



What similar physical processes occur on both Earth and Mars?



Investigation Overview

Could life exist on Mars? This is a question that humans have wondered about for centuries. What physical processes on Earth led to an environment suitable for life? Do these physical processes also occur on Mars and could they also create a suitable environment for life on that planet? This investigation compares and contrasts physical processes that occur on both Earth and Mars. Students are given unidentified images of Earth and Mars. Their task is to arrange the images into pairs that show evidence of similar physical processes. Then they identify each image as one of Earth or one of Mars by comparing and contrasting physical features that they observe in the image pairs.

Time required: One or two 45-minute sessions

Materials/Resources

Briefing and Log (one copy of each per student or student group)
Figures 3-12 (one set per student or student group)

Content Preview

Mars' and Earth's physical features and processes may be similar because they may share similar origins. One theory assumes that some planets in our solar system formed from the debris of an exploded star that was once in the location of the Sun. Different agents of erosion (wind, water, ice) produce different landforms.

Classroom Procedures

Beginning the Investigation

1. In preparation for this investigation, explain the theory that some planets in our solar system, particularly Mars and Earth, formed from the debris of an exploded star. This establishes the possible links between land features and physical land formation processes on Earth and Mars. More information on this theory can be found in the **Background**.
2. Have students identify physical processes that shape Earth such as earthquakes, volcanoes, floods, water and wind erosion, glaciation, and mountain building. Ask students to speculate whether these same processes could occur on other planets in our solar system, particularly Mars. The answer is "maybe." Both Earth and Mars have an atmo-

Geography Standards

Standard 4: Places and Regions

The physical and human characteristics of places

- Analyze the physical characteristics of places.

Standard 7: Physical Systems

The physical processes that shape the patterns of Earth's surface

- Analyze physical patterns in terms of the processes that created them.

Geography Skills

Skill Set 3: Organize Geographic Information

- Integrate various types of materials to organize geographic information.

Skill Set 4: Analyze Geographic Information

- Interpret information obtained from maps, aerial photographs, satellite produced images, and geographic information systems.

Skill Set 5: Answer Geographic Questions

- Develop and present combinations of geographic information to answer geographic questions.

sphere. Both have water. And both have been hit by meteors. However, there are significant differences that may affect physical processes. By using Earth as an analogy, scientists hope to learn more about land formation processes on Mars.

Developing the Investigation

- This investigation requires the use of **Figures 3-12**. The images may be printed on transparencies and projected on a screen using an overhead projector. They may also be projected directly from the CD if there is a projector available to use with the computer in your classroom. The images may also be printed and distributed to each student or student group. The image pages should be cut into individual images.
- Distribute copies of the **Briefing** and **Log** for this investigation and have students follow the directions given. This may be done individually or in student groups.
- The first image pair is given as an example in the **Briefing**. Guide students through this example to give direction in completing the investigation.
- The figures are presented in no particular order. The students must first sort and classify the images into pairs based on comparisons of the physical processes that formed the features in each image. One image should be of Earth and the other image of Mars. Once the pairings have been completed, the students answer questions comparing and contrasting the features observed in each image. Finally, students identify the planet represented in each image.

Concluding the Investigation

- As a class, have students or student groups discuss and defend their Log answers.
- Have students continue their discussions of other areas on Earth that may have been created by processes similar to those on Mars. Examples include the flow of the Colorado River causing erosion in the Grand Canyon, flooding along the Mississippi River Delta due to extensive rains and snow, and volcanic building of the Hawaiian Islands from layers of lava cooling beneath the Pacific Ocean.

Background

One theory of the formation of rocky planets like Earth and Mars states that both were formed from the debris of an exploded star that was once near the location of our current Sun. Over a period of millions of years, the debris accumulated into many larger "clumps" of debris that then formed into some of the planets, moons, asteroids, and comets that now make up our present solar system. According to this theory, it would seem logical that since Earth and Mars formed from similar processes, both planets would also have similar features.

Understanding Mars is an important task because NASA is currently investigating plans that will send the first humans to Mars within the next two decades to explore our planetary neighbor and possible future home for explorers. If this timeline works out, the first persons sent to Mars are in a middle school/junior high school classroom at this time. Could it be one of your students?

Evaluation

- Students may discuss their answers and compare them. Have them be prepared to defend their answers to each question.
- Students should match the figures as indicated below: (Pairs A-E may be in any order)
Example: Figure 1—Olympus Mons, Mars
Figure 2—Island of Maui, Earth

Pair A: Figure 3—Arres Valles "Twin Peaks," Mars
Figure 7—Lavic Lake Desert, Earth

Wind erosion (aeolian processes) are important in arid (dry) environments. There is little vegetation to hold material down, so wind action causes most erosion.

Pair B: Figure 4—Yuty Crater, Mars
Figure 6—Meteor Crater, Earth

Meteor impacts produce unique landforms on both Earth and Mars. Vegetation obscures some craters on Earth.

Pair C: Figure 5—Warrego Valles, Mars
Figure 11—Yemen, Earth

Running water (fluvial processes) produces the distinctive branching pattern of streams evident in both images. Yemen, like Mars, was once a much wetter environment than it is today. Both images show “relic” landscapes, evidence of climate change.

Pair D: Figure 8—Grand Canyon, Earth
Figure 9—South Candor Chasma, Mars

Running water can be powerful enough to create canyons, in a process known as canyon incision. The processes illustrated in these images though producing the same result, may not be the same. The Grand Canyon was formed by a combination of two processes: uplifting and downcutting.

Pair E: Figure 10—North Polar Region, Mars
Figure 12—Antarctica, Earth

Polar regions on both Mars and Earth are covered by ice sheets. On Earth at the Poles the only substance that can freeze is water. On Mars, where it is colder, carbon dioxide also freezes.

Resources

NASA Spacelink
<http://spacelink.nasa.gov/>
GSFC Science Visualization Studio
<http://svs.gsfc.nasa.gov/>
NASA Image Exchange
<http://nix.nasa.gov/nix.cgi>
JPL Robotics
<http://robotics.jpl.nasa.gov/>
Lunar and Planetary Institute
<http://cass.jsc.nasa.gov/lpi.html>
Spacebourne Imaging Radar—Seeing Earth in a New Way CD-ROM
Mars Millennium Project
<http://cass.jsc.nasa.gov/education/MarsMillennium>
U.S. Geological Survey
<http://www.usgs.gov>

Figure 3



Figure 4

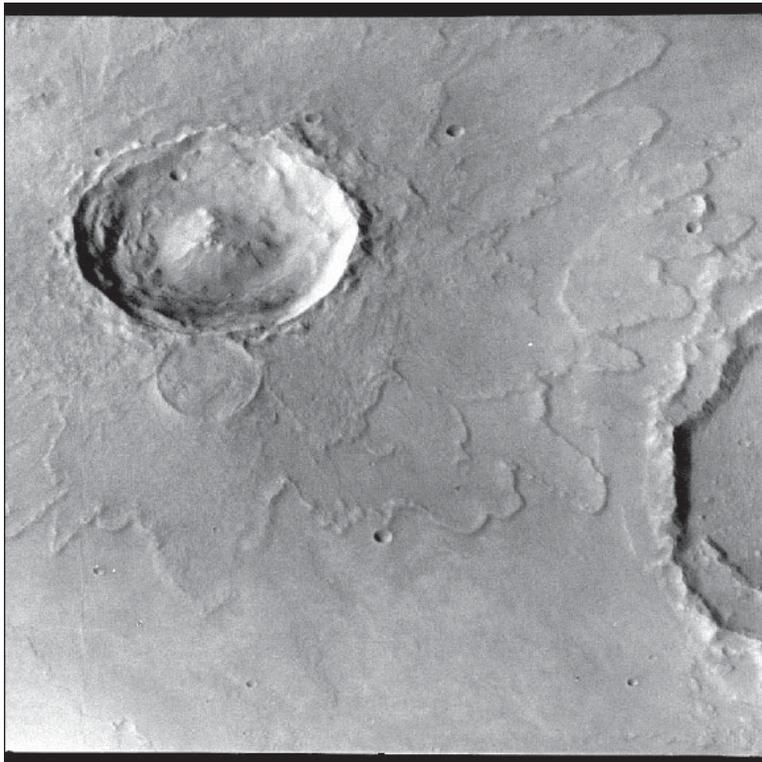


Figure 5

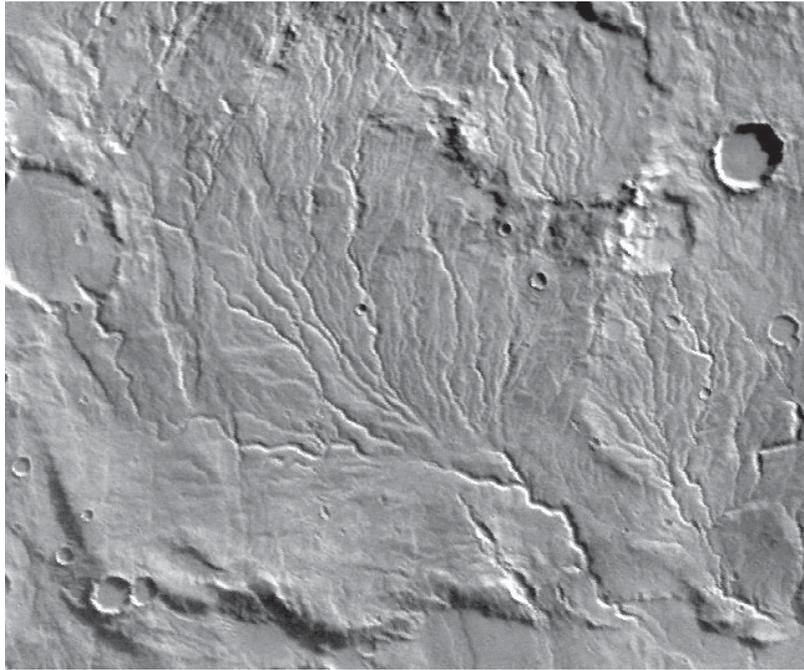


Figure 6



Figure 7



Figure 8

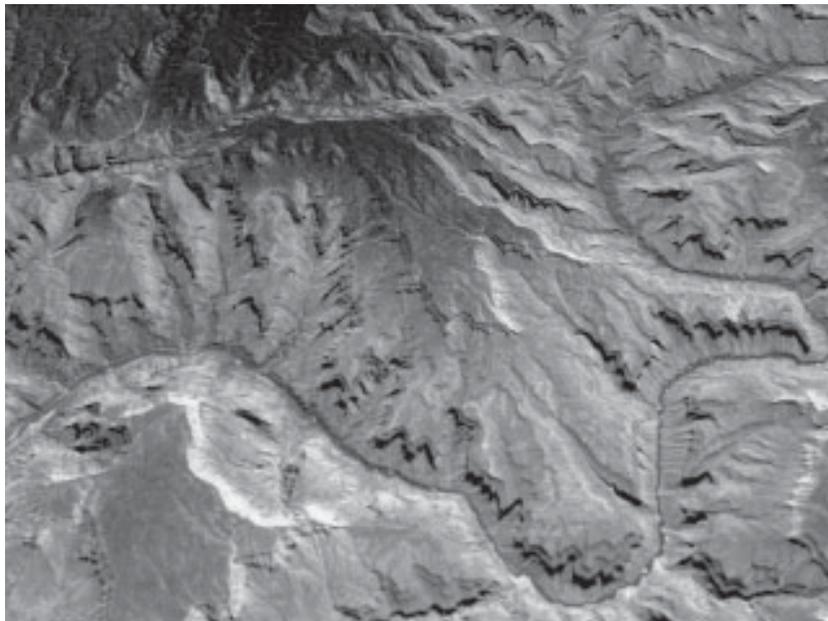


Figure 9

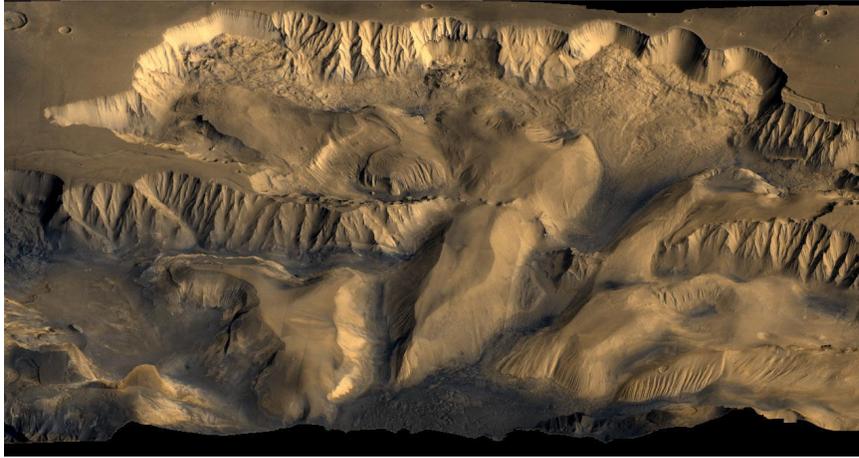


Figure 10

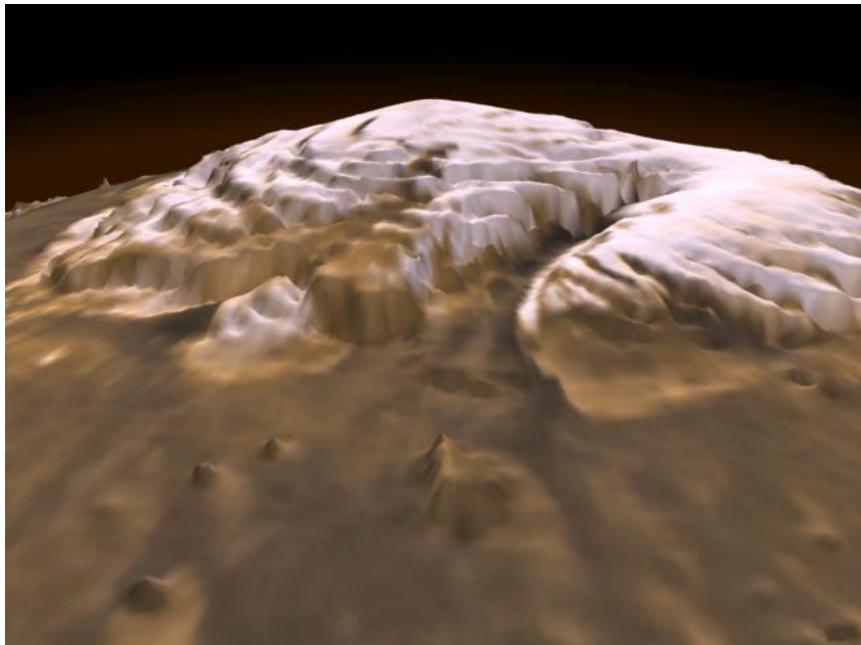
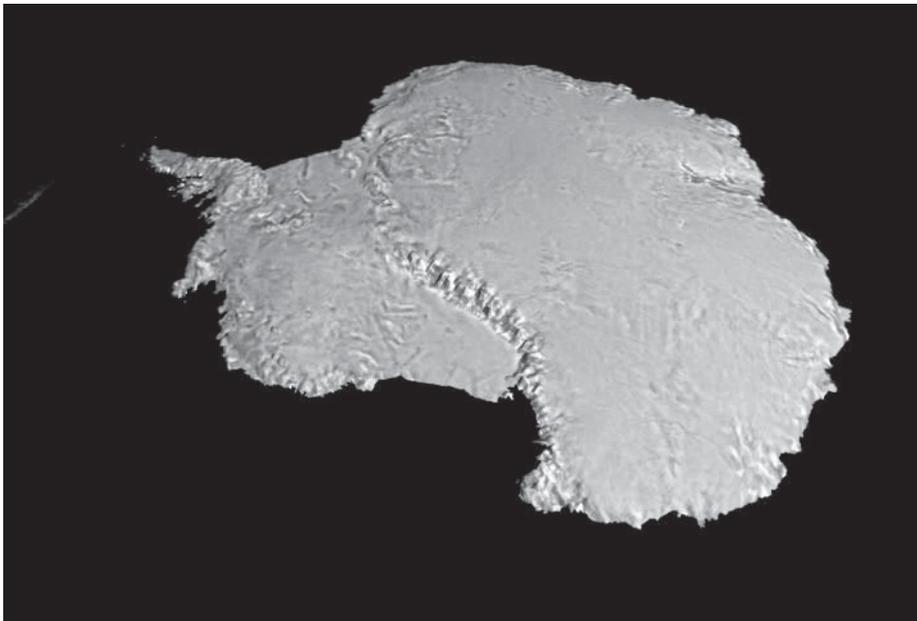


Figure 11



Figure 12





Module 2, Investigation 3: Briefing

What similar physical processes occur on both Earth and Mars?

Background

How did Earth form? Did some of the other planets in our solar system form from the same processes? One theory states that Earth and Mars formed from the same processes that formed other rocky planets. The theory assumes that our solar system formed from the debris of an exploded star that was once in the location of our current Sun. Over a period of millions of years, the debris accumulated into many larger “clumps” of debris that then formed into the rocky planets of Mercury, Venus, Earth, and Mars as well as the moons, asteroids, and comets that now make up our present solar system. Based on this theory, both Earth and Mars should have similar features since they formed from similar processes. Earth and Mars do have many striking resemblances in their physical properties and processes. They also have many striking differences. This investigation allows you to observe and identify these similarities of Earth and our planetary neighbor, Mars.

Understanding Mars is an important task because NASA is currently investigating plans that will send the first humans to Mars within the next two decades to explore our planetary neighbor and possible future home for explorers. This knowledge may help you in the near future when you may make a trip to Mars yourself. Have fun with your explorations.

Objectives

Upon completion of this investigation, you will

- identify similarities and differences between the physical processes that occur on Earth and Mars,
- classify images of Earth and Mars by observing physical features in each image, and
- speculate about physical processes that create the physical features observed in each image.

Procedures

1. Arrange the unidentified images of both Earth and Mars into pairs by identifying characteristics that appear to have been formed by similar physical processes. Examples of some physical processes are volcanic activity, water or wind erosion, glaciation, tectonics, and impacts from space. One image should be of a location on Earth and the other a location on

Mars. The first image pair has been done for you to use as an example. Identify some of the similarities between the two images in the example.

2. Individually or in small groups, observe each image pair. Answer the questions provided for each image pair. Be prepared to defend your answers.

Example

Figure 1

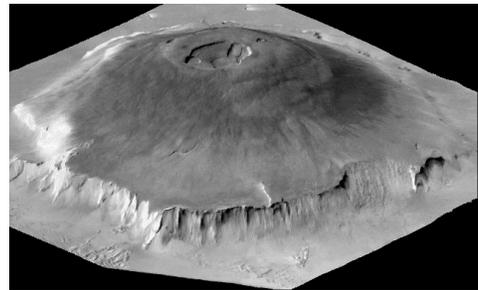
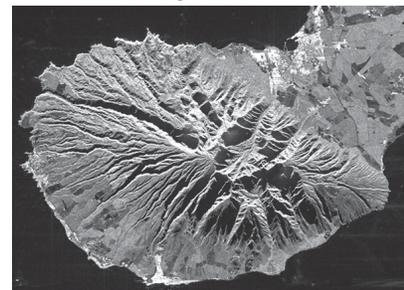


Figure 2



- Ex 1. Identify ways the images appear similar:
(answers vary based on your observations)
- Ex 2. Identify ways the images appear different:
(answers vary based on your observations)
- Ex 3. Identify the similar physical feature(s) that you observe in both images: *mountains, volcano, caldera, jagged cliffs*
- Ex 4. Speculate about what physical process(es) formed the features identified in question 3: *volcanic activity, tectonics, erosion*
- Ex 5. Which image is Earth? (Figure 2) Mars? (Figure 1)



Module 2, Investigation 3: Log

What similar physical processes occur on both Earth and Mars?

Image Pair A:

Figure _____

Figure _____

1. Identify similarities between the images: _____

2. Identify differences between the images: _____

3. Identify the similar physical feature(s) that you observe in both images: _____

4. Speculate about what physical process(es) formed the similar features identified in question 3:

5. Which image is Earth? _____ Mars? _____

Image Pair B:

Figure _____

Figure _____

1. Identify similarities between the images: _____

2. Identify differences between the images: _____

3. Identify the similar physical feature(s) that you observe in both images: _____

4. Speculate about what physical process(es) formed the similar features identified in question 3:

5. Which image is Earth? _____ Mars? _____



Module 2, Investigation 3: Log

What similar physical processes occur on both Earth and Mars?

Image Pair C:

Figure _____

Figure _____

1. Identify similarities between the images: _____

2. Identify differences between the images: _____

3. Identify the similar physical feature(s) that you observe in both images: _____

4. Speculate about what physical process(es) formed the similar features identified in question 3:

5. Which image is Earth? _____ Mars? _____

Image Pair D:

Figure _____

Figure _____

1. Identify similarities between the images: _____

2. Identify differences between the images: _____

3. Identify the similar physical feature(s) that you observe in both images: _____

4. Speculate about what physical process(es) formed the similar features identified in question 3:

5. Which image is Earth? _____ Mars? _____



Module 2, Investigation 3: Log

What similar physical processes occur on both Earth and Mars?

Image Pair E:

Figure _____

Figure _____

1. Identify similarities between the images: _____

2. Identify differences between the images: _____

3. Identify the similar physical feature(s) that you observe in both images: _____

4. Speculate about what physical process(es) formed the similar features identified in question 3:

5. Which image is Earth? _____ Mars? _____