MISSION FUTURE

An Experiential Future

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The AR sandbox is the most popular component of the exhibition and the one that most visitors find relevant to their own experiences.

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"Let's go on a journey to the year 2045. What will the future be like? That's for us to decide..."

These are the opening lines of a video that transports Arizona Science Center visitors to one possible future. As they soon learn, their guide is a simulated human, and they are headed to a future where Earth is hotter and people can live in the harsh environment of space.

Mission Future: Arizona 2045 is a 2,500-square-foot exhibition that integrates an immersive scenic environment, interactive components, imaginative storytelling, and authentic science to explore what life might be like in Arizona around 20 years from now. Installed in February 2023 for display through the end of 2025, the exhibition is expected to engage around 174,000 people (71 percent of science center visitors) each year in learning about Earth and space science and futures thinking, for a total of around 522,000 people.

In this article, we discuss three approaches *Mission Future* uses to engage visitors in learning about climate change, space exploration, and equitable futures: theory from the field of futures studies; methods of experiential futures combined with those of science center exhibitions; and practices for culturally sustaining learning about STEM (science, technology, engineering, and math). Based on data from summative evaluation and exploratory research, we conclude that the exhibition is successful in supporting visitors' futures capabilities and STEM content learning and suggest ways that other exhibitions might be informed by design strategies used in *Mission Future*.

BACKGROUND

Mission Future was inspired by *Seven Siblings from the Future*, a larger exhibition created by Heureka, the Finnish Science Centre, in 2017. The exhibition was also adapted for an Australian context and displayed at MOD., a future-focused museum of science, art, and innovation, from 2020 to 2021.[1] In *Seven Siblings*, museum visitors explore a version of what the world might be like in the future, meeting characters who have different values and ideas about what is most important. A Heureka planning document explains that *Seven Siblings* was not meant to "create a fantasy about the future," but to consider "the real present-day options through which the future will be created."[2] The *Mission Future* team adopted this purpose from *Seven Siblings*, as well as many of the design strategies we discuss here. We altered the storyline, characters, and interactive components to create a smaller exhibition focused on Earth and space science that was responsive to our Arizona context.

Mission Future was led by the Center for Innovation in Informal STEM Learning (CIISL) at Arizona State University, in partnership with NASA's Science Activation program and the Arizona Science Center. The team also included members of the National Informal STEM Education (NISE) Network. The Museum of Science, Boston, served as our external evaluators, bringing experience with previous CIISL and NISE Network projects and expertise in contextually and culturally responsive evaluation.

GOALS AND DESIGN STRATEGIES

Our team had three overarching goals for *Mission Future*:

1. *Encourage futures thinking*. In developing our learning objectives, we drew on key concepts from futures studies, as well as prior work engaging museum visitors in learning about climate change and space exploration.

2. *Create an experience* of *the future, not just* about *the future*. Here we drew on methods for experiential futures, including world-building and storytelling.

3. *Offer a culturally sustaining learning experience for Hispanic/Latinx visitors.* To this end, we created opportunities for visitors to connect their personal identities with the use of STEM and futures thinking to create a more equitable future.

Theory and Methods from Futures Studies

The interdisciplinary field of futures studies is based on three key ideas:

1. *The future is not predetermined.* There are many possible futures.

2. *The future is not predictable.* There are far too many interrelated variables to figure out which future will actually happen.

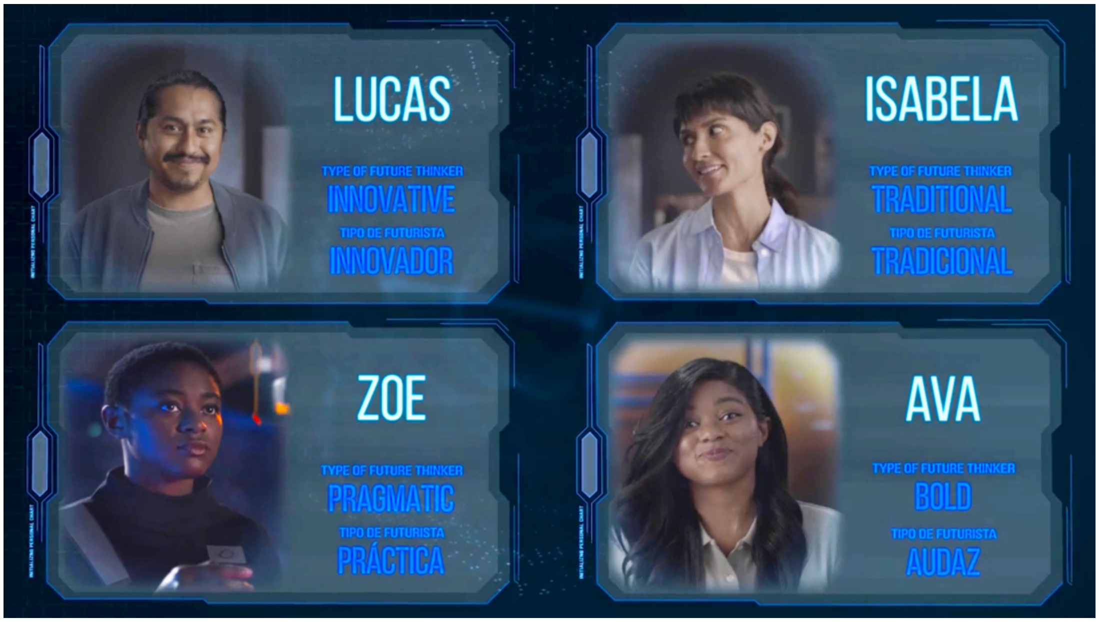
3. *The future can be influenced by our choices in the present.* People today have agency to shape the future in ways large and small, individually and collectively.[3]

An important implication of these three ideas is that we have the opportunity and responsibility to think about and work toward our preferred future.[4] Multiple perspectives are important to shaping the future, as different people have different ways of thinking about alternative futures.[5]

To bring these ideas to life, *Mission Future* uses an approach called *experiential futures*. This method creates physical spaces and objects through which people can experience a plausible future world and imagine themselves within it.[6] Experiential futures can help bridge abstract ideas of the future and people's embodied experience of the present.[7] As such, they require a wide range of perspectives and data to craft.[8] World-building and storytelling are crucial to creating an experience that people can understand and relate to while also exploring a scenario's greater context and implications.[9]

Fig. 1.

In the exhibition's introductory video, visitors meet four characters that model different kinds of futures thinking.



ARIZONA STATE UNIVERSITY

Learning about Futures

Visitor learning objectives for *Mission Future* were informed by the field of futures studies, as well as the team's previous work creating informal STEM learning materials about Earth and space science.[10] As a result of visiting *Mission Future*, we intended learners to:

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

Together, these learning objectives represent a foundation for futures capabilities, especially for issues such as climate change, where STEM has a role to play in developing solutions but cannot provide all the answers. Many of the exhibition's key ideas are explicitly presented to visitors in the antechamber, where an Artificial Intelligence Learning Investigator (AILI) welcomes visitors and prepares them to visit Arizona in the year 2045.[11] AILI introduces four human characters and explains that each one represents a different type of future thinker:[12]

- Lucas is *innovative*; he is excited about using new technologies to create a more sustainable future.
- Isabela is *traditional*; she worries about how the future may affect the cultural and natural environment she values.
- Zoe is *pragmatic*; she is focused on figuring out what is most likely to happen and being prepared for it.
- Ava is *bold*; she can imagine many possibilities for the future, even living in space (fig. 1).

Once visitors have met the characters, AILI says, "It's time to step into the future! Come and help the people of 2045. Their future is in *your* hands!"

Experiencing Alternative Futures

Our second goal for *Mission Future* was to create an alternative future that visitors could experience, reflect on, and discuss. To do this, we drew on methods for experiential futures and practices for creating interactive science center exhibitions, namely:

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Fig. 2.

A visitor explores Isabela's study, where scenic design, props, and a high-definition video establish the context and the character's interests.

storytelling through videos; world-building through scenic elements, media, and props; and hands-on components.

When visitors enter the exhibition, they meet Isabela and Lucas as life-size videos. The siblings explain that they are trying to decide what is best for their family ranch, which is experiencing extreme heat and drought. They invite visitors into their home to learn more about the challenges facing the ranch and possible solutions. Visitors can explore Isabela's study, where her interests in natural and cultural history are revealed through genuine specimens (on loan from ASU's Natural History Collections) and imagined future artifacts (such as tools for monitoring air quality and biodiversity) (fig. 2). Lucas's room similarly includes real artifacts on his desk (green building materials) and imagined ones (a social media feed featuring not-yet-invented reaction emojis).

Next, visitors enter an R&D lab at a commercial space company, where they meet Ava (on Earth) and her sister Zoe (communicating from a space station) (fig. 3). The sisters are interns who are trying to decide what career paths to follow. To create the visual world of the space station, we consulted experts at ASU who are developing a commercial space station for launch within a decade. Our film team used a game engine, generative AI, and human creativity – and common sense – to create digital backgrounds for the actor who plays Zoe.

To sustain visitors' sense of immersion in a future world, the exhibition does not use instructional labels or interpretive signage. Instead, scenic elements and props offer clues and contextual information that help visitors successfully navigate the experience. For example, one hands-on

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Fig. 3.

View of the R&D lab, where visitors meet the characters Ava and Zoe.

Fig. 4. Visitors can find hints for ways to build their drones by looking at Ava's sketches and notes, which are printed on the work surface.

NISE NETWORK

exhibit encourages visitors to design, build, and test prototype drones for exploring other planets using Ava's notes and sketches for guidance and inspiration (fig. 4).

Envisioning Equitable Futures

In creating this experiential future, we wanted to create a culturally sustaining learning environment for the Hispanic/Latinx communities that represent 32.5 percent of Arizona's population.[13] We present a future where there is broader participation in STEM and decision-making as part of our vision for a more equitable society. We also made sure the exhibition includes opportunities for visitors to connect their own identities and experiences to that vision so that they might see the ways we all can work toward the future we want to create.

Isabela and Lucas reflect Hispanic/Latinx cultural values, such as *familismo*, and use vernacular Spanish. Isabela affectionately calls her brother *cabeza dura* because of his fascination with new technologies, and Lucas says Isabela has "old-timey ways, like an *abuelita*," but they are committed to working together. They model a proactive and collective process of working toward a preferred future. Isabela invites visitors into the house – and the siblings' conversation – by saying, "Maybe you can figure out what's best for the future of our ranch. Is there a way for us both to be right?"

Inside, there is a magnetic board where visitors can help Lucas and Isabela plan for the ranch, taking into consideration the characters' priorities and their own (fig. 5). There is also an augmented reality (AR)

Fig. 5.

Visitors help Isabela and Lucas plan the future of their ranch.

sandbox, which projects topographic lines and water flow onto sand forms that visitors create (intro image). In the context of the story, the AR sandbox is a tool that allows Isabela and Lucas to understand the relationship between changes to the land and the resulting water distribution. These hands-on components are intended to help visitors think about the relationship of STEM, society, and human values, and to contribute their own ideas.

Before visitors exit the exhibition, AILI encourages them to take a quiz to discover their own future orientation and to see how common their type is among visitors overall.[14] This is an invitation for visitors to develop an identity as a future thinker who can influence what the world will be like for the next generation.

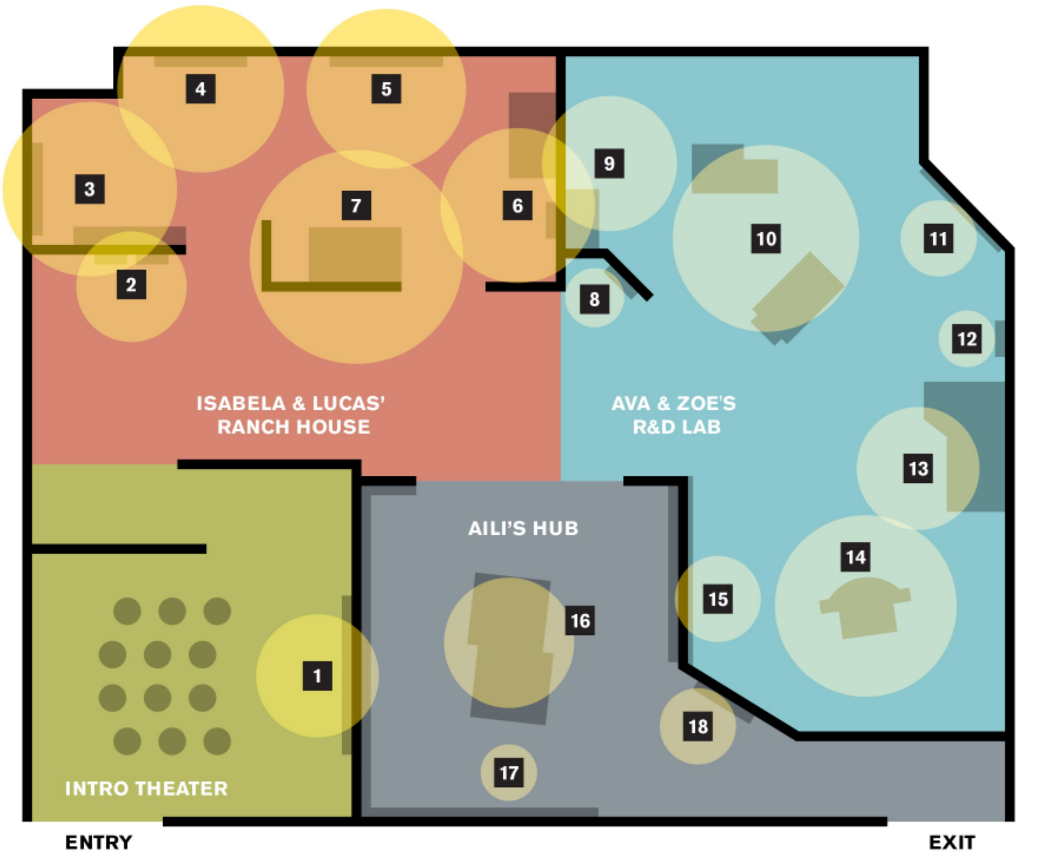
SUMMATIVE EVALUATION

The summative evaluation for *Mission Future* focused on gathering data to understand who used the exhibition, how they used it, and what they learned.[15] We also conducted exploratory research that examined possible connections between learning outcomes and exhibition design. Since the exhibition is bilingual, evaluation instruments were available in English and Spanish. Data collection involved two data collectors – one fluent in Spanish – and primarily took place over three days in March 2023. Through continuous random sampling, exhibition visitors were either observed using a tracking-and-timing protocol or invited to participate in a recall activity to understand which exhibition components they visited. Participants were then invited to fill out an exit survey.

Findings suggest that visitors thoroughly used *Mission Future*. On average, visitors spent about 15 minutes in the exhibition and visited 9 of the 18 components. These figures compare favorably with a majority of exhibitions studied by exhibit and evaluation consultant Beverly Serrell, who has established two metrics to compare visitors' use of exhibitions. Serrell's first metric is the sweep rate index (SRI), which examines how quickly visitors move through the exhibition. SRI is calculated by dividing the exhibition's square footage by average total time spent in the space. Serrell's second metric is percent diligent visitors (%DV), which characterizes how much of an exhibition visitors generally use. This statistic is the proportion of visitors who went to at least half of the available components in the exhibition. Using these metrics, *Mission Future* had a 150 SRI and 57 %DV, putting it in Serrell's category of "exceptionally thoroughly used exhibitions."[16]

In other words, compared to other exhibitions, visitors spent a lot of time in *Mission Future* and engaged with many of its components. The most frequently visited components were the AR sandbox, the drone station (pictured in fig. 3), and a pretend personal spacecraft, with over 74 percent of visitors stopping to interact with each one. The videos were used less than the open-ended, hands-on components, with 74 percent of visitors watching at least one partial video and 26 percent watching at least one complete video (fig. 6).

Almost all visitors (93 percent) reported that they increased their understanding of content related to societal aspects of Earth and space science at least "a little" as a result of visiting *Mission Future*. More specifically,



Percent of Visitors Using Components

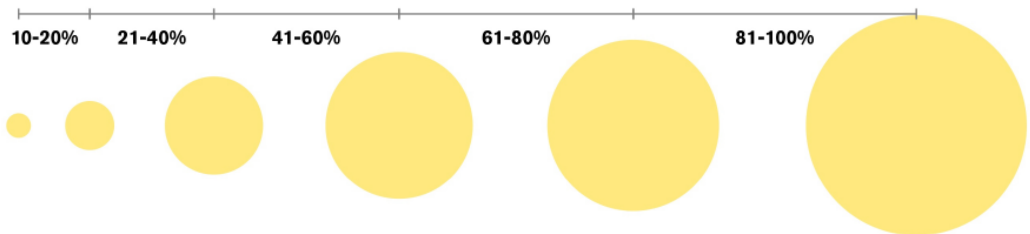


Fig. 6.

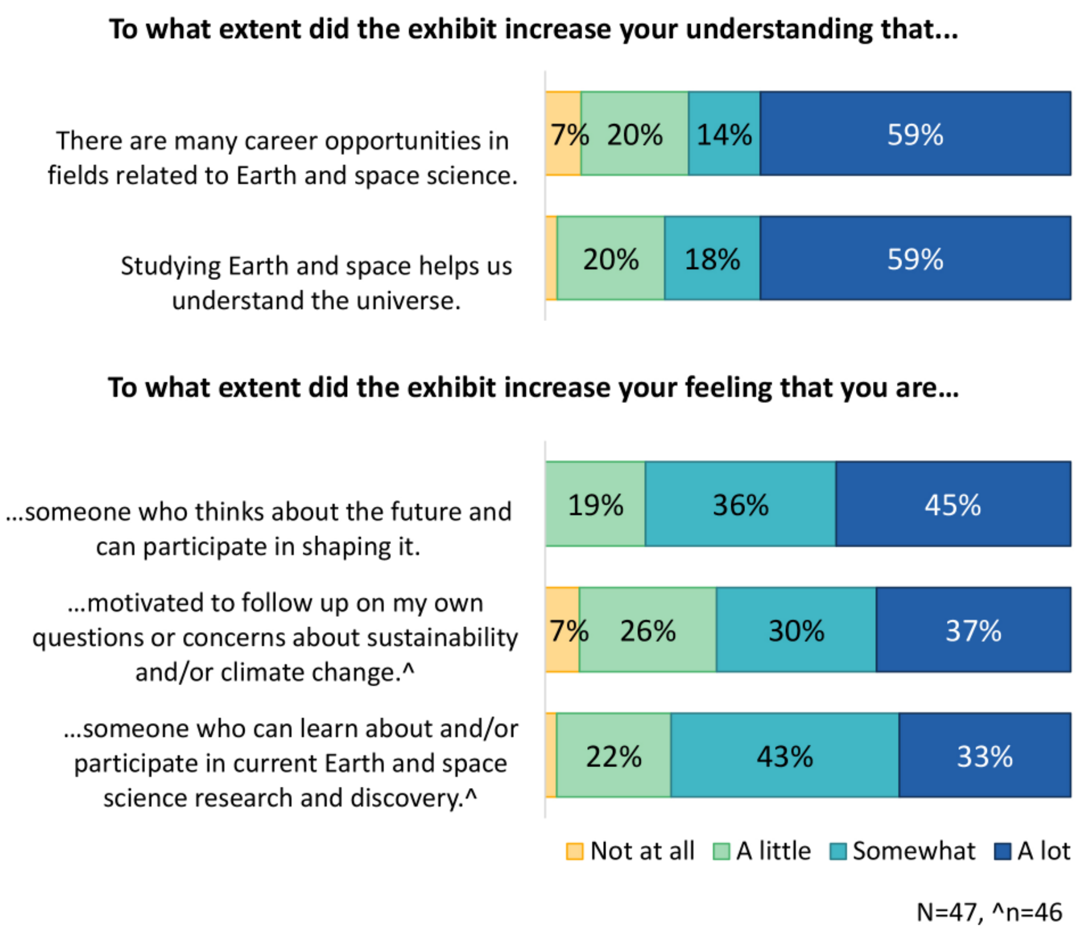
Floor plan indicating how frequently visitors used different exhibition elements.

Mission Future Exhibition Components

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

Fig. 7.

Visitors' responses to survey questions about their understanding and confidence related to the exhibition's learning objectives.



59 percent reported that the exhibition increased their understanding "a lot" about how Earth and space science helps humans understand the universe and about the many career opportunities in the field. Similarly, almost all visitors (93 percent) reported that *Mission Future* strengthened their self-efficacy at least "a little" for our indicators related to learning about and participating in shaping the future. The exhibition helped some visitors feel "a lot" more confident in their ability to shape the future (45 percent), to learn more about Earth and space science (37 percent), and to follow up on their concerns about climate change (37 percent) (fig. 7).

In our exploratory research, we were interested in how our design strategies impacted visitors' experiences in the exhibition, particularly the videos, interactive components, and bilingual labels. Visitors reported that the interactive elements made the exhibition feel relevant, particularly the AR sandbox, where 84 percent of people who used it felt that it connected to their life or prior experiences. Most of the visitors (71 percent) who watched some or all of the videos agreed that they also made the exhibition feel relevant; overall, however, the impacts of the videos on visitor learning were inconclusive. Although not many bilingual or primarily Spanish-speaking visitors participated in the study (15 percent), all bilingual visitors who responded to this part of the survey reported that having Spanish text and captions available was useful or appreciated.

OPPORTUNITIES FOR FUTURE STUDY

Although our evaluation found that the videos are not as well-used as other elements of *Mission Future*, we feel they are important in establishing the idea that the future will be actively created by people. Characters can also expose visitors to new ideas and create opportunities for reflection and discussion.[17] We think visitors might spend more time with the videos if the clips are shorter, so we are planning to edit the videos to present the key messages and storylines more concisely.

Additionally, due to resource constraints for data collection, we were unable to directly connect specific design strategies to visitor outcomes. A richer, qualitative study could further explore how different exhibition elements affect visitors' experiences. Another line of inquiry would be to investigate the role of cultural relevancy and emotional engagement with the exhibition and how that impacts learning. A final possibility would be to examine the social interactions that the exhibition fosters to understand how these influence outcomes.

CONCLUSIONS AND IMPLICATIONS FOR THE FIELD

Mission Future has several widely applicable characteristics that Serrell associates with long dwell times and diligent use: a coherent exhibition concept with well-integrated learning experiences and a small size with carefully selected components.[18] Moreover, our findings suggest that the design of the exhibition – including the integration of key concepts from future studies, methods for creating experiential futures, and practices for culturally sustaining learning environments – contributed to visitors' learning outcomes. Other exhibitions aiming to support visitors' futures capabilities or to explore the relationship of STEM, society, and human values should consider integrating similar strategies.

Based on our experience with this and other projects, we offer these suggestions for colleagues seeking to create exhibitions that support learning about the future or about complex socio-scientific topics:

1. *Use stories to create connections to new places and ideas.* Stories orient visitors to a future world, introduce some of its challenges and potential solutions, and provide an opportunity to consider different viewpoints. Allow characters to invite visitors in and engage their emotions.

2. *Build a world that invites exploration.* Scenic elements, videos, media, and props create the sense of a real place for characters to live and work. Include familiar elements that visitors can immediately understand as well as unfamiliar ones that point to ways the future might be different.

3. *Create a layered and integrated experience.* Appealing "anchor" interactives can be surrounded by hands-on components, media, and scenic elements that offer complementary content and activities. Provide many ways of exploring the exhibition's themes that extend and reinforce one another.

4. *Offer opportunities for conversation.* Hands-on components and videos can encourage visitors to reflect and talk with others. Make space for meaningful dialogue about our shared future.

Mission Future has made us confident that children and adults can engage with futures thinking and STEM together in an exhibition environment. This project suggests strategies that other science centers and museums can use to support visitor learning as one step toward a future that is more equitable, sustainable, and inclusive for everyone.

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Mission Future *was inspired by the exhibition* Seven Siblings from the Future *created by Heureka, the Finnish Science Centre, with support from the Independence Fund of Finland (SITRA).*

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10 "Earth & Space Learning and Content Frameworks," NISE Network, 2021, https://www.nisenet.org/earth-space-frameworks.

11 For an overview showing excerpts of exhibition media, as well as visitors using the interactive components, see NISE Network, "Mission Future: Arizona 2045 Exhibition," *vimeo*, 2:28, March 22, 2023, https://vimeo.com/810705790.

12 Adapted from Lepistö, Kahlos, and Väätänen, "7 Siblings from the Future: Exhibition Concept," 22–23.

13 U.S. Census Bureau, "Quick Facts: Maricopa County, Arizona," July 2022, https://www.census.gov/quickfacts/fact/table/maricopacountyarizona,AZ/PST045222.

14 The quiz is for learning purposes and is not a validated scale, but it is still interesting to see the distribution of types among science center visitors: approximately 40 percent traditional, 20 percent innovative, 20 percent bold, and 20 percent practical.

15 Allison Anderson, Sonya Harvey-Justiniano, and Elizabeth Kunz Kollmann, "Mission Future: Arizona 2045 Exhibition Summative Evaluation," NISE Network, 2024, https://www.nisenet.org/catalog/summative-evaluation-mission-future-exhibition.

16 Beverly Serrell, "The Aggregation of Tracking-and-Timing Visitor-Use Data of Museum Exhibitions for Benchmarks of 'Thorough Use,'" *Visitor Studies* 23, no. 1 (April 2020): 1–17.

17 We have found this with other story-based projects; see Rae Ostman, Peter Nagy, Areej Mawasi, Ed Finn, and Ruth Wylie, "Exploring Responsible Research and Innovation in Museums Through Hands-On Activities," *Curator: The Museum Journal* 65 no. 2 (November, 2022): 1–29, https://doi.org/10.1111/cura.12530; and Stephanie Long and Rae Ostman, "Using Theatre and Film to Engage the Public in Nanotechnology," in *Little by Little: Expansions of Nanoscience and Emerging Technologies*, ed. H. van Lente et al. (Heidelberg, Germany: Akademische Verlagsgesellschaft/IOS Press, 2012), 59–64.

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