage imagination, inspire personal expression	N/A (interview elaborated)
Gender Representation	4 male characters and actors mentioned; no women	No gender represented at all	Image of 4 young girls using interactive, 2 “icons” out of 5 are female, 2 out of 12 novels have female authors, only male characters mentioned (3)	3 out of 6 supplementary videos are with women, a boy and girl equally prominent on promotional poster

Table E. *Content analysis data*

	Museum of Science	Pacific Science Center	EMP Museum	Tempe Center for the Arts
Relevance to Mission	Yes	Yes	Yes	Yes
High Attendance	Yes	Yes	No	Yes
New & Diverse Audiences	No	Yes	Yes	Yes
Identifying the “Sci-Fi Audience”	“might be something more appealing to boys”	“dad-centric... given the content, particularly the pop culture content”	General/family audience	“a lot of guys”, “Comic-Con”
Gender in Exhibit	No information	No information	Equal representation	Equal representation
Gender in Audience	Equal attendance	Dads around Father’s Day; no other information	Equal attendance	Equal attendance
Exhibit Aspects Appealing to Girls	Example of stereotypical answer; no actual answer given	No answer given	Inclusion of female characters and creators	Inclusion of female role models

Table F. *Self-reported themes in interviews*

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