

Mars Habitat Front-End Evaluation_Full Report

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April 2021

BACKGROUND

The Front-End Evaluation for the *Mars Habitat* exhibit component was conducted to inform the project team about overall public reactions to the concept of the exhibit, as well as to gather feedback about content, activity and the potential structure and building aspects of the component. This data will also be used to help guide the development of an exhibit prototype and the subsequent testing of related ideas, materials and builds. This document includes the full data set and results of the front-end data collection.

EVALUATION QUESTIONS

The questions that were used for this evaluation included three main focus areas designed to elicit participant responses about General Disposition about Mars and the potential Ideas for exhibit activities. Specifically, the question topics primarily include what participants think about people living on Mars, as well as any questions, concerns or musings they may have about this hypothetical scenario. This evaluation also included an opportunity to ask participants about problem solving around pre-defined exhibit activity ideas.

KEY FINDINGS

1. There's significant mention of the potential risks when thinking about people living on Mars, but there's also some excitement about the possible opportunities and rewards.
2. People generally wonder and have questions about how day to day life would be like on Mars, as well as how people might survive and be able to travel back to Earth.
3. In terms of what ideas / activities people favored solving problems around, day to day life and building structures were top responses, followed by addressing limited resources.
4. Overall, the majority of people really liked the idea of building structures to survive in the Mars environment.
5. Top reasons given for what people liked about the ideas presented were the hands on building opportunities, the challenge and creativity aspects.
6. Participants offered additional suggestions for ideas mostly about preferences for immersive experiences and the resources available on Mars.

METHODS AND PARTICIPANTS

A convenience sampling method was implemented through the use of an online survey that included close-ended and open-ended questions. The survey was distributed across various online platforms. The survey was created using the Alchemer survey website and the link was shared and made available broadly through specific online sources including digital distribution through NISE network social media sites (Facebook, Twitter, and LinkedIn), and the Science Museum of Minnesota's Member email list, plus the museum's member Facebook page. In order to facilitate and share the link in a relevant way, a special social media post (see Figure 1 below) was created for the online data collection. Through this virtual outreach, a total of 48 participants completed the online survey. The survey was available between March 19 and March 26, 2021.

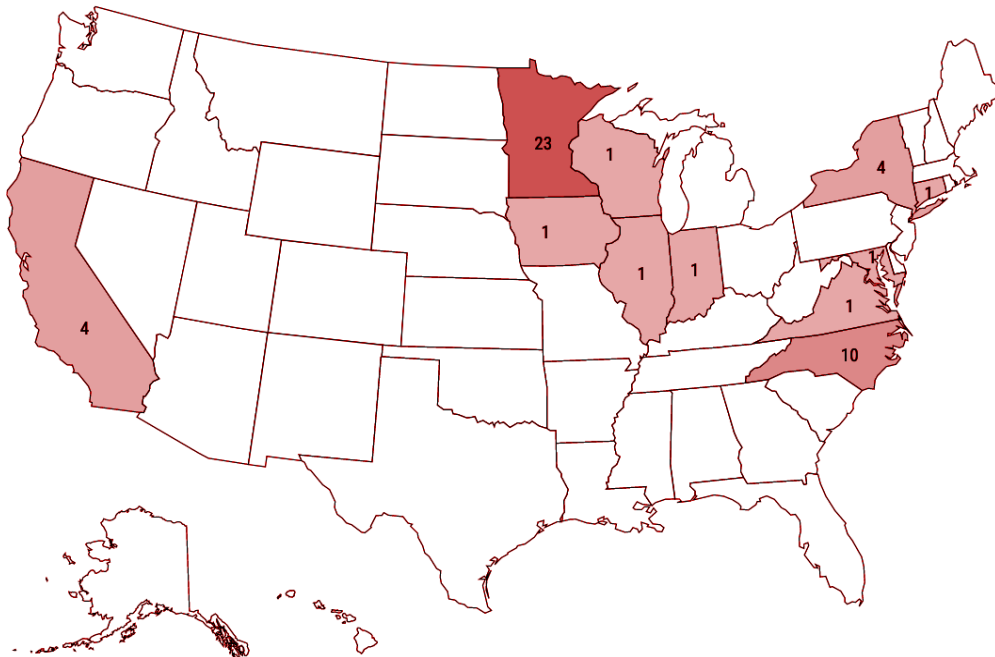


Figure 1. Image created for social media posting.

SAMPLE DISTRIBUTION

Through the online methods described above, we were able to collect a total of 48 responses from 11 states. About half ($n=27$) were from the midwest/great lakes area (Minnesota, Wisconsin, Iowa, Illinois, Indiana), with the majority of respondents ($n=23$) being from Minnesota. About a third ($n=17$) were from the East coast (Connecticut, Maryland, North Carolina, Virginia). Four were on the west coast (California). See Figure 2 below.

Figure 2. Geographic distribution of responses. (n=48)



Language

Most (n=39) respondents said that English was the primary language spoken in the home. Three respondents indicated English and another language (i.e., German, Brazilian, Portuguese) were spoken, and two respondents reported Spanish for their household.

Table 1: What is/are the primary language(s) spoken in your household? (n=43)

Language	Count
English	42
Spanish	2
German	1
Brazilian	1
Portuguese	1

Connection to STEM and Household Composition

About two-thirds of respondents (67%, n=43) reported that they or someone in their household works in an occupation that uses Science, Technology, Engineering, or Math. The exhibit component targets 4th-8th grade family audiences, but some institutions are likely to target a younger audience (e.g., Children's Museums), so data collection was expanded to include more grade levels. As such, over half of respondents (56%, n=43) indicated that they lived with a child in 1st through 8th grade.

This report also includes disaggregate data (See Appendix A) by these two factors (i.e., connection to STEM and household composition) to further inform content and design strategies to engage audiences, beyond the project's target. The full set of participant demographics is included in Appendix C.

RESULTS

General Disposition

Question 1: What comes to mind when you think about people living on Mars? (n=46)

The top response themes to this question were about the **Risks, Sacrifices, and Rewards** about living on Mars, followed by descriptions of the types of **Infrastructure, Buildings, and Life Support Systems**. Another salient theme was the **Mars Landscape** itself.

- The Risks, Sacrifices, and Rewards tied to living on Mars were the most frequently mentioned comments (39%), and respondents frequently mention them together as opportunity/cost trade-offs
- A third (33%) of respondents described the types of Infrastructure, Buildings, and creative work arounds humans would design to live on Mars—domes, pods, farms, and life support systems.
- The Mars landscape was described by 17% of respondents. Some gave objective descriptions (red, rocks, dust, cold, desolate), while others’ descriptions were more subjective (harsh, really cool scenery).
- Some respondents (17%) mentioned specific films and books (The Martian, Total Recall, Robinson Crusoe) or science fiction in general.
- Some (13%) respondents’ responses described the emotions tied to Mars habitation. While a couple individuals described “excitement,” most leaned towards fearful and isolated.

Table 2. What comes to mind when you think about people living on Mars? (n=46)

Theme	%	count
Risks and rewards	39%	18
Infrastructure	33%	15
Fiction/Movies/Books	17%	8
Landscape descriptors	17%	8
Emotions	13%	6
Other	15%	7

Comments may receive multiple codes. Total exceeds 100%

Question 2: What questions do you have about what it would be like to live on Mars? (n=47)

A significant portion of these responses includes themes about **Daily Life, Survival / Traveling Back to Earth**, and the **Climate / Environment of Mars**. Top responses also included questions about **Human Infrastructure**.

- Just over half of (55%) had questions about what daily life would be like. Most of these were tied to how the environment and living arrangements would impact the ways people normally go about their lives (leisure activities, sleep schedules, exercise, health and hygiene).
- A little over a third (38%) of respondents had questions about general survival (both in the short term and long term) and the ability to eventually return to earth.
- Another common line of questions (38%) was related to the climate and environment of Mars. Some questions were around knowledge gaps regarding things like temperature, gravity, impacts on circadian rhythms, while others focused on human adaptation to the environment.
- Just over a quarter of responses (28%) were questions about logistics related to human infrastructure on Mars.

Table 3. What questions do you have about what it would be like to live on Mars? (n=47)

Theme	%	Count
Daily life	55%	26
Climate/environment	38%	18
Survival/return to earth	38%	18
Human infrastructure	28%	13
Other	4%	2

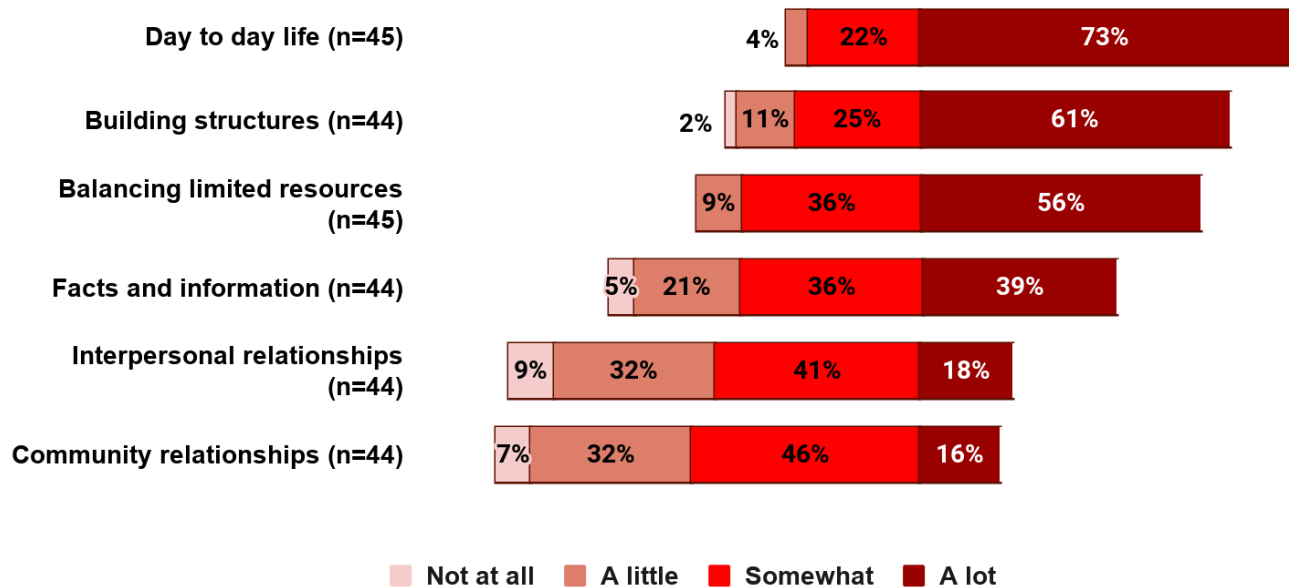
Comments may receive multiple codes. Total exceeds 100%

Exhibit Idea Activities

Question 3: How much would your group enjoy solving problems based on the following ideas or activities? (N=45)

The best liked ideas or activities rated by respondents were about **Day to Day Life (73%, n=45, 95% responded either "Somewhat" or "A lot")**, **Building Structures (61%, n=44)**, and **Balancing Limited Resources**, followed by **Facts and Information**. The two relationship categories (interpersonal and community) received lower ratings from most respondents compared to the other ideas. Respondents more closely aligned with the target audience appear to favor **Building structures** over **Day to day life**. (see Appendix A for more details)

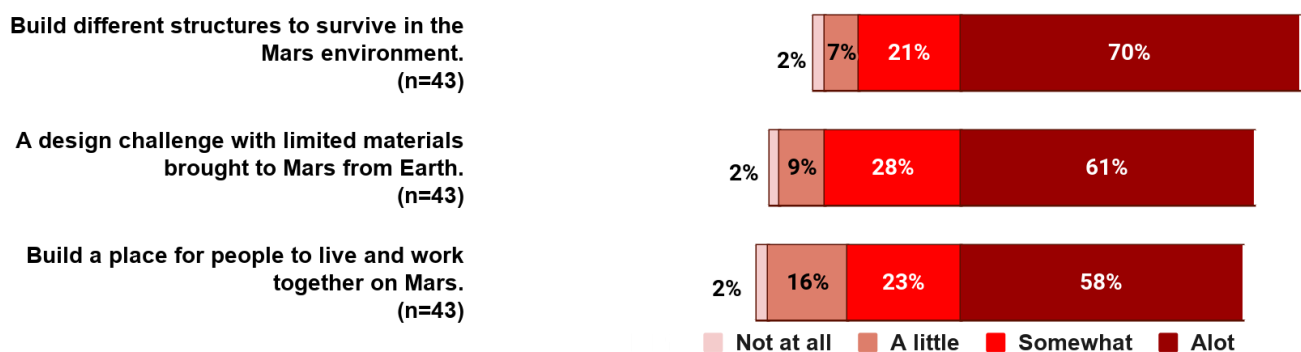
Figure 3. How much would your group enjoy solving problems based on the following ideas or activities?



Question 4: How much do you like the following ideas? (n=43)

The majority of respondents (70%, n=43) said that they liked the **Building Structures to Survive in the Mars Environment** "A Lot". This was followed by **A Design Challenge with Limited Materials Brought from Earth** and **Build a Place for People to Live and Work Together on Mars**. (See Figure 4.)

Figure 4. How much do you like the following ideas?



Question 5: What do you like or dislike about these ideas? (n=36)

The majority of responses indicated a favorable reaction to the ideas (See Table 4). When participants were asked about what they liked, the top themes included **Hands On / Building / Engineering**, the **Challenge Level**, and the potential for **Creativity** involved.

About a fifth of respondents indicated they were thinking about family and social connections in relationship to the activity ideas. In addition, about a third (28%) provided some suggestions, in terms of what could be included. Some of the latter examples are provided below in Table 5.

Table 4. Tone of responses (n=36)

Tone	% mutually exclusive	% with both inclusive	Count
Positive	75%	81%	27
Negative	17%	19%	6
Both	6%		2
Neutral	3%	4%	1

Comments may receive multiple codes. Total exceeds 100%

Table 5. What do you like or dislike about these ideas? (n=36)

Theme	%	Count
Hands on/Building/engineering	39%	14
Challenge level	33%	12
Creativity	25%	9
Suggestion/gap	28%	10
Family and social connections	19%	7
Other	14%	5
Mars Resources	8%	3

A little less than one-third (28%) of respondents offered a suggestion or pointed out a gap in the described experiences. These are summarized in the following list.

- Basic engineering and technical knowledge assistance for kids.
- Compelling stories and exercises to explore.
- Conceptualize how hard it is to get to Mars and land there safely.
- Hands on activities that are quick to understand and start right away.
- A physical experience, not just a computer/virtual experience.
- Include Mars' natural resources and landscapes
- Selection process for people living on Mars.
- The science of what we know will work.
- What has been done in similar situations such as the shuttle and space stations.

Question 6: Is there anything else you'd like to share about any of the questions on this survey? (n=22)

About three-fourths of respondents (73%, n=22) used this space to make other suggestions for the activity – mostly how to make the experience immersive (32%).

Somerpondents reiterated that Mars' resources (23%) should be integrated into the activity, and a few suggestions did not fall into a category (18%). See Table 6.

Table 6. Is there anything else you'd like to share about any of the questions on this survey? (n=22)

Theme	%	Count
Suggestions	73%	13
Immersive experience	32%	7
Mars resources	23%	5
Other suggestions	18%	4
Other, general	9%	2
None/Thanks	27%	6

Comments may receive multiple codes. Total exceeds 100%

Appendices

[Appendix A: Disaggregation by Connection to STEM and Household Composition](#)

[Appendix B: Participant Demographics](#)

[Appendix C: Open Text Responses](#)

[Appendix D: Online Survey Instruments](#)

[Appendix E: Social Media and Email Sharing](#)

Appendix A: Disaggregation by Connection to STEM and Household Composition

About two-thirds of respondents (67%, n=43) report that they or someone in their household works in an occupation that uses Science, Technology, Engineering, or Math, which is not surprising given data collection methods where recruiting occurred primarily among science museum members and audiences who engage with the organization's social media. Over half of respondents (56%, n=43) live with a child in 1st through 8th grade. The activity targets 4th-8th grade family audiences, but some sites will likely have a younger audience, so data collection was expanded to include more grade levels.

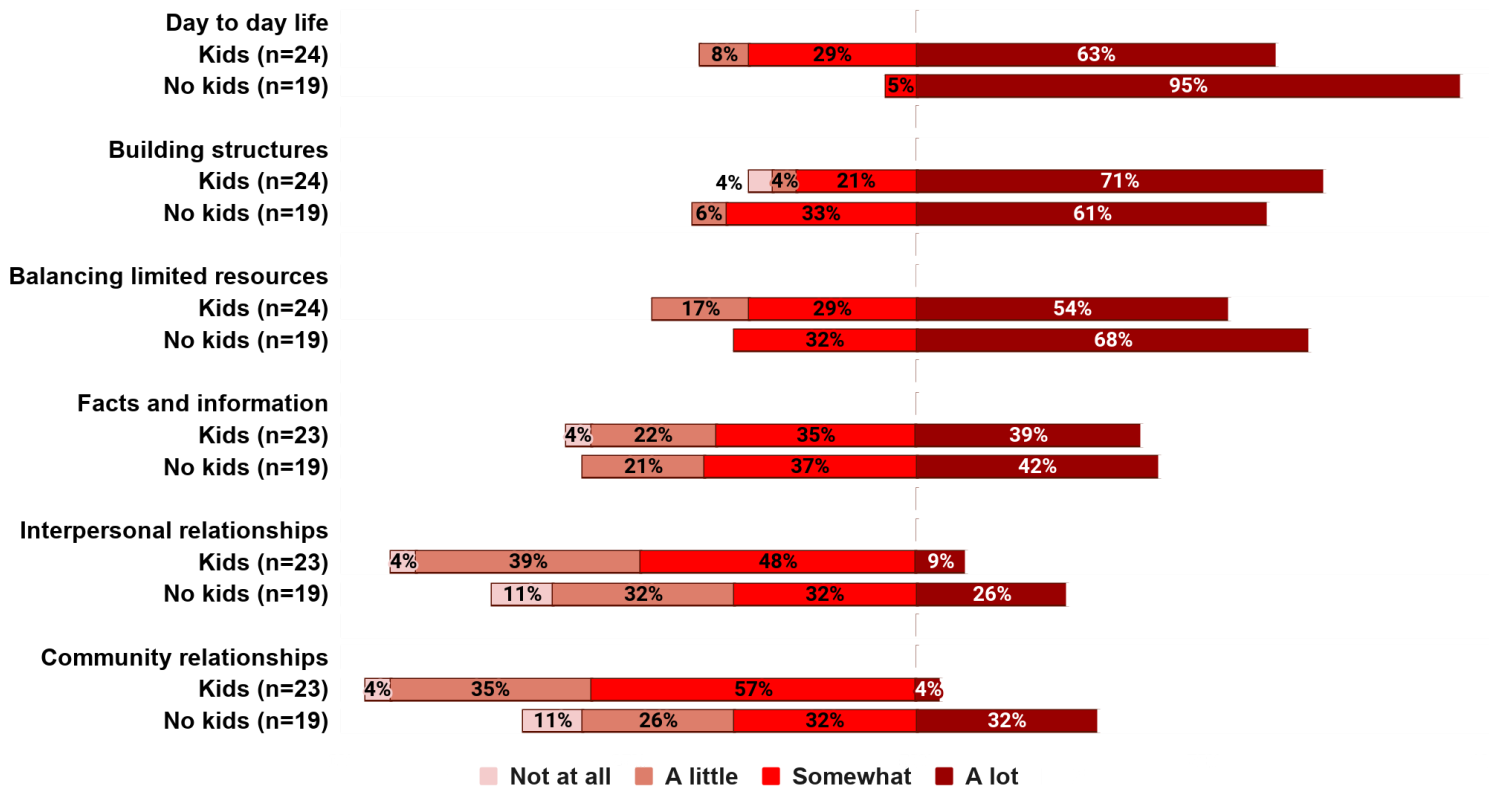
Disaggregating responses by the two characteristics described above (household composition and relationship to STEM) reveals some possible differences and can provide insights regarding ways to best engage a target audience that may not be as familiar with STEM.

One pattern that emerged is respondents with children in the household tended to give lower ratings for both questions across all categories and ideas (i.e., a larger percentage of responses fell into the "Somewhat" and "A little" categories compared to households without children). A possible interpretation of this pattern is that the options offered were biased towards adult audiences, and there are other ideas that would be more exciting to the target audience. It is also possible that benchmark ratings by this demographic tend to be lower in general, and therefore comparable to households without children. Additionally, respondents without a STEM occupational connection gave much higher ratings for each of the three activity scenario ideas than those with a household STEM occupational connection. Both of these patterns may be something to follow up on during the formative evaluation phase.

Question 3: How much would your group enjoy solving problems based on the following ideas or activities?

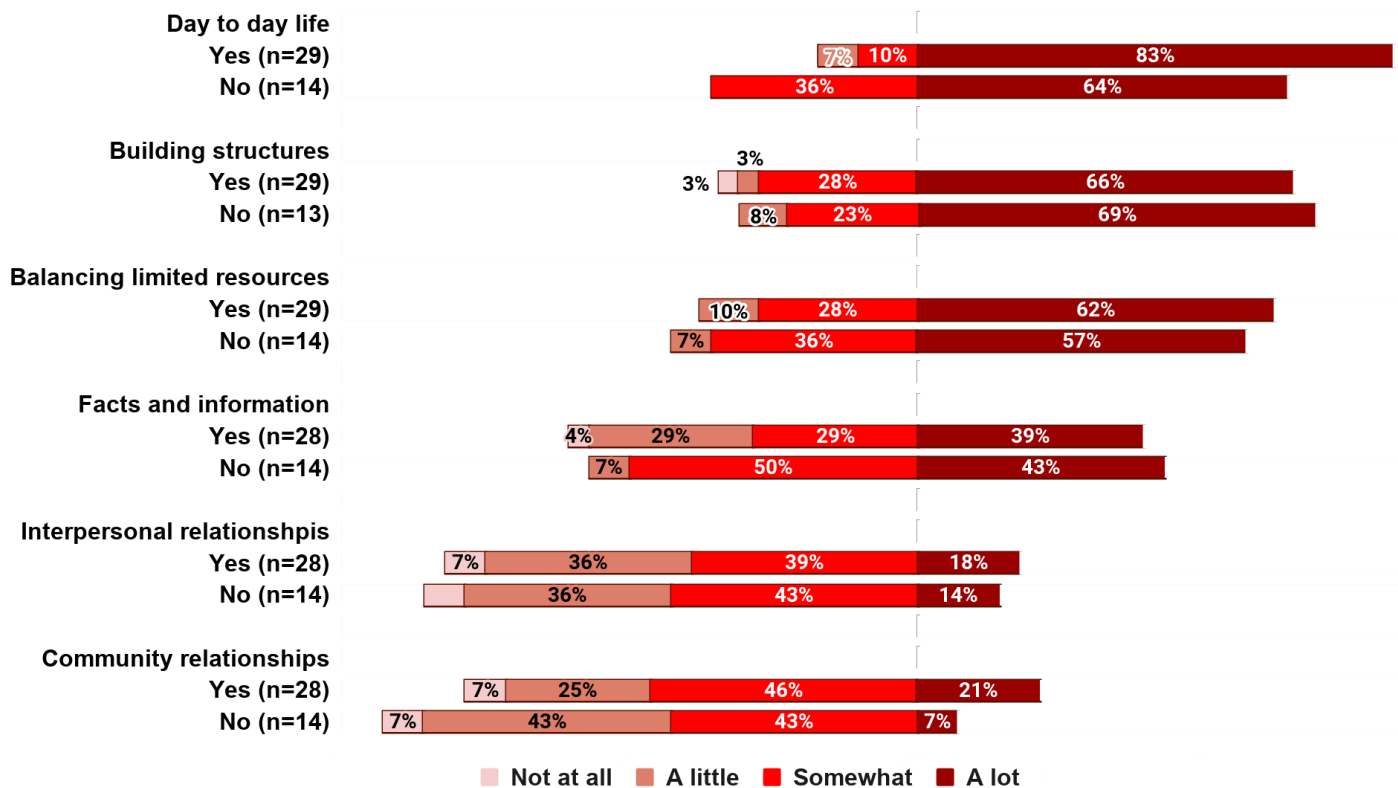
Respondents more closely aligned with the target audience (those with children in grades 1-8) appear to favor the "Building structures" option over "Day to day life," which was given the top rating "a lot" by all but one of the respondents without children in grades 1-8. The facts and information and "relationship" categories still fell to the bottom for both groups, but it is clear that groups in the target audience find these much less enjoyable activity options than other audiences. See Figure 1 below.

Figure 1. How much would your group enjoy solving problems based on the following ideas or activities? by Do any children in 1st through 8th grade live in your household?



Familiarity with STEM appears to follow the trends seen in the overall group, which is likely because respondents with a household occupational connection comprise two-thirds of the sample. An interesting divergence appears with the “Facts and information” category-- nearly all (92%, n=12) of respondents without a STEM occupation in the household said their group would enjoy activities in the category “somewhat” or “a lot” compared to two-thirds (68%, n=28) of those with a STEM occupation connection. Like respondents in the target audience, those who possibly have fewer day-to-day connections with STEM more frequently gave higher ratings to the “Building structures category” than “Day to day life.” See Figure 2 below.

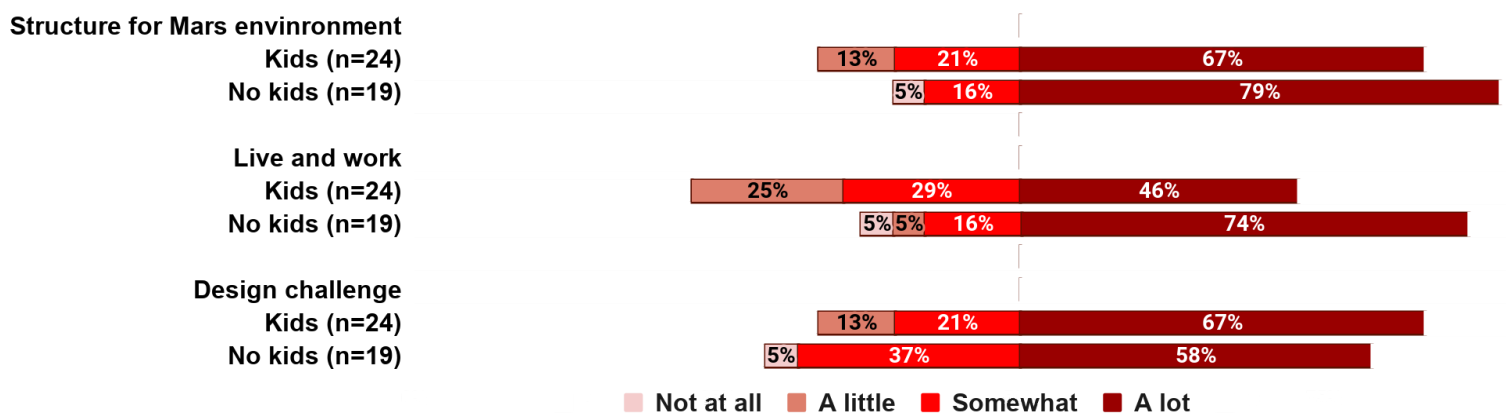
Figure 2. How much would your group enjoy solving problems based on the following ideas or activities? by Do you or anyone in your household work in an occupation that uses Science, Technology, Engineering, or Math?



Question 4: How much do you like the following ideas?

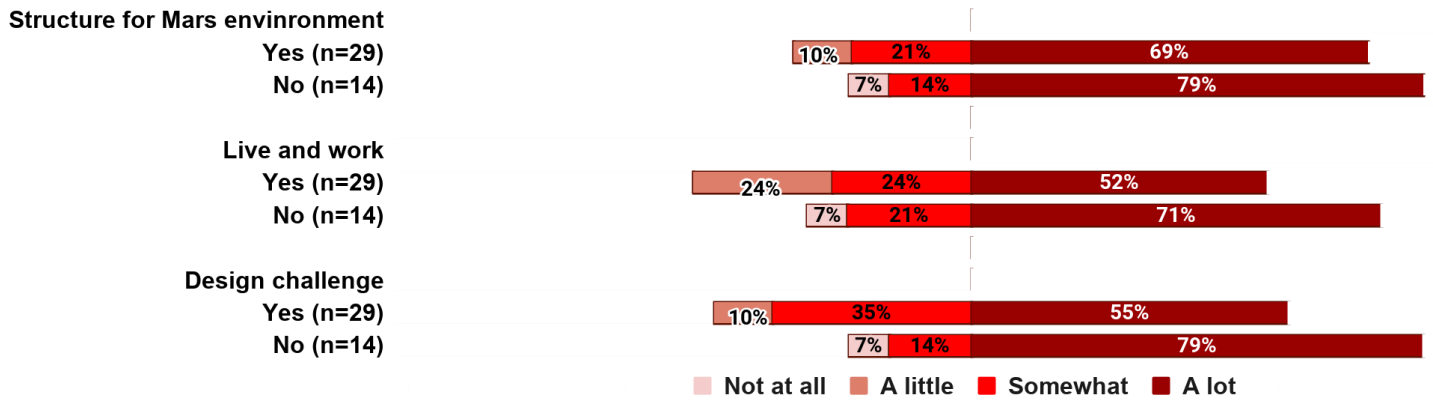
Respondents in the target audience seem to like equally activity ideas around building structures to survive on Mars and activities based on design challenges. An activity based on building living and working spaces was not as appealing to this audience as it was to respondents who do not have kids in the desired grade levels. See Figure 3 below.

Figure 3. How much do you like the following ideas by Do any children in 1st through 8th grade live in your household?



Something to note when considering activity option ratings based on familiarity with STEM, those who do not have that kind of occupational connection in their household tended to indicate they liked every idea much more than their counterparts with a STEM occupational connection. See Figure 4 below.

Figure 4. How much do you like the following ideas by Do you or anyone in your household work in an occupation that uses Science, Technology, Engineering, or Math?



Appendix B: Participant Demographics

Disability

Table 1. Do you, or anyone in your household have a permanent or temporary disability? (n=43)

	% of respondents
Yes*	2%
No	98%

** A single individual indicated they or a group member have a permanent or temporary mobility disability*

Age

Table 2. How old are you? (n=38)

	% of respondents
18-29	5%
30-39	24%
40-49	37%
50-59	18%
60-69	5%
70-79	11%
80+	0%

The participant age range was between 25 and 75.

Gender

Table 3. What is your gender? (n=42)

	% of respondents
Female	60%
Male	41%
Prefer to self-describe	0%

Race or Ethnicity

Table 4. With which racial or ethnic group(s) do you identify? (Select all that apply) (n=40)

	% of respondents
White	85%
Hispanic or Latino/a/x	8%
Asian	3%
Black or African American	3%
Other	3%

Education

Table 5. Which of the following categories best represents your highest level of education? (n=43)

	% of respondents
Graduate Degree	42%
College Degree	41%
Some College	7%
Some Graduate Work	7%
Other	2%

Appendix C: Open Text Responses

(comments may appear under multiple code headers)

Question 1: What comes to mind when you think about people living on Mars? (n=46)

Risks and rewards (18)

Aliens, floating because of no gravity, rocks, hard to eat fresh fruits and veggies, no oxygen.

Attention to detail and checklists. Life would be so dependent on technology and an artificial environment that it would need to be constantly checked and maintained. I imagine each day would have something like an FAA pre-flight checklist to make sure all the life-supporting mechanisms were in perfect working order. Not too sexy. But there would also be an adventurous, pioneering life of exploration that would hopefully make the monotonous routine of sustaining life worth it.

Challenging living conditions

Habitats. New government. Resource challenges. Successes and failures. The movie, Total Recall (the original one).

Harsh environment!

Harsh environment.

I think of the dangers involved but also of the incredible opportunities for scientific discovery.

Isolation. Alone. Pioneers.

Lack of water and air

Lots of things! For the rewards of this, the chance for humans to live on another world, the potential discovery of life on another planet, the excitement and learning for all of humanity that will be gained from such an endeavor, the advancement of science and tech that is part of this. For risks, the long trip there, the isolation, the dangers and risks they will face including radiation exposure, zero g in flight and 1/3 g on Mars. But

My husband's dreams about the future of our species.

Oxygen- how will we survive? Water sources? Healthcare, sustainability

Small communities, indoor activities, no gravity, difficulty living.

Small spaces, self sustainable, creative, one way ticket.

the movie The Martian Exciting, isolated extreme weather, constant danger because can't be outside unprotected unique farming techniques scientific advances

Water, food, getting back to earth

What will they eat? It's a pretty inhospitable environment. In some ways, it seems almost like living through this pandemic, in that you would likely be trapped in a small space with just a few other people.

Where the water will come from, growing vegetables and grains in Martian soil, what will happen to their bodies after years living with that lower gravity, how the colonists will govern themselves, will the colony be able to become self-sustaining.

Infrastructure (15)

Air supply, water, and food would come from ?

Attention to detail and checklists. Life would be so dependent on technology and an artificial environment that it would need to be constantly checked and maintained. I imagine each

day would have something like an FAA pre-flight checklist to make sure all the life-supporting mechanisms were in perfect working order. Not too sexy. But there would also be an adventurous, pioneering life of exploration that would hopefully make the monotonous routine of sustaining life worth it.

cities under giant bubbles

Desolate landscapes and cold nights. And also highly structured and controlled living environments.

Domes, people in space suits, lots of red rocks and dust.

Futuristic biodomes connecting to form a city.

Glass domes

Growing plants to create oxygen.

Habitats. New government. Resource challenges. Successes and failures. The movie, Total Recall (the original one).

Large indoor colonies with big rooms filled with plants. Like a biodome.

Living in geodesic domes, and only going outside in a cumbersome hazmat-type suit.

Shelter pod domes or tunnels from the hot elements. Human habitat structure

Small communities, indoor activities, no gravity, difficulty living.

The movie the Martian. Space suits, rovers, habitats & really cool scenery.

Where the water will come from, growing vegetables and grains in Martian soil, what will happen to their bodies after years living with that lower gravity, how the colonists will govern themselves, will the colony be able to become self-sustaining

Fiction/Movies/Books (8)

Habitats. New government. Resource challenges. Successes and failures. The movie, Total Recall (the original one).

I remember reading Andy Weir's "The Martian".

Matt Damon and Elon Musk.

Robinson Crusoe.

Science fiction movies

The book by Andy Weir and the movie, MARS; growing plants on MARS. Potatoes??

The movie The Martian Exciting, isolated extreme weather, constant danger because can't be outside unprotected unique farming techniques scientific advances.

The movie the Martian. Space suits, rovers, habitats & really cool scenery.

Landscape descriptors (8)

Desolate landscapes and cold nights. And also highly structured and controlled living environments.

Domes, people in space suits, lots of red rocks and dust.

Harsh environment!

Red

Shelter pod domes or tunnels from the hot elements. Human habitat structure the harsh environment

The movie the Martian. Space suits, rovers, habitats & really cool scenery.

Where the water will come from, growing vegetables and grains in Martian soil, what will happen to their bodies after years living with that lower gravity, how the colonists will govern themselves, will the colony be able to become self-sustaining

Emotions (6)

Cold. Dangerous. Lonely.

Desolation, isolation, self sufficiency, fear.

Isolation. Alone. Pioneers.

Loneliness.

Lots of things! For the rewards of this, the chance for humans to live on another world, the potential discovery of life on another planet, the excitement and learning for all of humanity that will be gained from such an endeavor, the advancement of science and tech that is part of this. For risks, the long trip there, the isolation, the dangers and risks they will face including radiation exposure, zero g in flight and 1/3 g on Mars. But

The movie The Martian Exciting, isolated extreme weather, constant danger because can't be outside unprotected unique farming techniques scientific advances

Other (7)

Ability to sustain life.

Breathing

Impossible. A silly way to spend a lot of money!

Is it a single country effort or a world effort?

The distant future. Visiting the planet maybe in 20 or 30 years. Living there perhaps in the late 21st century.

We should leave it alone and abide by the oaths taken by this government and others back in 60's to not set foot on the planet

Why not

Question 2: What questions do you have about what it would be like to live on Mars?

(n=47)

Daily Life (26)

An accurate view -- we've seen the Hollywood version; what would the reality be? How will it be different from how people live on earth (aside from the obvious "we don't need life support systems to take a walk here"...)?) what will people eat? how will they spend their time? what natural resources there can they leverage? will they have pets? how big a colony will need to be there to be self-sufficient (is that possible? after how long?)

Could terra forming work since Mars doesn't have a strong magnetic field? Could an artificial magnetic field be produced? If so, could an atmosphere return to Mars? What kind of government would be established, or would there be a wild west period of competing lawless explorers/ventures? Considering multi-billionaires are heavily invested in Mars exploration, it would be only natural that capitalism is exported to the red planet, so will income inequality be assumed? Will caste systems or indentured servitude be normalized? For instance, would poor people "work off" a ticket to Mars, basically enslaving themselves so their children might have access to new opportunities on Mars?

How hard would it be?

How much communication is possible with earth? How will health problems be addressed?

What form of government/society will it be? What level of privacy vs shared living space?

How will the people be selected? What personal items can each person bring?

How people would go outside their homes.

How safe would it be? How would people get back to Earth? What would people do on Mars?
 Just study Mars, or do other things too?

How would life flow and function?

How would we go to the bathroom

How would women's menstrual cycle work without the moon. Would babies be safe? How would humans maintain good mental health without the planet our species first evolved on. What would we eat?

Is there gravity, what can we eat, what does the surface look like, can we swim

What do we have to give up?

What is the gravity like? Can you get regular exercise? What will you do for food and water?
 What will you do for leisure time? How long are the days and nights compared to earth?

What is the gravity like? How will you grow food?

What would a normal day be like? What would I eat and wear? Are there video games? How do I sleep? Would I have friends to play with?

What would daily life look like?

What would the view look like, how would you eat (and go to the bathroom, exercise...daily activities), how would you get your food.

What would you eat? What if you need emergency medical care (hospital)? How would supplies get back and forth from Earth to Mars?

What would you eat? Would you be able to grow your own food? How difficult would it be to walk around on the surface and explore?

When will the first baby (human) be born on Mars? What's the travel time back to Earth?

Where would people get water and food? Would there be a doctor in case of illness or injury?
 And, if colonies are long-term, what provisions would there be for legal matters such as marriage and death?

Where would you be able to go in vacation

Why would anyone want to live on MARS, so maybe interview with the first astronauts who are preparing for the future missions? I read the book, Packing for MARS and I wonder how humans will survive without things like song birds, rain storms, vast expanse of oceans and waves, etc. So many things that make up what it means to physically and psychologically be "human" on Earth.

Will the Longer day be noticeable? How will that be incorporated? Always get an extra half hour of sleep? Info about Suit details. Mobility, hygiene & raising plants? Will animals ever be brought to Mars? How does solar power on Mars compared to Earth?

Would I be able to travel back and forth between Earth and Mars? Or is it a one-way trip? Would I have a job...what would it be?

Would the lack of green drive me crazy?

Would we be able to go outside? Would we be able to breath? How hot will it be?

Climate and Environment (18)

1. Can humans survive on Mars? 2. Can humans come home again since their bodies will become adapted to a 1/3 gravity environment? This could be especially challenging for humans born on Mars since their bodies will be grow in a lower gravity environment and may not be strong enough to withstand the full 1 G of Earth, 3. What will be the effects of radiation on those living on Mars? 4. Will we discover life? 5. How will they be able to deal with the fine dust all over Mars? 6. What resources can we use on Mars to help us survive?

7. Can we grow our own food there? 8. Can we set up closed loop recycling systems like creating compost out of our waste to grow food there?

A world without plants or trees? I don't know how to get my head around that.

Air, water, temperature

Could it be terraformed for better habitability?

Could terraforming work since Mars doesn't have a strong magnetic field? Could an artificial magnetic field be produced? If so, could an atmosphere return to Mars? What kind of government would be established, or would there be a wild west period of competing lawless explorers/ventures? Considering multi-billionaires are heavily invested in Mars exploration, it would be only natural that capitalism is exported to the red planet, so will income inequality be assumed? Will caste systems or indentured servitude be normalized? For instance, would poor people "work off" a ticket to Mars, basically enslaving themselves so their children might have access to new opportunities on Mars?

How much gravity. The make-up of the atmosphere. The dangers other than temperature and lack of oxygen.

How to recycle air and water. Growing food on Mars. Ability to use Martian soil for cultivation.

How would an emergency evacuation possibly happen?

Is the ground capable of growing food. Is the climate ideal for living?

Is there gravity, what can we eat, what does the surface look like, can we swim

Is there oxygen in Mars?

What are the long term effects of zero g and less than earth gravity?

What is the average temperature on Mars? Does the planet experience seasons like on Earth?

What resources could be found on Mars? What would be the objective for a Mars base?

What would you eat? Would you be able to grow your own food? How difficult would it be to walk around on the surface and explore?

Why would anyone want to live on MARS, so maybe interview with the first astronauts who are preparing for the future missions? I read the book, Packing for MARS and I wonder how humans will survive without things like song birds, rain storms, vast expanse of oceans and waves, etc. So many things that make up what it means to physically and psychologically be "human" on Earth.

Will the longer day be noticeable? How will that be incorporated? Always get an extra half hour of sleep? Info about suit details. Mobility, hygiene & raising plants? Will animals ever be brought to Mars? How does solar power on Mars compared to Earth?

Would the lack of green drive me crazy?

Would we be able to go outside? Would we be able to breathe? How hot will it be?

Survival/return to earth (18)

1. Can humans survive on Mars? 2. Can humans come home again since their bodies will become adapted to a 1/3 gravity environment? This could be especially challenging for humans born on Mars since their bodies will be grown in a lower gravity environment and may not be strong enough to withstand the full 1 G of Earth, 3. What will be the effects of radiation on those living on Mars? 4. Will we discover life? 5. How will they be able to deal with the fine dust all over Mars? 6. What resources can we use on Mars to help us survive? 7. Can we grow our own food there? 8. Can we set up closed loop recycling systems like creating compost out of our waste to grow food there?

An accurate view -- we've seen the Hollywood version; what would the reality be? How will it be different from how people live on earth (aside from the obvious "we don't need life support systems to take a walk here"...)?) what will people eat? how will they spend their time? what natural resources there can they leverage? will they have pets? how big a colony will need to be there to be self-sufficient (is that possible? after how long?)

Could terra forming work since Mars doesn't have a strong magnetic field? Could an artificial magnetic field be produced? If so, could an atmosphere return to Mars? What kind of government would be established, or would there be a wild west period of competing lawless explorers/ventures? Considering multi-billionaires are heavily invested in Mars exploration, it would be only natural that capitalism is exported to the red planet, so will income inequality be assumed? Will caste systems or indentured servitude be normalized? For instance, would poor people "work off" a ticket to Mars, basically enslaving themselves so their children might have access to new opportunities on Mars?

How much communication is possible with earth? How will health problems be addressed? What form of government/society will it be? What level of privacy vs shared living space? How will the people be selected? What personal items can each person bring?

How safe would it be? How would people get back to Earth? What would people do on Mars? Just study Mars, or do other things too?

How to recycle air and water. Growing food on mars. Ability to use martian soil for cultivation. How would an emergency evacuation possibly happen?

How would people communicate back to Earth? Would it always be on a delay?

How would women's menstrual cycle work without the moon. Would babies be safe? How would humans maintain good mental health without the planet our species first evolved on. What would we eat?

It is hard to imagine it being self sustaining

See answers to previous question [Where the water wii come from, growing vegetables and grains in Martian soil, what will happen to their bodies after years living with that lower gravity, how the colonists will govern themselves, will the colony be able to become self-sustaining]

Sources of water food & energy

Sustainability. Plant life and oxygen

What are the long term effects of zero g and less than earth gravity?

What would you eat? What if you need emergency medical care (hospital)? How would supplies get back and forth from Earth to Mars?

When will the first baby (human) be born on Mars? What's the travel time back to Earth?

Where would people get water and food? Would there be a doctor in case of illness or injury? And, if colonies are long-term, what provisions would there be for legal matters such as marriage and death?

Why would anyone want to live on MARS, so maybe interview with the first astronauts who are preparing for the future missions? I read the book, Packing for MARS and I wonder how humans will survive without things like song birds, rain storms, vast expanse of oceans and waves, etc. So many things that make up what it means to physically and psychologically be "human" on Earth.

Would I be able to travel back and forth between Earth and Mars? Or is it a one-way trip? Would I have a job...what would it be?

Human infrastructure (13)

Could it be terraformed for better habitability?

Could terra forming work since Mars doesn't have a strong magnetic field? Could an artificial magnetic field be produced? If so, could an atmosphere return to Mars? What kind of government would be established, or would there be a wild west period of competing lawless explorers/ventures? Considering multi-billionaires are heavily invested in Mars exploration, it would be only natural that capitalism is exported to the red planet, so will income inequality be assumed? Will caste systems or indentured servitude be normalized? For instance, would poor people "work off" a ticket to Mars, basically enslaving themselves so their children might have access to new opportunities on Mars?

How much communication is possible with earth? How will health problems be addressed?

What form of government/society will it be? What level of privacy vs shared living space?

How will the people be selected? What personal items can each person bring?

How much space to live in?

How much would it cost?

How safe would it be? How would people get back to Earth? What would people do on Mars?

Just study Mars, or do other things too?

How to recycle air and water. Growing food on mars. Ability to use martian soil for cultivation.

How would an emergency evacuation possibly happen?

How will they breathe? Is farming possible? How will they get water? What sort of government will they have?

See answers to previous question [Where the water wii come from, growing vegetables and grains in Martian soil, what will happen to their bodies after years living with that lower gravity, how the colonists will govern themselves, will the colony be able to become self-sustaining]

Sources of water food & energy

Sustainability. Plant life and oxygen

What are some of the big technological gaps that we still need to fill to make it possible? Who will go? How long will they stay?

Where would people get water and food? Would there be a doctor in case of illness or injury?

And, if colonies are long-term, what provisions would there be for legal matters such as marriage and death?

Other (2)

None, we should focus on the moon instead. Like what effects on the body would we expect due to less gravity or how would we protect ourselves from solar radiation since the earths magnetic field and atmosphere wouldn't protect us.

What resources could be found on Mars? What would be the objective for a Mars base?

Question 5: What do you like or dislike about these activity ideas? (n=36)

Hands on/Building/engineering (14)

Positive (11)

Building things!

Hands on is always fun for my boys.

Hands on. Active learning.

I like that they engage creativity and potentially building materials for a more hands-on, problem-solving experience.

I like the challenge of working with limited resources. It reminds me of *The Martian* (book/movie). I also like the idea of designing different structures depending on location e.g. near the ice cap vs top of mountain or deep in a gorge and purpose of the structure e.g. emergency shelter vs science lab vs long term living quarters.

I like the more specific ideas, building structures to survive, places to live over the more general design challenge.

The opportunity to build something makes it more real and easier to comprehend. We all need a place to live and work.

They all involved building and were open-ended.

They are all open ended activities that involve creatively solving the challenges of living and surviving on Mars. As a long time educator about science, the environment and Mars, I have found that creating fun engineering challenges is a great way to engage youth ages 8+ especially.

They seem fun. I think the biggest thing would be to have some kind of physical experience, not just a computer/virtual experience of the exercise.

They're all about building/engineering solutions, which is cool. I'd personally be more interested in helping conceptualize how hard it is to get to Mars and land there safely. That's such a monumental thing to attempt.

Both (1)

Limited material design really makes you think about solving problems differently. I think it is too hard for people to understand how different the environment is on Mars and therefore building a place for people to live would not stretch the brain as much.

Negative (1)

I'd worry about the design challenge being too complicated, and the other two potentially being too simple. When I was younger and visited science museums, I most enjoyed hands on activities that were quick to understand enough to start right away. And if they were challenging and interesting enough, I'd stay quite a while.

Neutral (1)

Will there be assistance with basic engineering and technical knowledge? If not, will they still be fun or potentially become frustrating for many kids?

Challenge level (12)

Positive (8)

I like that they engage creativity and potentially building materials for a more hands-on, problem-solving experience.

I like the challenge of working with limited resources. It reminds me of *The Martian* (book/movie). I also like the idea of designing different structures depending on location e.g. near the ice cap vs top of mountain or deep in a gorge and purpose of the structure e.g. emergency shelter vs science lab vs long term living quarters.

I like the working out of the ideas. Kids not being told how it is but thinking it out for themselves.

I want to learn about the science of what we know will work and learn about what has been done in similar situations such as the shuttle and space stations. I like the idea of problem solving and how to use a limited set of materials for multiple tasks.

The challenge

They all sound neat and fun and challenging

They are all open ended activities that involve creatively solving the challenges of living and surviving on Mars. As a long time educator about science, the environment and Mars, I have found that creating fun engineering challenges is a great way to engage youth ages 8+ especially.

They're all about building/engineering solutions, which is cool. I'd personally be more interested in helping conceptualize how hard it is to get to Mars and land there safely. That's such a monumental thing to attempt.

Negative (2)

I have seen them before, in fact I think I have written a few, and building a habitat with limited materials that must survive a _____. Seems too basic; I think there must be more compelling stories and exercises to explore with visitors.

I'd worry about the design challenge being too complicated, and the other two potentially being too simple. When I was younger and visited science museums, I most enjoyed hands on activities that were quick to understand enough to start right away. And if they were challenging and interesting enough, I'd stay quite a while.

Both (1)

Limited material design really makes you think about solving problems differently. I think it is too hard for people to understand how different the environment is on Mars and therefore building a place for people to live would not stretch the brain as much.

Neutral (1)

Will there be assistance with basic engineering and technical knowledge? If not, will they still be fun or potentially become frustrating for many kids?

Creativity (9)

Positive (9)

Creative and practical. Realistic

Get to use ideas I'm used to

I like that they engage creativity and potentially building materials for a more hands-on, problem-solving experience.

I like the concepts and creativity

I like the Simulation idea. I used to play this game called Outpost on the PC and it was fascinating to build a colony on another planet.

I like the working out of the ideas. Kids not being told how it is but thinking it out for themselves.

The science involved to make it work.

They are all open ended activities that involve creatively solving the challenges of living and surviving on Mars. As a long time educator about science, the environment and Mars, I have found that creating fun engineering challenges is a great way to engage youth ages 8+ especially.

Working with constraints is a great way to fuel creativity and make it more realistic. Kids would benefit from both.

Family and social connections (7)

Positive (7)

Hands on is always fun for my boys.

I can see my husband geeking out about this with my oldest kid.

I realize the fact that if there is life in Mars we will need each other and we will have to work as a team. Currently, there is a lot of division going out in the world and so I think the people who get to live in Mars will have to be carefully selected.

I think my children would enjoy these activities

Kids will like.

They all sound like something our family would enjoy participating in.

Working with constraints is a great way to fuel creativity and make it more realistic. Kids would benefit from both.

Mars resources (3)

Positive (1)

I like the challenge of working with limited resources. It reminds me of The Martian (book/movie). I also like the idea of designing different structures depending on location e.g. near the ice cap vs top of mountain or deep in a gorge and purpose of the structure e.g. emergency shelter vs science lab vs long term living quarters.

Negative (1)

Missing is what Mars resources can be used in the project.

Both (1)

I like the challenge of using earth materials in a very different environment. I don't like that they don't use any of Mars' natural resources.

Other (5)

Positive (2)

Personalized

The science involved to make it work.

Negative (3)

Mars should be left alone.

None of it touches on the actual planet. It's all the colony.

Seem like I've done them before

Question 6: Is there anything else you'd like to share about any of the questions on this survey? (n=22)

Suggestions (13)

Immersive experience (7)

Develop a way for kids to experience the intense difference in the environment - heat, humidity, light, dark, dusty, no O₂, etc.

I'd like a hands on information about what the planet is like. Rock formation to climb on, demonstrations about gravity on Mars, oxygen/ air quality

I don't know that this would be feasible, but it might be interesting to create an immersive experience -- what does Mars look and feel like? Use surround video in a contained space, adjust the temperature and humidity, have a bouncy floor to simulate the weaker gravity, etc.

I think developing an interactive display of life on Mars would help children realize the hardships they may face.

I'd like there to be some background music, specifically The Planets orchestra piece by Holz with emphasis on Mars: Harbinger of War. Such great music to play in the background. Perhaps a collaboration with the Minnesota Orchestra?

It would be cool if the activity put the user into the activity from a 'you' day in the life thing like you said. Like pick a role, what your day looks like. Vs having to figure out how to play ceo for the development of mars. But maybe the development is the goal of the activity. More fun to imagine yourself in it vs construction of it and community.

This sounds like a great project. I would encourage you to use as many real images and data from NASA and other space agencies as you can so that participants really get a sense of what Mars is like. Would it be possible to create an immersive simulation of what the surface is like? I really liked all the landscape images created in the movie the Martian as they looked and felt very realistic.

Mars resources (5)

Again the exhibit or activity should include what opportunities a Mars base would provide

Develop a way for kids to experience the intense difference in the environment - heat, humidity, light, dark, dusty, no O₂, etc.

I'd like a hands on information about what the planet is like. Rock formation to climb on, demonstrations about gravity on Mars, oxygen/ air quality.

Water is a question and the importance of it.

What resources would accompany a long deployment? How would resources be replenished?

Other suggestions (4)

I wonder if there is a way to engage my 8-year-old, unicorn-loving, favorite-color-is-pink girl as much as my adventure-loving 11-year-old boy.

Life on Mars (past & present).

Yes, highlight the fact that we if are not careful, it will be corporations and not governments that would run things and ultimately pollute the planet.

I have 4 kids and would love a hands on exhibit. Makes learning more fun!

Other, general (2)

Pass the survey to public school PTA, let more people join the survey.

What would the goal of the exhibit be?

None/Thanks (6)

No. (2)

Nope. (2)

Nothing other than to say this is a good idea and I hope the final version meets your goals.

Thanks for your help. Good luck putting it together. Have fun with it!

Appendix D: Online Survey Instruments

Mars Habitat - English Version

[Change the survey language with the drop down in the upper right-hand corner

Cambie el lenguaje de la encuesta usando el menu localizado a mano derecha y hacia arriba de su pantalla.]

Thank you for your interest in helping us develop a new activity about Mars! All of your opinions and thoughts will be used to help the people creating a new exhibit activity.

Here's some important information about your participation:

- We are only looking for adult respondents: You are encouraged to ask for youth perspectives, but the individual answering these questions must be at least 18 years old.
- Participation is voluntary: You may answer these questions with as much detail as you want, skip any questions, or stop taking the survey at any point.
- Your responses will be anonymous: No information will be collected that could identify you.

If you encounter problems or have any questions about this survey, please contact Gretchen Haupt, Science Museum of Minnesota, Evaluation & Research Associate (ghaupt@smm.org).

Thanks again for your help with this project!

This material is based upon work supported by NASA under Grant Number 80NSSC20M0030. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Aeronautics and Space Administration (NASA).

1) What comes to mind when you think about people living on Mars?

2) What questions do you have about what it would be like to live on Mars?

Imagine you are at the museum with at least one other person between the ages of 8 and 13 in your group. You are visiting a hands-on museum exhibit about Earth and space science that includes an activity about people living on Mars.

3) How much would your group enjoy solving problems based on the following ideas or activities?

	Not at all	A little	Somewhat	A lot
Balancing limited resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Building structures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facts and information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interpersonal relationships	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community relationships	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Day to day life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below are three ideas for an activity about living on Mars. These are just basic concepts and are not fully realized activities yet. We want to know how much you like them, and what makes them appealing or not.

4) How much do you like the following ideas?

	Not at all	A little	Somewhat	A lot
A design challenge with limited materials brought to Mars from Earth.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Build a place for people to live and work together on Mars.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Build different structures to survive in the Mars environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5) What do you like or dislike about these activity ideas?

6) Is there anything else you'd like to share about any of the questions on this survey?

For these final questions, we want to know a little bit about you. The project team prioritizes equity, access, and inclusion in STEM, and in order to understand where gaps exist in our programming, it is essential to understand who our participants are and to identify any differences in experience. You may skip any or all of these questions.

7) What is/are the primary language(s) spoken in your household?

8) Do you or anyone in your household work in an occupation that uses Science, Technology, Engineering, or Math?

- Yes
- No
- Prefer not to answer

9) Do any children in 1st through 8th grade live your household?

- Yes, full time
- Yes, part time
- No
- Prefer not to answer

10) Do you, or anyone in your household have a permanent or temporary disability?

- Yes
- No
- Prefer not to say

11) How would you describe the disability? (Select all that apply)

- Mobility
- Learning
- Visual
- Cognitive
- Auditory
- Other::

12) How old are you?

13) What is your gender?

- Male
- Female
- Prefer to self-describe::
- Prefer not to say

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

- American Indian or Alaskan Native
- Asian
- Black or African American
- Hispanic or Latino/a/x
- Native Hawaiian or Pacific Islander
- White
- Other::
- Prefer not to say

15) Which of the following categories best represents your highest level of education?

- Some high school
- High school degree
- Some college
- College degree
- Some graduate work
- Graduate degree
- Other::
- Prefer not to say

Thanks so much for sharing your feedback and ideas!

The exhibit we are building won't be in your museum for a while, so we wanted to give you an opportunity to explore Mars right now! Visit the following links to learn more about Mars and to access some fun activities.

- Create fun photos with the Mars photo booth, vote on your favorite photos, play a game, and listen to sounds of Mars: [Mars Activities](#)
- Learn more about the NASA Mars Perseverance Rover here: [Perseverance Rover](#)
- Learn more about the planet Mars here: [About Mars](#)

Mars Habitat / La Vida en Marte Survey Instrument - Spanish Version

Change the survey language with the drop down in the upper right-hand corner **Cambie el lenguaje de la encuesta usando el menu localizado a mano derecha y hacia arriba de su pantalla.**

¡Gracias por su interés en ayudarnos a desarrollar una nueva exhibición sobre el planeta Marte! Lo siguiente es información importante sobre su participación:

Nada más estamos buscando participantes adultos. Puede responder las preguntas con la participación de menores, pero el individuo que complete la encuesta tiene que tener a lo menos 18 años.

Su participación es voluntaria. Puede responder las preguntas con cuanto detalle quiera, puede elegir no responder a cualquier pregunta, y también puede terminar la encuesta en cualquier momento. Sus respuestas serán anónimas. Ninguna de la información será colectada que le pueda identificar.

Si tiene algún problema o tiene alguna pregunta sobre esta encuesta, por favor póngase en contacto con Hever Velázquez, Science Museum of Minnesota, Evaluation & Research Associate (hvelazquez@smm.org).

¡Gracias por su ayuda con este proyecto!

This material is based upon work supported by NASA under Grant Number 80NSSC20M0030. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Aeronautics and Space Administration (NASA).

1) ¿Qué le viene a la mente cuando piensa en humanos viviendo en Marte?

2) ¿Qué preguntas tiene sobre cómo sería vivir en Marte?

Imagine que está en el museo con a lo menos otra persona de edad entre 8 y 13 años en su grupo. Están visitando una exhibición para uso interactivo sobre la ciencia de la Tierra y el espacio, que incluye una actividad sobre humanos viviendo en Marte.

3) ¿Cuánto piensa que le encantaría a su grupo resolver problemas basadas en las siguientes actividades?

	Nada	Un poco	Algo	Mucho
El equilibrio de recursos limitados	()	()	()	()
Construyendo estructuras	()	()	()	()
Datos e informacion	()	()	()	()
Relaciones interpersonales	()	()	()	()
Relaciones comunitarias	()	()	()	()
La vida cotidiana	()	()	()	()

Las siguientes tres ideas son para una actividad sobre cómo sería vivir en Marte. Estas ideas nada más son conceptos básicos que no están completamente desarrollados. Queremos saber cuánto le encantan, y que es lo que las hace agradables o no.

4) ¿Cuánto le encantan las siguientes ideas?

	Nada	Un poco	Algo	Mucho
Un reto de diseño con materiales limitados traídos a Marte desde la Tierra.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Construir un lugar para humanos para vivir y trabajar juntos en Marte.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Construir diferentes estructuras para sobrevivir el medio ambiente de Marte.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5) ¿Qué es lo que le gusta o no le gusta de estas ideas?

6) ¿Hay algo más que le gustaría compartir sobre cualquier pregunta en esta encuesta?

El Science Museum of Minnesota considera la equidad, el acceso, y la inclusión en la educación informal de la Ciencia, Tecnología, Ingeniería, y Matemáticas, como cosas importantes para entender las diferencias en la participación y experiencias de la audiencia pública en nuestros programas y entender quienes son nuestros participantes. Puede omitir algunas o todas las preguntas.

7) ¿Cuál es el lenguaje(s) que se habla más en su hogar?

8) ¿Usted o alguna otra persona en su hogar trabaja en un oficio donde se usa la ciencia, tecnología, ingeniería, o matemáticas?

- Si
- No
- Prefiero no contestar

9) ¿Viven niños entre los grados 1 y 8 en su hogar?

- Si, tiempo completo
- Si, medio tiempo
- No
- Prefiero no contestar

10) ¿Tiene usted o alguna persona que lo haya acompañado una discapacidad permanente o temporal?

- Si
- No
- Prefiero no contestar

11) ¿Cómo describiría la discapacidad? (Elija todas las opciones que correspondan)

- De movilidad
- De aprendizaje
- Visual
- Cognitiva
- Auditiva
- Otro; por favor especifique::
- Prefiero no contestar

12) ¿Cuál es su edad?

13) ¿Cuál es su género?

- Masculino
- Femenino
- Otro; por favor especifique::
- Prefiero no contestar

14) ¿Con cuál(es) grupo(s) racial(es) o étnico(s) se identifica? (Elija todas las opciones que correspondan)

- Nativo/a de América del Norte/ Nativo/a de Alaska
- Asiático/a
- Negro/a o Afroamericano/a
- Hispano/a o Latino/a/x
- Nativo/a de Hawai'i/ Islas del Pacífico/a
- Blanco/a
- Otro; por favor especifique::
- Prefiero no contestar

15) ¿Cuál de las siguientes categorías es la que mejor representa su nivel más alto de educación?

- Algo de educación de secundaria
- Diploma de secundaria
- Algo de educación universitaria
- Diploma universitaria
- Algo de educación pos-universitaria
- Diploma pos-universitaria
- Otro; por favor especifique::
- Prefiero no contestar

¡Gracias por compartir sus opiniones e ideas!

La exhibición que estamos desarrollando no estará en su museo hasta dentro de un poco tiempo, y queremos darle la oportunidad de explorar a Marte ahora! Visite cualquier de estas contraseñas para aprender más sobre el planeta Marte y poder disfrutar de actividades relacionadas.

- Tome fotos con el Mars photo booth, vote por sus fotos favoritas, juegue un juego, y escuche los sonidos de Marte: [Actividades de Marte](#)
- Aprenda más sobre el NASA Mars Perseverance Rover: [Perseverance Rover](#)
- Descubra más sobre Marte: [Sobre Marte](#)

Appendix E: Social Media and Email Sharing

[PLEASE ADJUST AS NEEDED FOR YOUR ORGANIZATION'S TONE AND STYLE]

Banner image (courtesy of Darrell)



Here is some suggested language for an email invite to take the front end survey:

Dear [name],

Have you ever wondered what it would be like to live on Mars? Exhibit developers working with [YOUR ORGANIZATION NAME] want to know! If you have a few minutes, click on the link below to share your thoughts and help us design a new NASA funded activity for the Sun Earth Universe exhibit. We are especially interested in hearing from households with children in 4th-8th grade.

[Click here to complete a 5-minute survey](#)

[Link here]

Thank you so much!

[your signature]

Here is the language for a FB-style social media post (emojis are optional)

🚀 What comes to mind when you think about living on Mars? 🚀 Help us develop a new NASA funded museum activity for families by using the survey link below! 🙋 We are especially interested in hearing from households with kids in grades 4-8. 👨👩 Take the survey and please share it far and wide with colleagues, parent networks, and other adults connected with your museum? [Link here]

Here is language for a Twitter post (emojis still optional)

🚀 What comes to mind when you think about living on Mars? 🚀 Help us develop a new NASA funded museum activity for families by using the survey link below! 🗣️ We are especially interested in hearing from households with kids in grades 4-8.

[Link here]