GENDER REPRESENTATION

IN SCIENCE CENTER AND MUSEUM CONTENT

FINDINGS FROM ASTC'S GENDER REPRESENTATION TOOLKIT

IF/THEN®

ASTC Association of Science and Technology Centers

IN THIS REPORT

ACKNOWLEDGMENTS

This report is the culmination of a two-year process to establish benchmarking data on the visual representation of gender in science museum content. This process and the development of this final report have been collaborative efforts, featuring contributions from many individuals and organizations.

OUR SUPPORTER

Our team is extremely thankful to **Lyda Hill Philanthropies** for their generous support of our work. We have greatly valued their partnership, insight, and encouragement throughout this process.

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We are grateful for contributions from the full ASTC project team.

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- Jamie Durana
- Adam Fagen
- Lesley Markham
- Christofer Nelson
- Gaby Wilson
- Keith Allison, *MOS*
- Our partners at the National Girls Collaborative Project, particularly Chief Executive Officer Karen Peterson

PROJECT ADVISORS & THE DESIGN TEAM

Our team is grateful to the project advisors and the design team who helped us develop, test, and improve ASTC's IF/THEN® Gender Representation Toolkit and this report.

- Marcie Benne, *Oregon Museum of Science and Industry*
- Kirsten Ellenbogen, *Great Lakes Science Center*
- Cecilia Garibay, *Garibay Group*
- Jeannie Gerulskis, *McAullife-Shepard Discovery Center*
- Ivel Gontan, *formerly with the Fleet Science Center*
- Lucy Hale, *formerly with EcoTarium*
- Margaret Middleton
- Cynthia Sharpe

PARTICIPATING INSTITUTIONS

This work would not have been possible without the contributions of the 76 museums that collected data with the toolkit and chose to share those data with ASTC. Despite the many unprecedented challenges museums faced during the pandemic, these participating institutions continued to prioritize equity. We are immensely grateful to them for engaging in this work with us and for contributing data to help us identify and understand trends within the science museum field. For a full list of participating museums, please see **Appendix A**.

Thank you to **Colorbox Industries** for providing graphic design for the toolkit and this report.

INTRODUCTION

WHY REPRESENTATION MATTERS

in science centers and museums

"Women make up **50%** of the total U.S. college-educated workforce, but less than **30%** of the science and engineering workforce.[1]"

Science, technology, engineering, and mathematics (STEM) professions—traditionally dominated by men—are often associated with persistent stereotypes such as the ideas that men are better suited to scientific careers or that boys are better than girls at math and science. These stereotypes have the power to negatively affect girls and women by pushing them away from these professions.[2] Science centers and museums are community hubs that engage diverse audiences in science learning and therefore have a role to play in combatting these harmful stereotypes by ensuring that groups underrepresented in STEM fields are more visible.

The images and videos displayed throughout science centers and museums have the **potential to inspire all community members who visit.**

Including images of diverse STEM professionals in museum content is one way to **intentionally challenge stereotypes of who can participate and be successful in STEM.**

1. National Science Board. 2018. Science and Engineering Indicators 2018. NSB-2018-1. Alexandria, VA: National Science Foundation. Available at www.nsf.gov/statistics/indicators.

2. Cheryan, Sapna, Allison Master, and Andrew N. Meltzoff. "Cultural Stereotypes as Gatekeepers: Increasing Girls' Interest in Computer Science and Engineering by Diversifying Stereotypes." Frontiers in Psychology 6 (2015). https://doi.org/10.3389/fpsyg.2015.00049.

ABOUT IF/THEN®

> "If we support a woman in STEM, then she can change the world."
>
> –Lyda Hill Philanthropies

Launched by Lyda Hill Philanthropies in 2019, the IF/THEN® Initiative is built on the mantra that "if we support a woman in STEM, then she can change the world." Working with partners across industries, IF/THEN® has created a diverse coalition that is activating a culture shift by undertaking projects to increase the representation of women and gender minorities in STEM fields.

As a member of the IF/THEN® Coalition, the Association of Science and Technology Centers (ASTC) is supporting our 400 U.S.-based science and technology center and museum members as they build content that more equitably represents women and gender minorities in STEM fields.

The focus of this report is **ASTC's IF/THEN® Gender Representation Toolkit**, designed to collect data on the visual representation of gender in museum content.

OTHER AREAS OF OUR WORK

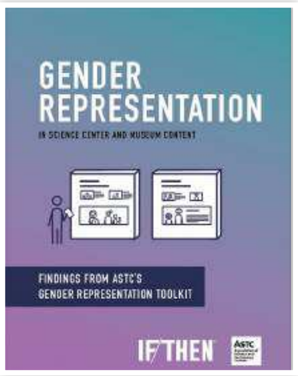
Gender Equity Grants

Awarding **$700,000 in IF/THEN® Gender Equity Grants** to ASTC-member museums in the United States to support projects that highlight women and gender minorities in STEM.

Digital Media Library

In partnership with the National Girls Collaborative Project, we are developing and managing the **IF/THEN® Collection**: a digital library of photos, videos, profiles, and other media showcasing women in STEM fields available for museums to download and use freely.

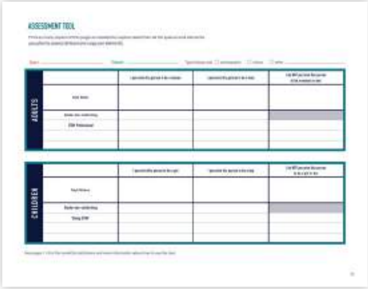
ABOUT THIS REPORT & THE TOOLKIT



About this report

Science and technology centers and museums of all sizes and types were invited to use ASTC's IF/THEN® Gender Representation Toolkit to assess the representation of gender in the images and videos displayed in their museum content—including exhibits, websites, program materials, signage, and promotional materials. Between the release of the toolkit in February 2020 and the end of data collection in April 2021, **76 ASTC-member science centers and museums, representing 29 U.S. states, Puerto Rico, Canada, and Australia**—used the toolkit and shared their collected data with ASTC to include in this report. While the focus of the IF/THEN® project is U.S.-based science centers and museums—institutions outside of the United States were also invited to use the toolkit and share their data with ASTC.

IF/THEN® Gender Representation Toolkit



Data collection sheet

About the Gender Representation Toolkit

ASTC's IF/THEN® Gender Representation Toolkit was developed through a multi-phase, iterative process in close collaboration with advisors and a design team of museum staff with expertise in gender equity and evaluation.

The initial challenge in creating the toolkit was developing a method for assessing the gender of people depicted in images and videos. While literature exists on how to survey people about their gender identity, there is no standard approach for collecting gender data for people depicted in photographs and videos: situations where you are not able to ask their gender identity. The goals of this project were both to develop a methodology for gathering these data and to analyze the collected data, gaining an initial snapshot of how museums and science centers are depicting gender in their content.

First and foremost, our effort has been a learning process. In developing this groundbreaking project, we sought to test and evaluate methods for data collection and analysis. We listened to our design team, advisors, and respondents and experimented with how to best adapt to the needs of the museums and develop a benchmarking analysis that would serve the science museum field now and in the future. In December 2020 we produced an interim report highlighting initial results from the first 51 museums that submitted data. At this stage of analysis, we were able to determine that we needed additional information to fully understand the trends we were beginning to see. We returned to the toolkit, adding questions about the age and discipline of each museum's content pieces, and asked these 51 museums to update their submissions.

For additional information on the IF/THEN® Gender Representation Toolkit, including the downloadable toolkit, data spreadsheet, and training sessions, please see the full IF/THEN® Gender Representation Toolkit.

KEY FINDINGS

KEY

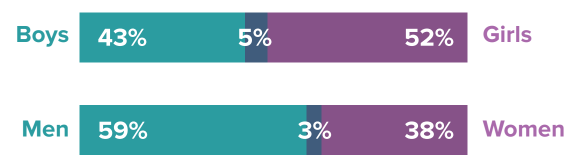
Perceived as men or boys | Perceived as neither | Perceived as women or girls

Overall gender representation

Across all museum content, 45% of individuals represented were perceived as women or girls.

Girls and women doing science

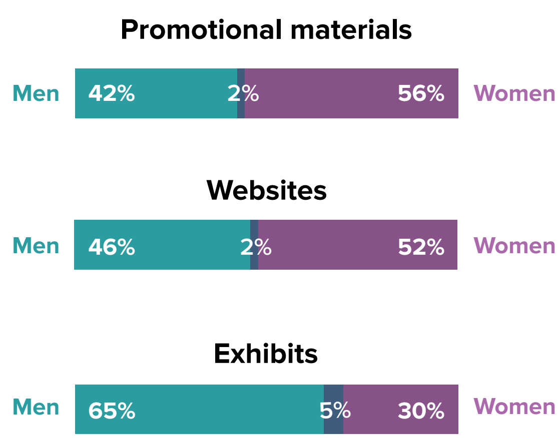
There were higher rates of perceived girls engaging in STEM than perceived women identified as STEM Professionals.



Museum content type

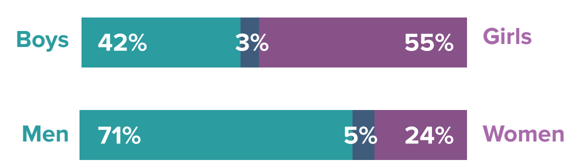
Women were depicted in the highest proportions on websites and in promotional materials.

Women were depicted in the lowest proportions in exhibits.



Exhibits and STEM

55% of children depicted “doing STEM” in exhibits were perceived as girls, while only 24% of adult STEM professionals depicted in exhibits were perceived as women.



ABOUT THE DATA

DEPICTIONS OF PEOPLE

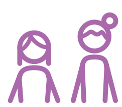
The assessment tool within the ASTC IF/THEN® Gender Representation Toolkit provides a way for museum staff to collect data on each person visually represented in photos and videos in museum content using the following categories.

PERCEIVED GENDER AND AGE

Gender was determined by the data collectors' personal perception of the gender of people depicted in images or videos. Adults are defined as age 18 or above and children are defined as age 0 through 17.

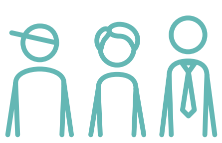
Women/Girls

Perceived as women

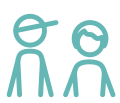


Perceived as girls

Men/Boys



Perceived as men



Perceived as boys

Neither

Not perceived to be a woman/girl or a man/boy, or cannot decide what gender they perceive.

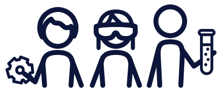
Perceived as neither men nor women

Perceived as neither boy nor girl

PERCEIVED AS ENGAGED IN STEM

Defined in the toolkit as using a scientific tool, such as those to observe or measure.

STEM professionals



Children doing hands-on STEM activities

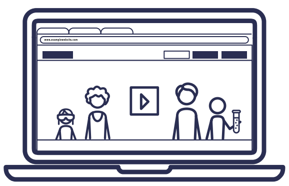
PERCEIVED AS GENDER NON-CONFORMING

Defined in the toolkit as a person perceived to have visual cues (e.g., clothing, hair style, etc.) that are primarily different than what is typical for their gender.

CONTEXT OF DEPICTION

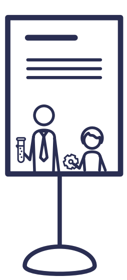
TYPE OF MUSEUM CONTENT

Exhibits



Websites

Promotional materials



Museum signage

Programmatic materials

TYPE OF MEDIA

Videos

Photos

Other (statues, drawings, etc.)

FOR EXHIBIT CONTENT ONLY

- **Subject Matter** | Data collectors could indicate if an exhibit focused on biology, space, Earth science, engineering, math, or multi-disciplinary content.
- **Age of Content** | Data collectors could indicate if an exhibit was designed and installed either 1) earlier than 2010, or 2) in 2010 or more recently.

PARTICIPATING INSTITUTIONS

"The opportunity to participate in IF/THEN® is transforming how we think about gender equity throughout the museum."

–Participating museum

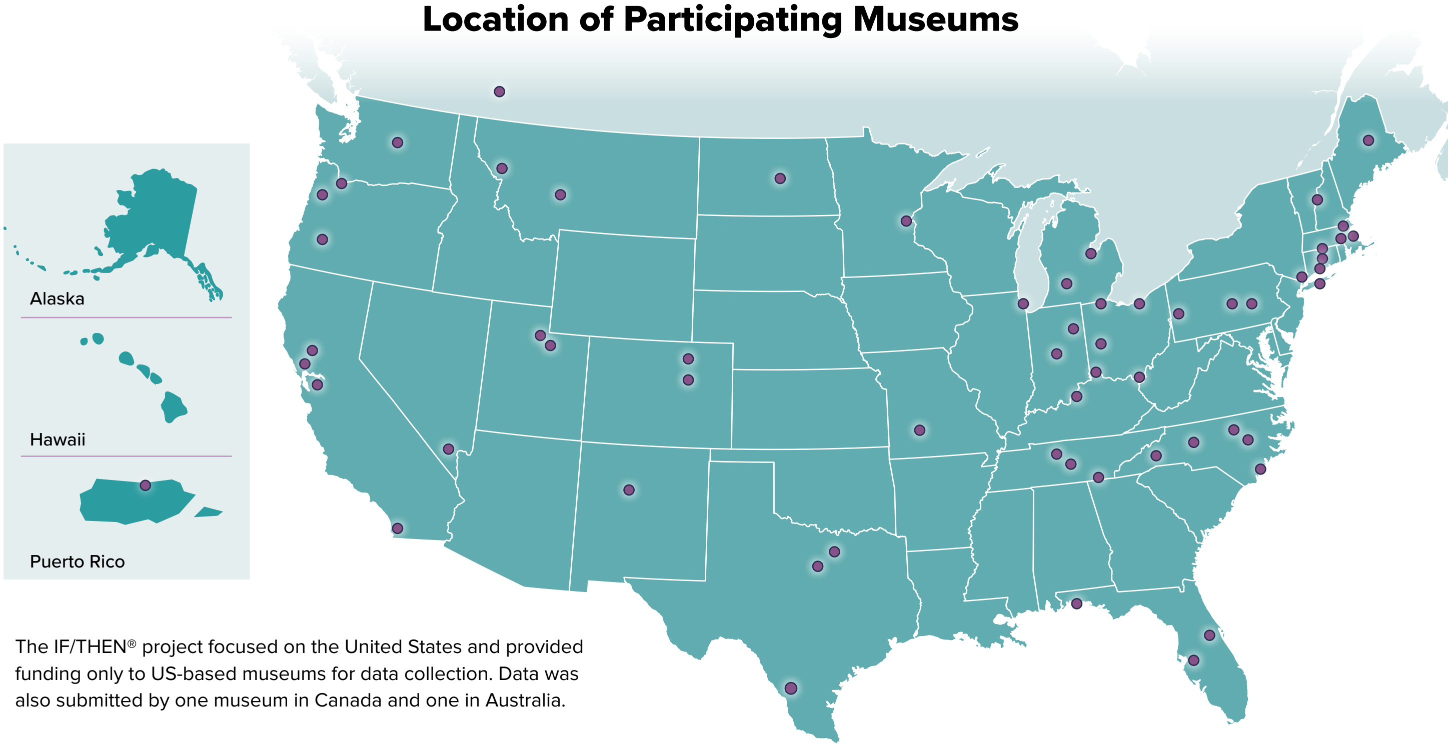
ASTC received data from 76 science centers and museums in 29 U.S. states, Puerto Rico, Canada, and Australia, representing a wide variety of sizes and types of institutions. Participating U.S. science centers and museums received a $500 award for sharing their data with ASTC if they reported at least 50 data points.

Museum sizes

ASTC uses annual operating income (AOI) to define museum size. AOI information was self-reported or gathered from publicly available information and reflects 2019 pre-pandemic totals. *AOI includes all revenue from museum operations, film, and exhibit rentals; all private and public support; all restricted and unrestricted grants; and all interest and endowment revenue.*

Size of Museum	Range of AOI	% of Participating Museums	% of All ASTC Members
Very Small	Less than $1 million	**24%**	**38%**
Small	$1 to $3 million	**28%**	**26%**
Medium	$3 to $10 million	**25%**	**21%**
Large	Over $10 million	**24%**	**15%**

Location of Participating Museums



The IF/THEN® project focused on the United States and provided funding only to US-based museums for data collection. Data was also submitted by one museum in Canada and one in Australia.

Participating Museum Types

ASTC-member science and technology centers and museums are a diverse group of organizations with a shared mission of engaging the public in science through inquiry-based learning and participatory science education. In addition to this general commitment to science and technology, 26 of the 76 museums also have a special emphasis in one of four areas: multi-subject, specialized, children's, or natural history.

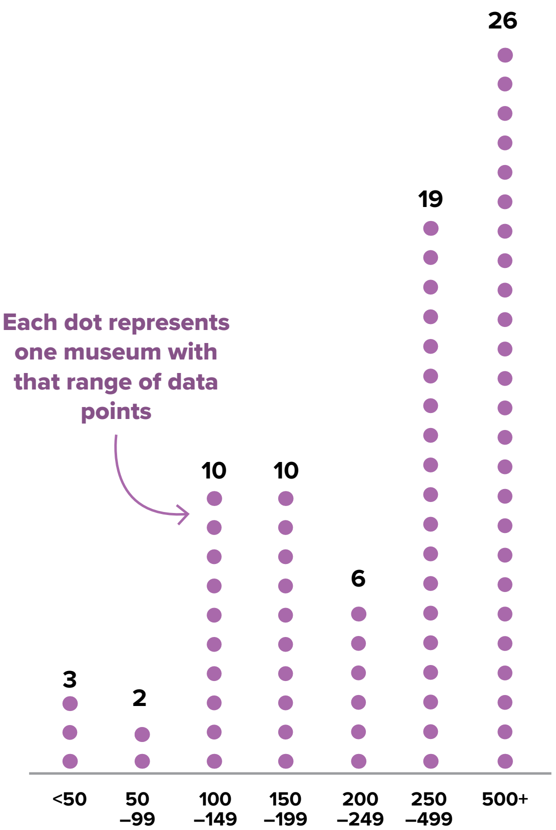
Type of Institution	Description	#of Institutions
Science or Technology	No content emphasis	50
Multi-Subject Museum	Museum that covers **two or more** fields of human endeavor, such as art, history, and science.	10
Specialized Museum	Museum focused on **one science topic** such as medicine, space, or aviation.	7
Children's Museum	Museum with a focus on serving children.	6
Natural History Museum	Museum with a focus on natural history, including displaying collections of current and historical records of animals, plants, fungi, ecosystems, geology, paleontology, climatology, and more.	3

Due to the relatively small number of institutions in each of these subcategories, we have not conducted an in-depth analysis of the data based on museum type.

ABOUT THE DATA

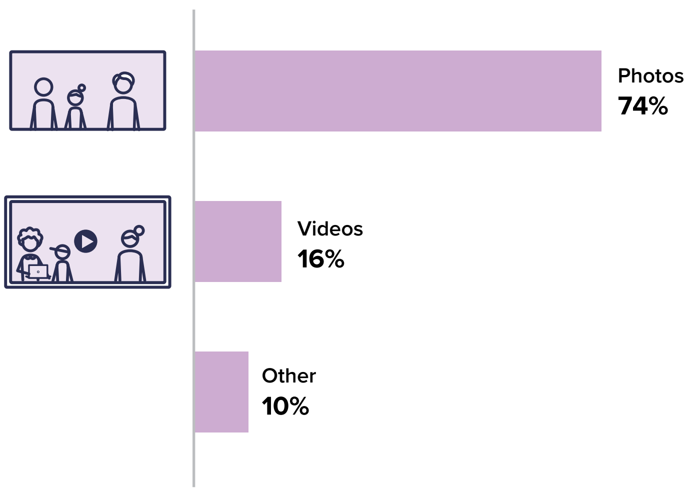
This analysis includes a total of 36,401 individual data points provided by all participating museums, with each data point representing one depiction of a person in exhibits, websites, program materials, signage, or promotional materials. The number of data points submitted by each museum varied greatly: from fewer than 50 data points to over 3,000. The average number of data points contributed by each museum was 479.

Among the types of museum content included in this analysis, the largest number of data points came from websites, with 18,002 individuals counted, followed by exhibit spaces (12,899), promotional materials (3,378), program materials (1,349), and museum signage (773). Approximately 74% of the data points submitted were from photographs and 16% from videos. The “Other” category of media type includes people pictured in animations, drawings, or other media.

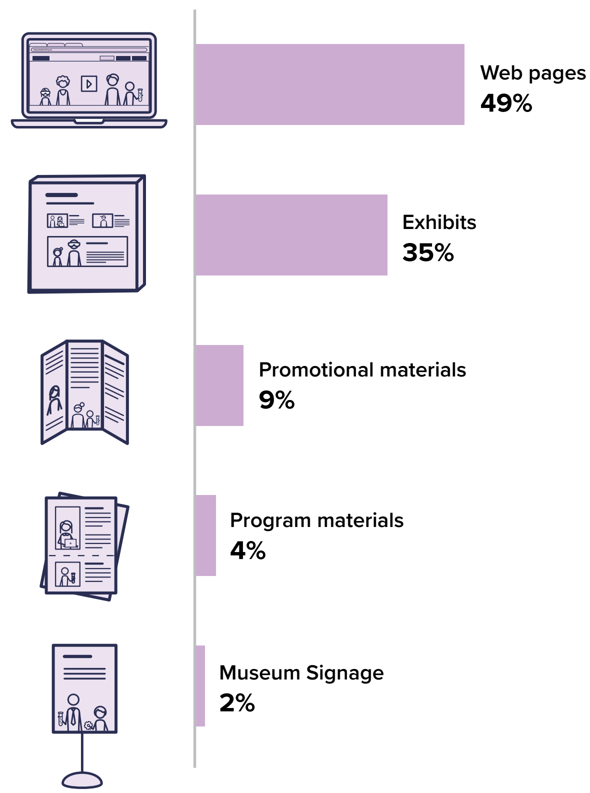


Range of quantity of data points collected
(one data point=one depiction of a person)

Percent of data
by museum content type



Percent of data
by media type



ADDITIONAL DATA ON EXHIBITS

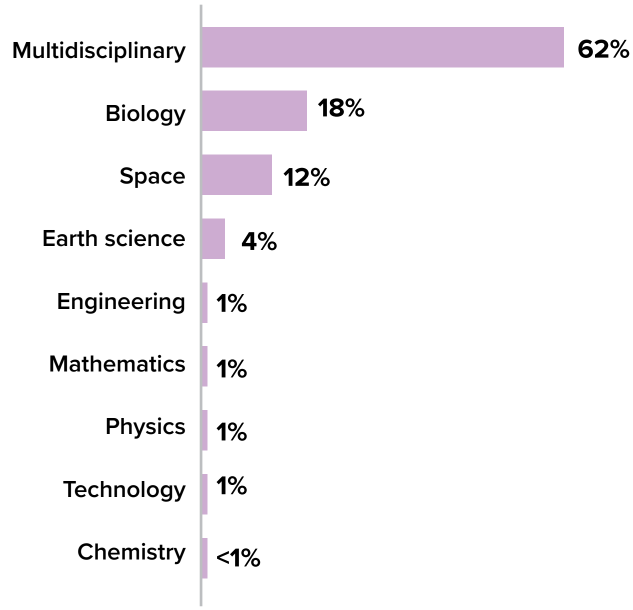
Age of Exhibits

Exhibit spaces offered an additional layer of potential analysis due to the frequently long-term nature of these installations, with many exhibits on display for multiple years or even decades. Our team collected information about the age of exhibit content to help inform our data analysis. We asked contributing museums to provide the decade that the exhibit content was developed and installed, and to give an estimate of what proportion of all of their exhibits were included in their submitted data.

Of the 495 spaces for which we had data, 391 (79%) were categorized by age. Within this number of exhibit spaces, approximately 60% of the data points came from exhibits that were developed and installed in 2010 or later.

Subject Matter of Exhibits

We also asked museums about the primary scientific topic for each of their exhibit spaces—this information was provided for 372 of the 495 spaces (75%). Most of the data points were categorized as multidisciplinary (5,321) followed by biology (1,524), space (1,066), Earth science (341), engineering (119), mathematics (113), physics (60), technology (51), and chemistry (10). We only analyzed results from multidisciplinary, biology, and space content due to the limited data on other topics.



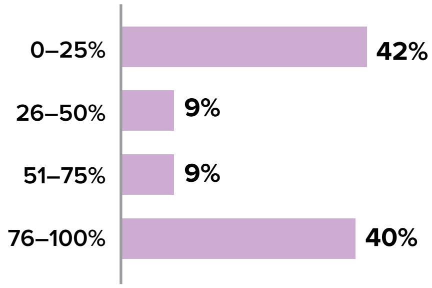
SELECTION OF EXHIBITS TO STUDY

The results did not show large differences in gender representation based on the percentage of exhibits included, indicating the selection of exhibits to analyze likely did not skew the data in either direction.

How did museums select exhibits?

Each museum had the opportunity to choose how many and which exhibit spaces (if any) would be included in their data collection efforts. Of the 66 museums that submitted data on exhibits and provided an estimate of the proportion of their total exhibit content assessed, 40% collected data on at least three-quarters of their museum's total exhibit space and 42% collected data on just one-quarter or less of their museum's total exhibit space.

Percentage of total exhibits included in data collection



We were curious to find out if the results of our analysis would vary based on the percentage of a museum's total exhibit content included in the data collection. If large differences were found between museums that collected data on a majority of their exhibit content and those that only collected data on a select few exhibits, it could indicate that museums chose exhibits to analyze specifically because they either had poor representation of women, or because they had the best representation of women. The results did not show large differences in gender representation based on the percentage of exhibits included, indicating the selection of which exhibits to analyze likely did not skew the data in either direction.

Additionally, we asked museums to describe why they chose the exhibits they did. Of the 58 museums that provided information about why they chose particular exhibit areas to include in the data collection, 21 reported they collected data on all exhibit content, or all exhibit content that contained images of people. A total of eight museums reported they only collected data on online content, with four of those specifically citing the global pandemic as a reason for focusing only on online content. Just two museums reported taking into account their expectations about how gender was represented in their exhibits, with one selecting exhibits where they expected to find the highest representation of women, and one choosing exhibits where they expected to find the lowest representation of women. Other reasons cited by museums include choosing exhibit content because it was the newest (5), part of the museum's permanent exhibits (3), or made in-house (2).

MORE ABOUT CATEGORIZING DEPICTIONS

37 out of 76 museums collected data on representation beyond observed gender.

Categories of representation beyond gender

Thirty-five museums chose to collect additional data on perceived race, most commonly using the term "person of color" or "people of color" or indicating that the person's race was "non-white." Sixteen museums chose to collect data on individuals perceived to be living with disabilities, noting either a visible disability or the use of an assistive technology. In total, roughly half of participating museums (37 of 76) collected data on one representation category beyond gender, and more than a quarter (23) collected data on two additional representation categories

Due to the small total numbers, gender non-conforming individuals are not included in the more detailed breakdowns of the data.

Beyond the Binary

Unclear gender identity: **7%** of children | **4%** of adults

In some instances, data collectors reported that an individual's perceived gender was unclear or neutral to them by selecting "not a boy nor girl"—**7% of all children**—or "not a man nor woman"— **4% of all adults**—when assessing an image.

Gender non-conforming: **1.3%** of children | **0.8%** of adults

Data collectors also reported if they perceived individuals to be gender non-conforming, defined in the toolkit instructions as a man or woman perceived to have visual cues (e.g., clothing, hair style, etc.) that are primarily different than what is typical for their gender. Data collectors could not mark individuals as both "not a boy/man nor girl/woman" and as gender non-conforming since this definition requires that a gender is perceived in order for there to be visual cues typical for their gender.

Approximately 1% of all observed individuals were perceived to be gender non-conforming (348 individuals, including 0.8% of all adults and 1.3% of all children). Women and girls were perceived to be gender non-conforming at a higher rate than men and boys: of all girls/women, 1.4% were perceived as gender non-conforming, whereas 0.7% of all boys/men were perceived to be gender non-conforming.

The majority of this report is focused on the **gender representation observed among adults**.

Adults vs. Children

Of all people depicted in museum content, 63% were adults and 37% were children. The data we received for children reflected similar percentages of individuals perceived as boys and girls in nearly every breakdown of the data. ***Because of this, and because the focus of IF/THEN® is portraying adult STEM role models, the majority of this report is focused on the gender representation observed among adults***. Information is provided in select sections where there were larger differences in depictions of children.

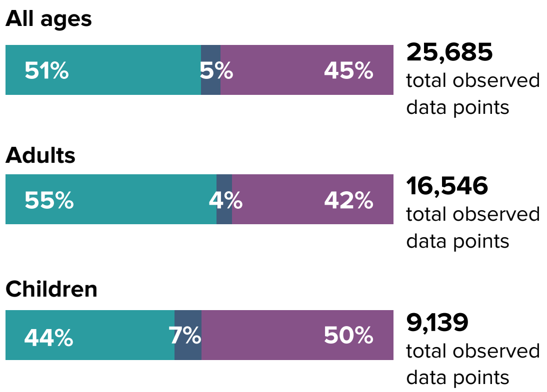
FINDINGS

OVERALL GENDER REPRESENTATION

See the **Data Collection Methods section on page 30** for more details on how we analyzed these data.

KEY: Perceived as men or boys | Perceived as neither | Perceived as women or girls

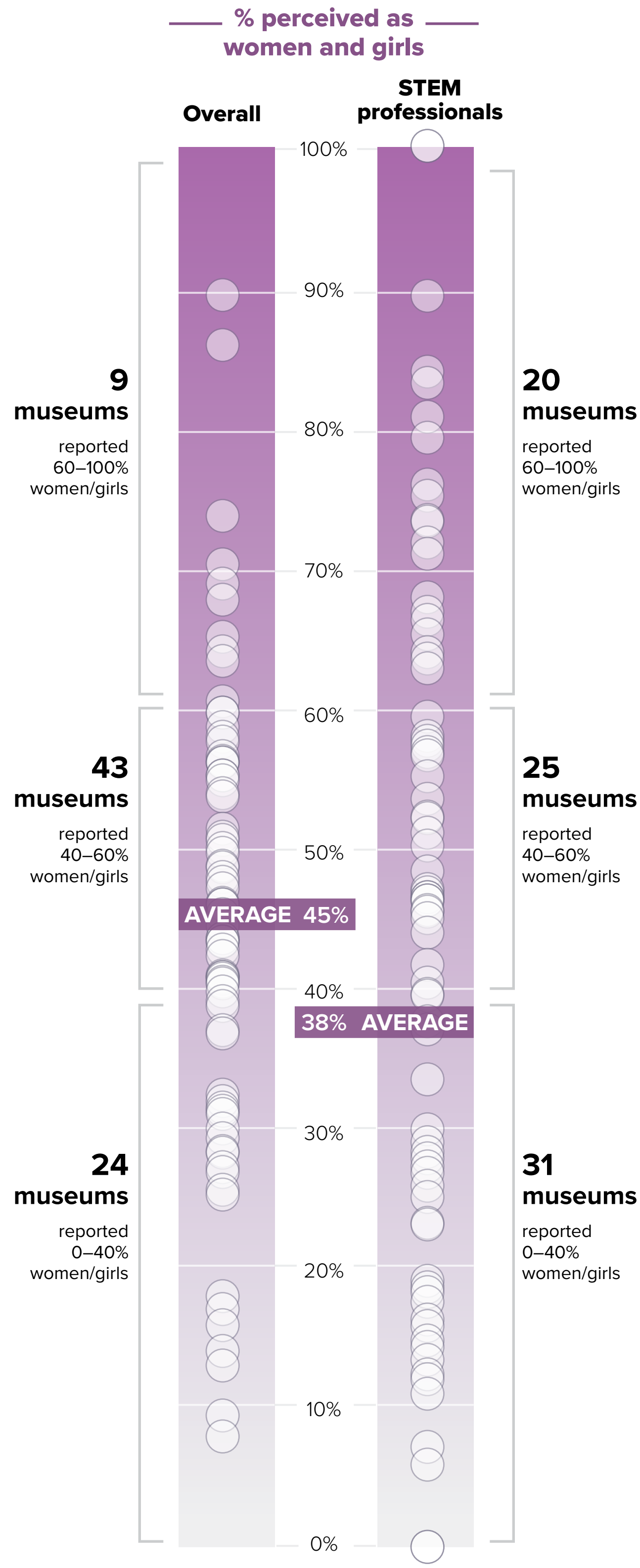
Gender Representation by Age



Gender Representation of adult STEM Professionals

Representation of women and girls across museums

Each dot represents one museum



ANALYSIS

Across all types of museums and types of content, 45% of the individuals observed were perceived as women or girls. On the surface, this may look like we are close to gender parity, but this result doesn't tell the whole story of how gender is depicted in museum content. Wide disparities in representation become evident when breaking down the data by different categories such as the age of individuals depicted, type of museum content, museum type, and other sub-categories. Each of these sub-categories is discussed in more detail below.

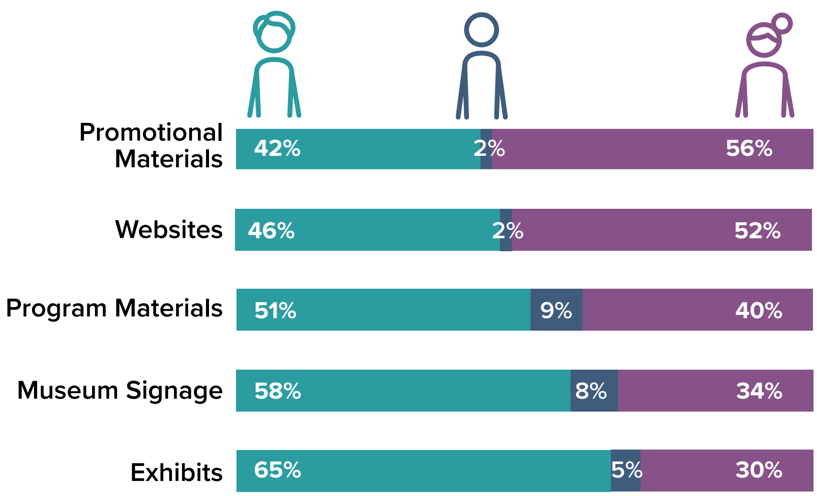
The percentage of adults perceived as women (42%) was lower than the percentage of children perceived as girls (50%). The majority of museums reported 40–60% of their data points as women or girls. There were outliers on both sides, with the highest percentage of women/girls reported at 83% and the lowest percentage at just 8%. However, 24 museums reported low representation levels (below 40%) while just 9 reported high representation levels (above 60%).

The remainder of the report is focused on the gender representation observed among adults, because children had similar percentages of boys and girls represented throughout.

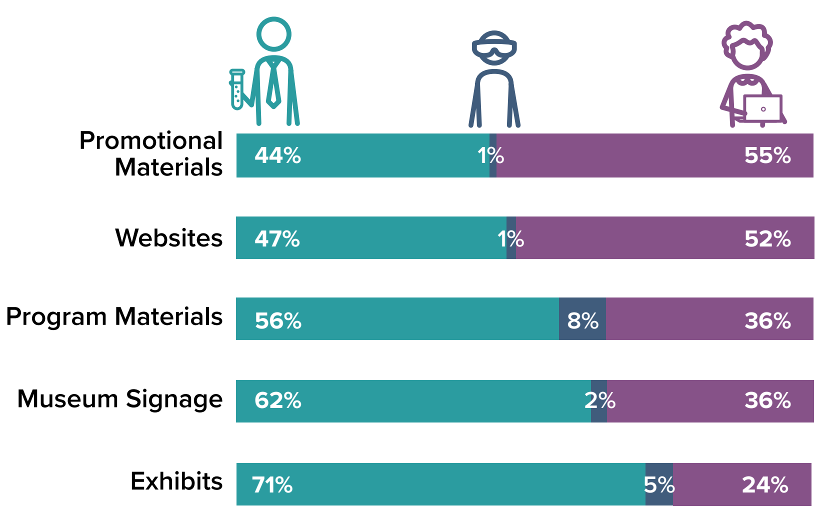
1 GENDER REPRESENTATION ACROSS TYPES OF CONTENT

KEY
Perceived as men or boys | Perceived as neither | Perceived as women or girls

Overall gender representation
by Museum Content Type



Gender representation of STEM professionals
by Museum Content Type



ANALYSIS

Although women represented an average of 42% of all adults counted, this number varies greatly by museum content type. Data points collected from websites and promotional materials yielded the highest percentage of perceived women at over 52%. Yet across museum exhibits, only 30% of all adults were perceived as women.

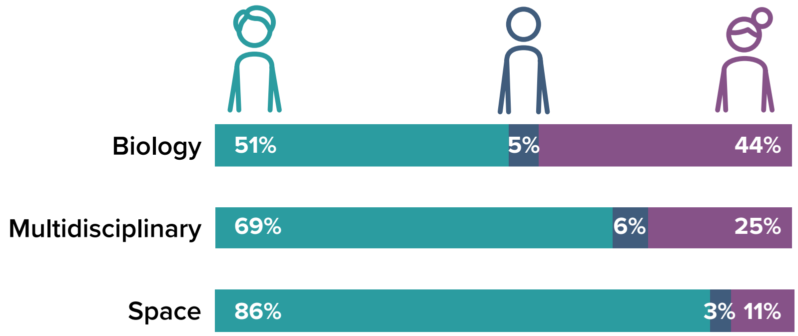
A similar trend appears when looking at the gender of STEM professionals depicted. Just over half of STEM professionals in promotional materials and on websites were perceived as women and only about one-third in museum signage and program materials. Out of all STEM professionals depicted in exhibits, less than a quarter were perceived as women.

2 GENDER REPRESENTATION ACROSS SCIENCE DISCIPLINES in EXHIBITS

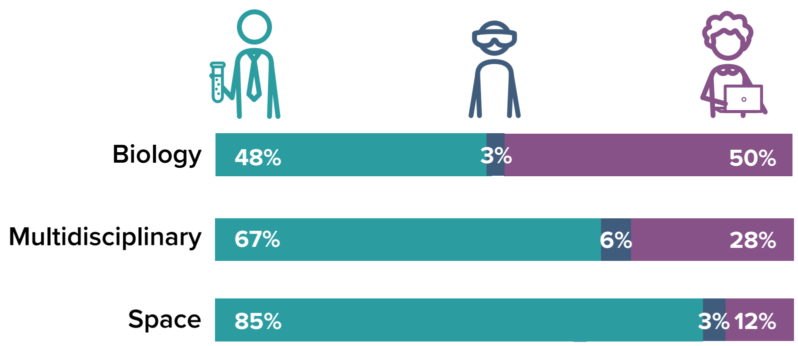
KEY

- Perceived as men or boys
- Perceived as neither
- Perceived as women or girls

Overall gender representation
by Science Discipline of Exhibit



Gender representation of STEM professionals
by Science Discipline of Exhibit



3. National Center for Science and Engineering Statistics. 2021. Women, Minorities, and Persons with Disabilities in Science and Engineering: 2021. Special Report NSF 21-321. Alexandria, VA: National Science Foundation. Available at https://ncses.nsf.gov/wmpd.

ANALYSIS

Data collectors were asked to select the primary science topic for exhibit content from a drop-down menu. Many STEM fields, like engineering and space science have well-documented historical gender disparities, and we were curious to find out whether museum content in these subject areas would mirror these disparities. For example, a National Science Foundation report documented that while women earned 57% of all bachelor's degrees in 2018, they earned only 22% of engineering degrees, and 38% of Earth science degrees (a topic that includes space science).[3]

We found similar discrepancies in how gender is represented among exhibits covering different scientific disciplines. Biology content (a subject that has one of the highest degree rates for women in science with 63% of all bachelor's degrees in biology being awarded to women)[3] had the highest proportion with 44% of the depictions of adults perceived as women, followed by multidisciplinary content at 25%, and space science content had the lowest proportion at just 11%. The percentage of STEM professionals perceived as women followed a similar trend with 50% for biology content, 28% for multidisciplinary content, and 12% for space content.

Due to the small number of data points (less than 1% of all collected data), other subject matters such as engineering, mathematics, and Earth science content are not included in this analysis.

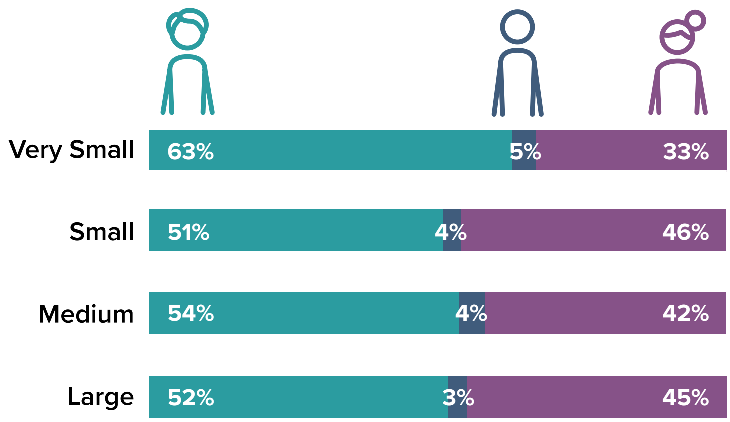
A National Science Foundation report documented that while women earned **57% of all bachelor's degrees** in 2018, they earned **only 22% of engineering degrees, and 38% of Earth science degrees.**

3 GENDER REPRESENTATION ACROSS

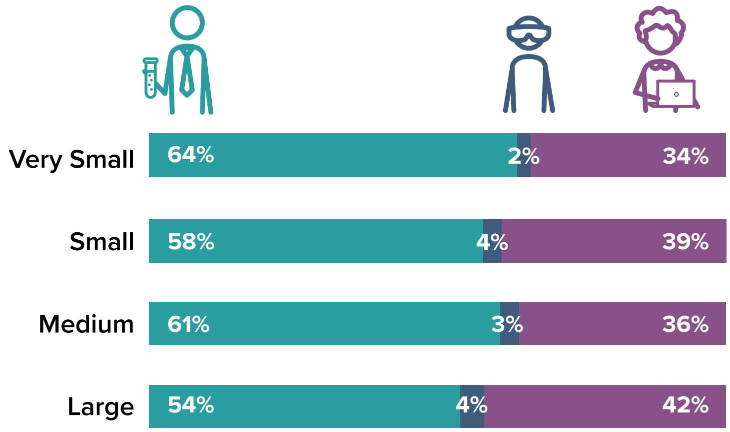
SIZE OF MUSEUM

KEY: Perceived as men or boys | Perceived as neither | Perceived as women or girls

Overall gender representation
by size of museum



Gender representation of STEM professionals
by size of museum

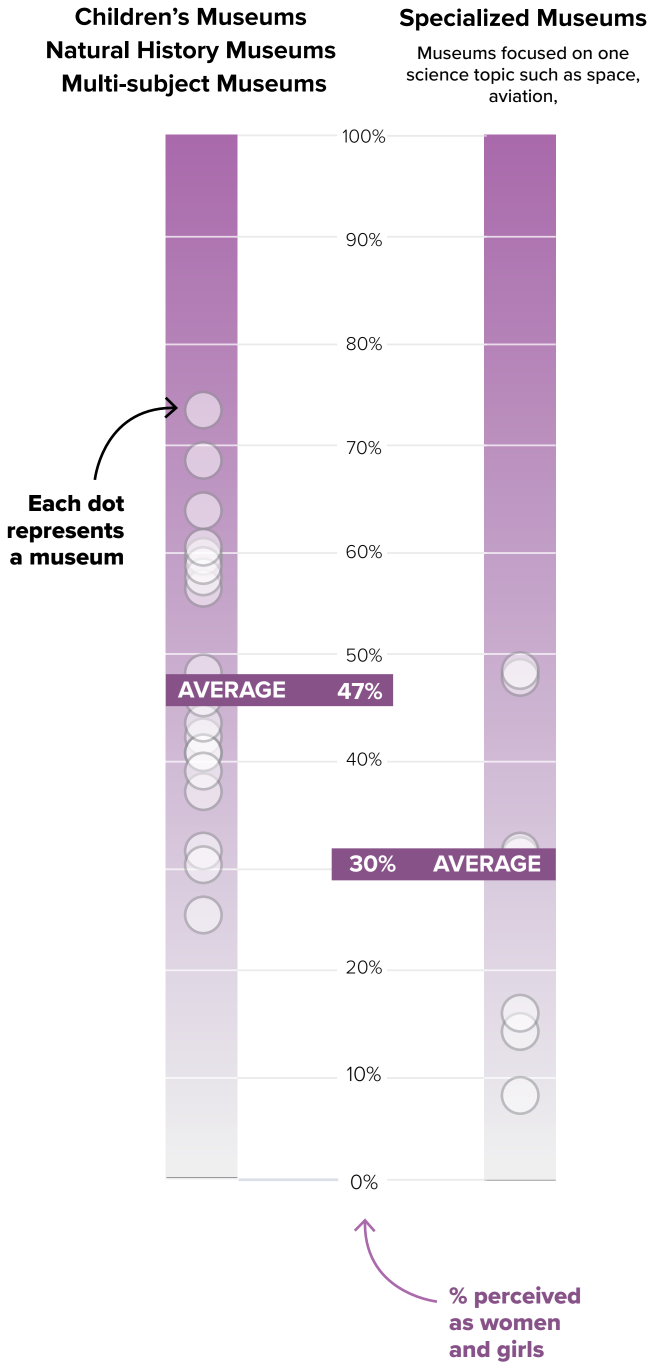


ANALYSIS

Across all types of museum content, very small museums reported a lower percentage of women depicted in their content than larger museums, as well as a lower number of women depicted as STEM professionals. Small museums recorded a slightly higher percentage of women STEM professionals (39%) than very small or medium museums (34% and 36%, respectively), with large museums reporting the highest percentage of depictions of women STEM professionals (42%)

Large museums reported the highest percentage of depictions of women STEM professionals (42%)

4 GENDER REPRESENTATION ACROSS TYPE OF MUSEUM



ANALYSIS

There were similar percentages of perceived women among most types of museums, including science-technology, multi-subject, children's, and natural history museums. These museum types each reported an average of 43–50% of all adults were perceived as women.

Specialized museums are the only museum type that showed a large difference in how women were depicted. For the seven specialized museums that shared their data, an average of 30% of adults and 17% of STEM professionals were perceived as women. Specialized museums primarily focus on topics like space, aviation, and mathematics: areas that historically have large gender disparities in their workforces.

Specialized museums were also one of the only areas of analysis where more children were perceived as boys than girls (52% boys compared to 42% girls) and where more children doing STEM were perceived as boys than girls (59% boys compared to 39% girls).

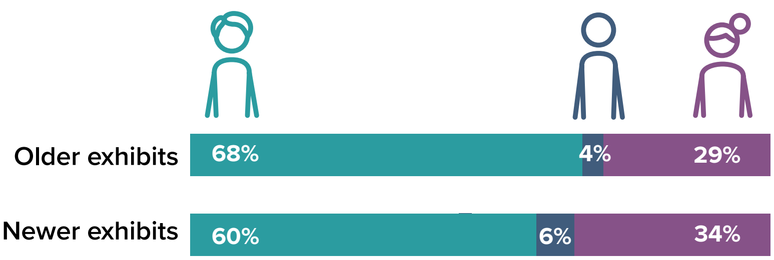
Due to the small number of museums within each type, further individual trends are not included in this analysis.

5 GENDER REPRESENTATION ACROSS

AGE OF CONTENT (IN EXHIBITS)

KEY: Perceived as men or boys | Perceived as neither | Perceived as women or girls

Overall gender representation
by age of content



Gender representation of STEM professionals
by age of content

ANALYSIS

To see if museums' visual representation of women is different in more recent exhibits compared to older exhibits, participating museums could indicate an exhibit's age according to one of two categories: 1) older exhibits designed and installed before 2010 or 2) newer exhibits designed and installed in 2010 or more recently.

We found there were small differences in representation of women in newer exhibits: the number of women depicted in newer exhibits is 5 percentage points higher than in older exhibits (34% vs 29%), and the number of women STEM professionals is four percentage points higher in newer exhibits compared to older exhibits (28% vs 24%).

SUMMARY & NEXT STEPS

KEY TAKEAWAYS

These key findings identify areas where museums can focus their efforts to increase the number of women and girls depicted in museum content.

1 | **Museums tend to have more equitable representation of children than adults.** Half of all depictions of children were perceived as girls while 42% of all depictions of adults were perceived as women.

2 | **Museums tend to portray STEM professionals as men more frequently than as women.** This disparity was largest in specialized museums with just 17% of STEM professionals perceived as women. In topic-specific content, a similar trend is apparent: biology content has the highest percentage of STEM professionals perceived as women at 50%, while multidisciplinary is at 28%, and space content is at just 12%.

3 | **Women are less likely to be depicted in educational content than in promotional materials**. Adults perceived as women were depicted in the lowest proportions in exhibits and program materials (30% and 40% respectively) but depicted in much higher proportions in promotional materials and websites (56% and 52%), content that is typically not as education-focused.

Focus on Exhibits

We paid special attention to exhibits in our analysis. Exhibits are frequently on display for extended periods of time (sometimes decades), are typically more resource-intensive to update than other types of content, and are seen each year by an estimated 120 million visitors to ASTC-member museums.

In exhibit content (including exhibit panels, display materials, and interactive elements), **only 30% of the STEM professionals or children "doing STEM" were perceived as women or girls**. Breaking that down further, we found there was a considerable disparity between portrayals of children and adults: 55% of children depicted "doing STEM" in exhibits were perceived as girls, while only 24% of adult STEM professionals were perceived as women.

This trend is even more apparent when comparing exhibits with a specific subject matter focus: **in space exhibits, only 11% or adults were women, and in multidisciplinary content, 25% of adults were perceived as women**. Of all the reported topic-specific content, biology content is the only area where there is approximately equal representation of women and girls (46%) and men and boys (48%). This mirrors historical trends in gender disparities in the in the workforce for these science disciplines.

While more data would be helpful in fully analyzing how exhibit content has changed over time, we did see some improvements in how women were portrayed over the last decade. In exhibits created and installed before 2010, 29% of all people and 24% of STEM professionals were perceived as women; in exhibits installed in 2010 or later, those numbers were higher: 34% and 28%, respectively.

LIMITATIONS & RECOMMENDATIONS

Limitations of this study

The findings in this report are based on data submitted by the 76 science centers and museums that chose to participate in this study. While we have identified several trends in these data, there are limitations that prevent us from suggesting that these trends apply to the entire U.S. science center and museum field.

Differences between data collectors. To encourage standardization, ASTC provided guidance for data collectors within the ASTC IF/THEN® Gender Representation Toolkit, as well as supporting resources such as training sessions. However, we cannot guarantee that data was collected in a consistent manner across all of the museums.

Measurement of perceived gender. The collected data represent the data collectors' personal perceptions of the gender, age, and other physical characteristics of the individuals depicted. These perceptions do not necessarily represent the actual age, gender identity, or other elements of the identities of the people in the images. This is an imperfect process and each data collector's perception of gender comes from their own understanding of the world around them, which is based on the collectors' unique life experiences related to culture, gender, age, sexuality, and other relevant characteristics.

Differences in content chosen for data collection. The selection of what content to assess using the toolkit was at the sole discretion of the museums. We noted a wide range of approaches with some museums assessing a small selection of their overall content while others assessed nearly all of their content. Some museums provided information about why they selected certain content to assess, but we cannot say with certainty how much the selection of content influenced a museum's results.

The global pandemic. Data collection efforts took place between February 2020 and April 2021, during the COVID-19 pandemic. All participating science centers and museums were closed for at least a portion of this time to respond to public health guidance. Due to closures and staff reductions, some museums were unable to collect data on areas of content that were not accessible online, such as exhibits or museum signage. Additionally, many museums that had planned to participate in this project were no longer able to support data collection and reporting.

Amount of data from each museum. The total number of data points collected at each museum varied greatly because of the quantity and/or types of content museums decided to include, as well as the number of people depicted in the included content. The results included throughout the report are averaged across all data points submitted, meaning some museums' data influenced overall results more than other museums. We have included dot plots (on pages 19 and 23) showing results from each museum in some sections of our analysis to remediate this effect.

Diversity of museums. Museums self-selected and volunteered to participate in data collection. While there is a wide diversity of institution types and sizes represented in the data, there are some museum types that do not have sufficient data for us to draw broad conclusions about that type of institution.

Collection of gender non-conforming data. In the toolkit, we define gender non-conforming as an individual perceived to have visual cues (e.g., clothing, hair style, etc.) that are primarily different than what is typical for their gender. This definition relies on the data collectors' individual beliefs about what is "typical," which is likely to vary among data collectors. Our reporting tool did not distinguish between areas left blank (not counted) and areas marked with a zero, meaning there is no way of knowing if the low numbers of gender non-conforming individuals are because they are not depicted frequently in museums content, or because some data collectors did not choose to collect these data.

Data from additional categories. In developing the toolkit, we heard from many museum staff who wanted to be able to collect data on additional dimensions of diversity such as race or visible disability as they went through the data collection process. Developing a framework to collect data on other representation categories was outside the scope of this project, but we decided to include blank spaces where museums could collect and report data on additional representation categories to be named and defined by each museum. This allowed flexibility for museums to collect the data they wanted to see, but without consistent definitions or rules for collecting that data, we are not able to include it in our analysis.

Recommendations for Future Directions

There are many areas that are promising for further study.

Undertaking a data collection process using standardized methods of selecting content and collecting data. An updated process would include standardizing the amount of data collected at each museum, more rigorous guidelines on how the spaces where data will be collected are defined and selected, and employing a small group of trained data collectors to complete all data collection to minimize differences in how data is recorded. This would address many of the limitations reflected in this study.

Collecting data from a larger number of museums. Collecting additional data from museums, especially those with a special emphasis like natural history or focus on children, would provide an opportunity to draw more conclusions about the state of the museum field.

Identifying content that is primarily educational in focus. Offering a way for data collectors to indicate if content is educational or not—especially for web content—would allow us to break down data and dig into the portrayal of gender in promotional materials compared to educational content in a more uniform way.

Determining how gender is represented across different scientific topics. Initial results from collected data indicate that museum exhibits reflect historical trends in gender disparities in topics such as engineering, mathematics, and biology, but more data is needed to confirm these trends.

Creating a version of the toolkit to measure representation beyond gender. This would allow for standardized data collection on additional dimensions of identity, such as race and visible disability. This is clearly of interest to many museums as evidenced by the approximately 50% of participating museums that chose to collect these data as optional additional categories.

Studying differences in how gender is perceived. Data in this study reflect the personal perceptions of dozens—if not hundreds—of individual data collectors. Because the method of collecting data about the perceived gender of individuals in photos and videos was new to the participating museums, we do not know how consistent the results are across data collectors. A study of how people perceive gender would be enlightening and could inform how museums might best portray individuals, especially gender non-conforming and non-binary individuals.

Next Steps for Museum Practitioners

We hope the information in this report will galvanize your museum's efforts to address gender equity by providing data to help better identify areas for improvement, establish goals, and develop strategies for continued improvement at your institution. Museum practitioners looking to use the information contained in this report to improve gender representation at their own museums can consider taking the following steps.

Use the Toolkit in your own museum, especially to collect data on how you portray adult STEM professionals in your exhibit content. We recognize that collecting data on all content in a museum can be a daunting task. If it isn't feasible to do museum-wide data collection, we suggest focusing on how adults in your exhibit content are depicted, especially STEM professionals. The toolkit can be used as a benchmarking tool to see how your museum compares with other museums, and it can be used periodically to see how your museum content changes over time. Museums can embed the toolkit into their existing content development processes so that equity in representation remains a priority.

Many museum staff have reported that the process of using the toolkit helped prompt important conversations about who is being depicted in museum content and how, as well as bringing equitable representation to the forefront for museum staff as they choose imagery for exhibits, programs, and other content areas.

Add images from the IF/THEN® Collection to your museum content. The IF/THEN® Collection is a digital media library containing thousands of photos and videos of amazing women in STEM, along with biographies, lesson plans, and other resources for highlighting STEM role models in your museum content. All resources are free for museums to use for any educational, non-commercial purpose. www.ifthencollection.org

Join the IF/THEN® Community of Practice, a nationwide peer network of science museums committed to gender equity. www.community.astc.org

Browse gender equity resources on the ASTC website including resources for engaging girls in STEM, understanding gender, and creating gender inclusive spaces, as well as a library of example museum projects that use the IF/THEN® Collection. www.astc.org/ifthen

DATA COLLECTION METHODS

Data Collection Methods

This report represents self-reported data from 76 museums. Each museum's team chose the types and amount of content to include and selected staff members to collect data. The project team provided materials for participating museums to conduct training sessions on how to collect data.

The toolkit includes data collection guidelines for all data collectors, including the following advice:

- If data collectors were unsure if an individual was a teenager or young adult, they were instructed to count them as an adult.
- A person's face should be at least partially visible in an image in order to be counted.
- Groups of people above seven individuals should not be counted. However, if only one person in a crowd is in focus, that person should be counted.
- In video content, an individual must be visible for at least 5 continuous seconds to be counted and only 30 seconds of each video should be considered.
- While multiple data collectors may have recorded data on the same content, museums were instructed to compile results before submitting their data so that each depiction was only counted once.

Data Analysis

The results in this report present descriptive analyses of data aggregated across all participating museums. Statistical weights were not applied despite differences in sample sizes (the amount of data submitted), primarily because site-to-site comparisons were not intended or employed.

Inferential techniques (e.g., chi-square tests) were not used to examine differences between groups. Although a sufficient number of data points are present to establish statistical significance between relatively small percentage differences in the aggregate data, the exploratory nature of these analyses did not warrant hypothesis testing, particularly with some of the limitations that are noted in the report. For the discerning reader, it is worth pointing out that differences as small as 1–2% are deemed statistically significant when using the full aggregated dataset.

APPENDIX A

Participating Science Centers and Museums

Adventure Science Center
Air Zoo
American Computer & Robotics Museum
Arizona Science Center
Asheville Museum of Science
Boonshoft Museum of Discovery
Bruce Museum
California Academy of Sciences
Cape Fear Museum of History and Science
Carnegie Science Center
Catawba Science Center
Centro Criollo Ciencias y Tecnología del Caribe (C3TEC)
Children's Museum of Pittsburgh
Cincinnati Museum Center
Connecticut Science Center
Creative Discovery Museum
Discovery Center at Murfree Spring
Discovery Center of Springfield
DISCOVERY Children's Museum
Discovery Museum
ECHO, Leahy Center for Lake Champlain
EcoExploratorio Museo de Ciencias de Puerto Rico
EcoTarium
Eugene Science Center
Evergreen Aviation & Space Museum
Explora
Exploratorium
Fleet Science Center
Florida Museum of Natural History
Fort Collins Museum of Discovery
Fort Worth Museum of Science and History
Gateway to Science
Great Lakes Science Center
Hands-On Science Center
Headwaters Science Center
Highlands Museum and Discovery Center
Imagination Station, Toledo
International Museum of Art & Science
International Museum of Surgical Science
Kentucky Science Center
Long Island Explorium
Maine Discovery Museum
McAuliffe-Shepard Discovery Center
Michigan Science Center
Montana Science Center
Montshire Museum of Science
Museum of Life and Science
Museum of Science
Museum of Science and Industry
Museum of the Earth at the Paleontological Research Institution
National Museum of Mathematics (MoMath)
North Carolina Museum of Natural Sciences
Oregon Museum of Science and Industry
Orlando Science Center
Pensacola MESS Hall
Reading Public Museum
Science Central
ScienceWorks Hands-On Museum
Scitech
Sci-Tech Discovery Center
South Dakota Discovery Center
Space Center Houston
spectrUM Discovery Area
Springfield Museums
TELUS Spark
Thanksgiving Point
The Bakken Museum
The Children's Museum of Indianapolis
The Lawrence Hall of Science
The Leonardo
The Tech Interactive
The Works Museum
Wenatchee Valley Museum & Cultural Center
Whitaker Center for Science and the Arts
Wings Over the Rockies
Yale Peabody Museum of Natural History