What on ~~Earth~~ Mars?
Teacher Version

Adapted from Hawai'i Space Grant's "Mars Landform Identification" activity at
www.spacegrant.hawaii.edu/class_acts/MarsQuizTe.html

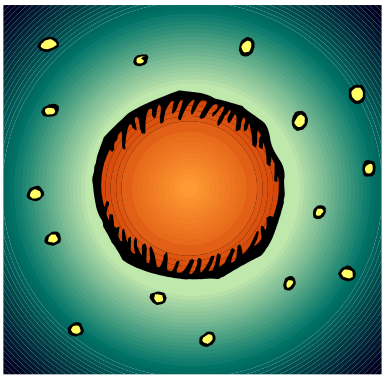
Introduction & Purpose

This is an excellent culminating activity for students who have completed the activities involving how the surface features of Mars were created (primarily meteorites, water, or wind). If your students have not yet completed the "Crater Creation," "Martianscape," or "The Winds of Change" activities, it is recommended that they do so before attempting this activity. They will gain knowledge and experience about Martian landforms in those activities that is crucial to their success in this activity.

This activity uses ten photographs, most of which were taken by Viking Orbiter cameras, to demonstrate nine different features on the surface of Mars -- impact craters, volcanoes / volcanic craters, river valleys, river beds, dry lake beds, polygonal ground, lava flows, sand dunes, and fractures. Each of these features is defined and described in the Student Activity Book. The students will examine these photographs, and then identify landforms, interpret what they see, and answer questions about each photograph.

Objective

Students will use their knowledge about Martian landforms to interpret several photographs of Mars.



Materials Needed

- 10 photographs of Mars (in Student Version)
- Pens and/or pencils
- Scratch paper
- Idaho TECH Lab Notebook
- Optional: colored pencils, markers, or other coloring implements

Procedure

1. Have the team read through the background information located in the Student Version. Understanding the definitions of the boldface terms is crucial to completing this activity. To verify that the students fully comprehend the terms, have them take turns explaining what each landform looks like and how it is created. You may want to take time to review the "Crater Creation," "Martianscape," or "The Winds of Change" activities to remind the team of features about which they have already learned.
2. Once the team is comfortable with the terminology, have them examine the ten images in the Student Version. They should respond to the questions next to each image and record their answers in their Lab Notebook. The table located before the images should also be completed by filling in various landforms, as they are identified.

A Quick Note…….

Remember
NASA does not know everything about Mars, so do not let the team become frustrated – instead, encourage creativity!

★ If the team wishes, they can code the landforms by coloring each feature a different color. For example, the team could color all impact craters orange and all volcanoes / volcanic craters blue.

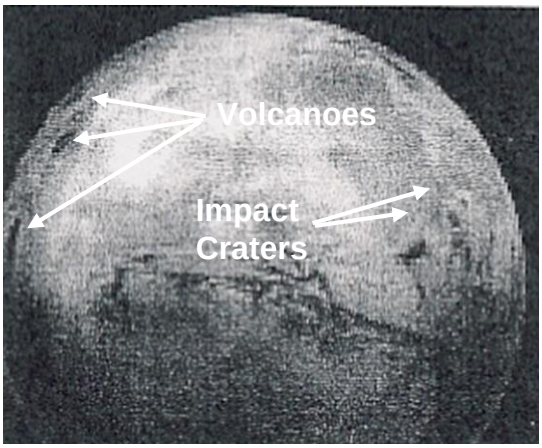
Image Answers

Below is the completed version of the chart the students will complete for this activity:

	Image #1	Image #2	Image #3	Image #4	Image #5	Image #6	Image #7	Image #8	Image #9	Image #10
Number of different features	2	2	2	3	2	3	2	3	2	3
Impact craters	X	X	X	X	X	X	X	X	X	X
Volcanoes / volcanic craters	X			X						
River valley			X							
River bed								X		X
Dry lake bed						X				
Polygonal ground					X			X		
Lava flows									X	
Sand dunes		X					X			
Fractures				X		X				X

For reference and debriefing purposes, the images and questions the students are asked to respond to in this activity are included below. Please note that the students' images are larger, clearer, and include a scale.

Image 1 – Mars Hemisphere

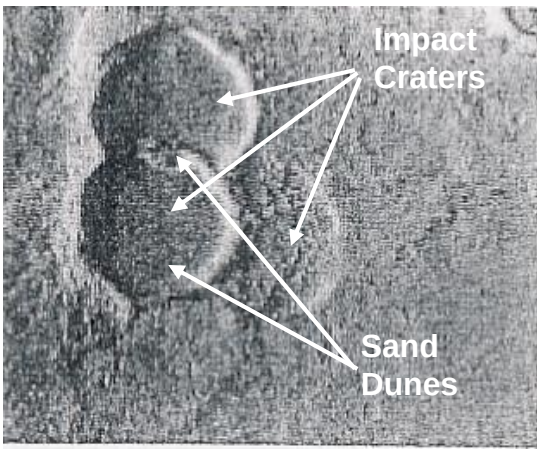


This photograph shows Mars from 2,500 km above the surface. It is a mosaic of 102 images taken by the Viking I spacecraft in 1976. This view shows some large impact craters and volcanoes. Each volcano is 25 km tall and about 350 km in diameter. *Valles Marineris*, a huge 4,800 km canyon, can be seen across the middle.

Student Questions

1. What do you think the feature across the middle of this picture of Mars is? How do you think it was formed?
2. What do you think the circles on the left side are? Why?

Image 2 - *(34.79N, 309.14W)*

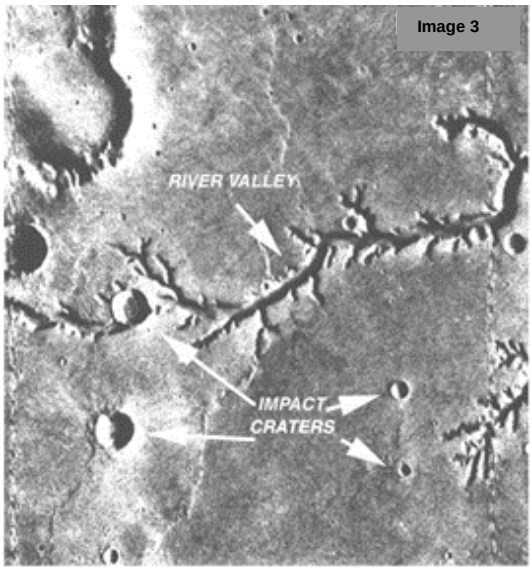


Craters, formed when meteors strike a surface, cover much of Mars. These craters are located in the heavily cratered uplands about 5,500 km east of *Ares Vallis* (the Ares Valley). When one impact happens near another, the resulting craters overlap. The squiggles in the bottom of the two upper craters are dune fields; wind is a significant factor in this area. The craters have two ejecta patterns-lobed (to the left) and striated (below). Lobed patterns suggest that water-rich material, such as mud, flowed upon impact. Striated patterns are caused when an impact propels material across the surface at high speeds.

Student Questions

1. In what order were these circular features formed? How can you tell?
2. What do you think formed these circular features – wind, water, or a meteorite? Why do you think so?

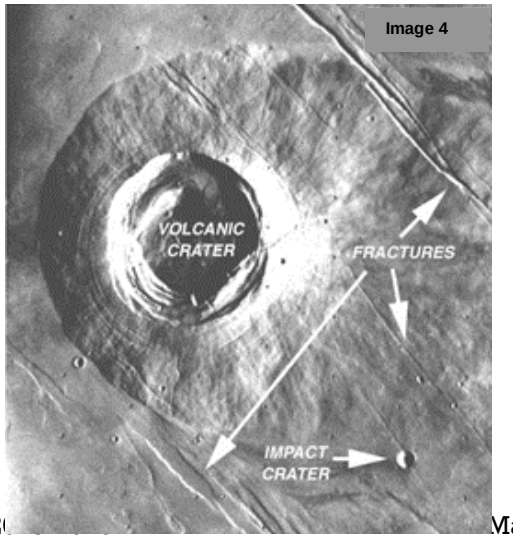
Image 3 - *(27.4°S, 44.2°W)*



Student Questions

1. What do you think created the feature across the middle of this picture? Have you ever seen anything like it on Earth?
2. Does anything in this picture look interesting to investigate on a rover mission? Do you see any places where a spacecraft could land to deploy a rover?
3. Do you think a rover could navigate from the top of the picture to the bottom?

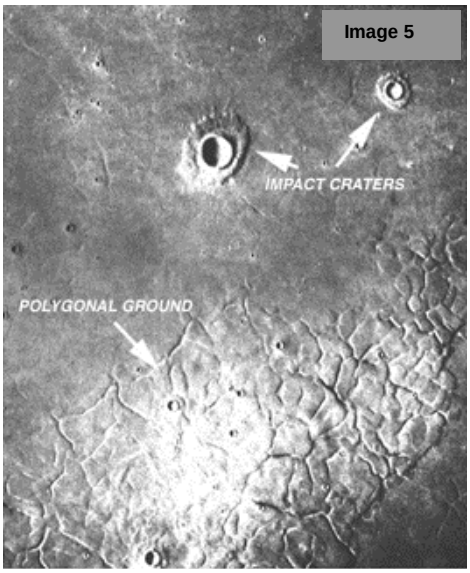
Image 4 - *(2.0°N, 124.0°W)*



Student Questions

1. Describe some characteristics of what you think made this circular feature – was it large or small? At what kind of angle did it form these features? Write down any ideas you have in your Lab Notebook.
2. What can you tell about the nature of the surface at this site from the linear patterns formed in the surface? From the circular feature?

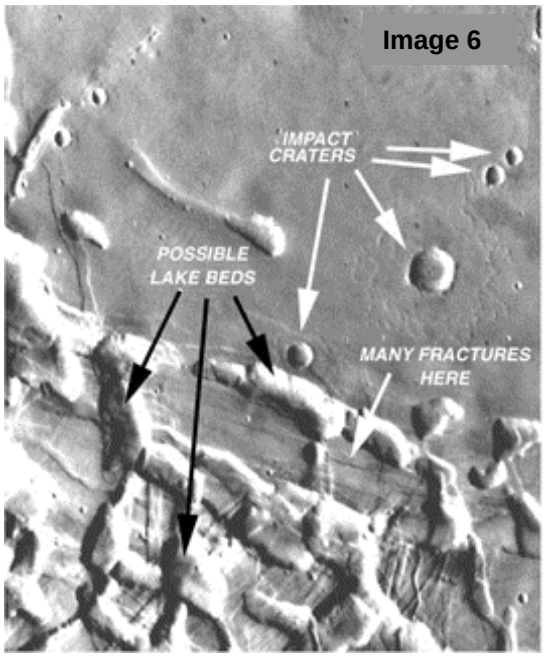
Image 5 - *(31.5°N, 245.0°W)*



Student Questions:

1. How do these circular features look different than those that you have examined in Images 2 and 4? What does this difference tell you about the surface in this area?
2. Do the geometric patterns in the lower half of the picture support your ideas about the surface from the previous question? Why or why not?

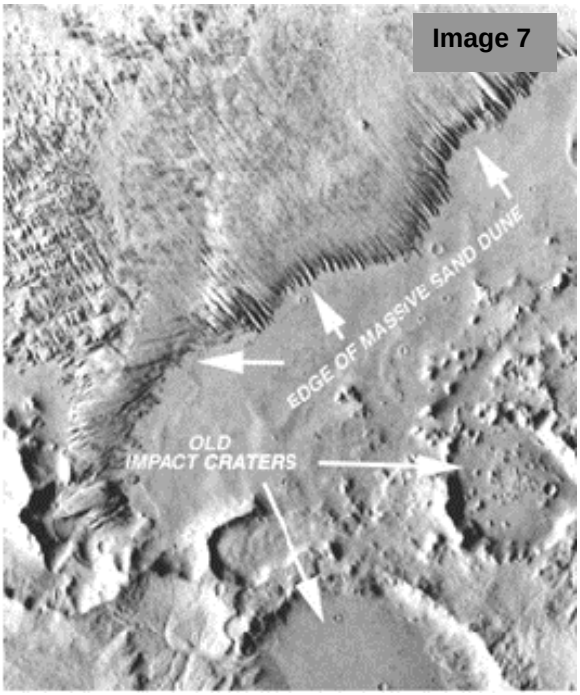
Image 6 - *(7.5°N, 101.7°W)*



Student Questions

1. What do you think created the features in the lower half of this picture? Why?
2. How big are these features? How can you tell?

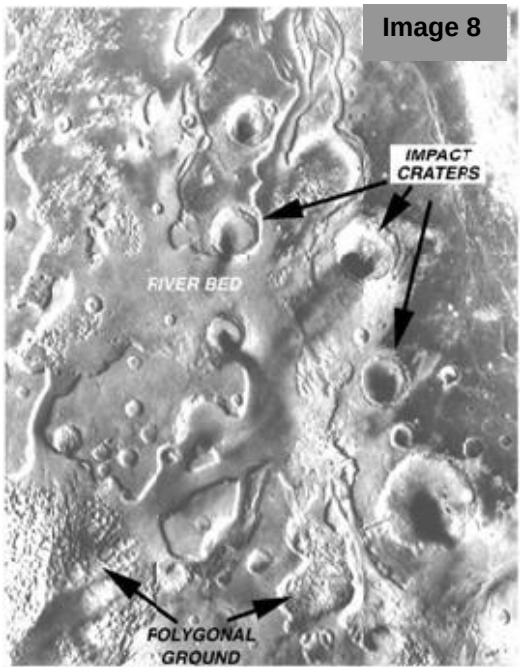
Image 7 - *(13.0°S, 183.0°W)*



Student Questions

1. What do you think formed the streaky lines that run diagonally across the middle of this picture – water, wind, or meteorites? Why do you think so?
2. What do you think created the circular features?
3. Which were formed first, the streaky lines or the circular features? Why do you think so?

Image 8 - *(7.3°N, 30.5°W)*



Student Questions

(1) Does this look like an interesting place to investigate with a rover? What would you like to explore? Why?

(2) Would this be a good place to land a spacecraft to deploy a rover? Why or why not?

(3) Would this be a safe place to navigate a rover? Why or why not?

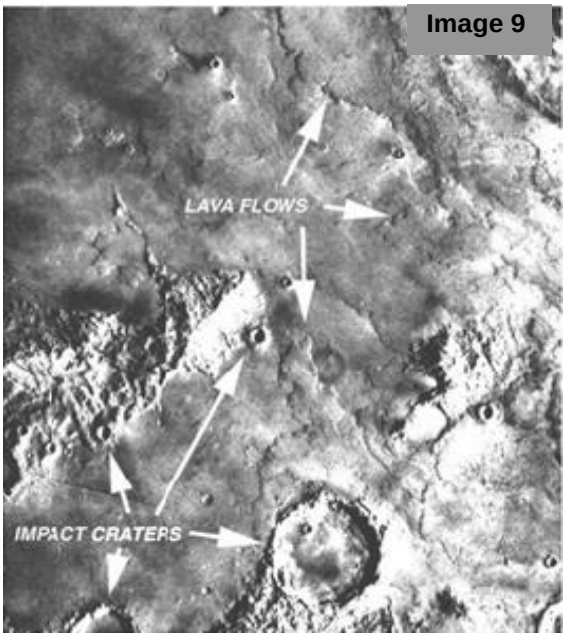


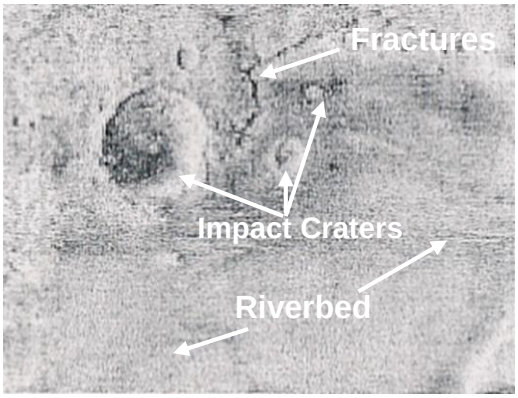
Image 9 - *(22.0°S, 140.0°W)*

Student Questions

1. How many different sizes of impact craters do you see in this picture?
2. What could have made these craters be so different in size?

Image 10 - *(27.0°N, 58.0°W)*

This image shows a rich diversity of geological processes. There are fractured ridged plains (top center), craters as big as 100 km, lobed ejecta blankets, an enormous channel, and wide streaks (going in the opposite direction of the former water flow).



Student Questions

1. How many different kinds of landforms do you see in this picture (this was left blank in your table on purpose!)?
2. How do you think each of these landforms was created? Why?
3. In what order were these landforms created? What clues in the picture led you to this decision?
4. What are the streaks in the middle and bottom center parts of the picture? What do these streaks tell you about the history of the Martian surface?

Debriefing

Compare student charts with the answer chart and discuss any discrepancies. Were some landforms easier to identify than others were? Did shadows (sun angle) help make some features easier to see? Which landforms would you like to explore the most? Which areas look like they would be the safest landing sites? Why?

If the team completed the "Crater Creation" activity prior to this one, challenge the students to identify and name the parts of an impact crater (e.g., ejecta blanket, rim, wall, etc.) in each photo.

Also, take the time to review the questions about each photo. Student answers to the questions will vary. Instead of judging their responses as right or wrong, look for sound, supporting evidence for their conclusions. Remember that even NASA does not know everything, so your students' responses may be better than what NASA has! Reward the students for solid justifications and creativity. If they are interested in what NASA thinks about these areas, have them do the "Further Explorations" section of this activity.

Finally, as a group, review the team's responses to the last set of questions that link this exercise with the Mars Rover Challenge *(included below)*. Encourage them to brainstorm and think ahead to their Rover design. Have students write their responses in their Lab Notebook:

1. Your Idaho TECH Engineering Team will be designing and constructing a model Mars Rover. What types of terrain must your Rover be able to navigate over and through if it were to travel on Mars?

2. What do you think Mars' surface is like to touch, to walk on, and to drive on?

Further Explorations:

Use the latitude & longitude coordinates on each photo to locate the areas on a map or globe of Mars. Then conduct some research online about each of these areas on Mars. What does NASA think about these landforms?