SPACE HAZARDS

PREPARING FOR A NASA MISSION

Science Pathway

Planetary Science Adventures for Out-of-School Time Grades 3–5

Contents

Welcome to Space Hazards!

In This Unit

In this unit, learners think and work like scientists and engineers. They investigate and engineer solutions for the extreme environmental hazards that NASA astronauts face in space.

The unit is composed of a Science Pathway and an Engineering Pathway. In both pathways, learners have the opportunity to build their problem solving, teamwork, communication, and creative thinking skills. Specifically, the PLANETS units are designed to ensure that learners will

- engage in real-world activities that provide inclusive ways for all learners to connect to science and engineering.
- choose their path through open-ended challenges that have multiple solutions.
- engage in the habits of mind of engineers and inquiry practices of scientists.
- communicate and collaborate in innovative, active problem solving.

Getting to Know PLANETS

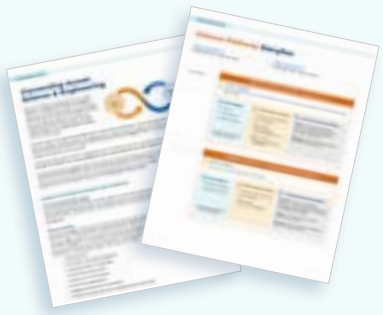
Planetary Learning that Advances the Nexus of Engineering, Technology, and Science (PLANETS) is an interdisciplinary and cross-institutional partnership that integrates planetary science, education, technology, and engineering.

The Center for Science Teaching and Learning at Northern Arizona University (NAU), the U.S. Geological Survey (USGS) Astrogeology Science Center, the Museum of Science, Boston, and WestEd have partnered to develop, pilot, and research the impact of three curriculum units and related professional development resources (http://planets-stem.org) for grades 3–8.

The purpose of PLANETS is to increase public awareness and use of NASA resources by highlighting the relationship between science, technology, engineering, and mathematics in the context of planetary science in out-of-school time settings.

Note

Much of the information at the start of this guide is the same for the Science and Engineering Pathways. If you have already read the Engineering Pathway, you can read just **Learners Working and Thinking Like Scientists,** pg. vi, and the **Science Pathway Storyline**, pgs. xxiii–xxv, then skip to the **Science Pathway Vocabulary,** pg. 1, and read from there.



Space Hazards *Unit Overview*

This guide contains the **Science Pathway**.

Astronauts are exposed to some of the most extreme conditions while working in space. These include hazards such as cold temperatures, high levels of radiation, impact from space debris (trash), dangerous dust, and changes in pressure, oxygen, and gravity. In this unit, learners become familiar with these hazards and the mitigation strategies that NASA uses to keep astronauts safe. The unit contains an Engineering Pathway and a Science Pathway.

DID YOU KNOW?

For over 50 years, humans have been sending objects into space, creating what we call "orbital debris" (duh-BREE) or "space junk." Most space junk bigger than 1 centimeter comes from exploding leftover rocket sections that stay in Earth's orbit after their missions are done. This space junk moves really fast! Even tiny pieces can cause big damage because of this speed - getting hit by a piece smaller than half an inch would be like being hit by a bowling ball moving at 300 miles per hour! NASA tracks large pieces and steers the space station around them, but smaller pieces can't be tracked, making collisions sometimes unavoidable. That's why astronauts wear special protective spacesuits during spacewalks, and why spacecraft windows have three protective layers that need replacing after almost every mission.

Science Pathway Overview: *Space Hazards*

Planetary scientists often use the technologies developed by engineers to further their understanding of issues that astronauts, spacecrafts, and instruments face during their time in space, such as hazards. In this pathway, learners think like planetary scientists as they investigate hazards on Earth and in space and examine different strategies humans have developed to mitigate them. Learners also explore factors that either help (e.g., research, teamwork) or complicate (e.g., loss of power or communication) hazard mitigation. In the final adventures, learners put together all they have learned from their investigations to design and share hazard mitigation strategies for an upcoming NASA mission.

The Science Pathway Storyline that more fully articulates the progression of activities can be found on pgs. xxiii–xxv.

Engineering Pathway Overview: *Engineering Space Gloves*

Materials engineering is an interdisciplinary field that draws upon physics, chemistry, and engineering to understand how materials behave. Materials engineers may combine existing materials such as metals, ceramics, and textiles to see how they perform under different conditions or design entirely new materials to meet the growing technological needs of society. All materials have properties, such as strength, flexibility, and resistance to hot or cold temperatures, that determine how they can be used in specific technologies, from snowboards to spaceships. When astronauts go to space, they face several challenges that materials engineers must solve through special designs. Here are some examples:

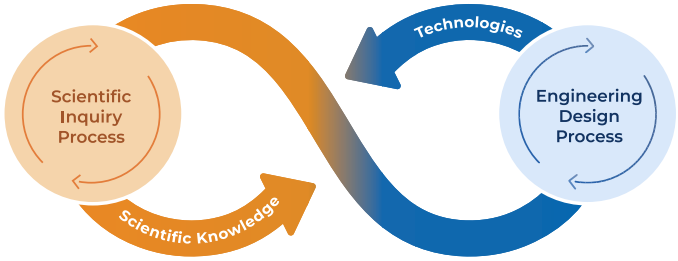
- **Cold Temperatures:** To protect against cold temperatures, materials engineers use thermal insulators, materials that slow the transfer of heat from one place to another.
- **Impact:** Astronauts also need to avoid collisions with heavy, moving space debris (trash). NASA estimates there are over 500,000 pieces of space debris, such as non-functioning satellites and fragments of other spacecraft, currently orbiting Earth at up to 18,000 miles per hour. The growing volume of space debris increases the chances of impact and damage.
- **Dangerous Dust:** In space exploration, dust can be dangerous. On the Moon, it is abrasive to materials, gets stuck in the joints of spacesuits, and compromises sterile environments. Astronauts work hard to keep dust out of their equipment and spacecraft. Mars dust is not as abrasive or static-y as moon dust, but it is toxic to humans due to the presence of chlorine.

Learners in the Engineering Pathway engage in adventures as material engineers as they design space gloves that mitigate three space hazards: cold temperatures, impact, and dangerous dust.

The Engineering Pathway Storyline that more fully articulates the progression of activities can be found on pgs. xxiii–xxvi of the Engineering Educator Guide.

Connecting Across Science & Engineering

Science and engineering depend on one another. Engineers leverage their scientific knowledge to effectively and efficiently develop new technologies. Scientists rely on a wealth of technologies that have been developed by engineers to advance understanding of the natural world—and their understanding, in turn, helps engineers develop additional technologies.



Scientific inquiry and engineering design require similar skills and practices, such as utilizing critical thinking skills, bringing a lens of curiosity, taking a systems approach, and tapping into creativity to answer questions and solve problems. Neither process follows a set path but both typically rely on similar tools, such as developing models, using mathematics and statistics, and computers. However, scientists primarily focus on understanding natural phenomena through an inquiry-based process, while engineers apply their knowledge, including scientific knowledge, to design and build practical solutions to help solve real-world problems.

The PLANETS curriculum provides equitable opportunities to engage learners in the habits of mind of engineers and the thinking practices of scientists can increase engagement and catalyze STEM identity and confidence for *all* learners. Learning activities that engage learners in the habits of mind and thinking practices of engineers and scientists also fuel development in the 21st Century learning skills of critical thinking, creativity, collaboration, and communication. For more insight into how these skills develop as learners engage in an engineering design process, see the PLANETS educator resource on Developing 21st Century Skills.

Learners Working & Thinking Like Scientists

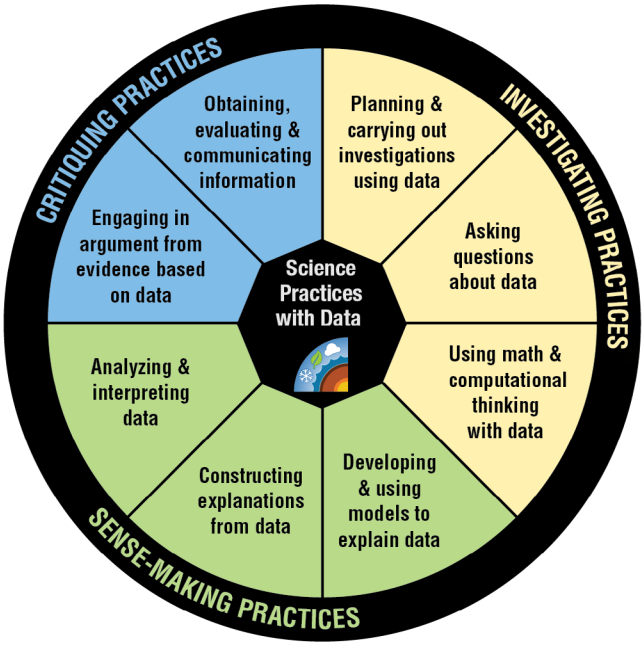
A Process of Scientific Inquiry

Like an engineering design process, scientific inquiry is a non-linear and iterative process of investigating, reasoning, evaluating data and models, and critiquing and communicating explanations based on evidence. During this process, scientists rely on mathematics, computers, and technologies that have been developed by engineers.

Science Practices

As scientists engage in the process of inquiry about and with natural phenomena, a few practices emerge from their work. These are known as practices instead of "skills" because they require a coordination between both knowledge and skill. The core practices that learners should engage in as they move iteratively through scientific investigations, reasoning, and critiquing are provided below. You'll notice that many science practices are similar to the habits of mind that engineers use—such as asking questions, using mathematics, and developing models. These practices include

- Asking questions
- Planning and conducting investigations
- Using mathematics and technology
- Developing and using models
- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence
- Finding, critiquing, and communicating scientific information



Adapted from My NASA Data, "Resources for Science and Engineering Practices (with Data)"

Navigating the Unit

For additional resources, please see the Space Hazards Unit Website

Considerations for Using the Space Hazards Unit

- The following pathways present suggested orders in which to teach the activities. However, you can adapt the order of activities as appropriate for your learners and setting. (For example, you can alternate between pathways.)
- If you have time, it is beneficial for learners to engage in the Science Pathway and then Engineering Pathway. Learners do not need to repeat the context-setting or Adventure 1.
- It is not necessary for learners to complete the Engineering Pathway activities to participate in the Science Pathway.

CONTEXT-SETTING ADVENTURE : *Ready, S.E.T., Go!*
Learners explore space trash. As scientists, they measure the energy of space trash impacts. As engineers, they design ways to protect against those impacts.

ADVENTURE 1: *Safety Stories: Sharing Experiences*
Learners share experiences with and stories about making hazards safer.

Science Pathway

ADVENTURE 2: *Everyday Hazards*
Learners act out everyday hazards and match them with safety tips.

ADVENTURE 3: *Hazards Where We Live*
Learners create their own hazard and mitigation cards and play a matching game with them.

ADVENTURE 4: *Earth Hazards*
Learners play a card game to learn about hazards on Earth and how people mitigate some of them.

ADVENTURE 5: *Hazards in Space*
Learners play a card game to learn about space hazards and their differences from hazards on Earth.

ADVENTURE 6: *Mitigating Hazards for Your Mission*
Learners think about hazards and mitigation strategies for NASA missions.

ADVENTURE 7: *Science Share-Out*
Learners share what they learned about hazards and mitigation strategies for NASA missions.

Engineering Pathway

ADVENTURE 2: *Everyday Gloves*
Learners try doing simple tasks wearing different kinds of gloves and compare results. Learners then find out about space hazards and spacesuit design.

ADVENTURE 3: *Chilling Out*
Learners test and compare materials to see which ones work best to protect against cold.

ADVENTURE 4: *Ready for Impact*
Learners test how well different materials protect against impact hazards.

ADVENTURE 5: *Dangerous Dust*
Learners test how dust resistant materials are.

ADVENTURE 6: *Creating a Space Glove*
Learners plan and create model space gloves and test how well they protect against space hazards.

ADVENTURE 7: *Improving a Space Glove*
Learners improve their space gloves and test them in a final test.

ADVENTURE 8: *Preparing for Engineering Share-Out*
Learners plan a presentation and present their space gloves to an audience.

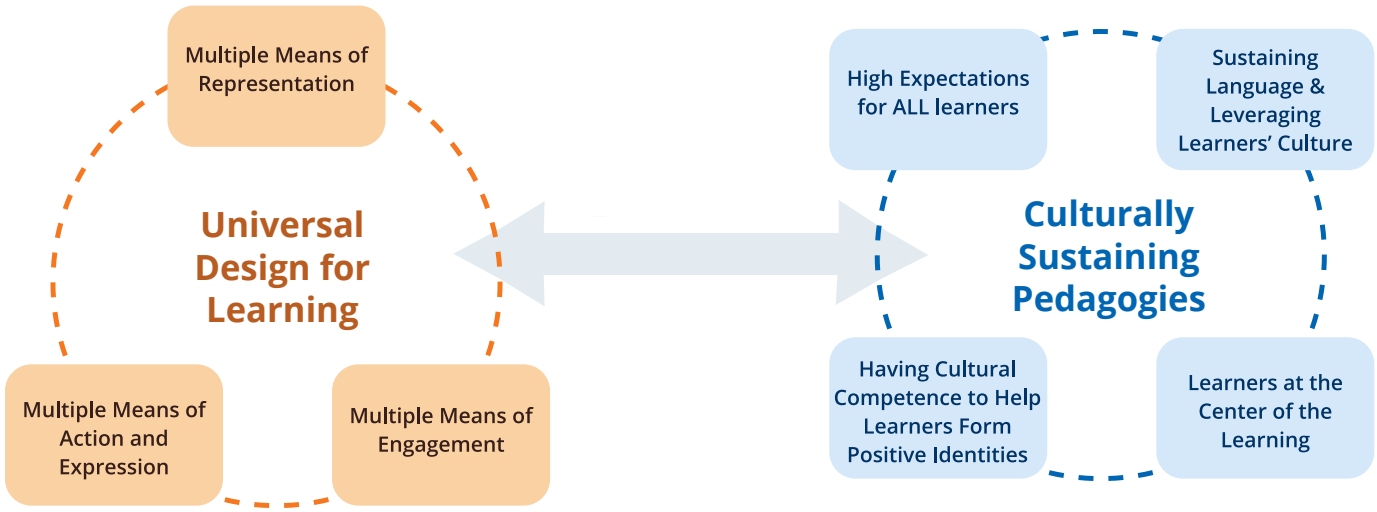
ADVENTURE 9: *Engineering Share-Out*
Learners plan a presentation and present their space gloves to an audience.

Educator Resources to Support Learning

An Inclusive and Equitable Approach for STEM Learning

The Space Hazards unit has been designed with an explicit focus on promoting STEM learning for all, and particularly Indigenous learners, emergent multilingual learners, and learners experiencing differing physical and/or sensory abilities. The Universal Design for Learning (UDL) and culturally sustaining pedagogies (CSP) conceptual frameworks informed the instructional design of this unit. This purposeful design supports all learners by reducing as many barriers as possible and incorporating planning for variability in learner strengths, needs, and interests.

These principles include the following:



Creating Inclusive & Collaborative Learning Environments

To create an inclusive learning environment, educators need to approach their learners with an asset-based mindset. Each learner possesses assets that contribute to the development and maintenance of that person's identity. Assets can be intellectual, physical, or social skills and personal strengths or qualities. A few ideas for cultivating inclusive and cooperative learning environments include the following:

Practices and Strategies for Inclusive Learning Environments

- Facilitate inclusive and cooperative learning environments.
- Build relationships with learners and their communities for learning partnerships.
- Build rapport to establish an emotional connection.
- Affirm the personhood of each learner by appreciating all aspects that they bring into a learning space and creating accessible and inclusive learning spaces.
- Design learning experiences that are authentic and relevant to the contexts of learners.
- Incorporate multisensory instruction.
- Provide options for multiple forms of expression to demonstrate understanding.
- Model and support self-advocacy.

Designing Instruction to Reach Diverse Learners

The strategies outlined below appear in this unit to support three groups of learners:

Multilingual learners: Youth who speak languages other than English at home and are in the process of becoming fluent speakers of English.

Indigenous learners: Youth who descend from the original, culturally distinct ethnic peoples of a land.

Learners with diverse abilities: Youth who experience differing physical abilities: (a) physical traits that affect mobility and/or dexterity; (b) sensory abilities that affect sight; and (c) sensory abilities that affect hearing.

DID YOU KNOW?

Some of these strategies, initially designed and highlighted below for specific learners, have shown potential benefits for all learners.

These strategies have been adapted from the *PLANETS Practical Guide for Inclusive and Engaging STEM Learning: Promoting Inclusion and Engagement in STEM Learning: A Practical Guide for Out-of-School-Time Professionals*.

The icons shown on the following pages appear throughout this guide in tips that are especially relevant for each group of learners.

Strategies for Multilingual Learners

Want to learn more about how PLANETS activities support Multilingual Learners? Please watch this educator support video.

Encourage translanguaging: learners using all the languages they know and making connections between those languages.

Why is this important?

Translanguaging signals to multilingual learners that their languages, culture, and experiences are valued and enrich learning.

It empowers learners to participate and can increase their comprehension and engagement.

Note that not all words have exact counterparts in English.

Strategy in Action

Encourage learners to share key vocabulary in their home or preferred languages. You can capture terms visually.

Note that some learners, including many Indigenous ones, communicate through gestures instead of speech.

Connections to the PLANETS Practical Guide

See Promising Instructional Practices, section 3: "Encourage Translanguaging and Storytelling" on pg. 20 of the Practical Guide.

Provide multiple means of accessing language.

Why is this important?

Providing learners enough support and tools (e.g., images, videos, diagrams with headings) to understand texts on their own empowers them to independently make sense of content without compromising the complexity of language.

Instead of simplifying language, amplify speech and text with supports and offer assistance to help learners grasp concepts effectively.

Strategy in Action

Actively listen and capture learners' ideas and use of vocabulary and language during partner, small-group, or whole-group discussions using written words, diagrams and pictures.
In PLANETS, this strategy is called the *Our Ideas Poster.*

Use icons and images to anchor language.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Welcoming Learning Environments" on pg. 13 of the Practical Guide.

Teach vocabulary in context.

Why is this important?

Exposing learners to vocabulary and concepts together and not separately helps learners make sense of key concepts and ideas.

Strategy in Action

Learners engage in activities and then use their experiences to make sense of vocabulary.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Features of Culturally and Linguistically Accessible and Welcoming Learning Environments" on pg. 13 of the Practical Guide.

Provide multiple means of expressing ideas.

Why is this important?

Multiple forms of expression, such as spoken, visual, and written, help learners share their understanding of science and engineering, make sense of concepts, and clarify their ideas.

Offering space to use different levels of formality (e.g., casual language from home vs. academic language from school) helps learners make sense of ideas.

Strategy in Action

Share-outs during group activities encourage multiple means of expression. Learners can share in diverse ways (e.g., posters, graphs, writing, drawings, audio, gestures, or videos).

Rather than "correcting" learners' speech, help them connect less-formal and more-formal words with similar meanings.

Connections to the PLANETS Practical Guide

See Promising Curriculum Design Elements, section 3, "Provide options for multiple forms of expression to demonstrate understanding" on pg. 28 of the **Practical Guide**.

Use strategic grouping.

Why is this important?

Conversations among peers who share languages (e.g., pairs, small groups, or whole-group share-out) provide a safe environment for learners to participate and gain comfort and confidence while testing out ideas. Educators can then build on the ideas expressed in whole-group discussions.

Strategy in Action

Activities engage learners in peer-to-peer conversations and sense-making discussions, including in pairs, small groups, and the whole group, depending on the needs of the learners.

Connections to the PLANETS Practical Guide

See Promising Instructional Practices, section 1, "Facilitate inclusive and cooperative learning environments" on pg. 16 of the **Practical Guide**.

Prioritize precise name pronunciation and understanding.

Why is this important?

Names are important in culture and personal identity. Pronouncing names correctly shows respect for individuals and their culture. (Because different languages use different sounds, it can take practice to pronounce names correctly.)

This approach is particularly beneficial for multilingual learners but creates an inclusive environment for all learners.

Strategy in Action

When meeting new learners, educators are encouraged to ask about, practice, and model pronouncing learners' names correctly.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Features of Culturally and Linguistically Accessible and Welcoming Learning Environments" on pg 13 of the **Practical Guide**.

Strategies for Indigenous Learners

Want to learn more about how PLANETS activities support Indigenous Learners? Please watch this educator support video.

Encourage narratives.

Why is this important?

Indigenous communities have strong narrative traditions. These traditions serve as vital conduits of cultural heritage, transmitting knowledge, values, and history across generations. Through oral narratives, these communities forge a profound connection to their ancestral roots, fostering a sense of identity.

Relating narratives lets learners receive stories and tell their own. Narratives can be spoken, written, in song, or in pictures.

Strategy in Action

Make time for learner narratives that connect their learning to existing knowledge, stories, and culture. The "Building Community and Family Connections" section on p. xvi offers extension activities to engage community and family.

Take time to understand how stories are told in a particular community. Rhetorical style and the expected parts of a narrative vary between groups.

Connections to the PLANETS Practical Guide

See Promising Instructional Practices, section 3: "Encourage Translanguaging and Storytelling" on pg. 20 of the Practical Guide.

Use strategic grouping.

Why is this important?

Collaborative decision-making is more effective than individual spotlights in some Indigenous cultures. Small-group rather than large-group work enhances communication for Indigenous learners.

Thoughtful talk is often valued over spontaneous contributions, and delayed engagement may signify politeness rather than disinterest or shyness.

Strategy in Action

Group work is built into each activity. Grouping suggestions provide a comfortable group setting for Indigenous learners and others, such as grouping learners in even numbers to avoid a single designated leader.

Connections to the PLANETS Practical Guide

See Promising Instructional Practices, section 1, "Facilitate inclusive and cooperative learning environments" on pg. 16 of the Practical Guide.

Prioritize precise name pronunciation and understanding.

Why is this important?

Names are important in culture and personal identity. Pronouncing names correctly shows respect for individuals and their culture. (Because different languages use different sounds, it can take practice to pronounce names correctly.)

Note that Indigenous learners may want to share other information, such as their connections to tribes and locations.

Strategy in Action

When meeting new learners, educators are encouraged to ask about, practice, and model pronouncing learners' names correctly.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Features of Culturally and Linguistically Accessible and Welcoming Learning Environments" on pg. 13 of the Practical Guide.

Design authentic and relevant learning experiences.

Why is this important?

Learners are most engaged when what they are learning is connected to their lives and communities. Providing a relevant cultural context helps to drive this engagement.

Strategy in Action

Spend time in learners' community and make connections with local knowledge keepers.

Learn about the cultural approaches of the community regarding competition and collaboration, communication styles, and systems of observation.

Connections to the PLANETS Practical Guide

See Promising Curriculum Design Elements, section 1, "Design learning experiences that are authentic and relevant to the contexts of learners" on pg. 23 of the **Practical Guide**.

Strategies for Learners with Diverse Abilities

Want to learn more about how PLANETS activities support Learners with Diverse Abilities? Please watch this educator support video.

Ask learners what they need.

Why is this important?

The needs of learners with diverse sensory and physical abilities vary. Learners and caregivers, being the most knowledgeable about their capabilities, provide valuable insights. Educators should emphasize learners' strengths and rely on them to guide facilitation of activities.

Strategy in Action

Ask learners directly about their needs prior to beginning an activity. This guide gives some ideas to consider when offering learners options.

Learn about etiquette for working with **blind learners**, etiquette for working with **D/deaf learners**, or etiquette for working with **wheelchair users**.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Create safe, accessible, and welcoming learning environments" on pg. 11 of the **Practical Guide**.

Incorporate multisensory activities.

Why is this important?

Visual representations can be particularly beneficial for learners who are deaf or hard-of-hearing. Visual science and engineering models are powerful tools to illustrate observations, processes, and connections.

Auditory modalities of instruction can facilitate access to learners who are blind or have low vision.

Tactile models and physical objects are beneficial for all learners but are particularly important for blind and low vision learners.

Strategy in Action

Learners are given diverse means to participate in activities. For instance, spectrographic information is presented both visually and aurally so that all learners can access it.

Allow blind and low-vision learners to explore pre-made models ahead of time and to join the educator during demonstrations to follow the educator's movements.

Connections to the PLANETS Practical Guide

See Promising Curriculum Design Elements, section 2, "Incorporate multisensory instruction" on pg. 26 of the **Practical Guide**.

Use strategic grouping.

Why is this important?

For blind and low vision learners, although a note-taking role may be a preferred option, provide learners with the flexibility and opportunity to choose from a variety of roles, fostering exploration and skill development.

For deaf and hard-of-hearing learners, group work can be challenging due to elevated noise levels. Engage learners in smaller groups, move groups to quieter spaces, and encourage learners to speak clearly so everyone can follow the conversation.

Strategy in Action

Educators are provided with guidance on **surfacing learners' diverse abilities** through activities.

It's essential to ask individual learners about their preferences and needs, as learners with diverse abilities have widely varying preferences.

Connections to the PLANETS Practical Guide

See Promising Practices for Program Design, section 1, "Create safe, accessible, and welcoming learning environments" on pg. 11 of the **Practical Guide**.

Building Community and Family Connections

Strong relationships are key to learner success. Building community and family connections with learners encompasses having ongoing and meaningful two-way interactions between educators and families and/or other communities of supportive adults. It also involves creating a learning environment within OST (Out-of-School Time) programs that is familial, supportive, and empowering. OST programs with strong learning environments and communities recognize the assets that learners bring and allow learners to express themselves, making them feel comfortable engaging in STEM content. Family connections set the stage for social-emotional learning in the unit via:

- **Relevance—**Family connections allow learners to draw connections between NASA science and engineering and the science and engineering in their daily lives and communities. This type of connection allows learners to bring their own funds of knowledge to the activities.
- **Belonging—**When learners see how their cultures and families use science and engineering principles, they feel that they belong in STEM.
- **Cultural responsiveness—**Family connections allow for relevant aspects of learners' cultures to enter or ground the learning in ways that the educator may not have been aware of. Learners' cultural knowledge can play an important scaffolding role in learning science and engineering while simultaneously sustaining that cultural knowledge for the next generation.

What does building community and connections look like in action?

A few examples of how to purposefully develop these relationships with learners and their families include the following:

- **Use a variety of communication methods.**
- **Acknowledge challenges to family and community engagement.**
- **Invite families to engage in and design STEM learning activities.**

Consider using some of the following ways to build family connections during this unit based on your capacity and/or your learners' ability to include family members:

- Add an activity in which you invite families to be guest speakers. (Families can also work with you to find guest speakers from the community.)
- A Level Up! tip at the end of each activity invites learners to discuss a particular question with their families. (You can also suggest family activities to spark conversation around a particular topic.) Learners can share what they discussed at the start of the next activity.
- Invite families to the Engineering and Science Share-Outs at the end of each pathway to not only share in celebration of their learners' accomplishments but also to provide their knowledge (cultural or otherwise) about the engineering or science discussed and used in the pathway.

Instructional Support Tips for Learning

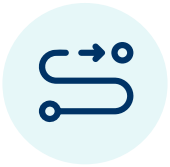
Within each activity across the Space Hazards unit, several strategic tips are provided as opportunities for additional instructional support. These tips are guided by the following PLANETS core design principles:

- Support Thinking
- Teaching Tips
- Connecting Across Activities
- Support Learner Differences
- Level Up

The table below provides guidance on the purpose and use of each of the tips found within the activities.

Instructional Support Tip:	Purpose:
Support Thinking 	Provides ideas for educators to productively support learners' thinking, such as • suggestions of targeted language to use with learners to increase social emotional supports. • things to emphasize during student collaboration. • language that explicitly helps students to realize they are working, thinking, and looking like engineers or scientists (metacognitive and representation/identity/ confidence in STEM). • additional resources that may enhance student engagement/thinking about the current instructions of the activity (e.g., videos, audio).
Teaching Tip 	Provides additional recommendations for educators with regards to the mechanics of the activity, such as • modifying materials. • grouping and/or roles of learners during parts of the activity based on materials, timing, and engagement. • additional procedural tips to increase effectiveness of investigations and designs. • modifying timing of activities with different procedures.

Instructional Support Tip: Connecting Across Activities



Purpose:
Highlights ways that the activities connect within the pathways and across the disciplines of engineering and science.

Instructional Support Tip: Support Learner Differences

Purpose:
Provides just-in-time supports during the activity that help educators ensure they are meeting the needs of all STEM learners—especially Indigenous learners, emergent multilingual learners, and learners experiencing differing physical and/or sensory abilities—such as

- ways to support multiple pathways for ensuring all learners can equitably engage in the activity.
- strategic peer grouping(s) to enhance engagement equity.
- additional challenges or ways to increase the learning rigor for learners who are ready.
- additional resources that increase equity to ensure that all learners can engage effectively in the activity (e.g., videos, audio).

Unique icons are used in PLANETS activities to help educators quickly identify specific tips that may apply to their learners:

 **Multilingual learners**

 **Indigenous learners**

 **Learners with diverse abilities**

 **Engaging all learners**

Instructional Support Tip: Level Up

Purpose:
Provides supplemental guidance to educators facilitating activities, such as

- ways to make the activities more inclusive to all STEM learners.
- extensions to broaden both content and options provided within each activity. Note that time estimates for Level Up activities are provided separately from the main activity timing.

References

Elsayed, R., Clark, J. G., Daehler, K. R., & Bloom, N. E. (2022). *A practical guide for out-of-school-time professionals to promote inclusion and engagement in STEM learning*. PLANETS, Northern Arizona University and WestEd.

Inclusion Activities

At the beginning of each activity, you can lead an inclusion activity that is appropriate for your group. Below are some possible activities:

Story of Your Name

In pairs or small groups, have learners share their names and stories behind them. For example, what do they mean? Why were they given? Have learners share other important information about their identities, such as locations they are from and tribes or other groups they belong to.

Handshakes and High Fives

Play three rounds of this inclusion activity. Each round, have learners pair up and introduce themselves in some way (e.g., handshake, high five, elbow bump, dance, nod, codeword). Then ask a question and have them discuss it for one minute. Once learners have completed all three rounds, have them re-find their three partners in order and repeat the introduction for each.

Paper Toss

Give each learner a piece of paper and a writing utensil. Ask a question and have them write an answer on the paper (for example, What is your name? What do you do for fun?) Have learners crumple the papers and throw them around. Then have them uncrumple the papers and share the answers with the group.

Choose an Object

Lay out a set of objects, such as small figurines, playing cards, or craft supplies. Ask a question (for example, How is your day going? What is a strength you bring to the group?) and have each learner choose an object that represents their answer (for example, *I chose the owl because I am good at watching what is happening*). Have learners share their objects and answers in pairs or small groups.

Interviews

Have learners pair up and spend three minutes each interviewing each other, then have them share about their partners in a large group. Possible interview questions include the following:

- What is your favorite place to hang out that is not school or home?
- What are some things you are good at?
- What tools or machines do you know how to use?
- What languages do you speak at home?
- What is something you did this week with someone else?
- How do you like to express yourself?

Accessibility Check

Have learners go around a circle and share their names and access needs. Access needs are things they might need to fully participate and feel comfortable in an activity or space. They can be anything that helps people learn, communicate, move around, or feel safe and included. As needed, share first yourself and give some examples, such as "I need short breaks during long activities to stay focused," "I need to refill my cup of water," "I feel more comfortable lying on the floor," or "I need pictures to help me understand what we are learning." Learners can also say "I'm still thinking about my access needs" or "All my access needs are met, check." Note that learners may not be comfortable sharing their needs until after several days of participation.

Design a NASA Mission Patch

NASA mission patches are special symbols that tell the story of each space mission. They use pictures, colors, and symbols to show the mission's goals, who the astronauts are, and important parts of the crew's lives. Have learners form groups of three, choose a mission name, choose a patch shape, and draw or write three things to include on their patch. Patches can include meaningful images, symbols, and colors. As needed, show examples from **NASA's Human Spaceflight Mission Patches.**

Transition

Say:

Let's talk about why we did this. Inclusion isn't just a nice idea–it's crucial for success, both here and in the real world. At NASA, every astronaut needs to know their team well. Why? Because in space, your crew is your lifeline. Similarly, in our group, everyone matters. We learn better when we understand each other. Knowing our teammates helps us work together and solve problems. By sharing parts of ourselves, we build trust and respect. This makes our "mission"— learning together—more fun and more effective. Remember, great teams are built on understanding and appreciating each person's unique strengths.

Conclude by connecting the inclusion activity to what learners are doing next. For example, say:

You just made different partners. Now you are going to work with one of those partners to...

Intentional Grouping Strategies

Intentional Grouping can support learners in a variety of ways.

Group roles can play to learners' **diverse abilities and strengths**. For instance, a blind or low vision learner might be much more skilled at tactile or auditory tasks, and having a role that plays to this strength will elevate that learner and strengthen the group. Never assume which tasks learners will prefer, because they can feel othered and misunderstood. Give them the first choice of group roles.

Grouping learners with **similar spoken or signed languages** can help multilingual learners bounce ideas off each other in their native language before translating them for the whole group. This will also help learners decide what words to share in their native languages.

Grouping learners by **culture** can allow them to work through things in ways that are familiar and valued at home before sharing with the larger group. For instance, Indigenous learners might benefit from being grouped together and working by consensus rather than by having a leader. Or they may decide to communicate their final challenge on posters during a gallery walk, rather than by presenting publicly.

Similarly, if learners are grouped by **shared interests or hobbies**, they may start to interpret the learning in the context of what they know, which is fantastic! For example, "We mitigate hazards when biking all the time by slowing down, wearing helmets, and not biking when it's dark outside."

The number of learners in a group

Groups of 2: If students are sharing personal information or stories, working in pairs first gives learners an opportunity to hear other ideas and rehearse their own ideas before sharing with the whole group. Pairing up is especially helpful for multilingual learners.

Groups of 4: Use groups of four when learners would benefit from lots of perspectives or ideas.

Please note, *these activities are not designed for groups of five or more. A group of five would likely have an outlier with not enough to contribute.*

Science Pathway Storyline

Science Adventures 2–4
Learners explore hazards and mitigations in their communities and on Earth.

Science Adventures 5–7
Learners expand what they have learned in the prior adventures to hazards and mitigations in space.

CONTEXT

CONTEXT SETTING ADVENTURE – *Ready, S.E.T., Go!*

ADVENTURE SNAPSHOT
Learners scientifically investigate the energy from space trash impacts, and they engineer a device to protect against those impacts.

Prep Snapshot

Prep Time: 70 min

- Read activity
- Print Notebooks
- Prepare materials
- Make *Our Ideas* poster

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection
- Critical Thinking

Habits of Mind
- Use a structured problem-solving process

Science Practices
- Construct explanations

Connecting Across Activities

Today, learners explore space trash. As scientists, they measure the energy of space trash impacts. As engineers, they design ways to protect against those impacts.

Next time, learners share experiences with and stories about making hazards safer.

1

SCIENCE ADVENTURE 1 – *Safety Stories: Sharing Experiences*

ADVENTURE SNAPSHOT
Learners share experiences with, and stories about, making hazards safer.

Prep Snapshot

Prep Time: 30 min

- Set up Materials Table

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection
- Communication

Science Practices
- Communicate effectively

Connecting Across Activities

Last time, learners explored space trash. As scientists, they measured the energy of space trash impacts. As engineers, they designed ways to protect against those impacts.

Today, learners share experiences with and stories about making hazards safer.

Next time, learners act out everyday hazards, figure out safety tips to address them, and start learning about hazard mitigation.

2

SCIENCE ADVENTURE 2 – *Everyday Hazards: Exploring Hazards and Mitigation*

ADVENTURE SNAPSHOT

Learners act out everyday hazards and match them with safety tips.

Prep Snapshot

Prep Time: 60 min

- Prepare *Our Ideas* poster
- Print, cut, and assemble Deck A

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Communication

Science Practices

- Obtaining, Evaluating, and Communicating Information

Connecting Across Activities

Last time, learners shared experiences with and stories about making hazards safer.

Today, learners act out everyday hazards, figure out safety tips to address them, and start learning about hazard mitigation.

Next time, learners will explore hazards near their community and consider how people mitigate those hazards.

3

SCIENCE ADVENTURE 3 – *Close to Home: Hazards Where We Live*

ADVENTURE SNAPSHOT

Learners create their own hazard and mitigation cards and play a matching game with them.

Prep Snapshot

Prep Time: 50 min

- Print and cut out Deck B
- Think about local hazards

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Critical Thinking

Science Practices

- Obtaining, Evaluating, and Communicating Information

Connecting Across Activities

Last time, learners acted out everyday hazards, figured out safety tips to address them, and started learning about hazard mitigation.

Today, learners explore hazards near their community and consider how people mitigate those hazards.

Next time, learners will learn about hazards on Earth and explore the methods people have come up with to mitigate some of them.

4

SCIENCE ADVENTURE 4 – *Dangerous Planet: Earth Hazards*

ADVENTURE SNAPSHOT

Learners play a card game to learn about hazards on Earth and how people mitigate some of them.

Prep Snapshot

Prep Time: 55 min

- Print, cut, and assemble Card Decks C and D for each small group

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Connecting Across Activities

Last time, learners explored hazards near their community and considered how people mitigate those hazards.

Today, learners learn about hazards on Earth and explore ways to mitigate them.

Next time, learners will learn that hazards also exist in space, some are the same as on Earth, and some are different.

5

SCIENCE ADVENTURE 5 – *Far from Here: Hazards in Space*

ADVENTURE SNAPSHOT

Learners play a card game to learn about space hazards and their differences from hazards on Earth.

Prep Snapshot

Prep Time: 50 min

- Print, cut, and assemble Card Deck E for each small group

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Connecting Across Activities

Last time, learners learned about hazards on Earth and explored ways to mitigate them.

Today, learners will learn that hazards also exist in space, some are the same as they are on Earth, and some are different.

Next time, learners will choose a NASA mission and think about the hazards, mitigation strategies, and other factors NASA should consider.

6

SCIENCE ADVENTURE 6 – *Putting it All Together: Mitigating Hazards for Your Mission*

ADVENTURE SNAPSHOT

Learners think about hazards and mitigation strategies for NASA missions.

Prep Snapshot

Prep time: 50 min

- Combine card decks

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Creativity

Science Practices

- Engaging in Argument from Evidence

Connecting Across Activities

Last time, learners learned that hazards also exist in space, some are the same as they are on Earth, and some are different.

Today, learners choose a NASA mission and think about the hazards, mitigation strategies, and other factors NASA should consider.

Next time, learners will share their proposed mission strategy with members of their community.

7

SCIENCE ADVENTURE 7 – *Sum it Up: Science Share-Out*

ADVENTURE SNAPSHOT

Learners share what they learned about hazards and mitigation strategies for NASA missions.

Prep Snapshot

Prep time: 40 min

- Invite people to the presentations

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Communication

Science Practices

- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Connecting Across Activities

Last time, learners chose a NASA mission and thought about the hazards, mitigation strategies, and other factors NASA should consider.

Today, learners share their proposed mission strategy with members of their community.

Next time, learners experience engineering related to this topic in the Space Hazards Engineering Pathway (optional).

Science Pathway Vocabulary

This list is included to provide an overview of the content of this pathway. Note that you should not pre-teach it to learners before the activities–terms are introduced after learners have direct experience with the materials and processes to which those terms are connected.

Science Adventure 2

- **Hazard**: A danger or something that can cause harm.
- **Mitigation**: Actions taken to reduce or prevent harm or damage.

Science Adventure 4

- **Dust storm**: A strong wind that blows dirt across the land, often making it hard to see.
- **Flood**: An overflow of water that covers the land and causes damage.
- **Lava flow**: Hot, melted rock from a volcano that flows down the sides during an eruption.
- **Meteor**: A small rock or piece of space debris.
- **Meteoroid impact**: A crash of a meteor into the Earth's surface.
- **Volcano**: A mountain that can erupt with hot, melted rock, ash, and gases from deep inside the Earth.

Science Adventure 5

- **Asteroid:** A large rock in space, often orbiting the Sun.
- **Low gravity:** A weaker force pulling things toward a planet or moon.
- **Poison soil:** Soil that has harmful chemicals or substances in it, making it unsafe for plants or animals.
- **Space radiation:** Dangerous energy from the Sun or other stars in space that can harm living things.

Science Materials List

The quantities below are for one group of 24 learners. Follow this weblink to calculate the amount of materials you'll need for your number of learners.

Quantity	Material
1 set	*Hazards Cards* Deck A–Everyday Hazards
1	marker
1 pair	scissors
1 roll	tape, masking
2	*Science Adventure 4 Hazards Card Game Rules Handout*
2	pencils
20	bags, small (to contain card decks)
700	index cards
	copy paper (for drawing)
	presentation materials, to make and display signs, posters, pictures, etc.

Quantity (Per Group of 4)	Material
1 small piece	aluminum foil
1 set	*Hazards Cards* Decks C, D, and E
1	*Science Adventure 4 Hazards Card Game Rules Handout*
1 tsp	Salt, rice, or sand
2	rulers
4	washers
1	*Playmat* (optional)

Quantity (Per Learner)	Material
1	marker
1	Science Notebook
2	pencils
3+	Cards from *Hazards Cards* Deck B–Blank Cards (at least 1 Hazard card and 2 Mitigation cards)

Science Advance Preparation

You can complete much of the preparation for the Science Adventures ahead of time. Follow the steps below.

Educator Background

1. Read through the entire PLANETS Science Pathway Educator Guide Introduction, pgs. iii–xxv, to learn more about the science content in this unit.
2. Read the Educator Science Background (weblink) for context about the science in the unit.
3. Print and laminate any pages you want available for easy reference. (The Inclusion Activities, pgs. xx-xxii, Intentional Grouping Strategies, pg. xxii, and Pathway Storyline, pgs. xxiii–xxv, are especially useful.)
4. Print your own copy of the Science Notebook (PDF) for reference.
5. Reflect on the learners who will engage in the pathway and identify ways to create an inclusive and collaborative learning environment (see pgs. viii–xviii).
6. Consider whether to split any adventures. If you have learners who would benefit from repetition and extra time, you can split the adventures at the points indicated throughout this guide. If you have learners who are already familiar with hazard mitigation in daily life, consider skipping Adventure 2. If you have learners who like to jump ahead, consider combining Adventures 2 and 3 and Adventures 4 and 5, then slowing down for Adventures 6 and 7 to allow more time for self-directed exploration.
7. Think about hazards relevant to your community and look up the words for these in your local languages or languages spoken by learners in your program.
8. View the following video playlists:
   - How to prepare and teach with the materials
   - Background science and engineering content
   - How to support learner differences

For the Whole Group

1. Invite staff, family, and community members to attend the Science Share-Out in Adventure 7. Make copies of the Science Adventure 6 Share-Out Invitation Handout, pg. 58, to distribute to family and friends.
2. Prepare an *Our Ideas* poster by following the Prep & Setup Guide (PDF). Print 1 copy of Hazards Cards Deck A–Everyday Hazards (PDF) (in color if possible) (15 cards). Cut these printed card sheets into individual cards with a paper cutter or scissors.

Support Learner Differences

- If internet access may be a problem, consider downloading videos ahead of time. If it would benefit your learners, you can adjust the video playback speed. Note that video links may change over time; if a link does not work, try searching the title of the video.
- All videos in this unit include captions. As needed, these captions can be translated by online video platforms.

3. Print 1 copy of Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45.
4. Print 1 copy of the Playmat (PDF). (If you have a large group, print multiple copies so everyone can reference it.) Tape it together. You can make the mat tactile by attaching wiki stix or other objects to it (optional).

For Each Group of Learners

1. Print 1 copy of each of the following handouts for each group of 4 learners:
   - Science Ready, S.E.T., Go! Visual Instructions Handout, pg. 16.
   - Playmat (PDF) (optional; tape it together)
   - Hazards Cards Deck C—Earth Icons (PDF) (in color if possible) (8 cards)
   - Hazards Cards Deck D—Earth and Space Icons (PDF) (in color if possible) (16 cards)
   - Hazards Cards Deck E—Space Icons (PDF) (8 cards)
   - Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45.

For Each Learner

1. Print and staple one Science Notebook (PDF) for each learner, in color if possible.
2. Print *Hazards Cards* Deck B–Blank Cards so that each learner has at least one blank Hazard card and two blank Mitigation cards. Cut these printed card sheets into individual cards with a paper cutter or scissors.

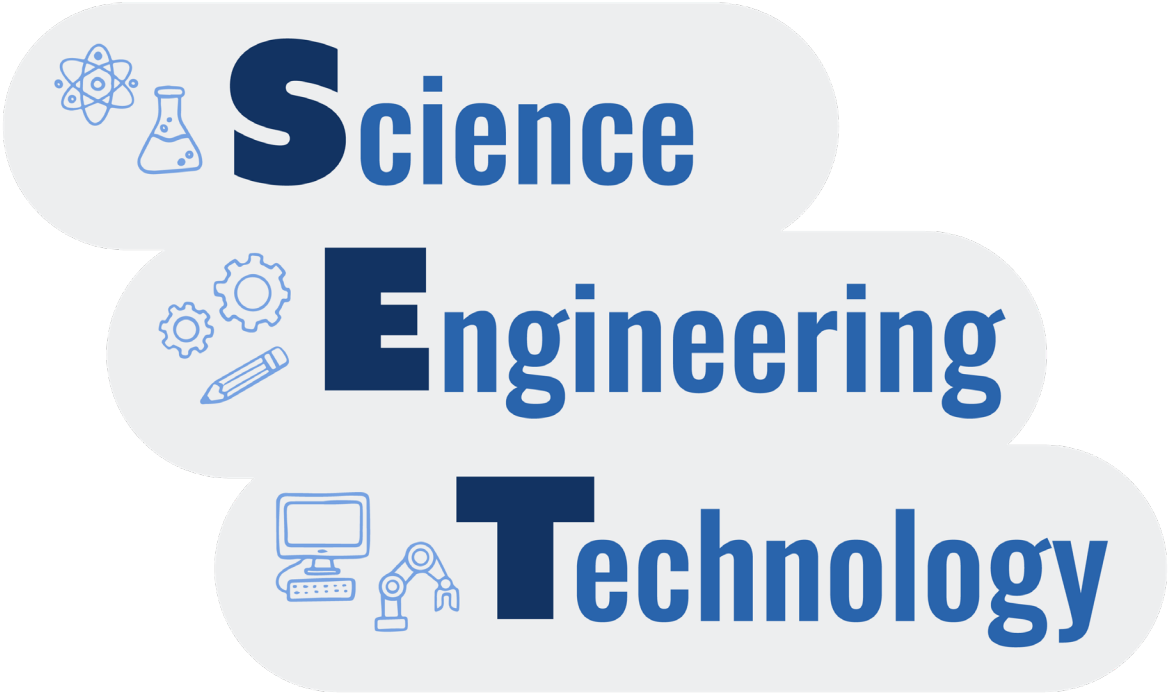
Support Learner Differences

- For blind/low-vision and multilingual learners, choose the BLV Deck version of the cards to provide QR codes on the backside of each card. Each QR code is linked to a unique webpage designed to be easy to use with text-to-speech and translation technology.
  - Accessible Version of Deck A (PDF)
  - Accessible Version of Deck C (PDF)
  - Accessible Version of Deck D (PDF)
  - Accessible Version of Deck E (PDF)
- To help orient blind/low-vision learners, place a thick sticker on the back of each card, centered along the top so that it's easy to tactically orient the cards right-side up and front-facing. This may take five additional minutes per deck.
- Add Wikki Stix or other raised lines to the playmat to help blind/low-vision learners orient to the mat. Remember to allow room between tables for all mobility equipment when setting up.
- A limited tactile version of the card decks (weblink) and playmat (weblink) are also available. An estimated 5–10 minutes is required to punch holes in all the required areas per deck with a one-hole punch. In this deck, learners can match cards by sight and/or by aligning tactile holes. Note that not all cards are included in these decks.

Teaching Tip

If you think learners will benefit from having more space in the Notebook, print one-sided or add sheets of blank paper as you make the Notebooks.

Ready, S.E.T. (Science, Engineering, Technology), Go!



Educator Preview

Adventure Snapshot

Learners scientifically investigate the energy from space trash impacts, and they engineer a device to protect against those impacts.

Timing | 60 minutes

Get Ready & Team Up	5 min.
Plan & Create (S.E.T.)	50 min.
Reflect (Go!)	5 min.
Total	**60 min.**

Level Up Activities 5–30 min. each

Prep Snapshot*

Prep Time 70 min.

- Read activity.
- Print Notebooks.
- Prepare materials.
- Make *Our Ideas* poster.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Habits of Mind

- Use a structured problem solving process.

Science Practices

- Constructing Explanations

Guiding Question

How does space trash damage spacecraft and can we design ways to protect against it?

Learners Will Do
As scientists, measure the energy of space trash as it impacts spacecraft. As engineers, design technology to protect against space trash impacts.

Learners Will Know
Scientists and engineers work together to solve problems.

Connecting Across Adventures

Ready, S.E.T., Go!	Adventure 1: Sharing Experiences
Today, learners explore space trash. As scientists, they measure the energy of space trash impacts. As engineers, they design ways to protect against those impacts.	**Next time**, learners share experiences with and stories about making hazards safer.

Adventure Resources
Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/91276ff5

Materials and Preparation

Materials

For the whole group

- blank poster or sheet of chart paper
- *Our Ideas* poster (on paper or a shared digital document)
  Examples | Templates
  - index cards
  - markers
  - scissors
  - tape

For each learner

- Science Notebook (PDF)

For each group of 4

- Engineering Ready, S.E.T., Go! Visual Instructions Handout, pg. 16
- salt, rice, or sand 1/8 tsp per trial
- 1 piece of aluminum foil, 6" × 6"
- 1 aluminum tray, 12" × 10" × 2.5"
- 1 piece of cheesecloth, 6" × 6"
- 1 piece of craft foam, 4.25" × 5.5"
- 1 piece of felt, 4.25" × 5.5"
- 1 pack of index cards (about 100 cards)
- 1 piece of masking tape, at least 12"
- 2 rulers
- 4 washers
- 1 piece of dark-colored paper (optional)

Ready, S.E.T., Go! Materials Preparation (70 min.)

Ahead of Time

1. Read through the PLANETS Science Pathway Educator Guide Introduction, pgs. iii–xxv to learn more about the content in this unit.
2. Print and staple one Science Notebook (PDF) for each learner, in color if possible. As needed, prepare to share the Notebook digitally.
3. Print your own copy of the Science Notebook for reference.

Teaching Tips

- If you think learners will benefit from having more space in the Notebook, print one-sided or add sheets of blank paper as you make the Notebooks.
- This adventure is the same in both the Science and Engineering Pathways. If you have already taught it in one pathway, you do not need to teach it again.
- This adventure can stand alone as a brief single-session program.

Support Learner Differences

The Science Notebook can be printed in large font and you can share a digital version that will work with screen readers. The Notebook is written in English, but you can translate the instructions into other languages; see translation guidance in our Translatable Glossary (DOCX).

4. Prepare an *Our Ideas* poster by following the online Prep & Setup Guide (PDF). Add the Guiding Question "How does space trash damage spacecraft and can we design ways to protect against it?" so learners can refer to it throughout the adventure.

5. For each group, cut a 6" × 6" piece of aluminum foil, a 6" × 6" piece of cheesecloth, a 4.25" × 5.5" piece of craft foam, and a 4.25" × 5.5" piece of felt.

6. Print one *Engineering Ready, S.E.T., Go! Visual Instructions Handout*, pg. 16, for each group of 4 learners.

In Your Space

7. Place the *Our Ideas* poster in a location all learners can access. Make a plan to store it between activities.

Teaching Tip

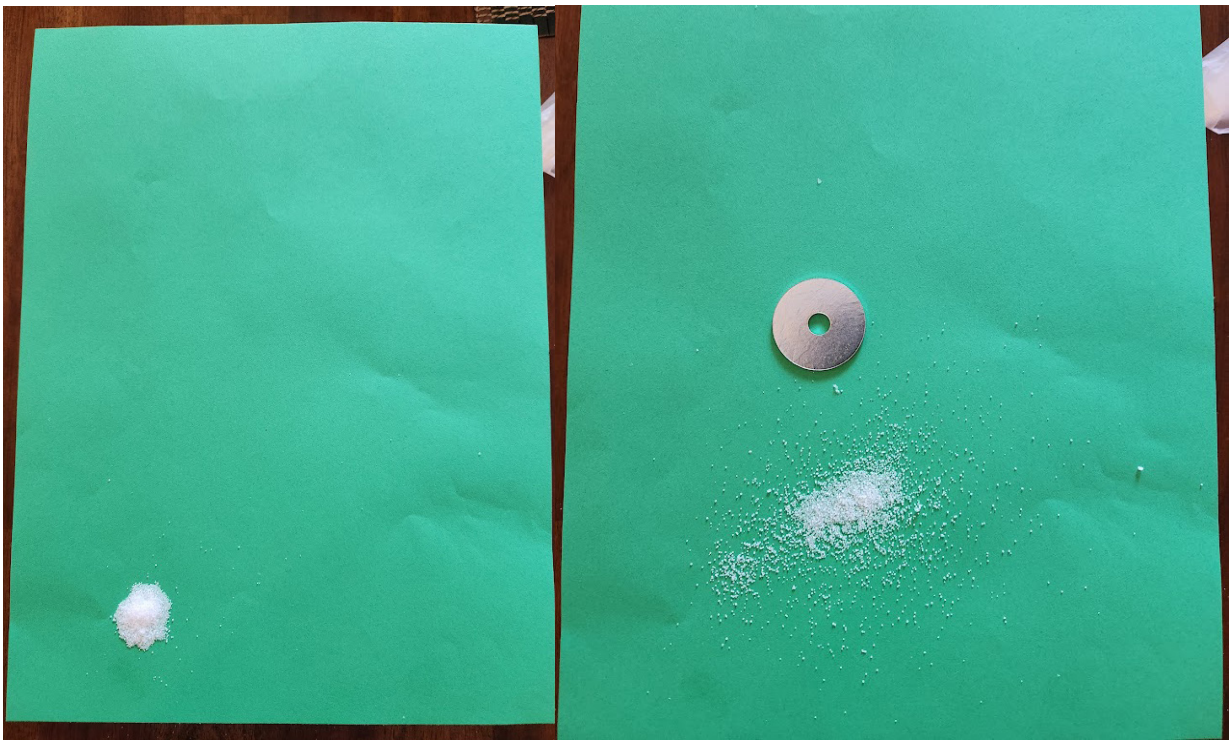
You can begin the *Our Ideas* poster with several standard 23" × 32" pieces of chart paper. You may fill them up before the end of the pathway, in which case you can add additional pieces as needed. See the Our Ideas poster example (PDF).

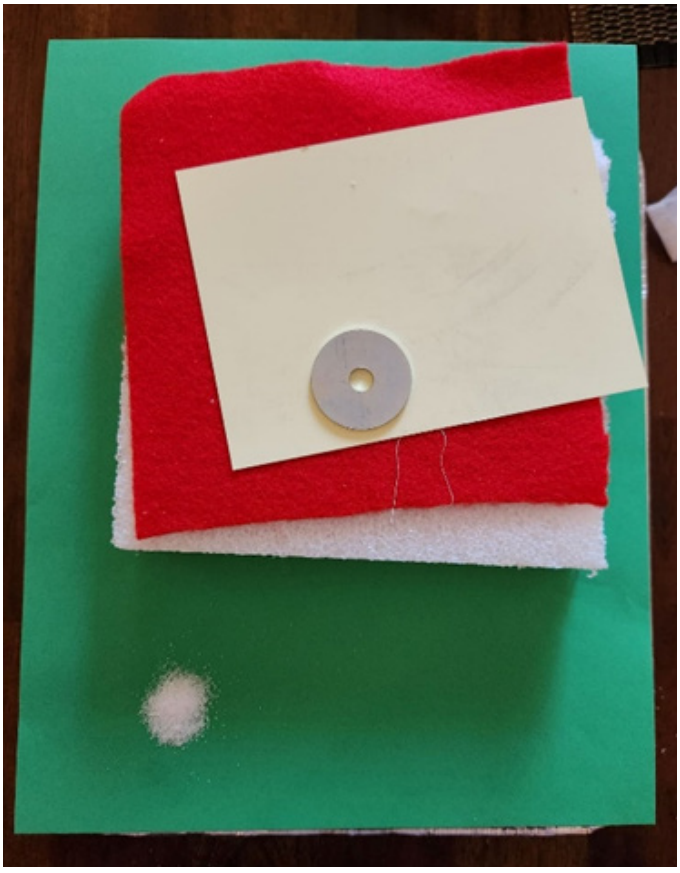
The *Our Ideas* posters capture students' authentic language and ideas as they emerge in real-time discussions. The posters are not meant to simply display and front-load vocabulary. The posters develop over time as the educator listens for and adds the language that learners use in the moment, thus validating their ideas, providing feedback and supporting sensemaking and language development.

Support Learner Differences

Different learners have different needs. Choose from the following tips to best support your learners:

- View the Translanguaging Video to support learners who speak multiple languages.
- For those with low vision: add tactile elements, such as three-dimensional representations and Braille. Prepare a shared digital document all learners can access, ensuring that it supports text-to-speech for your learners.
- Add learner questions to the *Our Ideas* poster to foster an interest-led approach.





Learners follow the directions on *Investigate It!*, pg. 7, in their Science Notebooks to measure the amount of damage to their "spacecraft" based on how much salt is disturbed. Then, they attempt to reduce the damage using the materials provided.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Give each learner a Science Notebook. Say: **This Notebook is a place to record your observations and ideas.**
2. Have learners read the *Ready, S.E.T., Go! Comic*, pgs. 2-6, in their Science Notebooks, to set the context for the adventure. Say: **Today you are going to investigate and solve the problem of space trash**. Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **How does space trash damage spacecraft and can we design ways to protect against it?**

Support Learner Differences

Have learners talk about places in outer space they know about and if any of those places are important to them. *(Possible responses include planets, moons, comets, and the Sun. Learners may have seen particular objects with family or community members, or they may know stories about those objects.)* If you have learners who speak multiple languages, encourage them to share in their preferred languages.

Support Learner Differences

If learners are new to you or each other, have them share their names, name pronunciations, and other important parts of their identities. These introductions are important for all learners and can be especially relevant for Indigenous learners, multilingual learners, and learners with different physical abilities. You can also distribute index cards and have learners write anything they want you to know but do not want to share with the whole group, such as resources that will help them learn. If everyone knows each other's names, ask if anyone has a middle name or nickname you could learn to pronounce. Invite them to share about it.

For more strategies to engage learners, refer to Designing Instruction to Reach Diverse Learners, pg. x.

You can project a digital version of the comic (PPTX) or share it so learners using text-to-speech technology can access the comics.

- iOS or macOS users should enable text-to-speech or voice-over.
- Windows users should use JAWS or NVDA at NV Access.

Be sure to read carefully and leave a visual shortcut to exit the program, or have your learner restore settings when they are done.

Teaching Tip

Throughout this guide, information for you to say to students appears in **bold**. You can say the bold sentences exactly as they are written or paraphrase them.

Plan & Create (S.E.T.) (50 min.)

3. Ask: **What kinds of trash might be in space?** *(Pieces of old rockets and satellites.)* **Why could space trash be a problem for people?** *(Space trash can hit astronauts and hurt them.)*
4. Say: **Even if space trash is tiny, it can cause a lot of damage to spacecraft because it is traveling so fast. Today, we're going to investigate what happens when space trash hits a spacecraft.**
5. Organize learners into groups of 4. Give a copy of Engineering Ready, S.E.T., Go! Visual Instructions Handout, pg. 16, to each group.
6. Give each group materials: an aluminum tray, four washers, a piece of tape, and two rulers. Say: **The washers represent a piece of space trash, and the aluminum tray represents the outside of the spacecraft. You will drop the washers onto the upside-down tray, making changes and observing what happens each time.**
7. Have learners turn to *Investigate It!*, pg. 7, in their Science Notebooks. Say: **You will be testing two kinds of changes.**
   a. **You will drop one, two, three, or four washers to represent space trash of different sizes. When you are dropping more than one washer, you will tape them together. It is important that you only *drop* the washers and do not throw them, in order to keep the test results consistent and avoid damaging the tray.**
   b. **You will drop the washers from one or two feet above the tray to represent space trash traveling at different speeds. You will measure how much the energy of the space trash damaged the spacecraft. You can measure this damage in three ways:**
      - **A louder sound means more damage.**
      - **More vibrations in the tray mean more damage.**
      - **A small pile of salt or rice will be on the edge of the tray. More movement of the salt or rice means more damage.**

Level Up!

- If you can, show the video clip NASA has big 'guns' to study micrometeorite & space debris impacts - See test fires (2:33–2:53). Preview audio before playing; it compares the speed of the test trash to the speed of a gun. (5 min.)
- Introduce this activity with a children's book about trash like Team Trash by Kate Wheeler and Trent Huntington (weblink), or one that is relevant to your community to get your learners invested in the character's problem. (30 min.)

Support Learner Differences

As needed, provide groups with a tub or other container to hold their materials. Give learners time to examine the materials before beginning the tests.

Check out the Intentional Grouping Strategies, pg. xxii.

Support Thinking

Play the translatable video Space Hazards Instructional Read Aloud, which describes the testing procedure.

8. Have groups discuss and record their predictions about damage in the "prediction" columns on the top part of *Investigate It!*, pg. 7, in their Science Notebook.

9. When groups have made their predictions, put 1/8 tsp of salt or rice on the edge of each group's tray. Have learners begin testing. Have them record the results in the "actual" columns on the top part of *Investigate It!*

10. When groups are finished testing, revisit the first part of the Guiding Question: **How does space trash damage spacecraft?** *(When space trash hits a spacecraft, its energy can break the spacecraft. We can observe this energy when the tray moves, vibrates, and makes noise.)* Ask: **What patterns do you notice about space trash damaging the spacecraft?** (*Space trash that is larger or moving faster does more damage.*) Give groups five minutes to discuss and record their ideas on the *Our Ideas* poster. Say: **We will keep recording ideas on this poster.**

Support Learner Differences

Covering the tray with a piece of dark-colored paper makes the salt or rice easier to see and has a minimal effect on sound and vibration. Vibrations can be felt by lightly touching the side of the pan during testing.

If necessary, increase the drop height so it is easier to time the fall.

Level Up!

If you have decibel meters or a decibel meter smartphone app available, learners can use them to measure the loudness of each impact. They can graph the results to observe how the loudness changes as other things change. (10 min.)

Have groups time how long it takes the washers to fall two feet, then calculate the average fall speed by dividing 2 feet by the amount of time. (Note that the average fall speed is not the same as the speed on impact, because the washers get faster as they fall.) (10 min.)

Support Learner Differences

Recording learners' ideas using words, diagrams, and pictures on the *Our Ideas* poster or shared digital document throughout the adventures allows them to refer to the poster to remember words and build on past ideas. You can refer to an "In-Use Example" in the Prep & Setup Guide (PDF).

If you have learners who speak multiple languages, encourage them to share in their preferred languages.

As needed, allow learners to choose other methods of sharing their ideas, such as audio recordings. Have them write the filename of each record on an index card and put the index cards on the *Our Ideas* poster. They will serve as placeholders. When necessary, you can ask, "Who has the idea named X?" and have the learner in question share the record.

11. Say: **You have been acting as scientists. Scientists often ask questions and gather evidence to answer the questions. Besides space trash, what other things do you know about that scientists study?** *(Responses will vary. Possible responses include living things, the Earth, and what objects are made of.)* Write the word *scientist* on the *Our Ideas* poster. Have learners come up with a description of scientists together and record it on the poster. (For example: Scientists ask questions, test things out, make observations and measurements, and gather evidence to answer the questions.) You can have learners add translations, drawings, or related images to the poster as well.

Level Up!

- Tell learners that when washers are dropped from 2 feet, they are moving at 11.2 feet per second when they hit the tray. Actual space trash can move at up to 18,000 miles per hour. Have them figure out how much faster the actual space trash is moving than the washers. (10 min.)
- For an additional challenge, have groups construct a shield using only 10 index cards, 12 inches of tape, and no other materials. (10 min.)
- Introduce the terms ***criteria*** (requirements for evaluating a design), ***constraints*** (limitations on a design), and ***tradeoff*** (a compromise engineers make to balance competing design requirements). Have learners consider how each term applies to the shields they are engineering. (10 min.)

12. Say: **Now that you have identified a problem, you will design something to solve the problem of protecting spacecraft when they are hit by space trash. You need to design a shield to absorb as much energy as possible when space trash hits it. You can use a variety of flat materials: cheesecloth, felt, foam, foil, and an index card. You will compare the damage done to the tray before with the damage done to each of these materials.** Give each group one piece of each material.

13. Have groups discuss how well they think each material will absorb the energy of the space trash. Have them record their predictions about damage in the first column on the bottom part of *Investigate It!*, pg. 7, in their Science Notebook.

14. When groups have made their predictions, have them test the shielding materials one at a time (dropping four washers from two feet each time). Have them record the results in the second column on the bottom part of *Investigate It!*, pg. 7, in their Science Notebook.

15. Ask: **Which materials absorbed the most energy? Why do you think so?** *(The foam and felt absorbed a lot of energy because the space trash was quiet when it hit them and didn't make a lot of vibrations that were felt or transferred to the salt or rice.)*

16. Explain that learners can now combine these materials to make the most effective shield. Have groups begin and work for about 15 minutes.

17. Revisit the second part of the Guiding Question: **How can we design ways to protect against space trash?** *(Responses will vary. Possible responses include we can stack layers of materials, and we can fold materials like index cards to make them more absorbent. When these materials absorb energy from the space trash, the spacecraft is protected.)*

18. Say: **You have been acting as engineers. Engineers design things to solve problems.** Write the word *engineer* on the *Our Ideas* poster. Have learners come up with a description of engineers together and record it on the poster. (For example: Engineers design things to solve problems.) You can have learners add translations, drawings, or related images to the poster as well.

19. **Your designs to protect against space trash are *technologies.* A *technology* is anything designed by people to solve problems. Scientists often ask questions, and engineers help them by designing technologies to answer those questions. They depend on each other.** Write the word *technology* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

Reflect (Go!) (5 min.)

20. Say: **You will be acting as scientists to help solve more problems in space. These problems will involve learning about and protecting against other *hazards*, or dangers.**

21. Say: **Space trash is one kind of hazard. What other hazards can you think of?** *(Accept all responses.)*

22. Say: **Next time, we will think about what we already know about protecting against other types of dangers.**

Level Up!

Learners may believe that *technology* refers only to devices powered by electricity. Explain that anything designed by people to solve a problem is technology. Have learners identify non-electrical technologies around them. (5 min.)

Have learners explore actual shielding for NASA spacecraft in the video How Can We Protect Our Astronauts in Space? (1:32) (5 min.)

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for Adventure 1.
   - Throw away the salt or rice and any materials that are too damaged to reuse. Check to ensure the foil trays have not developed holes.
   - Collect the washers and other shielding materials.
2. Have learners invite people from the community, including their families and friends, to the Science Share-Out in Adventure 7.
3. Plan ahead for Adventure 1. See Adventure 1 Preparation on pgs. 18–19.
4. Take time to reflect on the following educator prompt. **How did you create connections between the science and engineering portions of the adventure?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Science Ready, S.E.T., Go! Visual Instructions Handout

Part 1

1 Gather materials


salt and colored paper


ruler

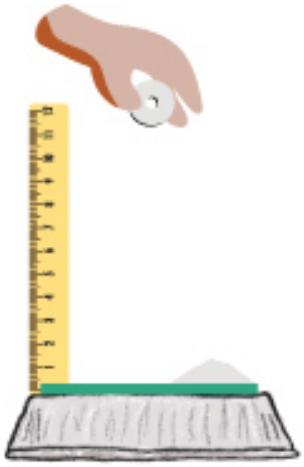

various sizes of metal washers


foil tray

2 Impact testing


tray with paper then salt in the corner

How to test:



3 Record your results

On the *Investigate It!* page:

1. Write your predictions.

2. Test.

3. Record what happened.

Part 2

4 ??? What other materials can you use?

Reset

1. Clean up the salt.
2. Put all materials back where they belong.

Educator Guide

Science Adventure 1: Safety Stories: Sharing Experiences

Educator Preview

Adventure Snapshot

Learners share experiences with, and stories about, making hazards safer.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Storytelling	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 5–60 min. each

Prep Snapshot*

Prep Time 30 min.

- Set up Materials Table.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Communication

Science Practices

- Obtaining, Evaluating, and Communicating Information

Guiding Question

Why is it important to make hazards safer?

Learners Will Do

Share a story or experience about a time they made a hazard safer in their home, town, or school.

Learners Will Know

Humans can make choices to make hazards safer.

Connecting Across Adventures

Ready, S.E.T., Go!	Adventure 1: Sharing Experiences	Adventure 2: Exploring Hazards and Mitigation
Last time, learners explored space trash. As scientists, they measured the energy of space trash impacts. As engineers, they designed ways to protect against those impacts.	**Today**, learners share experiences with and stories about making hazards safer.	**Next time**, learners act out everyday hazards, figure out safety tips to address them, and start learning about hazard mitigation.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/a00dfff8

Materials and Preparation

Materials

For the educator

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
  - index cards
  - markers
  - scissors
  - tape

For the Materials Table

- drawing supplies (such as pencils, crayons, markers)
- building supplies (such as clay, Legos, beads, natural materials)

For each learner

- Science Notebook (PDF)

Adventure 1 Materials Preparation (30 min.)

Ahead of Time

1. If you did not do so before the Ready, S.E.T., Go Adventure, prepare an *Our Ideas* poster by following the Prep & Setup Guide (PDF). Add the Guiding Question "Why is it important to make hazards safer?" so learners can refer to it throughout the adventure.
2. Learn about local hazards, reasons why hazards are important in local communities and cultures, and ways they are made safer. This information will help you understand learners' stories, and you can use it to provide examples and prompt learners' thinking.

Teaching Tips

- This adventure is the same in both the Science and Engineering Pathways. If you have already taught it in one pathway, you do not need to teach it again.
- You can combine this activity with Science Adventure 3, in which learners think about specific hazards in their communities.

3. Learn about or reflect on the storytelling styles of learners' communities. Think about the kinds of stories learners might tell and how you can structure the adventure to support them.

In Your Space

4. Place the *Our Ideas* poster in a location all learners can access. Make a plan to store it between activities.
5. Set up a Materials Table with the items listed in the Materials section.
6. Optional: Set the mood for the adventure by playing music.

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(As scientists, we figured out what affected energy from impacts. As engineers, we designed ways to protect spacecraft from impacts.)*
2. Say: **Our ultimate goal is to answer the question "How can we mitigate hazards on a particular NASA mission?"** Write the question in a prominent place at the top of the *Our Ideas* poster. **To start figuring this out, we're going to share what we know about hazards and how to make them safer.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **Why is it important to make hazards safer?**
3. Organize learners into groups of four and distribute Science Notebooks.

Support Learner Differences

If learners are new to you or each other, have them share their names, name pronunciations, and other important parts of their identities. These introductions are important for all learners and can be especially relevant for Indigenous learners, multilingual learners, and learners with different physical abilities. You can also distribute index cards and have learners write anything they want you to know but do not want to share with the whole group, such as resources that will help them learn. Lead an inclusion activity that is appropriate for your group (a list of possible activities is available on pgs. xx-xxii). This tip is repeated because you may have new learners joining you in this and future sessions. Whenever you have new learners, repeat this strategy.

For more strategies to engage learners, refer to Designing Instruction to Reach Diverse Learners, pg. x.

Support Learner Differences

- If you have learners who speak multiple languages, consider pairing learners with the same preferred language so they can share with each other in that language. Check out the Intentional Grouping Strategies, pg. xxii.
- If you have learners who speak multiple languages, have them discuss words for "hazards" and "safety" in their preferred languages and notice similarities between languages. If you can, provide an example from a language you know. Take time to learn learners' words and use them throughout the activities.

Storytelling (25 min.)

4. Say: **We all have stories. They can be stories we've heard from other people, stories we've watched or read about, or stories about things we have experienced ourselves. We experience stories every day in conversations, art, traditional craft, and online videos. Today, we're going to share stories about times we made a hazard safer in our homes, towns, or schools.**

5. Have learners turn to *My Safety Story*, pg. 9, in their Science Notebook. Say: **To start, everyone will have 15 minutes to think about a story to tell about making a hazard safer. Create some art that tells your story. You can write it down or write a poem that tells it, draw it, record it on a device, create a performance about it, or build something to demonstrate it.** Note that there are drawing and building materials on the Materials Table. During this time, check in with each group. If learners are struggling, consider sharing your own short story about hazards to spark ideas.

6. After 15 minutes, say: **Now, everyone in your group will take a few minutes to share their stories. If your story is long, you can choose one or two minutes of it to share so there is time for everyone.**

7. Allow learners to share their stories for 10 minutes. Remind them to switch so that everyone has time to share. Visit each group and listen to learners' perspectives on hazards and safety.

Reflect (10 min.)

8. Say: **Thank you for sharing your stories. They gave us great reasons why it is important to make hazards safer.** Point out common themes you noticed among stories. Emphasize how addressing hazards protects people and communities. Ask: **Is there anything else you want to share to answer the Guiding Question?** Revisit the Guiding Question: **Why is it important to make hazards safer?**

Support Thinking

Learners may want to make up their own stories. Bear in mind that the goal of the activity is to identify why making hazards safer is important to learners and communities they belong to, which made-up stories may or may not do.

Support Learner Differences

It is possible that stories about hazards may bring up trauma. If you notice this, ask the learner privately what they might need at that moment. If they do not know, you can offer some ideas from the Arizona Adverse Childhood Experiences Consortium Resource Library.

In this activity, you will need to strike a balance between allowing learners to share complete stories and ensuring there is enough time for everyone to share. Different cultures have different conventions for storytelling, which may involve very long stories with many parts, the significance of which is not immediately apparent. Consider the best way to approach time management, which may involve dedicating multiple sessions to this activity.

You can use storytelling as an opportunity for learners to practice social skills such as taking turns and showing respect for other people's experiences.

9. Have learners record answers to the Guiding Question near it on the *Our Ideas* poster. You can
   a. have each group designate a member to record responses on the *Our Ideas* poster.
   b. have each learner write or draw something on a (physical or digital) index card and add it to the *Our Ideas* poster.

10. Say: **Next time, we will think further about hazards in the communities we belong to.**

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for Adventure 2.
   - If learners created objects related to their stories, save those objects for reference in future activities.
2. Plan for Science Adventure 2. See the Adventure 2 Preparation on pgs. 24–26.
3. Take time to reflect on the following educator prompt. **What strategies helped learners feel comfortable sharing stories?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Support Thinking

Learners may bring up ideas that will be relevant in future activities, such as clothing that protects against hazards. As appropriate, note that the group will return to these ideas.

Support Learner Differences

As needed, allow learners to choose other methods of sharing their ideas, such as audio recordings. Have them write the filename of each record on an index card and put the index cards on the *Our Ideas* poster. They will serve as placeholders. When necessary, you can ask, "Who has the idea named X?" and have the learner in question share the record.

Level Up!

- Check out some great examples of the more than 2,000 NASA spin-off technologies that enrich our lives–and keep us safe–thanks to space exploration. (5 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We shared stories about why it is important to make hazards safer." (5 min.)

Educator Guide

Science Adventure 2: Everyday Hazards: Exploring Hazards and Mitigation

Educator Preview

Adventure Snapshot

Learners act out everyday hazards and match them with safety tips.

Timing | 70 minutes

Get Ready & Team Up	5 min.
Introduction to Hazards	55 min.
Reflect & Wrap Up	10 min.
Total	**70 min.**
Level Up Activities	5–25 min. each

Prep Snapshot*

Prep Time 60 min.

Prepare *Our Ideas* poster.
Print, cut, and assemble Deck A.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Communication

Science Practices

- Obtaining, Evaluating, and Communicating Information

Guiding Question

How do people stay safe from everyday hazards?

Learners Will Do

Match safety tips with hazards in a card game.

Learners Will Know

Humans have developed methods to lessen some hazards. These methods are known as *mitigations*.

Connecting Across Adventures

Adventure 1: Sharing Experiences	Adventure 2: Exploring Hazards and Mitigation	Adventure 3: Hazards Where We Live
Last time, learners shared experiences with and stories about making hazards safer.	**Today**, learners act out everyday hazards, figure out safety tips to address them, and start learning about hazard mitigation.	**Next time**, learners will explore hazards near their community and consider how people mitigate those hazards.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/2f1acfb1

Materials and Preparation

Materials

For the educator

- Scissors or paper cutter to prepare cards
- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
  - index cards
  - markers
  - scissors
  - tape

For the whole group

- *Hazards Cards* Deck A–Everyday Hazards (PDF)
- Playmat (PDF) (1 or more copies, optional)
- Paper for learners to draw on (optional)

Adventure 2 Materials Preparation (60 min.)

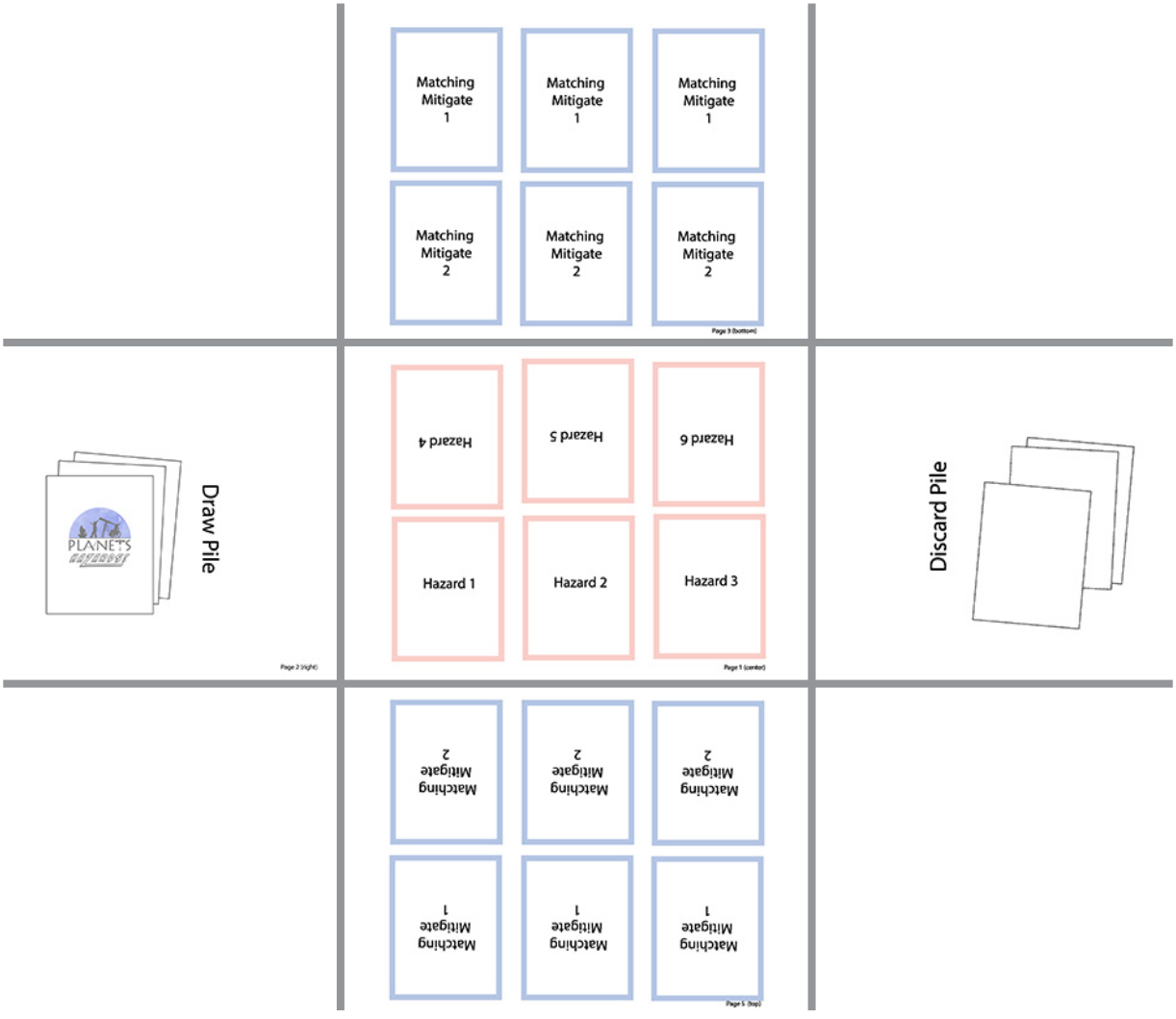
Ahead of Time

1. Print **one** copy of *Hazards Cards* Deck A–Everyday Hazards (in color if possible) (15 cards).
2. Cut these printed card sheets into individual cards with a paper cutter or scissors.

Support Learner Differences

- For blind/low-vision and multilingual learners, choose the BLV Deck version of the cards to provide QR codes on the backside of each card. Each QR code is linked to a unique webpage designed to be easy to use with text-to-speech and translation technology.
  - Accessible Version of Deck A (PDF)
- To help orient blind/low-vision learners, place a thick sticker on the back of each card, centered along the top so that it's easy to tactically orient the cards right-side up and front-facing. This may take five additional minutes per deck.
- A limited tactile version of the card decks (weblink) and playmat (weblink) also available. An estimated 5–10 minutes is required to punch holes in all the required areas per deck with a one-hole punch. In this deck, learners can match cards by sight and/or by aligning tactile holes.

3. Optional: Print one copy of the *Playmat*. (If you have a large group, print multiple copies so everyone can reference it.) Tape *Playmat* together in the arrangement shown below.



4. If you did not do so before the Ready, S.E.T., Go Adventure, prepare an *Our Ideas* poster by following the Prep & Setup Guide (PDF). Add the Guiding Question "How do people stay safe from everyday hazards?" so learners can refer to it throughout the adventure.

In Your Space

5. Place the *Our Ideas* poster in a location all learners can access. Make a plan to store it between adventures.

Teaching Tips

- You will need to prepare additional decks of cards for upcoming adventures. To save time, consider preparing all decks now. Refer to the Adventures 3–5 Materials Preparation sections.

  You will need to invite family and community members to the Science Share-Out in Adventure 7. To ensure invitees have enough advance notice, consider inviting them now. Refer to the Adventure 7 Materials Preparation section on pg. 60.

- If learners like to move quickly, you can combine Adventures 2 and 3 into a single session.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We told stories about hazards and how we have made them safer.)* Draw learners' attention to their work on the *Our Ideas* poster about the hazards they addressed.
2. Have learners read the *Science Comic,* pgs. 10-14, in their Science Notebooks, to set the context.
3. Say: **Today, you'll explore everyday hazards on Earth.** Share the Guiding Question with learners aloud and point it out on the *Our Ideas poster* (using multiple languages as needed): **How do people stay safe from everyday hazards? Eventually, you will use what you learn to help astronauts stay safe from hazards in space.**
4. Organize learners into groups of four. (Everyone is going to play a game together, and each group will be a team.)

Introduction to Hazards (55 min.)

5. Say: **You will play a matching game of hazards and safety tips. The goal is to remove all hazards.**
6. Ask: **What is a hazard?** Have learners decide on a definition of *hazard* as a whole group. Add *hazard* and the definition that you agree on to the *Our Ideas* poster, along with translations into learners' preferred languages and relevant images. (You may want to add a danger icon next to the term.) Say: **We will keep gathering ideas on the poster.**
7. Set the deck of *Hazards Cards* Deck A–Everyday Hazards (15 cards) facedown on a "Draw Pile" location. Gather learners around a clear area. (Optionally, you can put the cards on a *Playmat* and lay out other *Playmats* for learners to reference.)

Support Learner Differences

- If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii).
- You can project a digital version of the comic (PPTX) or share it so learners using text-to-speech technology can access the comics.
  - iOS or macOS users should enable text-to-speech or voice-over.
  - Windows users should use JAWS or NVDA at NV Access.

  Be sure to read carefully and leave a visual shortcut to exit the program, or have your learner restore settings when they are done.
- If you have learners who speak multiple languages, consider pairing learners with the same preferred language so they can share with each other in that language.
- If possible, ensure that groups contain a mix of blind/low-vision and sighted learners.

  Check out the Intentional Grouping Strategies, pg. xxii.

8. Say: **In a moment, you will draw cards from this pile. Your goal is to get others to guess what is on your cards. You must present your cards without using the words themselves. You can present using any of these various options:**
   - acting out the idea on the card without using words.
   - describing the idea on the card without using the word itself or a direct translation.
   - drawing the card idea on a separate sheet of paper.
   - using another method decided on by the group.

Support Learner Differences

If needed, give learners time to become familiar with the cards and have each group share words in their preferred languages (or gestures) that communicate the idea on their card.

If an icon is unfamiliar to learners, have them create a new icon that represents the card and add it to the *Our Ideas* poster or create a new card on the blank templates provided in *Hazards Cards* Deck A–Everyday Hazards.

9. Have each group draw a card from the draw pile. Point out that the Hazard cards are red. Repeat until the deck is gone.
10. Say: **Hazards will be presented first, then Safety Tips will be presented and placed under Hazards they can solve. When a Hazard card has two Safety Tips under it, it has been avoided.**
11. One at a time, have groups with Hazard cards present their cards. When someone guesses what is on a card, the presenters place it in the open area (or in the correct location on the *Playmat*).
12. When all Hazard cards have been placed, have learners present Safety Tip cards. When someone guesses what is on a card, the presenters place it next to a Hazard it can address.
13. Once a Hazard card has two matching Safety Tip cards next to it, have learners flip the Hazard card over and put the Safety Tip cards in a "Discard" location. This action means the Hazard has been avoided.

Support Learner Differences

As necessary, describe aloud or in sign language what presenters are doing so that learners of all abilities can understand it.

14. If Hazard cards remain after all Safety Tips are played, shuffle the discard pile and place it in the "Draw Pile" location.
15. Say: **Another way to say *safety tip* is *mitigation*, which means a way to make a hazard less dangerous or painful. It is related to the word *mitigate*, which means to make a hazard less dangerous or painful.** Discuss and revise these definitions of *mitigation* and *mitigate* as a whole group. Add the words and definitions you agree on to the *Our Ideas* poster, along with translations into learners' preferred languages and relevant images.

Support Thinking

Encourage learners to consider how mitigation connects to the work of engineers. Refer back to the Ready S.E.T. Go activity, if helpful for your learners. (*Engineers often design ways to mitigate hazards.)*

16. Explain to learners: **Things that you have done to prepare for or deal with hazards are all mitigations. We can't usually solve or stop hazards from happening, but we can mitigate them.**

Reflect & Wrap Up (10 min.)

17. Gather learners and review the game. Revisit the Guiding Question: **How do people stay safe from everyday hazards?** Ask: **How did you know which safety tips mitigated which hazards? What are other ways you could mitigate these hazards?** Remind learners of the terms *hazard* and *mitigation* on the *Our Ideas* poster.

18. Say: **Next time, you will think about how to mitigate hazards where you live.**

Support Thinking

Say: **Mitigating hazards is good for everyone. For example, sidewalk ramps make crossing the street safer for people in wheelchairs and also easier for bikes, skateboards, and hoverboards. Even pedestrians are less likely to trip.** Have learners think of other mitigations that are good for everyone. Add learners' ideas to the *Our Ideas* poster as examples of mitigations.

Level Up!

- Lay out all Safety Tip cards. Ask: **What do the safety tips have in common?** Let learners share patterns they notice. Add learners' ideas on what the safety tips have in common (make safe, helpful, cause less harm, reduce risk) to the *Our Ideas* poster. Highlight the words *in common*. Help learners make connections between their definitions of *mitigation* and *safety tip*. These should be very similar. (10 min.)
- Ask this story prompt: **How do you avoid hazards at home or in communities you belong to?** Have learners share with a partner in their preferred languages. (5 min.)
- Did you know that NASA monitors hazards and other processes here on Earth? Check out this short video about NASA's Earth Observatory Introducing: NASA's Earth System Observatory (1:53).
- Before the next adventure, have learners interview family or community members to hear their stories of science, hazards, and mitigation. Tell learners, if anyone asks what they did today, they can say "we figured out safety tips to protect us from everyday hazards" or "we figured out mitigations for everyday hazards" and then ask them the above story prompt. Encourage learners to think of more answers at home before the next adventure. Download customizable flyers and get ideas on the Space Hazards Family and Community Connections webpage. Consider returning to learners' ideas at the start of the next adventure. (25 min.)

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in Adventure 3.
   - Save the *Playmat* for use in Adventure 4.
   - Set aside the cards from *Hazards Cards* Deck A–Everyday Hazards. They are not used in future adventures.
2. Plan for Science Adventure 3. See Science Adventure 3 Preparation on pgs. 32–33.
3. Take time to reflect on the following educator prompts: **How did you help support learners' acquisition of the vocabulary used in this adventure?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Science Adventure 3: Close to Home: Hazards Where We Live

Educator Preview

Adventure Snapshot

Learners create their own hazard and mitigation cards and play a matching game with them.

Timing | 50 minutes

Get Ready & Team Up	5 min.
Hazards Where We Live	35 min.
Reflect & Wrap Up	10 min.
Total	**50 min.**
Level Up Activities	5–45 min. each

Prep Snapshot*

Prep Time 50 min.

Print and cut out Deck B.
Think about local hazards.

**See Materials & Preparation for full info*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Obtaining, Evaluating, and Communicating Information

Guiding Question

What hazards exist where we live and how do we mitigate them?

Learners Will Do

Create Hazard cards reflecting hazards in the local area and Mitigation cards reflecting strategies the local community uses to address those hazards.

Learners Will Know

Scientists and communities have the skills and knowledge to mitigate hazards.

Connecting Across Adventures

Adventure 2: Exploring Hazards and Mitigation	Adventure 3: Hazards Where We Live	Adventure 4: Earth Hazards
Last time, learners acted out everyday hazards, figured out safety tips to address them, and started learning about hazard mitigation.	**Today**, learners explore hazards near their community and consider how people mitigate those hazards.	**Next time**, learners will learn about hazards on Earth and explore the methods people have come up with to mitigate some of them.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/046714cd

Materials and Preparation

Materials

For the educator

- Scissors or paper cutter to prepare blank cards

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates

For each learner or pair

- 3 blank cards from Hazards Cards Deck B–Blank Cards (PDF)
- Writing and drawing tools (i.e., pencils, markers)

Adventure 3 Materials Preparation (50 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. Print blank cards from Hazards Cards Deck B–Blank Cards (PDF). Print enough copies so each learner or pair can have at least one blank Hazard card and two blank Mitigation cards. (Save the extra Hazard cards in case learners want to use them.)
3. Cut these printed card sheets into individual cards with a paper cutter or scissors.

Support Learner Differences

This activity can be done in pairs or individually. Choose the best approach for your site resources (if you have limited printing budget) and learners. Check out the Intentional Grouping Strategies, pg. xxii.

4. As an educator, think about hazards relevant to your community and look up the words for these in your local languages or languages spoken by learners in your program. For example, if you live in Hawai'i, you might look up the Indigenous language terms for invasive species or volcanic hazards like lava flows. If you live in Kansas, you might look up the terms for crop-eating pests or tornados in learners' preferred languages.

In Your Space

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.

Support Learner Differences

Indigenous language terms can at times be difficult to look up on the Internet as they are primarily oral languages and often do not offer direct translations for noun-centric terms. If your program has native language speaking staff, ask them to assist, or consider asking a community member. Translations can be done over the course of the pathway or even afterwards to build this into your program in the future. Other multilingual learners may benefit from this approach as well.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Invite learners who did Adventure 2, Exploring Hazards and Mitigation, to share what they did. *(They acted out everyday dangers and played a card game matching hazards with safety tips to help keep you safe from the hazards.)* As learners share, refer to the *Our Ideas* poster and the words *hazard* and *mitigation*. Read their descriptions aloud to the group and display related images. If learners shared words in their preferred languages that were captured in the poster, invite the learners to say them again in front of their peers.

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii).

2. Say: **Today, you will explore hazards where you live.** Share the Guiding Question with learners aloud and write it on the *Our Ideas* poster (using multiple languages as needed): **What hazards exist where we live and how do we mitigate them?**

3. If you choose the pairing up option, organize learners into pairs.

Support Learner Differences

Encourage learners to identify their own strengths and the roles they would like to play during testing, and form pairs that can play a variety of roles. For example, one learner can specialize in drawing and another in writing and translating.

Hazards Where We Live (35 min.)

4. Say: **You will create your own Hazard and Mitigation cards today.** If learners did not experience the last adventure, show all cards from *Hazards Cards* Deck A–Everyday Hazards as examples.

5. To ensure learners understand why the game is changing, say: **Along with common everyday hazards, some hazards are specific to where we live. The new cards will show hazards specific to our community and how people deal with them.** Pass out one blank Hazard card and two blank Mitigation cards to each learner or pair.

6. On the Hazard card, have each learner or pair of learners draw or write about one hazard they and communities they belong to deal with frequently. Then, on the Mitigation cards, have them draw or write about tools or strategies they and their communities use to protect themselves from this hazard. If they thought about hazards and mitigation at home after the last adventure, they can use the ideas they came up with.

Support Thinking

If your learners need more specific prompts, use examples. Hazards can be everyday (like tripping hazards of things left on the floor) or natural (like pests, weather, or extreme events like earthquakes, hurricanes, or blizzards). You might try giving examples or limiting this to an area relevant to them (e.g., the playground).

7. Once all cards are filled, pair learners if done individually or group in fours if already paired and have them take turns explaining their cards.

8. Once learners have finished developing their Hazard and Mitigation cards, return to the *Our Ideas* poster where those words were defined in the previous adventure. Revisit the Guiding Question: **What hazards exist where we live and how do we mitigate them?** Have learners share what examples of hazards and mitigations they would like to add under these categories on the poster.

Reflect & Wrap Up (10 min.)

9. Say: **You will use the Hazard and Mitigation cards you made today in the next few activities. So far, all cards apply to Earth. How could the cards you created be hazards or mitigations in space?** *(A possible response: the hazard of tools or backpacks on the floor might be similar to not putting tools away in a small spacecraft, where they could float around.)* Give learners the chance to talk about this in pairs.

10. Say: **Next time, you will think about how to mitigate natural hazards that affect other parts of Earth.**

Support Learner Differences

- Indigenous learners and others may be interested in describing spiritual hazards in addition to physical ones.

  Invite a community member to share examples of terms for hazards and mitigations in traditional languages.
- It is possible that stories about hazards may bring up trauma. If you notice this, ask the learner privately what they might need at that moment. If they do not know, you can offer some ideas from the Arizona Adverse Childhood Experiences Consortium Resource Library.
- To ensure equitable participation, consider using strategies that support all learners sharing their ideas, such as providing time to think before asking for answers and allowing learners to discuss in pairs or small groups before sharing with the whole group.

Level Up!

- Have a whole-group discussion about the hazards and mitigations learners chose and how they appear in the local community. Be aware that learners may have experienced natural disasters; think ahead of time about how to be sensitive to their experiences. (10 min.)
- Have each group invent a story using the cards they created. Allow learners to share their stories with the whole group. (10 min.)
- Ask this story prompt: **What is a hazard you have experienced and how did you mitigate it?** Have learners share with a partner. Tell learners, if anyone asks what they did today, they can say "we shared stories about hazards where we live and ways we mitigate them," and then ask them the above story prompt. Consider returning to learners' ideas at the start of the next adventure. (5 min.)
- Get families or a community member involved to share relevant stories of experiencing and mitigating hazards in your local area. Download customizable flyers and get ideas on the Space Hazards Family and Community Connections webpage (45 min.).

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in Adventure 4.
   - Keep the cards learners created for use in future adventures.
2. Plan for Science Adventure 4. See Science Adventure 4 Preparation on pgs. 39–40.
3. Take time to reflect on the following educator prompt: **How did you support learners making personally relevant connections to local events?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Educator Guide

Science Adventure 4: Dangerous Planet: Earth Hazards

Educator Preview

Adventure Snapshot

Learners play a card game to learn about hazards on Earth and how people mitigate some of them.

Timing | 60 minutes

Get Ready & Team Up	5 min.
Hazards on Earth	50 min.
Reflect & Wrap Up	5 min.
Total	**60 min.**

Level Up Activities 5–45 min. each

Prep Snapshot*

Prep Time 55 min.

Print, cut, and assemble Card Decks C and D for each small group.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Guiding Question

What natural hazards do people on Earth face and how do they mitigate them?

Learners Will Do

Match mitigation strategies with hazards in a card game.

Learners Will Know

Scientists learn about natural hazards to think about ways to mitigate them.

Connecting Across Adventures

Adventure 3: Hazards Where We Live	Adventure 4: Earth Hazards	Adventure 5: Hazards in Space
Last time, learners explored hazards near their community and considered how people mitigate those hazards.	**Today**, learners learn about hazards on Earth and explore ways to mitigate them.	**Next time**, learners will learn that hazards also exist in space, some are the same as on Earth, and some are different.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/32d85156

Materials and Preparation

Materials

For the educator

- Scissors or paper cutter to prepare cards
- Small bags to contain each deck of cards
- Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45
- Playmat (PDF) from Adventure 2 to show for game configuration (optional)

For each group of 3 or 4 learners

- *Hazards Cards* Deck C (PDF) and Deck D (PDF)
- Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45
- Playmat (PDF) (optional)

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
- Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45

For each learner

- Science Notebook (PDF)

Adventure 4 Materials Preparation (55 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. For each group of 3 or 4 learners:
   a. Optional: Print one copy of the *Playmat* and tape it together. See diagram below (*Gameplay Orientation*).
   b. Set out *Hazards Cards* Deck B–Blank Cards, learners' written or drawn cards from Adventure 3 (3 cards per learner or pair).
   c. Print *Hazards Cards* Deck C–Earth Icons (in color if possible) (11 cards).
   d. Print *Hazards Cards* Deck D–Earth and Space Icons (in color if possible) (16 cards).
   e. Cut Decks C and D out by hand or with a paper cutter.
   f. Combine Decks C and D to make stacks of 27 cards each. Keep Deck B separate.
   g. Print the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45.

In Your Space

3. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
4. Set up to display and share the video How to Play the Space Hazards Card Game.

Teaching Tips

- For Adventure 2, you prepared one deck of *Hazards Cards* (Deck A). For Adventure 3, you prepared blank cards (Deck B) for each learner or pair of learners. For Adventure 4, you'll prepare two decks of cards (Deck C and Deck D) and one set of rules for each small group. (If you used the *Playmat* in Adventure 2, you can re-use it as a whole-group display for how the game is set up.)

  For ease of sorting, note that deck labels align with the planet icons on the cards. Deck C has only Earth, Deck D has Earth and other planets, and Deck E (used later) has only other planets. Learn more about the cards and game play in the video How to Play the Space Hazards Card Game (2:51).

- If learners will understand what to do, they can play without a *Playmat*.
- Print Hazards Cards Deck E-Space Icons (PDF) (20 cards) to save time in Adventure 5.
- If learners like to move quickly, you can combine Adventures 4 and 5 into a single session.

Support Learner Differences

For blind/low-vision and multilingual learners, choose the BLV Deck version of the cards to provide QR codes on the backside of each card. Each QR code is linked to a unique webpage designed to be easy to use with text-to-speech and translation technology.

- Accessible Version of Deck C (PDF)
- Accessible Version of Deck D (PDF)
- Accessible Version of Deck E (PDF)

To help orient blind/low-vision learners, place a thick sticker on the back of each card, centered along the top so that it's easy to tactically orient the cards right-side up and front-facing. This may take five additional minutes per deck.

Add Wikki Stix or other raised lines to the playmat to help blind/low-vision learners orient to the mat. Remember to allow room between tables for all mobility equipment when setting up, and to consider the arm reach and leg space needs of wheelchair users when setting up the *Playmat*.

A limited tactile version of the card decks (weblink) and playmat (weblink) also available. An estimated 5–10 minutes is required to punch holes in all the required areas per deck with a one-hole punch. In this deck, learners can match cards by site and by aligning tactile holes. Note that not all cards are included in these decks.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Invite learners who did Adventure 3, Hazards Where We Live, to share what they did in small groups. *(They made cards showing hazards where they live and mitigations that protect people from those hazards.)* Offer learners the *Our Ideas* poster to help them explain the activities to any peers who missed the prior adventure. Encourage learners to share in their preferred languages.

2. Say: **Today you will play another card game to explore natural hazards on Earth.** Share the Guiding Question with learners aloud and write it on the *Our Ideas* poster (using multiple languages as needed): **What natural hazards do people on Earth face and how do they mitigate them?** Say: **The new cards show hazards from nature in many different places and how people deal with them.**

3. Organize learners into groups of 3 or 4 and distribute Science Notebooks.

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii)..

Hazards on Earth (50 min.)

4. Say: **You will play a card game about mitigating natural hazards on Earth.** If necessary, review their definitions of *hazard* and *mitigate* on the *Our Ideas* poster. Give each group *Hazards Cards* Deck B (the drawn or written cards created in Adventure 3), Decks C+D combined (Only Earth Icons and Earth+Space Icons), and the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45. Show the video How to Play the Space Hazards Card Game, which explains the rules of the game. Review the rules with learners and demonstrate as you do so.

5. For learners who were present last time, have each group replace at least one Hazard card from the combined Deck C+D with a Hazard card from their own cards (Deck B). Have them replace at least one matching Mitigation card from the combined Deck C+D with two Mitigation cards from their own cards (from Deck B). Use this replacement to increase relevance. For example, if there aren't volcanoes where you live, this card can be replaced.

Support Learner Differences

Group learners in a way that lets each learner use their self-identified strengths. If you have learners who speak multiple languages, consider grouping learners with the same preferred language so they can share with each other in that language.

Teaching Tip

The *Hazards Cards Explanation* on pg. 46 explains how to interpret the cards.

Level Up!

- Have learners brainstorm natural hazards they have witnessed or heard about. (5 min.)
- If you want the game to last longer, you can simply add the Deck B cards without removing any Deck C+D cards.

6. For new learners, ask them to view the created cards (Deck B) and think of their own hazard and mitigation examples. They can use them to replace cards in the deck. Add any new key vocabulary on the *Our Ideas* poster under the Earth icon in the "Natural Hazards on Earth" category.
7. Have each group talk about the roles they like to play during group work. Have learners select roles (or assign them yourself).
8. Start gameplay. Check that each group understands rules.
9. As learners play, revisit the Guiding Question: **What natural hazards do people on Earth face and how do they mitigate them?** Have learners record the Hazards they face and Mitigations they play on *Earth Hazards*, pg. 15 in their Science Notebooks.
10. Ask learners to think in pairs about which of these hazards are easier or harder to mitigate in real life. Have them arrange the cards in a spectrum, with those that are easy to mitigate in real life on one end and those that are hard to mitigate in real life on the other. Then you can have them share with the whole group. As they share, capture the descriptive vocabulary that they use, such as *easier* or *harder*, on the *Our Ideas* poster.

Support Learner Differences

- Suggested group roles are listed on the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45. Change the role names and responsibilities to work for your group, and swap roles for each adventure. Check out the Intentional Grouping Strategies, pg. xxii.
- If you have learners who speak multiple languages, have them share words for any new hazard and mitigation strategies in their preferred languages. You can prompt them by sharing words you know.
- Acknowledge the importance of consensus in decision-making with Indigenous learners. Tell them they will have a chance to practice this skill in the game because they must work together to win.
- As necessary, pair learners so they can support each other in completing the *Earth Hazards* game.

Support Thinking

If learners want more background on particular hazards, you can show the Educator Science Background (weblink) and or the videos Earth Hazards and Climate Change (1:19) and Volcanic Hazards (until 0:32).

Level Up!

- You can make the game even harder by discarding the Hazard cards you mitigated into the discard pile and reshuffling them into the draw pile along with the other cards.
- If learners will benefit from more movement, play a version of the game in which some learners play the role of hazards and others play the role of mitigations, and all learners move around making corresponding hazard-mitigation pairs. Be mindful of learners' mobility, as described in the video about supporting learners with diverse physical abilities.

Reflect & Wrap Up (5 min.)

11. Gather learners and ask: **What do hazards on Earth and in space have in common? Which mitigations might work in both places?**

12. Say: **Next time, you will learn about space hazard mitigation.**

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in Adventure 5.
   - Keep the *Hazards Cards* and *Playmats* for use in future Adventures.
2. Plan for Science Adventure 5. See Science Adventure 5 Preparation on pgs. 48–49.
3. Take time to reflect on the following educator prompts: **How did you connect the topics in this adventure, such as weather, climate, and geography, to learners' prior knowledge and experiences? What strategies can you use again in the future?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Level Up!

- Have learners think about how different Earth hazards might be affected by climate change, then show the video Earth Hazards and Climate Change to help them learn more. (5 min.)
- NASA spacecraft don't deal with hazards only in space: they have to escape hazards on Earth first! The first Artemis mission was set to launch on November 12, 2022, but Hurricane Nicole had other plans. Launching during a hurricane would have been too dangerous for the Orion capsule and fuel tanks, so NASA mitigated this hazard by delaying the launch to November 16, 2022. *Artemis I* successfully launched and completed its mission of orbiting the Moon. Learn more about *Artemis I* here: "NASA Prepares Rocket, Spacecraft Ahead of Tropical Storm Nicole, Re-targets Launch – Artemis" (5 min.)
- Invite a family or community member to come in as a special guest and share their knowledge about hazard-related topics. (45 min.)
- Ask this story prompt: **Can you tell me a story about a time when you mitigated a natural hazard in your neighborhood?** *(Possible responses include shoveling walkways after a blizzard, keeping storm drains clear to avoid flooding during rainstorms, and preparing for hurricanes and typhoons.)* Have learners share with a partner. Tell learners, if anyone asks them what they did today, they can tell them "We played a card game to learn about hazards and how to mitigate them, or make them less bad" and ask them the above story prompt. Consider returning to learners' ideas at the start of the next adventure. (5 min.)

Hazards Card Game Rules

1 Setup

1. Deal 6 Hazard cards face up in the middle of the table.
2. Shuffle all remaining Hazard cards with the Mitigate and Chance cards to make a draw pile.
3. Deal 2 cards face up to each player.
4. Choose a player to go first.

card examples

2 On your turn

PHASE 1: PLAY A CARD

1. If you have any Chance cards, play 1 and do what it says.
2. If you don't have any Chance cards, play 1 Mitigation card on a matching Hazard.
3. If you can't play a card, discard your hand and draw 2 cards.

PHASE 2: DRAW CARDS

1. All players draw cards until they have 2 cards in their hands.
2. If a player draws a Hazard card, they play it and draw again.
3. If the draw pile runs out, shuffle the discard pile to make a new draw pile.

3

Group Roles

You can choose a role for each player.

MISSION DIRECTOR

The Mission Director makes sure everyone's ideas are heard and keeps the team focused on goals.

REFEREE

The Referee deals cards and makes sure everyone takes turns.

RULES EXPERT

The Rules Expert answers questions about game rules. They also record the team's ideas.

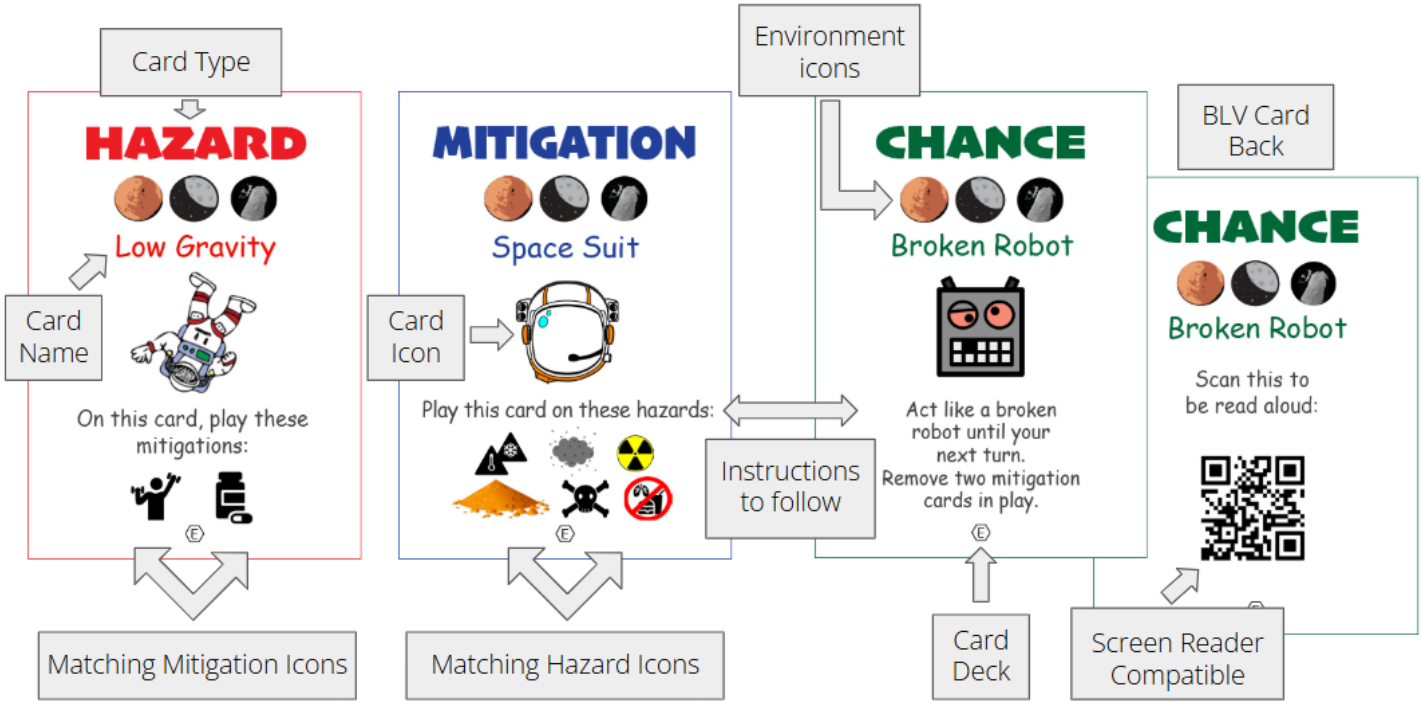
COMMUNICATIONS OFFICER

The Communications Officer lets the educator know if there is a word the group needs help understanding. They also keep track of choices in the game and share ideas with the larger group.

How to Win

1. When a Hazard card has 2 Mitigation cards on it, flip it face down. Discard the Mitigation cards.
2. When there are no face-up Hazard cards, you win!

Hazards Cards Explanation



Icons

Each card has its own large icon. Mitigation cards and some Chance cards have small icons along the bottom that indicate their matches for hazards. The top row indicates what environments the card applies to. For example, some cards have only an Earth icon, meaning they are applicable only on Earth, but others have an icon for the Moon, Mars, or an asteroid. Letters at the bottom of the cards allow them to be sorted into Decks C (Earth icons only), D (Earth+Space icons), and E (Space icons only).

Educator Guide

Science Adventure 5: Far from Home: Hazards in Space

Educator Preview

Adventure Snapshot

Learners play a card game to learn about space hazards and their differences from hazards on Earth.

Timing | 55 minutes

Get Ready & Team Up	5 min.
Hazards in Space	40 min.
Reflect & Wrap Up	10 min.
Total	**55 min.**

Level Up Activities 5 min. each

Prep Snapshot*

Prep Time 50 min.

Print, cut, and assemble Card Deck E for each small group.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Guiding Question

How do NASA missions mitigate hazards in space?

Learners Will Do

Learn about hazards on the Moon, Mars, and asteroids.

Learners Will Know

Scientists compare hazards on Earth to hazards in space to think about ways to mitigate them.

Connecting Across Adventures

Adventure 4: Earth Hazards	Adventure 5: Hazards in Space	Adventure 6: Mitigating Hazards for Your Mission
Last time, learners learned about hazards on Earth and explored ways to mitigate them.	**Today,** learners will learn that hazards also exist in space, some are the same as they are on Earth, and some are different.	**Next time**, learners will choose a NASA mission and think about the hazards, mitigation strategies, and other factors NASA should consider.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/4e74e636

Materials and Preparation

Materials

For the educator

- Scissors or paper cutter to prepare cards
- Small bags to contain each deck of cards

For the whole group

- *Our Ideas* poster (on paper or a shared digital document)
  Examples | Templates
- Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45

For each group of 3 or 4 learners

- *Hazards Cards* Decks B (written or drawn cards from Adventure 3) (PDF), D (PDF), and E (PDF).
- Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45
- Playmat (PDF) (optional)

Adventure 5 Materials Preparation (50 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. Read the Educator Science Background (weblink) to support your understanding of hazards in space.
3. For each group of 3 or 4 learners:
   a. Set out *Hazards Cards* Deck B–Blank Cards, the written or drawn cards from Adventure 3 (3 cards per learner or pair).
   b. From each Adventure 3 stack, sort out *Hazards Cards* Deck D—Earth and Space Icons (16 cards).
   c. Print *Hazards Cards* Deck E—Space Icons (in color if possible) (20 cards).
   d. Cut out Deck E cards by hand or with a paper cutter.
   e. Combine Decks D and E to make stacks of 36 cards each.
   f. Set out the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45, from Adventure 4.

In Your Space

4. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.

Support Learner Differences

- For blind/low-vision and multilingual learners, choose the BLV Deck version of the cards to provide QR codes on the backside of each card. Each QR code is linked to a unique webpage designed to be easy to use with text-to-speech and translation technology.
  - Accessible Version of Deck E (PDF)
- To help orient blind/low-vision learners, place a thick sticker on the back of each card, centered along the top so that it's easy to tactically orient the cards right-side up and front-facing. This may take five additional minutes per deck.
- Add Wikki Stix or other raised lines to the playmat to help blind/low-vision learners orient to the mat. Remember to allow room between tables for all mobility equipment when setting up.
- A limited tactile version of the card decks (weblink) and playmat (weblink) also available. An estimated 5–10 minutes is required to punch holes in all the required areas per deck with a one-hole punch. In this deck, learners can match cards by site and by aligning tactile holes. Note that not all cards are included in these decks.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Invite learners who did Adventure 4, Earth Hazards, to share what they did with a partner or in small groups. *(They played Earth Hazard cards and used Mitigation cards to deal with those hazards.)* As learners share, encourage them to refer back to the *Our Ideas* poster and point to the words *hazard* and *mitigate*, Earth hazards that were identified, and information about which hazards were easier or harder to mitigate. If learners shared words in their preferred languages that were captured in the poster, invite the learners to say them again in front of their peers.

2. Say: **Today you will play the card game again, adding hazards in space. Hazards exist in space, not just on Earth, and robots and people in space need to deal with those hazards.** Share the Guiding Question with learners aloud and write it on the *Our Ideas* poster (using multiple languages as needed): **How do NASA missions mitigate hazards in space?** Say: **The new cards show hazards in space and how robots and people deal with them.**

3. Organize learners into groups of 3 or 4 and distribute Science Notebooks. Have each group talk about the roles they like to play during group work. Have learners select roles (or assign them yourself).

Hazards in Space (40 min.)

4. Give each group *Hazards Cards* Deck B–Blank Cards (the drawn or written cards created in Adventure 3), Deck D–Earth and Space Icons, Deck E–Space Icons, and a copy of the rules. Say: **The rules are the same; only the cards have changed.**

5. Ask learners to look at the cards in their groups and divide the cards among Hazard, Mitigation, and Chance by color or feel.

6. For learners who were present for the last two adventures, have them identify the cards they created (Deck B) that would apply in space and add these to the deck.

7. For new learners, ask them to observe the created cards (Deck B) and think of their own hazard and mitigation examples. Add any new key vocabulary on the *Our Ideas* poster under the Earth icon in the "Natural Hazards on Earth" category.

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii).

Support Learner Differences

Suggested group roles are listed on the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45. Change the role names and responsibilities to work for your group, and swap roles for each adventure. Check out the Intentional Grouping Strategies, pg. xxii.

Support Thinking

Learners may disagree about which Earth hazards would also apply in space. Encourage them to discuss why particular hazards might or might not be present in space.

8. Start gameplay. Visit each group, ask which cards they want to know more about, and read them relevant information from the Educator Science Background. If necessary, show the video How to Play the Space Hazards Card Game or refer to the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45.

9. As they play, have learners record the Hazards they face and mitigations they play on *Hazards in Space*, pg. 16, in their Science Notebooks.

10. After learners have finished playing, revisit the Guiding Question: **How do NASA missions mitigate hazards in space?** Have learners share hazards they encountered during the game. Record them under "Space" in the "Hazards" category on the *Our Ideas* poster and help learners understand difficult words (e.g., *radiation*, *micro-impact*) by giving examples, translating, gesturing, or acting out the words.

11. Have learners share mitigations they used during the game. Record them on the poster as well. Help learners understand difficult words (e.g., *evacuate*, *insulation*, *shielding*) by giving examples, translating, gesturing, or acting out the words.

Support Learner Differences

As necessary, pair learners so they can support each other in completing the *Hazards in Space* game.

Due to differences in human abilities, some people have more experience with mitigating hazards in their everyday life than others. For example, a blind person might be an expert at navigating in dark environments that would make their sighted (or seeing) friends feel uncomfortable. A person with food allergies may be an expert in reading food labels. Ask learners: **Can you think of some examples in your own life where something that makes you different also makes you an expert at hazard mitigation?**

Support Thinking

A lot of content learning paired with the cards is located in the Educator Science Background (weblink), and the hazard videos playlist: *Dangerous Dust* (1:08), *Micro-Impacts and Low Gravity* (1:30), *Space Radiation* (1:27), *Extreme Temperatures in Space* (1:17), and *Volcanic Hazards* (from 0:32) and mitigation videos: *Using Local Resources (What's Around?)* (1:26) and *Robots and Space Hazards* (1:19).

Level Up!

Share information about how astronauts with various abilities have improved and continue to improve NASA's spaceflight program in "About Mission: AstroAccess." (5 min.)

Reflect & Wrap Up (10 min.)

12. Ask: **In real life, do you imagine it would be harder to mitigate Earth hazards or space hazards?** As learners share, capture keywords they use to compare between hazards and mitigation strategies, such as *more difficult* and *easier*. Add them to the *Our Ideas* poster.

13. Say: **Next time, you will choose and plan for a NASA mission.**

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in Adventure 6.
   - Keep the *Hazards Cards* and *Playmats* for use in future adventures.
2. Plan for Science Adventure 6. See Science Adventure 6 Preparation on pg. 54.
3. Take time to reflect on the following educator prompt: **How did you help learners understand the similarities and differences between this version of the card game and previous versions?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Support Thinking

To help learners remember the different locations, have them sort the cards by location.

Level Up!

- Ask this story prompt: **What is a problem you have faced that is similar to a hazard in space?** Have learners share with a partner. Tell learners, if anyone asks them what they did today, they can tell them "We played a card game to learn about hazards in space and how to mitigate them, or make them less bad" and ask them the above story prompt. Consider returning to learners' ideas at the start of the next adventure. (5 min.)
- NASA has learned a lot about how to mitigate hazards in space from time spent by astronauts on the International Space Station. Learn more about these hazards in 5 Hazards of Human Spaceflight - NASA. (5 min.)

Science Adventure 6: Put It Together: Mitigating Hazards for Your Mission

Educator Preview

Adventure Snapshot

Learners think about hazards and mitigation strategies for NASA missions.

Timing | 55 minutes

Get Ready & Team Up	5 min.
Prepare for the Mission	40 min.
Reflect & Wrap Up	10 min.
Total	**55 min.**

Level Up Activities 5 min. each

Prep Snapshot*

Prep Time 50 min.

Combine card decks.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Creativity

Science Practices

- Engaging in Argument from Evidence

Guiding Question

How can we mitigate hazards on a particular NASA mission?

Learners Will Do

Choose a mission to plan, then list mission hazards and find ways to mitigate them.

Learners Will Know

Scientists predict hazards in an area they want to study, and think about ways to mitigate them.

Connecting Across Adventures

Adventure 5: Hazards in Space	Adventure 6: Mitigating Hazards for Your Mission	Adventure 7: Science Share-Out
Last time, learners learned that hazards also exist in space, some are the same as they are on Earth, and some are different.	**Today**, learners choose a NASA mission and think about the hazards, mitigation strategies, and other factors NASA should consider.	**Next time,** learners will share their proposed mission strategy with members of their community.

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/bfc39d8d

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
- presentation materials, to make and display signs, posters, pictures, etc.

For each group of 3 or 4 learners

- *Hazards Cards* Decks B (PDF), C (PDF), D (PDF), and E (PDF)
- blank paper

For each learner

- Science Notebook (PDF)

Adventure 6 Materials Preparation (50 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. Have the Educator Science Background (weblink) on hand for learners to reference.
3. For each group of 3 or 4 learners, combine Decks B, C, D, and E into a full stack.

In Your Space

4. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Invite learners who did Adventure 5, Hazards in Space, to share what they did with a partner or in small groups. *(They played Hazard cards and used Mitigation cards to deal with those hazards.)*
2. Revisit the *Science Comic* with learners, focusing on the different missions they can design for.
3. Say: **Today you will imagine you are helping NASA plan a mission.** Share the Guiding Question with learners aloud and write it on the *Our Ideas* poster (using multiple languages as needed): **How can we mitigate hazards on a particular NASA mission?** Ask for a volunteer to use the *Our Ideas* poster to share what the group has learned about hazards and how to mitigate the hazards in space. Ask: **How will your ideas be helpful for a NASA mission?** *(anticipating hazards can help us avoid dangers and protect spacecraft, instruments and humans).*
4. Organize learners into groups of 3 or 4 and distribute Science Notebooks. Have each group talk about the roles they like to play during group work. Have learners select roles (or assign them yourself).

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii).

Prepare for the Mission (40 min.)

5. Pass out Decks B, C, D, and E to each group.
6. Have learners read the "Congratulations!" section of *Mitigate Hazards for Your Mission*, pg. 17, in their Science Notebooks.
7. Have each group choose a mission (described on *Mitigate Hazards for Your Mission*, pgs. 17-24, in their Science Notebook. There are four possible missions: 1) robots studying an asteroid, 2) people launching a rocket from Earth, 3) people going to the Moon, and 4) people going to Mars.

Support Learner Differences

Suggested group roles are listed on the Science Adventure 4 Hazards Card Game Rules Handout, pgs. 44-45. Change the role names and responsibilities to work for your group, and swap roles for each adventure. Check out the Intentional Grouping Strategies, pg. xxii.

Level Up!

Allow learners to design a mission that involves using NASA science and engineering to solve a problem in their community. Provide them with Science Activity 6 Mission 5 Handout (PDF).

8. Say: **Each group will need to create a plan for your mission. The plan must explain (1) the hazards you expect on the mission and (2) mitigations that can deal with each hazard.**

9. Have groups review the cards to find information for their plans. They can add their ideas to the *Our Ideas* poster or list them on *Plan Your Mission*, pg. 25, in their Science Notebook.
    1. Have groups sort the Hazard cards and think about which apply to their missions.
    2. Have groups sort the Mitigation cards and think about which apply to their hazards.
    3. Have groups sort the Chance cards and identify other factors affecting them.
    4. Now pass out Deck B, the hand-drawn cards from Adventure 3, and ask learners if they think that any of their created cards apply to their mission. If so, they should use them!
10. Visit each group, ask which cards they want to know more about, and read them relevant information from the Educator Science Background (weblink).
11. Have each group decide how to share their plan during the Science Share-Out. Possible ways to share include the following:
    - Post Hazard cards and the corresponding Mitigation cards on a poster.
    - Explain out loud to NASA about how to mitigate each hazard on the mission.
    - Stage a play that shows how mitigations address each hazard.
    - Draw a comic showing how astronauts and mission control mitigate each hazard.

Support Learner Differences

As necessary, group learners so they can support each other in completing *Plan Your Mission*.

Teaching Tip

If learners would benefit from more movement, have them act out the various motions on the Chance cards as part of the planning process.

If time is short, pause the adventure here and have learners plan how to share during another session.

Support Learner Differences

- Some learners may disengage if the Share-Out contains too much whole-group discussion. Think about what your learners need and ensure they choose an appropriate Share-Out structure.
- If you have learners who speak multiple languages, encourage them to share in their preferred languages. Circulate and ask groups: **Where can you include your preferred language or other languages you know in your share-out?** Encourage learners to make welcome signs and present in different languages spoken by the audience.
- All learners should contribute to the Share-Out, but not everyone will feel comfortable presenting in the same style. Indigenous learners may feel it is inappropriate to present directly as the center of attention. Ensure nonverbal presentation methods are available, and encourage participation behind the scenes, not only presenting in front of the group.

Reflect & Wrap Up (10 min.)

12. Revisit the Guiding Question: **How can we mitigate hazards on a particular NASA mission?** Have each group share what they learned about the hazards on their mission. As needed, remind them of terms on the *Our Ideas* poster.

13. Say: **Next time, you will share your mission ideas with family and community members.** Hand out copies of *Science Adventure 6 Share-Out Invitation Handout,* pg. 58, for learners to give to caregivers, family, and friends.

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in the Science Share-Out.
   - Keep learners' presentation materials for use in the Science Share-Out.
2. Plan for Science Adventure 7. See Science Adventure 7 Preparation on pg. 60.
3. Take time to reflect on the following educator prompt: **How did you support multiple means of expression?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Support Thinking

Ask: **Which hazards are most likely? Which are least likely? Which mitigations are easiest, cheapest, or apply to the most hazards?** As learners share, add key descriptive vocabulary to *Our Ideas* poster, such as *most likely*, *least likely*, *cheapest*, and *most expensive*.

Level Up!

- The Curiosity Rover encounters a lot of rocks while it's roving around on Mars. NASA designed the wheels of the next rover, Perseverance, differently to try to mitigate this rocky hazard! Check out this article from when Perseverance was fitted with its new shoes before launch: "NASA's Perseverance Mars Rover Gets Its Wheels and Air Brakes." (5 min.)
- Ask these story prompts: **Why is it important to share ideas? When have you shared your ideas before (for example, with family or community members)?** Have learners share with a partner. Tell learners, if anyone asks them what they did today, they can tell them "We made a plan to mitigate the hazards on a space mission" and ask them the above story prompts. Consider returning to learners' ideas at the start of the next adventure. (5 min.)

Science Share-Out Invitation

You're invited to the Science Share-Out

Come see your young scientist share their plans for a NASA Mission!

Date: _____

Time: _____

Location: _____

Grantee

Science Adventure 7: Sum It Up: Science Share-Out

Educator Preview

Adventure Snapshot

Learners share what they learned about hazards and mitigation strategies for NASA missions.

Timing | 50 minutes

Get Ready & Team Up	5 min.
Science Share-Out	40 min.
Reflect & Wrap Up	5 min.
Total	**50 min.**

Level Up Activities 5–15 min. each

Prep Snapshot*

Prep Time 40 min.

Invite people to the presentations.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Communication

Science Practices

- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Guiding Question

How can we mitigate hazards on a particular NASA mission?

Learners Will Do

Present their mission plans.

Learners Will Know

Scientists have valuable knowledge to share about the problem they have solved.

Connecting Across Adventures

Adventure 6: Mitigating Hazards for Your Mission	Adventure 7: Science Share-Out	Engineering Pathway
Last time, learners chose a NASA mission and thought about the hazards, mitigation strategies, and other factors NASA should consider.	**Today,** learners share their proposed mission strategy with members of their community.	**Next time,** learners experience engineering related to this topic in the Space Hazards Engineering Pathway (optional).

Adventure Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii–xxv. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/2f1d4748

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates

For each group of 3 or 4 learners

- *Hazards Cards* Decks B, C, D, and E: these might have already been prepared or organized in the last adventure by the learners
- Other materials for use in sharing

Adventure 7 Materials Preparation (40 min.)

Ahead of Time

1. Invite family or community members to attend the Share-Out.
2. Have the Educator Science Background (weblink) on hand.
3. Decide what to do with learners' presentation materials after the adventure.

In Your Space

4. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Invite learners who did Adventure 6, Mitigating Hazards for Your Mission, to share what they did with a partner or in small groups. *(They chose missions and made plans to mitigate hazards on those missions.)*
2. Say: **Today you will share your mission plans.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **How can we mitigate hazards on a particular NASA mission?**
3. Organize learners into their groups from Adventure 6. Have each group talk about the roles they like to play during group work. Have learners select roles (or assign them yourself).

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx–xxii) and use other engagement strategies as necessary (pgs. viii–xviii).

Science Share-Out (40 min.)

4. Ask each group to share their mission and hazards, mitigations, and chance factors. Remind learners that they can share in their preferred languages. As groups are sharing out, make sure you point to the *Our Ideas* poster for key terms.
5. Ask: **What hazards did the human missions have to mitigate? What hazards did the robotic missions have to mitigate? Do you think we should send people or robots on missions in space? Why?** Ask for a volunteer to record the group's ideas for which hazards and mitigations apply to humans and which to robots on the *Our Ideas* poster. Color-code or write symbols next to the hazards and mitigations; for example, R=robot and H=human.

Support Learner Differences

Suggested group roles are listed on the *Science Adventure 4 Hazards Card Game Rules Handout*, pgs. 44-45. Change the role names and responsibilities to work for your group, and swap roles for each adventure. Check out the Intentional Grouping Strategies, pg. xxii.

Reflect & Wrap Up (5 min.)

6. Ask: **What do you want to do or learn more about in the future after these adventures?** *(Find ways to mitigate hazards at home, at school, or in the neighborhood; learn about NASA missions; learn how to create or control robots.)* Record ideas on the *Our Ideas* poster.
7. Congratulate learners on their great work mitigating hazards. Choose a way to recognize their accomplishments, such as by shaking their hands or providing them with badges.

After the Adventure

1. Clean up:
   - Collect the Science Notebooks.
   - Decide if you want to keep the *Our Ideas* poster.
   - Reset the space in which you held the Share-Out.
   - Save cards for use if you teach this pathway again.
2. Take time to reflect on the following educator prompts: **How did you support connections among learners and members of the community? What strategies could you use in the future?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

webklink: https://hov.to/940428f7

Level Up!

- Encourage learners to explore actual NASA missions to the places they have been considering. The Artemis Program is sending astronauts to the Moon and preparing NASA for a trip to Mars. The OSIRIS-REx mission collected samples from an asteroid and returned them to Earth in 2023. (15 min.)
- Encourage learners and their families to try out the PLANETS At Home activities and those at yes.mos.org/families, which include more challenges to do together. (5+ min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We shared a plan to guard against the hazards on a space mission." (5 min.)
- If your learners enjoyed this planetary science challenge, they would also enjoy the Rover Observation and Discoveries in Space (ROADS) student challenges. Show your learners the NASA National Student Challenges (weblink). (15 min. to review weblink, 10–15 hours per challenge)