



**Museum Visitor Studies, Evaluation & Audience Research**

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# **Exhibition Evaluation**

**Front-end Evaluation**

***Explore: Blue Planet • Red Planet* Exhibition**

*Prepared for the*  
**Museum of Science and Industry**  
**Chicago, IL**

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# EXECUTIVE SUMMARY

This report presents the findings from a front-end evaluation conducted by Randi Korn & Associates, Inc. (RK&A), of *Explore: Blue Planet•Red Planet*, an exhibition being developed by the Museum of Science and Industry (MSI) in Chicago, Illinois. The evaluation was undertaken to help MSI staff find common ground between the proposed content and interpretation of the exhibition and potential visitors. Data were collected in May 2008 from drop-in visitors at MSI and consist of 35 in-depth interviews with 105 people.

**Only selected highlights of the study are included in this summary. Please consult the body of the report for a detailed account of the findings.**

## OVERALL PERCEPTIONS OF EXPLORATION

- ◆ Most interviewees said “space” came to mind when they thought about exploration. Other associations interviewees had with exploration included “traveling the world,” “new frontiers,” “the ocean,” and historical explorers such as “Christopher Columbus.”
- ◆ Most interviewees said people explore to discover new places and things. Several interviewees said economic gain was a common motivation to explore.
- ◆ When asked to describe some of the ways people can be explorers, most interviewees cited various types of scientists including “astronauts,” “doctors” and “archeologists.” Many interviewees said that anyone can be an explorer depending on their outlook and curiosity.

## RESPONSES TO CONCEPT STATEMENTS

Interviewees were shown five concept statements related to the *Explore* exhibition and asked a series of questions about them.

- ◆ Nearly all interviewees said the statement “We’ve explored all there is to explore on Earth” is “false.”
- ◆ Most interviewees said that “Exploration may result in loss of life or environmental harm, but the danger of not exploring is even greater” is “an important idea for society.” In contrast, some said that exploration is important, but not at all costs.
- ◆ Many interviewees responded positively to “I would be willing to go on a dangerous mission to explore something unknown,” citing the opportunity for excitement and to make history as strong motivations. In contrast, some answered “false,” citing age, personal demeanor, and parental responsibilities as deterrents.
- ◆ When asked their reaction to, “We’re connected to all life-forms—even life-forms that are too small to see,” most interviewees referred to the statement as “true” and “an important idea for society.” Many of these cited an ecological connection between all life-forms.
- ◆ Most interviewees said that “The discovery of microscopic life on another planet would have great implications for life on Earth,” was “true” and “an important idea for society.” Reasons these interviewees cited included the potential for humans to inhabit a planet other than Earth, the possible discovery of natural resources in space, scientific breakthroughs that might help cure disease or combat

environmental threats, and the religious implications of bringing the origins of life into question. In contrast, a few interviewees said that the discovery of microscopic life on another planet would have little impact on their daily lives and that society should focus on preserving the health of Earth before spending resources exploring outer space.

## REACTIONS TO THE STORYBOARDS

Interviewees were shown four storyboards and asked a series of questions to identify their reactions to and understanding of ideas planned for the exhibition. The topics of the storyboards included the deep sea, caves, Antarctica, and Mars.

- ◆ When asked which story was most compelling or interesting, about two-thirds of interviewees cited either the Mars: Are We Alone? or Frozen Frontiers storyboards. Of the interviewees who preferred Frozen Frontiers, many said this story interested them because it was unfamiliar. Most of the interviewees who said they found the Mars story most compelling attributed their preference to the prospect of finding life on the Red Planet.
- ◆ A few interviewees said that the Under Pressure: Life in the Deep Sea was the most compelling storyboard. Of those, most said they were fascinated by the unusual marine life living there. And a few interviewees said Caves: Exploring Deep Earth was most compelling because they had visited a cave or because it seemed like the most accessible environment.
- ◆ Most interviewees said that they thought Caves: Exploring Deep Earth was the least compelling of the four storyboards because they were not interested in “snottites” bacterium and because the environment is the most familiar of the four. Some interviewees said the Under Pressure: Life in the Deep Sea storyboard was least interesting—either because they were already familiar with deep sea exploration or because the hydrothermal vents highlighted in the storyboard were not personally relevant.
- ◆ Some interviewees said that the Mars storyboard was least compelling, attributing their lack of interest to the subject’s overexposure in the media. A few interviewees had a negative visceral reaction to the cold Arctic environment described in the Frozen Frontiers story and, therefore, said that storyboard was least interesting.
- ◆ When asked what connections the four storyboards have in common regarding exploration, most interviewees cited microscopic life, risk, and extreme conditions as common themes.
- ◆ The interviewer asked interviewees what connections, if any, they could think of between exploration on Earth and exploration in space. Most said that there was the potential to find microscopic life in space similar to bacteria found in extreme environments on Earth.
- ◆ When asked what implications the discovery of microscopic life on Earth has for the search of life on other planets, most interviewees said that life-forms that can survive in extreme conditions on Earth could likely survive on Mars. However, while they understood the implications of finding microscopic life, some interviewees’ comments indicated that they did not care.
- ◆ Most interviewees shared the sentiment that calculated risk is necessary to make new discoveries and advance society. Many interviewees noted that explorers, such as scientists, choose to take risks and are, therefore, responsible for their own safety.
- ◆ Several interviewees said that it is not acceptable to jeopardize the health of the environment to make a scientific discovery. In addition, a few interviewees expressed strong opposition to space exploration and implied that humans are risking the health of planet Earth.
- ◆ The interviewer asked interviewees how, if at all, the information presented in the storyboards was personally relevant. Many interviewees said that they might benefit from possible discoveries found in

extreme environments such as cures for diseases or solutions to environmental problems. Similarly, several interviewees' comments indicated that they thought the opportunity to live on Mars might be possible. In contrast, some interviewees said that none of the information in the storyboards was personally relevant.

## DISCUSSION AND RECOMMENDATIONS

Findings from the front end study of *Explore: Blue Planet•Red Planet* demonstrate that visitors are knowledgeable and curious about the exploration of Earth and Mars, and they expressed interest in the exhibition under development at the Museum of Science and Industry (MSI). While some visitors noted that popular media has already presented programs on Mars exploration, once they were taken through the exhibition materials, most seemed genuinely surprised and interested in MSI's exhibition ideas, noting that the Museum's perspective is fresh and intriguing. MSI is certainly on the right path in exhibition development, as studies show that a museum that provides visitors with new, unexpected content, will exceed visitors' expectations and create memorable visitor experiences (Korn, 2003; RK&A, 1997). Findings also revealed some subtle red flags that could potentially impede visitors' full understanding of the exhibition's main ideas. The discussion below highlights a few strategies to address these challenges and identifies questions, concerns, and points of interest emerging from the interviews.

### TAKING VISITORS TO A NEW UNDERSTANDING

As stated above, exploration is a familiar idea to most science museum visitors. Interviewees readily described their ideas about exploration, noting examples such as exploring space, the human body, and "new frontiers." They also demonstrated an understanding that explorers come from a wide variety of vocations and represent brave, persistent individuals willing to take risks. When presented with specific statements related to exploration, interviewees demonstrated true open-mindedness, agreeing that there is much more to explore, that risk is inherent in exploration, and that there are great implications for finding microscopic life on other planets. These findings indicate a high degree of familiarity and comfort with the topic, which can be an excellent platform for building a memorable visitor experience.

However, exhibition teams are always challenged to create a comfortable learning environment surpassing visitors' expectations by moving visitors from familiar ideas to new ideas: interviewees' responses to specific storyboard ideas reinforced this notion. When interviewees were presented with specific exploration storylines, an interesting phenomenon emerged: most visitors were attracted to the more obviously exotic, unfamiliar storylines—Mars and Antarctica—than to the ideas they perceived to be familiar and closer to home—caves and the deep sea. Even though the caves and deep sea stories introduced extremely unusual microscopic life, these particular ideas did not resonate with visitors enough to produce an "Aha" effect. Though exhibition developers are excited by the discovery of microbes in these two extreme environments on Earth, not all interviewees expressed the same feelings. The challenge for exhibition developers is to help visitors realize the extraordinary quality of these extreme environments and help visitors see what they see. The exhibition will need to continuously push visitors to "explore" somewhat familiar environments, such as the deep sea and caves, while drawing correlations between Mars exploration and the less familiar ideas of possible microbial life on other planets.

### HELPING VISITORS FIND PERSONAL RELEVANCE IN UNFAMILIAR IDEAS

While visitors seek to understand the unfamiliar, they also need a reason to do so. In other words, many visitors crave personal relevance in exhibition materials and seek to answer the "so what?"

question. This was clear throughout the interviews, as visitors continuously said they were interested in various exhibition ideas because they were important and relevant. Notably, visitors were interested in the Antarctica storyline, not only because it is an extremely unusual and unfamiliar place, but also because the issue of whether or not to drill in Lake Vostok gave them a *reason* to want to know more, in the form of an environmental message. With global warming, rising oil prices, and other environmental concerns currently on the minds of most Americans, the Antarctica storyline struck a chord and helped visitors see its relevance. Similarly, many interviewees attributed their interest in the Mars storyboard to the possibility of colonizing or making discoveries on Mars that would help to relieve overpopulation, disease, and other personal and global threats. On the other hand, the caves and deep sea storylines did little to answer the “so what?” question, as there was no evidence for visitors that these places should matter.

Another clear instance of the desire for personal relevance was how interviewees understood the implications of finding microscopic life on other planets. Notably, visitors understand, on a basic level, what microscopic life is, as well as what implications finding microscopic life in extreme environments on Earth has for finding life on Mars. Most interviewees agreed that all life-forms are interconnected. Some said we are connected ecologically (i.e., web of life), whereas others said we are connected on a cellular and genetic level. Yet these ideas were not particularly compelling to visitors when presented specifically in the context of an extreme environment on Earth. In particular the “snottites” and “black smokers” did not interest visitors, as they could not readily see why they mattered. Findings suggest that exhibit planners should not rely on microbes as an interpretive hook without exploring ways to explicitly communicate the value and personal relevance of such organisms in our everyday lives.

## HELPING VISITORS SEE THE INTANGIBLE REWARDS OF EXPLORATION

Through the exhibition, MSI intends to take visitors on a search for answers to some of life’s great mysteries, such as “How and where did life originate on Earth?” “What is the future of humankind on and off the planet?” and “Is there life on other worlds?” These are fascinating, compelling questions that scientific exploration raises, but they also conjure issues of philosophy and religion. Even though the search for answers to these questions would be undoubtedly interesting, most visitors tend to think of exploration much more concretely, and, for the most part, the ideas presented to visitors during the front-end evaluation did not inspire them to reflect on these big ideas.

Rather, findings show that visitors appear to have a misconception, or at least a superficial understanding, about the nature of the rewards of exploration. Throughout interviews, visitors spoke of the gains from exploration in terms of extrinsic, concrete rewards such as cures for diseases, living on Mars, and immediate scientific breakthroughs. Visitor comments implied that they can imagine or may even expect these types of tangible rewards in their lifetimes. There is a gap between what MSI sees as the benefits of exploration and what visitors see as the benefits of exploration. This gap in expectations goes back to the idea that visitors may need to know how science exploration is relevant to them. Findings suggest that exhibition planners should not expect visitors to make the conceptual leap from exploring Earth and Mars to pondering the meaning of life without first testing ways to explicitly lead visitors to these big questions and their relevance to everyday life. The few interviewees who considered these big questions in the study did so because some of the exhibition ideas made them question their religious, philosophical, or environmental beliefs—all issues that may provide hooks for visitors.

## RECOMMENDATIONS

- ◆ Explore interpretive techniques to continuously push visitors to see how familiar environments (i.e., Earth environments) relate to Mars and the more unfamiliar idea of possible life on other planets.
- ◆ Challenge visitors' ambivalent perceptions of microbes and include explicit examples of how microscopic life-forms (i.e., bacteria) are relevant and beneficial to visitors' lives. For example, provide visitors with a reason why they should care about the existence of "snottites" bacteria living in caves beyond the implications this bacterium has for the search for life on Mars.
- ◆ Similarly, reconsider the use of microbes as an interpretive hook (e.g., the proposed "Microbial Matt" exhibit agent) without exploring ways to explicitly communicate the value and personal relevance of such organisms in our everyday lives.
- ◆ To lead visitors to think about exploration's implications for understanding life's great mysteries, provide opportunities throughout the exhibition for visitors to share their reflections and personal opinions. Although user-contributed content in museum exhibitions is not a new idea, museums are experimenting with new approaches to this interpretive strategy. Regardless of the technique, the key to eliciting meaningful responses from visitors is to start with provocative and relevant questions (McLean, Pollock, 2007). As indicated by interviewees' reactions to the Frozen Frontiers/Lake Vostok storyboard, environmental risk is particularly relevant for visitors and would likely elicit meaningful responses in a "talk-back" exhibit. Similarly, relating exhibition ideas to religion and philosophy may inspire thoughtful reflection.
- ◆ Throughout the exhibition, reinforce that many of the rewards or benefits of current exploration may not be seen for generations to come.
- ◆ Although museum exhibitions have difficulty competing with television, film, and other new media for visitors' attention, other RK&A studies found that visitors are interested in "real things" (RK&A, 1994; 1996). Therefore, exhibition planners must ensure that *Explore: Blue Planet· Red Planet* includes what digital media can not—the opportunity to see artifacts in person. Throughout the exhibition, include opportunities for visitors to view NASA artifacts and other "real" exploration-related equipment.

## REFERENCES CITED

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# INTRODUCTION

This report presents and analyzes the findings from a front-end evaluation conducted by Randi Korn & Associates, Inc. (RK&A), of *Explore: Blue Planet · Red Planet*, an exhibition being developed by the Museum of Science and Industry (MSI) in Chicago, Illinois. Front-end evaluation helps planners understand how visitors comprehend and think about themes, ideas, and concepts that will be presented in an exhibition. It seeks common ground between visitors and the exhibition. Findings from this study demonstrate people's understanding of concepts integral to the exhibition and will inform MSI in the exhibition development process.

Specifically, the evaluation objectives were to:

- ◆ Gauge visitors' general associations and impressions with exploration (both on Earth and in space—Mars), particularly its purpose and value;
- ◆ Identify the strategies that best help visitors understand, appreciate, and *personally* value exploration, particularly:
  - ❖ The connections between exploration on Earth *and* in space (Mars) and how, together, they inform our understanding of our place in the Universe;
  - ❖ The importance of risk-taking and significance of rewards, even for knowledge's sake only;
  - ❖ That biodiversity (microscopic life) on Earth is fascinating and has great implications for our life on Earth and our search for life on other planets (Mars).

## METHODOLOGY

Data consisted of in-depth interviews conducted in May 2008 with drop-in visitors to MSI.

### IN-DEPTH INTERVIEWS

Interviews are a useful tool for understanding ideas and concepts from the visitors' point of view. In-depth interviews encourage and motivate interviewees to describe their experiences, express their opinions and feelings, and share with the interviewer the meaning they construct about ideas, concepts, and experiences. In-depth interviews produce data rich in information because interviewees talk about their own experiences and ideas.

RK&A designed a three-part interview strategy (see Appendix A for interview guide): first, the interviewer asked interviewees questions about their associations with exploration to ease them into a more difficult line of questioning. Second, the interviewer showed visitors statements about exploration and microscopic life-forms and asked them to respond (see Appendix B for list of statements). Third, the interviewer presented visitors with four storyboards conveying ideas and concepts about exploration in extreme environments (see Appendix C for storyboards). The interview guide was intentionally open-ended to allow interviewees the freedom to discuss what they felt was meaningful.

Family groups with at least one adult and one child aged 8 to 14 were eligible to be interviewed. Participants were selected following a continuous random sampling method. According to this procedure, the interviewer approached the first eligible visitor to enter a designated area and invited that

visitor and his or her group to participate in the study. Once the interview was completed, the interviewer returned to the designated area and intercepted the next eligible visitor.

All interviews were conducted in English and audio-recorded with participants' permission and transcribed to facilitate analysis.

## **DATA ANALYSIS**

Interviews are qualitative, meaning that the results are descriptive. In analyzing qualitative data, the evaluator studies the responses for meaningful patterns, and, as patterns and trends emerge, groups similar responses. These groupings are reported and quotations are included to exemplify visitors' experiences and ideas.

## **REPORTING METHOD**

Following the qualitative tradition of data reporting, trends and themes within the interview data are presented from most to least frequently occurring. Verbatim quotations from interviews (edited for clarity) in this report illustrate visitors' thoughts and ideas as fully as possible. The quotations give the reader the flavor of visitors' experiences. Within quotations, the interviewer's questions appear in parentheses and an asterisk (\*) denotes a new speaker.

# PRINCIPAL FINDINGS

## VISITOR DEMOGRAPHICS

RK&A interviewed 35 visitor groups comprised of 105 people (63 adults and 42 children). Of 48 visitor groups approached, 13 refused to participate, making the refusal rate 27 percent, which is slightly higher than the average rate for museum studies. Most visitors said they refused because they lacked time.

Overall, female interviewees (51 percent) outnumbered male interviewees (49 percent). The adults ranged in age from 19-60 with a median age of 35. The children ranged in age from 5-17 with a median age of 12.

Fifty-two (50 percent) of the 105 visitors interviewed were visiting the Museum for the first time, and 53 (50 percent) had visited the Museum previously. Four of the 105 visitors said they were Museum members.

## PART I: OVERALL PERCEPTIONS OF EXPLORATION

### ASSOCIATIONS WITH THE TERM “EXPLORE”

To begin each interview, the interviewer asked what came to interviewees’ minds when they thought of the word “exploration.” Most interviewees said they thought of “space” exploration, while many said they thought of “traveling the world” or “new frontiers.” Several interviewees said “the ocean,” and some cited “Columbus discovering America.” Some interviewees associated exploration with paleontology, including “dinosaur digs” and “fossil hunting.” Some interviewees cited other explorers in addition to Christopher Columbus, including Captain Cook, Ferdinand Magellan, and Lewis and Clark, whereas two interviewees mentioned the fictional explorer Indiana Jones. In addition, a few interviewees gave idiosyncratic answers including “nanotechnology,” “going back in time,” “the human body,” “caves” and “oil.”

### PERCEPTIONS OF WHY PEOPLE EXPLORE

To further elicit interviewees’ perceptions of exploration, the interviewer asked them to articulate reasons why people explore. Most interviewees said people explore to discover new places and things including conquering and colonizing new territories (see the first quotation below), making scientific and medical discoveries (see the second quotation), finding new planets or signs of other life in the Universe (see the third quotation, next page), and researching ancient cultures. Several cited economic gain as a common motivation to explore (see the fourth quotation). In contrast, a few cited intrinsic motivations including excitement, challenge (see the fifth quotation), and innate curiosity (see the sixth quotation).

(What are some of the reasons people explore?) To find new things. (What are some examples?) Depends on what era of history you’re talking about. Centuries ago they looked for new countries to conquer. Now we look at exploring new environments like the deep sea. [male, 23]

[People explore to] find new things and make new discoveries. (Any discoveries in particular?) Scientists explore places like the rainforest to find undiscovered plants, and...doctors are exploring ways to help cure diseases. [female, 52]

[People explore] to discover new planets in the Universe and, I suppose, to find life out there. [male, 26]

[People explore] for economic reasons. (Can you say a little more about that?) Prospectors mine looking for gold, diamonds.... Historically, if it wasn't for the possibility of striking it rich, a lot of people would have just stayed put. [female, 49]

(What are some of the reasons people explore?) Excitement and adrenalin... You get bored doing the same old thing, so you explore to see what's out there and what's possible. [male, 32]

It's part of human nature to explore and expand. It's built into our DNA. [male, 50]

## WHO ARE EXPLORERS?

When asked to describe ways people can be explorers, most interviewees cited various types of scientists including “astronauts,” “doctors” and “archeologists.” Many interviewees said that anyone can be an explorer depending on their personal outlook and curiosity (see the first and second quotations below). Similarly, some described explorers as “risk-takers,” “easily bored,” “perseverant,” and “brave.” A few commented that explorers include not only people who are going on a mission, but also the team members who made the expedition possible (see third quotation).

Everyone can be an explorer if they have the right attitude. People who go climb mountains or travel into space... students can be explorers too. I think it's a mental state of mind, a desire to learn, a willingness to try new things and new ways of thinking. [female, 45]

There are degrees of explorers—from professional explorers like astronauts to someone who is just inquisitive and wants to, for example, take a toaster apart just to see how it works. [male, 57]

Even people who are part of the team but who stay back at home and do the research and help make the mission happen are, in a way, explorers. [female, 39]

## PART II: RESPONSES TO CONCEPT STATEMENTS

In the second part of the interview, interviewees were shown five concept statements related to the *Explore* exhibition. Some of the statements were true while others were intentionally open-ended, to gauge where interviewees stood in relation to the ideas. The statements were:

1. We've explored all there is to explore on the Earth.
2. Exploration may result in loss of life or environmental harm, but the dangers of not exploring are even greater.
3. I would be willing to go on a dangerous mission to explore something unknown.
4. We're connected to all life—even life-forms too small to see.
5. The discovery of microscopic life on another planet would have great implications for life on Earth.

To give interviewees a point of departure for talking about these concepts and validate their thoughts and opinions, they were given a list of the following phrases: “probably true,” “probably false,” “an important idea to me,” “an important idea for society,” “not an important idea,” and “I don't understand what this means.” Interviewees were asked to choose at least one phrase that most accurately described how they felt about the statement. After the interviewees selected a statement, they were asked follow-up questions to encourage deeper conversation.

## WE'VE EXPLORED ALL THERE IS TO EXPLORE ON EARTH

Nearly all interviewees said the statement “We’ve explored all there is to explore on Earth” is “false,” citing various reasons for disagreeing with the statement. The quotations below exemplify the range of responses.

(We’ve explored all there is to explore on Earth.) False. (What makes you say that?) Because there’s an endless amount of adventure on Earth and you can always explore more. [male, 13]

(What sort of thoughts or feelings does that statement bring up for you?) I would think that life could get pretty boring because there would be nothing new to do. [female, 56]

There’s still so much more we don’t know about—the ocean, other planets, our ancestors, alternative fuels, dinosaurs... We’re discovering new things all the time. I think the more we find out, the more questions arise. It’s a never-ending process. [male, 47]

There’s a lot we haven’t touched...cures for diseases, bodies, going green... A lot of the ocean hasn’t been explored...There are still species undiscovered. We’re finding new animals and plants daily. [female, 31]

The interviewer asked interviewees how they would feel about seeing a museum exhibition about the idea in statement 1. Most interviewees said that it would be important for the museum to communicate that the statement is false (see the quotations below).

(How would you feel if you saw that idea presented in a museum exhibition?) Happy as long as the museum said the statement was false. I wouldn’t come back to the museum if they said it was true because there wouldn’t be anything left to explore. [female, 58]

Whoever would say that would be an idiot or set in their ways. [male, 12]

It would be good to convey that the statement is false. We want kids to know there is still a lot more to explore because it would end up fostering their curiosity. [female, 37]

## EXPLORATION MAY RESULT IN LOSS OF LIFE OR ENVIRONMENTAL HARM, BUT THE DANGERS OF NOT EXPLORING ARE EVEN GREATER

Most interviewees said that statement 2 (“Exploration may result in loss of life or environmental harm, but the dangers of not exploring are even greater.”) is “an important idea for society” and provided a range of arguments to support their opinion (see the first four quotations below). In contrast, some interviewees said that exploration is important, but not at all costs (see the fifth and sixth quotations).

That [statement 2] is an important idea to society. (What makes you say that?) Despite the risks, we need to explore—no pain, no gain. We need to find resources...new energy sources or we’ll be screwed in the future. [male, 21]

The only way we’ve gotten to where we are today is by exploring. It’s important.... You won’t know what’s out there, good or bad, unless you take a risk. Like in the rainforest, they’re finding all kinds of medicines that do a lot of good for society, but we wouldn’t know that if they didn’t explore. [female, 48]

Everything is evolving...diseases, viruses. If we don’t continue to explore, these problems will continue to get greater. [male, 26]

(What makes you say that statement 2 is an important idea for society?) Because it's important that people don't lose their sense of wonder about things. It's important to inspire people to strive to make progress... For example, the green house [*Smart Home: Green + Wired* exhibit] that's here on exhibit...all those materials are made from recycled stuff, but we wouldn't have green technology if we didn't explore. [male, 23]

Saving lives is more important than conquering new frontiers. [male, 13]

We shouldn't put exploration ahead of loss of life or environment. There's nothing wrong with mindful exploration but not at cost to environment. [male, 40]

When asked what thoughts or feelings arose in response to statement 2, some interviewees' reiterated the inherent contradiction presented in the statement (see the first three quotations below). Similarly, a few interviewees said that the paradox of statement 2 is an important idea to be presented in a museum exhibition (see the fourth quotation).

We're losing our environment—forests are going, animals are disappearing—because we've been using cars and building up and polluting the environment as a result of exploration. But if we don't keep exploring, seeking cleaner alternatives, then our planet will die. It's a catch-22. [female, 29]

It's a toughie—you could argue both ways. I think it's important for humans to think about and weigh both sides...weigh the risks. [male, 47]

There's always been this idea of manifest destiny, and the idea itself has manifested in so many ways. America has always been a place of constant improvement and innovation—it's an American ideal. It [statement 2] is probably true for society, but I don't know if it's true for me personally. [male, 59]

It would be good to educate people that sometimes harm has to happen for good to result. It's important to point out that dangers and loss of life are risks inherent in exploration. Don't just glorify exploration for its own sake. It's not black and white. [female, 36]

### **I WOULD BE WILLING TO GO ON A DANGEROUS MISSION TO EXPLORE SOMETHING UNKNOWN**

Many interviewees responded positively to statement 3 (“I would be willing to go on a dangerous mission to explore something unknown.”), saying that having an exciting opportunity to make history was a strong motivation. In addition, some interviewees said that statement 3 was “an important idea for society.” A selection of quotations below exemplifies the range of responses.

I think that's true (What makes you say that?) It would be cool to make history...to be the first to discover something important and have it named after you. [female, 14]

I'd go on a dangerous mission for the excitement and adventure and to go beyond where my peers have been. [male, 40]

It [statement 3] is true (Why do you think that is?) Because it would actually give my life meaning instead of being just another drone.... I'd be willing to go out on a limb if it was for a cause... like an important scientific discovery that could save the planet. [male, 29]

It's important that we foster curiosity in our society. We need at least some people [who] are willing to take risks to move society forward. We can't all be couch potatoes. [female, 22]

In contrast, some answered "false" to statement 3, citing age, personal demeanor, and parental responsibilities as deterrents (see the first, second, and third quotations below). A few interviewees responded more cautiously to the statement with "it depends" (see the third and fourth quotation).

For me, personally, it's false (What do you think that is?) I'm just not the adventurous type. I'm a chicken, but I'm glad other people aren't. [male, 56]

When I was younger, maybe I would have been willing to take the risk, but I'm more reserved now. I'm a mother. I don't want to die...my kids need me. [female, 47]

It depends on who wanted me to go and how dangerous the mission was. (What would be worth the danger?) Maybe if a colony on Mars was starting up, and we were the first people to go there, I would do it because it would be a big scientific breakthrough.... Or finding a cure for disease might be worth the risk of infecting yourself if that would help lots of people. [male, 13]

I wouldn't do something blindly. It depends on what the prize was at the end—why it would be worth it to face danger? A little danger is good for the spirit, but not if you could easily die. [male, 60]

The interviewer asked interviewees how they would feel if statement 3 ("I would be willing to go on a dangerous mission to explore something unknown.") was presented in a museum exhibition. Several interviewees said that personal risk-taking as an important message to convey to young people (see the first quotation below). In addition, some suggested including polling opportunities and exhibits intended for visitors to experience risk-taking scenarios firsthand (see the second, third, and fourth quotations).

It would be good to put this idea into young people's heads. (Which idea?) That you need to get out there, educate yourself, and go explore and try to make a difference. Sometimes I think youth kind of forgets how everything happened. They think it's all just here and don't realize that people took a lot of risks to get us to where we are today—everyone from Columbus setting out to prove the world wasn't flat to Rosa Parks having the courage to sit at the front of the bus. [female, 58]

It would be interesting to see how far other people would respond to that [statement 3]. Such as taking a poll to see where you stacked up to other people in respect to that question. [female, 56]

It would be fun if you [the Museum] could somehow simulate like we were going on an adventure. With video games, you have a character and your character does dangerous stuff and risks being destroyed. You could have people [visitors] go on a virtual mission. But the [virtual] environment and mission would have to be random so other people you're with won't tell you what happened. [male, 12]

It would be cool if you could have an experience in the museum that pushes you to take a chance. (Off the top of your head, what are some examples?) I was in Jersey at Liberty [Science] Center, and they had a maze that you had to go through basically blind...a crawl-through maze to show you what it's like to be blind. I thought it was awesome because you

don't realize usually how much blind people explore with their other senses. It showed how adventurous blind people are every day. [female, 23]

### **WE'RE CONNECTED TO ALL LIFE—EVEN LIFE-FORMS THAT ARE TOO SMALL TO SEE**

When asked their reaction to statement 4 (“We’re connected to all life-forms—even life-forms that are too small to see.”) most interviewees said the statement was “true” and “an important idea for society.” Many interviewees—including those who said they did not believe in evolution—cited an ecological connection between all life-forms (see the quotations below).

True. (What makes you say that?) The things we end up doing, like development and destroying habitat, can affect life-forms we can't see. [male, 47]

(You said that the statement [statement 4] is an important idea for society. In what way?) People, especially in the U.S., think individualistically and don't consider that their actions affect life-forms [too small to see]. How I treat the water, take care of my garbage... all that affects nature, even microscopic [life-forms]. From large to small and everything in between, our collective actions matter. [female, 40]

What we do affects the environment and all creatures in the environment. We're not literally all connected but we—all life-forms—are interdependent. We're connected in a sense of a web. We share habitats, food, and sometimes even structure. [female, 36]

I'd say it [statement 4] is true. However, because of our religion, it would be false to try and prove that we're related to animals—that we come from animals. (Can you say a little more about that?) I know my mom and I don't like evolution that much. (And how does that relate to the statement “We're connected to all life, even life-forms too small to see?”) Well ...our religion says that we cannot be related completely. Even though we're made up of cells, we [humans] we're created to be different than other life. (You said before that you thought this statement was true. What other ways, if any, do you think we're connected?) I think we're connected because we rely on other creatures in our world to live. [male, 13]

In addition, several interviewees said that humans are connected to other species on a genetic or cellular (i.e., biological) level (see the first two quotations below). A few interviewees' comments specifically addressed the effects of bacteria on humans (see the third and fourth quotations).

We're connected genetically; we all come from common lineage. We started from the smallest amoeba. That's how life came about. [male, 60]

We are all made from atoms and molecules... We all have the same stuff, the same organic elements. We're intertwined because we come from and return to the same thing—dust. [female, 47]

True. (Why?) For example, you have bacteria on your arm. You can't see it, but we're all connected to them. There are good bacteria and there are bad bacteria. We need the good bacteria to stay healthy. [female, 14]

Everyone has been sick, like with colds, from germs from someone else. Germs or bacteria are too small to see, but they connect us. We're affected by them. That's an important idea to society because of all the diseases that are out there like AIDS affect a lot of people. [female, 22]



When asked how they felt about the idea (“We’re connected to all life-forms—even life-forms that are too small to see.”) being presented in a museum exhibition, interviewees’ responses were mixed. Although some said that they would appreciate that type of ecological message (see the first and second quotations below), other comments indicated that the idea would not be conceptually or personally relevant to most visitors (see the third and fourth quotations.).

It would be good if it were presented in a way that lets you see how things are affecting us. It would help broaden people’s understanding of ecology and appreciation of all life-forms. [female, 35]

I would welcome that kind of presentation. Our troubles as a society stem from the belief that we’re not connected. We need to change that attitude. [male, 51]

I think there are probably many microscopic organisms that are interesting that we don’t think about. But as for whether or not that’s a good idea for an exhibit, I’m not sure. You would have to tell people why they should care about that stuff... You’d have to say why microbes are important. [female, 31]

I think the idea that we’re connected to all life-forms would be over most people’s heads. (What makes you say that?) People don’t really read at all. They’re just getting stuff visually, so you got to convey the message quickly. That idea is maybe too deep. [male, 60]

#### **THE DISCOVERY OF MICROSCOPIC LIFE ON ANOTHER PLANET WOULD HAVE GREAT IMPLICATIONS FOR LIFE ON EARTH**

Most interviewees said that statement 5 (“The discovery of microscopic life on another planet would have great implications for life on Earth.”) was “true” and “an important idea for society.” Reasons interviewees cited (in order of frequency) included the potential for humans to inhabit a planet other than Earth, the possible discovery of natural resources in space, scientific breakthroughs that might help cure disease or combat environmental threats, and the religious implications of bringing the origins of life into question. The quotations below exemplify the range of responses.

I think that’s probably an important idea for society. (Why do you think that is?) Because we might want to move to that planet if we could figure out how that life-form survives—whether it’s an alien race or just microscopic. \*We [humans] might start to explore and form colonies on other planets. [male, 13; male 13]

If we ruin our planet, which seems to be [what will happen at] the rate we’re going, we might be able to go to another planet if life-forms were there. We’re going to need a place to go when we destroy Earth. [female, 36]

It could either be really good or really harmful. We’re using up our resources fast...and we might need to go to another planet to find resources. Where there’s life, there might be carbon and maybe oil. [female, 31]

They [other life-forms] might have greater technology for fighting diseases and stuff like that or [can] help figure out how to recycle better. [female, 12]

It [statement Five] is probably true. (Why do you think that is?) Because we could see how the Universe was formed. It would show that life can evolve on other planets. If cells are related

then that means other organisms might have formed the same way. It would make us have to reflect on who we are as a species and where we came from. [female, 52]

Yes, it's true that the discovery of microscopic life out there [space] would have great implications for life here [Earth]. (What makes you say that?) It would mean we're not alone. And the thought that we're not alone might somehow shatter our whole belief system about how we got here and where we're going. It would have great religious implications. [male, 54]

In contrast, a few interviewees said that the discovery of microscopic life on another planet would have little impact on their daily lives and that society should focus on preserving the health of Earth before spending resources exploring outer space (see the first two quotations below). A few interviewees said that they thought scientists had already found evidence of life on Mars (see the third quotation).

It might be interesting to academics, but I don't think it would have practical implications on Earth for trying to make people's lives any easier or any better. We need to focus on the planet we have. It seems audacious to think that we're the only life in the Universe [male, 32]

I don't see how it [finding microscopic life on another planet] would have great implications for life on Earth. (What makes you say that?) It might inform us about an exotic new life-form, and it might be exciting, but I don't think it would have such great importance to us and would be worth the astronomical cost of sending people or probes to Mars looking for it [life-forms]. (What makes you say Mars in particular?) There's just been a great fuss to go to Mars and find life. There's overblown emphasis on finding life in outer space. We *are* life in outer space, and, in my view, we're not honoring and taking care of our planet Earth. So I don't see why we deserve to encounter other life-forms at the moment until we've learned some lessons on this planet. [male, 51]

I thought they already found some sort of fossils that were signs of life from up there, didn't they? There was that asteroid that came from Mars that they thought had fossilized bacteria. [male, 22]

As with the previous statements, the interviewer asked interviewees how they would feel if the idea ("The discovery of microscopic life on another planet would have great implications for life on Earth.") was presented in a museum. Interviewees offered a range of opinions including "cool," "interesting," and "inspirational" (see the quotations below).

It would be cool if they [the museum] compared microscopic life on Earth and how it started and show what conditions other planets would need to sustain what we call life. [male, 23]

It would be interesting to have some sort of hands-on thing [exhibit] where you could build your own custom life-form based on certain parameters...like a simulation. [female, 35]

The prospect of finding life on another planet would be a good way to motivate kids to get used to exploring new things and new ideas. It would be inspiring and help open people's minds. [female, 55]

## PART III: REACTIONS TO THE STORYBOARDS

Interviewees were shown four storyboards and asked a series of questions to identify their reactions to and understanding of ideas planned for the exhibition. Questions were designed to uncover connections visitors made to the ideas as well as gaps in their understanding. The storyboards included:

- ◆ Under Pressure: Life in the Deep Sea
- ◆ Caves: Exploring Deep Earth
- ◆ Frozen Frontiers
- ◆ Mars: Are We Alone?

### STORYBOARD PREFERENCES

#### ***MOST INTERESTING STORIES***

When asked which story was most compelling or interesting, about two-thirds of interviewees cited either the Mars: Are We Alone? or Frozen Frontiers storyboards (about one-third, respectively). Of the interviewees who preferred Frozen Frontiers, many said this story interested them because they were not familiar with Lake Vostok in Antarctica (see the first quotation below). Several said they were struck by the environmental conundrum the Lake Vostok story posed (see the second quotation). A few were intrigued by the idea of ancient life-forms frozen under the ice (see the third quotation).

I like that one [Frozen Frontiers storyboard] best. (Why do you think that is?) Well, we've heard a lot about the deep ocean and space, especially Mars, but you never really see what they do in Antarctica. There don't seem to be too many secrets left on Earth. [male, 48]

Since the life-forms are ancient and haven't been seen for thousands of years, exploring [Lake Vostok] would be a way to see how life started on Earth. There's a time capsule element to it. It's a mysterious place under the ice. \*Yeah, I didn't know about this...that there's a lake under two miles of ice. It could hold new discoveries. [male, 22; male, 23]

It's an interesting dilemma. Antarctica is one of the last wild places on Earth. You'd kind of hate to lose that to the threat of contamination, but it would be interesting to know what's down there. The risk is interesting.... It might provide climate info to help combat global warming. [female, 34]

Most of the one-third of interviewees who said they found the Mars story most compelling attributed their preference to the prospect of finding life on the Red Planet (see the first and second quotations below). Moreover, a few interviewees' responses indicated that they viewed exploration and possible colonization of Mars as a way to alleviate the impacts of overpopulation on Earth (see the third and fourth quotations, next page). A few interviewees' responses revealed a misconception that life had already been discovered on Mars (see the fifth quotation).

(Which of these stories strikes a chord with you?) The Mars story. (Why do you think that is?) Maybe microscopic life-forms on Mars could evolve to the point we are today since we evolved from them. [male, 26]

I think it would be sweet if there's another planet that has organisms on it. [female, 17]

Mars. (In what way is the Mars story compelling?) [Be]cause there might be life on it, and you could probably live on it one day. [male, 10]

Maybe by exploring Mars, we could alleviate the problem of overpopulation here. [female, 45]

(In what way is the Mars story compelling?) The rest of these [stories] are earthbound...this one is far out, and I guess maybe because of conversations I've had with my son on whether there could be life on other planets or not. I think it's fascinating because they proved that we are not currently the only planet in the Universe with life. Since they found life on Mars, then who knows what else is out there? (What makes you say that life has been found on Mars?) You hear about it in the news all the time. They're always talking about Mars. I think they found a meteorite from there with signs of life on it. [male, 47]

Some interviewees cited philosophical and emotional reasons why they thought the Mars storyboard was most interesting. A few interviewees' comments said the possibility of discovering life on Mars was interesting for philosophical reasons (see the first and second quotations below). Others associated space exploration with positive childhood memories and national pride (see the third quotation).

(Which of these stories strikes a chord with you?) Mars, because I think it's really interesting to think about whether we're alone in the Universe. [male, 23]

I'm not religious, but what if there's a possibility we weren't created by God? Maybe we were created somewhere else and brought here from some other form. [female, 34]

I gotta go with Mars. To me, Mars epitomizes exploration. (Why do you think that is?) \*We grew up with the whole space race thing. I was a teenager when we were starting to go to the moon. The space program is something America can be proud of. There are other places on Earth that are amazing that we've never explored, but I think Mars is more glamorous. [male, 60; male, 61]

Only a few interviewees said that Under Pressure: Life in the Deep Sea was the most compelling storyboard. Of those interviewees, most said they were fascinated by the unusual marine life living there (see the first and second quotations below).

(Which of these stories do you find most compelling?) Deep Sea. (Why do you think that is?) Because I've seen pictures of some of those things that can survive down there, and they're pretty crazy looking. \*Yeah, like fish that glow! [female, 22; male, 25]

I think it's interesting that all those things survive in such different environments than humans do.... There's no light down there. [female, 36]

Of the four storyboards, only a few interviewees said Caves: Exploring Deep Earth was most compelling. Of those, most said they preferred the Caves story because they either had visited a cave or that it seemed like the most accessible environment to them compared with Antarctica, the Deep Sea, and Mars (see the first and second quotations, next page). In contrast, three interviewees cited unfamiliarity with the cave environment as the reason they thought the Caves storyboard was interesting (see the third quotation).

It's closer to home. I've gone in a couple caves down in southern Illinois and Kentucky. I guess the fact that I could actually go someplace is interesting. I can't see going to any of those other places [presented in storyboards] anytime soon. [male, 29]

It seems most accessible to me. Of these different places [presented in the storyboards], caves seem like the most likely one for me to be able to go to. I guess that's what I think of when I think of exploring.... It would be cool to go on some kind of adventure... not to sound cheesy, but [an adventure] like Indiana Jones. [female, 31]

I've read about the others [environments], but not really about caves. Not knowing about it makes it interesting. It's interesting that there's water as strong as battery acid there. Why would anything want to live down there? [female, 48]

Additionally, a few interviewees said that all the stories were interesting and they could not single out a "favorite" storyboard. The commonality among those interviewees' responses was an expressed interest in the technology used to explore extreme environments (see the quotation below).

I think the development of technology to be able to explore all of these environments is interesting. It amazes me that we figure out how to go to places where humans weren't really intended to go. God knows how life-forms can even get a toehold in those places. [female, 45]

### **LEAST INTERESTING STORIES**

Most interviewees said that they thought Caves: Exploring Deep Earth was the least compelling of the four storyboards, specifically because they were not interested in the "snottites" bacterium referenced (see the first, second, and third quotations below). In addition, some attributed their lack of interest in the caves storyboard to their familiarity and personal experience with caves (see the fourth quotation). Similarly, some said the Under Pressure: Life in the Deep Sea storyboard was least interesting either because they were familiar with deep sea exploration through other media or that the hydrothermal vents highlighted in the storyboard were not relevant to them (see the fifth, sixth and seventh quotations).

(Which of these stories is the least compelling?) The cave one [story]. (Why do you think that is?) That slimy dangling stuff is kind of gross. [female, 22]

Those snottites don't seem that important. Who really cares? [female, 46]

Learning about slimy bacteria in caves isn't that appealing...\*The story has a lot of the same elements as the others, but I guess it doesn't have emotional appeal. It's an emotional reaction. [male, 37; female, 33]

The caves [storyboard] doesn't really do it for me. (Why do you think that is?) I've been to caves, so that's familiar, whereas the other places [mentioned on the other storyboards] I haven't personally explored. [female, 36]

(Which of these stories is the least compelling?) The Deep Sea. (What makes you say that?) I've seen this before on Planet Earth. It's old news. [female, 23]

The one [story] about exploring the deep ocean is probably the least interesting to me. (What makes you say that?) I've already heard about that in documentaries and TV shows like Animal Planet. \*Seems like we've been there, done that. [male, 35; male 32]

(What about the Deep Sea story doesn't appeal to you?) I don't really care about "black smokers." It doesn't affect us. [female, 48]

Although most interviewees said either *Mars: Are We Alone?* or *Frozen Frontiers* was most interesting, some interviewees had the opposite reaction to those storyboards. Again, the degree of familiarity and exposure to a topic influenced interviewees' level of interest in that topic, as was the case with the *Mars* storyboard (see the first and second quotations below). A few interviewees reacted viscerally to the cold Artic environment described in *Frozen Frontiers* and, therefore, said it was the least interesting storyboard (see the third and fourth quotations below).

We've been exploring it for so long. We're always sending probes up there and stuff. Besides, you can go to the Adler [Planetarium] to learn about Mars. It's already being covered in Chicago. [female, 34]

We've been hearing a lot about Mars. It's gotten a lot of coverage about the possibility of bacteria...It's been out there. It would be interesting to see something new. [male, 22]

The Antarctica story doesn't really interest me—it's cold and barren. (What about it doesn't appeal to you? Do you think it's the physical environment or the story itself?) I guess ice is just not that interesting. It sounds cold... I wouldn't want to travel to that cold of a place. [female, 47]

Snow and ice are familiar—we live in Chicago, after all... [winter] is in our face here. \*I guess on an emotional level, extreme cold is kind of depressing. [male, 39; female, 33]

#### COMMONALITIES BETWEEN STORIES

When asked what connections the four storyboards have in common regarding exploration, most interviews cited microscopic life, risk, and extreme conditions as common themes. Some said that the stories illustrated that there is still a lot we don't know about Earth. In addition, a few said the search for life tied all four stories together. Two interviewees referred to the stories as “glamorous” examples of exploration. The quotations below exemplify the range of responses.

Exploring has an element of risk and danger associated with it. (In what ways?) Caves are acidic. The *Frozen Frontier* is cold and there's risk of contamination... There's a possibility that submersibles would collapse in the deep sea . . . and, on Mars, your space suit could break. [female, 39]

Exploration raises as many questions as answers. There's still a lot of unknown. (What makes you say that?) That Antarctica one [storyboard] makes you think about places we haven't been yet. [female, 49]

(What, if anything, do these stories have in common?) They're all concerned with microscopic life-forms and the question of . . . what conditions are needed for life to live. [male, 59]

They [the stories] all point to extreme environments where our typical conception of being life-friendly is challenged. They're all about the search for life in some way. [male, 37]

All the stories are glamorous, sensationalized examples of exploration. I don't really see much close to home. My father goes to work every day in the lab. It's not glamorous but he's still exploring. [female, 34]

## CONNECTIONS BETWEEN EARTH AND SPACE EXPLORATION

The interviewer asked interviewees what connections, if any, they saw between exploration on Earth and exploration in space. Most said that there was a potential of finding microscopic life in space similar to bacteria found in extreme environments on Earth (see the first and second quotations below). Several interviewees described Mars, the deep sea, caves, and Antarctica as “unknown frontiers” and “extreme” or “harsh” environments. In addition, two interviewees commented that some of the technologies developed for space exploration have applications for exploration on Earth (see the third quotation).

Finding organisms that live under harsh conditions probably means we might be able to find bacteria in space cause it's harsh there too. [male, 20]

If there's microscopic life in extreme environments on Earth, then there's a possibility for life on Mars and other planets... It's more than likely we're not going to find a developed hominid. We're probably going to find something microscopic. [female, 53]

A lot of the technologies you see for deep ocean exploration have been used in space, like the zero gravity weightless effect. [male, 29]

## IMPLICATIONS OF MICROSCOPIC LIFE

When asked what implications the discovery of microscopic life on Earth has for the search for life on other planets, interviewees' responses were similar to the findings above. Most interviewees said that life-forms that can survive in extreme conditions on Earth could likely survive on Mars (see the first quotation below). However, while they understood the implication of finding microscopic life, some interviewees' comments indicated that they did not care (see the second quotation).

I guess life doesn't necessarily need an awesome environment; things can survive in pretty extreme conditions. If we found bacteria on Mars like the bacteria they found in caves, then there's a possibility of more complex life-forms developing because human beings started out as bacteria. [male, 22]

If we find life on Mars and know it's not like the monsters in the 1980's movies—that it's bacteria—then that's not all that exciting. [male, 12]

## VALUE VERSUS INHERENT RISK OF EXPLORATION

When asked to reflect on the value of and possible risks inherent in exploration, most interviewees shared the sentiment that calculated risk is necessary to make new discoveries and advance society (see the first and second quotations, next page). Many interviewees noted that explorers such as scientists consciously choose to take risks and are, therefore, responsible for their own safety. However, when weighing the risks versus the rewards of exploration, several interviewees said that it is not acceptable to jeopardize the health of the environment to make a scientific discovery (see the third quotation). In addition, a few interviewees expressed strong opposition to space exploration and implied that humans are risking the health of planet Earth by diverting resources to exploring other planets (see the fourth quotation).

Maybe not your average person, but there are people, like scientists, who are willing to take risks to find new information to help us move forward as a society. The benefits outweigh the risks as long as there are people willing to do it. [female, 22]

If you never really explore, then you never really know what's out there.... We grow economically and technologically through taking risks and exploring. [female, 48]

The personal risk some explorers take is a matter of choice—they *choose* to undertake missions that are risky. But I don't think any discovery is really worth contaminating the environment for. After all, Mother Nature doesn't get to choose whether or not to take a risk. We choose for her, and often to her detriment... \*I agree. The story about the lake [Vostok] in Antarctica hit that point home. Sure, it would be cool to know what's living down there [under the ice], but it's not worth the risk of contaminating it. [female, 40]

I don't think exploration is worth risk. (When you say "exploration," are you thinking about any particular type of exploration?) Space...especially Mars. I think we should take a break from exploring Mars and spend our money and resources making sure that we're taking care of life on this planet first. Just stop with the whole probes to Mars thing until everyone around the globe has food and clean water to drink. [male, 40]

### PERSONAL RELEVANCE OF INFORMATION

The interviewer asked interviewees how, if at all, the information presented in the storyboards was personally relevant to them. As reflected in previous findings, many interviewees said that they might benefit from possible discoveries found in extreme environments such as cures for diseases or solutions to environmental problems (see the first and second quotations below). Similarly, several interviewees' comments indicated that they thought the opportunity to live on Mars might be possible (see the third quotation).

[How, if at all, is this information personally relevant for you?] Well, we're all feeling the hit from higher gas prices. Maybe exploring those [extreme] places might help with the energy crisis. They might find some new fuel sources. We have to...explore to find new reservoirs. I'm worried about what's going to be left when he [son] is my age. [female, 31]

We could find a cure for cancer in a cave or maybe even space. My mom is a breast cancer survivor. It would be the greatest thing in the world to find a cure, but we won't if we don't keep exploring. [female, 31]

Maybe we might be able to go to these places and live. It would be cool to live on another planet. [male, 11]

Several interviewees said that the content of the storyboards was personally relevant to them because the stories reinforced the concept that all life-forms are interconnected (see the first quotation below). In contrast, some interviewees said that none of the information in the storyboards was personally relevant to them in their everyday lives (see the second quotation). A few interviewees reiterated that finding other life in space would have implications for their beliefs and understanding of the origins of the Universe (see the third quotation). One interviewee said that microscopic life was relevant to her life because, working in a hospital, she associates bacteria with "bad bacteria."

[How, if at all, is this information personally relevant for you?] We're all interconnected. The more we understand the world around us, the less chance we have of destroying the environment. The Earth is a more challenged place, and we're going to have to find new ways organisms can survive difficult circumstances. [male, 59]

I guess the theme of pushing forward in your own mundane life is important, but all of this [information on the storyboards] isn't that relevant on a day-to-day basis. \*That's true....The



topics—like the lake in Antarctica—might be of some interest, but I don't see how they would affect our lives directly. [male, 39; female, 33]

Finding life on Mars would shake things up for me. That's relevant from a philosophical point of view. It points to questions about origins of life. [male, 37]

# APPENDICES

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## APPENDIX A

REMOVED FOR PROPRIETARY PURPOSES

## APPENDIX B

### CONCEPT STATEMENTS

1. We've explored all there is to explore on the Earth.
2. Exploration may result in loss of life or environmental harm, but the dangers of not exploring are even greater.
3. I would be willing to go on a dangerous mission to explore something unknown.
4. We're connected to all life—even life forms that are too small to see.
5. The discovery of microscopic life on another planet would have great implications for life on Earth.

*(Choose all that apply)*

Probably false

Probably true

An important idea to me

An important idea for society

Not an important idea

I don't understand what this means

## APPENDIX C

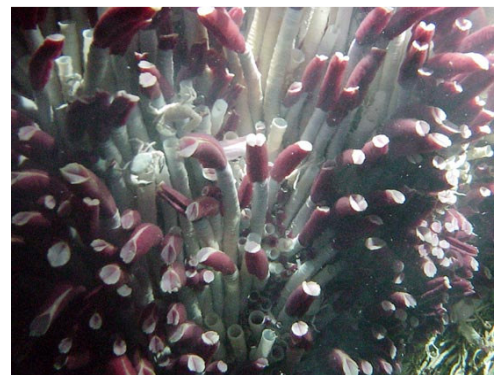
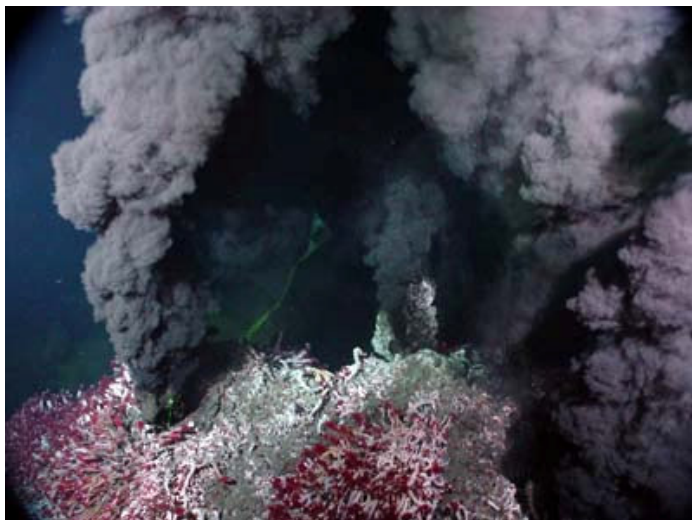
### STORYBOARDS

A

## Under Pressure: Exploring the Deep Sea

Explorers have found life forms where they least expected—nearly two miles below the ocean’s surface where creatures must withstand total darkness, extreme cold and great pressure.

In this hostile environment, hydrothermal vents called “Black Smokers” spew hot, acidic water. Unique life forms live near these vents including the giant *riftia* tubeworm. Microscopic bacteria live within the tubeworms and provide the worms with food and energy.



# B

## Caves: Exploring Deep Earth

In a cave in Mexico, explorers pass through water as strong as battery acid and wear masks to protect them against poisonous gases.

Bacteria live in these tough underground conditions and form slimy, dangling colonies called *snottites*. These extreme microbes get their energy from sulfurous gas, which sparks questions about where life can be found on Earth and beyond.

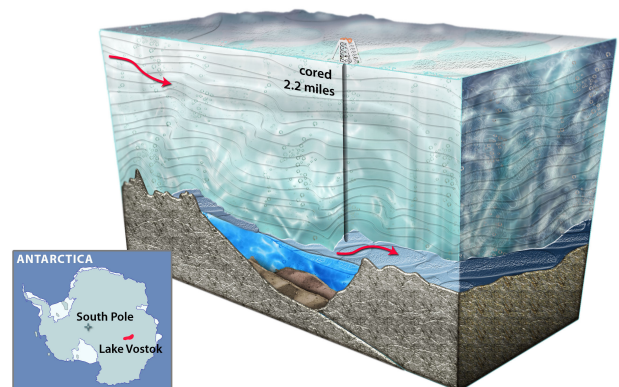
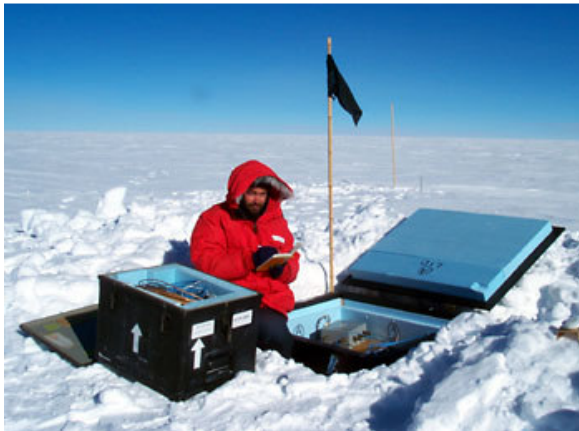


# C

## Frozen Frontiers

Buried beneath two miles of ice in Antarctica, lies Lake Vostok. This unexplored environment could hold ancient life forms not seen on Earth's surface for thousands of years.

Before scientists drill into Lake Vostok to sample its waters, they must confront one major issue— how to explore this sealed environment without contaminating it forever. Do the possible discoveries merit this risk?



## Mars: Are We Alone?

Mars—Earth’s closest planetary neighbor—is an extreme environment characterized by a cold, dry, thin atmosphere. However, pictures sent back from probes orbiting the “Red Planet” have sparked scientists to consider the possibility of habitats there suitable for life.

While life has not yet been found on Mars, most scientists suspect that any organisms discovered there will probably be microscopic, like the bacteria we have on Earth.

