WATER IN EXTREME ENVIRONMENTS

WATER IN THE SOLAR SYSTEM

Science Pathway

Planetary Science Activities for Out-of-School Time Grades 6–8

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Welcome to Water in Extreme Environments!

In This Unit

In this unit, learners think and work like scientists and engineers. They investigate and engineer solutions for the problem of locating and reusing water in extreme environments, including outer 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.

Water in Extreme Environments
Unit Overview

This guide contains the **Science Pathway**.

Water is fundamental for life. When traveling in outer space, astronauts will need to reuse water efficiently, and the search for life across the solar system is focused on planetary bodies with liquid water. In this unit, learners design water reuse processes for extreme environments and analyze planetary bodies to determine the most promising locations to search for life. The unit contains an Engineering Pathway and a Science Pathway.

A video index for the complete unit is available on the website.

DID YOU KNOW?

The story of water is the story of life. Oceans define our home planet, covering the majority of Earth's surface and driving the water cycle that dominates our land and atmosphere. Earth isn't the only ocean world in our solar system. Water exists in different forms (solid, liquid, or gas) on other planets, moons, dwarf planets, and even comets. Water plays a significant cultural and spiritual role for many indigenous communities.

DID YOU KNOW?

Water resource engineering focuses on the design of systems and equipment, including water treatment facilities, to ensure that people are provided with clean water for drinking, living, and recreation. Access to drinkable water is not only a problem here on Earth—it is one of the biggest challenges facing planetary explorers, who must use water filtration systems that purify contaminated water to produce drinkable clean water.

Science Pathway Overview: *Water in the Solar System*

Learners in the Science Pathway (this guide) engage in activities as planetary scientists. Their goal is to identify different planetary bodies in the solar system where life could be present. This goal requires finding water. Future astronauts will need to find, generate, and reuse water to survive long-duration spaceflights, and water is essential to all life as we know it.

Learners explore the reservoirs and states of water on different bodies and choose one as the destination for a mission.

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

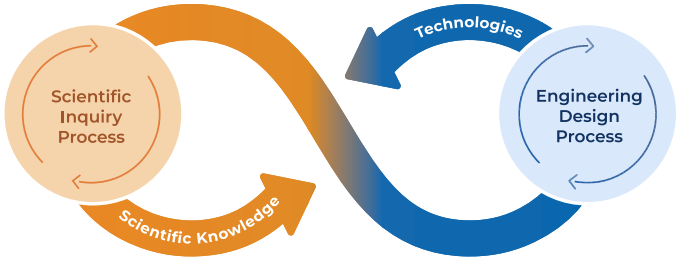
Engineering Pathway Overview: *Engineering a Water Reuse Process*

Learners in the Engineering Pathway engage in activities as process engineers and water resource engineers. A process is any series of steps designed to meet a goal, such as the steps of an assembly line or directions for creating a product. Process engineers work to optimize and improve processes so they are efficient and result in high-quality products. In this pathway, learners tackle process engineering by creating a step-by-step process to increase the amount of water that can be reused by adjusting the order that water flows through filters.

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 our 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 bringing a lens of curiosity, taking a systems approach, and tapping into creativity to answer questions and solve problems. Both processes do not follow a set path. Both draw on lived experiences and direct observation, then translate the knowledge gained into inquiry and teaching. And both processes engage thinkers in using tools like models, mathematics, and computers.

Finding 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 educator resource on **Developing 21st Century Skills.**

Learners Working & Thinking Like Scientists

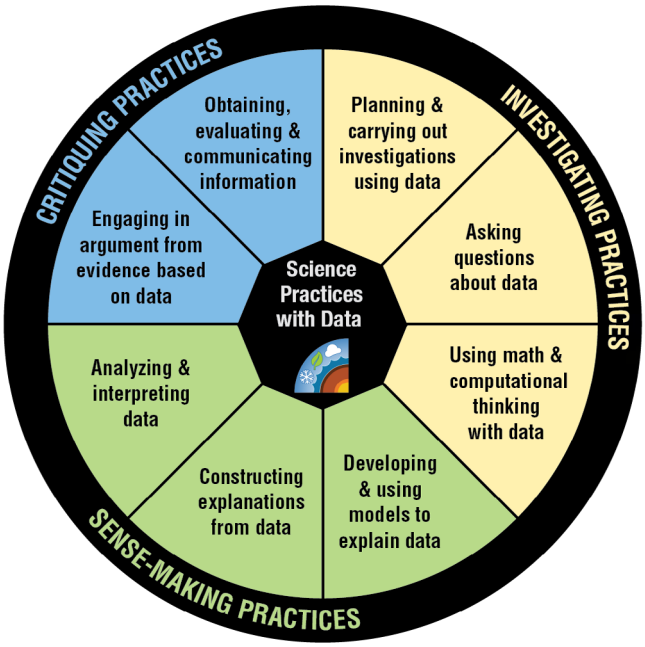
A Process of Scientific Inquiry

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)"

For additional resources, please see the Water in Extreme Environments Unit Website.

Navigating the Unit

Considerations for Using the Water in Extreme Environments 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 activity or Activity 1.
- It is not necessary for learners to complete the Science Pathway activities to participate in the Engineering Pathway.

CONTEXT-SETTING ACTIVITIES: ***Ready, S.E.T., Go!***
Learners investigate water. As scientists, they figure out where water is located. As engineers, they design a technology to get the water.

ACTIVITY 1: ***Water Stories: Sharing Experiences***
Learners share experiences with and stories about water.

Science Pathway

ACTIVITY 2: ***Water on Earth***
Learners explore the different reservoirs of water on Earth.

ACTIVITY 3: ***Water Habitability***
Learners explore how different living things need liquid water to survive.

ACTIVITY 4: ***Exploring the Solar System***
Learners explore the physical properties of planetary bodies in the solar system.

ACTIVITY 5: ***Water in the Solar System***
Learners explore the different reservoirs of water on planetary bodies in the solar system.

ACTIVITY 6: ***Choose a Potential Water Reservoir to Explore***
Learners combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

ACTIVITY 7: ***Science Share-Out***
Learners recommend a water reservoir to explore.

Engineering Pathway

ACTIVITY 2: ***Water Where We Are From***
Learners consider who uses water in their community and how, and they make water samples.

ACTIVITY 3: ***Investigating Water Quality***
Learners measure the water quality of the samples they have made.

ACTIVITY 4: ***Investigating Filters***
Learners investigate the ability of various filter materials to remove contaminants from a water sample.

ACTIVITY 5: ***Investigating a Reuse Process***
Learners apply what they learned about water quality to reconfigure a model building to reuse as much water as possible.

ACTIVITY 6: ***Create a Process***
Learners work in groups to plan, create, and test a water reuse process for an extreme environment.

ACTIVITY 7: ***Improve a Process***
Learners improve their water reuse processes to better meet the criteria for their environment.

ACTIVITY 8: ***Preparing for Engineering Share-Out***
Learners prepare to communicate their ideas about designing a water reuse process in the Engineering Share-Out.

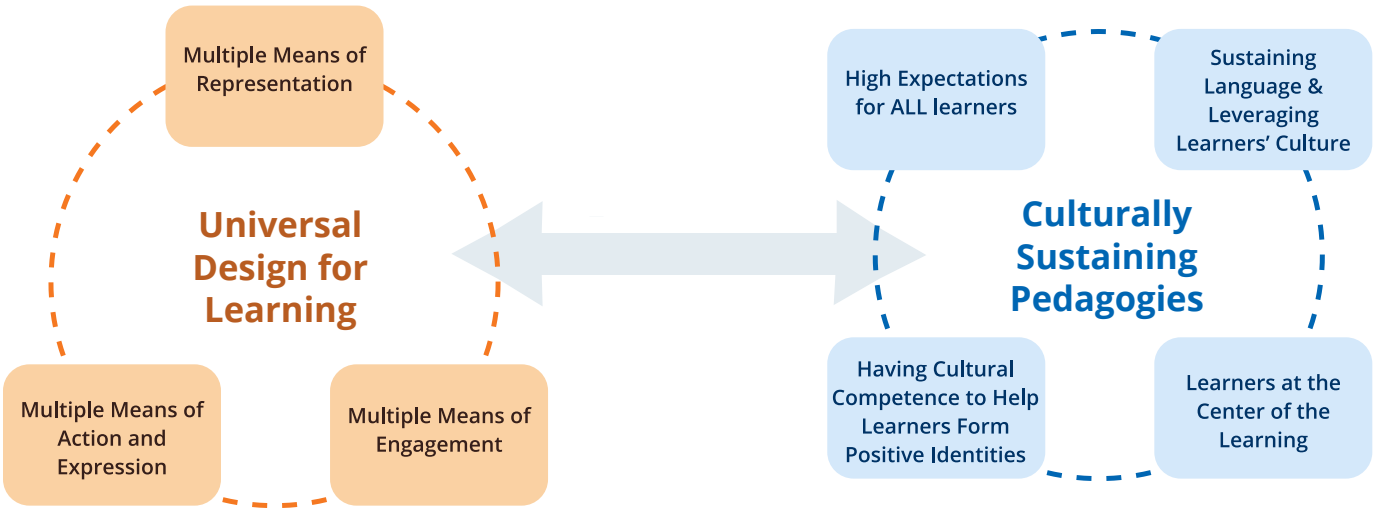
ACTIVITY 9: ***Engineering Share-Out***
Learners communicate their ideas about designing a water reuse process in the Engineering Share-Out.

Educator Resources to Support Learning

An Inclusive and Equitable Approach for STEM Learning

The Water in Extreme Environments 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

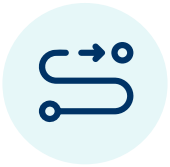
Within each activity across the Water in Extreme Environments unit, several strategic tips are provided as opportunities for additional instructional support. These tips are guided by the following PLANETS core design principles:

- 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: **Support Thinking** 	**Purpose:** 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).
Instructional Support Tip: **Teaching Tip** 	**Purpose:** 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 Activities 1–3
Learners begin thinking about water in their communities and on Earth.

Science Activities 4–7
Learners expand what they have learned in the previous activities to investigate water throughout the solar system.

CONTEXT

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

ACTIVITY SNAPSHOT
Learners investigate water. As scientists, they figure out where water is located. As engineers, they design a technology to get the water.

Prep Snapshot

Prep Time: 90 min

- Read unit.
- Print Notebooks.
- Prepare containers.
- 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
- Planning and Conducting Investigations

Connecting Across Activities

Today, learners start exploring water. As scientists, they figure out where water is located. As engineers, they design a technology to get the water.

Next time, learners will share experiences with, and stories about water.

1

SCIENCE ACTIVITY 1 – *Water Stories: Sharing Experiences*

ACTIVITY SNAPSHOT
Learners share experiences with, and stories about, water.

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
- Obtaining, Evaluating, and Communicating Information

Connecting Across Activities

Last time, learners started exploring water. As scientists, they figured out where water was located. As engineers, they designed a technology to get the water.

Today, learners share experiences with, and stories about, water.

Next time, learners will explore the different reservoirs of water on Earth.

2

SCIENCE ACTIVITY 2 – *The Blue Planet: Water on Earth*

ACTIVITY SNAPSHOT

Learners explore the different reservoirs of water on Earth.

Prep Snapshot

Prep Time: 10 min

- Prepare cups of water.

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Critical Thinking

Science Practices

- Asking Questions and Defining Problems

Connecting Across Activities

Last time, learners shared experiences with, and stories about, water.

Today, learners explore the different reservoirs of water on Earth.

Next time, learners will explore how different living things need liquid water to survive.

3

SCIENCE ACTIVITY 3 – *To the Extremes: Water Habitability*

ACTIVITY SNAPSHOT

Learners explore how different living things need liquid water to survive.

Prep Snapshot

Prep Time: 40 min

- Cut out cards.

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Critical Thinking

Science Practices

- Engaging in Argument from Evidence

Connecting Across Activities

Last time, learners explored the different reservoirs of water on Earth.

Today, learners explore how different living things need liquid water to survive.

Next time, learners will explore the physical properties of planetary bodies in the solar system.

4

SCIENCE ACTIVITY 4 – *Around the Sun: Exploring the Solar System*

ACTIVITY SNAPSHOT

Learners explore the physical properties of planetary bodies in the solar system.

Prep Snapshot

Prep Time: 30 min

- Print and cut *Planetary Cards or Optional Large Print/ Translatable Planetary Cards.*

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Collaboration
- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Connecting Across Activities

Last time, learners explored how different living things need liquid water to survive.

Today, learners explore the physical properties of planetary bodies in the solar system.

Next time, learners will explore the different reservoirs of water on planetary bodies in the solar system.

5

SCIENCE ACTIVITY 5 – *Distant Reservoirs: Water in the Solar System*

ACTIVITY SNAPSHOT

Learners explore the different reservoirs of water on planetary bodies in the solar system.

Prep Snapshot

Prep Time: 10 min

- Prepare the *Our Ideas* poster.

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Collaboration
- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Connecting Across Activities

Last time, learners explored the physical properties of planetary bodies in the solar system.

Today, learners explore the different reservoirs of water on planetary bodies in the solar system.

Next time, learners will combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

6

SCIENCE ACTIVITY 6 – *Destination Water: Choose a Potential Water Reservoir to Explore*

ACTIVITY SNAPSHOT

Learners combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

Prep Snapshot

Prep time: 30 min

- Invite guests to the Science Share-Out in Activity 7.

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Collaboration
- Communication
- Critical Thinking

Science Practices

- Constructing Explanations

Connecting Across Activities

Last time, learners explored the different reservoirs of water on planetary bodies in the solar system.

Today, learners combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

Next time, learners will recommend a water reservoir to explore.

7

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

ACTIVITY SNAPSHOT

Learners recommend a water reservoir to explore.

Prep Snapshot

Prep time: 5 min

* See *Materials & Preparation* for more information

Skills, Habits, Practices

21st Century Skills Connection

- Communication

Science Practices

- Engaging in Argument from Evidence
- Constructing Explanations
- Communicating Information

Connecting Across Activities

Last time, learners combined what they have learned to choose an extraterrestrial water reservoir to explore for life.

Today, learners recommend a water reservoir to explore.

Next time, learners will experience water reuse engineering in the Water in Extreme Environments 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.

Ready, S.E.T., Go!

- **Engineer**: A person who designs things to solve problems
- **Scientist**: A person who asks questions and gathers evidence to answer the questions
- **Technology**: Any object, system, or process designed by people to solve a problem

Science Activity 2

- **Atmosphere**: The air around a planet
- **Reservoir**: A place where water is stored
- **Subsurface**: Places under the surface of a planet
- **Surface**: The part of a planet exposed to the atmosphere or space

Science Activity 3

- **Extremophile**: A living thing that lives in extreme conditions
- **Habitable**: Able to support life

Science Activity 5

- **Kuiper Belt**: A donut-shaped region of icy bodies beyond the orbit of Neptune
- **Main Asteroid Belt**: A region in the solar system located roughly between the orbits of Mars and Jupiter that is occupied by numerous irregularly shaped bodies called *asteroids* or *minor planets*

Teaching Tip

No new vocabulary terms are introduced to learners in Science Activities 1, 4, 6, and 7.

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	computer and projector
1 cup	sand
1 pair	scissors
1	tablespoon
1 small bottle	vinegar, white
6	to-go coffee cups (or other opaque containers) with lids
8	markers, permanent or wet-erase that will work on a plastic cup
21	felt dots (or other raised adhesive objects) (optional)
30	cotton balls
30	craft sticks
30	cups, plastic, clear, 8 oz
30	straws
100	index cards
	soda water (or water and non-medicated seltzer tablets)
	tape (painter's tape if possible)
	water
	additional substance such as water ice, dirt, or rocks

Quantity (Per Group of 4)	Material
1 square foot	aluminum foil
1	to-go coffee cup (or other opaque container) with lid
1 deck	*Planetary Cards (PDF)* or *Optional Planetary Cards: Large Print/ Translatable version (PDF)*
1	measure with milliliters (such as a medicine cup), at least 5 mL
1 square foot	plastic wrap
2–3 Tbsp	table salt
5	paper clips
5 feet	string

Quantity (Per Pair)	Material
1	object to attach to the wall, such as a sticky note or magnet

Quantity (Per Learner)	Material
1	pencil
1	Science Notebook
1 set	safety gloves and goggles (optional)

Science Advance Preparation

You can complete much of the preparation for the Science activities 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. View the following video playlists:
   - How to prepare and teach with the materials
   - Background science and engineering content
   - How to support learner differences
3. Read the Educator Science Background (weblink) for context about the science in the unit.
4. Print and laminate any pages you want available for easy reference. The Inclusion Activities, pgs. xx-xxi, Intentional Grouping Strategies, pg. xxii, and Pathway Storyline, pgs. xxiii–xxv, are especially useful.
5. Review the Level Up activities throughout the pathway, decide which ones you might use, and plan accordingly.
6. Print your own copy of the Science Notebook (PDF) for reference.
7. 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).
8. Try accessing and navigating NASA's Eyes on the Solar System app to determine if this tool will be a good fit for your learners. As needed, consider ways of demonstrating the scale of the Solar System in other modalities, such as the tactile NISE's Exploring the Solar System: Pocket Solar System and auditory Solar System in Sound.

Teaching Tip

"Solar System in Sound" is a sonification of our solar system that covers 35 astronomical units in 90 seconds.

One AU is 1.5×10^{11} m and the speed of light is 2.99×10^{8} m/s, so it takes light 8.3 minutes to travel 1 AU. It would take light 4.9 hours to travel 35 AU.

So the 90 second audio clip is like traveling at roughly 200× light speed!

The table shows the audio amplitudes vs distance or time. Each planet has an audio frequency that is inversely proportional to its radius, so bigger planets have lower frequencies.

Planet	Distance (AU)	Time in 90s file	Radius (relative to Earth)
Mercury	0.39	1.0	0.38
Venus	0.72	1.9	0.95
Earth	1	2.6	1
Mars	1.5	3.9	0.53
Jupiter	5.2	13.4	11.2
Saturn	9.5	24.4	9.5
Uranus	19.2	49.4	4.0
Neptune	30.1	77.4	3.9

For the Whole Group

1. Invite staff, family, and community members to attend the *Science Share-Out* in Activity 7. Make copies of the Science Activity 6 Share-Out Invitation Handout, (PDF) to distribute to family and friends.
2. Prepare an *Our Ideas* poster by following the Prep & Setup Guide (PDF).
3. Print and cut out Science Activity 3 Temperature and Salinity Signs, pgs. 42-43. If it will be useful for your learners, mark the signs in a tactile way so their meaning is clear from feeling the signs.
4. Download and prepare to share the Ready, S.E.T., Go! slides (PPTX). If you cannot project them, print copies for each group instead.

Level Up!

Get families or a community member involved to share relevant stories of engineering in your community. Download customizable flyers and get ideas on the Water In Extreme Environments Family and Community Connections (weblink). (45 min.)

Teaching Tip

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.

Support Learner Differences

All videos in this unit include captions. As needed, these captions can be translated by online video platforms.

For Each Group of Learners

1. Print one set of Planetary Cards (weblink), in color and on cardstock if possible. It is important to set the printer to double sided (flip on long edge) to ensure the cards print correctly front to back. There are several sheets of cards that form a deck. Cut the cards with scissors (or a paper cutter) to make decks of 54 cards. Print one additional deck to use as a whole group. These decks will be used in Activities 4–7.

2. Print one of the following handouts for each group of four learners:
   - Science Activity 2 Water Where We Are From Handout, pg. 32
   - Science Activity 2 Where Is the Water? Handout, pgs. 33-34
   - Science Activity 4 Planetary Cards Explanation Handout, pg. 64
   - Science Activity 4 Sorting Instructions Handout, pg. 65
   - Science Activity 4 Challenge Instructions Handout, pgs. 66-67
   - Science Activity 5 Types of Reservoirs Handout, pg. 78

Teaching Tips

- To reduce preparation time, you can print one set of cards for every two groups, then divide the decks in half. Ensure each group has at least two atmosphere cards.
- Consider printing an extra set of cards as a backup. If a card is lost, you can quickly cut out a replacement.
- Use transparent card sleeves to protect the cards for long-term use.

Support Learner Differences

Card Holder Hack: Cut pool noodles into sections, slice lengthwise, and cut a 1/2" slot on top to hold cards.

Translatable & Screen-Readable Options: For multilingual and low-visual support, print out the Planetary Cards: Large Print/Translatable version (PDF). Each card has a QR code linking to an accessible version with read-to and translation availability.

Tactile Aids for BLV Learners:

Add a sticker or glue dot at the top center of each card for orientation.

Use Wikki Sticks on the back to mark reservoir locations:

Top = Rings

1" from top = Atmosphere

1" from bottom = Surface

Bottom = Subsurface

Advance Access: Let BLV learners take cards home early to review QR content at their own pace.

Tactile Planet Icons: Use a hole punch to mark the planet icon on each card's right side for easier identification.

Mobility Considerations: Ask learners what modifications they need—some may not require any.

For Each Pair

3. Print one of the following handouts for each pair of learners:
   - Science Activity 3 Find Your Water Handout, pg. 45
   - Science Activity 3 Tabletop Grid Handout, pg. 44
     - If it will be useful to your learners, add tactile elements to the grid so it can be navigated by feeling the signs.
   - Science Activity 3 Water Type Chart Handout, pg. 46
   - Science Activity 5 Finding Water Worlds Handout, pg. 77

4. Print Science Activity 3 Living Things Handout, pgs. 47-55, and cut out one slip for each pair of learners.

Level Up!

For a larger set of living things, you can use the Science Activity 3 Additional Living Things Handout (PDF) and Science Activity 3 Additional Water Type Chart Handout (PDF) as well.

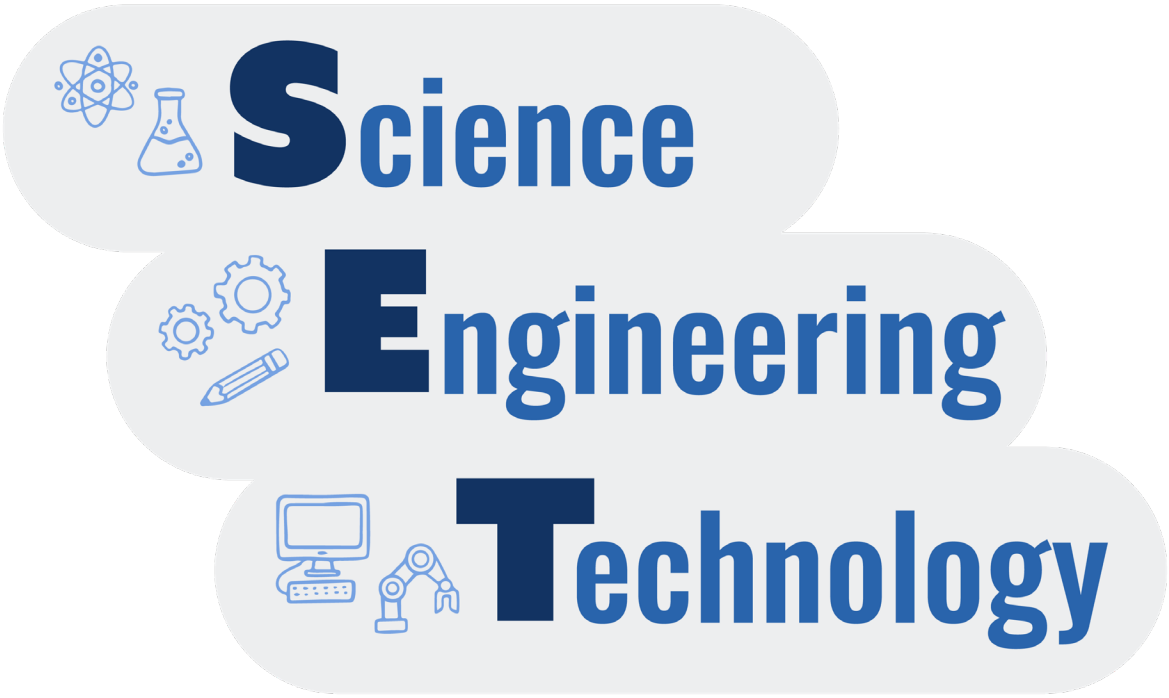
For Each Learner

1. Print and staple one Science Notebook (PDF) for each learner, in color if possible.

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

Activity Snapshot

Learners investigate water. As scientists, they figure out where water is located. As engineers, they design a technology to get the water.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Plan & Create (S.E.T.)	25 min.
Reflect (Go!)	10 min.
Total	**45 min.**

Level Up Activities 5–30 min. each

Prep Snapshot*

Prep Time 90 min.

- Space Need: Sink
- Read unit.
- Print Notebooks.
- Prepare containers.
- 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

- Planning and Conducting Investigations

Guiding Question

How can we identify where there is water? How can we get it?

Learners Will Do
As scientists, identify which containers hold water. As engineers, design a way to get the water out.

Learners Will Know
Water is a limited natural resource, but scientists can figure out where water is, and work with engineers to get it and use it.

Connecting Across Activities

Ready, S.E.T., Go!	Activity 1: Sharing Experiences
Today, learners start exploring water. As scientists, they figure out where water is located. As engineers, they design a technology to get the water.	**Next time**, learners will share experiences with and stories about water.

Activity 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/9009148c

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 each learner

- Science Notebook (PDF)
- safety gloves and goggles (optional)

For the whole group

- 1 cup sand
- 1 permanent marker
- 6 to-go coffee cups (or other opaque containers) with lids
- 21 felt dots (or other raised adhesive objects for labeling containers, optional
- soda water (or water and non-medicated seltzer tablets)
- vinegar
- water
- additional substance such as water ice, dirt, or rocks
- Disinfecting wipes (to clean lids)

For each group of 4

- 1 cup, clear plastic
- 1 square foot of aluminum foil
- 1 square foot of plastic wrap
- 1 to-go coffee cup (or other opaque container) with lid
- 5 cotton balls
- 5 craft sticks
- 5 feet of string
- 5 index cards
- 5 paper clips
- 5 straws

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., Go! Materials Preparation (90 min.)

Ahead of Time

1. Read through the PLANETS Science Pathway Educator Guide Introduction, pgs. iii–xxv, to learn more about the science content in this unit.

Teaching Tip

This activity is the same in both the Science and Engineering Pathways. If your learners have already done this activity in one pathway, you do not need to repeat it.

This activity can stand alone as a brief single-session program.

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 Notebook for your reference.
4. Download and prepare to share the *Ready, SET, Go* slides. If you cannot project them, print a copy for each group instead.
5. Prepare an *Our Ideas* poster by following the online Prep & Setup Guide (PDF). Add the Guiding Question "How can we identify where there is water? How can we get it?" so learners can refer to it throughout the activity.

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).

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 more pieces as needed.

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.

6. Assemble one set of materials for each group (cup, plastic wrap, cotton balls, string, index cards, paperclips). You can store each group's materials in a bag for easy distribution.
7. Label six coffee cups with the numbers 1 to 6. Optional: Attach the listed number of felt dots to each cup (1 felt dot on cup 1, 2 felt dots on cup 2, etc.).

Support Learner Differences

Adding felt dots to the cups allows all learners to refer to them by number (for example, "Container 2"), even if they cannot see the written labels. Using stickers or squares of tape, or punching through the back of a sticky note with a pen-tip to make raised hole punches, can also work.

In Your Space

8. Place the *Our Ideas* poster in a location all learners can access. Make a plan to store it between activities.
9. Fill one unnumbered coffee cup with water for each group.

Teaching Tip

Lead this activity in a room with a sink for easy setup. Otherwise, bring a half-gallon of water.

10. Fill Cup 1 with water. Put on the lid.
11. Fill Cup 2 with sand. Measure or feel to ensure its weight is roughly the same as Cup 1. Put on the lid.
12. Fill Cup 3 with water and add roughly a teaspoon of vinegar. Measure or feel to ensure its weight is roughly Cup 1. Put on the lid.
13. Leave Cup 4 empty. Put on the lid.
14. Fill Cup 5 with soda water (or water and non-medicated seltzer tablets). Measure or feel to ensure its weight is roughly the same as Cup 1. Put on the lid.
15. Fill Cup 6 with the non-liquid-water choice most appropriate for your site. Measure or feel to ensure its weight is roughly the same as Cup 1. Put on the lid.
    - Filling a cup with water and freezing it overnight into solid ice can spark conversations around the differences of water in solid form and what it would take to convert it to liquid.
    - Filling the cup with another material–such as beads, rocks, dirt, or marbles–can result in a distinct sound or odor distinguishable from water.
16. Set out the six numbered cups at six different stations.

Teaching Tip

You will need to make clear that learners should **NOT** drink out of any of the cups. Consider marking the cups to indicate that they are not for drinking. You can also tape over the holes in the coffee cup lids, although this will make the contents more difficult to smell.

Activity Guide

Get Ready & Team Up (10 min.)

1. Organize learners into groups of four.
2. Say: **NASA is sending spacecraft to explore many planets, moons, and asteroids around the solar system. One of the things NASA is searching for is water. Water is fundamental for life. Human explorers will need clean water to survive, and we might find other living things in water around the solar system. Today, we're going to explore two problems that NASA is facing.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **How can we identify where there is water? How can we get it?**

Plan & Create (S.E.T.) (25 min.)

Science: Find the Water

3. Display *Ready, S.E.T., Go!* slide 1: *Searching for Water*. Have learners discuss in their groups: **What do you notice about these images?** *(They all show ways of finding water. Observing animals who hunt fish; cattails grow by water; smooth stones often show up in riverbeds and dry washes; people dig wells to find water; satellites can identify where there is water.)*
4. Say: **Many times, people can't see the water they are searching for, so they have to detect it in other ways, such as by using the things you just talked about.**
5. Say, **Today, we're going to use more methods to figure out where there is water.** Have learners discuss in their groups: **What are other ways that people are able to find water without seeing it?**
6. Give each learner a Science Notebook. Say: **This Notebook is a place to record your observations and ideas.**

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, pgs. x–xv.

Check out the Intentional Grouping Strategies, pg. xxii.

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.

7. Have learners turn to *Find the Water*, pg. 2 in their Science Notebook. Say: **This page gives instructions to help you identify where there is pure, liquid water. As a group, you will go to six different stations. You will have about two minutes at each station. You cannot open or look into the containers, but you can use hearing, smell, and the way each container feels to gather data about them. Do NOT drink or eat anything from the containers.** Demonstrate how to "waft" the scent from the container with your hand to your nose, and warn learners about smelling the containers too deeply or closely.

Teaching Tips

- Consider ways to help learners remember not to look in the containers, such as by having them close their eyes.
- If you have safety gloves and goggles, have learners put them on.
- Ensure there is a quiet space to listen for bubbles. You may need to refresh bubbles between groups.

8. Allow each group to go to a station and begin examining the container there. As needed, offer clarifications and explain that learners are trying to determine whether each container has water and/or something else inside without opening it.
9. Every 1–2 minutes, have each group switch to the next station.
10. After learners have finished their final stations, revisit the first part of the Guiding Question: **How can we figure out where there is water?** *(We can make observations by sound, smell, and feeling. We can use what we know about water and other substances.)* Have groups pair up to discuss or record their ideas on the *Our Ideas* poster. Say: **We will keep gathering ideas on this poster.**
11. Open the numbered containers and tell learners what was in each of them. Discuss the differences among the clean liquid water, water mixed with other substances (vinegar, bubbles), and (if you included it) ice.
12. Point to a container that most learners thought did not have water. Ask: **Why did you think there was not water in this container?** *(Because it was too heavy; because it didn't sound like water.)* Explain that learners used these observations to make hypotheses, hypotheses, which are ways people explain what they think will happen based on what they know.

Support Learner Differences

- Recording learners' ideas using words, diagrams, and pictures on the *Our Ideas* poster or shared digital document throughout the activities 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.

13. Display the *Searching for Water* slide again. Say: **Humans often need to find water that we can't see directly. Throughout history, people have done this in many ways, from studying local animals and plants, to digging holes and wells, to analyzing types of rocks, to measuring how light reflects from other planetary objects in space. Like these people, you have been using some practices of scientists. There are many other things scientists do that we did not have time to do today, such as choosing a question and analyzing our results.** 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.

Engineering: Access the Water

14. Ask: **When people figure out how to find water they can't see, what kinds of things do they do next?** *Drill a well, get it out, use it.*

15. Say: **Now that you have identified where water is, you will design something to get it out of the container. You can use a variety of different materials: plastic wrap, cotton balls, string, index cards, and paper clips. You can't move the container because it represents a natural water source, like a lake, that can't be moved.**

16. Have learners turn to *Collect the Water*, pgs. 3-5 in their Science Notebook. Say: **This page gives you instructions to figure out how to collect the water. As a group, you will have about 10 minutes to follow the instructions.**

17. Give each group one coffee cup with water, one plastic cup, and the materials you listed.

18. Give groups 10 minutes to follow the instructions. As needed, offer clarifications and explain that learners are moving water from the container to the cup using the materials provided, without touching the cup directly. Say: **Try to move at least a few tablespoons of water.**

Level Up!

NASA has used satellite data to create a map of where water can likely be found near the surface of Mars. This map could be used by future astronauts to find drinking water on Mars! Read more here: https://www.nasa.gov/solar-system/nasas-treasure-map-for-water-ice-on-mars/ (5 min.)

Support Thinking

To help learners understand what they will be doing during this activity, play the translatable video Water in Extreme Environments Read Aloud.

Support Learner Differences

Give learners time to examine the materials before they begin the challenge.

Level Up!

For an additional challenge, learners can attempt to move the water using only index cards.

19. After about 10 minutes, revisit the second part of the Guiding Question: **How can we get water?** *(We can design devices that help us collect it.)* Have groups pair up to demonstrate their devices, discuss, or record their ideas on the *Our Ideas* poster.

20. Display *Ready, S.E.T., Go!* slide 2: *Water Technologies.* Say: **Humans often need to move water from one place to another. Throughout history, people have done this in many ways, from the shadoof in Egypt to stepwells in India, to water storage systems in the Southwest and water redirection systems in Central America. Like these people, you have been using the practices of engineers.** 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.

21. Say: **Scientists often start with a question and work to answer it. Engineers start with a problem and work to solve it. The objects, systems, and processes engineers design to solve problems are *technology*; for example, your designs to move and collect water are technologies. Engineers often design technologies that help scientists answer their questions.** Write the word *technology* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

22. Have learners refer to *Collect the Water*, pgs. 3-5 in their Science Notebook. Say: **Engineers record how the technologies they design work and find ways to improve them. As a group, you have about five minutes to record how your water collection technologies worked and think of ways you could improve them if you had other materials.**

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. (10 min.)
- Have learners think about how their technologies would function if they were larger and used in a different setting, such as a river next to a farm field. What would have to change to make sure the technologies kept working as intended? (5 min.)
- Have learners create portrayals–through drawing, acting, or some other method of their choice–of scientists and engineers working together to identify and get water. (30 min.)

Reflect (Go!) (10 min.)

23. Have learners discuss the following questions in their small groups: **Where on Earth do you think it is easier or harder to get water? Why? What about other places in the solar system?**

24. Say: **Next time, we will think about what we already know about water and why it is important.**

After the Activity

1. Clean up:
   - Keep the *Our Ideas* poster for Activity 1.
   - Collect all materials and containers. Where possible, save the materials and substances for reuse.
   - Keep the cups for Activity 2.
2. Have learners invite people from the community, including their families and friends to the Science Share-Out in Activity 7.
3. Plan ahead for Activity 1. See Activity 1 Preparation on pgs. 18-19.
4. Take time to reflect on the following educator prompt. **How did you create continuity between the science and engineering portions of the activity?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Science Activity 1: Water Stories: Sharing Experiences

Educator Preview

Activity Snapshot

Learners share experiences with, and stories about, water.

Timing | 70 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 water important?

Learners Will Do

Share a story or experience about water.

Learners Will Know

Water is essential for life.

Connecting Across Activities

Ready, S.E.T., Go!	Activity 1: Sharing Experiences	Activity 2: Water on Earth
Last time, learners started exploring water. As scientists, they figured out where water was located. As engineers, they designed a technology to get the water.	**Today**, learners share experiences with, and stories about, water.	**Next time**, learners will explore the different reservoirs of water on Earth.

Activity 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/2645a555

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)

Activity 1 Materials Preparation (30 min.)

Ahead of Time

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

Teaching Tip

This activity is the same in both the Science and Engineering Pathways. If your learners have already done this activity in one pathway, you do not need to repeat it.

If your learners are especially motivated by learning about plants and animals, consider teaching Activity 3 first to explore the importance of water for life, then teaching Activities 1 and 2 to explore local water and the distribution of water on Earth.

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 activity 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 activity by playing music or water sounds.

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 where water was, as engineers we designed a technology to get water.)*
2. Say: **Our ultimate goal is to figure out where there is water in our solar system. To start figuring this out, we're going to share what we know about why water is important for life.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **Why is water important?**

Support Learner Differences

This is an opportunity to celebrate cultural stories about water. As appropriate, share one yourself, invite a community member to share, or suggest learners can share any they know.

Watch the video Working with Indigenous Learners.

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-xxi). 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, pgs. x–xv.

3. Organize learners into groups of four.

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 "water" 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 why water is important. These stories could be about why water is important for life, how water connects different parts of the world, how water has spiritual significance to many communities, how caring for water is an important responsibility, and how some communities have more reliable access to clean water than others.**

5. Have learners turn to *My Water Story*, pg. 6 in their Science Notebook. Say: **To start, everyone will have 15 minutes to think about a story to tell that shows why water is important. 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 water to spark ideas.

Support Thinking

Learners may want to make up their own stories. Bear in mind that the goal of the activity is to identify why water 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 the importance of water may bring up trauma related to the lack of access to clean safe water (e.g., the water crisis in Flint, Michigan; lack of running water in certain Indigenous communities). 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.

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 water.

Reflect (10 min.)

8. Say: **Thank you for sharing your stories. They gave us great reasons why water is important.** Point out common themes you noticed among stories. Emphasize the importance of water for life. Ask: **Is there anything else you want to share to answer the Guiding Question?** Revisit the Guiding Question: **Why is water important?**

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

Support Learner Differences

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.

Support Thinking

Learners may bring up ideas that will be relevant in future activities, such as water phases, water reservoirs, availability of water, and habitability of water. 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!

To explore why the chemistry of water makes it so important for life, show the video Properties of Water. (5 min.)

10. Say: **Our ultimate goal is to figure out where in the solar system to search for life. Next time, we'll use the ideas we explored today to think about water here on Earth and how we can access it.**

Level Up!

- Tell learners, if anyone asks them what they did today, they can tell them "We shared stories about why water is important." (5 min.)
- Check out some great examples of the more than 2,000 NASA spin-off technologies that enrich our lives–and keep water clean and usable–thanks to space exploration. (5 min.)
- Read the book We Are Water Protectors, which tells a story about people fighting to keep water clean. Although this is a picture book, it has a message that is important for all ages. (60 min.)

After the Activity

1. Clean up:
   - Keep the *Our Ideas* poster for Activity 2.
   - If learners created objects related to their stories, save those objects for reference in future activities.
2. Plan for Science Activity 2. See the Activity 2 Preparation on pgs. 24-25.
3. Take time to reflect on the following educator prompt. **What strategies helped learners feel comfortable sharing stories?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Educator Guide

Science Activity 2: The Blue Planet: Water on Earth

Educator Preview

Activity Snapshot

Learners explore the different reservoirs of water on Earth.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Investigating Water on Earth	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 5–45 min. each

Prep Snapshot*

Prep Time 10 min.

- Space Need: Sink
- Prepare cups of water.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Asking Questions and Defining Problems

Guiding Question

Where is there water on Earth?

Learners Will Do

Explore the different reservoirs of water on Earth.

Learners Will Know

Water is a limited natural resource that can be found in different forms.

Connecting Across Activities

Activity 1: Sharing Experiences	Activity 2: Water on Earth	Activity 3: Water Habitability
Last time, learners shared experiences with, and stories about, water.	**Today**, learners explore the different reservoirs of water on Earth.	**Next time**, learners will explore how different living things need liquid water to survive.

Activity 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/9a619e3b

Materials and Preparation

Materials

For the whole group

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

For each learner

- 1 pencil
- 2 index cards

For each group of 4

- 1 measure with milliliters (such as a medicine cup), at least 5 mL
- 1 tablespoon sand
- 1 permanent or wet-erase marker that will work on a plastic cup
- 2–3 tablespoons table salt
- 5 clear plastic cups, 8 oz

Activity 2 Materials Preparation (10 min.)

Ahead of Time

1. Review the "In-Use Example" in the online Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Print one of the following handouts for each group of four learners:
   - Science Activity 2 Water Where We Are From Handout, pg. 32
   - Science Activity 2 Where Is the Water? Handout, pgs. 33-34
3. Try accessing and navigating NASA's Eyes on the Solar System app to determine if this tool will be a good fit for your learners. As needed, consider ways of demonstrating the scale of the Solar System in other modalities, such as the tactile NISE's Exploring the Solar System: Pocket Solar System and auditory Solar System in Sound.

In Your Space

4. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
5. For each group, fill a cup with about 140 mL (about 5 fl oz) of water. (Leave the other four cups per group empty.)
6. Optional: Set up a device with a projector and internet access, then test video links and view:
   - Are There Oceans on Other Worlds? We Asked a NASA Expert (0:00 to 1:00)
   - Why Does NASA Want to Explore Jupiter's Ocean Moon? (0:00 to 1:07)

Teaching Tip

Lead this activity in a room with a sink for easy setup.

Support Learner Differences

To ensure all learners can use the cups, even if they cannot see them, get measuring cups with raised lines or tape fill lines at different levels on the cups.

Level Up!

You can explore lab equipment application for blind and low-vision learners in this article about Independence Science Educational Laboratory Kits.

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We told stories about why water is important, which helped us understand why it's important to answer questions about water.)* Draw learners' attention to their work on the *Our Ideas* poster about how water is important for humans and other living things.

2. Show the first 1:00 of the video Are There Oceans on Other Worlds? We Asked a NASA Expert and the first 1:07 of the video Why Does NASA Want to Explore Jupiter's Ocean Moon? Ask: **Why might NASA want to look for water beyond the Earth?** *Where there is water, there is often life. NASA wants to figure out if the ocean on Europa could support life.*

3. Say: **NASA does not have limitless time and resources, so it cannot send spacecraft to explore everywhere. NASA needs to make decisions about which places are most likely to have what it is looking for. Once it has made those decisions, it spends the money and time to visit a few of those places. As scientists, we are going to try to answer the same big question as NASA: Where in the solar system should NASA search for life?** Write the question in a prominent place at the top of the *Our Ideas* poster.

Support Learner Differences

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

Teaching Tips

- If you cannot show the videos, tell learners that NASA is sending a spacecraft to Europa, one of the moons of Jupiter. Europa is a bit smaller than Earth's Moon, but its surface is covered in ice instead of rock. Scientists think there is a giant ocean underneath the ice. There may be vents that warm up parts of this ocean and create the conditions for life. NASA wants to figure out if places like Europa could support life. Find out more here: Meet Europa Clipper.
- Display NASA's Eyes on the Solar System app. Show and describe the parts of the solar system to get learners thinking about it. As needed, use NISE's Exploring the Solar System: Pocket Solar System or Solar System in Sound instead.

4. Ask: **What smaller questions will we need to answer in order to answer this question?** Allow learners to think of questions in pairs, then share them with the whole group. Record their questions on the *Our Ideas* poster in related categories. Possible categories of questions include:
   - Location of water: Where is there water? What kinds of places have water? (answered in Activity 2)
   - Habitability of water: What things live in water? Can we find water that doesn't have things living in it? What kind of water do different living things need? How can we figure out what living things are in water? (answered in Activity 3)
   - Planetary Bodies: What planets are in the solar system? What moons are in the solar system? What other types of planetary bodies (asteroids, dwarf planets, etc.) are in the solar system? (answered in Activity 4)
   - Water on Planetary Bodies: Which planetary bodies have water? How much water do they have? Is it liquid water? Which planetary bodies have water with the right conditions for life? (answered in Activity 5)

Teaching Tip

Each activity in this pathway has a suggested Guiding Question. As much as possible, replace these questions with similar ones from the list of questions learners have thought of. Using learners' questions will increase their engagement. There will likely be questions you do not answer in the pathway. When you can, mention these questions and have learners think about ways to answer them in the future.

5. Say: **Today, we're going to start by investigating our questions about what kinds of places have water. We're going to start with what we know about places with water here on Earth.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **Where is there water on Earth?**
6. Organize learners into groups of four.

Investigating Water on Earth (25 min.)

7. Give each group a copy of Science Activity 2 Water Where We Are From Handout, pg. 32 and give each learner two index cards. Say: **This page gives instructions to help you think about different places with water. As a group, you have about 5 minutes to follow the instructions.**

8. After about five minutes, ask: **What kinds of places did you think of?** Have groups pair up and sort their index cards into categories that make sense together. *(Rivers, streams, ponds, and some lakes are places with fresh liquid water on land. Bays, gulfs, seas, and oceans are all salty water bodies. Clouds, mist, and fog are all examples of water in the air. Snow, glaciers, ice sheets, and icebergs are all frozen water. Some water is underground.)* **What do these places have in common?** *(All of these places store water. They are all reservoirs.)* Circulate and listen to groups' discussions.

9. Say: **Scientists use the word *reservoir* to mean a place where water is stored. All the places you have thought of are reservoirs. They can be on the surface of a planetary body, in the part of the planetary body under the surface (the subsurface), or in the air around the planetary body (the atmosphere).** Write the words *reservoir*, *surface*, *subsurface*, and *atmosphere* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

Support Thinking

- Following the instructions on Science Activity 2 Water Where We Are From Handout, pg. 32, learners will be identifying places with water. Provide examples as needed to prompt learner thinking. For example, water can be found in the ocean, rivers, lakes, ice sheets, clouds, living things, and the ground.
- Encourage learners to think about places with water that they shared in their stories during the previous activity.
- To help learners understand what they will be doing during this activity, play the translatable video Water Where We Are From Instructional Read Aloud.

Support Learner Differences

As needed, allow learners to choose other methods of sharing their ideas, such as audio recordings or Braille. Post index cards with filenames on them so the record can be referenced later.

Support Thinking

Support learners' understanding of reservoirs by mentioning human-made reservoirs near where you are and describing how they store water.

10. Say: **You've identified many of the key reservoirs of water on Earth. They include (1) in ice sheets, (2) underground, (3) in the ocean, (4) in lakes and streams, (5) in the air, and (6) inside life forms. Now, we're going to think about how much water is in each reservoir.** You can add names of these reservoirs, such as *ice sheets*, to the *Our Ideas* poster next to the terms *surface*, *subsurface*, and *atmosphere*. You can have learners add translations, drawings, or related images to the poster as well.

11. Give each group a copy of Science Activity 2 Where Is the Water? Handout, pgs. 33-34. Say: **This page gives instructions to help you think about how much water is in each reservoir on Earth. As a group, you have about 10 minutes to follow the instructions.**

12. Give each group 1 full cup, 4 empty cups, a marker, and a measure with milliliters (such as a medicine cup).

13. Give groups 10 minutes to follow the instructions. As needed, offer clarifications and explain that learners are estimating how much of Earth's water is in each of the reservoirs. Make sure they record their estimated amounts of water on *Science Activity 2 Where Is the Water? Handout,* pgs. 33-34.

14. Have each learner find the two index cards they wrote, that name places with water. Say: **Every place you thought of in your community is part of a reservoir. Take five minutes to put each index card in front of the reservoir it is a part of.**

Support Learner Differences

- Give learners time to examine the materials before they follow the instructions.
- If you have learners who speak multiple languages, have them discuss words for "ice sheet" and related words 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.

Level Up!

Have each group estimate how many cups of water like the one they received they would need to have in order to have all the water on Earth. Say: **The total amount of water on Earth is 10^22 (ten to the twenty-second) times larger than the amount of water in one of those cups.** Help learners understand just how big this number is by writing it out or otherwise expressing it in a way they can grasp. (Written out, it looks like 10,000,000,000,000,000,000,000; the USGS estimates there are 1,386,000,000 cubic kilometers of water on Earth in its FAQ "How much natural water is there?") (5 min.)

Support Thinking

- To help learners understand what they will be doing during this activity, play the translatable video Where Is the Water Instructional Read Aloud.
- It may help learners if you remind them how numbers can be expressed as percentages or as fractions. For example, a cup with 25% of the water has 1/4 of the water. The values of all the cups together need to add up to 100%, which is equal to 1.

15. After about 5 minutes, ask: **Which reservoirs are your places a part of?** Have groups pair up to discuss or record their ideas on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well. Groups can also attach their index cards to the poster.

16. Say: **Now we will learn the actual amount of Earth's water in each reservoir. You will record these amounts and adjust the water in your cups to match.**
    - **96.5% of the water on Earth, represented by 134 milliliters of your water, is in the oceans on the surface.**
    - **About 1.5% of the water on Earth, represented by 2 milliliters of your water, is in ice sheets.**
    - **Another 1.5% of the water on Earth, represented by another 2 milliliters of your water, is underground.**
    - **The last 0.5% of the water on Earth, represented by 1 milliliter of your water, is in lakes, rivers, the atmosphere, soil, and living things.**

17. To help groups remember what is in each cup, do the following:
    - Give salt to each group and have learners add it to their ocean cups.
    - Give sand to each group and have learners add it to their underground cups.
    - Have each group draw snowflakes on the outside of their ice sheet cups.

Support Thinking

Share these PLANETS Water in Extreme Environments resources: Science Activity 2 Optional Reference Visuals (PDF) and the videos Earth's Water Availability, Accessibility, and Usability and Water Phases and Reservoirs to help learners understand the amount and type of water in each reservoir.

Level Up!

Take pictures of learners' cup and index card setups, print them out, and attach them to the *Our Ideas* poster. (20 min.)

Reflect (10 min.)

18. Have learners revisit the Guiding Question in their small groups: **Where is there water on Earth?**
    (Almost all water on Earth is salt water in the oceans, but it is also present in the atmosphere, in ice sheets, in living things and underground.) Ask: **How does the amount of water in these reservoirs help us think about where there might be life?** *If most of the water in the solar system is salt water, like it is on Earth, then life is probably in salt water.* As needed, remind learners of the terms *reservoir*, *surface*, *subsurface*, and *atmosphere* on the *Our Ideas* poster.

19. Say: **Next time, we will keep answering our questions about the kinds of living things that we can find in water.**

Level Up!

- Ask this story prompt question: **Can you tell a story about a time you needed to find or get to water?** *(Possible responses include while traveling or digging a well.)* Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We explored how much water there is on Earth and where it is." (5 min.)
- To observe the effects of salt on living things, give each group two potato slices and a cup of fresh water. Have them put one slice in their salty ocean cup and one in the cup of fresh water. Save the cups and have learners observe them next time, considering the effects of the different kinds of water on the two potato slices. (You can also run variations of this activity with halved grapes or gummy bears, and you can compare additional solutions such as water with sugar, vinegar, or baking soda.) (5+ min.)

After the Activity

1. Clean up:
   - Save the *Our Ideas* poster for Activity 3.
   - Dispose of the salt water and sand.
   - Collect and save the markers, measures, and cups.
2. Plan for Science Activity 3. See Science Activity 3 Preparation on pgs. 36-37.
3. Take time to reflect on the following educator prompt. **What kinds of reservoirs did learners think of? Why do you think they thought of those kinds of reservoirs?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Water Where We Are From

1. Think about a community you belong to. What are the different forms of water there? What are the places where you can find water?
2. Write one place where you can find water on each of your index cards. You can also draw a picture or describe it some other way.

Where Is the Water?

1. Label the empty cups with the places on the list below:
   - Ice Sheets
   - Ocean
   - Rivers, Lakes, Air, Soil, Living Things
   - Underground
2. Imagine the water you have is all the water on Earth. Pour it into the cups to show how much of Earth's water you think is in each place. (For example, if you put 25% of your water in a cup, you think 25% of Earth's water is in that place.) Record your group's estimates in the chart.

Reservoir	Estimated Amount	Actual Amount
Ice	%	%
Ocean	%	%
Rivers, Lakes, Air, Soil, Living Things	%	%
Underground	%	%

1

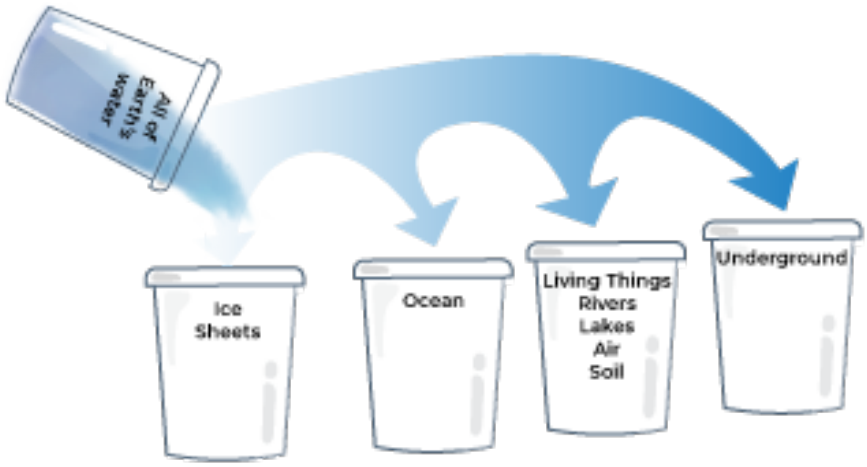
cup with water sample | 4 empty cups | marker | cup for measuring

2

Label empty cups

3

Pour all of Earth's water into cups



Pour the amount you think is in each place compared to the others.

Science Activity 3: To the Extremes: Water Habitability

Educator Preview

Activity Snapshot

Learners explore how different living things need liquid water to survive.

Timing | 70 minutes

Get Ready & Team Up	10 min.
Investigating Habitability	25 min.
Reflect	10 min.
Total	**45 min.**
Level Up Activities	5–45 min. each

Prep Snapshot*

Prep Time 40 min.

- Cut out cards.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Engaging in Argument from Evidence

Guiding Question

What kind of things live in or need water?

Learners Will Do

Identify features of water that affect its habitability.

Learners Will Know

Scientists seek and study water because all living things need liquid water to survive.

Connecting Across Activities

Activity 2: Water on Earth	Activity 3: Water Habitability	Activity 4: Exploring the Solar System
Last time, learners explored the different reservoirs of water on Earth.	**Today**, learners explore how different living things need liquid water to survive.	**Next time,** learners will explore the physical properties of planetary bodies in the solar system.

Activity 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/5e178b31

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples & Templates
- Science Activity 3 Temperature and Salinity Signs, pgs. 42-43
- tape

For each pair

- 1 living thing slip (cut from Science Activity 3 Living Things Handout, pgs. 47-55)
- 1 copy of Science Activity 3 Tabletop Grid Handout, pg. 44
- 1 copy of Science Activity 3 Find Your Water Handout, pg. 45
- 1 copy of Science Activity 3 Water Type Chart Handout, pg. 46
- 1 object to attach to the wall, such as a sticky note or magnet

Activity 3 Materials Preparation (40 min.)

Ahead of Time

1. Review the "In-Use Example" in the online Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Print and cut out Science Activity 3 Temperature and Salinity Signs, pgs. 42-43. If it will be useful for your learners, mark the signs in a tactile way so their meaning is clear from feeling the signs.
3. Print Science Activity 3 Living Things Handout, pgs. 47-55, and cut out one slip for each pair of learners.

Support Learner Differences

To increase learner understanding and engagement, you can add living things from your local area on blank slips.

Level Up!

For a larger set of living things, you can use the Science Activity 3 Additional Living Things Handout (PDF) and Science Activity 3 Additional Water Type Chart Handout (PDF) as well.

4. Print one copy each of Science Activity 3 Tabletop Grid Handout, pg. 44, Science Activity 3 Find Your Water Handout, pg. 45, and Science Activity 3 Water Type Chart Handout, pg. 46, for each pair of learners. If it will be useful to your learners, add tactile elements to *Science Activity 3 Tabletop Grid Handout* so it can be navigated by feeling the papers.

In Your Space

Teaching Tip

Lead this activity in a room with a large open area.

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
6. Post the four temperature signs in ascending order up the side of a wall. Put the four salinity signs in ascending order horizontally to the right and above the temperature signs. Ensure the signs are in reach of all learners.
7. Tape lines on the wall (or use string, rope, or some other item) to create a grid that can be felt by learners.

	Fresh	Semi-Salty	Salty	Very Salty
Hot				
Warm				
Cold				
Ice				

Teaching Tip

If you have a large, open space and it is appropriate for your learners, you can set up the large grid on the floor rather than on the wall. Instead of placing objects, pairs can place themselves in the grid during the activity.

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We thought of places with water on Earth and put water in cups to understand the amount of water in different reservoirs.)* Draw learners' attention to their work on the *Our Ideas* poster and the terms *reservoir*, *surface*, *subsurface*, and *atmosphere*.
2. Ask: **What is the big question we are trying to answer?** *(Where in the solar system should NASA search for life?)* Display and describe NASA's Eyes on the Solar System app to remind learners about the solar system. As needed, use NISE's Exploring the Solar System: Pocket Solar System or Solar System in Sound instead.
3. Say: **Today we will try to answer our questions about the water that living things can use.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **What kind of things live in or need water?**
4. Organize learners into pairs.

Investigating Habitability (25 min.)

5. Say: **Today, each pair is going to represent one living thing. Your goal will be to help your living thing survive by finding water that it can use.** Give each pair of learners a slip from *Science Activity 3 Living Things Handout*, pgs. 47-55, and read it aloud to them.
6. Give each pair a stickable object, such as a sticky note or magnet, a copy of *Science Activity 3 Tabletop Grid Handout*, pg. 44, and a copy of *Science Activity 3 Find Your Water Handout*, pg. 45. Say: **This page gives instructions to figure out where your living thing should go. As a pair, you have about 10 minutes to follow the instructions.**

Support Learner Differences

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

Level Up!

As pairs receive their living things, you can have them come up with ways to act their living things out or have them practice the American Sign Language for their living things (PPTX).

Support Thinking

- Following the instructions on Science Activity 3 Find Your Water Handout, pg. 45, pairs will be trying to figure out the temperature and salinity of the water their living things need. Ask questions to prompt learner thinking, such as **What habitat do you think this living thing is from? What do you think the temperature and salt are like in that habitat?**
- You can use the website Map of Life to help learners visualize where specific living things are found.

7. Give learners 10 minutes to place their objects on their grids according to the temperature and salinity of the water they think their living things need.

8. Once pairs have all placed their objects, have them discuss the following question with others nearby: **Why did you choose to place your object where you did? What do you think it is like to be your living thing?**

9. Say: **Now you will get information on where these living things actually live and use it to organize yourselves again. This time, instead of placing your object on a small grid, we will all place our objects on this larger version of the grid on the wall.** Indicate the wall grid and give learners time to examine it if necessary.

10. Give each pair a copy of *Science Activity 3 Water Type Chart Handout*, pg. 46, and give them another 5 minutes to place their objects on the wall grid using the information on the chart.

11. After all pairs have found the correct locations, have each pair share with the group what their living thing is and what type of water they are located in.

12. Have learners discuss the following question with others nearby: **What do you notice about the temperature of water where these things live?** *(They almost all need liquid water that is warm but not too hot or too cold. Only a few can live in extremely hot or extremely cold water.)* Say: **All living things live in, or otherwise need, liquid water.** Write the word *liquid* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

13. Have learners discuss the following question with others nearby: **What do you notice about the saltiness of water where these things live?** *(Different living things need different amounts of salt in the water. Only a few can live in extremely salty water.)* Say: **Scientists use the word *salinity* to describe how salty water is.** Write the word *salinity* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

Support Thinking

To help learners understand the organization system, have a few volunteers place their objects on the wall grid and explain what the locations mean in terms of temperature and salinity.

Level Up!

- To share more information about temperature, show the video Tiny Extremophiles Living in Rocks! (until 1:48). If necessary, you can turn on captions, slow down the playback speed, and break the video into chunks: 0:00–1:21 (Cold Environments), 1:21–1:48 (Hot Environments). Afterward, ask: **What do the extremophiles that live in hot and cold environments have in common? Can you think of other places on Earth or space where extremophiles could exist?** (5+ min.)

- To share more information about salinity, show the video Salinity (6:21). If necessary, you can turn on captions, slow down the playback speed, and break the video into chunks: 0:00–1:22 (Salinity), 1:22–3:34 (Osmosis), 3:34–5:40 (Fish Adaptations). Afterward, ask: **Can you think of other examples of how osmosis might work? For example: a water filter.** (10 min.)

14. Have learners discuss the following question with others nearby: **How would you describe the water where these living things live?** *(The water is the habitat or part of the habitat for these living things.)* Say: **Just like the name for where a living thing lives is its *habitat*, scientists use the word *habitable* to describe an environment that can support life. We've shown that many environments on Earth are habitable, but the same environments are not habitable for all living things.** Write the word *habitable* on the *Our Ideas* poster near the living things cards. You can have learners add translations, drawings, or related images to the poster as well.

15. Have learners discuss the following question with others nearby: **What do you notice about the limits of life?** *(Different living things need different kinds of water, but there are limits to the kind of water they can live in. Only a few living things can live in water that is extremely cold, hot, or salty.)* Say: **There are a few living things that can live in these conditions, which are extreme compared to the conditions that favor most life forms, and scientists use the word *extremophiles* to describe those living things.** Write the word *extremophile* on the *Our Ideas* poster near the living things cards. You can have learners add translations, drawings, or related images to the poster as well.

Level Up!

- To share more information about extremophiles, show the video: Water and Habitability (1:01). If necessary, you can turn on captions, slow down the playback speed, and break the videos into chunks: 0:00–0:22 (Human Needs), 0:22–1:01 (Extremophiles). After each chunk, ask: **Why might it be important to study life that looks very different from ours?** (10 min.)
- Have learners discuss where other living things would go on the temperature-salinity grid. (5 min.)

Reflect (10 min.)

16. Have learners revisit the Guiding Question in their pairs: **What kind of things live in or need water?** *(All living things live in or need liquid water. Different living things need different water temperatures and salinities.)* Ask: **What kind of water on other planetary bodies is most likely to have living things?** *(All living things on Earth need liquid water, so living things other places in the solar system will probably be in liquid water.)* As needed, remind learners of the terms *extremophile* and *habitable* on the *Our Ideas* poster.

17. Say: **We've been exploring water that is habitable on Earth. Next time, we'll explore water that is habitable in other places in the solar system.**

Level Up!

- Ask this story prompt question: **Can you tell a story about a specific thing that lives in water–something you've observed or learned about in some other way?** *(Possible responses include stories about pets, wild animals, plants, diseases, and mythical creatures.)* Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We learned about what living things can live in different kinds of water." (5 min.)
- Get families or a community member involved to share relevant stories of science. Download customizable flyers and get ideas on the Family and Community Connections weblink. (45 min.)

After the Activity

1. Clean up:
   - Save the *Our Ideas* poster for Activity 4.
   - Collect the signs, objects, slips, and handouts.
2. Plan for Science Activity 4. See Science Activity 4 Preparation on pg. 59.
3. Take time to reflect on the following educator prompt. **How did learners use their prior knowledge to figure out the kinds of water different living things need?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Temperature Signs

Hot

Warm

Cold

Ice

Fresh

Semi-Salty

Salty

Very Salty

Tabletop Grid

	Fresh	Semi-Salty	Salty	Very Salty
Hot				
Warm				
Cold				
Ice				

Find Your Water

1. Read about the living thing on your slip of paper.
2. Think about the kind of water this living thing would live in or use.
   - How warm or cold do you think the water is?
   - How much salt do you think the water has?
3. Put the object on your grid in the area that represents the kind of water you think your living thing needs.

Water Type Chart

Use this chart to figure out the temperature and saltiness of the water your living thing uses.

Living Thing	Temperature	Saltiness
American Alligator	Warm	Fresh
American Crocodile	Warm	Salty
American Crow	Warm	Fresh
Bald Eagle	Warm	Fresh
Blue Whale	Cold	Salty
Brine Shrimp	Warm	Very Salty
Bull Shark	Warm	Fresh, Semi-Salty, Salty
Common Haircap Moss	Warm	Fresh
Emperor Penguin	Cold, Cool	Fresh
Goldfish	Warm	Fresh
Monarch Butterfly	Warm	Fresh
Red Kangaroo	Warm	Fresh
Red Mangrove	Warm	Fresh, Semi-Salty, Salty
Saguaro Cactus	Warm	Fresh
Salt-Loving Bacterium	Warm, Hot	Very Salty
Sea Turtle	Warm	Salty
Sugar Maple	Warm	Fresh

Living Things

American Alligator

American alligators live in wetlands in the southeastern United States.

American Crocodile

American crocodiles live along coasts in Florida, the Caribbean, Central America, and parts of South America.

American Crow

American crows live throughout much of North America.

Bald Eagle

Bald eagles live throughout much of North America.

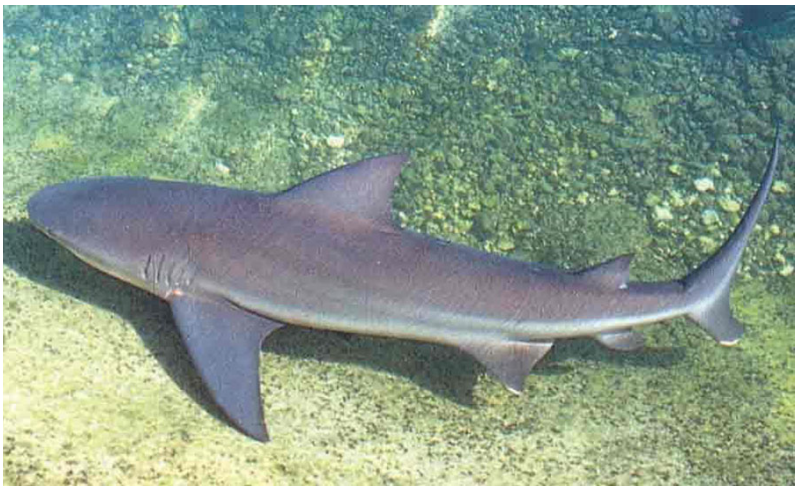
Blue Whale

Blue whales live in oceans around the world.

Brine Shrimp

Brine shrimp can live in the Great Salt Lake in Utah.

Bull Shark



Bull sharks live along coasts and in rivers around the world.

Common Haircap Moss

Common haircap moss lives in wet areas around the world.

Emperor Penguin

Emperor penguins live in Antarctica.

Goldfish

Goldfish are native to lakes, ponds, and rivers in East Asia.

Monarch Butterfly

Monarch butterflies live across North America.

Red Kangaroo

Red kangaroos live across most of Australia.

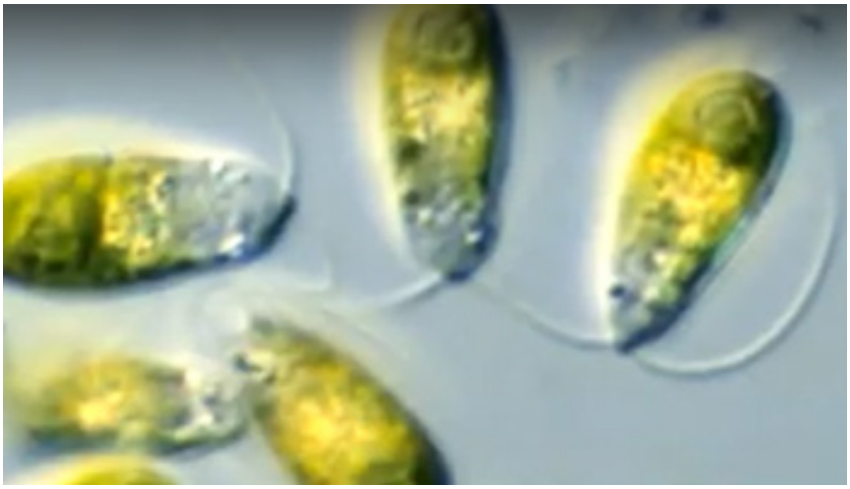
Red Mangrove

Red mangroves live along coasts around the world.

Saguaro Cactus

Saguaro cacti live in Mexico and the Southwest United States.

Salt-Loving Bacteria



Salt-loving bacteria can live in very salty water around the world.

Sea Turtle

Sea turtles live in all oceans, except in polar regions.

Sugar Maple

Sugar maples live in the Midwest and Northeast United States and parts of Canada.

Educator Guide

Science Activity 4: Around the Sun: Exploring the Solar System

Educator Preview

Activity Snapshot

Learners explore the physical properties of planetary bodies in the solar system.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Exploring the Solar System	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 5–45 min. each

Prep Snapshot*

Prep Time 30 min.

- Space Need: Tables
- Print and cut *Planetary Cards* or *Optional Planetary Cards: Large Print/Translatable version*.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Collaboration
- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Guiding Question

What are the different planetary bodies in the solar system, and what are their properties?

Learners Will Do

Get information about different planetary bodies in our solar system.

Learners Will Know

Scientists study places in the solar system and compare these places with Earth.

Connecting Across Activities

Activity 3: Water Habitability	Activity 4: Exploring the Solar System	Activity 5: Water in the Solar System
Last time, learners explored how different living things need liquid water to survive.	**Today,** learners explore the physical properties of planetary bodies in the solar system.	**Next time**, learners will explore the different reservoirs of water on planetary bodies in the solar system.

Activity 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/a821e7f3

Materials and Preparation

Materials

For the educator

- scissors

For the whole group

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

For each group of 4

- 1 prepared deck of Planetary Cards (weblink) *or Optional* Planetary Cards: Large Print/Translatable version (PDF)

For each learner

- pencil

Activity 4 Materials Preparation (30 min.)

Ahead of Time

1. Review the "In-Use Example" in the online Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.

2. Print one set of Planetary Cards (weblink) for each group, in color if possible. It is important to set the printer to double sided (flip on long edge) to ensure the cards print correctly front to back. There are several sheets of cards that form a deck. Cut the cards with scissors (or a paper cutter) to make decks of 54 cards. Print one additional deck to use as a whole group. These decks will be used in Activities 4–7.

3. Print one of the following handouts for each group of four learners:
   - Science Activity 4 Planetary Cards Explanation Handout, pg. 64
   - Science Activity 4 Sorting Instructions Handout, pg. 65
   - Science Activity 4 Challenge Instructions Handout, pgs. 66-67

4. Review the Science Activity 4 Planetary Cards Explanation Handout, pg. 64, to understand how to read the cards.

Teaching Tips

- To reduce preparation time, you can print one set of cards for every two groups, then divide the decks in half. Ensure each group has at least two atmosphere cards.
- Consider printing an extra set of cards as a backup. If a card is lost, you can quickly cut out a replacement.

Support Learner Differences

- Translatable & Screen-Readable Options: For multilingual and low-visual support, print out the Planetary Cards: Large Print/ Translatable version (PDF). Each card has a QR code linking to an accessible version with read-to and translation availability.
- This and other accessibility modifications for blind/low vision learners, including early access, tactile modifications, and mobility aids are listed in *Science Advance Preparation* on pg. 3 and available at this weblink.

In Your Space

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

Teaching Tip

Lead this activity in a room with at least one table for each group.

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We thought about the different living things that live in or need water on Earth.)*

Support Learner Differences

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

2. Ask: **What is the big question we are trying to answer?** *(Where in the solar system should NASA search for life?)* Display and describe NASA's Eyes on the Solar System app to remind learners about the solar system. As needed, use NISE's Exploring the Solar System: Pocket Solar System or Solar System in Sound instead.
3. Say: **Now that we've thought about Earth, we are going to investigate which other places in the solar system might have water that is habitable for living things.** Refer to the word *habitable* on the *Our Ideas* poster. Point out learners' questions about planetary bodies and the water on them.
4. Say: **Today you will look at NASA images of other planetary bodies to start investigating where water is found in the solar system.** Use NASA's *Eyes on the Solar System app* to show examples of different types of planetary bodies as you name them. **Planetary bodies include asteroids, dwarf planets, planets, and moons. This search will help us find out where living things might live. Eventually, we will understand why NASA has chosen certain locations to search for life.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **What are the different planetary bodies in the solar system, and what are their properties?**
5. Organize learners into groups of four.

Exploring the Solar System (25 min.)

6. Give each group a copy of *Science Activity 4 Planetary Cards Explanation Handout*, pg. 64. Say: **Each card in this deck describes a planetary body, such as a planet, dwarf planet, moon, or asteroid, in the solar system. Different parts of the card tell us different things about it, or properties of it.** Give a deck of *Planetary Cards* to each group. Give groups 5 minutes to become familiar with the cards.

Support Thinking

As needed, show NASA's Dwarf Planets Overview (weblink) for a fun way to support understanding of dwarf planets and why Pluto was reclassified.

Support Learner Differences

If you have learners who speak multiple languages, have them discuss words for "gravity," "rock," "ice," "gas," and related words 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.

7. Say: **Some moons and planets have multiple cards, representing multiple water reservoirs. To get the total amount of water on a body, including liquid water and frozen water from all reservoirs, add up all the droplet numbers from that body's cards.**

Teaching Tip

The water drop is a relative number comparing the volume of water on different planetary bodies.

8. Give each group a copy of *Science Activity 4 Sorting Instructions Handout*, pg. 65. Say: **This page gives instructions to help you sort the cards. As a group, you have about 10 minutes to follow the instructions.**

9. Give groups 10 minutes to follow the instructions. As needed, offer clarifications and explain that learners are choosing one property and sorting the cards using that property.

10. After about 10 minutes, ask: **How did you sort the cards? What did you learn from sorting them?** *(By distance from the Sun, size, gravity, materials, amount of water. Most of the planetary bodies are in the outer solar system. Most of the planetary bodies are smaller than Earth and have lower gravity.)* Have groups pair up to discuss or record their ideas on the *Our Ideas* poster.

11. Give each group a copy of *Science Activity 4 Challenge Instructions Handout*, pgs. 66-67. Say: **To get to know the cards better, we will complete some challenges with them. This page lists two different challenges. Take a few minutes to read them, and then we will try them all together.**

Support Thinking

- As needed, you can give example properties to sort by, such as distance from the Sun, status as a planet or moon, amount of water, reservoir type, type of planet, gravity, or size.
- To help learners understand what they will be doing during this activity, play the translatable video Sorting Instructions Instructional Read Aloud.
- If it would be helpful to learners, show the translatable videos Rock, Ice, Gas Instructional Read Aloud and Water How to Science (1:39–2:16), as well as Surface, Subsurface, Atmosphere Instructional Read Aloud and Water How to Science (2:16–2:55).

12. Give groups a few minutes to read the instructions. As needed, offer clarifications and explain the rules.
13. When groups are ready, have them try the challenges one after the other.

Reflect (10 min.)

14. Have learners revisit the Guiding Question on the *Our Ideas* poster in their small groups: **What are the different planetary bodies in the solar system, and what are their properties?** *(There are many planets, dwarf planets, asteroids, and moons in the solar system, and these different bodies have different properties.)* **Which properties would make it easier or harder to send a spacecraft to a planetary body?** *(Planetary bodies that are close by and have low gravity are probably easier to visit than planetary bodies that are far away and have high gravity.)* **Which planetary bodies are probably easier to get to?** *(Mercury, Venus, Earth's Moon, Mars.)*
15. Say: **Next time, in order to continue searching for life in the solar system, we'll focus specifically on the water in each body.**

Level Up!

- As learners participate, have them make the American Sign Language sign for each category when they complete that category:
  - **Rock**: Curl your two hands into fists, then knock the dominant fist over the non-dominant fist, as if you are knocking two rocks together.
  - **Ice**: Make your hands look like claws and have your palms face down. Pull the claws in towards your torso.
  - **Gas**: Put one hand horizontally above the other with fingers spread apart. Wiggle your fingers. Move your hands toward each other and then away. (5 min.)
- Learn about American Sign Language for states of matter (PPT). (5 min.)
- Have learners try movement challenges using Science Activity 4 Movement Challenge Instructions Handout (PDF). Allow learners to invent alternative movements or continue working on the previous challenges. Or, have learners play a game in which each learner puts a card facing out on their forehead, then ask other learners questions to determine what is on their card. (20 min.)
- To help learners learn more about how the planetary bodies formed and their properties, have them watch The Solar System's Formation (3:02) and make a scale solar system.

Level Up!

- Ask this story prompt question: **What kinds of stories do you know that include other planets or moons?** *(Possible responses include stories about the night sky, space travel, or the spiritual significance of different bodies.)* Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We learned about the different bodies in the solar system." (5 min.)
- Give each learner a copy of the Family Connection flier (PDF) to share at home. (5 min.)
- Invite a family or community member to come in as a special guest and share their knowledge about water-related topics. (45 min.)
- Have learners invent games to play using the cards. (45 min.)

After the Activity

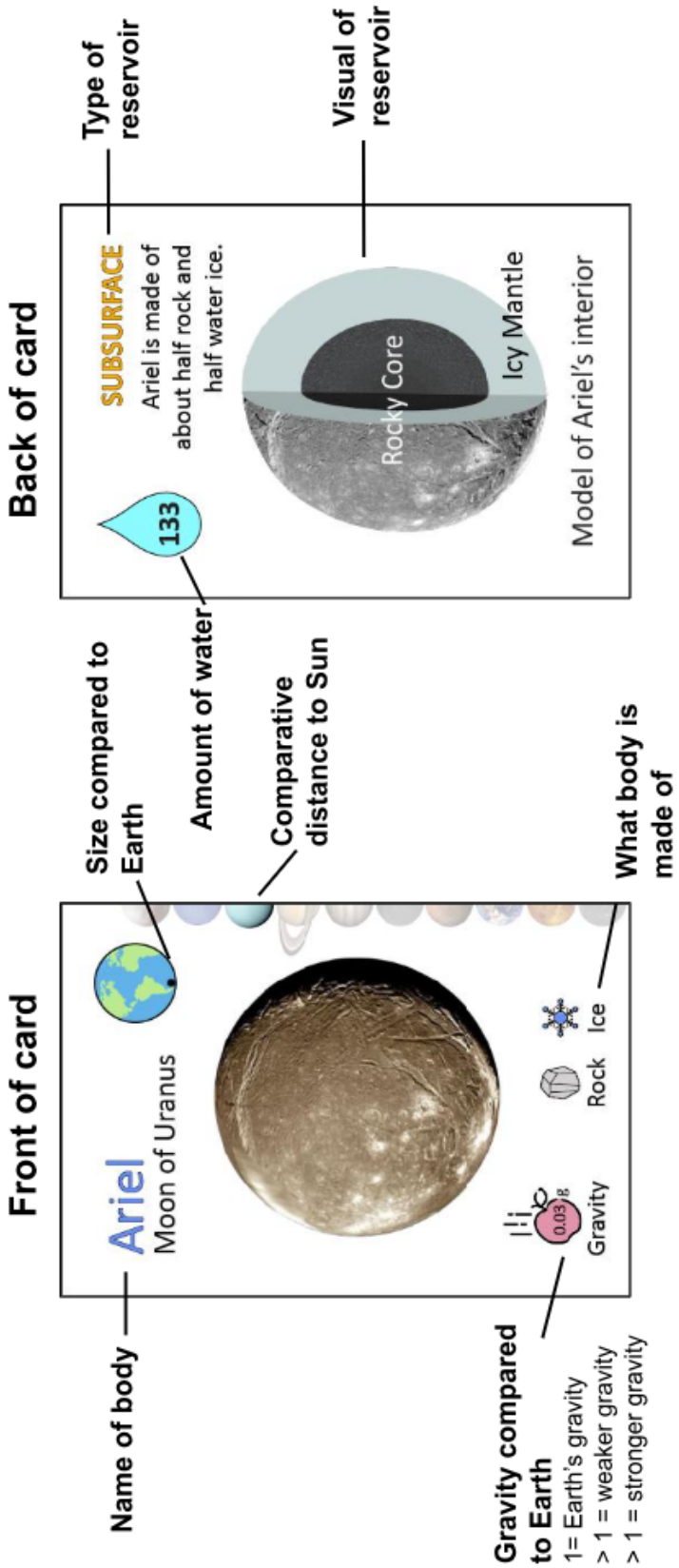
1. Clean up:
   - Save the *Our Ideas* poster for Activity 5.
   - Collect the *Planetary Cards*.
2. Plan for Science Activity 5. See Science Activity 5 Preparation on pg. 71.
3. Take time to reflect on the following educator prompt. **How did learners apply concepts from previous activities during this activity?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Planetary Cards Explanation

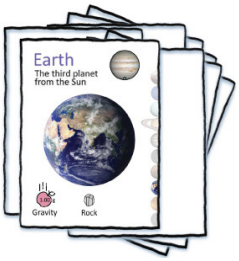


Sorting Instructions

1. As a group, choose a way to sort the planetary cards. You can put them into categories or in a certain order.
2. Organize the cards in the way that you chose.

Challenge Instructions

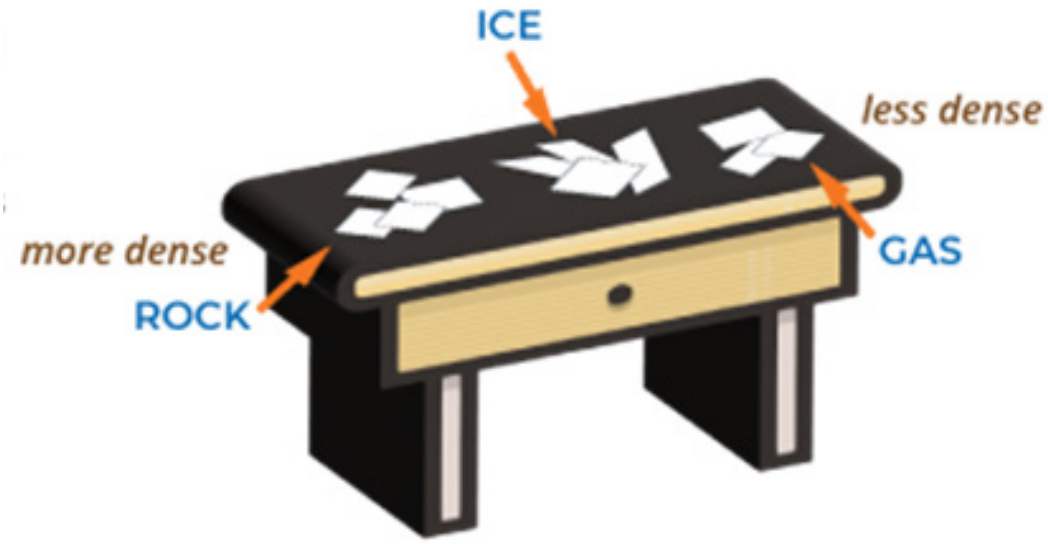
Rock, Ice, Gas

1. Shuffle the deck. 

2. Choose one end of the table to be “More Dense” and one end of the table to be “Less Dense.”

3. When the challenge starts, sort the deck as fast as you can by what the planetary bodies are made of–rock, ice, or gas.

   - **Rock:** Because rocks are dense, put all rock cards at the “More Dense” end of the table.
   - **Ice:** Because ice is less dense than rock, put all ice cards in the middle of the table
   - **Gas:** Because gas is less dense than ice, put all gas cards at the “Less Dense” end of the table.

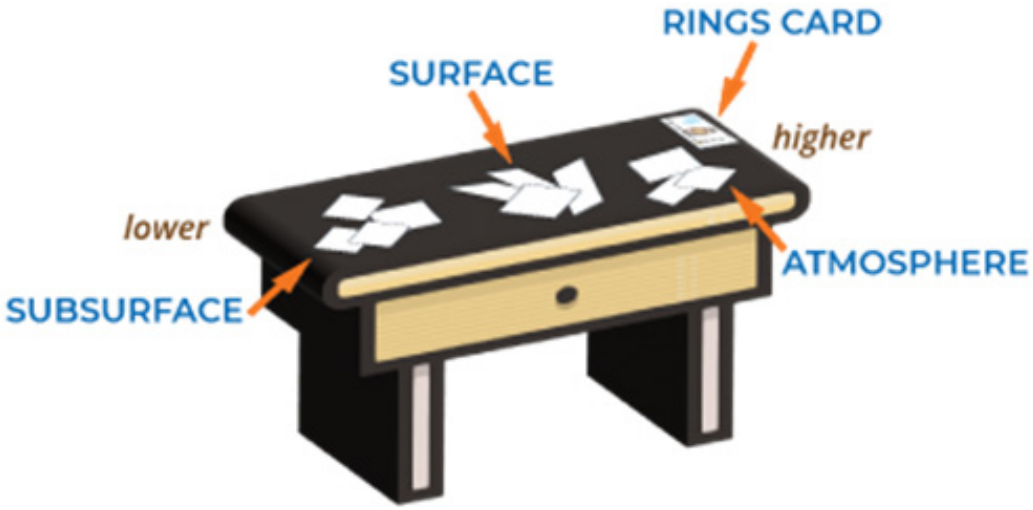


4. Once you have sorted all the cards, make a sound effect or cheer!

Surface, Subsurface, Atmosphere

1. Shuffle the deck.

2. Choose one end of the table to be “Higher” and one end of the table to be “Lower.”
3. When the challenge starts, sort the deck as fast as you can by type of reservoir–subsurface, surface, atmosphere, or rings.
   - **Subsurface:** Put all subsurface cards at the “Lower” end of the table.
   - **Surface:** Put all surface cards in the middle of the table.
   - **Atmosphere:** Put all atmosphere cards at the “Higher” end of the table.
   - **Rings:** Put the rings card on the “Higher” edge of the table.



4. Once you have sorted all the cards, make a sound effect or cheer!

Educator Guide

Science Activity 5: Distant Reservoirs: Water in the Solar System

Educator Preview

Activity Snapshot

Learners explore the different reservoirs of water on planetary bodies in the solar system.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Investigating Water in the Solar System	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 20–45 min. each

Prep Snapshot*

Prep Time 10 min.

- Space Need: Large open area
- Prepare the *Our Ideas* poster.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Collaboration
- Critical Thinking

Science Practices

- Analyzing and Interpreting Data

Guiding Question

Where is the most water in the solar system?

Learners Will Do

Get information about different planetary bodies to discover where water can be found in our solar system.

Learners Will Know

Scientists gather data to understand the natural world, including the solar system.

Connecting Across Activities

Activity 4: Exploring the Solar System	Activity 5: Water in the Solar System	Activity 6: Choose a Potential Water Reservoir to Explore
Last time, learners explored the physical properties of planetary bodies in the solar system.	**Today**, learners explore the different reservoirs of water on planetary bodies in the solar system.	**Next time**, learners will combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

Activity 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/2b464918

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples & Templates
- 1 deck of Planetary Cards (weblink) or Planetary Cards: Large Print/ Translatable version (PDF)
- tape (painter's if possible)

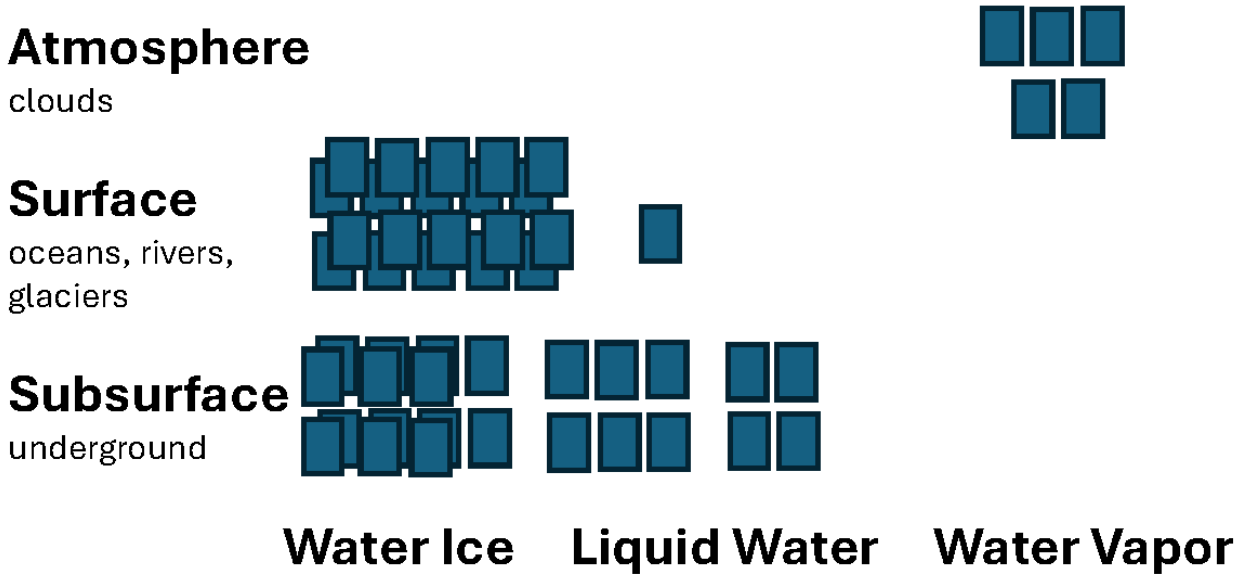
For each learner

- pencil

Activity 5 Materials Preparation (10 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 activity.
2. Ensure that there is an area of the *Our Ideas* poster open to make a chart. Along one side of the chart will be the reservoir type (atmosphere, surface, subsurface), and along the other side will be the state of water (ice, liquid, vapor). You may need to rewrite these terms in an open part of the poster.



3. Print one copy of Science Activity 5 Finding Water Worlds Handout, pg. 77, for each pair of learners.
4. Print one copy of Science Activity 5 Types of Reservoirs Handout, pg. 78, for each group of four learners.

In Your Space

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

Teaching Tip

Lead this activity in a room with a large open area.

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We explored the planets, dwarf planets, moons, and asteroids in the solar system. This helped us start thinking about where to search for life.)*

2. Ask: **What is the big question we are trying to answer?** *(Where in the solar system should NASA search for life?)* If necessary, display NASA's Eyes on the Solar System app to remind learners about the solar system. As needed, use NISE's Exploring the Solar System: Pocket Solar System or Solar System in Sound instead.

3. Say: **Today, we will continue our search for life in the solar system. We've learned many factors about habitability, including temperature, salinity, where to find water, and how much water is present on different planetary bodies, but in this activity, we're going to focus only on where water is and how much of it there is on each body in the solar system.** Refer to the word *habitability* on the *Our Ideas* poster. Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **Where is the most water in the solar system?**

4. Organize learners into pairs.

Investigating Water in the Solar System (25 min.)

Planetary Systems Challenge

5. Give each pair a copy of *Science Activity 5 Finding Water Worlds Handout*, pg. 77. Say: **This page gives instructions to help you think about where there is water throughout the solar system. You'll be collecting groups of cards that are all located near the same planet or belt. For example, the Earth category includes the Earth Subsurface, Earth Surface, Earth Atmosphere, and Moon Surface cards.** Show these cards to learners to support their understanding. **As a pair, you have about 10 minutes to follow the instructions.**

6. Deal one deck of *Planetary Cards* so each pair has approximately the same number of cards.

7. Give learners a few minutes to review the instructions and ask questions. As needed, offer clarifications and explain that learners are trading cards so each pair has all the cards for one planet and all its moons, or for all the dwarf planets, moons, and asteroids in one belt.

Support Learner Differences

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

Teaching Tip

The following Planetary Systems Challenge works best with exactly 10 learner pairs. If you have more than 20 learners, make some groups of four as needed to have exactly 10 groups. If you have fewer than 20 learners, have some pairs collect multiple card sets with few cards (e.g., Mercury and Venus; all inner planets).

Support Thinking

To help learners understand what they will be doing during this activity, play the translatable video Water How to Science (2:55–3:22).

8. Give learners 10 minutes to follow the instructions.
9. After about 10 minutes, pairs should be arranged in a line by distance from the Sun, with the Mercury group on one side of the room, the Kuiper Belt group on the other side, and all the other groups between them. If needed, provide support to ensure they are organized correctly.
10. Say: **You have organized yourself by planetary locations. Now, we are going to represent the amount of water at each planetary location.** Have learners represent the water in two different ways:
    - **Hand Raising:** Have pairs with a total water value below 50 hold their cards down low; with a value between 50 and 100 at normal hand level; with a value above 100 up high.
    - **Speech Volume:** One pair at a time, in distance order from the Sun, have all pairs say their total water value. Have pairs with lower values speak quietly and pairs with higher values speak loudly.
11. Have learners think about their data representation. Ask: **What do you notice about where water is in the solar system?** Have learners discuss in pairs and record their ideas on the *Our Ideas* poster. *(There is generally less water in the inner solar system, closer to the Sun, and more water in the outer solar system, farther from the Sun.)*

Teaching Tip

For reference to remember the order of the planets from the sun, you can share the Solar System Mnemonic, pg. 6 in the STEM Event Water Cards Activity (PDF) with your learners.

Level Up!

As a third way of displaying the information, tape the sets of cards on a wall at different heights depending on how much water is in each planetary system. (5 min.)

Level Up!

To help learners remember the graph they created

- have them draw a version of it in their Notebooks.
- take a picture or audio/video recording. If you take a picture, print it and attach it to the *Our Ideas* poster.
- have them enter the data into a spreadsheet and use it to create a graph and compare it to the human graph they created.

See the Water in the Solar System Key, pgs. 79-80, for a brief overview of the droplet values for all cards. (45 min.)

Support Thinking

- Show the video Water in the Solar System and the Science Activity 5 Water Worlds in the Solar System Poster (JPG) to support learner understanding about the locations of water in the solar system.
- After learners have created their representation, project the Water in the Solar System Key, pgs. 79-80 to make the patterns easier to analyze.

Reservoirs Challenge

12. Organize learners into groups of four.

13. Collect all the *Planetary Cards*.

14. Give each group a copy of *Science Activity 5 Types of Reservoirs Handout*, pg. 78. Say: **Now that we have explored where water is generally located in planetary systems, we will explore the reservoirs where water is found and what form it is in within those systems. This page helps you understand different forms of water and where they are found. You'll be sorting water into groups based on its form and its location. For example, the "Water vapor in the atmosphere" category includes the atmosphere cards for Venus, Earth, Mars, Jupiter, and Saturn.** Show these cards to learners to support their understanding. **As a group, you have about 10 minutes to follow the instructions.**

15. Shuffle the single deck of *Planetary Cards* and re-deal them so each group has about the same number of cards.

16. Give learners a few minutes to review the instructions. As needed, offer clarifications and explain that learners are trading cards so each group has all the cards for a particular reservoir (atmosphere, surface, subsurface) and form of water (ice, liquid, vapor). Note that some reservoirs contain water in multiple forms (for example, subsurface water can be ice and liquid). Explain that such cards can be placed in either of the categories to which they belong.

17. Give learners 10 minutes to follow the instructions.

18. After about 10 minutes, say: **You know that water can be found in different reservoirs – on the surface, in the subsurface, and in the atmosphere.** Refer to these words on the *Our Ideas* poster. **You also know that it can take different forms.** Refer to the word *liquid* on the *Our Ideas* poster. Ask: **Besides liquid, what other forms can water take?** *(Water can be a solid, as water ice, or a gas, as water vapor.)* Add the terms *water ice* and *water vapor* to the *Our Ideas* poster.

Teaching Tip

The following Reservoirs Challenge works best with exactly 6 groups. If you have more than 24 learners, make larger groups as needed to have exactly 6 groups. If you have fewer than 24 learners, have some groups collect multiple card sets.

Support Thinking

- To help learners understand what they will be doing during this activity, play the translatable video Water How to Science (3:22–4:05).
- Learners may not be familiar with the term *water vapor*. Provide ways for them to experience water vapor, such as by observing water evaporating (for example, from a cup of hot water) and condensing (for example, on a cold surface). Ask: **Where have you experienced water in the air before?**

19. Say: **In order to remember where water is located, add your cards to the poster in the category where they belong.** Have each group tape their cards on the poster with backside circles of painters tape (so they can be reused) in the category to which they belong (for example, surface+ice or subsurface+liquid).

Level Up!

Have learners identify which reservoirs contain water in multiple states (for example, ice and liquid) and tape those cards in between categories on the *Our Ideas* poster. (5 min.)

Reflect (10 min.)

20. Have learners revisit the Guiding Question in their small groups: **Where is the most water in the solar system?** *(Most of the water in the solar system is in the outer solar system in the subsurface of planetary bodies.)* Ask: **How does this information help us decide where to search for life?** *(We can prioritize the bodies that have liquid water because we know life on Earth needs liquid water. Except for Earth, all this liquid water is underground, so we will need a way to learn about the subsurface of planetary bodies.)* **What are some planetary bodies with liquid water?** *(Callisto, Europa, Ganymede; Dione, Enceladus, Titan; Titania; Triton; Pluto)* As needed, remind learners of the terms *water ice*, *liquid water*, *water vapor*, *subsurface*, *surface*, and *atmosphere* on the *Our Ideas* poster.

21. Say: **Next time, you will use the information you've gathered to make a recommendation about the best planetary bodies to search for life.**

Level Up!

Have learners think about ways their knowledge of water on other planetary bodies is limited. Ask: **What else would you like to learn about water in these reservoirs?** (5 min.)

Level Up!

- Ask this story prompt question: **What kind of stories do you know about traveling to explore other planets?** *(Possible responses include stories from fiction and stories of humans sending robots to other planets.)* Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We learned about where there is water in the solar system." (5 min.)
- Read more about where NASA missions have found water on Mars! NASA Is Locating Ice on Mars With This New Map - NASA. (5 min.)

After the Activity

1. Clean up:
   - Save the *Our Ideas* poster for Activity 6.
   - Collect the ***Planetary Cards***.
2. Plan for Science Activity 6. See Science Activity 6 Preparation on pg. 82.
3. Take time to reflect on the following educator prompt. **How were learners thinking about habitability during this activity? How do you know?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Finding Water Worlds

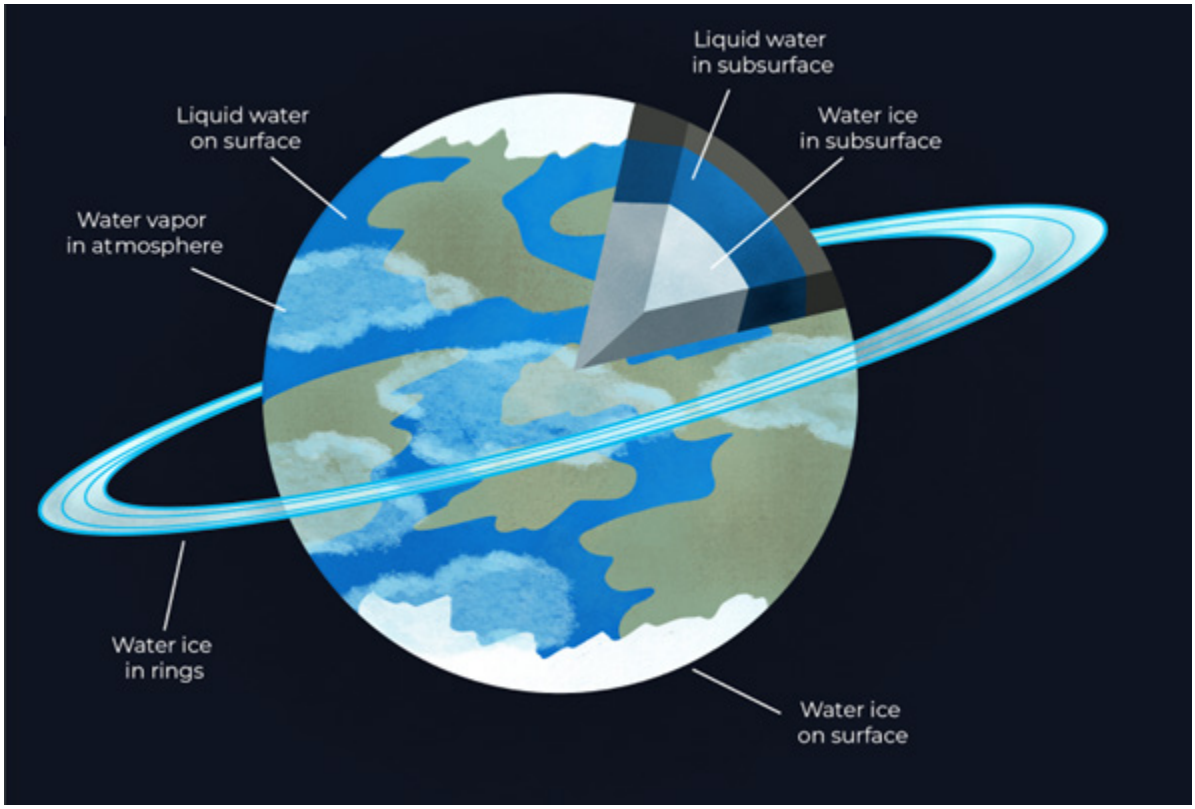
1. As a pair, review the cards you have.
2. Trade cards with other pairs until you have all the cards for one of these locations:
   - Mercury (1 card)
   - Venus (1 card)
   - Earth and the Moon (4 cards)
   - Mars and its moons (3 cards)
   - Main Asteroid Belt (2 cards)
   - Jupiter and its moons (8 cards)
   - Saturn and its moons (17 cards)
   - Uranus and its moons (11 cards)
   - Neptune and its moons (3 cards)
   - Kuiper Belt (4 cards)

Note: You will need to read some cards closely to figure out which location they are in.

3. Once you have all the cards for one location, give away the rest of your cards to pairs that need them.
4. Add the water values on your cards. Remember the total.
5. Form a line in order of distance from the Sun. The Mercury group should be on one side of the room and the Kuiper Belt group should be on the other side.

Types of Reservoirs

1. As a group, review the cards you have.

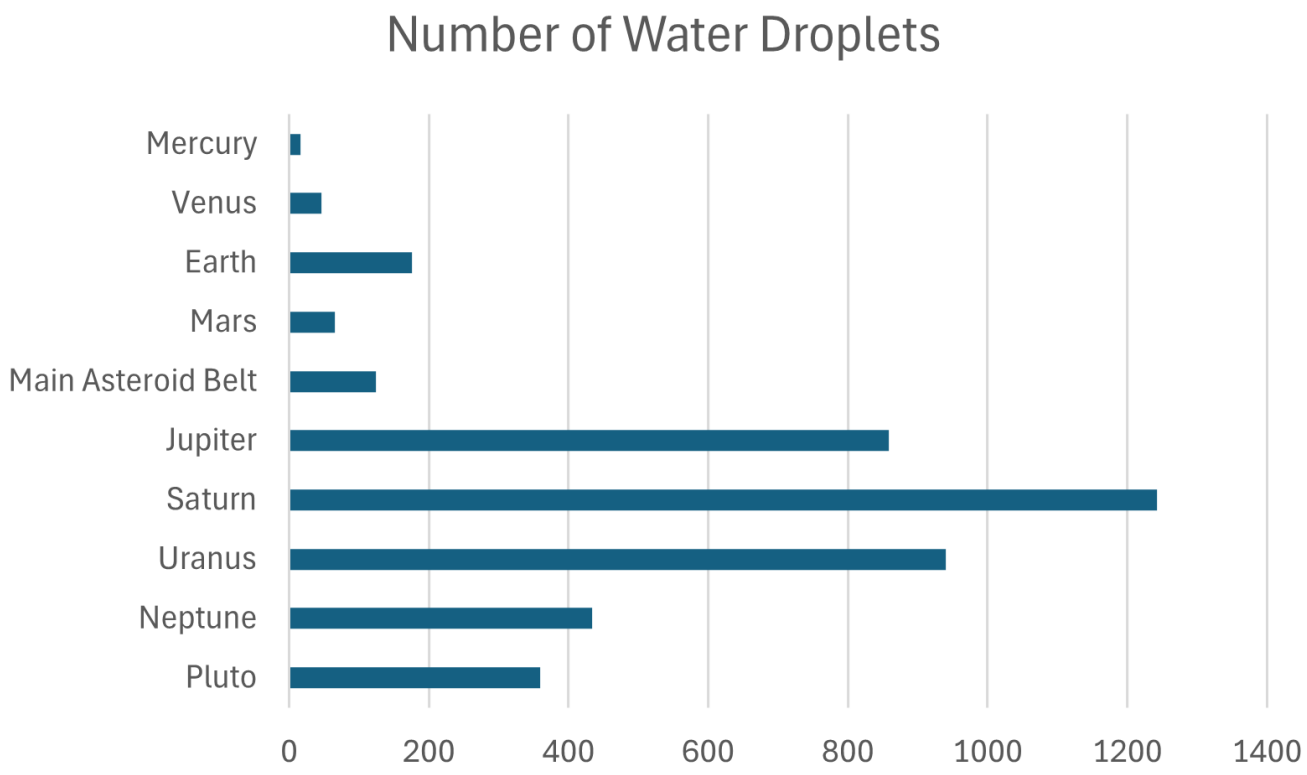


2. Trade cards with other groups until all your cards fit in one of these categories:
   - Water vapor in the atmosphere (6 cards)
   - Water ice on the surface/in rings (~20 cards)
   - Water ice in the subsurface (~14 cards)
   - Liquid water on the surface (1 card)
   - Liquid water in the subsurface (~10 cards)
   - No water (3 cards)

Note: Some cards can be used in multiple categories.

3. Once you have all the cards in one category, give away the rest of your cards to groups that need them.

Water in the Solar System Key



Location in the Solar System	Planetary Body (Planet or Moon)	Subsurface (Groundwater, Ground Ice, Subsurface Oceans)	Surface (Oceans, lakes rivers, polar caps)	Atmosphere (Clouds, rain, snow, humidity)	Rings	Total number of water droplets
Inner	Mercury	0	16	0	0	16
Inner	Venus	0	0	46	0	46
Inner	Earth	14	155	3	0	172
Inner	Moon	0	4	0	0	4
Inner	Mars	22	42	4	0	66
Asteroid Belt	Vesta	0	0	0	0	0
Asteroid Belt	Ceres	124	0	0	0	124
Outer	Jupiter	0	0	77	0	77
Outer	Io	0	0	0	0	0
Outer	Europa	175	19	0	0	194
Outer	Ganymede	285	32	0	0	317
Outer	Callisto	244	27	0	0	271
Outer	Saturn	0	0	72	0	72
Outer	Rings	0	0	0	91	91
Outer	Mimas	79	9	0	0	88
Outer	Enceladus	81	9	0	0	90
Outer	Tethys	134	15	0	0	149
Outer	Dione	129	14	0	0	143
Outer	Rhea	141	16	0	0	157
Outer	Titan	255	28	0	0	283
Outer	Iapetus	153	17	0	0	170
Outer	Uranus	200	0	0	0	200
Outer	Miranda	86	10	0	0	95
Outer	Ariel	133	15	0	0	148
Outer	Umbriel	138	15	0	0	153
Outer	Titania	156	17	0	0	173
Outer	Oberon	154	17	0	0	171
Outer	Neptune	197	0	0	0	197
Outer	Triton	213	24	0	0	237
Kuiper Belt	Pluto	187	21	0	0	208
Kuiper Belt	Charon	137	15	0	0	152

Educator Guide

Science Activity 6: Destination Water: Choose a Potential Water Reservoir to Explore

Educator Preview

Activity Snapshot

Learners combine what they have learned to choose an extraterrestrial water reservoir to explore for life.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Choose a Reservoir	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 20–25 min. each

Prep Snapshot*

Prep Time 30 min.

- Invite guests to the Science Share-Out in Activity 7.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Collaboration
- Communication
- Critical Thinking

Science Practices

- Constructing Explanations

Guiding Question

Besides Earth, where in the solar system is most likely to have life?

Learners Will Do

Combine the information they have learned in the previous activities to choose a potential water reservoir to explore.

Learners Will Know

Scientists must consider a lot of factors when choosing a place to study.

Connecting Across Activities

Activity 5: Water in the Solar System	Activity 6: Choose a Potential Water Reservoir to Explore	Activity 7: Science Share-Out
Last time, learners explored the different reservoirs of water on planetary bodies in the solar system.	**Today**, learners combine what they have learned to choose an extraterrestrial water reservoir to explore for life.	**Next time**, learners will recommend a water reservoir to explore.

Activity 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/0b2b1013

Materials and Preparation

Materials

For the whole group

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

For each group of 4

- 1 deck of Planetary Cards (weblink) *or* Planetary Cards: Large Print/Translatable version (PDF)

For each learner

- pencil
- Science Notebook (PDF)

Activity 6 Materials Preparation (30 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 activity.
2. Invite staff, family, and community members to attend the Science Share-Out in Activity 7.

In Your Space

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

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We explored where water is located in the solar system.)*

Support Learner Differences

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

2. Ask: **What is the big question we are trying to answer?** *(Where in the solar system should NASA search for life?)* If necessary, display NASA's Eyes on the Solar System app to remind learners about the solar system. As needed, use NISE's Exploring the Solar System: Pocket Solar System or Solar System in Sound instead.

3. Say: **NASA chooses certain reservoirs to search for life. Like NASA, you will consider everything you have learned and use it to choose the water reservoir you think is most likely to have life. Later, you will share the evidence and reasoning for your choice with others.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **Besides Earth, where in the solar system is most likely to have life?**

4. Organize learners into pairs and distribute Science Notebooks.

Support Learner Differences

Check out the Intentional Grouping Strategies, pg. xxii.

Choose a Reservoir to Explore (25 min.)

5. Have learners turn to *Searching for Life in the Solar System*, pgs. 9-12 in their Notebook. Say: **This page gives instructions for you to choose somewhere in the solar system to search for life. As a pair, you have about 10 minutes to follow the instructions. You can refer to the *Our Ideas* poster for information about the different planetary bodies and living things.**

6. After about 10 minutes, say: **You are going to have a chance to share which reservoir you chose and why. We are going to have a Share-Out to share what we're thinking with others.**

7. The Share-Out is a chance for learners to explain their thinking and reflect on what they learned about water in the solar system throughout the unit. As a group, agree upon a structure for the Share-Out. Possible structures include the following:
   - **Storytelling**: Groups use the evidence they've collected to tell stories about the reservoirs and what the scientists might find there. They can also tell their stories about water from Activity 1.
   - **Gallery Walk**: Groups host stations and explain their posters, graphs, maps, writings, drawings, or audio or videos on small devices.
   - **Pair-Share**: Groups pair off and share their choices with one another.
   - **Screening**: If time permits, groups make slideshows, animations, videos, or audio files. The whole group observes as these creations are screened.
   - **Performance**: Some people play scientists asking questions about learners' choice of reservoirs. You can develop script cards to include adults in the play.
   - **Discussion**: Learners and community members share their knowledge. You can write discussion prompts to lead this discussion.

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 just in presenting in front of the class.

8. Use the remaining time for pairs to prepare their presentation. As pairs are working, help guide their thinking by asking: **What evidence did you use to help you choose your water reservoir?**

Reflect (10 min.)

9. Have learners revisit the Guiding Question on the *Our Ideas* poster: **Besides Earth, where in the solar system is most likely to have life?** Have pairs group up and share their chosen planetary bodies.

10. Say: **Next time, you will share what you have learned and the reservoirs you have chosen.** Hand out copies of *Science Activity 6 Share-Out Invitation Handout*, pg. 86, for learners to give to caregivers, family, and friends.

Level Up!

- Ask this story prompt question: **Can you tell a story about a time you had to locate certain living things–plants, animals, or something else?** *(Possible responses include gathering plants, hunting, fishing, and birdwatching.)* Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We thought about where to explore water in the solar system." (5 min.)
- Invite family and community members to participate in the Science Share-Out by sharing their stories and expertise. (25 min.)

After the Activity

1. Clean up:
   - Save each group's design and presentation materials for the Science Share-Out.
   - Keep the *Our Ideas* poster for use in Activity 7.
2. Plan for Science Activity 7. See Science Activity 7 Preparation on pg. 88.
3. Take time to reflect on the following educator prompt. **What structure did learners choose for the Share-Out? Why do you think they chose that structure?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Science Share-Out Invitation

You're invited to the Science Share-Out

Come see your young scientist share what water reservoir in the Solar System they want to explore!

Date: _____

Time: _____

Location: _____

Grantee

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

Educator Preview

Activity Snapshot

Learners recommend a water reservoir to explore.

Timing | 45 minutes

Get Ready & Team Up	10 min.
Science Share-Out	25 min.
Reflect	10 min.
Total	**45 min.**

Level Up Activities 5–30 min. each

Prep Snapshot*

Prep Time 5 min.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Communication

Science Practices

- Engaging in Argument from Evidence
- Constructing Explanations
- Communicating Information

Guiding Question

What water reservoir in the solar system do you recommend exploring?

Learners Will Do

Share their selected reservoirs and explain why they want to explore them.

Learners Will Know

Scientists have valuable knowledge to share about their findings and decisions.

Connecting Across Activities

Activity 6: Choose a Potential Water Reservoir to Explore	Activity 7: Science Share-Out	Engineering Pathway
Last time, learners combined what they have learned to choose an extraterrestrial water reservoir to explore for life.	**Today**, learners recommend a water reservoir to explore.	**Next time**, learners will experience water reuse engineering in the Water in Extreme Environments Engineering Pathway (optional).

Activity 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/3f488c20

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples & Templates
- all tactile, audio, and video resources needed for the Share-Out

For each learner

- pencil
- Science Notebook (PDF)

Activity 7 Materials Preparation (5 min.)

Ahead of Time

1. Invite staff, family, and community members to attend the Science Share-Out.
2. Decide what to do with learners' designs and presentation materials after the activity.

In Your Space

3. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
4. Optional: Set up a device with a projector and internet access, then test video links and view:
   - Why Does NASA Want to Explore Jupiter's Ocean Moon?

Activity Guide

Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** Have learners share with partners or small groups. *(We chose water reservoirs to explore and made plans to share our reasoning.)*

Support Learner Differences

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

2. Say: **Today you will share the reservoirs that you think are most likely to have life. Like scientists, you will need to explain the reasoning and evidence for your choices.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **What water reservoir in the solar system do you recommend exploring?**
3. Organize learners into their pairs from Activity 6.

Science Share-Out (25 min.)

4. When learners are ready, invite guests into the room and explain how the Share-Out will proceed. Carry out the steps of the Share-Out as the group has planned.

Support Learner Differences

To ensure the Share-Out is accessible as possible, provide tactile, audio, and video resources from throughout the pathway to attendees as appropriate.

5. As they experience the Share-Out, invite families and other guests to think about their family, cultural, or other knowledge related to what they observe and share that knowledge with learners individually or the event as a whole.
6. Ask or encourage attendees to ask the following questions:
   - Why did you choose this reservoir to investigate for life?
   - What do you think living things in this reservoir might be like?
   - Is there a common type of reservoir in the solar system that multiple groups identified as promising?
   - What surprised you?
   - What is one thing you will remember?
7. At the end of the Share-Out, congratulate your group on doing a great job communicating and being scientists. Have learners thank attendees before concluding.

Reflect (10 min.)

8. Show the full video Why Does NASA Want to Explore Jupiter's Ocean Moon?
9. Have learners discuss the following questions in pairs: **NASA is focusing its search for life in the solar system on Mars, Europa, and Enceladus. Why do you think they chose those planetary bodies? How do those choices compare to yours?**
10. Say: **Congratulations on your excellent scientific work.**

After the Activity

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 the ***Planetary Cards*** deck for later use.
2. Take time to reflect on the following educator prompt. **What did you find out about your learners as a result of completing these science activities?**

Water in Extreme Environments Additional Resources

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

weblink: https://hov.to/7cb5c428

Level Up!

- Tell learners, if anyone asks them what they did today, they can tell them "We shared a location in outer space that we think might have life." (5 min.)
- Have learners research NASA's missions to Mars, Europa, and Enceladus to learn more about the search for past or present habitable conditions in those places. (30 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)