Mission Future: Arizona 2045
Summative Evaluation

By Allison Anderson, Sonya Harvey-Justiniano
and Elizabeth Kunz Kollmann

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Family using the *Mission Future: Arizona 2045* "Space Station Interactive"
Photo credit: Brad Herring for NISE Network

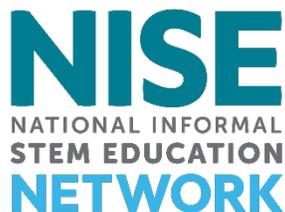## NISE NATIONAL INFORMAL STEM EDUCATION NETWORK

Acknowledgements

Allison Anderson

Museum of Science, Boston
1 Science Park
Boston, MA 02114
aanderson@mos.org
(617) 723 - 2500

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Space and Earth Informal STEM Education Project

Summative Evaluations Executive Summary

The NISE Network Space and Earth Informal STEM Education (SEISE) project was funded through the National Aeronautics and Space Administration (NASA)'s Science Mission Directorate (SMD) Science Activation program.

The National Informal STEM Education Network (NISE Network) is a community of informal educators and scientists dedicated to supporting learning about science, technology, engineering, and math (STEM) across the United States. Over 500 NISE Network partner organizations participated in the SEISE project between 2015 and 2023.

Evaluating the impact of the project

Evaluations were focused on understanding the overall impacts of the SEISE project on professionals' Earth and space work, as well as the impacts of SEISE products on the public's interest, engagement, relevance, understanding of SMD content areas (Earth science, heliophysics, planetary science, astrophysics) and their societal implications. More information about the five summative evaluation studies and the methods they employed can be found in the accompanying reports on:

nisenet.org/evaluation/summative-evaluation-reports↗

Project Deliverables

For the Public

Explore Science: Earth & Space toolkits

included engaging, hands-on Earth and space science experiences with connections to science, technology, and society.
To learn more: https://www.nisenet.org/earthspacekit↗

Sun, Earth, Universe exhibition

offered activities, games, and graphics that allowed visitors to engage in fun interactive Earth and space science experiences, while using skills essential to STEM learning.
To learn more: https://www.nisenet.org/sunearthuniverse↗

Mission Future: Arizona 2045 exhibition

provided an immersive experience integrating authentic Earth and space science, imaginative storytelling, and hands-on activities to explore what Arizona might be like in the year 2045.
To learn more: https://www.nisenet.org/mission-future-exhibition↗

For Professionals

Professional development

included 66 Online Workshops, an in-person Earth & Space Partner Meeting, as well as training resources and materials to help professionals engage the public.
To learn more: https://nisenet.org/pd↗

Professional learning community

was a cohort of professionals from 99 informal education organizations, who met monthly to learn about and work together towards making Earth and space science more relevant and inclusive for their communities.
To learn more: https://www.nisenet.org/earthspaceprojects2021↗

Space and Earth Informal STEM Education Project

2016-2023 SEISE Project Reach

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By the end of 2023, the NISE Network SEISE project had reached tens of millions of public participants and thousands of professionals in urban and rural areas.

1,200 toolkits
53 exhibitions

21,108 professionals & volunteers

33,139,000 members of the public

Distribution of toolkits and exhibitions

Educational products were awarded to over 500 institutions in all 50 states and several US territories.

Alaska

Hawaii

Puerto Rico & US Virgin Islands

Guam   American Somoa
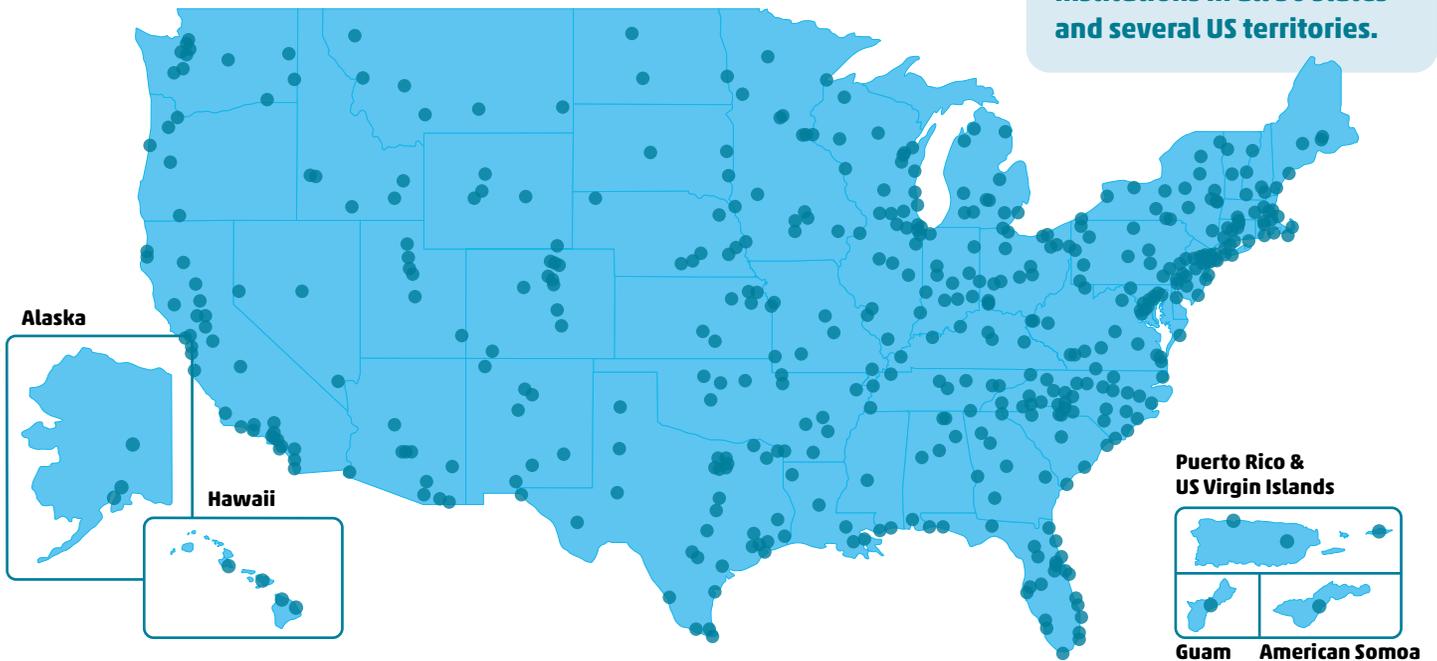
Summative evaluation reports:

Anderson, A., Atwood, A., Harvey-Justiniano, S., Kollmann, E. K. (2024). *Space and Earth Informal STEM Education (SEISE) professional learning community summative evaluation*. Boston, MA: Museum of Science, Boston for the NISE Network.

Anderson, A. Harvey-Justiniano, S., Kollmann, E. K. (2024). *Mission Future: Arizona 2045 exhibition summative evaluation.*
Boston, MA: Museum of Science, Boston for the NISE Network.

Beyer, M., Anderson, A., Kollmann, E. K. (2021). *Space and Earth Informal STEM Education (SEISE) project professional impacts summative evaluation.*
Boston, MA: Museum of Science, Boston for the NISE Network.

King, Z., Velázquez, H., Robertson, S. (2020). *Summative evaluation of the Sun, Earth, Universe exhibition*.
St. Paul, MN: Science Museum of Minnesota for the NISE Network.

King, Z., Velázquez, H., Robertson, S. (2019). *Summative study of Explore Science: Earth & Space activity toolkits*.
St. Paul, MN: Science Museum of Minnesota for the NISE Network.

Space and Earth Informal STEM Education Project

2023 Public Impacts Evaluation
Mission Future: Arizona 2045 Exhibition

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Installed at the Arizona Science Center, the *Mission Future: Arizona 2045* exhibition engages visitors in exploring a plausible, place-based future scenario. The exhibition integrates an immersive scenic environment, interactive components, imaginative storytelling, and authentic science to explore what life might be like in Arizona in the year 2045. The public impacts evaluation focused on how this exhibition supported the public's interest, engagement, and understanding of Earth and space science. This summary highlights the main findings from observations and surveys.

Annual exhibition reach

>174k
visitors per year

This exhibition is expected to reach approximately 70% of Arizona Science Center's annual visitation.

Visitors' experience in *Mission Future*

Visitors thoroughly used the exhibition and reported that they enjoyed the experience.

15 min.
average dwell time

Visitors spent a lot of time in this 2,500ft^2 exhibition and engaged with many of the available components. Comparing visitors' use of this exhibition against industry metrics for understanding and comparing visitor behaviors across different sizes and types, *Mission Future* was exceptionally thoroughly used by visitors at the Arizona Science Center.

Visitors enjoyed the exhibition and were particularly drawn to the open-ended interactive elements.

Augmented Reality (AR) Sandbox

87%
of visitors engaged

Drone Interactive

76%
of visitors engaged

"Our girls were interested in the hands on activities" – an adult

Key: Percent of Visitors Using Components

10-50%   51-100%

ISABELA & LUCAS' RANCH HOUSE

AVA & ZOE'S R&D LAB

AILI'S HUB

INTRO THEATER

ENTRY   EXIT
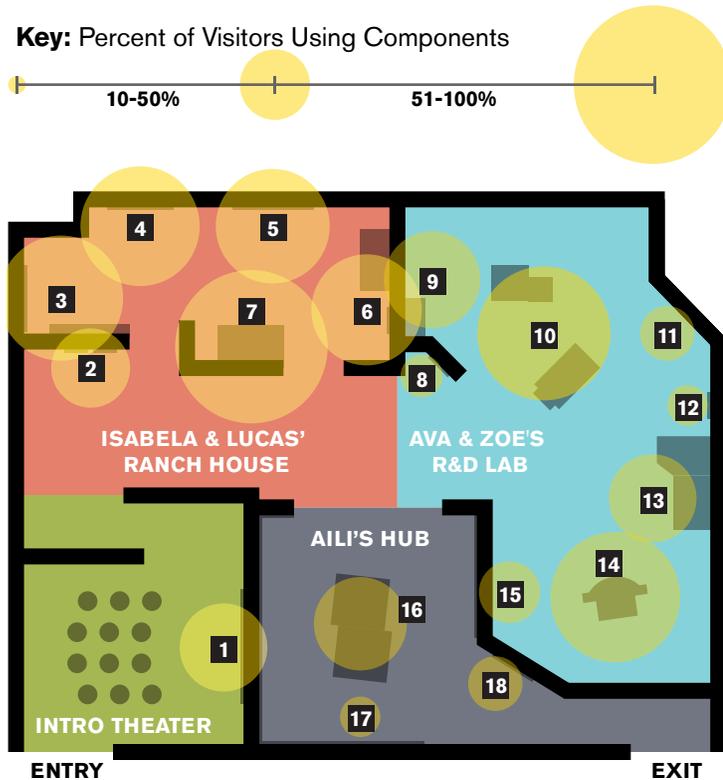
1	Introductory Video	10	Drone Interactive
2	Isabela and Lucas Videos	11	Lab View Video
3	Isabela's Desk, Desert View Video	12	Zoe Video
4	Heat and Land Use Interactive	13	Space Station Interactive
5	Plan a Community Interactive	14	Personal Spacecraft Interactive
6	Lucas' Desk, Social Media Feed	15	Earth and Space Exploration Video
7	AR Sandbox Interactive	16	Future Thinker Quiz
8	Ava Video	17	AILI Video
9	Ava's Desk, Social Media Feed	18	Future Perspective Interactive

[1]Serrell, B. (2020). The aggregation of tracking-and-timing visitor-use data of museum exhibitions for benchmarks of "thorough use". *Visitor Studies*, 23:1, 1-17, DOI: 10.1080/10645578.2020.1750830

Space and Earth Informal STEM Education Project

2023 Public Impacts Evaluation
Mission Future: Arizona 2045 **Exhibition**

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Learning about societal content and futures thinking

To what extent did the exhibit increase your feeling that you are...

...someone who thinks about the future and can participate in shaping it.
| 45% | 36% | 19% |

..motivated to follow up on my own questions or concerns about sustainability and/or climate change.
| 37% | 30% | 26% | |

...someone who can learn about and/or participate in current Earth and space science research and discovery.
| 33% | 43% | 22% | |

■ A lot   ■ Somewhat   ■ A little   ■ Not at all

Visitors felt the exhibition increased their confidence in their ability to learn about or to shape the future.

"I really enjoyed imagining I was in the future." – an adult

Learning about societal connections with Earth and space science

93%
of visitors
reported learning about how people and communities choose to explore Earth and space science, and develop solutions for the future.

93%
of visitors
learned about many career opportunities in fields related to Earth and space science.

Inclusion of Spanish text and subtitles

Visitors felt that including both Spanish text and subtitles alongside English labels made *Mission Future* feel inclusive and welcoming.

Spanish speakers appreciated having bilingual text or felt that it was helpful, while English-only speakers either reported that bilingual labels did not impact their experience, or made the exhibition feel inclusive or accessible.

"[having Spanish available] was cool! Being bilingual I really appreciated it."

– an adult

1. Introduction

1.1   Project overview

Mission Future: Arizona 2045 was installed as a pilot exhibition at Arizona Science Center in February 2023. The exhibition explored the future of Earth and space science, through imaginative story-telling and hands-on activities. The exhibition was created through the Space and Earth Informal STEM Education (SEISE) project, which was supported by the National Aeronautics and Space Administration (NASA) Science Activation (SciAct) program (cooperative agreements NNX16AC67A and 80NSSC18M0061). The SEISE project's goal was to create educational products and support informal educators' professional development in engaging the public with Earth and space content. SEISE has created and distributed numerous public facing materials, including the *Explore Science: Earth & Space* hands-on toolkits and the *Sun, Earth, Universe* exhibition, along with many professional development opportunities, including online workshops and a project-based professional learning community.[1]

In 2021, the project was awarded additional funding, which was used to extend professional development opportunities and pilot an exhibition utilizing NASA assets. The second stage of funding (SEISE 2.0) supported a project-based professional learning community and online workshops that leveraged materials created in the first five years of the project. Beyond that work, the development for this exhibition was led by the Center for Innovation in Informal STEM Learning at Arizona State University, Arizona Science Center, and the National Informal STEM Education Network (NISE Network). The summative evaluation for the exhibition is the focus of this report.

1.2   Mission Future: Arizona 2045 exhibition

Mission Future was an immersive exhibition that integrated authentic Earth and space science, imaginative storytelling, and hands-on activities to explore what central Arizona might be like in the year 2045. Visitors experienced some of the ways climate change will affect life on our home planet and learned how Earth and space science will create new opportunities to explore the universe. Throughout the exhibition, visitors met characters from the future representing different ways of thinking and listening to their stories. Prompted by an inquisitive AI character, visitors reflected on and shared their own ideas, values, and priorities as they progressed through the exhibition, growing their understanding of how they can participate in Earth and space science and contribute to a collective vision for the future. Visit the NISE Network website to learn more and watch a short video about the *Mission Future* https://nisenet.org/mission-future-exhibition.

1.2.1   Learning and experience goals

The primary goal for public audiences was to increase their understanding of Earth and space science and engineering, especially related to its societal context. Visitors had opportunities to reflect on and share their own ideas, values, and priorities as they progressed through the exhibition, growing their understanding of how they can participate in Earth and space science and contribute to a collective vision for the future. The overarching goals for the exhibition were that visitors will:

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[1] Additional reports for the SEISE project include King, Velázquez, & Robertson (2019); King, Velázquez, & Robertson (2020); Beyer, Anderson, & Kollmann (2021); and Anderson, Atwood, Harvey-Justiniano, & Kollmann (2023).

- Practice STEM process skills.
- Increase their understanding of Earth and space science content, and especially the relationship of STEM and society.
- Develop their sense of self-efficacy related to using STEM to meet challenges of the future.
- Develop new ways of thinking about the future and their role in making an impact on the future they envision.

1.2.2 Components

Mission Future was a 2,500ft^2 exhibition, broken up into 4 "rooms": the Intro Theater, Isabela & Lucas' Ranch House, Ava & Zoe's Research and Development (R&D) Lab, and AILI's Hub. The rooms were thematically connected to the characters' stories, with immersive scenery and interactive components. They also had videos for each character and other supporting media that provided additional context to the future world.

When visitors entered the exhibition they started in the **Intro Theater**, which played a short video introducing the characters and setting the scenario for the exhibition, see Table 1. After leaving the Intro Theater, visitors were expected to move sequentially to the Ranch House, then the R&D Lab, before exiting the exhibition through AILI's Hub.

Table 1. *Intro Theater*

Component Name and Description	Image
Introduction Video Visitors could watch a short video introducing the setting and primary messages for *Mission Future*. In the video, AILI invites visitors to imagine what the future might be like on Earth and in Space, briefly introduces each character, and talks about the different types of future thinkers.	

The **Ranch House** was introduced to visitors through a video of Isabela and Lucas sharing and discussing their perspectives of their family ranch. In this room, visitors had three interactive components available: "Heat and Land Use Interactive," "Plan a Community Interactive," and "Augmented Reality (AR) sandbox." The area also included two desks with props and artifacts for Isabela and Lucas, a desert landscape "window," and a social media feed for the siblings. See Table 2 below for an image and description of each component in the Ranch House.

Table 2.   *Isabela & Lucas' Ranch House*

Component Name and Description	Image
Isabela and Lucas Videos Visitors could learn more about the siblings' perspectives on the future of their family's ranch. Isabela and Lucas converse through their videos, which were located together by the entrance to the Ranch House.	
Isabela's Desk and Desert View Window Visitors could explore **Isabela's desk**, which has materials related to nature, history, conservation, and land stewardship. The artifacts on the desk established that she cares about the history, nature, and culture of the ranch land. Visitors could observe the landforms and ecology of the desert in central Arizona through the **desert view window**. This was a video recording of the natural desert designed to feel like looking through a window in the ranch house.	
Heat and Land Use Interactive Visitors could view real satellite and aerial images that highlight changes in land use over time. Visitors could learn about conditions in the present year and think about how people today might choose to respond to climate change.	
Lucas' Desk and Social Media Feed Visitors could browse **Lucas' desk**, which has a variety of sustainable building materials. The artifacts on Lucas' desk establish his interest in technologies that can be present solutions to climate impacts and enable more sustainable ways of living. Visitors could learn more about Isabela and Lucas' lives through a simulated **social media feed**. Posts reflect some of Isabela and Lucas' interests and activities, and address what the climate may be like in Arizona in 2045.	
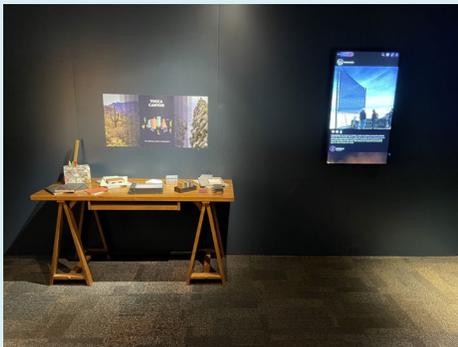
Plan a Community Interactive Visitors could work together to create their own plan for Isabela and Lucas' ranch by placing magnetic map tiles on a desert landscape. Isabela had plans related to conservation of the natural land and Lucas had plans related to a model sustainable development. This was indicated by the color-coding of the map pieces.	
Augmented Reality (AR) Sandbox Interactive Visitors could observe how changes to landforms affect water availability. Through topographically coded image projection visitors created sand models and simulated water flow to show how different landforms and water interact.	

As visitors entered the **Research & Development (R&D) Lab**, they were greeted by a video highlighting Ava's perspective, as she has a conversation with her twin sister Zoe. Another video in this section highlights Zoe's perspective as she has a different conversation with her sister. Visitors had three interactive components they could use in this area: "Drone Interactive" that had building and testing stations, "Space Station Interactive," and "Personal Spacecraft Interactive." This room also had three scenic components: Ava's desk, a window to a clean room, and a video wall with rotating images of NASA science and mission discoveries. See Table 3 for an image and description of each component in the R&D Lab.

Table 3. *Ava & Zoe's Research & Development (R&D) Lab*

Exhibit Name and Description	Image
Ava Video and Zoe Video Visitors could learn how the twins were thinking about their future as Ava and Zoe discuss what STEM career they want, and whether they want to live on Earth or in space. **Ava's video** was displayed at the entrance to the R&D Lab, while **Zoe's video** was located in the room, next to the lab view video.	

Ava's Desk and Social Media Feed
Visitors could browse **Ava's desk**. Here they will find various materials related to instrument development. Ava is building small drones that are designed to collect data in different atmospheres.

Visitors could learn more about this version of the future in the **social media feed**, where posts reflected Ava and Zoe's career options and interests.

Drone Interactive
Visitors could design small crafts for lift and descent which they could then test in the wind tubes. Visitors could then improve their designs so that they could fall gently or hover in the air stream.

Lab View Video
Visitors could watch a video from a real cleanroom at a NASA research center, designed to look like a window into the lab room. Visitors could observe how scientists and engineers work in teams and use specialized tools.
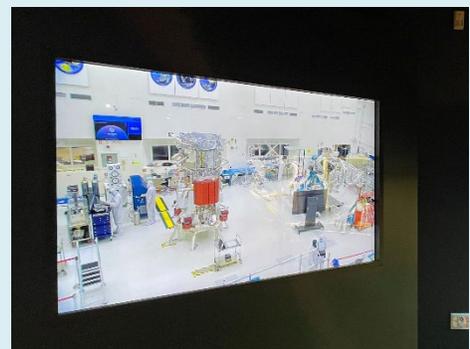
Space Station Interactive
Visitors could operate a simulated space station at this interactive. This game modeled power and life-support systems for a space station, challenging uses to balance energy collection and use.
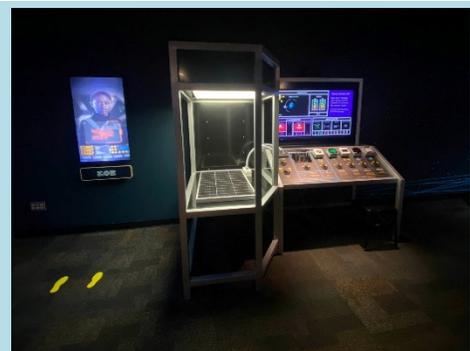
Exhibit Name and Description	Image
Personal Spacecraft Interactive Visitors could explore a mockup of a personal spacecraft associated with the space station and pose for photos.	
Earth and Space Exploration Video Visitors can watch a video that presents current and future missions from the NASA Science Mission Directorate, with topics including the Sun, Earth, our solar system, and beyond.	
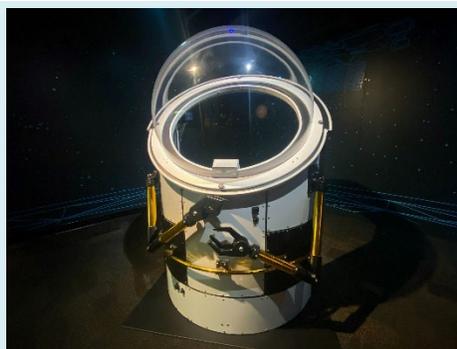
Visitors were expected to make their last stop in the exhibition in **AILI's Hub**. This room contained multiple kiosks to take a quiz on a tablet to determine what kind of future thinker they were. Also, in this area, was AILI's video and abstract desert plants by a local Arizona artist. Before leaving the exhibition, one last interactive remained, the future perspective interactive, where visitors used tokens to identify what type of thinker they were. See Table 4 for an image and description of each component in AILI's Hub.

Table 4. *AILI's Hub*

Exhibit Name and Description	Image
Future Thinker Quiz Visitors use kiosks to take a digital quiz to learn about what kind of future thinker they are. At the end, they could see a summary with other visitors' results, showing the proportion of different kinds of thinkers visiting the exhibition.	
AILI Video Visitors could reconnect with AILI and hang out in the hub. AILI asked some questions, shared information, and asked visitors to take a quiz to figure out what kind of future thinker they were.	

Future Perspective Interactive
Visitors reflected and shared how they feel about Arizona's future by putting a token in a slot that best aligned with their point of view.

1.3   Evaluation questions

The *Mission Future* summative evaluation focused on the impacts of the exhibition on public audiences at Arizona Science Center. Specific evaluation questions guiding this study included:

- **How many people does the exhibition reach annually?**
- **Who is using the exhibition?**
- **How do visitors use the exhibition?**
- **What do visitors learn from the exhibition?**

As a pilot exhibition, in addition to the summative questions, the evaluation sought to explore the relationship between some elements of the exhibition's design and visitor learning.

The *Mission Future* exhibition was created using best practices for design and supported by high quality science, so public audiences could authentically engage with Earth and space science. The development team also referred to NISE Network Earth and Space content and learning frameworks, for activities and exhibitions "based on the research, discoveries, and missions from NASA's Science Mission Directorate." The content framework outlines six Earth and space-related science topics covering the Sun, Earth, planets, galaxies, forces and energy, and societal connections, see Figure 1. The learning framework addresses the ways that visitors can engage in learning about science content, including experiencing phenomena, using the scientific process, and participating in the scientific community, see Figure 2.

Figure 1.   *The NISE Network Earth & Space Content Framework*
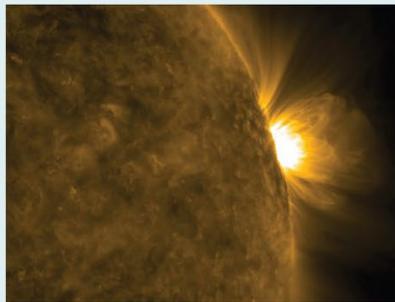
The Sun powers Earth and our solar system.

Our nearest star emits a massive amount of energy across the electromagnetic spectrum and through a stream of charged particles.

Earth is a dynamic planet.

Interactions between air, water, rock, and life, including human activities, change our planet and its climate.

Planets and moons beyond our home world may contain water and life.

Exploring the variety of planets, moons, and smaller objects in and outside our solar system helps us to better understand life on Earth.

The universe is very large, old, and mysterious.

Billions of galaxies, including countless stars, planets, and nebulas, fill a vast and expanding universe.

Our society chooses to explore Earth and space.

Our values influence how we ask questions, develop specialized tools and technology, and work together when exploring Earth and space.

Forces and energy connect everything in the universe.

Gravity, magnetism, and the energy transmitted by light shape all parts of the universe and help us learn more about Earth and space.

Figure 2. *The NISE Network Earth & Space Learning Framework*

PRINCIPLES

Experience Earth and space **phenomena** and explore science findings	Use the scientific **process** and reflect on science as a way of knowing	**Participate** in the scientific community and identify as a science learner

SUPPORTING STATEMENTS WITH EXAMPLE CONNECTIONS

Experiencing the joy of active learning, including play, discovery, invention, and experimentation	Using an iterative design process similar to engineering and scientific research	Working together in groups to accomplish goals and tackle challenges
Experiencing real phenomena, celestial events, and compelling imagery	Using a variety of tools and approaches to make discoveries	Exploring the relevance of Earth and space science
Exploring our place in the universe	Experiencing the power and limitations of data sets	Considering the social dimensions of Earth and space science
Investigating the big questions that drive Earth and space research	Making and using models to communicate and further our understanding	Identifying as someone who learns about and sometimes participates in current research
	Using our imagination and ingenuity to explore the universe	

Exploring the Universe: Filtered Light

Exploring the Universe: Star Formation

Exploring the Solar System: Asteroid Mining

STRANDS OF LEARNING

| **Developing interest in science:** Experience excitement, interest, and motivation to learn about science	**Understanding science knowledge:** Generate, understand, and use explanations, arguments, models, and facts related to science	**Engaging in scientific reasoning:** Manipulate, predict, question, observe, and make sense of the natural and physical world	**Reflecting on science:** Reflect on science as a way of knowing and as a personal process of learning about phenomena	**Engaging in scientific practice:** Participate in scientific activities and learning practices with others using scientific language and tools	**Identifying with the scientific enterprise:** Develop an identity as someone who knows about, uses, and sometimes contributes to science

2.0 Evaluation Methods

The *Mission Future* summative evaluation focused on the impacts of the exhibition on Arizona Science Center visitors. Methods included sweep count observations, tracking and timing observations of visitors, experience recall activity, and exit surveys to understand the impacts of the exhibition. The authors Anderson and Harvey-Justiniano led the planning, data collection, and analysis for this project. Further details about the evaluation methods and the data analysis are described below.

2.1 Data collection

2.1.1 Overview

Data collection primarily took place over a three-day weekend in March 2023 at Arizona Science Center, which informed the methods, instruments, and sampling strategy. Additional data were collected by staff at Arizona Science Center through sweep count observations later that year in June. Since the exhibition included signage and captions in both English and Spanish, and Phoenix has a large percentage of Spanish speakers, the surveys and experience recall materials were available in both languages. We had one English-only and one Spanish-English bilingual data collector for the main data collection efforts. To optimize the time at the Arizona Science Center, visitors were recruited through continuous random sampling, excluding camp or school groups, and parental consent was sought for any minors participating. Visitors were offered a small thank you gift after participating in data collection, a *Mission Future* branded sticker and an Earth eraser or planet-themed pencil.

2.1.2 Tracking and Timing observation and experience recall activity

Visitors participated in either tracking and timing observations or experience recall, followed by a request to complete an exit survey. Both methods were used to understand component attractiveness and who used different components, while observations also looked for evidence that visitors were practicing science process skills and how exhibit features might support visitor outcomes. Data collectors continuously sampled groups entering the exhibition, and randomly selected the first person in that group to enter as the "focus visitor" that would be observed and later surveyed. Focus visitors were selected based on whether they were observed to be approximately 13 years or older. If the focus visitor was observed to be under 18, data collectors would make sure that the child's parent or guardian was also nearby to consent to their child being surveyed afterwards.

Tracking and timing involved a data collector observing a focus individual as they entered the exhibit, using a digital observation form created using an online survey platform, that recorded the cumulative time spent in a "room" (e.g. the Ranch house). We noted which components the focus visitor used, how they interacted with the exhibit, and how they interreacted with others. Evaluators looked for behaviors such as using a component, watching a group member or other visitor using a component, talking to a group member about the content or component, etc.

Visitors not being observed were recruited to participate in an experience recall activity after they left *Mission Future*. Experience recall involved the data collectors prompting visitors to sort cards with pictures of exhibit components (e.g. "Lucas' desk," "Drone Interactive," "Future Thinker Quiz") into three categories "visited," "did not visit," and "not sure." Visitors were also asked to sort images of the videos into the categories "watched some," "watched all," "did not watch," and "not sure." During analysis, "not sure" was interpreted as they did not visit that component or watch that video.

2.1.3   Exit survey

After either being observed through tracking and timing or completing the experience recall activity, visitors were invited to complete an exit survey. These were used to understand the visitors' perspective of their experience in the exhibition and what they learned from the exhibition, in terms of the understanding of Earth and space-related content and societal connections. Some questions addressed the exploratory questions of the study, around the impact of bilingual signage and other exhibition components. Surveys were also used to collect demographic data to understand who was visiting *Mission Future.*

Survey respondents were asked several questions about themselves and their group so that we could understand, with more context, who was providing data about the exhibition. The surveys each included demographic questions about age, gender, and race/ethnicity. The exhibition was created with Spanish-speaking audiences in mind, so the demographics included questions about primary language(s) spoken at home. Respondents were also asked to share the age ranges of their group members.

2.1.4   Sweep count observation

As a separate strand of work, the evaluation included a small counting study to estimate the annual reach for the exhibition. This included counting visitors in *Mission Future,* then observing the entrance and exit to count the number of visitors that entered the exhibition over a 20-minute period. Data were collected twice per day, once in the morning and once in the afternoon, for each day of the week. Attendance data shared by Arizona Science Center were used to extrapolate an annual reach number.

2.2   Data analysis

Analysis focused on understanding the impact of the *Mission Future* exhibition, looking at outcomes with public audiences at Arizona Science Center. Most of the data were quantitative, and descriptive statistics such as counts, percentages, means, and medians were used. Open-ended survey responses were analyzed through inductive coding methods. Inductive coding involves "immersion in the details and specifics of data to discover important patterns, themes, and interrelationships" (Patton, 2002). Findings from the qualitative sections addressed questions about usability, content-learning, and impacts of bilingual text. See Table 5 for a summary of the data referenced in the report. The sweep count sample size notes the total observations, while the tracking & timing, experience recall, and exit survey reflect visitor groups.

Table 5.   *Analyzed data sets referred to in this report*

Data Source	Sample Size
Sweep count observations (total observations)	N=14
Tracking & timing observations	N=39
Experience card sort recall	N=26
Exit Survey	N=47

2.3 Data limitations

2.3.1 Short timeline for data collection

The short time available for data collection is a potential limitation of the study. The evaluation team was not local to Arizona Science Center, and so had to travel for data collection. This meant that all the primary data (tracking and timing, experience recall, and surveys) were collected during one weekend. Due to the timeline, limited number of data collectors, and need for bilingual data collection, instruments were simplified to maximize the amount of data that could be collected. This meant relying on observations, visitor experience recalls, and close-ended survey questions. The quantitative data is extremely valuable to understanding what visitors did and how they experienced the exhibition. However, a longer timeframe to collect data would have allowed for interviews or more qualitative data, that could have provided a richer understanding of exhibition's impacts.

2.3.2 Social desirability bias with card sort reporting

A possible limitation to using the data collector observations and visitor self-report to understand what visitors did or saw in *Mission Future* is the potential for biases between externally observed usage and visitor remembered usage. Both methods were used to understand exhibition use and maximize the data that could be collected in a limited amount of time. Comparison between the two methods indicates that data collectors did not observe statistically different experiences than visitors reported. Descriptive frequencies suggest that data collectors observed visitors use fewer exhibits than reported in the visitor recall. It is possible that visitors that only used a few components were some of those that declined to participate in the visitor recall and survey because they did not feel like they had done enough. However, these differences were not statistically significant, thus visitor experiences are reported together across the two methods.[2]

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[2] Mann-Whitney U Test comparing number of exhibits visited with method used, p=0.191, z=-1.309

3. Introduction to findings

This report brings together the *Mission Future* summative evaluation for the SEISE team to understand the impacts of the exhibition with considerations for designing similar experiences in the future. Each finding section addresses an area of interest for the study:

> **Section 4:** Reach & Demographics
>
> **Section 5:** Exhibit Use
>
> **Section 6:** Visitor Learning
>
> **Section 7:** Supporting Visitor Outcomes

Summative evaluation of the *Mission Future* exhibition was focused on who visited the exhibition, how they interacted with it, and what they learned. Using a continuous random sampling method, data were collected through exit surveys from visitors who were either observed through a tracking and timing protocol or engaged in an experience recall activity describing their experience in the exhibition. Data was collected at Arizona Science Center in March 2023. Overall, 65 groups were observed (n=39) or completed the experience recall activity (n=26), with 47 visitors from these groups also completing a survey.

4. Findings: Reach and Visitor Demographics

The evaluation questions related to reach and visitor demographics for the *Mission Future* exhibition were:

- How many people will the exhibition reach annually?
- Who is using the exhibition?

A counting study was conducted to estimate how many people will visit the exhibition each year, using observed data for the exhibition and historical attendance data from Arizona Science Center. Visitors were asked to respond to demographic questions primarily about themselves. These were introduced with an explanation that the evaluation would use this information to understand the experiences of all visitors, and how people with various identities experience an exhibit in different ways. In addition to asking survey respondents to share their age, gender, disability status, race/ethnicity, and primary language, they were asked to share the age and gender of all group members. In total, 45 of the 47 survey respondents answered the demographic section and represented a total of 128 visitors that took part in the study.

Findings are discussed in detail in the following sections, the key takeaways are that:

- *Mission Future* will reach approximately 174,000 visitors per year at Arizona Science Center.
- Visitors to *Mission Future* were often from multi-generational groups, represented a wide range of ages, and were a little more likely to be women and girls.
- Most visitors to *Mission Future* identified as white or Caucasian, and almost all visitors primarily spoke English at home.

4.1 *Mission Future* will reach approximately 174,000 visitors per year at Arizona Science Center.

Mission Future was installed at Arizona Science Center in February 2023. The exhibition was located near the entrance to multiple exhibit halls, so most visitors will pass by *Mission Future* at the beginning or end of their visit to the Science Center. Calculated from the sweep count observations for visitors entering the exhibition, approximately 70% of Arizona Science Center visitors will experience *Mission Future.*[3] Using the most recent attendance data from 2022 and 2023, it is estimated that approximately 174,000 visitors will see the exhibition per year.

4.2 Visitors to *Mission Future* were often from multi-generational groups, represented a wide range of ages, and were a little more likely to be women and girls.

The survey asked several questions about the visitors and their group so that we could understand more about who was visiting the exhibition. The majority of visitors to *Mission Future* were multi-generational groups that included adults and children (65%), with a little over a third of groups visiting in adult-only groups (35%). Overall, visitors to *Mission Future* represented a wide range of ages, from young learners (under 6) to older adults (65+), with the largest percentage of visitors being older children and teens (24%), see Figure 3. Focus visitors' ages ranged from 11 to 54, although most survey respondents were adults, with a few older children and teens participating in the study. Young children were intentionally not included in survey recruitment, due to the focus of the exhibition.

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[3] Reach Memo citation

Figure 3. *Focus visitor and accompanying group members' ages (n=128 total visitors, across 45 groups)*

What is your age / the ages of your other group members (open-response)
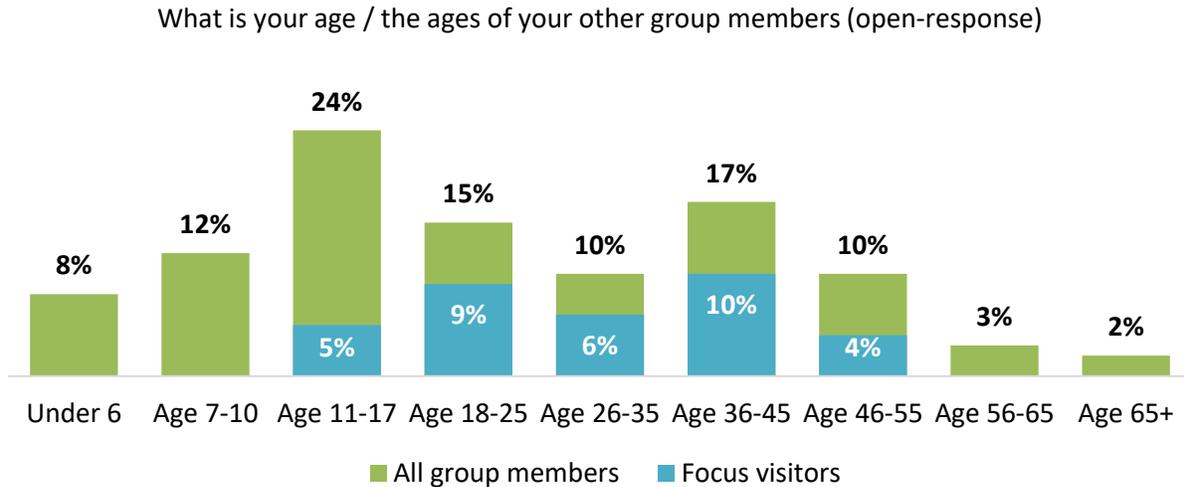
The majority of visitors to *Mission Future* self-identified as girls and women (61%), with the rest identifying as boys and men (39%), as show in Figure 4. Survey respondents were slightly more likely to identify as female, however were proportionally close to the overall sample. Most survey respondents identified as not having a permanent or temporary disability (93%, n=43 groups).

Figure 4. *Focus visitor and accompanying group members' genders (n=128 total visitors, across 45 groups)*

What is your gender / the gender of your other group members (open-response)
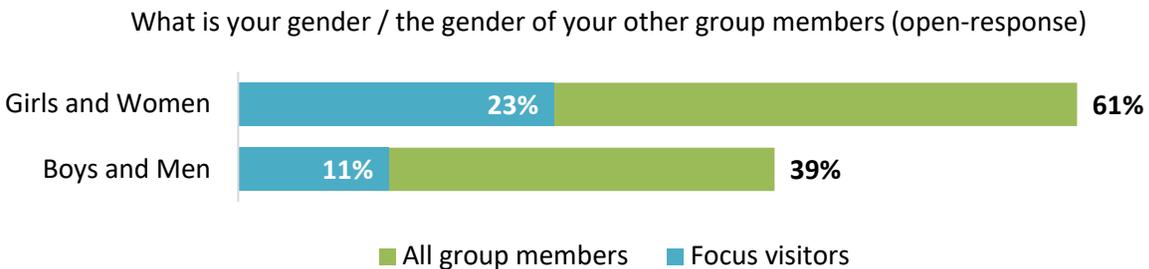
4.3 Most visitors to *Mission Future* identified as white or Caucasian, and almost all visitors primarily spoke English at home.

Mission Future was designed to be culturally relevant to people who identify as Hispanic or Latinx, in part to reflect the demographics of the greater Phoenix area. For perspective, the Maricopa County census indicates that 32% of residents identify as Hispanic or Latino (U.S. Census Bureau, n.d.). In the *Mission Future* summative evaluation, the majority of survey respondents identified as white or Caucasian (69%), and approximately one fifth identified as Hispanic or Latinx (20%). Almost all respondents (93%) said that they primarily speak English at home.

Figure 5. *Race and/or ethnicity of survey respondents (n=39)[4]*

With which racial or ethnic group(s) do you identify? (check all that apply)

White or Caucasian	**69%**
Hispanic or Latinx	**23%**
Asian or Asian American	**10%**
Black or African American	**8%**
Other	**3%**
Prefer not to say	**3%**
Native Hawaiian or Pacific Islander	
American Indian or Alaskan Native	

■ Focus visitors

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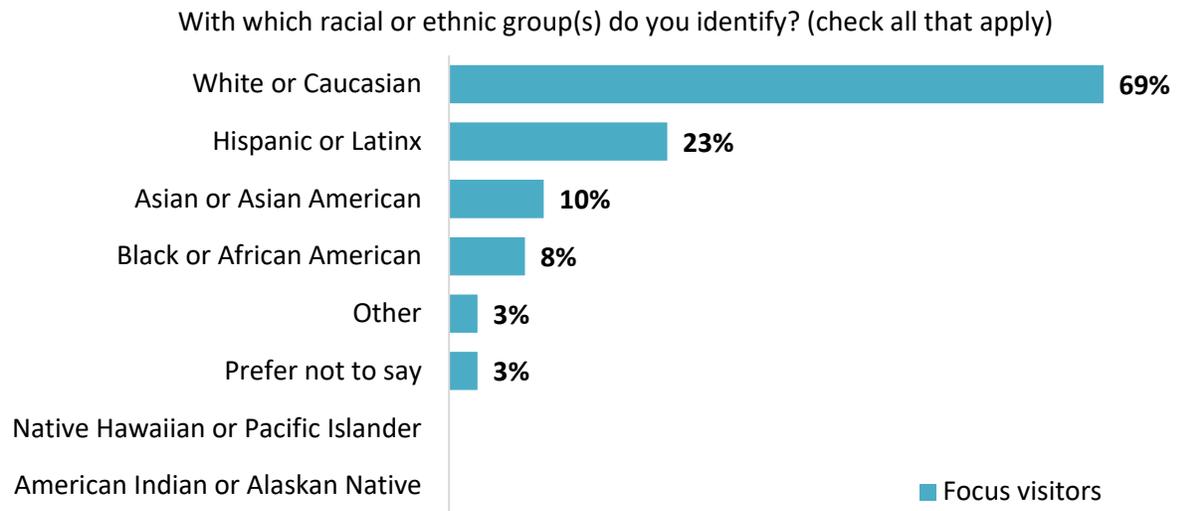
[4] Nine respondents skipped the question, rather than use the "prefer not to say" response option.

5. Findings: Exhibition Use

The evaluation sought to understand the behaviors of visitors in *Mission Future,* to answer the question:

- How do visitors use the exhibition?

Tracking and timing observations were the primary method used to understand visitor behaviors and were augmented by the experience recall activity to characterize exhibit attractiveness. The tracking and timing protocol involved observing the focus visitor, who was the first person to enter the exhibition in the target age range. The observations primarily captured what the focus visitor did in the exhibition, such as watching videos, exploring scenery, using interactive components, and social behaviors between group members. In addition to tracking what the focus visitor did in the exhibition, data collectors also made notes about what other group members were doing. Since groups could split apart and visit different areas, observations of group members were incomplete and not used in the primary analyses in this report. However, these observations were used to better understand how group members interacted with the focus visitor, such as the focus visitor watching someone else in their group use an exhibit or having conversations with other group members.

Findings are discussed in detail in the following sections, the key takeaways were that:

- On average, visitors to Mission Future had a long average stay time as compared to the exhibition's size and they engaged with many exhibit components.
- Visitors were particularly drawn to the open-ended interactive elements in the Ranch House and R&D Lab.

5.1 On average, visitors to *Mission Future* had a long average stay time as compared to the exhibition's size and they engaged with many exhibit components.

Mission Future was a 2,500 ft² exhibition, divided into four rooms for visitors to explore. On average, visitors spent about 15 minutes in the exhibition, with dwell times ranging from just over a minute (entering and stopping briefly at one exhibit) to over 55 minutes. The majority of visitors had shorter experiences in the exhibition, with 61% spending 15 minutes or less in the space. Those who had particularly long dwell times were observed spending a lot of their time at either the "AR Sandbox" or "Drone Interactive". Visitors were observed engaging with many elements of the exhibition, on average stopping at 9 of the 18 available components.

Serrell (2016) uses two metrics calculated from tracking and timing data to compare use of exhibitions that vary across content area, exhibition size, and number of exhibits: the sweep rate index (SRI) and percent Diligent Visitor (%DV). SRI is calculated by dividing the exhibition's square footage by the average total time spent in the space, with a low number indicating that visitors are spending a long time in the exhibition and are engaged with many learning-related behaviors. The %DV is the percentage of visitors that stop at over half of the exhibition components, with a higher percentage indicating that many visitors are using many of the components, rather than ignoring or skipping components. These metrics are used together to categorize exhibitions into five categories, see Table 6. *Mission Future* fits into category E, or "exceptionally thoroughly used," with a 150 SRI and 57% DV, indicated by a star in Figure 6. This category indicates that *Mission Future* was an exhibition where visitors were likely to engage with much of the content and experiences—therefore, they were more likely to meet exhibition goals.

Table 6. *Categories describing exhibition use (Serrell, 2016), based on visitor sweep rate index (SRI) and percent Diligent Visitor (%DV)*

Zone	SRI	%DV	Description
A	>300	<25%	Sweeping glances, few stops
B	>300	>25-50%	Fast sweep rate, but above average diligent visitors
C	<300	<25%	Slow sweep rates, but many exhibits skipped
D	<300	>25-50%	Many exhibits attracted attention
E	<300	>50%	Exceptionally thoroughly used

Figure 6. Mission Future *is an "exceptionally thoroughly used" exhibition within Serrell's Tracking-Timing aggregation (2020), with 57% DV and 150 SRI*
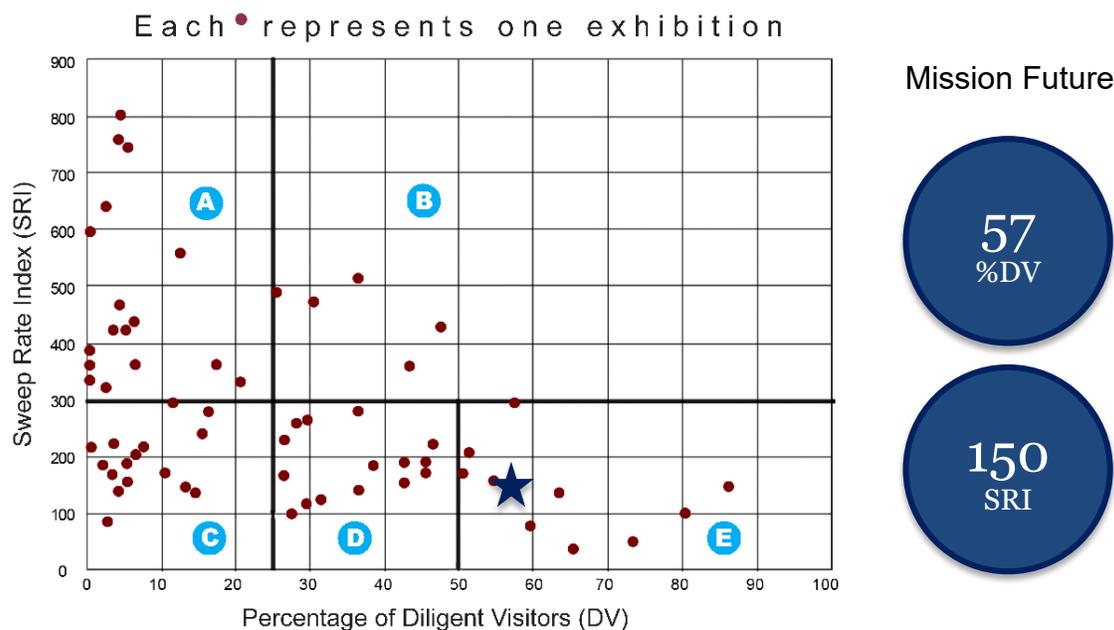
5.2 Visitors were particularly drawn to the open-ended interactive elements in the Ranch House and R&D Lab.

This section highlights how visitors interacted with *Mission Future* and what they found to be the most appealing or engaging experiences. Data are primarily drawn from the observations and experience recall activity (N=65) to understand what components visitors engaged with and a subset of these data (tracking and timing only, n=39) are used to understand additional visitor behaviors at those exhibits.

Broadly, most visitors initially moved through the exhibition as expected, entering through the Intro Theater, and then using many exhibits in the Ranch House. As visitors moved through the other rooms, they stopped at fewer of the available exhibits but had notably long dwell times in the R&D Lab. Almost all visitors engaged with the open-ended and interactive exhibits, suggesting that these were the most attractive components in *Mission Future*.

5.2.1 *The Ranch House and R&D Lab were the most attractive areas for visitors, with most visitors using the open-ended, interactive components.*

The two most visited sections of the exhibition were the Ranch House and R&D Lab, with over 90% of visitors engaging with at least one component in each area (N=65), see Figure 7. Fewer

visitors used components in the other areas, with 62% visiting AILI's Hub and 48% using the Intro Theater. Visitors were observed (tracking and timing, n=39) spending most time in the R&D Lab, spending on average just under eight minutes (7 min 57 sec) in the area. The next longest dwell time was in the Ranch House, where visitors spent over five minutes (5 min 18 sec) on average. AILI's Hub and the Intro Theater had the shortest dwell times, with visitors averaging about three minutes in each of these room.

Figure 7. *Proportion of visitors for each area of Mission Future (N=65)*
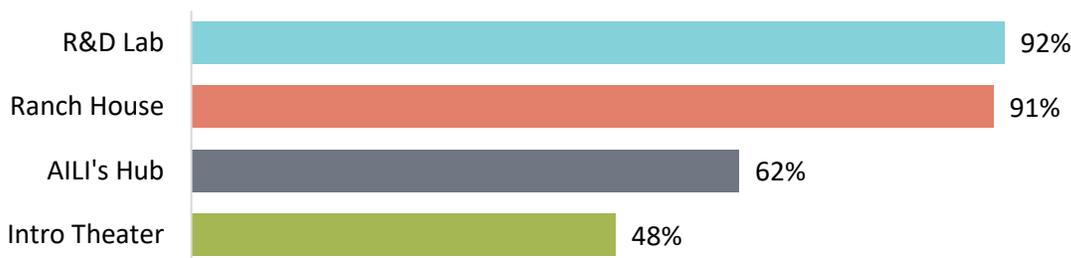
While visitors spent a long time in the R&D Lab, then tended to use few of the available components, with 33% of visitors to this area stopping at five or more of the eight components (n=60). Visitors usually engaged with most of the components in the Ranch House, with 75% stopping at four or more of the six components in the area (n=59). AILI's Hub had three components, and half of visitors (50%, n=40) stopped at just one of these. The Intro Theater only had one component, and while most people moved through this room about half stopped to watch the video (48%, N=65).

The components that were most visited were the open-ended experiences. These included the "AR Sandbox" (87%, N=65), the "Drone Interactive" (76%), and the "Personal Spacecraft Interactive" (74%). Figures 8-10 show visitors engaging with the three most visited exhibits. Other components in the Ranch House were also well used, with over 60% of visitors stopping at each of the components. While fewer people overall visited AILI's Hub, 53% of all visitors used the "Future Thinkers Quiz." The fewest people stopped at the videos, as is discussed in more detail below. See Figure 11 for a heatmap of the *Mission Future* showing the proportion of visitors that visited each component, detailed data for this figure can be found in Appendix B.

The videos contained much of the exhibition's content, through conversations between the characters that highlighted different types of future thinkers. As such, understanding how visitors interacted with the videos was a particular interest to the development team. Overall, 72% of visitors watched at least part of a video, with visitors most commonly watching part of one (31%) or two (20%) videos (N=65). This included visitors either very briefly stopping or staying more than halfway through. A few visitors (8%) watched at least part of all five videos, with two visitors watching all in their entirety. Visitors stopped at the videos more often towards the beginning of the exhibition, with 50% watching at least part of the Intro Video and 45% stopping at Isabela and Lucas' video. The three videos later in the exhibition were at least partially watched by less than a quarter of visitors (24% Ava, 23% Zoe and AILI).

Figure 8. *Visitors changing the topography of the sand in the "AR Sandbox"*

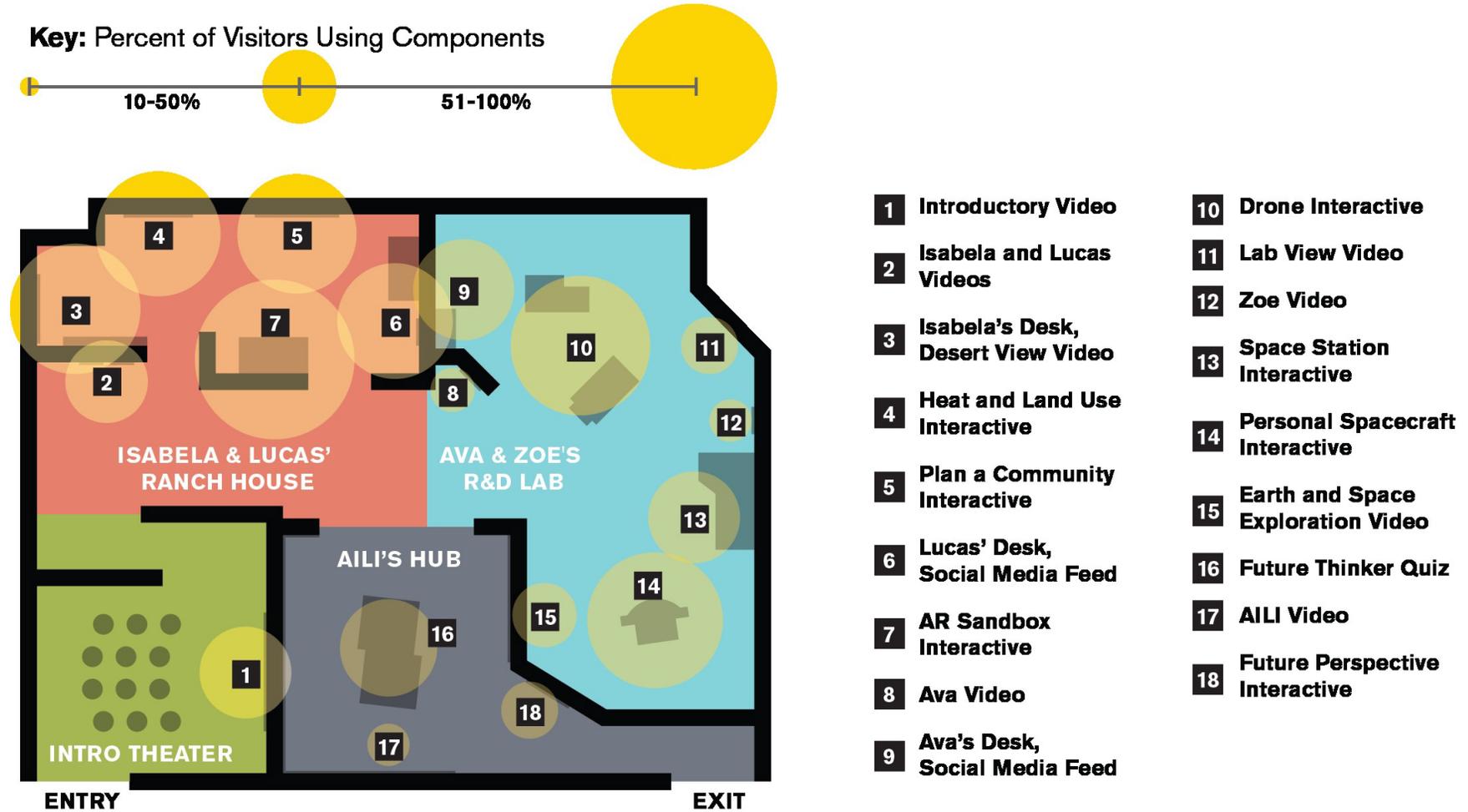***Figure 9.*** *Visitor testing their design at "Drone Interactive"*

Figure 10. *Visitor posing for a photo in the "Personal Spacecraft Interactive"*

Photo credit for Figures 8-10: Brad Herring for the NISE Network

Figure 11. *Visitor engagement heatmap for Mission Future, showing the proportion of visitors who used each component (N=65)*

5.2.2 Observations of other visitor behaviors indicated that they often used the exhibits as expected.

Generally, visitors were observed entering *Mission Future* through the Introductory Theater and leaving through AILI's Hub as intended, however, some visitors exited through the Introductory Theater or walked through AILI's Hub without stopping. Even with clear entry and exit points, visitors did not always stop or engage with components in those areas, with 48% of visitors stopping in the Introductory Theater and 62% of people visiting at least one of the components in AILI's Hub (N=65).

While in the Ranch House, visitors were often observed looking at scenery or interacting with exhibits. As noted above, the most visited component in this area was the "AR Sandbox," a sandbox with a topographic map that responds to the peaks and valleys in the sand, which was used by 87% of visitors (N=65). Visitors who were observed in the Ranch House commonly had conversations with other groups members in the area around the "AR Sandbox," "Plan and Community," and "Heat and Land Use," including about the component or related content (59%, n=34).

Visitors who went to the R&D Lab primarily engaged with the "Drone Interactive" (76%, N=65), an engineering activity where visitors could design, build, and test an object to fly in an air tube. Half of visitors to the R&D Lab were observed building and/or testing a design at "Drone Interactive" (50%, n=35) and a few iterated on a drone's design (12%). Some visitors (35%) were observed watching other visitors interact with "Drone Interactive," and/or talking to group members about the component or related content. The other highly visited component in this area was the "Personal Spacecraft Interactive" (74%, N=65), a model of a spacecraft that visitors could touch and take pictures in. At this exhibit visitors were often observed looking closely at the component (68%, n=35), touching the spacecraft (47%), or taking a picture/video of someone in their group (32%).

When in AILI's Hub, half of visitors stopped at just one of the three components in the area. This was usually the "Future Thinkers Quiz," a digital quiz that prompted visitors to respond to a series of statements to identify what kind of future thinker they were, which was used by 53% of all visitors (N=65). Many people who were observed in AILI's Hub talked with group members about the quiz or related content (59%, n=22).

6. Findings: Visitor Outcomes

As part of the evaluation for the *Mission Future* exhibition, visitor learnings were framed around the SEISE content and learning frameworks, included in Section 1.3. The evaluation questions were:

- What do visitors learn from the exhibition?
  - To what extent do they increase their understanding of the content?
  - To what extent do they develop self-efficacy related to using STEM to meet challenges of the future?
  - To what extent do visitors think about the future differently or see their role in making an impact on the future?

The primary goal for Mission Future was for public audiences to increase their understanding of Earth and space science and engineering, especially related to its societal context, while they practiced STEM process skills. Components prompted visitors to reflect on and share their own ideas, values, and priorities as they move through the exhibition. Topics addressed in the exhibition include:

- Earth and space science explore our Sun and solar system; our dynamic home planet, Earth; planets and moons beyond Earth; and the universe.
- Our society chooses to explore Earth and space.
- There are many possible futures.
- The exhibition presents one possible version of what Arizona might be like in 2045 and some people who live there.

Additional affective goals for *Mission Future* visitors were for learners to express positive attitudes about the exhibition experience. This included:

- Finding the exhibition enjoyable.
- Finding the exhibition to be relevant and making connections to their lives and interests.
- Finding the characters relatable.
- Developing a greater sense of self-efficacy related to using STEM to shape the future.

Findings are discussed in detail in the following sections. The key takeaways are that:

- Overall, visitors found *Mission Future* enjoyable and most often replied that the interactive activities made the exhibition feel connected to their lives.
- Visitors felt the exhibition increased their confidence in their ability to learn about or shape the future.
- Most visitors reported learning about how people and communities choose to explore Earth and space science, along with related career opportunities.
- Visitors felt that including Spanish text and subtitles alongside the English labels made *Mission Future* feel inclusive and welcoming.

6.1 Overall, visitors found *Mission Future* enjoyable and most often replied that the interactive activities made the exhibition feel connected to their lives.
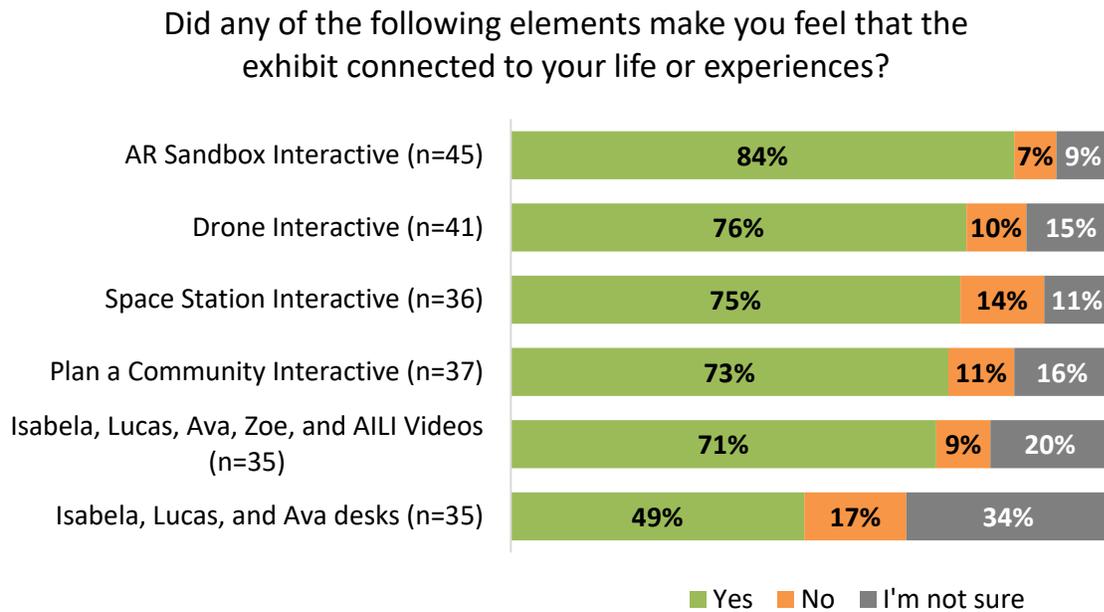
On the survey, visitors were asked to rate how enjoyable they found the exhibition on a 4-point scale, from "not at all enjoyable" to "very enjoyable." Overall, visitors enjoyed the exhibition with 91% selecting either of the two highest categories, see Figure 12.

Figure 12. *Visitor's ratings for how much they enjoyed* Mission Future *exhibition (n=45)*

How enjoyable was this exhibit?

9%	53%	38%

☐ Not at all enjoyable ☐ A little enjoyable ☐ Enjoyable ☐ Very enjoyable
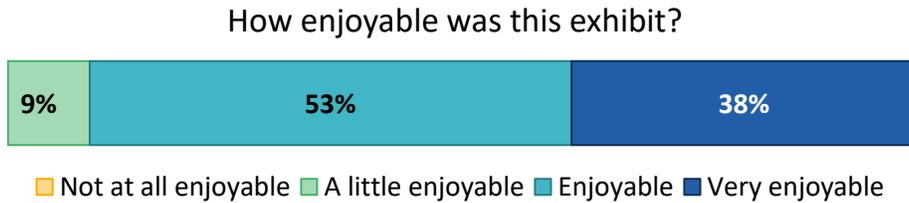
To understand whether visitors found *Mission Future* relevant, they were asked if key elements made the exhibition feel connected to their life or experiences. Components that visitors were asked to think about were the character-centered elements and interactive activities that had content the exhibition developers anticipated people would relate to. The "AR Sandbox Interactive," where a video projection reacted to changes visitors made in the sandbox, made the exhibition feel relevant to most visitors (84%). As described in Section 5.2 , this was also the most visited component in the exhibition. The elements that the fewest people found relevant were the desks for Isabela, Lucas, and Ava that were designed for visitors to learn more about and feel connected to the characters, with 49% of visitors saying they made the exhibition feel relevant and 34% saying they weren't sure. As shown in Figure 13, the other hands-on activities and character videos also helped the exhibition feel relevant, with 71-76% of visitors agreeing.

Figure 13. *Visitors' responses to whether key elements made the exhibition feel relevant, for visitors that used the exhibit[5]*

Did any of the following elements make you feel that the exhibit connected to your life or experiences?

Element	Yes	No	I'm not sure
AR Sandbox Interactive (n=45)	84%	7%	9%
Drone Interactive (n=41)	76%	10%	15%
Space Station Interactive (n=36)	75%	14%	11%
Plan a Community Interactive (n=37)	73%	11%	16%
Isabela, Lucas, Ava, Zoe, and AILI Videos (n=35)	71%	9%	20%
Isabela, Lucas, and Ava desks (n=35)	49%	17%	34%

☐ Yes ☐ No ☐ I'm not sure

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[5] Elements were described using descriptive language (e.g. "Magnetic Map Wall" instead "Plan a Community Interactive"), since the components were not titled in the exhibition itself. See the survey in Appendix A for specific language.

6.2 Visitors felt the exhibition increased their confidence in their ability to learn about or shape the future.

One of the main goals for *Mission Future* was for public audiences to feel more confident in being a future thinker. As visitors moved through the exhibition, they were presented with content through the videos and interactive activities, which prompted visitors to reflect on and share their own ideas, values, and priorities. These concepts were framed on the survey as being someone who could learn about or participate in shaping the future, particularly in relation to climate change or Earth and space science.

Visitors were asked to rate on a 4-point scale, from "Not at all" to "A lot", to what extent did the exhibit increase their feelings around these future thinker concepts. Across the three related items, almost all visitors (93%) reported that *Mission Future* strengthened their self-efficacy at least "a little" related to learning about or participating in shaping the future. More specifically, the exhibition had a large impact on some visitors, who shared that they were "a lot" more confident in their ability to shape the future (45%), to follow up on their concerns about climate change (37%), and to learn more about Earth and space science (33%).
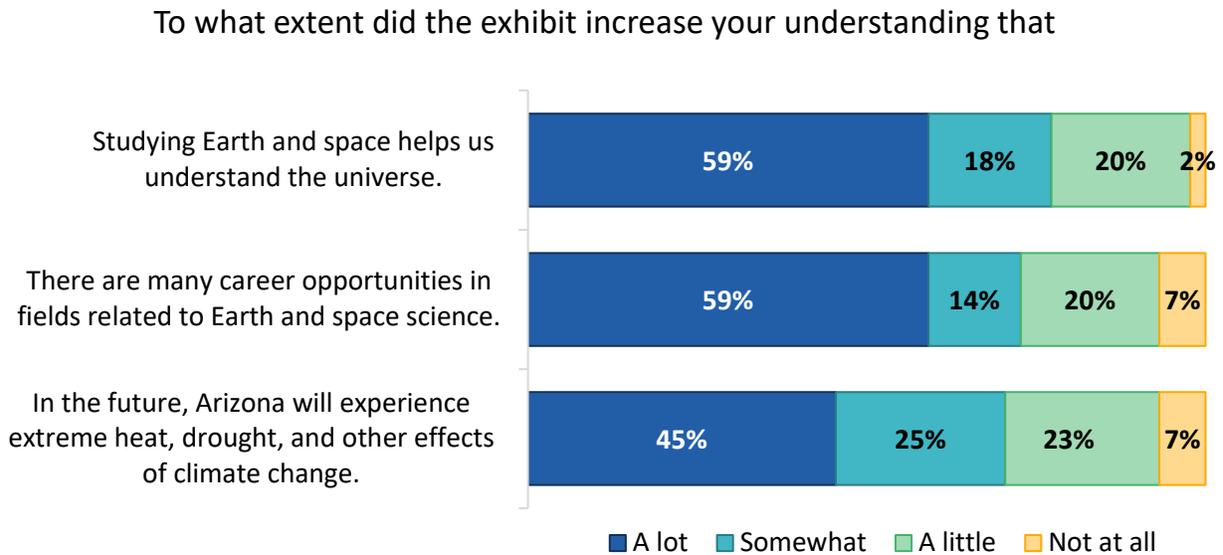
Figure 14. *Visitor's changes in self-confidence as future thinkers (N=47, ^n=46)*

To what extent did the exhibit increase your feeling that you are…
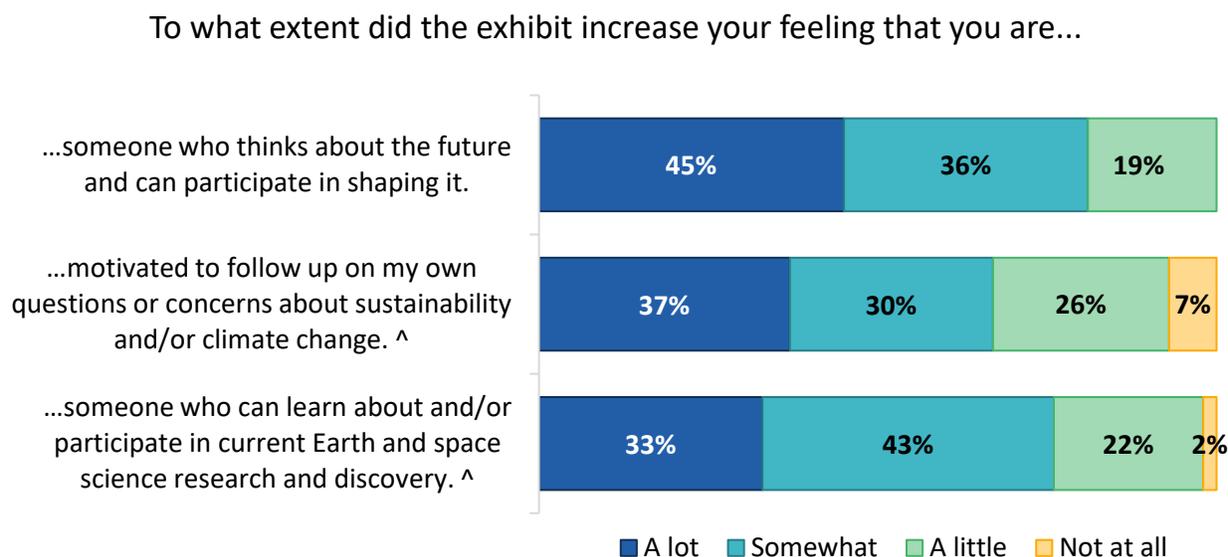
6.3 Most visitors reported learning about how people and communities choose to explore Earth and space science, along with related career opportunities.
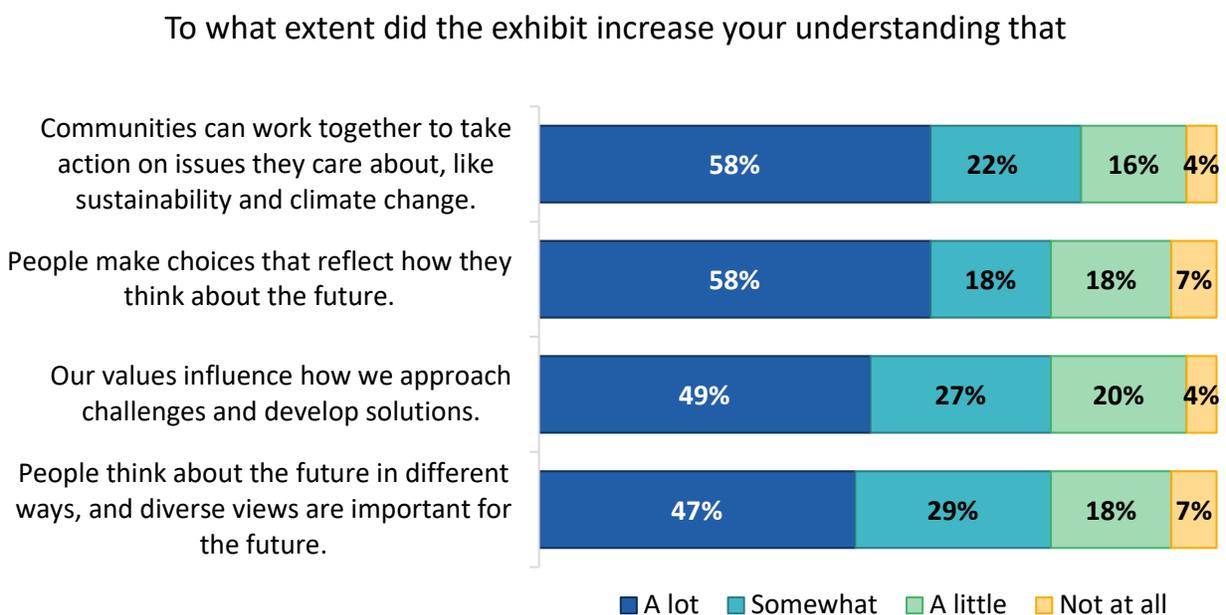
Another objective for public audiences was that *Mission Future* would increase their understanding of Earth and space science and engineering, especially related to its societal context. This content was the primary focus of the hands-on interactives and components across the Ranch House and R&D Lab. Visitors were asked to what extent did the exhibition increased their understanding of Earth and space science and climate change topics and rated it on a 4-point scale from "not at all" to "a lot". Across the related items, almost all visitors (93%) reported that they increased their understanding of content related Earth and space science at least "a little" as a result of visiting *Mission Future*. The two areas that visitors reported the greatest increase was around career opportunities in fields related to Earth and space science and that the field helps humans understand the universe, with 59% reported that the exhibition increased their understanding "a lot", as shown in Figure 15.

Figure 15. *Visitor's responses around what they learned in the exhibition, related to Earth and space science content (n=44)*

To what extent did the exhibit increase your understanding that

Studying Earth and space helps us understand the universe. — A lot 59%, Somewhat 18%, A little 20%, Not at all 2%

There are many career opportunities in fields related to Earth and space science. — A lot 59%, Somewhat 14%, A little 20%, Not at all 7%

In the future, Arizona will experience extreme heat, drought, and other effects of climate change. — A lot 45%, Somewhat 25%, A little 23%, Not at all 7%

■ A lot ■ Somewhat ■ A little ■ Not at all

Similarly, across all the items around societal content related to Earth and space science, almost all visitors (93%) reported that they increased their understanding at least "a little" as a result of visiting *Mission Future*. The exhibition had the greatest impact on visitors' understanding that communities can work together to take actions and that people make choices that reflect how they think about the future, where 58% said the exhibition impacted their understanding "a lot," as shown in Figure 16.

Figure 16. *Visitor's responses around what they learned in the exhibition, related to societal connections to Earth and space science content (n=45)*

To what extent did the exhibit increase your understanding that

Communities can work together to take action on issues they care about, like sustainability and climate change. — A lot 58%, Somewhat 22%, A little 16%, Not at all 4%

People make choices that reflect how they think about the future. — A lot 58%, Somewhat 18%, A little 18%, Not at all 7%

Our values influence how we approach challenges and develop solutions. — A lot 49%, Somewhat 27%, A little 20%, Not at all 4%

People think about the future in different ways, and diverse views are important for the future. — A lot 47%, Somewhat 29%, A little 18%, Not at all 7%
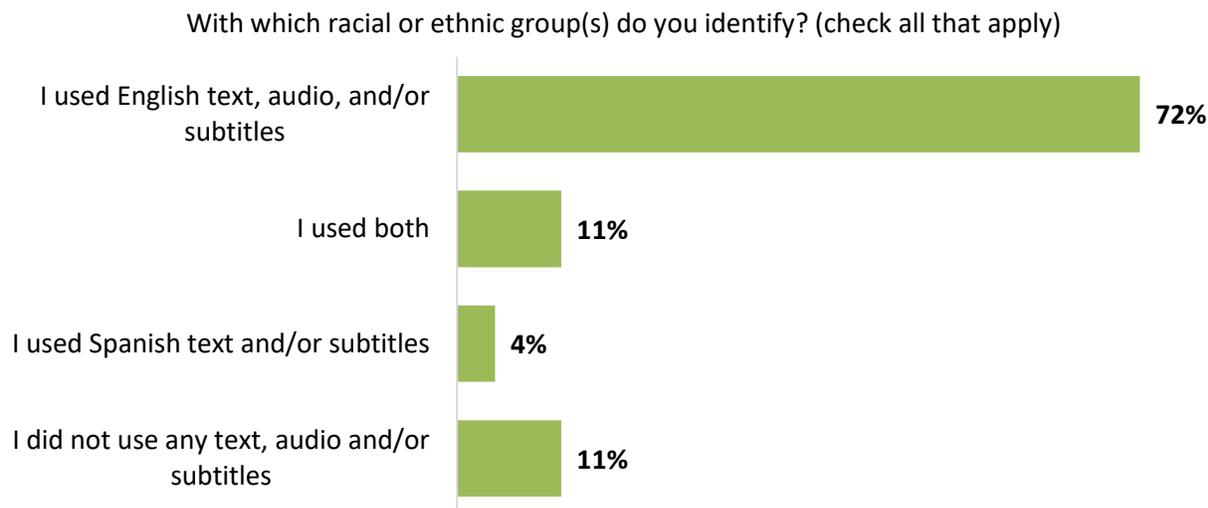
■ A lot ■ Somewhat ■ A little ■ Not at all

6.4 Visitors felt that including Spanish text and subtitles alongside the English labels made *Mission Future* feel inclusive and welcoming.

Throughout the exhibition all media was presented in both English and Spanish. The characters spoke in English, periodically Isabela and Lucas casually integrated Spanish phrases such as "cabeza dura" (pig-headed or stubborn) or "abuelita" (grandma), and all the videos include Spanish subtitles. Some of the interactive and social media components have an "automatic translation" feature for posts originally made in either language, while others had translations that were given visual weight equal to the English text. Visitors were asked on the survey whether or not they used any of the text and subtitles, and, if so, which languages they used. An open-ended follow-up question asked visitors how the presence of Spanish impacted their experience.

A small percentage of visitors that participated in the study were primarily Spanish speakers (7% of visitors reported they primarily spoke Spanish at home, see Section 4.3, a few more visitors were bilingual as indicated by the data about which text or labels they interacted with. Overall, 15% of visitors reported using Spanish text and subtitles, as shown in Figure 17 below. Almost all (6 out of 7) bilingual visitors shared that having Spanish text and captions available was either useful or appreciated, while English-only speakers felt that the translations either had no impact on them or made the space feel inclusive. See Table 7 for codes and example quotes.

Figure 17. *Visitors' responses for which language(s) they used in the exhibition (n=46)*

With which racial or ethnic group(s) do you identify? (check all that apply)

I used English text, audio, and/or subtitles	72%
I used both	11%
I used Spanish text and/or subtitles	4%
I did not use any text, audio and/or subtitles	11%

Table 7. *Responses to "How did the availability of Spanish text/subtitles impact your experience?" (n=24)*

Code	Percentage	Example quotes
Spanish text/subtitles were helpful and/or appreciated	38%	*"It was cool! Being bilingual I really appreciated it"* *"naturally gravitate to Spanish"* *"muy bueno!"*
Spanish inclusion had no impact on the visitors' experience	33%	*"I didn't use them, so not at all."* *"Not at all"*
Spanish text/subtitles made the exhibition feel inclusive	29%	*"I appreciated that they were there but didn't use them"* *"I like how accessible it is in Spanish."* *"felt very inclusive :)"*

6.5 The impact of the videos on visitor outcomes would benefit from further study.

The character videos contained much of the exhibition content, where characters talked about their values and Earth and space science. As discussed in Section 5.2, visitors rarely watched videos in their entirety, most commonly watching fragments of one or two of the character videos. The "Introductory Video" was watched by the most visitors, with 50% watching at least part of the video, and the least watched videos (Ava, Zoe, and AILI) were at least partially watched by fewer than 25% of visitors. Despite visitors appearing to not pay close attention to the videos, many still left the exhibit having met the content learning and attitude goals for the exhibition. Additionally, most visitors (71%) who watched some or all of the videos agreed that they made the exhibition feel relevant (Section 6).

Visitors were slightly more likely to report watching more videos in the experience recall activity, as compared to the tracking and timing observations, though the numbers are too small to statistically compare. It is possible that people were consciously listening to the videos after they are no longer looking at the screen or had walked away, or visitors may have absorbed the messages without needing to pay close attention as the videos played on loop. Exploratory analysis of relationships between how many videos visitors watched and their ratings on the learning and self-efficacy question were inconclusive. Further study should be done to understand what visitors pay attention to or internalize from watching or listening to the videos in *Mission Future*.

7. Conclusion

Mission Future: Arizona 2045 was an immersive exhibition that integrated authentic Earth and space science, imaginative storytelling, and hands-on activities to explore what central Arizona might be like in the year 2045. Visitors engaged with a possible future, that they learned about from characters representing different perspectives and ways of thinking. Their stories were presented across four rooms where visitors could interact with components representing the characters as well as hands-on and interactive experiences.

The summative evaluation focused on the impacts of the exhibition on Arizona Science Center visitors, in terms of what visitors learned from the exhibition and what features supported those outcomes. Additionally, the evaluation addressed who and how many people use the exhibition, along with understanding how they interact with the space. Data were collected using sweep rate observations, tracking and timing observations of visitors, an experience recall activity, and exit surveys. The following summary provides an overview of the main findings from this evaluation report, and a discussion of how aspects of the SEISE project contributed to these results.

Mission Future *was an exceptionally thoroughly used exhibition that reached a large percentage of Arizona Science Center visitors.*

Mission Future was designed for families with children ages 6 and older, and information was presented bilingually in English and Spanish. On average, visitors spent approximately 15 minutes in *Mission Future* and visited 9 of the 18 components, categorizing it as exceptionally thoroughly used from Serrell's (2016) metrics for exhibition use. Visitors were particularly drawn to the open-ended interactive elements in the Ranch House and R&D Lab; the most visited components were the "AR Sandbox Interactive" (87%, N=65), "Drone Interactive" (76%), and "Personal Spacecraft Interactive (76%). It was noted that most visitors had (59%) conversations related to the component or content with other group members in the Ranch House, and half of visitors 50% built or tested designs at the "Drone Interactive."

Mission Future is expected to reach over 174,000 visitors per year, or 71% of Arizona Science Center's annual visitation. Visitors to Arizona Science Center that participated in the study represented a wide range of ages, with most groups attending as multi-generational groups with children. Additionally, visitors were more likely to identify as women or girls. Finally, visitors mostly self-identified as white, English speakers of non-Hispanic, Latino, or Spanish origin.

Findings suggest that* Mission Future *achieved its intended outcomes of giving visitors a chance to learn about and practice future thinking and feel more confident in their abilities to participate in decision making about the future.

The primary goal for *Mission Future* was for public audiences to increase their understanding of Earth and space science and engineering, especially related to its societal context. Components prompted visitors to reflect on and share their own ideas, values, and priorities as they moved through the exhibition. Overall, visitors enjoyed *Mission Future*, and many felt that the exhibition impacted their understandings and their perceptions about their own abilities. Approximately half of visitors reported that the exhibition had a large impact on their understandings of the role individuals and communities take in shaping the future, as well as opportunities around studying Earth and space science. Some visitors said that the exhibition had a large impact on their self-efficacy around learning about or using STEM to face challenges in the future.

Design strategies utilized in* Mission Future *appear to be effective at supporting visitor outcomes; however, it was unclear how the videos impacted visitors and further studies should be done.

The exhibition team was interested in understanding how the design strategies utilized in the exhibition impacted visitor outcomes, particularly through Spanish language accessibility, incorporating storytelling through character videos, and activities that prompted choices and challenges. Bilingual text and subtitles were helpful for Spanish speakers, and even many non-Spanish speakers felt they made the exhibition feel inclusive. Overall, only a few visitors (15%) that participated in the evaluation used the Spanish text and/or subtitles, either alone or with the English versions. However, the inclusion of Spanish text made the exhibition felt inclusive or accessible regardless of visitors' language preference. Spanish speakers also appreciated having bilingual text or felt that it was helpful, and some English-only speakers also reported that bilingual labels did not take away from their experience. Most visitors reported that the interactive activities, particularly the AR sandbox, made the exhibit feel connected to their lives or experiences. The impacts on visitors of watching videos were inconclusive, with little to no correlation between what visitors reported they learned and how many videos they watched.

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Appendix A: Instruments

The **Tracking & Timing Protocol** included directions for the data collector and started with metadata about the subjects in case the visitor declined to participate in the survey or to help match the observation to the survey. The observation form was digital, recording data through an online survey.

Tracking & Timing Observations

Track one person in the group ("focus visitor") and their use of the exhibit. The focus is the first visitor approximately aged 8+ that stops at an exhibit.

Group Composition

Focus Visitor (approximate age and apparent gender): _____

Other group members (total #, with approximate age and genders): _____

Visitor Observations

Qualtrics will record visitor dwell time for each exhibit area (e.g. Ranch House). **Data collector** will record engagement behaviors primarily for the focus visitor, noting group members' behaviors when interacting with or near the focus.

Exhibit	Behaviors

Entrance	o Skipped Intro video
	o Watched partial video (note which portions they saw)
	    o Overview
	    o Isabella
	    o Lucas
	    o Zoe
	    o Ava
	    o Aili
	o Watched Entire Introductory Video

Ranch House	o Watched *Meet Isabela and Lucas* (Video)
	    o Partial
	    o Complete (~2 min)
	o Look at the view through ranch house window
	o Explore Isabela's desk
	    o Touch artifacts
	o View Satellite and aerial images
	o Explore Lucas' desk
	    o Touch artifacts
	o Uses Plans for the Ranch
	    o Reads labels
	    o Moves magnetic wall and tiles
	o Uses Landforms and water (Topobox)
	    o Reads labels
	    o Moves sand around Topobox

	o Views Social Media Feed o Had dialogue about the exhibit o Uses component(s) with others o Watched others interact with the exhibit

R&D Lab	o Watched Ava and Zoe Video
	    o Partial
	    o Complete (~2 min)
	o Looked through the lab window
	o Explored Ava's desk
	    o Touched artifacts
	o Initiated Drone Prototyping Activity
	    o Built drone
	    o Tested drone in wind tube
	    o Retried design
	o Views Ava and Zoe's Social Media
	o Initiated Space Station Activity
	o Watched Hyperwall video
	o Explore space craft prototype
	    o Touch artifacts
	o Had dialogue about the exhibit
	o Watched others interact with the exhibit

AILI's Hub	o Watch AILI Video
	    o Partial
	    o Complete (~2 min)
	o Answers quiz questions
	    o How many questions answered? _____
	o Share opinions in Final Thoughts Interactive
	o Touched artifacts
	o Had dialogue about the exhibit
	o Watched others interact with the exhibit

Other Notes (e.g., exhibit malfunctioning, observable confusion, interruptions of activity, conversations, etc.)

Card Sort Protocol

Before you take the survey, we want to know what you did while you were in the exhibit. I will give you some cards with images of different areas of the exhibit and ask you to sort them into different groups.

Which of these videos did you watch?

	Watched some	Watched all	Did not watch	Not sure
Intro Theater				
Isabela & Lucas				
Ava				
Zoe				
AILI				

Which areas did you visit?

		Visited	Did not visit	Not sure
Ranch House	**Isabella's desk / window**			
	Map wall			
	Magnet board			
	Lucas' desk / social media			
	Sandbox			
R&D Lab	**Ava's desk / social media**			
	Lab Window			
	Air tubes / Drone			
	Space station			
	Hyperwall			
	Spacecraft			
AILI's Hub	**AILI's quiz**			

Mission Future Exhibit Survey (In Spanish)

Sus respuestas a esta encuesta nos ayudarán a comprender los impactos de la exposición Mission Future: Arizona 2045 y mejorar nuestras exposiciones para los visitantes futuros. La participación es voluntaria y sus respuestas serán anónimas. ¡Gracias!

¿Que tan <u>agradable</u> fue la exhibición?

☐ No fue agradable ☐ Un poco agradable ☐ Agradable ☐ Muy agradable

2. Hoy, en esta exposición, ¿con qué frecuencia usted o su grupo se encontraron con los siguientes problemas?

	Nunca	Casi nunca	A veces	A menudo
Yo/ tuve /nosotros tuvimos consultas o nos sentimos confundidos al usar la exposición.	☐	☐	☐	☐
Yo/ tuve /nosotros tuvimos dificultades para comprender el contenido de la exposición.	☐	☐	☐	☐
Yo/ tuve /nosotros tuvimos dificultades para usar la exposición por nuestra cuenta.	☐	☐	☐	☐
Yo/ tuve /nosotros tuvimos dificultades para usar la exposición con otras personas.	☐	☐	☐	☐

3. Explique los problemas o las dificultades que usted o su grupo tuvieron:

4. La exposición tiene textos y videos tanto en inglés como en español. Seleccione las opciones que haya utilizado:

- ☐ Utilicé los textos o los subtítulos en español
- ☐ Utilicé los textos, el audio o los subtítulos en inglés
- ☐ I did not use any text, audio, and/or subtitles

5. ¿Cómo impactó en su experiencia la posibilidad de acceder a textos o subtítulos en español?

6. ¿Alguno de los siguientes elementos lo hizo sentir que la exposición estaba relacionada con <u>su vida o sus experiencias</u>?

	Sí	No	No estoy seguro/a	No lo utilicé
Los videos de Isabela, Lucas, Ava, Zoe o AILI	□	□	□	□
Las estaciones de trabajo de Isabela, Lucas o Ava	□	□	□	□
Caja de arena	□	□	□	□
Mapa mural magnético	□	□	□	□
Tubos de aire	□	□	□	□
Estación espacial	□	□	□	□

7. Indique en qué medida la exposición aumentó su percepción respecto de lo siguiente:

	Para nada	Un poco	De alguna manera	Mucho
Usted es alguien que puede aprender o participar en investigaciones y descubrimientos actuales en la ciencia espacial y de la Tierra.	□	□	□	□
Usted es alguien que piensa en el futuro y puede participar en la construcción de nuestro futuro.	□	□	□	□
Usted es alguien motivado a darle seguimiento a sus inquietudes o preguntas sobre la sustentabilidad o el cambio climático.	□	□	□	□

8. Indique en qué medida la exposición aumentó su entendimiento de lo siguiente:

	Para nada	Un poco	De alguna manera	Mucho
Las personas piensan en el futuro de distintas maneras y esas miradas diferentes son importantes de cara al futuro.	□	□	□	□
Las personas toman decisiones que reflejan cómo piensan respecto del futuro.	□	□	□	□
Nuestros valores influencian cómo abordamos los desafíos y desarrollamos soluciones.	□	□	□	□
Las comunidades pueden trabajar juntas para actuar respecto a los problemas que les interesan, como la sustentabilidad y el cambio climático.	□	□	□	□

9. Indique en qué medida la exposición aumentó su entendimiento de lo siguiente:

	Para nada	Un poco	De alguna manera	Mucho
En el futuro, Arizona experimentará calor extremo, sequía y otros efectos del cambio climático.	☐	☐	☐	☐
Estudiar la Tierra y el espacio nos ayuda a comprender el universo.	☐	☐	☐	☐
Hay muchas oportunidades laborales en áreas relacionadas con la ciencia del espacio y de la Tierra.	☐	☐	☐	☐

10. ¿Hay algo más que quisiera compartir sobre la exposición o su experiencia?

Cuéntenos sobre usted y su grupo. Le solicitamos esta información para comprender las experiencias de todos los visitantes y cómo las personas con diversas identidades pueden percibir la exposición de formas distintas.

¿Cuál es su edad? _____

¿Cuál es su identidad de género? _____

¿Tiene usted o alguna persona que lo haya acompañado una discapacidad permanente o temporal?
- Sí
- No
- Prefiero no contestar

¿Qué idioma(s) predomina(n) en su hogar? (Seleccione todas las opciones que correspondan).
- Inglés
- Español
- Otro(s): _____

¿Eres de origen hispano, latino o español?
- No, no soy de origen hispano, latino o español.
- Sí, mexicano, mexicano americano, chicano
- Sí, otro origen hispano, latino o español
  Por favor especifica
  _____

¿Con cuál(es) grupo(s) racial(es) o étnico(s) se identifica? (Seleccione todas las opciones que correspondan).
- Indio Americano o nativo de Alaska
- Asiático/a Americano/a
- Negro/a o Afroamericano/a
- Hispano/a o Latino/a/x
- Hawaiano nativo/a u otro isleño del Pacífico
- Blanco
- Prefiero autodescribirme:_____
- Prefiero no contestar

Sin incluirse a usted mismo/a, ¿cuáles son las edades y los géneros de los otros miembros del grupo?

Género	Edad		Género	Edad		Género	Edad		Género	Edad

¡Gracias por participar en nuestra encuesta!

Mission Future Exhibit Survey (In English)

Your responses to this survey help us understand the impacts of the Mission Future: Arizona 2045 exhibit and improve our exhibits for future visitors. Participation is voluntary and all responses are anonymous. Thank you!

1. **How enjoyable was this exhibit?**

   ☐ Not at all enjoyable   ☐ A little enjoyable   ☐ Enjoyable   ☐ Very enjoyable

2. **Today in this exhibition, how often did you or your group encounter the following issues?**

	Never	Rarely	Sometimes	Often
I / we had questions or confusion when using the exhibit.	☐	☐	☐	☐
I / we had difficulty understanding exhibit content.	☐	☐	☐	☐
I / we had difficulty using the exhibit alone.	☐	☐	☐	☐
I / we had difficulty using the exhibit with others.	☐	☐	☐	☐

3. **Please explain any issues or difficulties you or your group had:**

4. **The exhibit has text and videos in both English and Spanish, please select which one(s) you used:**

   ☐ I used Spanish text and/or subtitles
   ☐ I used English text, audio, and/or subtitles
   ☐ I did not use any text, audio, and/or subtitles

5. **How did the availability of Spanish text/subtitles impact your experience?**

6. Did any of the following elements make you feel that the exhibit <u>connected to your life or experiences</u>?

	Yes	No	I'm not sure	Did not use
The Isabela, Lucas, Ava, Zoe, and/or AILI videos	☐	☐	☐	☐
Isabela, Lucas, and/or Ava's work stations	☐	☐	☐	☐
Sandbox	☐	☐	☐	☐
Magnetic map wall	☐	☐	☐	☐
Air tubes	☐	☐	☐	☐
Space station	☐	☐	☐	☐

7. To what extent did the exhibit <u>increase your feeling</u> that you are…

	Not at all	A little	Somewhat	A lot
…someone who can learn about and/or participate in current Earth and space science research and discovery.	☐	☐	☐	☐
…someone who thinks about the future and can participate in shaping it.	☐	☐	☐	☐
…motivated to follow up on my own questions or concerns about sustainability and/or climate change.	☐	☐	☐	☐

8. To what extent did the exhibit <u>increase your understanding</u> that:

	Not at all	A little	Somewhat	A lot
People think about the future in different ways, and diverse views are important for the future.	☐	☐	☐	☐
People make choices that reflect how they think about the future.	☐	☐	☐	☐
Our values influence how we approach challenges and develop solutions.	☐	☐	☐	☐
Communities can work together to take action on issues they care about, like sustainability and climate change.	☐	☐	☐	☐

9. **To what extent did the exhibit <u>increase your understanding</u> that:**

	Not at all	A little	Somewhat	A lot
In the future, Arizona will experience extreme heat, drought, and other effects of climate change.	☐	☐	☐	☐
Studying Earth and space helps us understand the universe.	☐	☐	☐	☐
There are many career opportunities in fields related to Earth and space science.	☐	☐	☐	☐

10. **Is there anything else about the exhibit or your experience that you would like to share?**

Please tell us about yourself and your group. We ask for this information in order to understand the experiences of all visitors, and how people with various identities experience an exhibit in different ways.

What is your age? _____

Do you identify as having a permanent or temporary disability?
- Yes
- No
- Prefer not to say

What is your gender identity?
_____

What language(s) do you primarily speak at home?
- English
- Spanish
- Other: _____

Are you of Hispanic, Latino, or Spanish origin?
- No, I am not of Hispanic, Latino, or Spanish origin
- Yes, I am Mexican, Mexican-American, or Chicano/a
- Yes, I am of a different Hispanic, Latino, or Spanish origin (Please specify: _____)

With which racial or ethnic group(s) do you identify?
- American Indian or Alaskan Native
- Asian or Asian American
- Black or African American
- Hispanic or Latinx
- Native Hawaiian or Pacific Islander
- White or Caucasian
- Prefer to self-describe: _____
- Prefer not to say

**Not including yourself, what are the ages and genders of your other group members?**

Gender	Age	Gender	Age	Gender	Age	Gender	Age

Thank you for being in our study!

Exhibit Sweep Counts

Walk through the exhibition and tally the number of adults and children in each area. Take a few minutes to note where visitors are (spread out or clustered as specific exhibits). Note any issues or concerns, such as:

- **Wayfinding/flow:** Crowding, bottlenecks, exhibits not used, use of entry & exit points
- **Usability:** Confusion, frustration, or questions about what to do or how to get started at exhibits
- **Exhibit misuse:** Misuse & abuse of exhibits, usage causing exhibit breakage or visitor injury
- **Broken exhibits:** Areas that need repair or attention
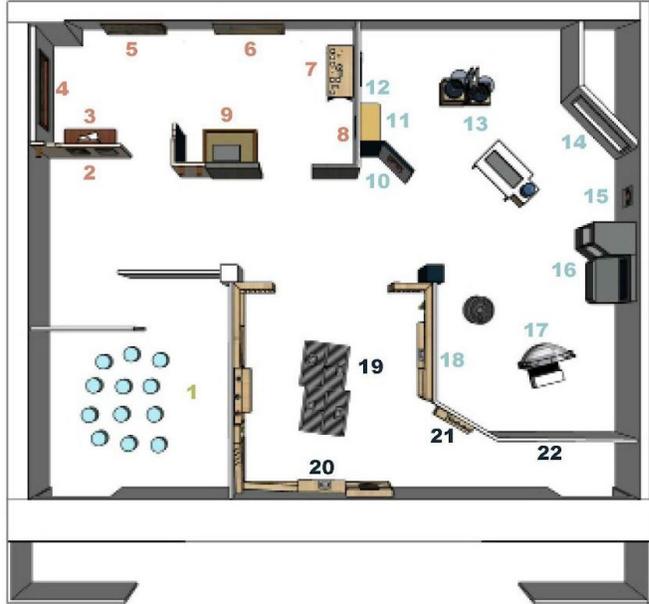
Start Time: _____   End Time: _____

	Tally Adults	**Tally Children**	**Generally, where are visitors in the space? Note any issues or concerns**
Intro Theater (1)	Total _____	Total _____	❐ Spread out evenly <u>or</u> ❐ clustered around:_____
Ranch House (2-9)	Total _____	Total _____	❐ Spread out evenly <u>or</u> ❐ clustered around:_____
R&D Labs (10-18)	Total _____	Total _____	❐ Spread out evenly <u>or</u> ❐ clustered around:_____
AILI's Hub (19-22)	Total _____	Total _____	❐ Spread out evenly <u>or</u> ❐ clustered around:_____

Start Time: _____   End Time: _____

After sweep count, stand outside the exhibit and tally all visitors entering the exhibit in a 20 min period.

Adults:

Children:

Total entering: _____

Appendix B: Additional Data

The figure below displays the data used for the exhibition heatmap in Section 8.2, Figure 9. Displayed in Figure B1 is the percentage of visitors who used each component, using data from the tracking and timing observations and the experience recall activity. Components were part of four rooms, which are displayed in the figure through symbols after each exhibit names and through color coded data bars.

Figure B1. *Percentage of visitors who used each component, includes both observed and self-report data (N=65).*