Educator Guide

Science Activity 3: Red Planet Places: Exploring Landforms on Mars

Educator Preview

Activity Snapshot

Learners examine images of landforms on Mars to find evidence of past water.

Timing | 45 minutes

Get Ready and Team Up	10 min.
Search for Evidence of Water	20 min.
Reflect	15 min.
Total	**45 min.**

Prep Snapshot*

Prep Time **60 min.**

Print resources.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Science Practices

- Analyzing & Interpreting Data

Guiding Question

How can landforms help us choose a landing site on Mars?

Learners Will Do

Recognize landforms on Mars that provide evidence of past water.

Learners Will Know

Scientists examine landforms to learn about the past history and climate of a location.

Connecting Across Activities

Activity 2: Introducing Landforms	Activity 3: Exploring Landforms on Mars	Activity 4: Introducing Topography
Last time, learners generated questions about Mars and explored how wind and water can make landforms on a planet's surface using models.	**Today**, learners act as scientists to examine images of landforms on Mars. These images are the first set of data they will use to choose a landing site.	**Next time**, they will deepen their understanding of landforms by considering topography.

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/b0d49f31

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

For each learner

- Science Notebook (PDF)

For each group of four

- 1 copy of Landforms Handout (PDF) from Science Activity 2
- 1 copy of Science Activity 3 Landforms on Mars Data Packet (PDF) (in color and in page protectors, if possible)
- 1 Landing Site Ovals Handout (PDF) (on transparency, if possible)
- 1 dry-erase marker, fine point (optional, if using page protectors)
- 1 piece felt or soft paper to erase marker (optional, if using page protectors)

Activity 3 Materials Preparation (60 min.)

Ahead of Time

1. Review the *Our Ideas* poster "In-Use Example" in the Prep & Setup Guide - Examples (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Print one *Science Activity 3 Landforms on Mars Data Packet (PDF)* in color, if possible, for each group of 2–4 learners. Note: Data Packets are large 1–5MB PDF files and should be downloaded and printed ahead of time.
3. Print one copy of *Landing Site Ovals Handout (PDF)* on transparency or regular paper. Cut along the dotted lines to separate the ovals so there is one oval for each group of 2–4 learners. Cut around the oval to make individual ovals. Store in a bag or envelope for easy distribution.
4. Optional: Print the images in *Science Activity 3 Landforms on Mars Data Packet* on swell paper with these printable files (weblink).

In Your Space

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally. Add a section divided into two columns. Title one column "Gale Crater" and the other "Jezero Crater."

Level Up!

Although this activity lists two possible landing sites, if you have time, the activity is more interesting and enriching with four choices that were all considered by NASA for the Perseverance Rover. If you are using the advanced version of this pathway with four possible landing sites, use the advanced version of the Science Activity 3 Landforms on Mars Data Packet with Level Up (PDF) and add columns titled "Nili Fossae" and "Iani Chaos" to the *Our Ideas* poster.

Activity Guide

Get Ready and Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We generated questions about Mars, including what the landscape was like and if there was life and water there. We explored models of Earth to understand how landforms form from water and wind. We compared images of landforms on Earth to images of landforms on Mars.)* Draw learners' attention to the list of landforms on the *Our Ideas* poster.
2. Say: **Our challenge is to choose the best landing site 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).
- Have learners discuss their knowledge of local landforms and the ways that those landforms are connected to water.

Support Thinking

Share information about current Mars orbiters to support understanding of the process of data collection.

3. Say: **Today we will focus on answering questions about the landscape of Mars.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **How can landforms help us choose a landing site on Mars?**
4. Organize learners into groups of four and distribute Science Notebooks.

Search for Evidence of Water on Mars (20 min.)

5. Say: **Now that you have some experience with landforms, you are ready to explore real NASA Mars data to search for landforms that may have been created by liquid water to see if Mars was once able to support life, or *habitable*.**
6. Provide each small group with a *Science Activity 3 Landforms on Mars Data Packet.* Tell groups to write their group name on this packet, so they get the same packet back to refer to in future sessions. Say: **Scientists need pictures to study planets from a distance. Multiple NASA spacecraft are circling Mars, and they have cameras on them that take pictures, or images of the surface. These images are one type of data sent back from the spacecraft that you can now explore.**
7. Say: **You will study the data from two potential landing sites (Gale Crater and Jezero Crater). Then, you will choose a place on each possible site to land a rover.** Demonstrate as you point out the following:
   - The *Map of Mars* pgs. 2-3 and the explanation of each site on pgs. 4-15 in the Science Activity 3 Landforms on Mars Data Packet.
   - Each site has multiple images. Each set of images provides different information about each site.
   - Viking images are really zoomed out and have less detail.
   - Context Camera (CTX) and High-Resolution Imaging Science Experiment (HiRISE) images are of the same sites but are more zoomed in and provide more detail than the Viking images.

8. As they investigate, have learners fill out Landforms We Notice, pg. 6 in the Science Notebook (PDF).

9. Hold up a *Landing Site Oval* as you say: **Landing on Mars is difficult! Engineers can design a rover to land in an area 10 miles by 5 miles (16 km by 8 km), but they can't pinpoint the landing location any better than that. This oval represents the landing area. To stay safe on Mars, rovers drive slowly over short distances, so a scientifically interesting landing site should contain evidence of past liquid water within the oval or very nearby.**

10. Demonstrate as you say: **With your group, you will choose and trace scientifically interesting landing site ovals within the Gale Crater and Jezero Crater Context Camera (CTX) images** (point out the Context Camera (CTX) images in the packet)**. Do not trace ovals on the High Resolution Imaging Science Experiment (HiRISE) or Viking images because the size of those images isn't the same as the oval size** (point out where it says "Do not place an oval on this image")**.**

11. Pass out one *Landforms Handout* from Science Activity 2 and one *Landing Site Oval* to each small group. (If you are using page protectors, also hand out dry erase markers.). Provide time for groups to choose and trace landing site ovals within the Gale Crater and Jezero Crater Context Camera (CTX) images.

Support Thinking

Help learners think about how big the oval is by talking about local landmarks that are 5 miles (8 kilometers) and 10 miles (16 kilometers) away. It's a large area!

If learners ask why landing on Mars is difficult, you can tell them that Mars has an atmosphere that is thick enough to burn up a spacecraft without a heat shield, but not thick enough for a parachute to slow the spacecraft down enough to land safely. Mars is also far away from Earth, so the spacecraft must go through the whole landing process automatically: it takes too long for radio signals to travel between Earth and Mars for a human to land the spacecraft with a joystick.

Support Learner Differences

Allow learners to first use their preferred language to think about and describe their work before using and applying the vocabulary and definitions from this activity in English.

Teaching Tip

Suggest roles that group members can fill, such as organizing the data, searching for landforms, and tracing the oval.

Reflect (15 min.)

12. Invite groups to share the landforms at each site and note which provide evidence of past water. Record their ideas on the *Our Ideas* poster.

13. Revisit the Guiding Question on the *Our Ideas* poster. Ask: **How can landforms help us choose a landing site on Mars?** *(Alluvial fans, deltas, and river valleys all provide evidence of water. If these are present at a site, liquid water may have once been present at that site, so it might be a good landing site to find evidence of habitability.)* Ask: **What questions do you still/now have?** *(What other types of data–besides visual data–are available? What are the size and scale of the landforms?, etc.)*

14. Ask: **Which of the water-related landforms have you seen in your everyday life? Are there other water-related landforms that you can think of that were not discussed here? Why not?** *(Mud cracks and rounded stones are good indicators of water, but they are too small to be seen from orbit, etc.)* Consider returning to learners' ideas at the start of the next activity.

15. Say: **Good job working as scientists today! The visual data that was collected by the cameras engineers designed are essential, but it provides only some information. You will need other types of remotely sensed data to choose a landing site–you cannot rely on just one sense. Now you are prepared for next time, when you will explore a different type of remotely sensed data that can give you more details about the surface of Mars. The process you are following is like the process NASA uses to choose landing sites.**

Teaching Tip

Use the following key for reference, but do not share it with learners.

- Gale Crater contains a river valley, alluvial fan, layered rocks*, sand dunes, and craters.
- Jezero Crater contains a delta, river valley, lava flow, crater rim, and craters.

Alluvial fans, deltas, and river valleys are evidence of water.

*Layered rocks sometimes form in water, other times not.

Support Thinking

Encourage learners to keep an eye out for these same water-related landforms the next time they look at a natural landscape from above, such as in online maps or from an airplane.

Level Up!

Tell learners that the Viking landers had landing ellipses more than 100 km long, but improvements in science and engineering have shrunk the uncertainty of Mars landings down to within just a few kilometers. Future missions may be able to land with pinpoint accuracy.

Have learners find out more about the mission types NASA uses to gather information about a planetary body surface. For Mars, these include the remote sensing instruments Mars Reconnaissance Orbiter (MRO); High Resolution Imaging Science Experiment (HiRISE), Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), landers and rovers (Insight, Spirit, Opportunity, Curiosity), and sample return (Perseverance). On the Moon, the Apollo and Artemis missions included sample return referenced in the *NASA Career Spotlight for Aaron Yazzie*, pg. 16 in the Science Notebook (PDF). (10 min.)

After the Activity

1. Clean up:
   - Keep the *Our Ideas* poster for Activity 4.
   - Collect the Science Notebooks, *Landforms Handouts* from Science Activity 2, *Science Activity 3 Landforms on Mars Data Packets*, and *Landing Site Ovals*.
2. Plan ahead for Science Activity 4. See Activity 4 Materials Preparation on pg. 52.
3. Take time to reflect on the following educator prompts: **How did you get learners engaged in data analysis? 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