Science Activity 2: The Lay of the Land: Introducing Landforms

Educator Preview

Activity Snapshot

Learners explore how different landforms are formed by wind and water.

Timing | 45 minutes

Get Ready and Team Up	15 min.
Explore Landforms	20 min.
Reflect	10 min.
Total	**45 min.**

Level Up: Crater Activity 30 min.

Prep Snapshot*

Prep Time 60 min.

As needed, dry sand the day before.

Set up Water and Wind Stations.

Print resources.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Developing & Using Models
- Analyzing & Interpreting Data

Guiding Question

What are landforms and how are they formed?

Learners Will Do

Explore how wind and water can create the same landforms on Earth and Mars.

Learners Will Know

Landforms are the result of the history and climate of a location.

Connecting Across Activities

Activity 1: Sharing Experiences	Activity 2: Introducing Landforms	Activity 3: Exploring Landforms on Mars
Last time, learners share experiences with, and stories about, technology.	**Today**, learners generate questions about Mars before they explore how wind and water can make landforms on a planet's surface using models.	**Next time**, they will examine images of Mars to identify landforms which may have been formed by liquid water. These images are the first set of data they will use to choose a landing site.

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-xxvi. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

QR Code for Activity Resources

weblink: https://hov.to/63187371

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) in Prep & Setup Guide (PDF) Examples | Templates
  - index cards
  - markers
  - scissors
  - tape
- 6 copies of Science Activity 2 Landforms Handout (PDF)
- 3 copies of Science Activity 2 Wind Station Directions Handout, pgs. 39-40.
- 3 copies of Science Activity 2 Water Station Directions Handout, pgs. 41-42.
- 3 bags, trash, (clear, if possible)
- 3 baking (cookie) sheets with raised rims
- 3 pieces cardboard wrapped with aluminum foil with small notch cut (alluvial fan barrier)
- 24 cleaning wipes (1 per learner, to clean safety goggles between users)
- 3 cups
- 6 drop cloths, tarps, or large trash bags (if working inside)
- 12 pairs safety goggles
- 3 jugs, bottles, or watering cans, for refilling
- 24 face masks (1 per learner)
- 3 pans or boxes, 9" × 13" (approx. 23 cm × 33 cm), such as dish pans, aluminum baking pans, or copy-paper box lids lined with plastic
- 3 cups gravel or pebbles
- 3–6 rocks, large, dry
- 10.5 cups of completely dry sand
- 24 straws (1 per learner)
- water
- 6 page protectors (optional)
- gloves, plastic (optional)

Teaching Tip

To let learners shape larger landforms, consider providing longer pans or stream tables.

For each group of four

- items marked ***1 per learner*** in Landforms Stations, above

Activity 2 Materials Preparation (60 min.)

Ahead of Time

1. Print one copy of the *Science Activity 2 Landforms Handout (PDF)* in color, if possible, for each group of 2–4 learners, in addition to the six copies needed for the stations.
2. Print three copies of *Science Activity 2 Wind Station Directions Handout, pgs. 39-40,* and three copies of *Science Activity 2 Water Station Directions Handout, pgs. 41-42,* for learners to reference when they are at the stations.

In Your Space

3. If you did not do so before Activity 1, prepare an *Our Ideas* poster by following the Prep & Setup Guide (PDF).
4. See *Station Assembly Instructions* (Wind, pg. 35, Water, pg. 36) for instructions on using the materials to set up the stations. Ensure all learners can access the stations.

Teaching Tips

- Quantities listed are for three setups per landform station (6 stations total). Three setups per landform station accommodate 24 learners total (6 groups of 4). If you have fewer learners, reduce the materials quantities and create fewer stations as appropriate.
- Laminate or place the *Science Activity 2 Landforms Handouts* in page protectors or large plastic zip-top bags to keep them from getting wet at the Water Station. Learners can write on them with dry erase markers, and they can be reused. You can reuse the *Science Activity 2 Landforms Handouts* from the stations instead of making new ones for each group.

To reduce mess, work outdoors. Use a hose for the Water Stations and create the dunes for the Wind Stations directly on concrete.

Play sand or aquarium sand work well. If you are able to find only wet sand, be sure to build in time to spread it out and let it dry.

Do one station at a time on different days to reuse the sand, saving the Water Stations for the end to keep the sand dry.

For safety at the Wind Station, have learners wear safety goggles and masks to prevent the sand from blowing into their eyes and noses.

Level Up!

Craters are visible in the images of Mars. If you have time, add a Crater Station by following online directions such as those on https://www.jpl.nasa.gov/edu/resources/project/make-a-moon-crater/. Craters are fun and interesting to model but usually are not directly related to finding water on Mars. (>30 min.)

Activity Guide

Get Ready and Team Up (15 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We told stories about why technology is important, which helped us understand why it's important to think carefully about designing technology.)* Draw learners' attention to their work on the *Our Ideas* poster about how technology makes a difference in their lives.

2. Say: **NASA has sent several missions to Mars. As scientists, our ultimate goal is to analyze the data collected by these missions and answer the big question "What is the best landing site for a Mars rover?"** Write the question in a prominent spot on the top of the *Our Ideas* poster. (Leave room at the end of this question to add the words "to look for past liquid water.")

3. Distribute one *Science Activity 2 Image of Mars / Image of Mars and Its Context in the Solar System Handout, pg. 38* per group. Say: **Look at these images. What questions do you have about Mars? What questions might scientists have about Mars?**

4. Say: **Those are all great questions.** If it hasn't come up, say, **Liquid water is needed for life. If liquid water was once present somewhere, it could have once supported some form of life. Scientists say the place could once have been habitable. The search for liquid water is the driving force behind several NASA missions. Turn to a neighbor and discuss: What do you already know about the importance of water?** After a few minutes, invite learners to share with the group. *(Answers may be similar or vary by culture. Encourage learners to draw from their experiences, stories from Elders, families, teachers, etc. Accept all answers as equally valid.)*

5. Say: **As scientists, your task is to examine data collected by remote sensing technologies. You will use these data to choose the best site to send a rover to look for past liquid water. Then, you will compare your choice to NASA's.** At the top of the *Our Ideas* poster, write "to look for past liquid water" after "What is the best landing site for a Mars rover" so that it says: "What is the best landing site for a Mars rover to search for past liquid water?"

Support Learner Differences

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

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.

Learners may not ask these questions directly, but they may ask related questions. For example, "Was there life on Mars?" can be investigated by looking for evidence of past water. Landforms and minerals can provide evidence of past water.

6. Ask: **What do you need to know to choose the best landing site to find liquid water?** 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 sets of questions include the following:
   - **Evidence of Life**: What evidence of life is there? Where is there water? What are the most interesting areas? What is the weather/atmosphere like?
   - S**afe Landing Sites**: What is the landscape like? Where is the safest place to land a rover? Can rovers go everywhere or are they limited? How much space does a rover need?
   - **Minerals:** What is the land made of? Which minerals are evidence of liquid water?

7. Say: **Those are all great questions. Today, we will start to answer questions about finding liquid water on the surface of the land.**

8. Organize learners into groups of four.

Explore Landforms (20 min.)

9. Say: **Turn to your neighbor and discuss: What are some natural land features in our community or that you know about?** After a few minutes say: **These natural shapes on the surface of a planet are called *landforms***. Have learners record landforms on the *Our Ideas* poster.

10. Say: **Scientists often examine landforms to learn about the past history and climate of a location. Today, we will think about how landforms might hold evidence of past liquid water.** Write the Guiding Question and share it or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **What are landforms and how are they formed?**

Support Thinking

Asking learners to discuss a few broad questions at the beginning of an activity surfaces helpful prior knowledge and acknowledges and values their experiences. This provides a more inclusive entry-point to developing new understandings.

Level Up!

The Engineering Pathway, Worlds Apart: Engineering Remote Sensing Devices (PDF), challenges learners to design many different remote sensing technologies to gather data from a distance.

Support Learner Differences

- Group learners with different abilities and strengths in a way they can all contribute. Check out Intentional Grouping Strategies, pg. xxii.
- Introduce the idea of a "sense of place": the meanings of and attachment to a place built from a person or community's experience. Have students discuss places that are meaningful to them and their connections to those places.
- As learners engage with important but perhaps unfamiliar concepts and vocabulary terms, provide visuals and examples to amplify their understanding. Invite them to share translations, both orally and in writing, of the terms in their preferred language. If time permits, ask learners to think of additional examples of the concept/term that they know from previous experiences. You can allow time for them to add ideas to the *Translatable Glossary (docx)*.

11. Say: **Before scientists study landforms and other things on Mars, they make sure they understand how they work on Earth. Here on Earth, what are some ways you can tell that water used to be somewhere, even though it is gone now?** *(Dried mud with cracks, ripples in sand, dry riverbeds, rounded rocks, lines, such as on the side of a teacup or bathtub, and patterns, such as the collapse of land at the edge of a riverbed.)* Prompt learners to think about communities they belong to and what they see after a rainstorm or windstorm.

12. Say: **Today, we will explore these ideas with models of Earth. In small groups, you will come to two stations. You will use sand, water, and air, representing wind, to model different landforms. You will rotate through both the stations, spending about 10 minutes at each.**
    - Demonstrate as you say: **Each station has a Landforms Handout that shows types of landforms. Try to make the landforms by acting out the natural processes involved, like water and wind.**
    - At the Wind Station, demonstrate how to have a partner hold the bag open as learners use a straw to blow across the sand to form dunes. Encourage learners to explore placing large rocks as obstacles. As needed, give learners time to feel the materials at the station.
    - At the Water Station, demonstrate how to create a river valley by tilting a container of sand and slowly pouring water into it at the higher end in one location. Encourage learners to explore tilting at different angles and to try to make different landforms. Caution learners to tilt the container gently, so they do not spill the sand. Demonstrate how to pour water slowly in one spot on one side of a barrier and explore what happens to the sand. As needed, give learners time to feel the materials at the station.

Supporting Learner Differences

Make connections to local phenomena with which learners are familiar, such as nearby hills, washes, and sources of water. If possible, share satellite images or photos of the community and point out some of these locations.

Support Thinking

To help learners understand what they will be doing, show the translatable video RS Science How To (0:16–1:08).

Precisely replicating the landforms is not the goal. In fact, they likely cannot be the same because the scale is so different. The goal is for learners to explore and get a sense of what water and wind can do before looking at the images of Mars. Encourage learners to think about and discuss their experience with wind- and water-related landforms in nature.

Teaching Tips

- Remind learners that they are creating models of how landforms naturally develop. So, learners should not sculpt the landforms with their hands. The idea is to allow the "natural" processes (wind, water) to create the landforms. Emphasize safety as you demonstrate.
- Consider running this activity as a whole group, guiding learners to create specific landforms, or as a demonstration rather than allowing groups to freely explore.

13. While groups are working, ask: **Do you have any of these landforms in your community? What do you notice about the shapes of different landforms when you observe them from above?** *(They look like snakes, rope, fans, etc.)*

14. As a group gains experience with each landform, have learners in that group look at the examples and read the landform's name and description from the *Landforms Handout*.

Reflect (10 min.)

15. Gather the whole group. Ask: **Which landforms were you able to make? Which were you not able to make? Why?** *(Sand dunes were difficult to make because of the scale of the images, etc.).* **What similarities or differences did you notice between landforms on Earth and Mars? What do these observations tell you?** *(Landforms are similar on Earth and Mars, suggesting that Mars has things like wind and water on it.)* **Why might scientists be interested in these landforms?** *(Landforms formed by water on Earth may provide evidence of past liquid water on Mars.)*

16. Revisit the Guiding Question: **What are landforms and how are they formed?** *(Wind, water, and volcanic activity on other planets create the same landforms that they do on Earth. Alluvial fans, deltas, and river valleys form in water. Sand dunes are formed by wind, and lava flows are formed by volcanic activity.)* Have learners record their ideas on the *Our Ideas* poster. As needed, remind learners of the term *habitable* and *landforms*.

17. Ask: **What are the different ways that land is shaped by water near our community?** *(Hills, mesas, mountains, plateaus; canyons, valleys, lakes, ponds, deltas etc.)* Encourage learners to name or describe their experiences with specific landmarks. Consider returning to learners' ideas at the start of the next activity.

18. Say: **Good job working as scientists today! Now you are prepared for next time, when you will examine images of Mars showing landforms at potential landing sites. The process you are following is like the process NASA uses to choose landing sites.**

Support Thinking

When introducing questions that require learners to extend their thinking and formulate new ideas, invite them to share ideas with a partner or small group before sharing with the whole group.

Consider adding these landforms and images to the *Our Ideas* poster to reinforce new vocabulary.

After the Activity

1. Clean up:
   - Keep the *Our Ideas* poster for Activity 3.
   - Throw away the straws, face masks, cleaning wipes, and gloves (if used). Clean the safety goggles. Allow the sand to dry. Store all Wind and Water Station materials for reuse.
2. Plan ahead for Science Activity 3. See Activity 3 Materials Preparation on pg. 44.
3. Take time to reflect on the following educator prompts: **How did you support learners' needs in acquiring the vocabulary used in this activity? How could you use similar strategies during future activities?**

Remote Sensing Additional Resources

QR code leads to resources available for this unit.

weblink: https://hov.to/248cf0d9

Wind Station Assembly Instructions

Use these materials to set up the Wind Station. Three setups are needed for a group of 24 learners. The Materials list at the start of this activity has additional details about the materials.

Materials for each setup:

- Science Activity 2 Landforms Handout (PDF)
- 1 page protector
- 8 straws
- 1 cookie sheet
- ½ cup dry sand
- 1 drop cloth
- 1–2 rocks
- 1 trash bag
- 4 safety goggles
- 8 cleaning wipes
- 8 face masks
- Science Activity 2 Wind Station Directions Handout, pgs. 39-40

1. If learners are working inside, lay out the drop cloth underneath the work area to make sand cleanup easier.
2. Place the cookie sheet inside the trash bag.
3. Pour the sand onto the cookie sheet.
4. Fold the bag closed until learners are ready to use it. You can use a rock to hold it closed.
5. Put the *Landforms Handout* in the page protector and place it next to the bag. Put the *Wind Station Directions* nearby.
6. Place the straws, safety goggles, cleaning wipes, and face masks next to the bag.

In the Wind Station setup, the pan is placed inside a trash bag for protection. Plastic sheet protectors keep the handouts from getting sandy.

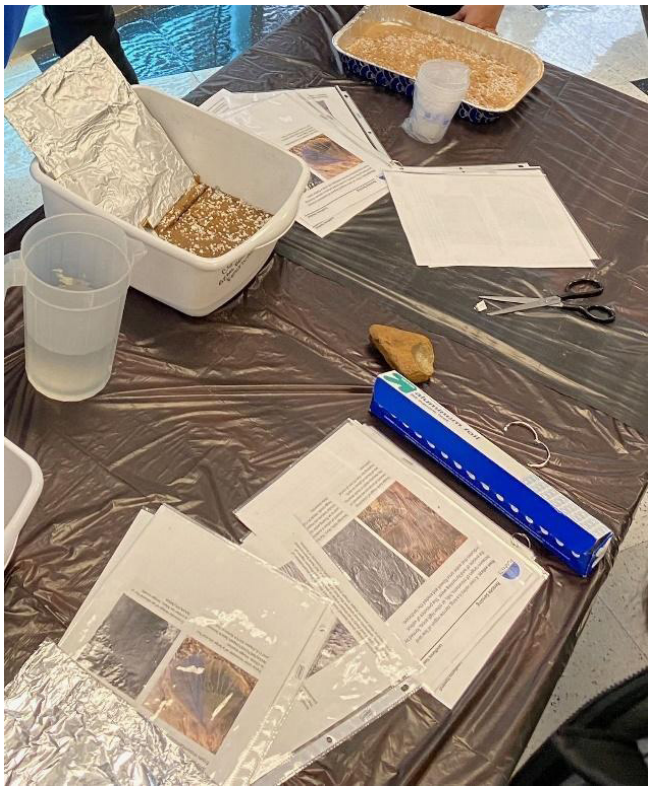
Water Station Assembly Instructions

Use these materials to set up the Water Station. Three setups are needed for a group of 24 learners. The Materials list at the start of this Activity has additional details.

Materials for each setup:

- Science Activity 2 Landforms Handout (PDF)
- 1 page protector
- pan or box
- 1 cup
- Mixture of 3 cups dry sand and 1 cup pebbles or gravel
- 1 drop cloth
- 1 jug
- 1 alluvial fan barrier
- water
- Science Activity 2 Water Station Directions Handout, pgs. 41-42

1. If learners are working inside, lay out the drop cloth underneath the work area to make water cleanup easier.
2. Place the pan or box on the drop cloth.
3. Fill the pan or box with the sand and pebble mixture.
4. Create the alluvial fan barrier. Cut a piece of cardboard the width of the pan. Cover it in aluminum foil. Add a 1" notch at the bottom to allow water to stream through the hole.
5. Put the *Landforms Handout* in the page protector and place it next to the pan of sand. Put the *Water Station Directions* nearby.
6. Set the cup and alluvial fan barrier next to the pan of sand.
7. Fill the jug with water and place it near the pan of sand.



In the Water Station setup, the table is covered with plastic to protect against spills. Two pans hold the gravel and sand mixture; an alluvial fan barrier is placed in one of them. Plastic cups are provided for pouring and a pitcher of water for refilling. Plastic sheet protectors keep the Landforms Handouts from getting wet.

A close-up view of the alluvial fan barrier. The one-inch notch allows water to flow through and create a fan-like shape in the sand. This barrier simulates what happens to water when it flows from a mountainous area where it can't spread out into a low-lying flat area where it can spread out.

Image of Mars

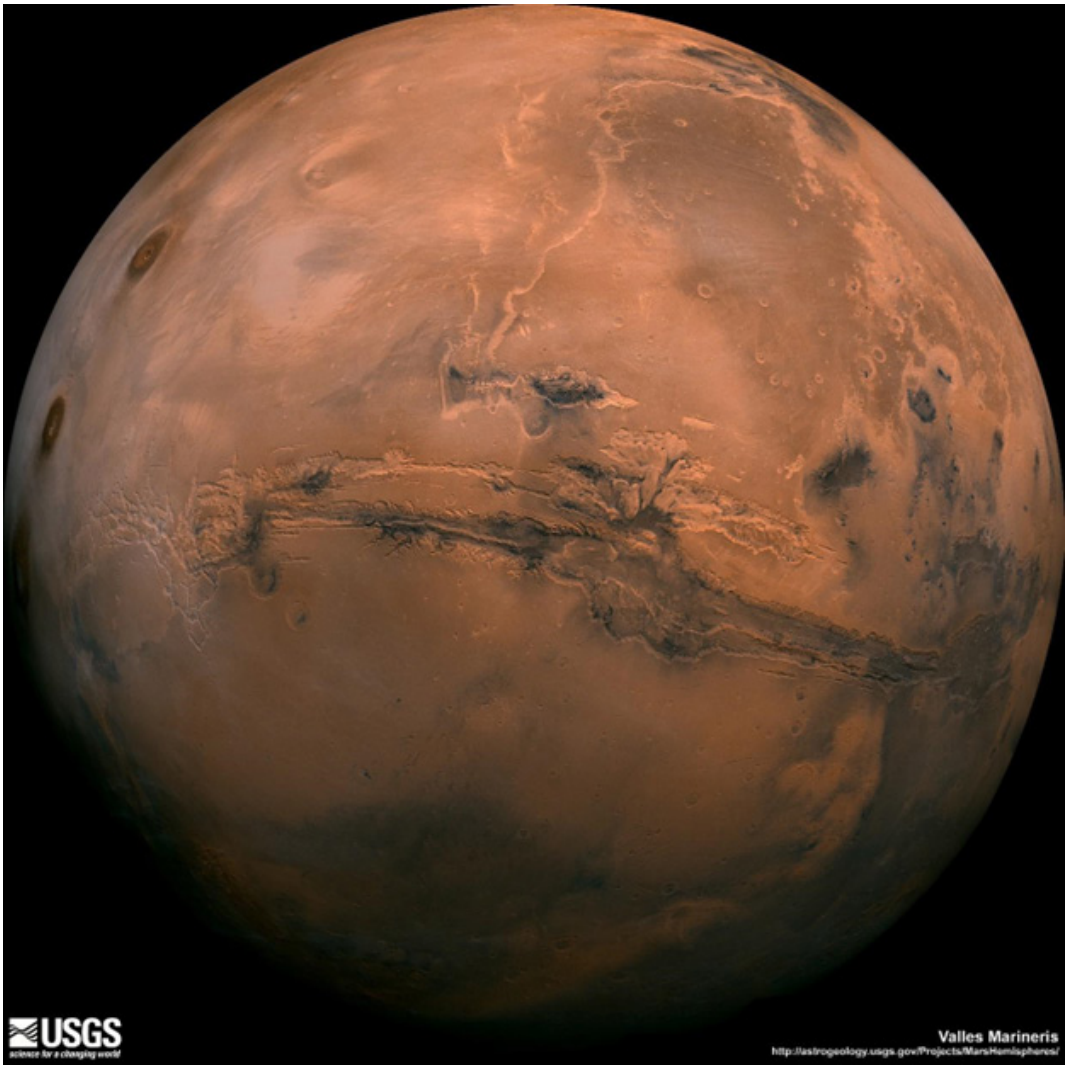


Image of Mars

Image of Mars in the Context of the Solar System

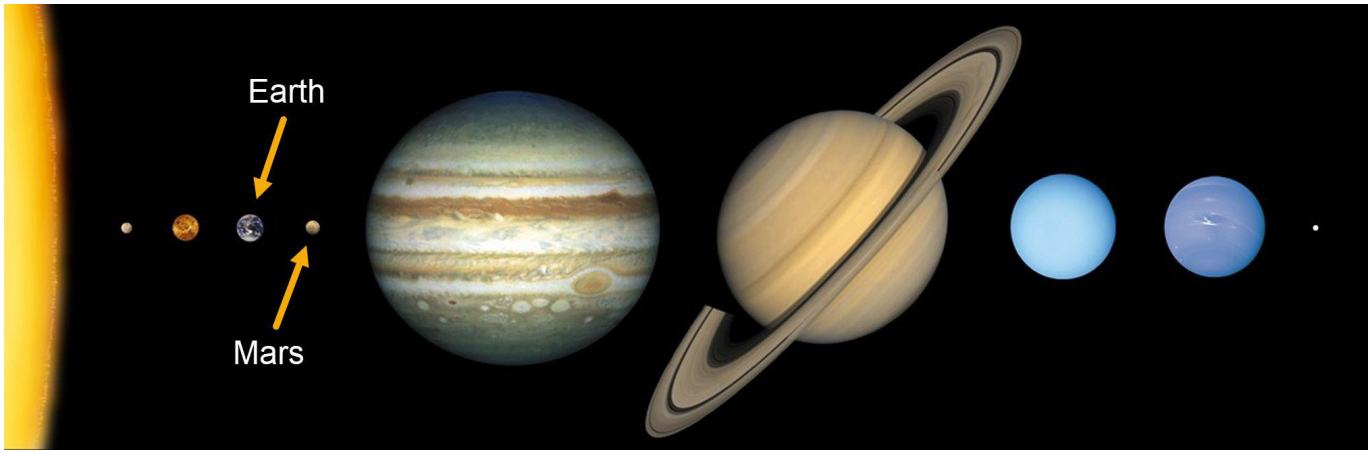
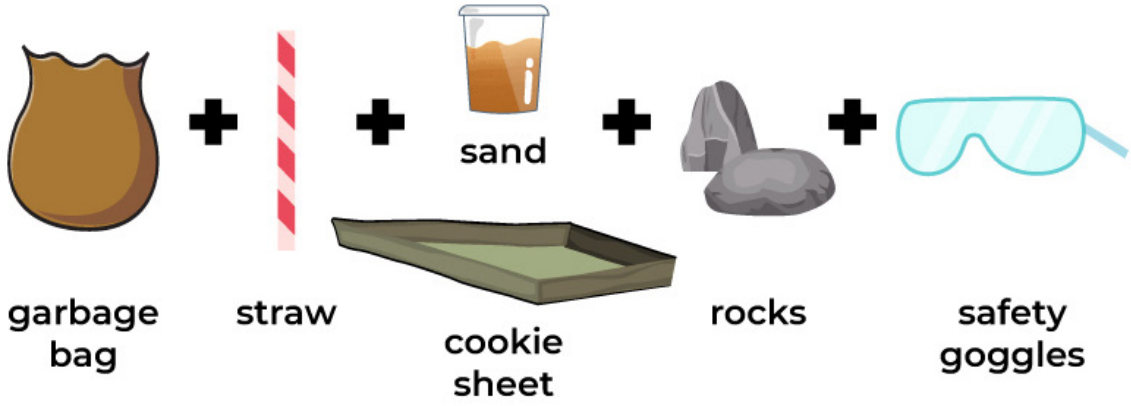


Image of Mars in the Context of the Solar System

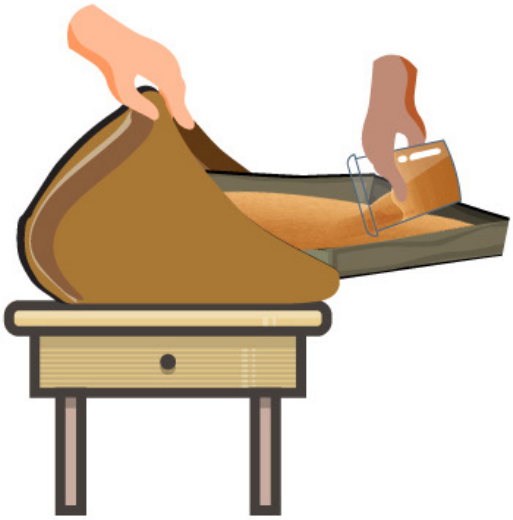
Wind Station Directions

Note: These instructions are also read aloud in a translatable online video.

1



2



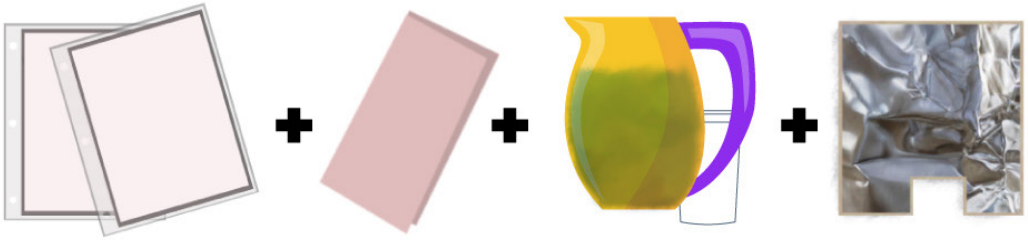
3

1. Have one person hold the bag open. Have the others use straws to blow gently across the sand to form dunes, ripples, or other "landforms".
2. You can try placing large rocks as obstacles.
3. Examine the dunes you make.
   - How are your dunes like the dunes on the Landforms Handout? How are they different?
   - Where have you encountered landforms like these before?
   - What do you notice about the shapes of different landforms when you observe them from above?
   - What are the different ways that land is shaped by wind near communities you belong to?

Water Station Directions

Note: These instructions are also read aloud in a translatable online video.

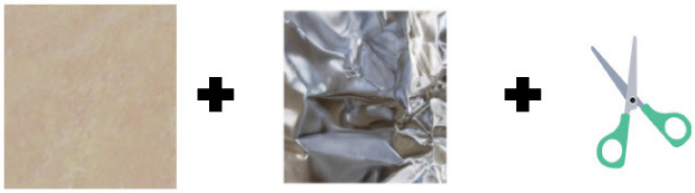
1



landform handout references in page protector + (1) drop cloth (if indoors) + pitcher of water & cup + (1) alluvial fan barrier*

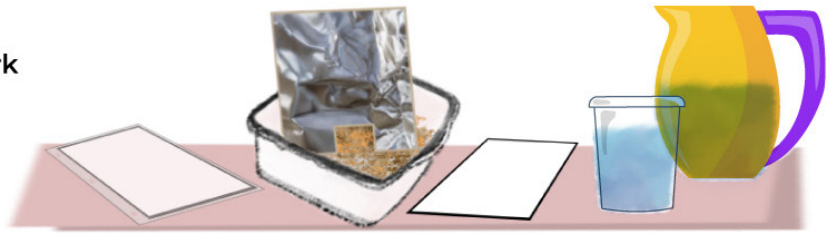
pan or box + (3) cups dry sand & (1) cup pebbles or gravel, mixed + Water Station directions

***1** alluvial fan barrier =



cardboard + aluminum foil + scissors

2 Set up work area



3 Try to make the same landforms as those in the Landforms handout

4. Try to make landforms from the *Landforms Handout* by pouring water into the sand. Pour from the cup and refill from the pitcher as needed.
5. To make a river valley, try tilting the container and slowly pouring water into it at the higher end in one location.
6. Explore tilting at different angles and to try to make different landforms. Make sure to tilt the container gently, so you do not spill the sand.
7. Try pouring water slowly in one spot on one side of a barrier and explore what happens to the sand.
8. Examine the landforms you make.
    - How are your landforms like the ones in the *Landforms Handout*? How are they different?
    - What do you notice about the shapes of different landforms when you observe them from above?
    - What are the different ways that landforms are shaped by water near communities you belong to?