Exploring New Worlds

Children work together in a group to create an Earth landscape, compare different environments on Earth, and talk about what makes Earth special (it's a good place for life!). Then they prepare for an imaginary trip to Mars, make observations to learn about the planet, and create their own models of the Martian landscape. As a group, they compare Earth and Mars, talking about how they are similar and different.

30–45 minutes

Workshop

4–5 children per adult

Content Learning Goals

Children begin to understand:

- Other planets are different from the Earth.
- Visiting other worlds requires special vehicles, clothes, and instruments.

Science Practices

Children will begin to engage in science practices around the phenomena of planetary properties by:

- Making **observations** of photographs showing the surface of Mars to notice similarities and differences between Mars and Earth.
- Use **evidence** drawn from photographs of the Martian surface to create a model that illustrates its features.
- **Compare and contrast** the surface of Mars and Earth using personal observations of the Earth and photographs of Mars.

Materials

- Earth globe
- Photos of a variety of Earth habitats
- Mars globe (optional)
- Photos of a variety of Martian surface features (volcanoes, polar caps, craters, canyons)
- 3–4 small toy animals from different environments
- Photos of the animals in their natural habitats
- Containers for building environments (tubs for working in groups, or paper plates for individuals)
- Landscape materials for earth environments:
  - Blue paper or cellophane
  - Cotton balls
  - Potting soil
  - Sand
  - Small rocks/pebbles
  - Clippings of plants
  - Small lumps of clay
  - Small sea shells
- Martian landscape materials:
  - Glue
  - Red / brown craft sand
  - Red and orange playdough or clay
  - Cotton balls

ACTIVITY DESCRIPTION

1. Introduction: Exploring the solar system • Full group • 10min

- Introduce the solar system through a series of pictures and lots of questions: *"Today, we're going to explore the solar system. Name some things that are in the solar system."* There are lots of things:
  - One star — the Sun
  - Planets
  - Comets
  - Moons
  - Asteroids
- *"Let's learn about the planets."* (point to each on a poster, or use the NASA picture set, putting them out one at a time, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune)
- *"And now let's count the planets."* (Children love to show off their counting skills!)
- *"We're going to explore just two of these planets today. Let's start with the planet that we know a lot about because it's the one we live on. Does anyone know its name?"* (hold up the Earth globe or a picture of the Earth from space)
  - What are the blue parts? (Prompt for water or oceans)
  - What about the white? (Prompt for clouds and ice)
  - What's green and brown? (Prompt for land, mountains, trees, deserts — there are lots of good answers)
- *"One of the exciting things that we've discovered as we've explored this big Earth is that everywhere we go, we find different kinds of animals and plants, different kinds of life."* Share each picture of Earth habitats and ask for children to identify different parts of the habitat. Are they wet, hot, dry, lush with plants?

2. Build an Earth environment: Three small groups, or full group if needed • 10min

- Break the class into small groups of 3–5 children, with an adult facilitator in each group. The adult builds the landscape as the children discuss and make choices for materials.
- Together as a group, choose an animal, and build an environment for it (ice? water? sand? soil? rocks? plants?). Although the adult is building the little habitat, this can be very participatory by asking the children to make choices about how much water (for instance you could cover the whole plate with blue paper and put an ice flow in the middle for a polar landscape), what kind of dirt (potting soil or sand, shells or plants), and what other elements should be in the habitat for your animal to thrive. One way to facilitate children's involvement in making these choices is to share some photographs of the animal they selected in its natural habitat. This will allow children to make their own observations and use this to select evidence-based materials for the animal's habitat.
- Bring the full group back into a circle and compare the three habitats through a series of questions: *Who has lots of water? Who has the dry environment?*
- Take a look at the three landscapes with the full group. Discuss each and compare them. The important point to emphasize is: ***Earth is special because it is a home for life!***
- When we look at other planets, we don't see animals or plants anywhere. Let's take some time to explore another planet, Mars, and the different environments that we might find there.

3. Explore Mars: Full group • 10min

Narrate a short trip to Mars, using the provided images and script. First, have children put on their pretend space boots, gloves, and helmets. Count down and blast off into space. Hold up a picture of Earth and wave goodbye. Look for that small planet in the distance. Ask children what it looks like; prompt for colors (red/orange planet and white polar cap).

As you get closer, let's look around to see what Mars is like. Share some pictures of volcanoes, craters, red sand, and rocks. Ask children what details they notice. As they describe or point to specific features of Mars in the images, help them make sense or label these aspects (such as identifying mountains or volcanoes, craters, etc. for them).

4. Build a Martian landscape: Individual or group project • 10min

"Let's take the remaining time to think about what we've just found out about Mars, and each make our own little model of the part of Mars that you'd most like to explore. Kind of like the Earth habitat that we built as a group, but this time each of you will make your own model of Mars that you can take home."

Demonstrate the materials that they will have available and how to use the glue. The glue will make it more permanent

so they can take it home. Make sure their names are on their plates. Introduce the materials for the children by connecting them to some of the Mars images you looked at so they can start thinking about how their model reflects the actual surface of Mars:

- Red soil
- Lava rocks from volcanoes
- White stuff to be snow, if you want to make a polar cap
- Playdough if you want to build a volcano

You could alternatively create a Mars landscape as a group, as with the Earth habitats.

5. Wrap-up: Compare Mars and Earth, using the models we built • Full group • 5min

Comparing the surfaces of Mars and Earth is an important part of the learning process for the children. Use questions that will help them share both similarities and differences between the planets:

- What is something that is the same about Mars and the Earth? You can point to things on your models if you like.
- What is something that is different about Mars on Earth?

DEVELOPMENTALLY APPROPRIATE STRATEGIES

The variety of component activities that comprise this investigation of other worlds ensures that children will eagerly engage in one or more of the learning experiences offered. There are ample opportunities for facilitators to support children's learning in developmentally appropriate ways. Some of these strategies are infused into the activity description above (e.g., Questions, Adding Challenge). Below we highlight one additional strategy of critical importance to this particular activity.

Provide Information
This activity is grounded in children's investigation of the properties of the Earth and Mars. Additional concepts arise, such as solar system and habitat. Strategic sharing of information is critical for facilitators who want to hit the "sweet spot" of providing enough background information without turning this activity into a direct instruction-like lesson. To engage with this activity, most children will need to learn some science facts. This can be accomplished in both direct and indirect ways. One strategy is to provide images that contain information. Give children opportunities to examine the images and generate their own understandings of the properties of each planet. Children's investigation of these images can be supported with the use of questions.

Questions can encourage children to notice relevant characteristics of the two worlds (e.g., *"Tell me what the surface of Mars looks like in this picture. How does that compare to the Earth's surface?"*). Another strategy is to verbally provide information as children engage with the activity (e.g. *"The solar system is made up of the eight planets that circle our Sun. Today we're going to investigate two of those planets: The Earth and Mars." "You're putting a lot of red sand on your Mars landscape. The real Mars also has a lot of sand, and some of it is red."*). It may sometimes be necessary to use paraphrasing with extensions.

Paraphrasing with Extensions can help move children toward more accurate understandings (e.g., *"Your prediction is that Mars is hot because it looks red. Let's touch our 'Mars Sand' and test your prediction. How does it feel? Right! It's cold. It is actually very cold on Mars!"*).

BACKGROUND INFORMATION

The following information about the learning sciences and astronomy is intended for the educator who will facilitate the "Exploring New Worlds" activity. The activity is a developmentally appropriate first step toward the children eventually understanding the concepts explained below, perhaps years later. We do not intend the educator to cover most of these concepts with the children during the activity. This information is provided to give the educator a good basic understanding of the scientific concepts that the activity is moving toward and the way that many children think about these topics, and preparation to answer questions from very curious children or adults.

LEARNING SCIENCES

Children's Understanding of the Earth

In the preschool years children are actively engaged in building an understanding of our planet. While young children learn that the Earth is "round" their interpretations of what that means often differ from adults' understanding.[1] Research has shown us how children incorporate what they are told (e.g., "the Earth is round") with what they experience (a world that looks flat). *My Sky Tonight* research partner Dr. Jennifer Jipson has explored young children's drawings and discussions of the earth, and she found that 4-year-olds come up with creative solutions to the confusing discrepancy between how the earth looks to us and how people talk about the earth.[2] For example, some young children seem to think of Earth as a hollow sphere with people living inside and the sky as a dome overhead. Research also suggests that culture, primary language and personal experience can influence how young children think about the natural world and what their parents would like them to learn.[3,4,5,6,7,8,9]

Children Making and Using Models

Research suggests that there is value in engaging children in creating models, rather than exclusively providing models to consider.[10] Children may misunderstand the models presented to them, believing that they are "correct" representations of reality rather than thinking tools that can be manipulated by the user to suit his or her needs.[11] When children are involved in constructing, testing, critiquing, and revising models, their participation can enhance conceptual learning opportunities.[12,13,14,15]

ASTRONOMICAL SCIENCE

The following text is excerpted from the NASA Discover Mars poster titled "Earth & Mars: As Different As They Are Alike" found at: http://mars.nasa.gov/classroom/pdfs/EarthMars_poster_front.pdf and https://mars.nasa.gov/classroom/pdfs/EarthMars_Poster.back.pdf.

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Surface Features
Mars can be compared with Earth in many ways. Both planets have north and south polar ice caps, volcanoes, rocks, canyon systems, flood plains, wind, weather, and dirt. Scientists use Earth as a working laboratory in understanding Mars. By studying places on Mars where water appears to have flowed across the surface in ancient times, scientists are unlocking the history of Mars when liquid water seemed abundant. Scientists reviewing pictures of Mars' surface during the Mars Pathfinder mission in 1997 noted that surface rocks at the Pathfinder landing site appear to lean in the same direction. This same feature occurs on Earth where large amounts of water have flooded across the surface, and so scientists believe this area on Mars was formed by flooding. This indicates that Mars had large amounts of water on its surface sometime in its past.

Temperature, Surface Pressure, and Gravity
If you could stand at Mars' equator, the surface temperature would change from 21 degrees Celsius (70 degrees Fahrenheit) at your feet to 0 degrees Celsius (32 degrees Fahrenheit) at the top of your head. This difference in temperature would make it feel like summertime at the bottom half of your body and wintertime at the top half! The average surface pressure of Mars is 8 millibars, approximately 1/100 that of Earth. Because of Mars' low surface pressure, you would need a space suit if you visited Mars. Otherwise, your internal organs would push out against your skin, making you look like a very large marshmallow — or worse! The gravity on Mars is approximately 1/3 that of Earth. That would allow a person on Mars to dunk a basketball in a basket three times higher than one on Earth!

Time
One Mars solar day (a sol) lasts 24 hours and 40 minutes, compared with Earth's day of 24 hours. One Mars year equals 687 Earth days, or 1.88 Earth years. How old would you be on Mars? 12 years old on Earth / 1.88 = 6.4 years old on Mars.

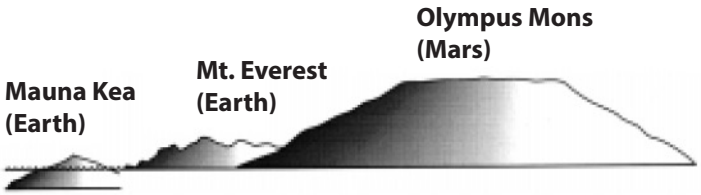
Atmospheric Composition
The air of Mars is mainly carbon dioxide (95%). Only 0.1% of the atmosphere is oxygen. Earth's air is 21% oxygen, 0.035% carbon dioxide, and 78% nitrogen.

Distance to Mars
If you could travel the minimum distance from Earth to Mars at 60 miles per hour (average car driving speed), it would take 66.5 years to get to Mars! Light travels at a speed of 670,000,000 miles per hour, allowing a light particle to get to Mars from Earth in 5 minutes when Earth and Mars are at their closest.

Compare Mountains and Canyons on Mars and Earth

Olympus Mons volcano on Mars versus Mt. Everest and Mauna Kea Hawaiian volcano on Earth:

27 km high (Olympus Mons)
10 km high (Mauna Kea)
9 km high (Mt. Everest)



Valles Marineris canyon on Mars compared with the United States and the Grand Canyon:

4000 km long by 7 km deep (Valles Marineris)
4000 km (United States)
400 km long by 1.8 km deep (Grand Canyon)

Where Are the Martians?
"Life has been found on Mars" — true or false? This is a question scientists are trying to answer. The question of life on Mars has been the topic of many scientific debates. We think that liquid water, an essential ingredient for life on Earth, once flowed on the surface of Mars. The current absence of surface water is most likely due to Mars' thin atmosphere as well as its low atmospheric pressure. Future missions to Mars will include lander vehicles responsible for collection of soil and rock samples that will be studied for the presence of ancient life forms. Future landing sites will include places on Mars that once had water, perhaps lakes or rivers. Today's students are the scientists of the future. Some of the children who visit your museum could be the first people to look at samples returned from Mars, or perhaps even the first

humans to walk on the surface of Mars!

Why Do We Care?

Why do people have an interest in planetary science, and what kind of technology do we gain from space travel? For example, science and technology have been aided by the advancements made in space science. NASA has developed materials for space travel that are lightweight, yet extremely strong. These materials can also be used in manufacturing and electronics industries on Earth. Helping to make life better on Earth and exploring the unknown are some of NASA's greatest achievements. By studying other worlds, we learn more about our own world.

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*My Sky Tonight is based upon work supported by the Division of Research On Learning (DRL) of the National Science Foundation under Grant no. AISL #1217441. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.