Activity Two: Isolation and Confinement

Educator Notes

Learning Objectives

Students will

- Research the hazards of isolation.
- Explore various analog facilities such as HERA (Human Exploration Research Analog) and NEK (Nezemnyy Eksperimental'nyy Kompleks) and studies such as SIRIUS (Scientific International Research In a Unique terrestrial Station) and USAP (U.S. Antarctic Program) and identify their research objective.
- Present a proposal that includes a company name, mission patch, and mitigation solution plan.
- Describe the ways NASA attempts to mitigate the negative effects of isolation and confinement on astronauts.

Challenge Overview

Teams of students will form a company to research the deep space hazards of isolation and confinement using various NASA resources and research. Teams will be instructed to select two or more CONNECT (Community, Openness, Networking, Needs, Expeditionary Mindset, Countermeasures, and Training) mitigation techniques and design a solution plan and an optional prototype, a company name, a mission patch, and a proposal to "sell" their company's idea to a simulated NASA panel.

Suggested Pacing

120 to 180 minutes (up to 1 week of sessions)

National STEM Standards

Science and Engineering (NGSS)	
Disciplinary Core Ideas • MS-LS2.D: Social Interactions and Group Behavior: Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. • MS-LS1-5: Structures and Processes: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	*Crosscutting Concepts* • Cause and Effect: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Technology (ISTE)	
Standards for Students • Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences. • Digital Citizen: Students recognize the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical. • Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts, and make meaningful learning experiences for themselves and others.	*Standards for Students (continued)* • Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful, or imaginative solutions. • Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats, and digital media appropriate to their goals. • Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.
ELA/Literacy (CCSS)	
ELA/Literacy • RST.9-10.8: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-8) • RST.11-12.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-8)	*ELA/Literacy (continued)* • RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, and multimedia) in order to address a question or solve a problem. (HS-LS2-8) • RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-8)

Challenge Preparation

The educator should

- Read the introduction and background information and Educator Notes.

- Review "Houston We Have a Podcast, Episode 58: Hazard 2: Isolation." Note: Educators may opt to assign this as listening homework ahead of time. A time stamp document is included after the Student Handbook.
- Review the CONNECT mitigation techniques that are defined and discussed in the podcast and review the CONNECT Table in the Explore Knowns and Unknowns section of the Educator Notes.
- Assemble materials or provide a list of materials students can use.
- Have videos preloaded for presentation.
- Provide computer access to students.
- Provide podcast links and optional time stamp documents to students:
  - Houston, We Have a Podcast, Episode 58: Hazard 2: Isolation (1 hour): www.nasa.gov/johnson/HWHAP/hazard-2-isolation
  - Houston, We have a Podcast, Episode 162: CONNECT During Social Isolation (1 hour): https://www.nasa.gov/johnson/HWHAP/connect-during-social-isolation

Handouts

- Student Handout (one per team)
- Straight From the Source: Dr. Thomas Williams (one per student)
- CONNECT Table and Resources for Students (one per team)
- Time Stamps for "Houston We Have a Podcast: Isolation" (one per student)
- Time Stamps for "Houston We Have a Podcast: CONNECT During Social Isolation" (one per student)

Materials

☐ Writing utensils
☐ Poster boards or recording devices to present final company name, patch design, and proposal presentations and/or promotional video
☐ Creative art supplies (markers, scissors, rulers, protractors, glue, old magazines, stickers, etc.)
☐ Requested items from team for construction if the team decides to make a prototype

Safety

- Students should be aware of their surroundings and carefully move throughout the room when viewing other teams' work.
- Before using scissors, discuss safety issues surrounding proper use.

Introduce the Challenge

- Provide context for this activity using the introduction and background information in this guide.
- To activate students' prior knowledge, ask students to define "hazard" in their own words. Then, have students list some potential hazards of deep space travel for astronauts. After several possibilities have been presented by students, write the acronym "RIDGE" as well as each of the concepts for which it stands: Radiation, Isolation and confinement, Distance from Earth, Gravity (or lack thereof), and hostile/closed Environments. Compare and contrast the student-generated list with NASA's list.
- Ask students this question: What would be your biggest hazard concern as a deep space astronaut? Have them share in discussion teams.
- Have students listen to "Houston We Have a Podcast, Episode 58: Hazard 2: Isolation."

  Note: It is recommended to assign this podcast as a homework assignment prior to the activity; otherwise, be sure to account for the time (approximately 1 hour) to have students listen and take notes or play the episode in sections over a week. A transcript is available at the link provided (see Challenge Preparation) and can be printed and distributed for students who might need it.
- Divide the students into teams (three students per team is ideal) and distribute the Student Handout to each team. Explain the details of the challenge, including the design criteria and constraints and the expectations for teamwork and classroom management.

NASA, We Have an Isolation Problem

- Share the following scenario with students:

  NASA has approached your company to help with the mitigation of a major hazard for deep space astronauts: isolation and confinement. How will we protect our astronauts during their deep space travels to Mars and back? Specifically, how will we protect them from the effects of isolation and confinement away from their home planet, Earth? Your company team will need to work together to develop a proposal to present to a simulated NASA panel. Included in your proposal must be your company's name, a mission patch design, a solution plan and optional prototype design of your CONNECT mitigation techniques for isolation and confinement, the initial analog facility or location for research, and the types of tests you will conduct to demonstrate validity.

- Explain to students that an analog is a situation on Earth that produces effects on the body similar to those experienced in space—physical, mental, and emotional. These studies help prepare for long-duration missions. NASA is associated with at least 14 analog missions throughout the world. www.nasa.gov/analogs/types-of-analogs
- Review the following criteria and constraints of the activity with students:

Criteria	Constraints
Design a solution plan that focuses on at least two of the seven CONNECT mitigations.	No real-time connections can be used in this design. Due to distance from Earth there will be a delay in any communications. (Note: "Real time" refers to the actual time during which a process or event occurs.)
Design must be identified with a creative acronym (e.g., "D-SMILE" for Deep-Space Mitigation on Isolation's "Lurking" Effects) and patch design.	
Design must be backed up with Human Research Program research.	
Describe which Earth analog facility (e.g., HERA) would best simulate a trip to deep space and what tests would be conducted here on Earth before the first deep space mission.	
Create a presentation to propose your company's mitigation solution plan to simulated NASA panel.	

Facilitate the Challenge

Meet the Problem

- Present this idea to students and have a large group discussion:

  Thinking back, have you ever felt confined and isolated in a particular situation? (Possible answers: During a pandemic, accidentally getting left behind, time spent away from home at a summer camp, etc.) How did you feel? If you felt stressed, what did you do to feel less stressed? Now imagine you are on a journey to deep space. How would you feel if you were not able to see or communicate in real time with your family and friends for months or even years?

- Show students the video "Isolation and Confinement": www.youtube.com/watch?v=FPinASEKA_I&feature=youtu.be

Share With Students

Brain Booster

Extended-duration missions on the International Space Station are stepping-stones to future missions to the Moon and Mars.

Learn more: www.nasa.gov/1ym

On Location

The Human Exploration Research Analog (HERA), located at Johnson Space Center, is a unique three-story habitat designed to serve as an analog for isolation, confinement, and remote conditions in exploration scenarios. Take the 3D tour if you have time!

Learn more: www.nasa.gov/analogs/hera

- Discuss the importance of NASA and the astronaut selection process, which looks for individuals who demonstrate high-performing characteristics such as resilience and adaptability.

Explore Knowns and Unknowns: Research

- After students have listened to the podcasts (educator decision), teams will break into jigsaw groups where a team member will become the "expert researcher" on one of the three topics below and report their findings back to their team. Students will use the handout "Straight From the Source: Dr. Thomas Williams" along with the research websites listed here.
  1. Side effects and mitigation techniques: What are some human side effects and possible mitigation techniques of isolation and confinement that have been observed in ongoing Human Research Program studies and during the pandemic?
     - Houston We Have a Podcast: CONNECT During Social Isolation. www.nasa.gov/johnson/HWHAP/connect-during-social-isolation
  2. Astronaut selection: What are some qualities that NASA looks for when selecting astronauts for long-duration space missions?
     - NASA astronaut selection: www.nasa.gov/content/astronaut-selection-program
     - Expeditionary skills for astronauts: www.nasa.gov/audience/foreducators/stem-on-station/expeditionary-skills-for-life.html
  3. Analogs: What are some NASA analogs on Earth, and what are their research objectives?
     - NASA analog missions: www.nasa.gov/analogs/what-are-analog-missions
     - NEK and SIRIUS: www.nasa.gov/analogs/nek/about
     - USAP: www.nasa.gov/hrp/research/analogs/antarctica
- Once the initial research phase is complete, have "expert researchers" come back together with their initial team to share their research with team members.

Generate Possible Solutions

- Have students continue research as teams to explore the CONNECT acronym and possible mitigations. Teams will use the CONNECT Table to identify, define, and provide examples for each part of CONNECT.

CONNECT Table

Mitigation	Definition	Examples
C Community	Being a part of something	Eating together, community chores
O Openness	Open to adaptations, changes	Trying a new food or music every week and journaling feelings along the way
N Networking	Connecting with family and friends	Not-in-real-time games, where players can continue playing at their leisure (e.g., Words With Friends, chess)
N Needs	Meeting physiological and emotional needs	Work out both muscles and brain, hobby, a reactive pet
E Expeditionary Mindset	A fixed attitude, disposition, or mood with the task in the forefront of one's mind	Teamwork, design a team-building exercise, mission-driven focus
C Countermeasures	An action taken to counteract a danger or threat	Self-awareness, journaling, physiological tests, reaction time tests help monitor sleep deprivation
T Training	The action of teaching a person a particular skills or behaviors for a successful mission	Reading up on and staying informed on deep space mission goals along the journey, virtual reality, mission-driven focus

- Have student teams agree upon at least two of the seven CONNECT mitigation focus points. Remind them that they will be proposing a solution plan that will mitigate the negative effects of being isolated and confined during an astronaut's deep space journey.
- Have students brainstorm ideas on how to maintain mental wellness and not feel as isolated. Encourage creativity but also refer to the criteria and constraints.
- Have students put themselves in an isolated situation: "Imagine your group is in an analog mission location. You are isolated from your friends and family and society for 3 months. How do you feel, and how do you cope?"
- Student teams will then work to develop a creative acronym for their team name, along with a mission patch design (see criteria for company name).
- Show the NASA eClips video "Our World: Mission Patches": nasaeclips.arc.nasa.gov/video/ourworld/our-world-mission-patches.

  Note: Tips and examples for creating mission patches can be found in this teacher guide from the 2019 NASA/Tynker™ Mission Patch Design Challenge: www.tynker.com/hour-of-code/nasa-mission-patch-guide.pdf
- Student teams will create a list of common materials for their solution plan and optional prototype design (if they decide to make one). Students may bring appropriate items from home if needed.

Consider Consequences

- Based on the team's selected CONNECT mitigation focus points, have students come up with a solution plan with suggested CONNECT activities. If the team has also elected to make a prototype design, students will assemble or sketch their prototype design with requested materials.
- Have students refer to the Human Research Program tests and research various analog/environmental tests to identify whether their solution plan or prototype can be used effectively.
- Have students answer the following questions as a team during their research:
  - How are current astronauts and current analog participants tested to see that they are in good health? www.nasa.gov/analogs/what-are-analog-missions
  - What are some ways that NASA measures astronauts' stress levels?
  - What is the Psychomotor Vigilance Self Test (reaction self test) and what is its importance? If time allows, have students take a version of this online test and compare their results with other team members.
  - How will your CONNECT mitigations be tested for validity on current analog participants here on Earth before a deep space mission?

Present Findings

After teams have completed their solution plan (and prototype design, if they have chosen to create one), they will present their proposal to a simulated NASA panel. It is recommended that the educator bring in others to form the panel. The educator can also nominate one team member from each team to be part of the panel. They will not be allowed to judge or rate their own team's ideas.

Engage students with the following discussion questions:

- Discuss the mitigation focus points (CONNECT) that are represented in your team's design.
- How will your solution plan and optional prototype design mitigate isolation's negative effects?
- What types of tests will be administered to astronauts to see if the various mitigation techniques are effective? Discuss tests in analog locations as well as in deep space.
- What were your team's struggles during the design process?
- What types of current research are being conducted for deep space travel?
- Isolation and pandemic connections:

- Compare and contrast your experience during isolation and/or confinement situations in your life with the research being conducted on the effects of deep space travel on astronauts.
- In your team's opinion, would any of these solution plans and optional prototypes be helpful during a pandemic or in a location on Earth where one must isolate from others for a significant amount of time?

Proposal Presentation Checklist

It is recommended that the educator use the following checklist to evaluate the final proposal presentation. The educator may also give the checklist to student teams as they are working on their project.

☐ Team company name: Must be a creative acronym that resembles the team's proposal
☐ Team company mission patch: Must represent the company's mission and follow the guidelines for making a patch (see NASA eClips video "Our World: Mission Patches")
☐ Background research writeup with culminating background research on one page
☐ Team CONNECT selections along with the activities/illustrations/prototype that go with each selection
☐ Team proposal for analog testing facility and how the team's solutions will be tested before a deep space mission

Optional: Share students' results on social media using #NextGenSTEM. Be sure to include the module and activity name.

Improve

- Have students take constructive criticism from the simulated NASA panel.
- Have students review and modify or improve their design for a final critique from the main educator.

Extensions

- Have students design a page to market their solution plan and optional prototype.
- Have students research NASA resources that directly tie to deep space and pandemics and write up recommendations to help prevent the negative effects of isolation based on their findings.
  - An Astronaut's Tips for Living in Space: www.nasa.gov/feature/an-astronaut-s-tips-for-living-in-space-or-anywhere
- Ask students, "How might NASA's Human Research Program be applied to other careers on Earth or to product and technology spinoffs?" (Possible answers: Military careers, technology for submarines or oil rigs, products for the aging population, etc.)
- Allow students to dive deeper into research analogs such as HERA and the U.S. Antarctic Program. Ask students, "Would you want to be a human subject? Why or why not?"
  - NASA Seeking U.S. Citizens for Social Isolation Study for Moon and Mars Missions: www.nasa.gov/feature/nasa-seeking-us-citizens-for-social-isolation-study-for-moon-and-mars-missions/

Reference

Project X-51 Contest: www.nasa.gov/stem-ed-resources/project-x-51.html

Activity Two: Isolation and Confinement

Student Handout

Your Challenge

NASA, We Have an Isolation Problem

NASA has approached your company to help with the mitigation of a major hazard for deep space astronauts: isolation and confinement. How will we protect our astronauts during their deep space travels to Mars and back? Specifically, how will we protect them from the effects of isolation and confinement far from our home planet, Earth? Based on various NASA resources and research, your team will select two or more CONNECT mitigation techniques and design a solution plan and optional prototype, a company name, a mission patch, and a proposal to "sell" your company's idea to a simulated NASA panel.

Your proposed solution must meet the following criteria and constraints:

Criteria	Constraints
Design a solution plan that focuses on at least two of the seven CONNECT mitigations.	No real-time connections can be used in this design. Due to distance from Earth there will be a delay in any communications. (Note: "Real time" is the actual time during which a process or event occurs.)
Design must be identified with a creative acronym (e.g., "D-SMILE" for Deep-Space Mitigation on Isolation's "Lurking" Effects) and patch design.	
Design must be backed up with Human Research Program research.	
Describe which Earth analog facility (e.g., HERA) would best simulate a trip to deep space and what tests would be conducted here on Earth before the first deep space mission.	
Create a presentation to propose your company's mitigation solution plan to simulated NASA panel.	

Meet the Problem

Discussion time: Thinking back, have you ever felt confined and isolated in a particular situation? (Possible answers: During a pandemic, accidentally getting left behind, time spent at a summer camp, etc.) How did you feel? If you felt stressed, what did you do to feel less stressed? Now imagine you are on a journey to deep space. How would you feel if you were not able to see or communicate in real time with your family and friends for months or even years?

Explore Knowns and Unknowns

- After listening to podcasts, your team will break into jigsaw groups where a team member will become the "expert researcher" on one of the three topics below and report back to your team members. Use the handout "Straight From the Source: Dr. Thomas Williams" and the research links provided.
  1. Side effects and mitigation techniques: What are some human side effects and possible mitigation techniques of isolation and confinement that have been observed in ongoing Human Research Program studies and during the pandemic?

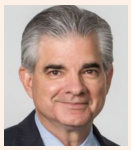
Fun Fact

"The Martian" merges fictional and factual narratives about Mars, building on the work NASA and others have done and moving it forward into the 2030s, when NASA astronauts regularly travel to Mars to explore and live on its surface. Although the action takes place 20 years in the future, NASA is already developing many of the technologies that appear in the book and film. NASA is also developing strategies to reduce risk factors for Mars astronauts isolated and confined far from Planet Earth.

Learn more:
www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian

Career Corner

Dr. Tom Williams is the element scientist for NASA's Human Factors and Behavioral Performance (HFBP) division. Affiliated with Johnson Space Center since 2015, Tom directs a multidisciplined team of scientists focused on human factors in the areas of habitability, mission processes and tasks, human automation robotic interactions, dynamic loads, and training, as well as spaceflight risks related to behavioral medicine, sleep and fatigue, and team performance.



Learn more:
www.nasa.gov/hrp/elements/hfbp/leadership-team

  - Houston We Have a Podcast: CONNECT During Social Isolation www.nasa.gov/johnson/HWHAP/connect-during-social-isolation

2. Astronaut selection: What are some qualities that NASA looks for when selecting astronauts for long-duration space missions?
   - NASA astronaut selection: www.nasa.gov/content/astronaut-selection-program
   - Expeditionary skills for astronauts: www.nasa.gov/audience/foreducators/stem-on-station/expeditionary-skills-for-life.html
3. Analogs: What are some NASA analogs on Earth, and what are their research objectives?
   - NASA analog missions: www.nasa.gov/analogs/what-are-analog-missions
   - NEK and SIRIUS: www.nasa.gov/analogs/nek/about
   - USAP: www.nasa.gov/hrp/research/analogs/antarctica

- Once the initial research phase is complete, your team will come back together and "expert researchers" will share their research with their entire team.

Generate Possible Solutions

- Next, you will research further into CONNECT mitigations. What are the CONNECT mitigation focus points? Work as a team to fill out the CONNECT Table provided with the student handouts.
- Agree upon at least two of the seven CONNECT mitigation focus points. Remember that you will be proposing a solution plan that will mitigate the negative effects of being isolated and confined during an astronaut's deep space journey.
- Brainstorm ideas on how to maintain mental wellness and not feel as isolated. Be creative but also refer to the criteria and constraints.
- Now that you have done some initial research, work as a team to develop a design to mitigate the negative effects of isolation. Your design, once complete, must follow the criteria and constraints.
- Put yourself in a deep space astronaut's boots or an analog participant's shoes. Discuss what team members did during the pandemic in 2020 and 2021. Be creative and refer to the criteria and constraints.
- Develop an acronym team name and design a mission patch (see criteria for name and patch).
- Create a list of materials your team will need and submit those to your instructor. If items are not provided, team members may bring appropriate items from home.

Consider Consequences

- Based on the team's selected CONNECT mitigation focus points, come up with a solution plan with suggested CONNECT activities. If your team has also elected to make a prototype design, you will assemble or sketch their prototype design with requested materials.
- Refer to the NASA Human Research Program tests. Your team will research various NASA analog/environmental tests to identify whether your solution plan or optional prototype can be used.
- Answer the following questions:
  - How are current astronauts and current analog participants tested to determine that they are in good health? www.nasa.gov/analogs/what-are-analog-missions
  - What are some ways that NASA measures the stress level of its astronauts?
  - What is the Psychomotor Vigilance Self Test (reaction self test)? Why is it important? Research and take a version of this test online. Compare your results with your team.
  - How will your CONNECT mitigations be tested for validity on current analog participants here on Earth before a deep space mission?

Present Findings

Address the following topics in your team presentation to the simulated NASA panel:

- Discuss the mitigation focus points (CONNECT) that are represented in your team's design.
- How will your solution plan and optional prototype design mitigate isolation's negative effects?
- What types of tests will be administered to astronauts to see if the various mitigation techniques are effective? Discuss tests in analog locations as well as in deep space.
- What were your team's struggles during the design process?
- What types of current research are being conducted for deep space travel?
- Isolation and pandemic connections:
  - Compare and contrast your experience during isolation and/or confinement situations in your life with the research being conducted on the effects of deep space travel on astronauts.
  - In your team's opinion, would any of these solution plans and optional prototype designs be helpful during a pandemic or in a location on Earth where one must isolate from others for a significant amount of time?

Proposal Presentation Checklist

- ☐ Team company name: Must be a creative acronym that resembles the team's proposal
- ☐ Team company mission patch: Must represent the company's mission and follow the guidelines for making a patch (see NASA eClips video "Our World: Mission Patches")
- ☐ Background research writeup with culminating background research on one page
- ☐ Team CONNECT selections along with the activities/illustrations/prototype that go with each selection
- ☐ Team proposal for analog testing facility and how the team's solutions will be tested before a deep space mission

Improve

- After your NASA panel presentation is complete, your team should take the constructive criticism you received from the "NASA Panel" and modify or improve your team's design for final critique from your lead educator.

CONNECT Table and Resources for Students

Mitigation	Definition	Examples
C Community		
O Openness		
N Networking		
N Needs		
E Expeditionary Mindset		
C Countermeasures		
T Training		

Resources for Students

Conquering the Challenge of Isolation in Space (NASA Spinoffs): www.nasa.gov/feature/conquering-the-challenge-of-isolation-in-space-nasa-s-human-research-program-director

Social Isolation and Space: www.nasa.gov/hrp/social-isolation/in-context

Self-Test Webpage: www.nasa.gov/mission_pages/station/research/experiments/explorer/Investigation.html?#id=955

Human Research Program: www.nasa.gov/hrp/elements/hfbp

Human Research Roadmap: humanresearchroadmap.nasa.gov/explore/

Interview Video: Dr. Tom Williams: www.youtube.com/watch?v=P1FYk1lkdh4

A good example of a Psychomotor Vigilance Test: www.sleepdisordersflorida.com/pvt1.html#responseOut

Other self-test examples: humanbenchmark.com/

Human Research Program Proposals: www.nasa.gov/feature/nasa-selects-21-research-proposals-to-advance-human-space-exploration/

Background on Expeditionary Skills for Astronauts: www.nasa.gov/audience/foreducators/stem-on-station/expeditionary-skills-for-life.html

Straight From the Source: Dr. Thomas Williams

NASA STEM Engagement staff interviewed NASA scientist Dr. Thomas Williams via email in November 2020.

1. Are there specific traits that NASA looks for in astronauts to be considered good "deep space" candidates?

The primary traits NASA looks for in preventing issues with being isolated are very close to the traits that help a team of students work together. We can place these traits under the following categories: the ability to relate well to one another, to be good team players and considerate of one another (good group-living skills), to be positive with one another, to respect the reality that sometimes each of us needs quiet time (a little privacy), we need to self-regulate our emotions if things don't go our way, and we need to be able to recognize that we serve as, in essence, an extended family away from our primary families (we laugh together, share joys and disappointments and excitements in a way that promotes the good of each other). It's always important to acknowledge that there may be conflict in any human relationship. There's an old saying that psychologists have: "Good mental health is not the absence of conflict between two people, but rather how you handle the conflict." We also spend a lot of time training our astronauts on living together in close quarters like a spacecraft, similar to what we're all now doing in our homes during the pandemic. We train our astronauts to be alert for, and avoid, "criticizing each other," showing "contempt" for each other (by putting each other down, talking down to each other, not respecting their differences), by being "defensive" if a member of our team points out that we have done something wrong; and then if we get upset with one another, "stonewalling," by not talking to them, or ignoring each other. We might all do one or two of these, we're all human. But trouble in any relationship starts when we start to do all four of these regularly with others at home, at school, during extracurricular activities, or in a small spacecraft.… That starts to damage our relationships, and whether you're on Earth or in a small spacecraft, it's much better to just be getting along with one another, feeling positive, and being open to the adventure of learning or adventure of space travel.

2. Any specific Human Research Project (HRP) studies targeting mental state of isolation on humans?

NASA Human Research Program funds several studies focused on better understanding how well humans can handle isolated environments with an interest in understanding how these isolated, confined, extreme (ICE) environments may impact our crews in a long-duration space exploration. We fund research with scientists and other individuals who "winter-over" in Antarctica for 12 or more months. What we have learned is that humans often experience what is called **"winter-over syndrome."** That means these individuals start to withdraw from one another (social narrowing and social withdrawal) by increasingly spending more time alone in their rooms. That would be difficult on a small spacecraft. They also start to express more tension, irritability, and somatic complaints (more aches and pains). If a crewmember starts to have increased medical complaints, they're too far from Earth to get the great medical care we have here in Houston. They also become more territorial—when they put something down, they don't want anyone else to move it. Some things they complain of— feeling down or depressed, have problems concentrating, sleeping, and problems with their memory. You can see why it's so important for NASA to understand how long-term isolation may impact our crew. But we don't know for sure this is something our crew will experience—but we need to be ready to help them if they do. That is why we use these studies to understand what "might" happen, and then we can develop countermeasures to help our crew if they start to experience these types of problems.

3. Any "safe" activities that come to mind when testing an astronaut's state of mind that we might be able to use in our K–12 STEM activities?

One "safe" activity that comes to mind that can be used is exercises to increase our self-awareness to be alert to our own feelings. In our research we spend a lot of time and effort to assess "how the astronauts are feeling." Understanding how we're feeling alerts us to how our feelings help us mobilize and coordinate our actions; and that helps ensure our crew can carry out their performance requirements. That's why our isolation research focuses on assessing the mood and emotions of our crews, because it helps us determine how the long-duration social isolation impacts on how they're feeling—and how they're feeling helps determine how they'll perform. So, a safe activity that helps enhance performance is to carry out a "self-check" on how different activities may activate different moods and emotions and use that increased awareness to then help shape our feelings about activities. For example, if approaching certain STEM problems seem harder than others, being alert to the feelings of "not getting it" can help us activate a mood or emotion to strive toward "mastery" of the problem rather than a feeling of being unprepared. That's what learning should be like.

Time Stamps for "Houston We Have a Podcast: Isolation"

This 58-minute podcast is available at www.nasa.gov/johnson/HWHAP/hazard-2-isolation. Use the following time stamps to quickly locate the topics you would like to research.

Start time, min:sec	End time, min:sec	Topic
0	1:15	Introduction
1:15	4:38	What is isolation, and its negative effects on humans—Dr. Tom Williams
4:38	6:30	Tests in the 1960s on social deprivation
6:30	8:24	Astronaut Shannon Lucid—Mir Space Station and books
8:24	10:40	Time delay—Astronaut Dr. Mike Barratt
10:40	12:05	Deep space time delay—Communication autonomy
12:05	13:40	Crew schedules and adjustments for deep space versus the International Space Station
13:40	15:30	Where does isolation come in for an astronaut day-to-day?
15:30	16:20	Psychological connections and changes of behavior—Mars 520 analog
16:20	17:10	Do you feel isolated on the International Space Station?—Astronaut Mike Barratt
17:10	20:00	Analog studies on behavioral changes for long-duration space missions: Human Exploration Research Analog (HERA)
20:00	25:00	HERA versus International Space Station research on sleep
25:00	27:38	Countermeasures: Sleep—Medicine and light study
27:38	29:22	Isolation and sleep balance
29:22	32:00	Analogs on Earth—Submarines, oil rigs, extreme environments
32:00	33:30	International Space Station research—Best analog for deep space—Hazards included
33:30	35:00	Oil rigs—Sleep cycle, high-performing individuals
35:00	36:30	High-performing individuals are used for analogs
36:30	38:10	Dr. Tom Williams—Background
38:10	40:50	Astronaut selection process
40:50	44:50	32 risks for long-duration spaceflight—Research, studies, and countermeasures
44:50	48:00	Acceptable amount of risks for mission success
48:00	51:00	Monitoring the astronauts—Journaling and predictions studies
51:00	52:00	How does the mind adapt to isolation?
52:00	56:00	What will deep space astronauts do on their mission to keep them at high performance and engaged? Training during journey

Time Stamps for "Houston We Have a Podcast: CONNECT During Social Isolation"

This 65-minute podcast is available at www.nasa.gov/johnson/HWHAP/connect-during-social-isolation. Use the following time stamps to quickly locate the topics you would like to research.

Start time, min:sec	End time, min:sec	Topic
0	2:30	Introduction: Pandemic and astronauts on long space missions—Using CONNECT in our own lives
2:30	4:03	What is social isolation? Introduction by Dr. Tom Williams
4:03	6:00	What are the results of social isolation versus feeling lonely?
6:00	8:05	Symptoms of what can come from social isolation; survey
8:05	11:45	Human spaceflight relates to social isolation (Hazards of Deep Space) in analogs and side effects
11:45	15:10	Social isolation in groups (crews and families)—Stressors
15:10	17:14	Parallels and CONNECT acronym—Seven stress reduction strategies
17:14	19:05	C—Community
19:05	20:45	Themes in Community: Positivity and purpose of surroundings (example: wearing a mask); "We are all in this together
20:45	23:10	O—Openness
23:10	25:00	Techniques to help with Openness: Mindfulness training, self-assessments, handling conflict
25:00	26:20	Nurturing the positive environment
26:20	30:30	N—Networking: Connecting with the ones we love
30:30	32:30	Astronaut networking on the International Space Station; Public Affairs Office events and celebrities
32:30	33:05	Delays in signal
33:05	38:08	N—Needs: Attending to the physiological, emotional, and psychological needs; self-care and team care
38:08	39:50	Physiological needs: Arranging their environment to meet needs
39:50	42:14	E—Expeditionary Mindset
42:14	45:30	How can we use Expeditionary Mindset to help with an end date? Set objectives that are attainable and share our successes.
45:30	48:44	C—Countermeasures. Help us maintain a sense of control
48:44	53:00	What ways can we sustain these CONNECTs when isolation does not seem to end? Reframe it! Mindfulness, journaling, how can you grow from the situation?
53:00	57:00	T—Training and Preparation. Experiences allow for growth; life has prepared us for this.
57:00	1:00:20	CONNECT: What are the impacts of social isolation? Isolation confronts that in our lives; we need to be innovative to connect. People live longer when you can connect. Happiness is connected to our health and spreads from person to person.
1:00:20	1:04:57	Space studies—Relevance to COVID–19 Value for human spaceflight—Fostering human connections