Lesson 6: Mars Match Game

This lesson is adapted from MarsQuest Online's "Earth or Mars?" produced by the Space Science Institute (http://www.marsquestonline.org/tour/welcome/earthormars/index.html).

Purpose: To deepen student understanding of Mars, Mars exploration and the similarities and differences between the Earth and Mars.

Standards

NCTE/IRA Standards for English Language Arts

Standard 5- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

National Science Education Standards

Science as Inquiry – Content Standard A

1. Abilities necessary to do scientific inquiry.
2. Understanding about scientific inquiry.

Physical Science – Content Standard B

Properties of objects and materials- objects have many observable properties such as size, and color.

Earth and Space Science– Content Standard D

Properties of Earth materials- Earth materials are solid rocks and soils, water, and the gases of the atmosphere.

Principles and Standards for School Mathematics

Measurement

1. Understand measurable attributes of objects and the units, systems, and processes of measurement.
2. Apply appropriate techniques and tools to determine measurements.

Connections

Recognize and apply mathematics in contexts outside of mathematics.

Overview

Of all the planets in the Solar System, Mars is the most like Earth. Though it currently has no liquid water flowing on the surface, there is evidence that suggests Mars was once warmer and wetter like the Earth. Geologic features revealed by orbiting robotic spacecraft, and secrets uncovered in Martian rocks by robotic rovers on the ground show that long ago Mars and Earth could have looked very much alike.

In this activity, students will compare physical properties of Earth to those of Mars. Students will also become planetary scientists as they investigate images of features on Mars and try to find similar features in images of the Earth.

Understandings

1. Our knowledge and understanding of our Earth and Solar System changes and/or expands as new discoveries are made.
2. Robots gather different information (data) depending on their design and use.
3. Combining the information (data) gathered by a variety of robots gives us a broader and more in-depth understanding of our Earth and Solar System.

Materials

1. Earth vs Mars slide show*
2. Earth/Mars game cards (included)
3. Earth/Mars comparison worksheet (included)
4. Mars Match Game Answer Key, Script (included)

*Slide show can be downloaded from the MarsBots Material section of the Phoenix Mission Website in both Microsoft PowerPoint (PPT) or Adobe Acrobat (PDF) format (http://phoenix.lpl.arizona.edu). ***note: we will make the specific address available as we make final preparations on the learning module.

Time

Ten to 30 minutes for PowerPoint depending on length of class discussion
Thirty to 45 minutes for activity and discussion

Directions

1. Show students the Earth vs. Mars slide show discussing the various differences between Earth and Mars. *Use the script provided in the notes section of the PowerPoint to assist you with the*

discussion. (Select "notes page" print option to print a copy of the PowerPoint presentation notes)

2. After discussing differences, hand out the Earth/Mars comparison images. *Each image from Mars has a matching image of Earth. Students are to look at each image from Mars and identify the Earth image that most resembles the image from Mars. Have students work in pairs for this activity.*

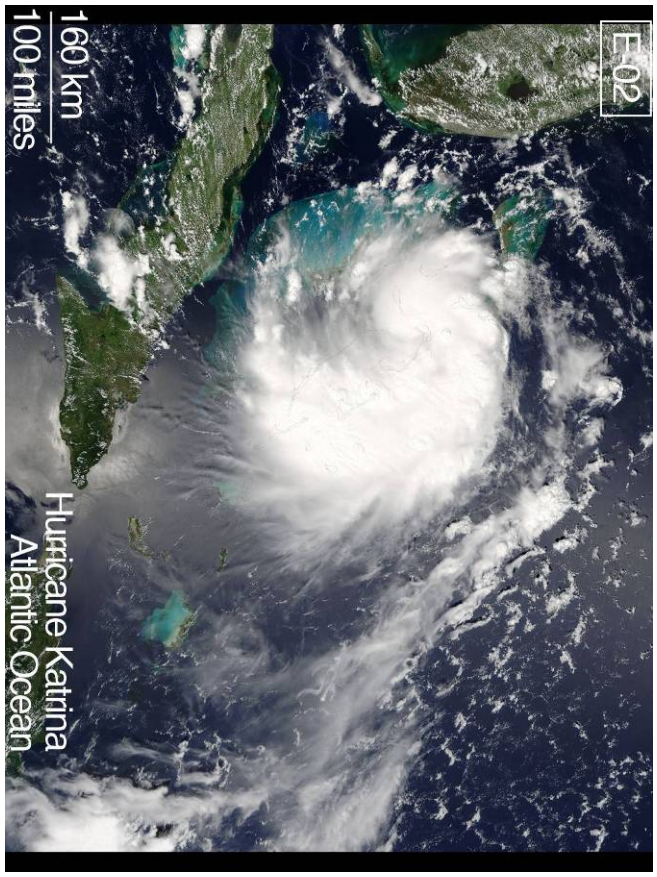
3. Hand out the Earth/Mars Comparison worksheets to help guide students as they make their choices.

4. Talk about how scientists compare features found on the Earth, known to be formed by liquid water, with features on Mars. *While some features seen on Mars could be explained by other processes (e.g. lava flows) others were almost certainly formed by water a long time ago. See the Mars section of the background information at the front of the MarsBots learning module.*

5. Discuss how robotic spacecraft have given us these images of Mars that allow us to see these similarities and differences.

Earth/Mars Comparison game cards

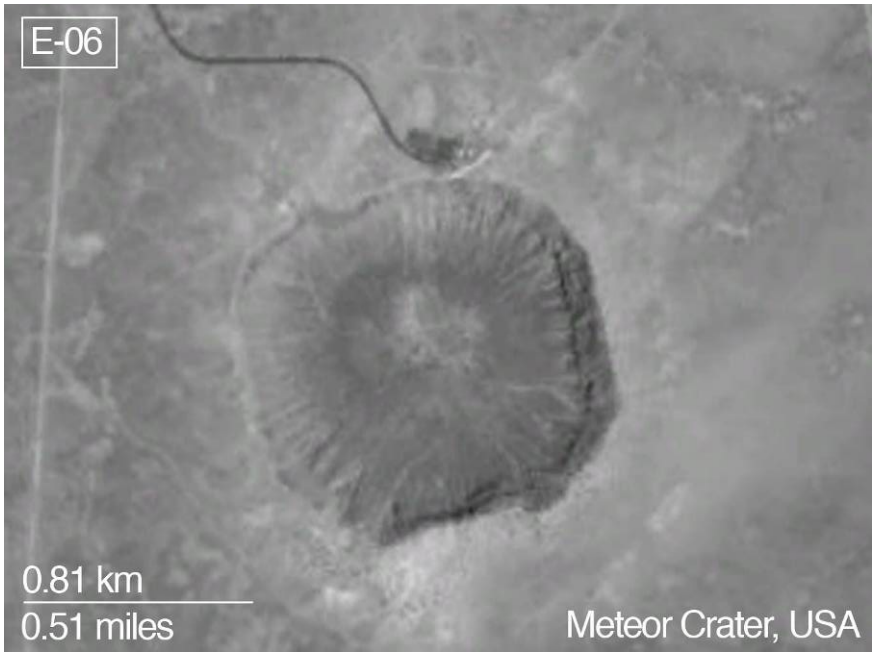
Print pages 37-48 double sided.

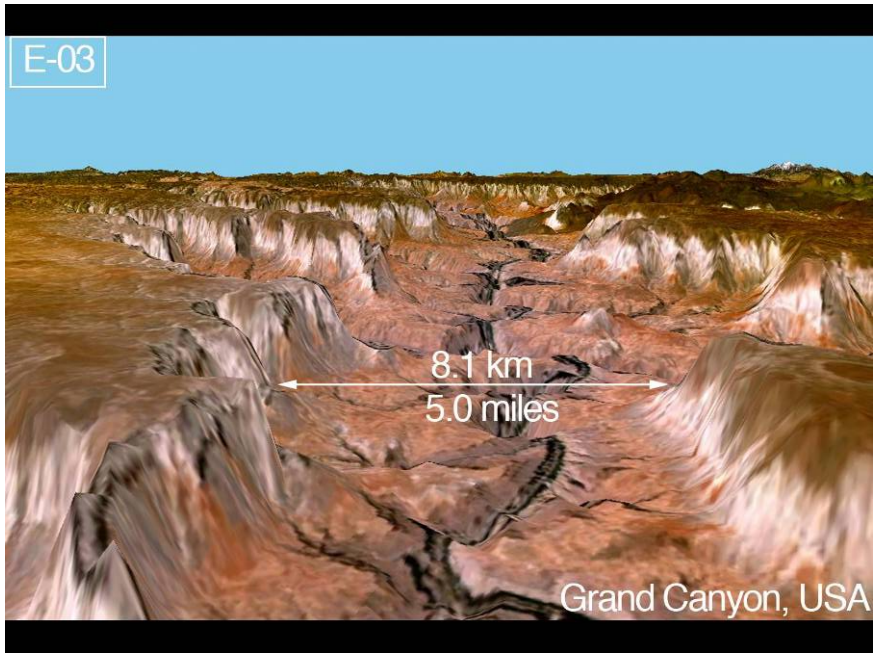


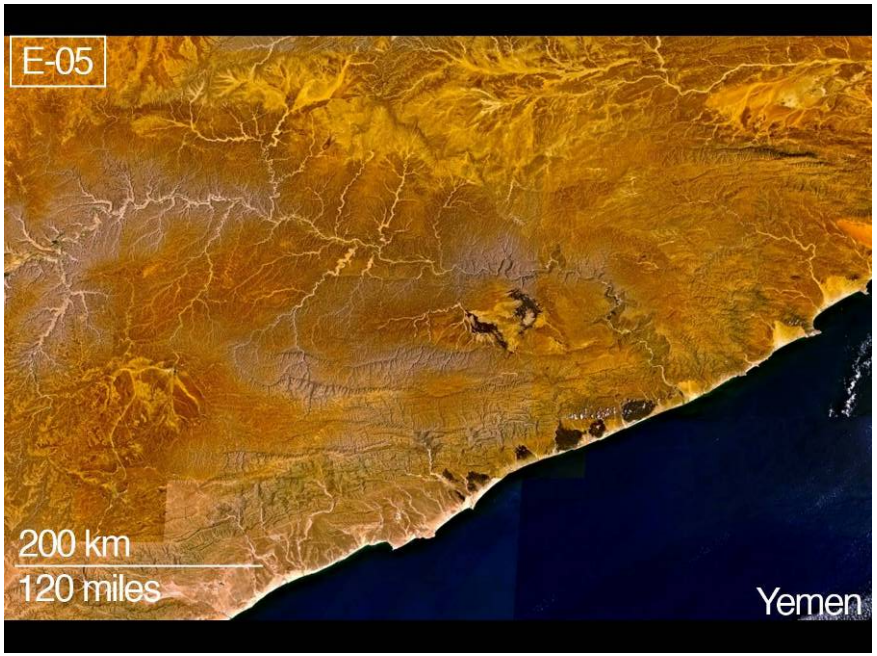
Rivers can change the direction they flow.

Cyclones are large storms on Earth.


E-04
0.27 km
0.17 miles
Amazon River, Brazil


E-06
0.81 km
0.51 miles
Meteor Crater, USA


E-03
8.1 km
5.0 miles
Grand Canyon, USA

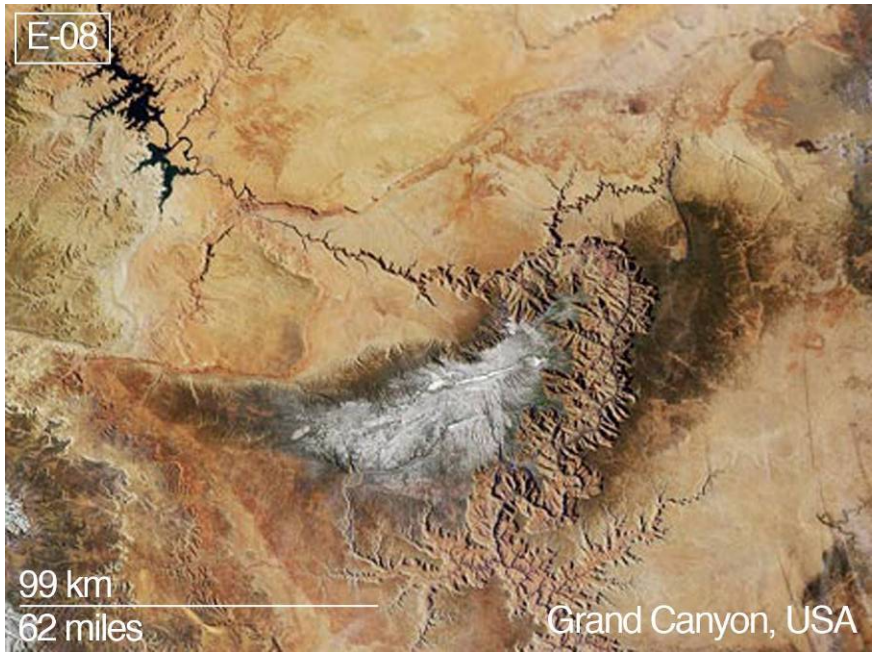

E-05
200 km
120 miles
Yemen

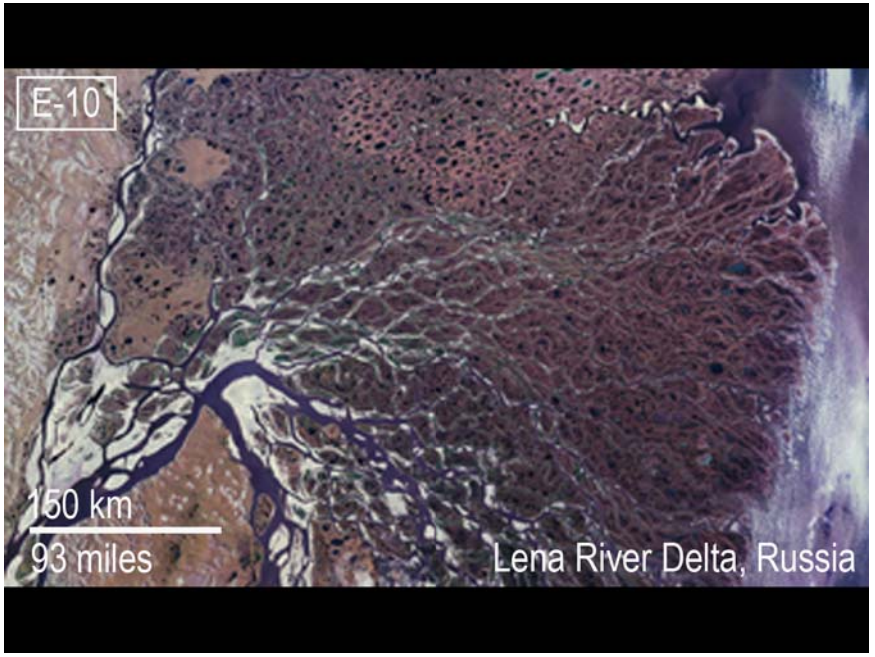
The Grand Canyon can be up to 18 miles across and 1 mile deep.

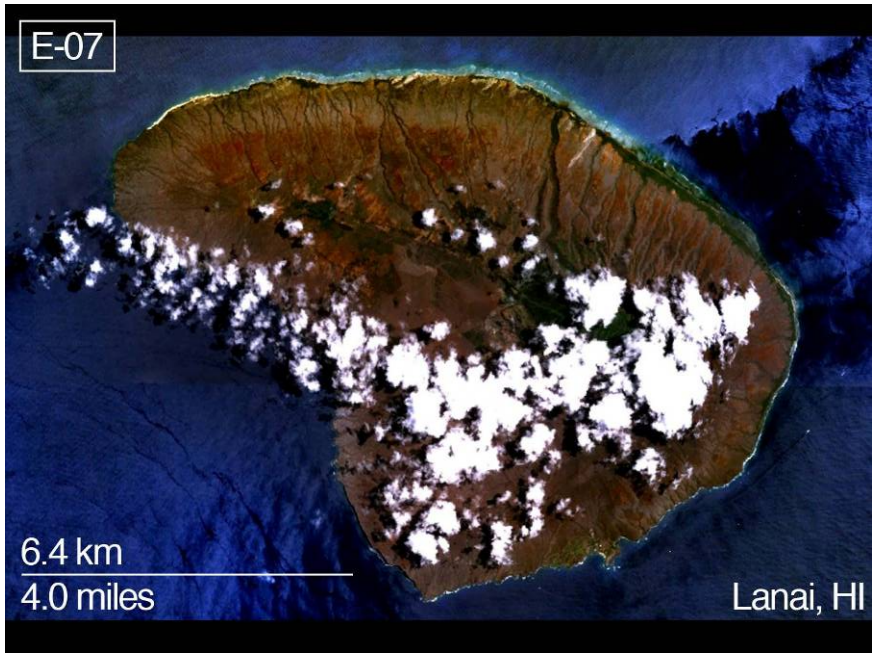
Small streams come together to make one big river.

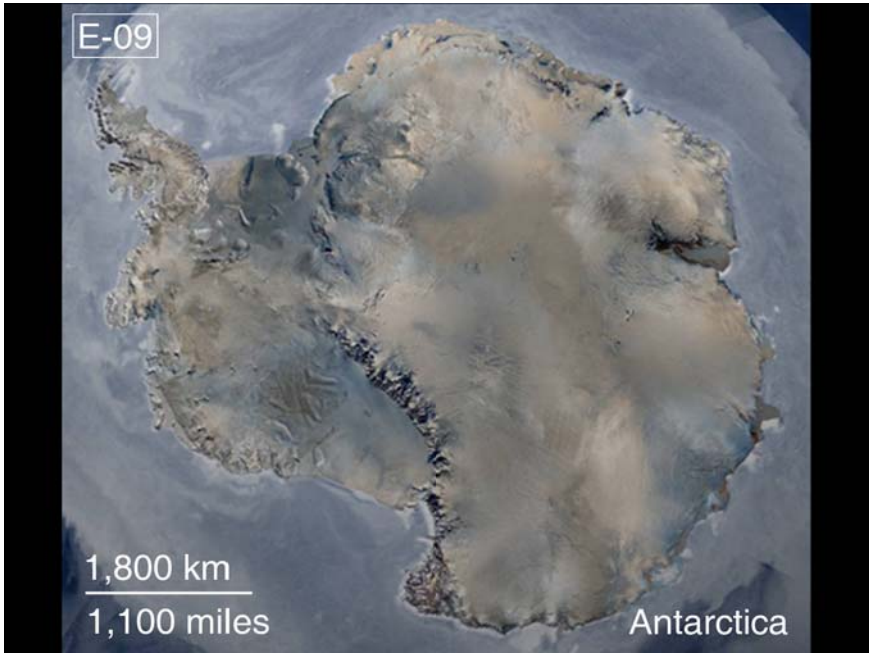
The island in this river did not erode as much as the land around it.

This crater is almost 1 mile across.


E-08
99 km
62 miles
Grand Canyon, USA


E-10
150 km
93 miles
Lena River Delta, Russia


E-07
6.4 km
4.0 miles
Lanai, HI

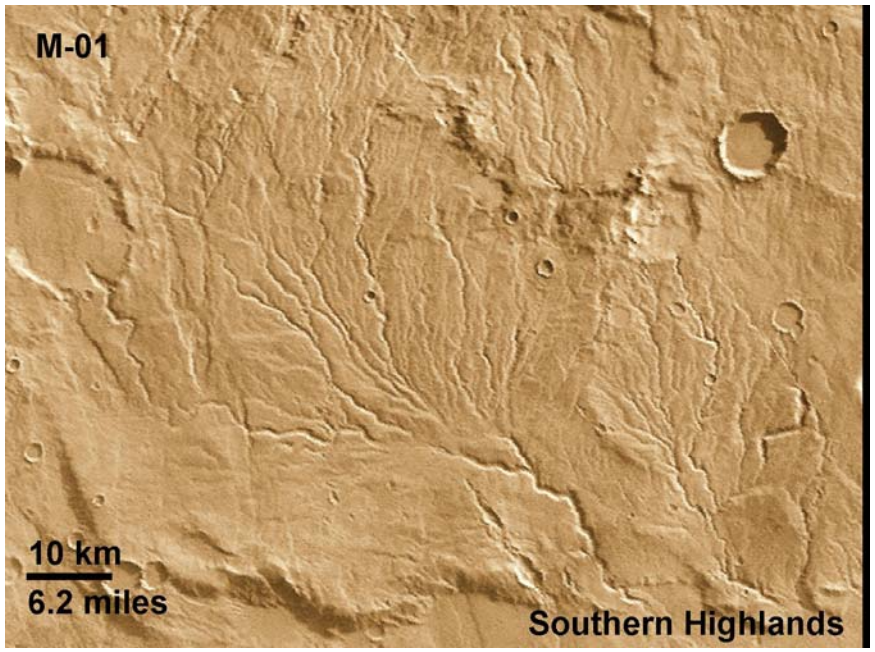

E-09
1,800 km
1,100 miles
Antarctica

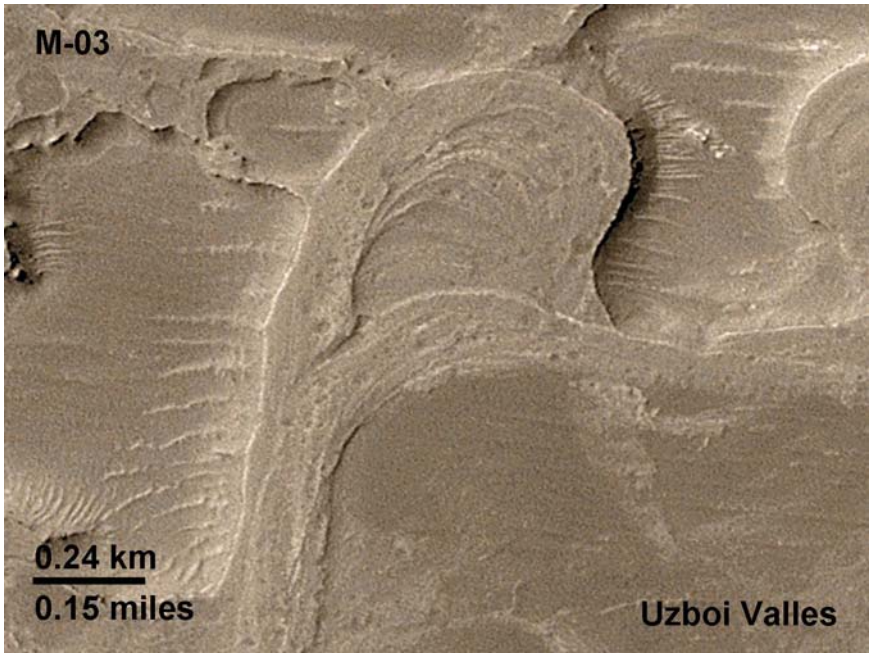
The island of Lanai (Hawaii) is a shield volcano.

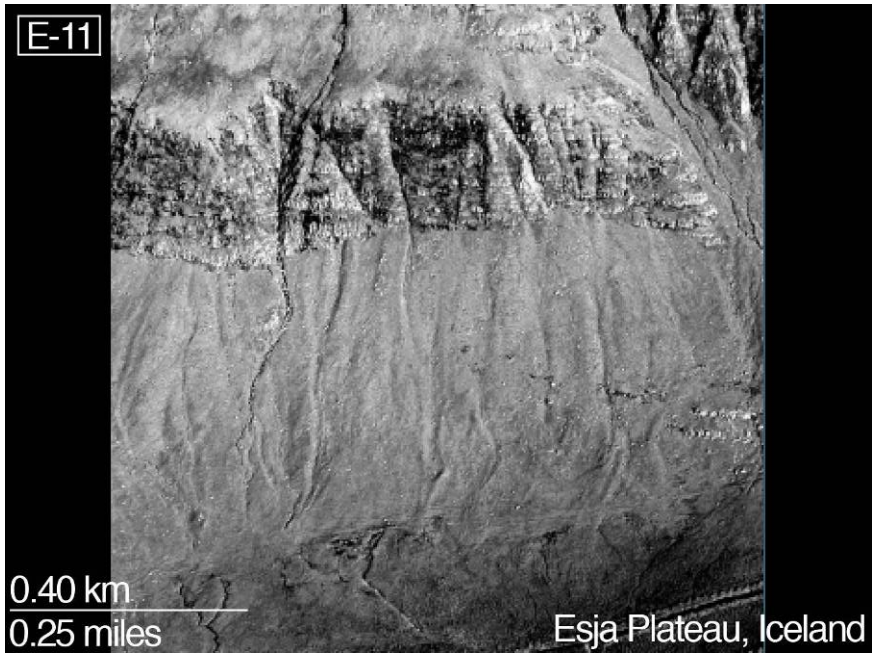
Both the north and south polar caps of Earth are made of frozen water. Most of Earth's fresh water is locked in the southern cap.

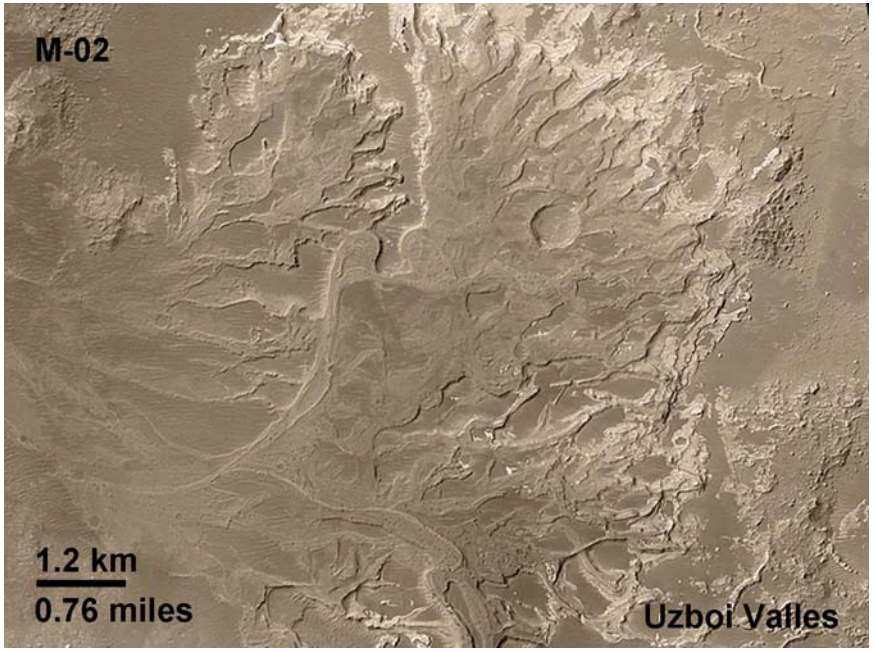
The Grand Canyon is 280 miles long.

Rivers end in lakes or oceans and form deltas.

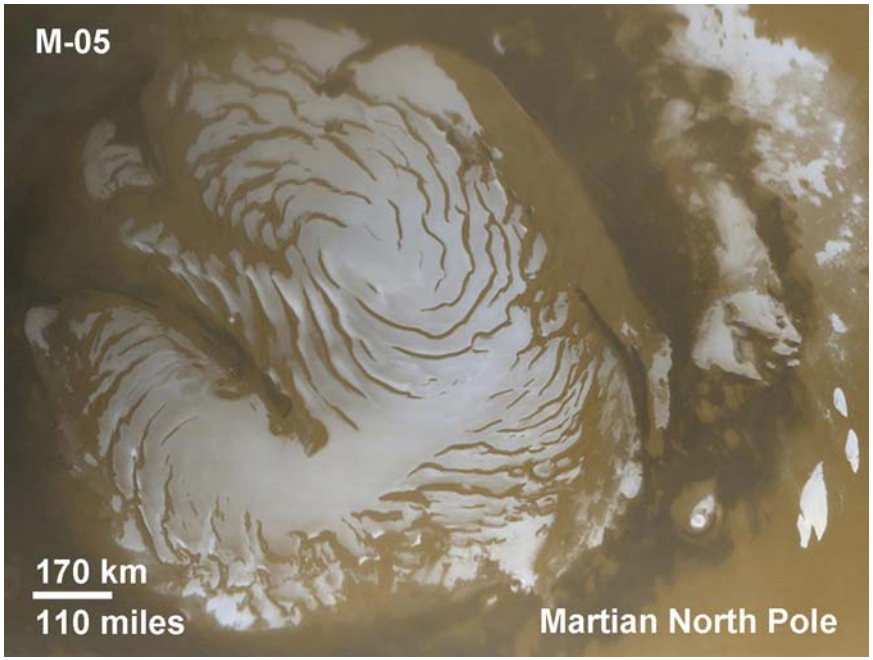

M-01
10 km
6.2 miles
Southern Highlands

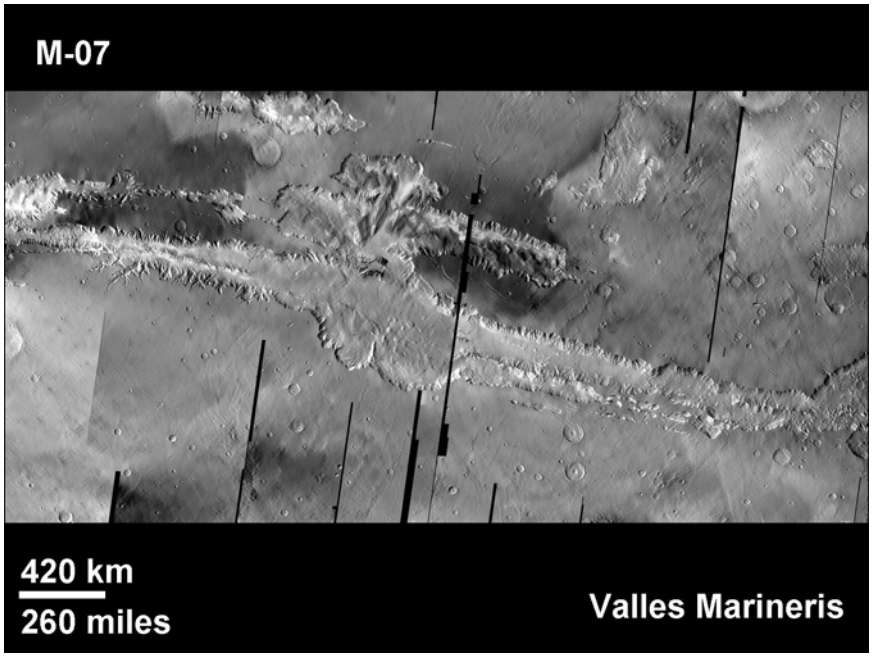

M-03
0.24 km
0.15 miles
Uzboi Valles

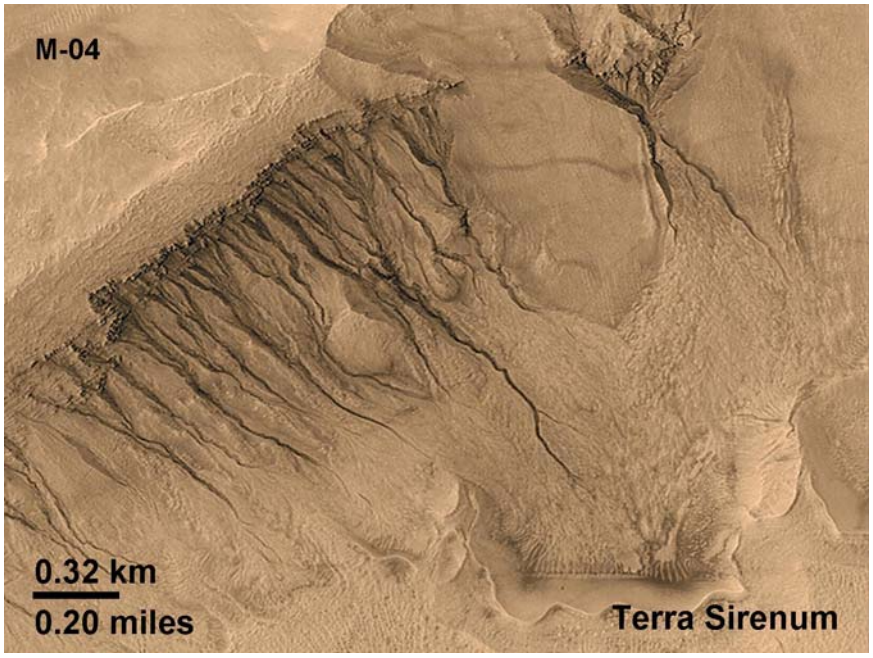

E-11
0.40 km
0.25 miles
Esja Plateau, Iceland

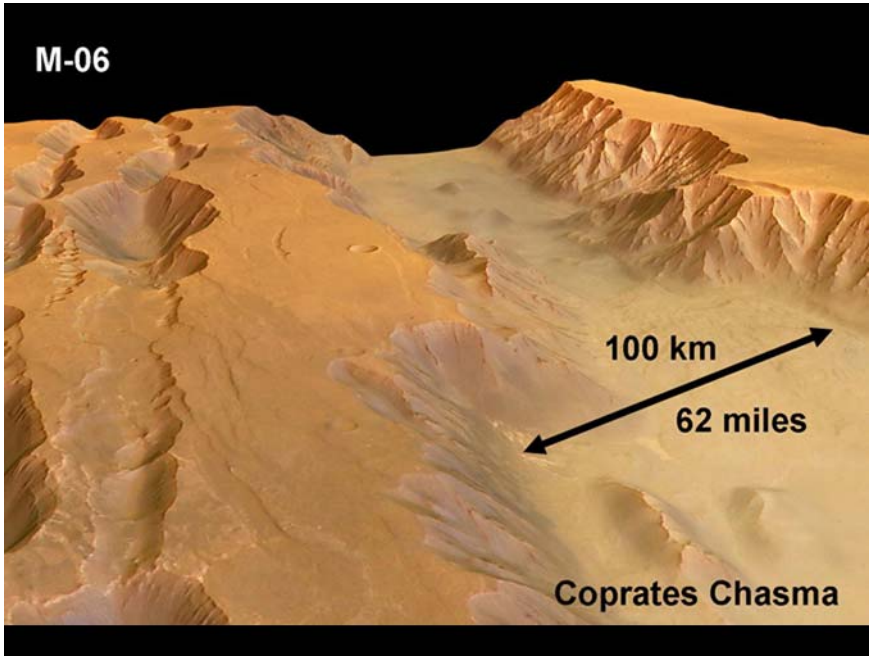

M-02
1.2 km
0.76 miles
Uzboi Valles

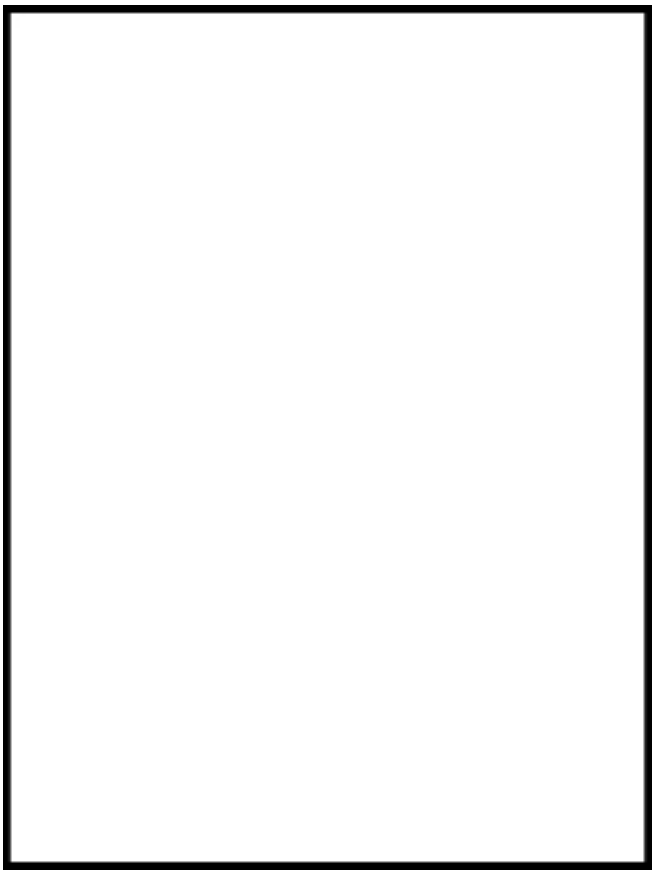
Gullies form on the slopes of hills where there is liquid water.

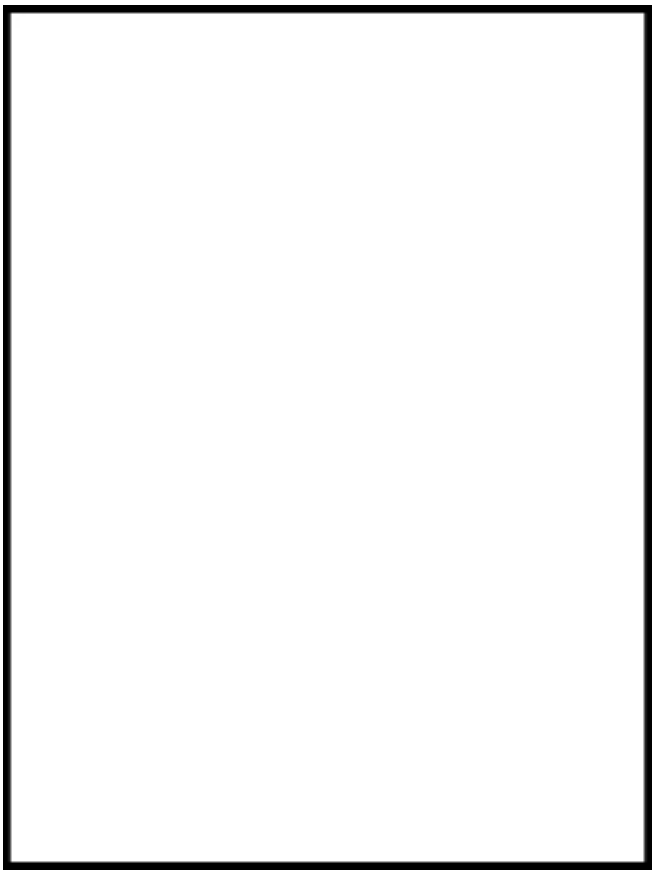

M-05
170 km
110 miles
Martian North Pole

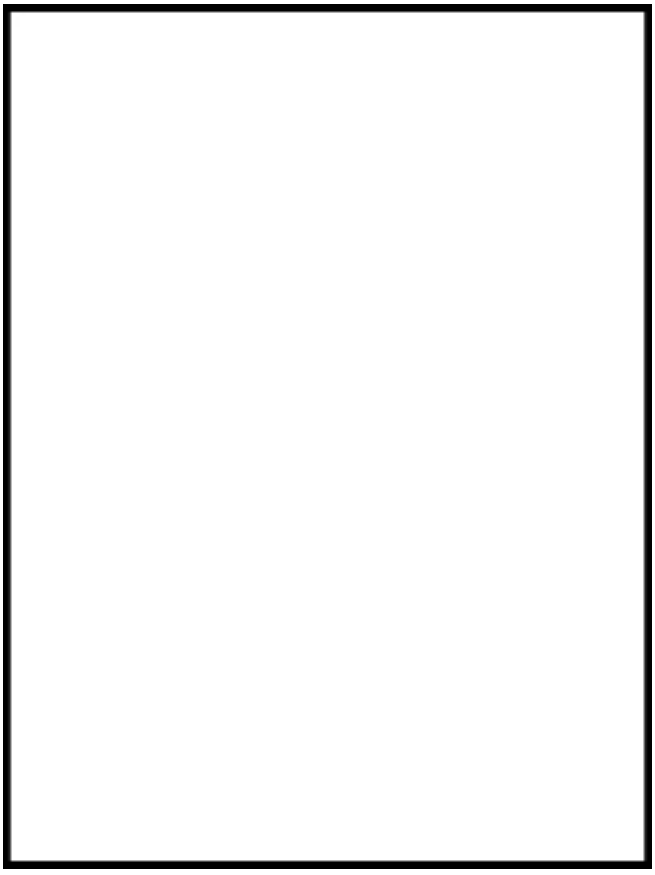

M-07
420 km
260 miles
Valles Marineris

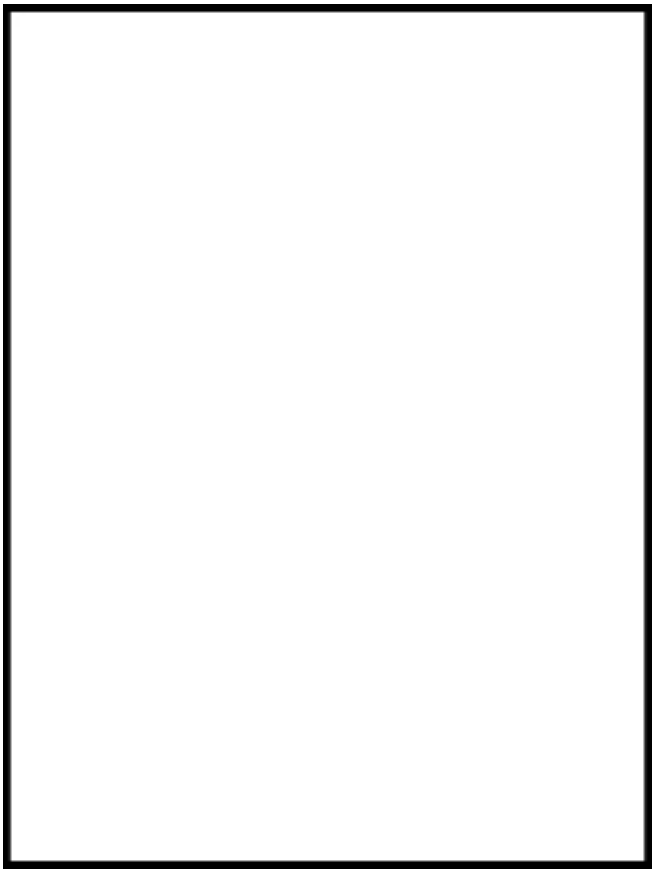

M-04
0.32 km
0.20 miles
Terra Sirenum

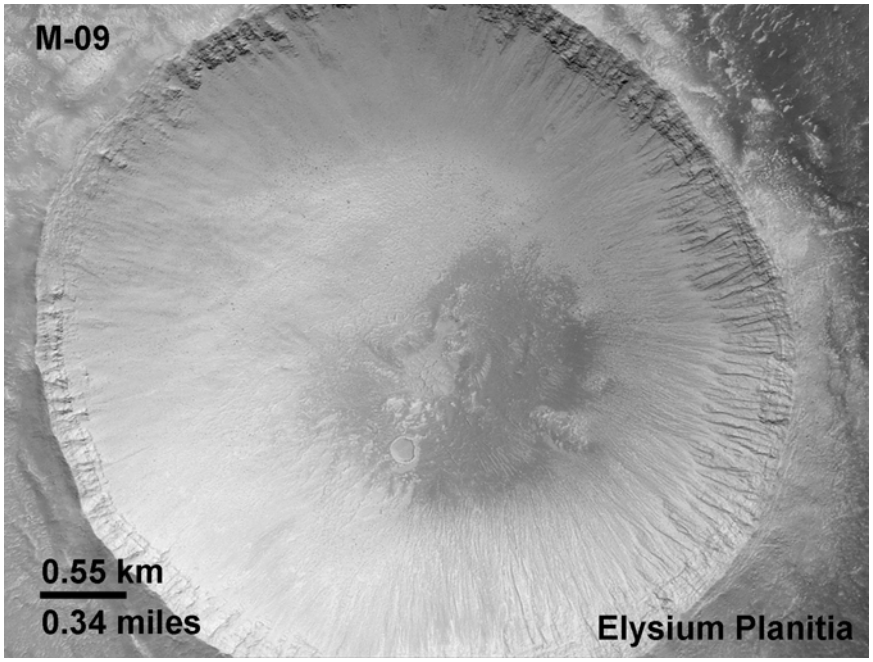

M-06
100 km
62 miles
Coprates Chasma

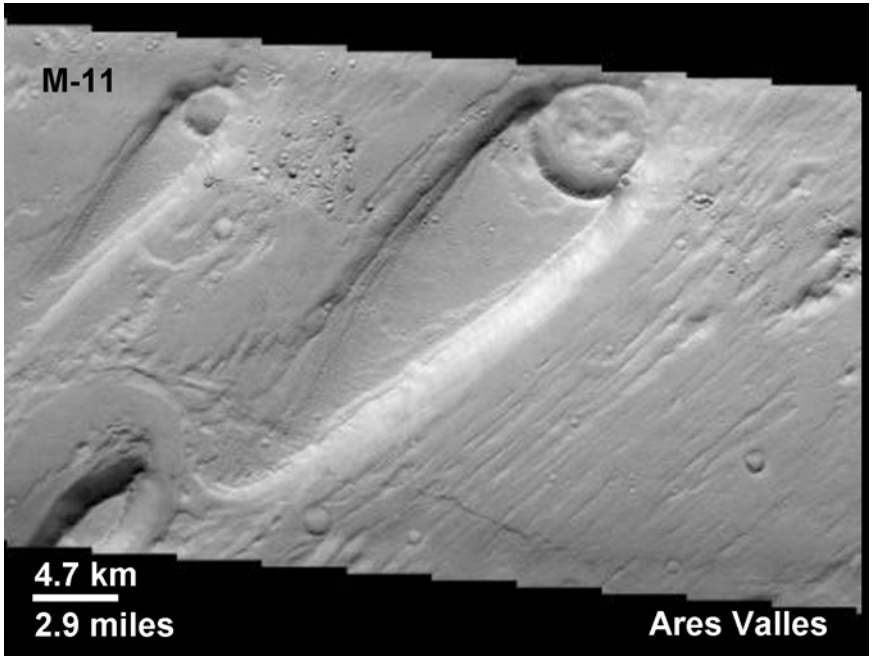


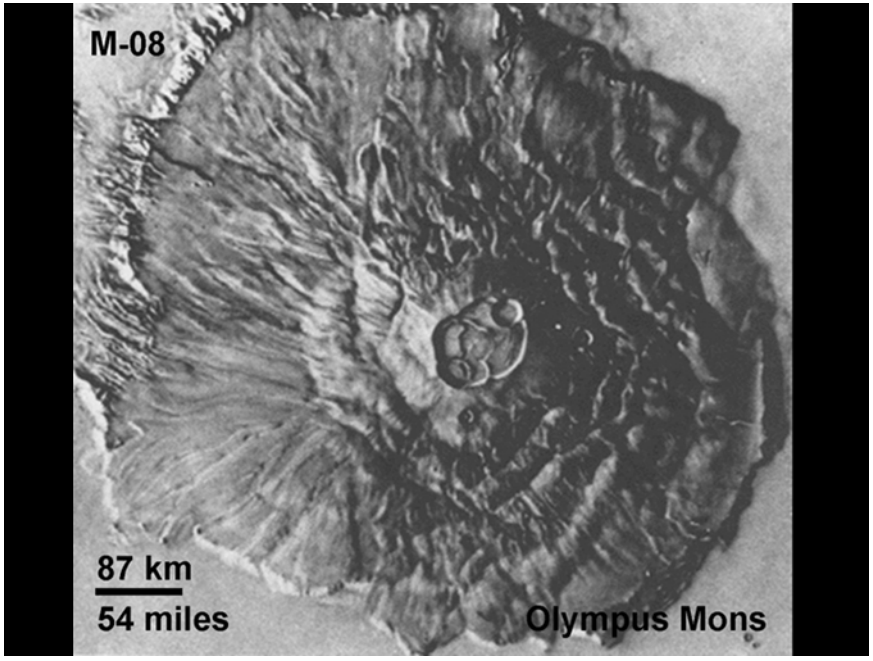


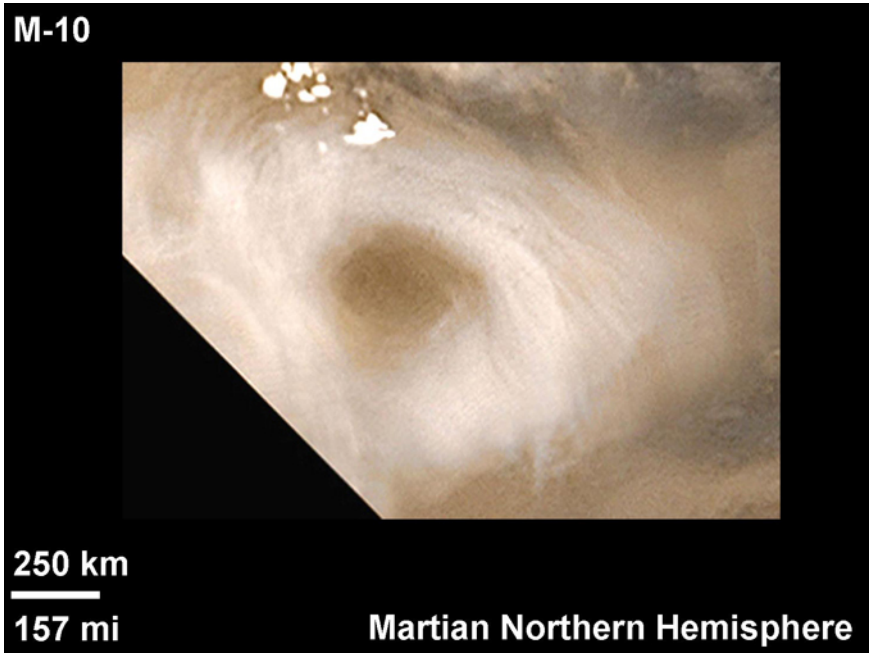


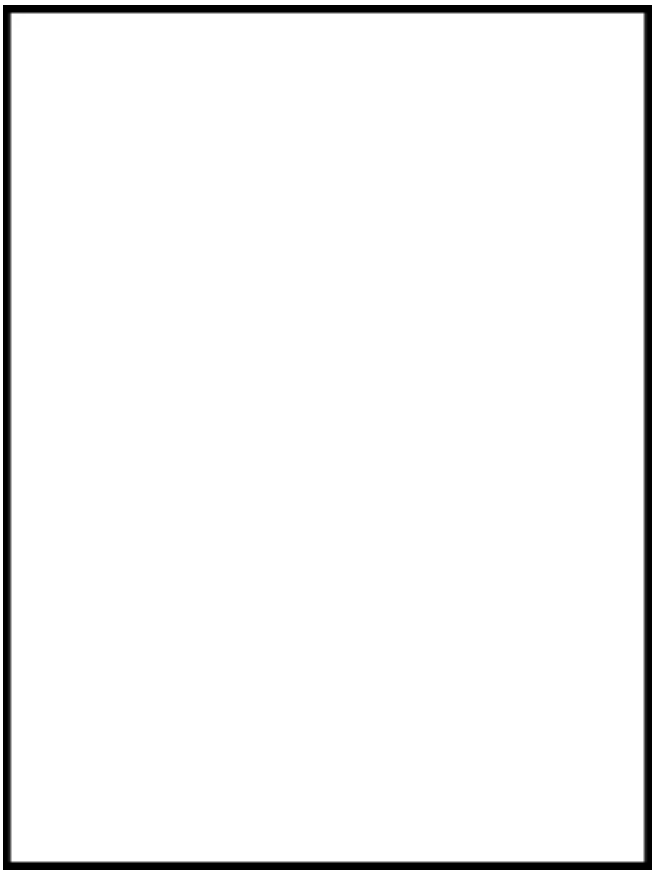


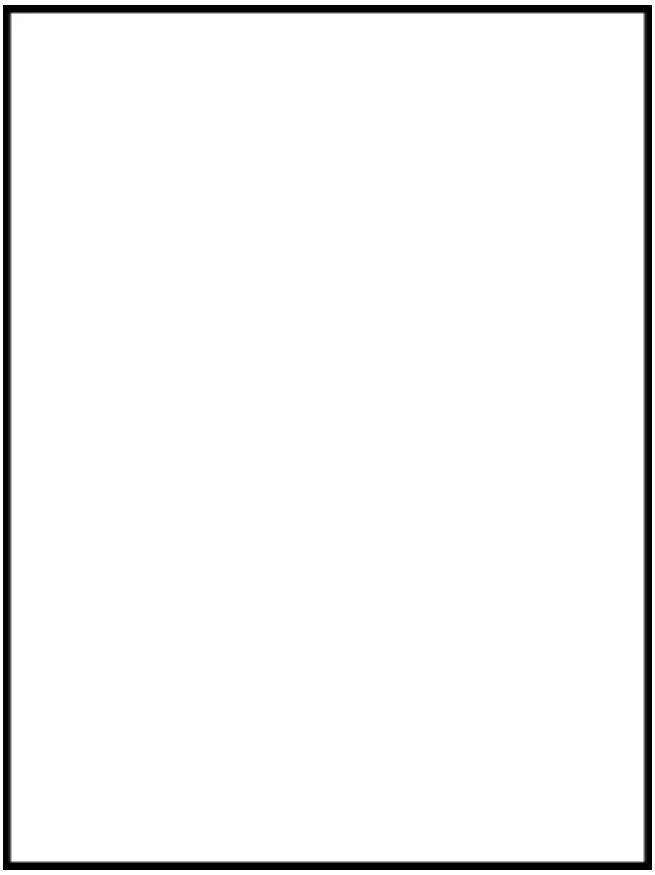

M-09
0.55 km
0.34 miles
Elysium Planitia

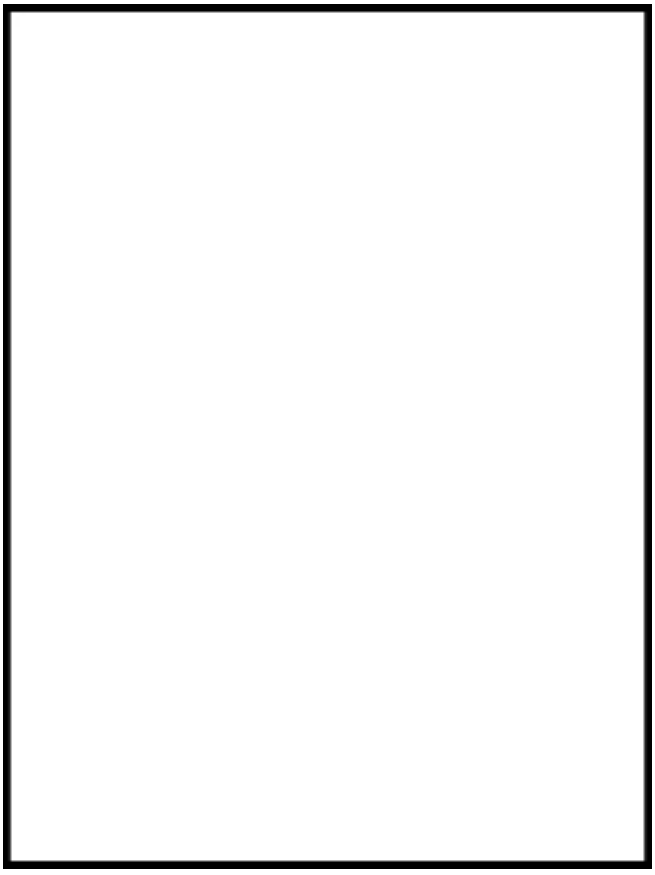

M-11
4.7 km
2.9 miles
Ares Valles

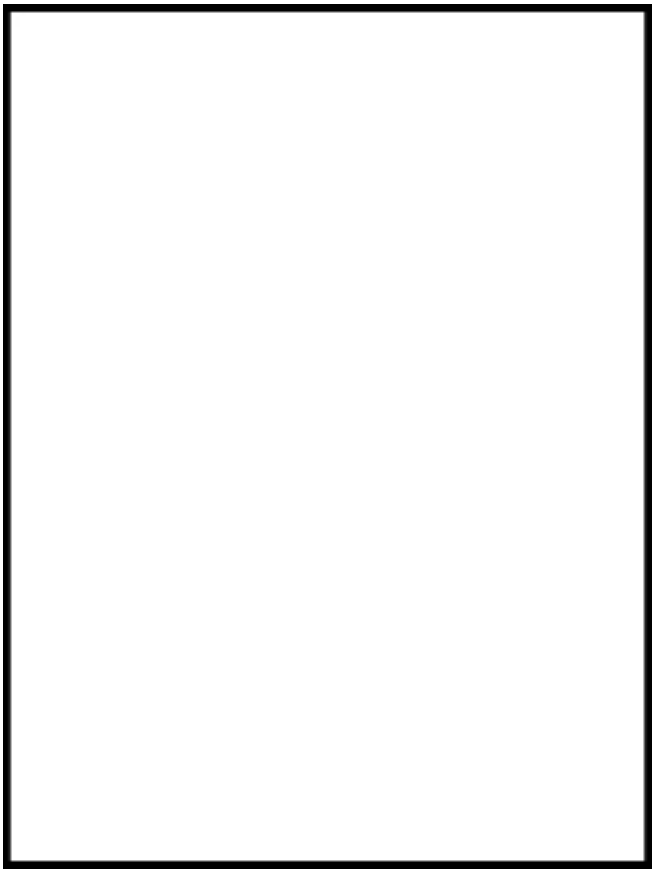

M-08
87 km
54 miles
Olympus Mons


M-10
250 km
157 mi
Martian Northern Hemisphere









Earth/Mars Comparison Worksheet

Use this worksheet to record your observations of the Earth and Mars images. Identify which Mars and Earth images you are comparing by writing the letter of the image on the appropriate line. Next, describe in words both the Earth and Mars image. Using your descriptions of each image, explain why you think the Mars image is a good comparison to the Earth image.

Mars Image _____ Earth Image _____

Description: Description:

Why these images match:

Mars Image _____ Earth Image _____

Description: Description:

Why these images match:

Mars Image _____ Earth Image _____

Description: Description:

Why these images match:

Mars Image ____ Earth Image ____

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Why these images match:

Mars Image ____ Earth Image ____

Description: Description:

Why these images match:

Mars Match Game Answer Key, Script

M-01, E-05 - Tributaries

This feature seen on Mars resembles a series of **tributaries** – small streams or rivers that combine to form larger streams and/or rivers. On Earth, smaller rivers or streams combine into larger and larger rivers. Eventually all these rivers become one single river and empty into a larger body of water such as a lake or an ocean.

M-02, E-10 – River Delta

This feature on Mars resembles a **river delta.** River deltas on Earth form where rivers empty into lakes or oceans. Deltas form as sand and other particles are dropped by the river into the lake or ocean. Over time, the sand and particles build up, eventually blocking the flow of the river. The river then re-directs its flow into the lake or ocean and the process starts over again. This image from Mars is considered strong evidence that liquid water once flowed on the surface of Mars for extended periods of time.

M-03, E-01 – Meandering River

This feature on Mars can be seen in Mars image 03. It is a close-up focusing on what looks like a **meandering river** that changed its direction of flow. The feature can be seen just to the left of center in Mars image 02. On the Earth, rivers redirect themselves over time as seen in the Earth image 01 of the Amazon River. The light blue is the current path of the river - the darker blue next to it shows the path the river took in the past. The same pattern can be seen in the Mars image 03 where the earlier path the water took is cut by the later path.

M-04, E-11 – Gullies

Gullies, like those in Mars image 04, are typically found in mid-latitude regions of Mars. They can be seen in the sides of hill and the walls of craters. Gullies seen on the Earth are typically formed by flowing water, although they may also be formed by landslides. One of the most debated topics in Mars science is whether or not gullies on Mars were formed by liquid water or landslides.

M-05, E-09 – Polar Ice Caps

Like the Earth, Mars has polar ice caps. Mars image 05 shows the northern polar ice cap with its distinct spiral shape. Like the Earth's ice caps, Mars' north and south ice cap are made of frozen water. However, during their respective winters, both the north and south ice cap are covered by a layer of carbon dioxide ice, or dry ice.

M-06, E-03 - Canyons

Mars image 06 shows a perspective of Coprates Chasma. Coprates Chasma is part of the Valles Marineris canyon system. Valles Marineris is as deep as 10 km (6 miles) and as wide as 600 km (372 miles)! In comparison, the Grand Canyon has an average depth of 1.6 km (1 mile) and a maximum width of 29 km (18 miles).

M-07, E-08 - Canyons

The Mars 07 image shows a view of Valles Marineris as seen from orbit around Mars. Valles Marineris stretches over 4000 km (~2500 miles) across the surface of Mars. If you were to put Valles Marineris on the Earth it would stretch across the entire United States! The Grand Canyon in comparison is just 446 km (277 miles) in length.

M-08, E-07 - Volcanoes

Mars has volcanoes like the Earth. Olympus Mons is a type of volcano called a shield volcano. The Hawaiian Islands and the Galapagos Islands are examples of shield volcanoes on the Earth. Most people think of volcanoes as steep, explosive mountains like Mt. St. Helens in Washington. Shield volcanoes, however, are broad, dome-shaped volcanoes that erupt rather quietly. Instead of erupting violently like an explosion, lava oozes out of vent located at and near the top of the volcano then flows down the slopes. Olympus Mons is the largest known volcano in the Solar System. The base of the volcano is as big as the state of Arizona and the top of the volcano is over 26 km (16 miles) high!

M-09, E-06 - Craters

Craters are formed when asteroids or comets slam into another body leaving a large hole in the ground. Craters can be seen scattered on Mars, particularly in the southern hemisphere, and on the Moon, Mercury, and the moons of the outer planets. There are craters on the Earth too, but not as many as we see on other planets like Mars. Why? *Ask the class why they think we don't see many craters on the Earth.* The Earth has been hit just as many times as the Moon, Mars, and Mercury. The difference is that Earth has weather that has eroded away many craters. Meteor crater in Arizona is the best preserved crater on Earth. This crater is small compared to craters on other bodies in the Solar System. It is only 1.2 km (0.75 miles) across. Gusev crater on Mars, for example, is 150 km (93 miles) wide.

M-10, E-02 – Storms

Cyclonic storms exist on both Earth and Mars. Examples of cyclonic storms on the Earth are hurricanes and tornadoes. Cyclonic storms on Mars are not hurricanes or tornadoes but very large dust storms which can engulf the entire planet.

M-11, E-04 – Streamlined Islands

The Mars 11 image shows an area where streamlined islands are believed to have been carved by a catastrophic flood. Water flowed from the upper right of the image to the lower left. These same types of features are seen on the Earth like in the Earth 04 image from the Amazon River.