Mars Match Game

Overview

Students view images of Earth and Mars to compare features, just like a scientist (planetary geologist) would. After matching pairs of Earth features with Mars analogues, students discuss why they matched the pairs together. Ideally, students will debate if pairs are not agreed upon, just like scientists would.

What's the point?

Scientists use evidence to support claims. We know a lot about the Earth, because it is easy to study most places on Earth. For other planets, it is much more difficult because we send robots (spacecraft) to gather our evidence for us. Often, we must compare what we see on another planet with what we find on Earth.

Scientists often debate because they do not always agree on the geologic processes at play. Debate usually leads to discussions of what types of evidence is needed to justify a position. This leads to more space missions with instruments that can help gather additional evidence. This is how we build our understanding of the Solar System.

Learning goals

After doing this activity, students will be able to:

- Engage in discussion about geologic features on another world.
- Explain logic behind pairing Mars and Earth geology together.

Materials

- Suggested reading: Bennett, Jeffrey. 2006. *Max Goes to Mars*. Boulder, Colo.: Big Kid Science. (Grades 2 and up)
- Earth/Mars Comparison Game Cards
- Mars Match Game Answer Key
- Recommended: Sharpies of different colors

Preparation

- Print, per group of 3-4, one set of Earth/Mars Comparison Game Cards, double sided with long edged binding

- Laminate the cards if desired
- Cut and shuffle the card in sets
- Recommended: Mark each card of each set with a sticker or sharpie mark to indicate they are from the same set (for example, a blue star on each card of the same set)

Procedure

- Read Max Goes to Mars to the students.
- Explain (or reiterate) that there are areas of Mars that we think had liquid water flowing on it in the past. Mars also has geologic features that resemble features we see on Earth. If necessary, explain that geologic features are features we notice in our landscape, like riverbeds, mountains, canyons, rocky fields, volcanoes, etc.
- Hand out Earth/Mars Comparison Cards.
- Explain that cards with an "M" are images of Mars and that cards with an "E" are images of Earth. Some cards have additional information on the back.
- In teams of 3-4, students will match one Earth feature and one Mars feature together, just like a scientist would.
- Note that students may match based upon their own criteria. This may include shape and color. Walk around the room and probe students on their various choices. Try not to give the "answers" away.
- After students finish matching the cards, call on volunteer teams to share a match they feel really confident about. Ask: Why did you match these two together? What strategies did you use? Ask: Did other groups have the same cards matched together?
- Continue calling on volunteers in this way until someone disagrees with the matched images
    - OR after a few volunteers share their matches, ask if any groups had a match that they did not feel confident about. Allow at least one group to share their "unconfident" matches and ask the groups if everyone matched the same pairs.
- It is very likely that many groups will have matched pairs of cards differently. Ask students why they chose the matches they did, and whether, after group discussion, any group would like to change their choices.
- Explain that scientists debate with one another all the time, and that we are limited by the evidence that we have.

- Ask: What evidence do you think you would need to figure out if your matches were correct? (Ans. visiting the planet, taking more measurements, improving the spacecraft with better cameras, sending improved instruments, sending a lander to take samples, sending a person with instruments etc.)
- While the point of this exercise is not to get a right answer, you may read the answers out to students from the Mars Match Game Answer Key. Explain that these answers are currently scientifically accepted, but that over time, and with better evidence, the answers may change.

Alternate ideas

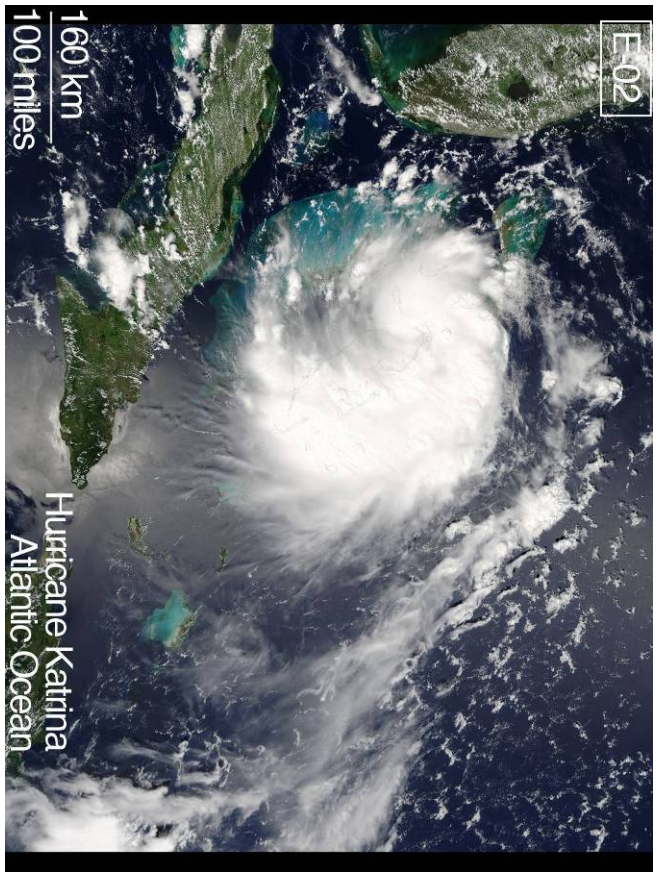
- Explore Earth and Mars using GoogleEarth (and GoogleMars)

Credits and Inspiration:

Sanlyn Buxner provided permission to modify the Mars Match Game, created by the Arizona State University.
http://was.cdlib.org/wayback/was/20140811234534/http://phoenix.lpl.arizona.edu/pdf/lesson_6.pdf

Earth/Mars Comparison game cards

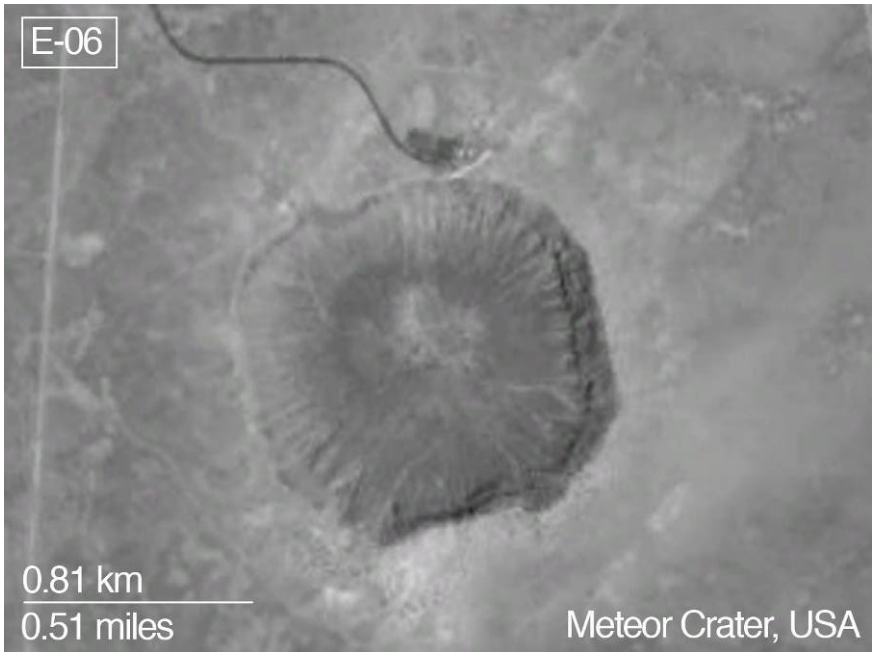
Print pages 37-48 double sided.

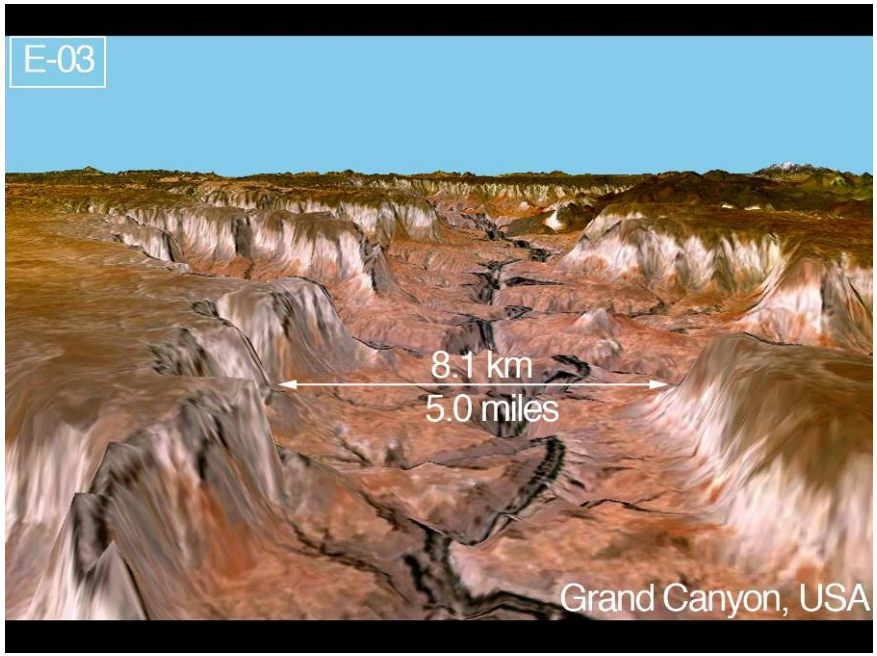


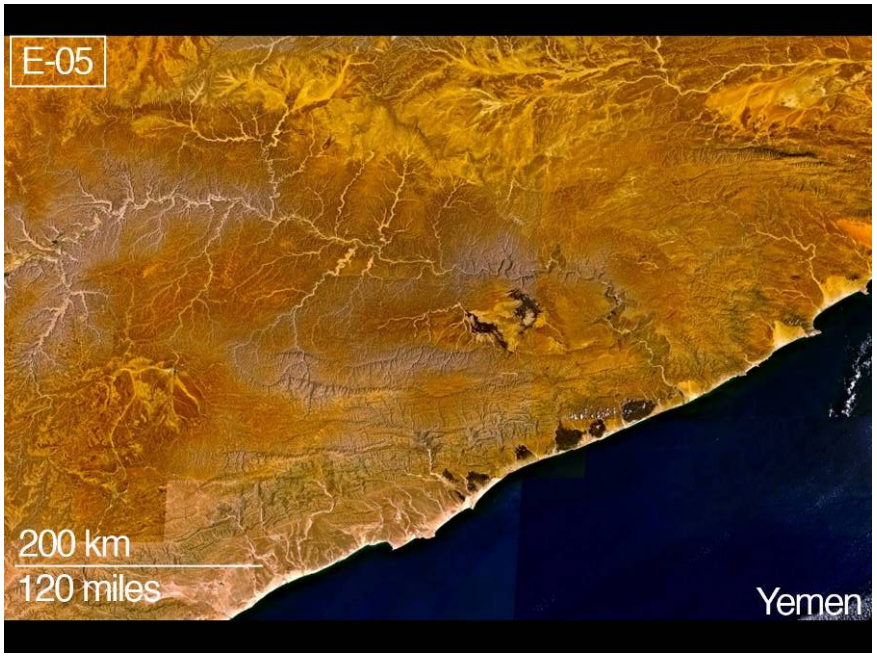
Rivers can change the direction they flow.

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

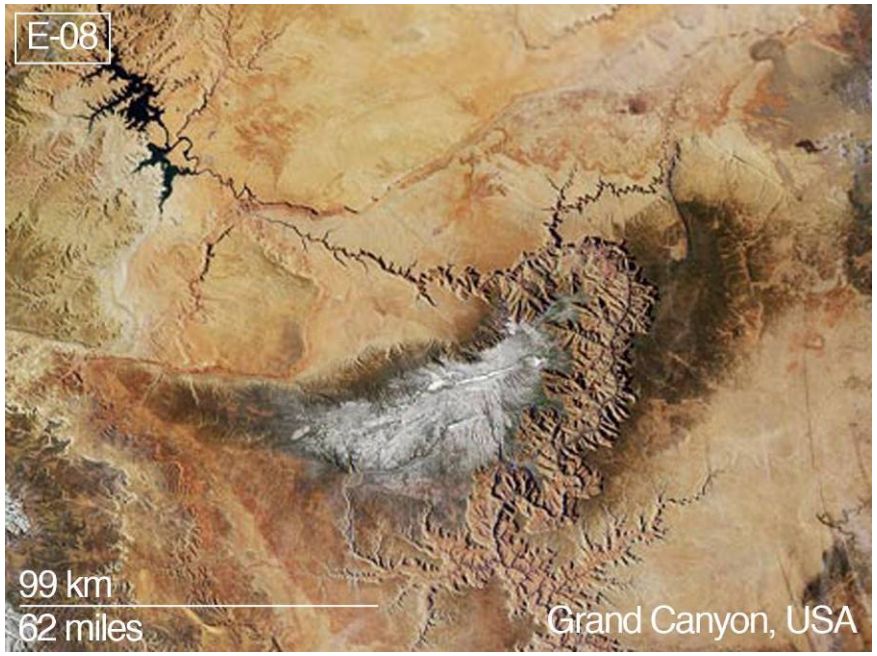

E-05
200 km
120 miles
Yemen

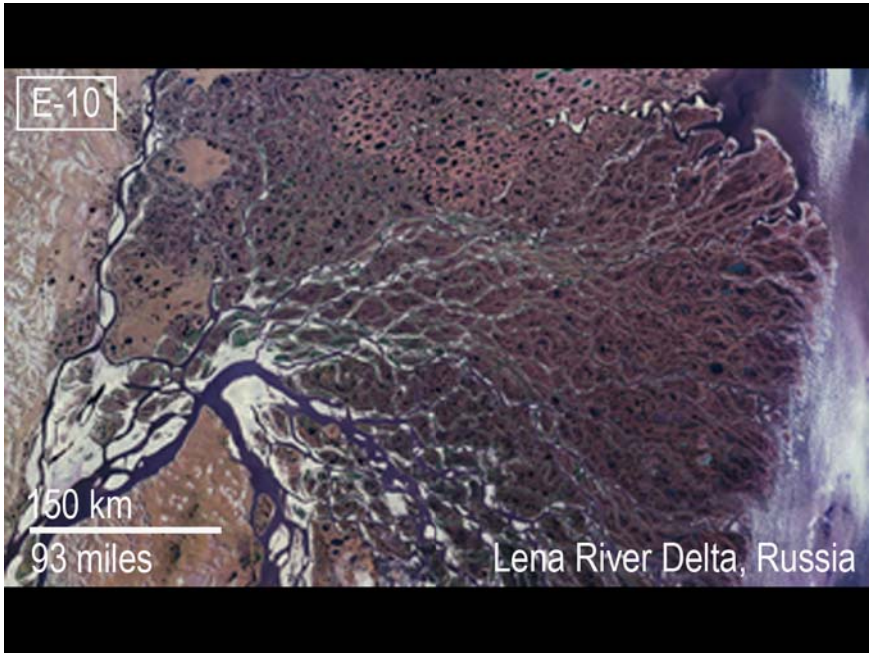
The Grand Canyon can be up to 18 miles across and 1 mile deep.

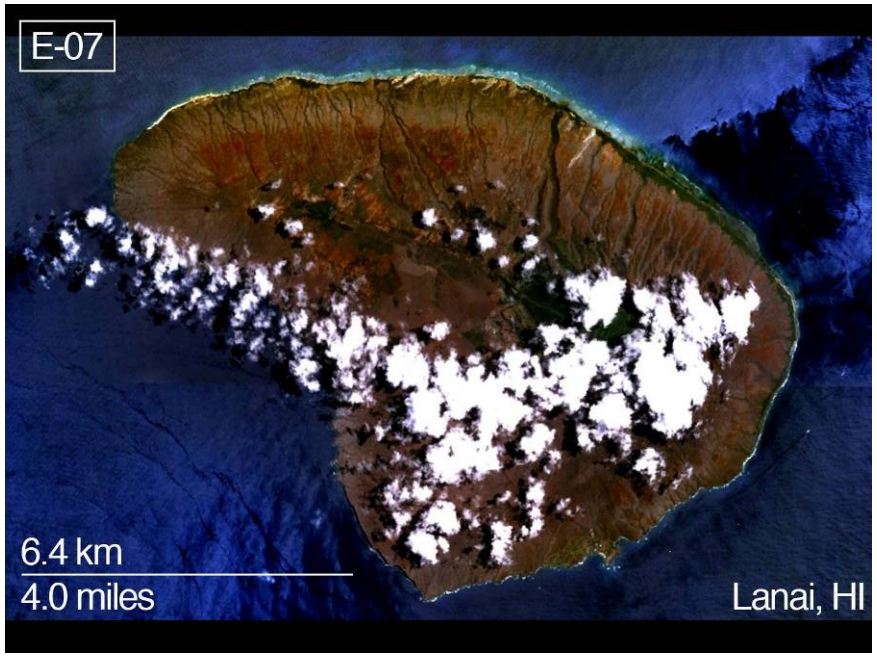
Small streams come together to make one big river.

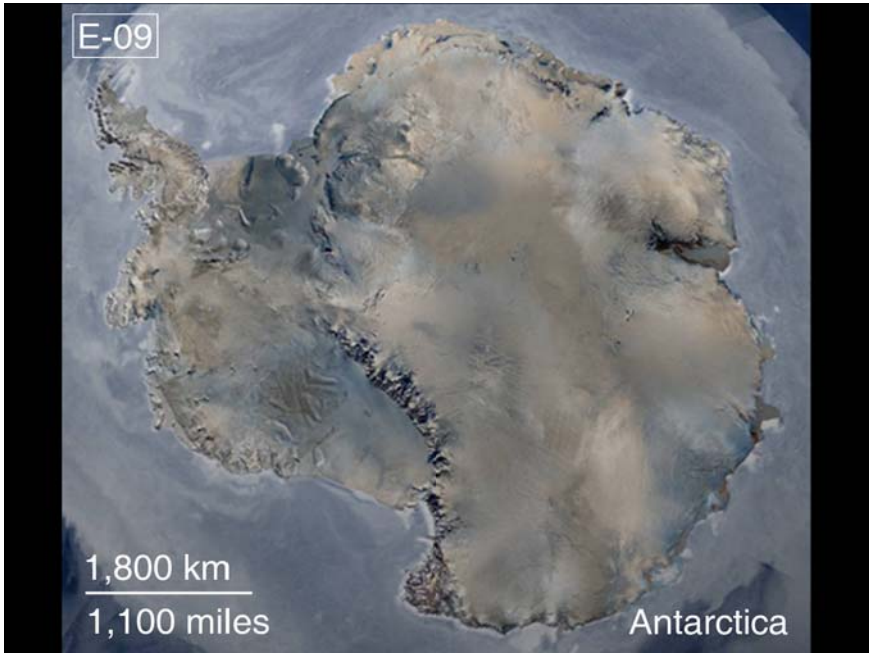
The island in this river did not erode as much as the land around it.

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

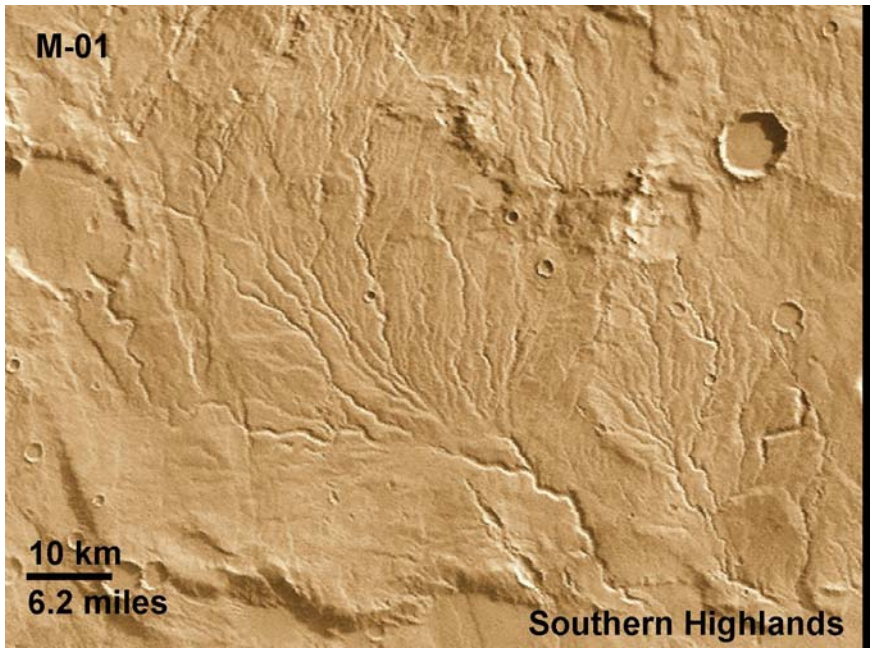

E-09
1,800 km
1,100 miles
Antarctica

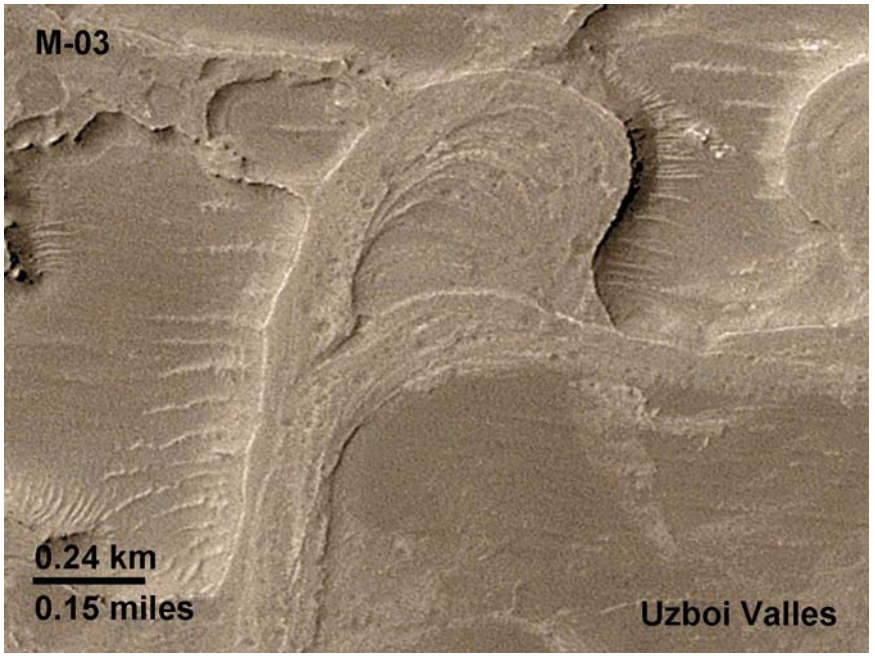
The island of Lanai (Hawaii) is a shield volcano.

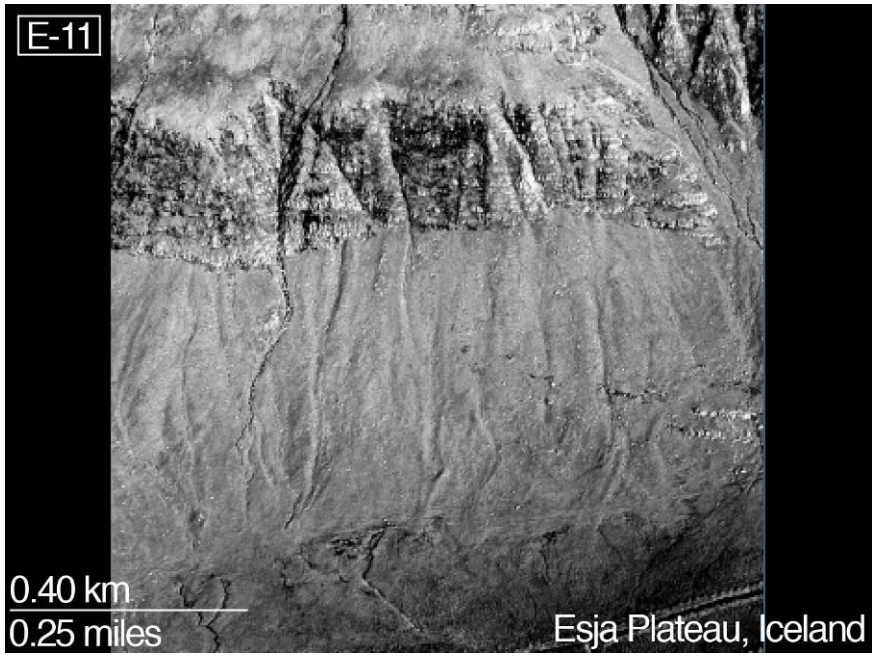
Both the north and south polar caps of Earth are made of frozen water. Most of Earth's fresh water is locked in the southern cap.

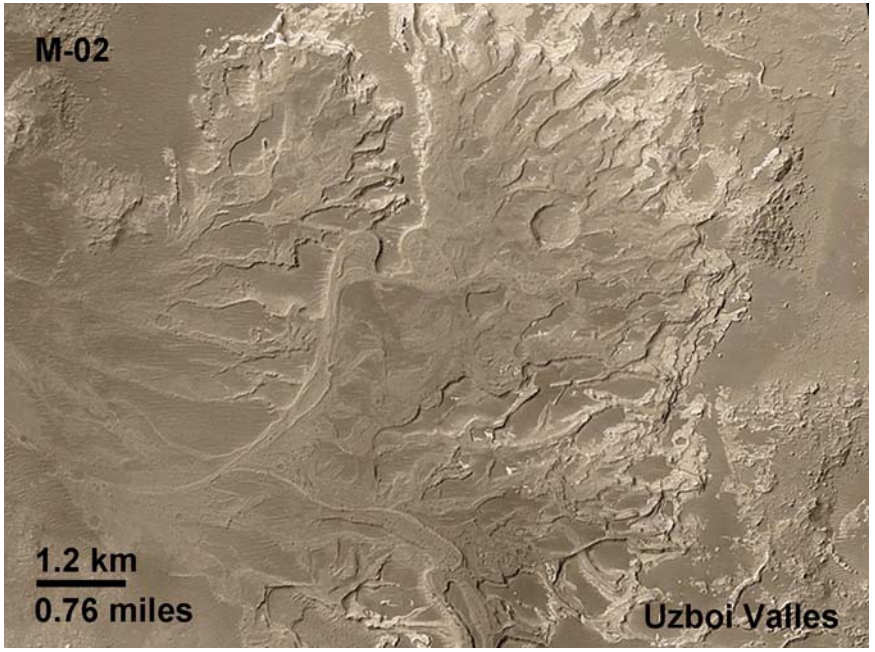
The Grand Canyon is 280 miles long.

Rivers end in lakes or oceans and form deltas.

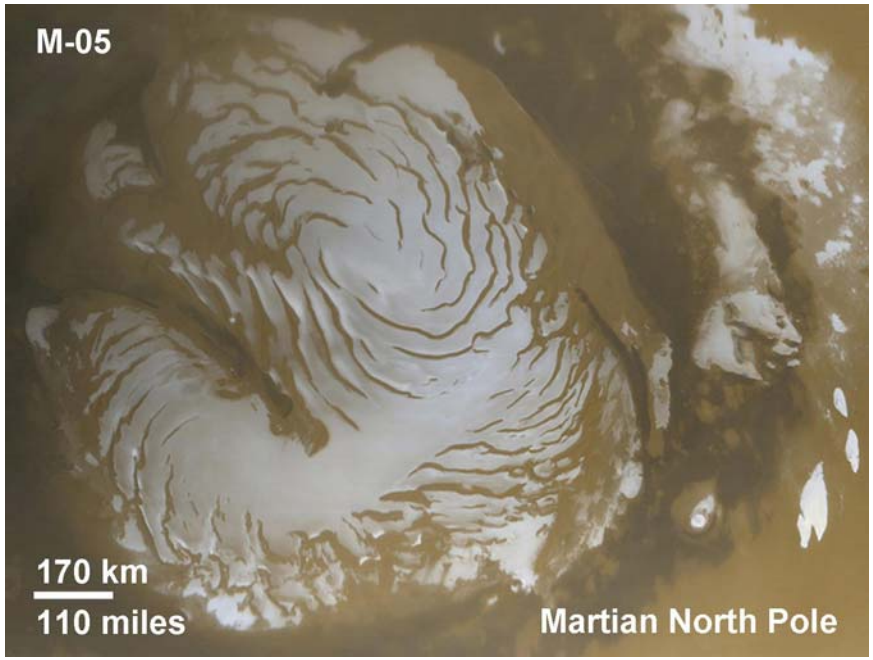

M-01
10 km
6.2 miles
Southern Highlands

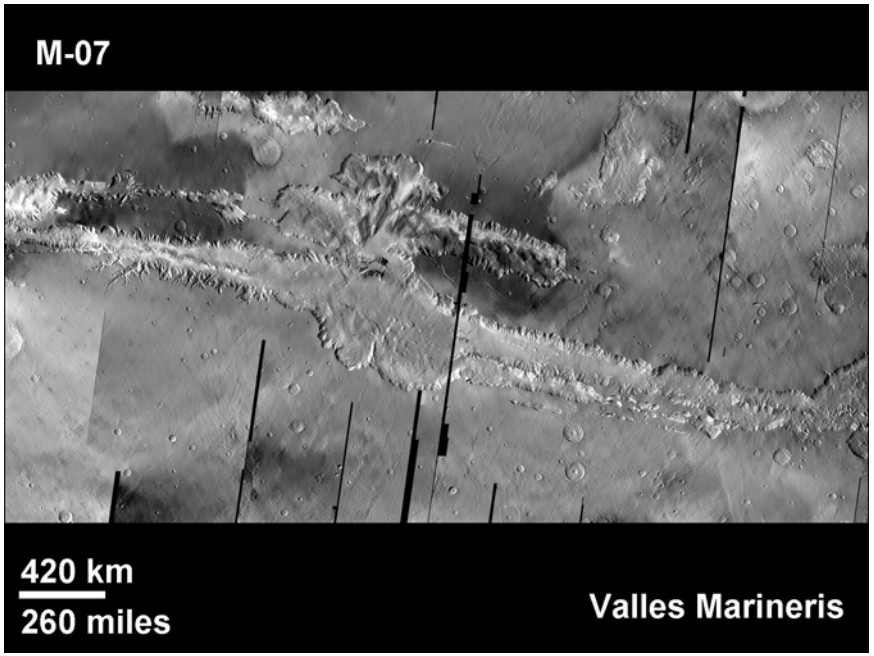

M-03
0.24 km
0.15 miles
Uzboi Valles

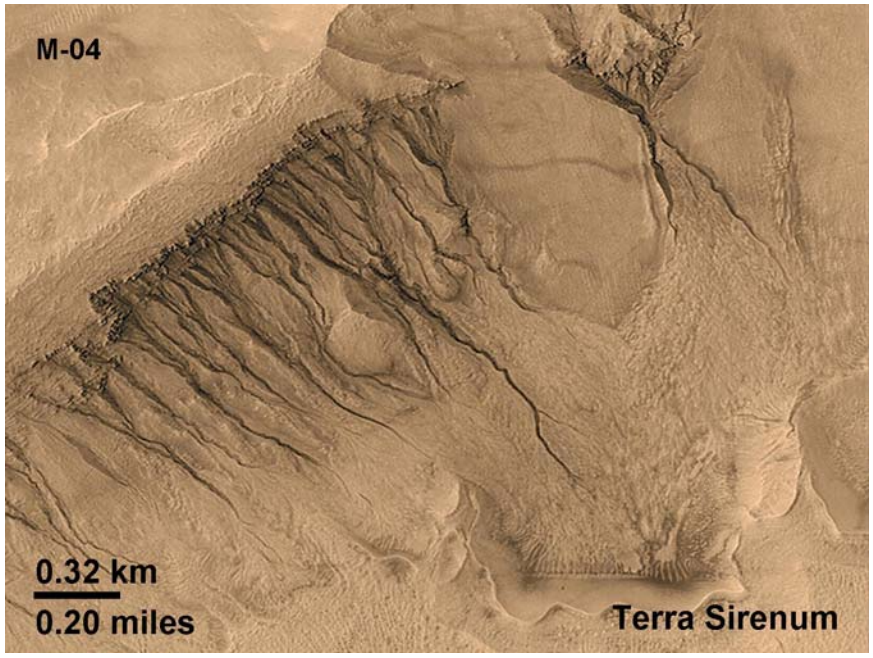

E-11
0.40 km
0.25 miles
Esja Plateau, Iceland

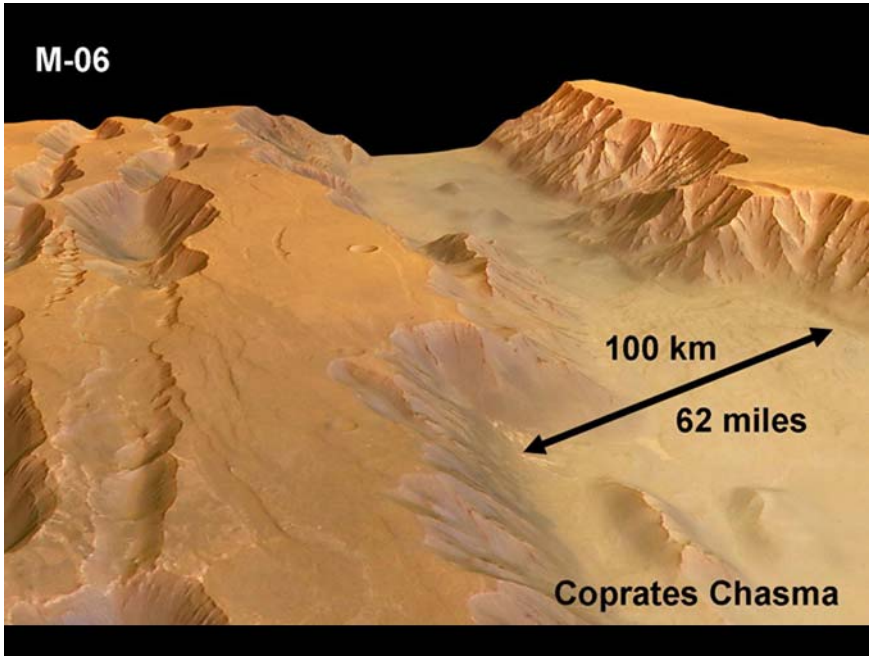

M-02
1.2 km
0.76 miles
Uzboi Valles

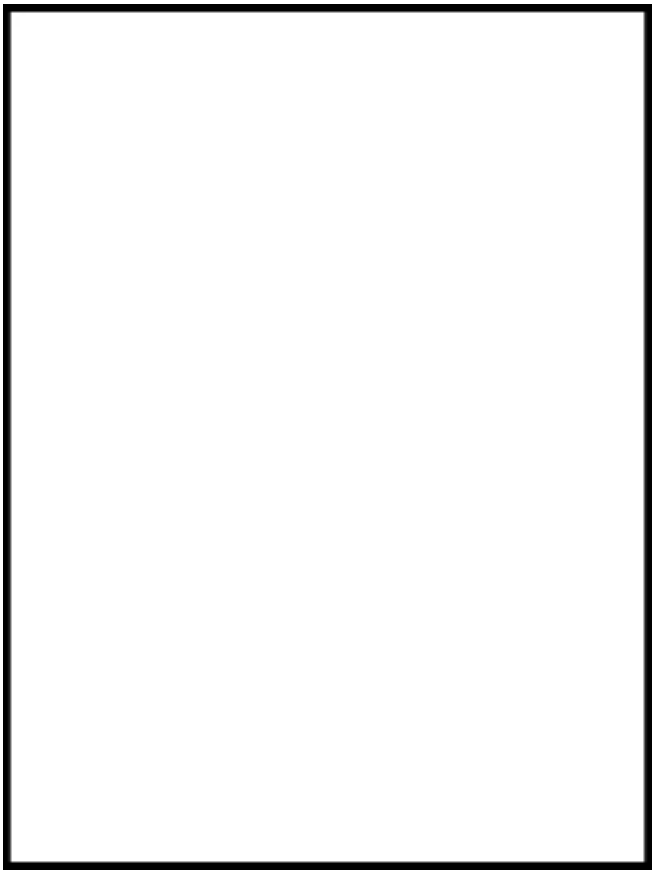
Gullies form on the slopes of hills where there is liquid water.

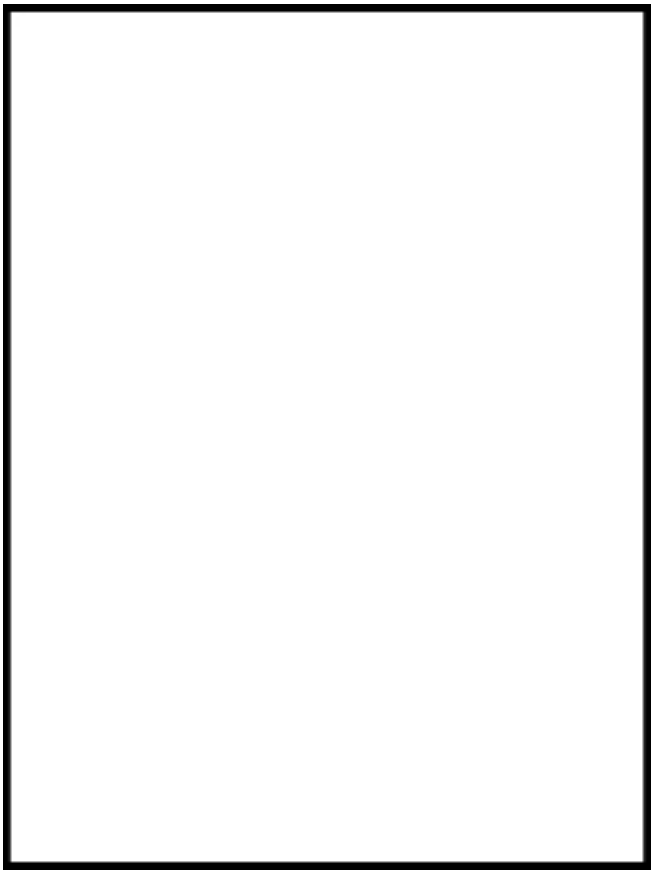

M-05
170 km
110 miles
Martian North Pole

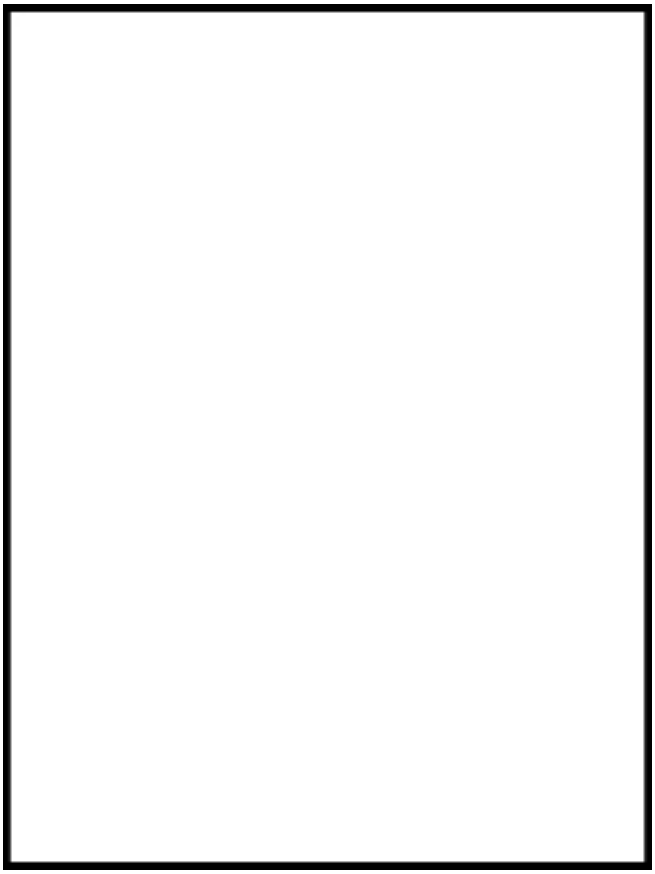

M-07
420 km
260 miles
Valles Marineris

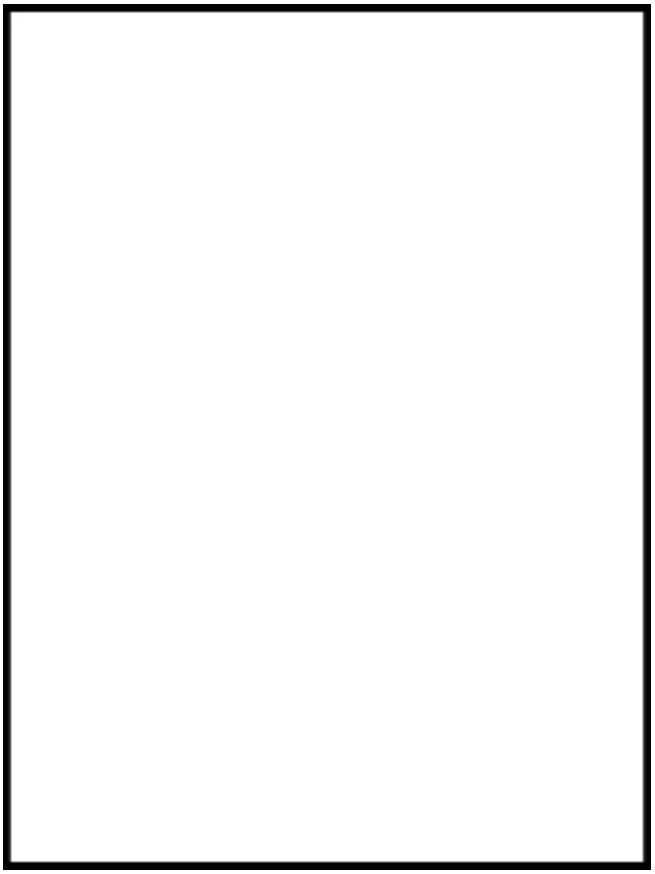

M-04
0.32 km
0.20 miles
Terra Sirenum

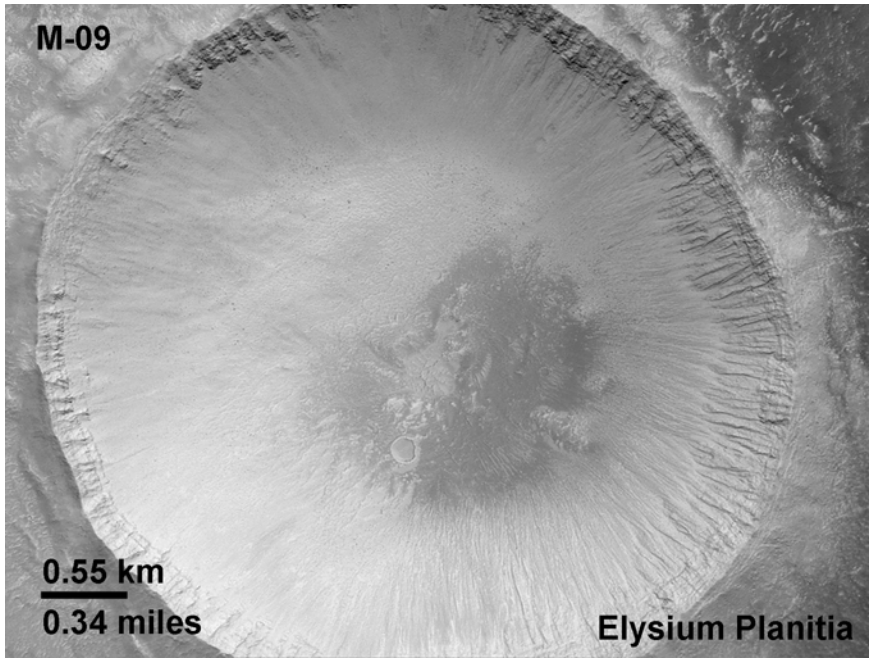

M-06
100 km
62 miles
Coprates Chasma

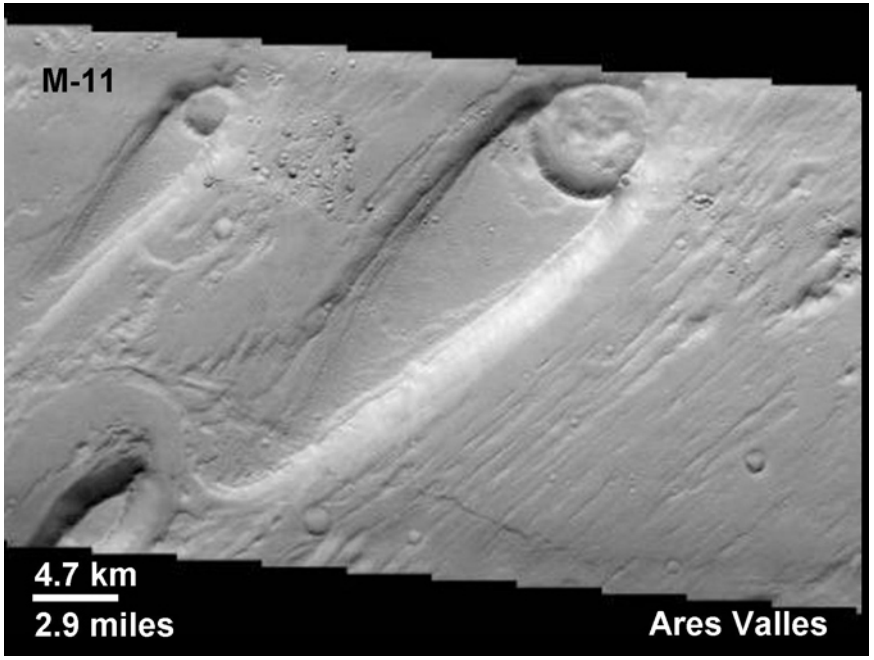


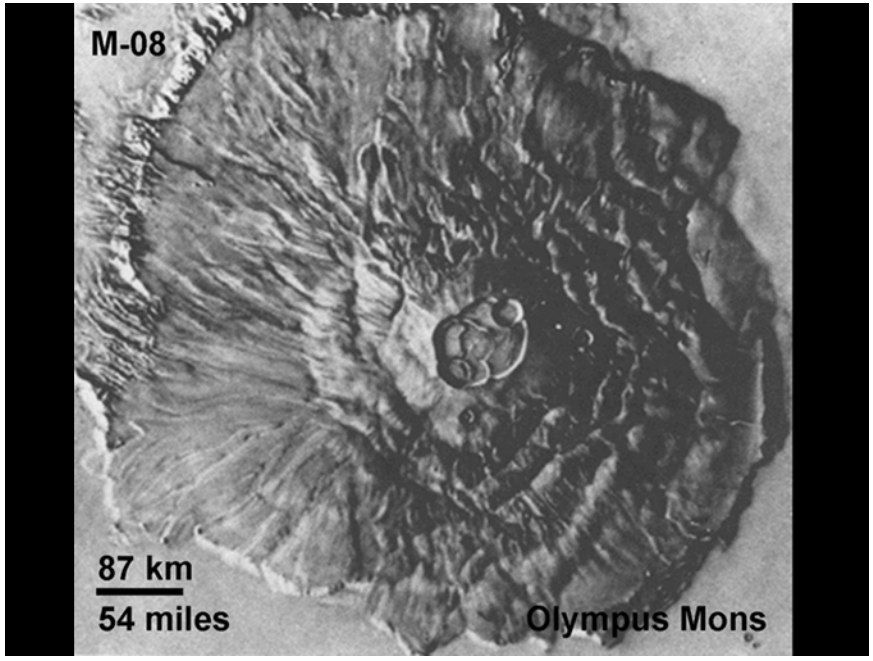


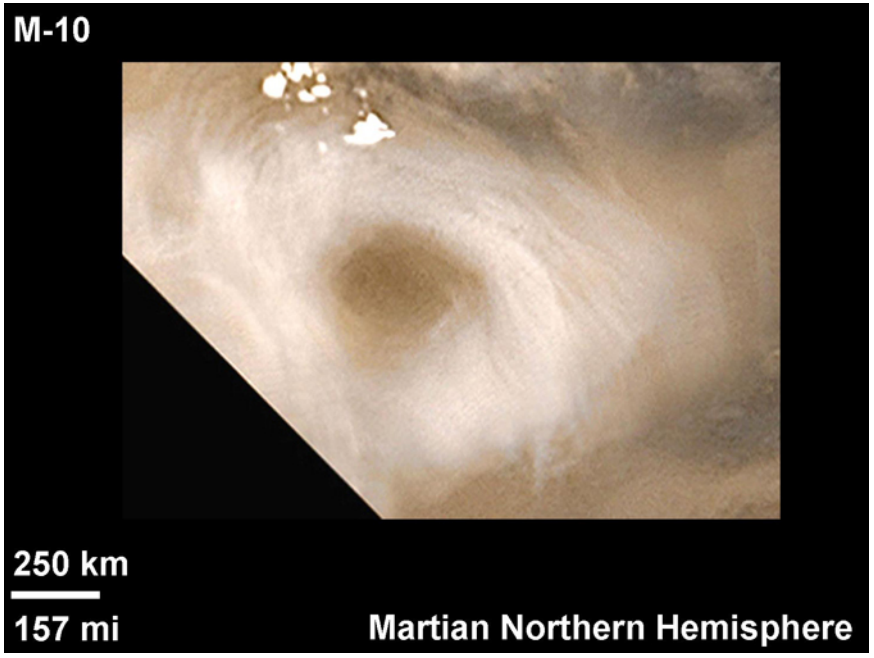


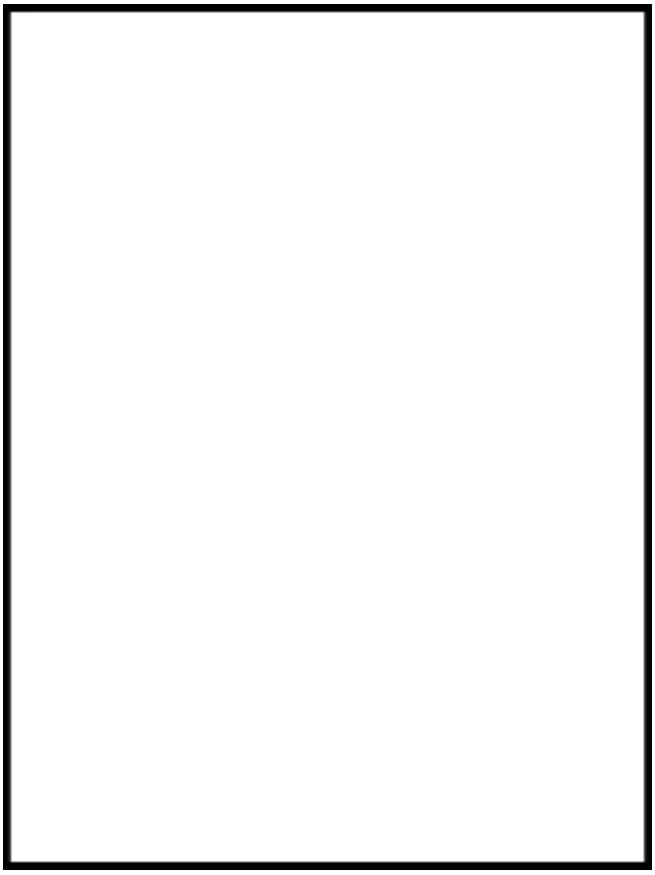


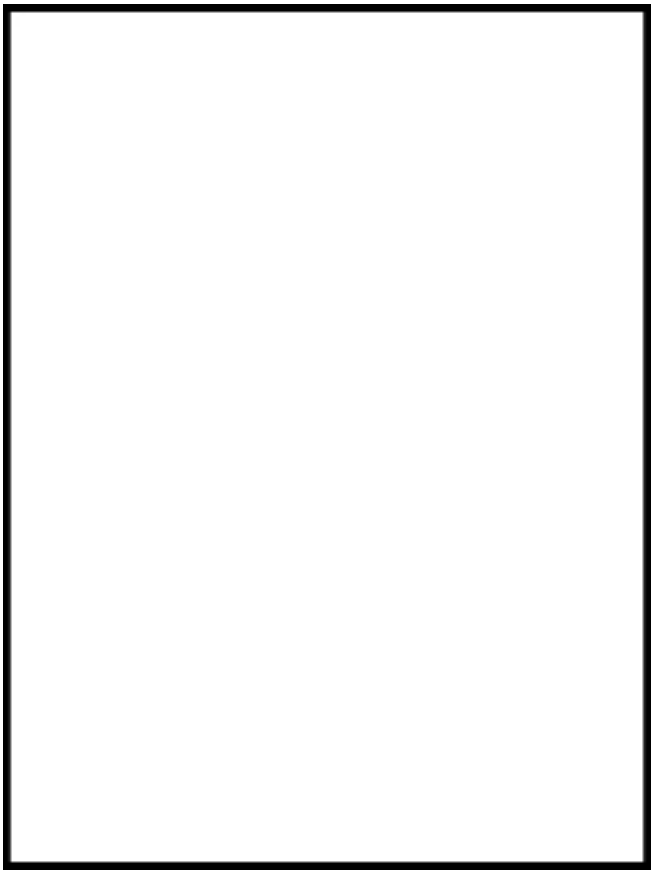

M-09
0.55 km
0.34 miles
Elysium Planitia

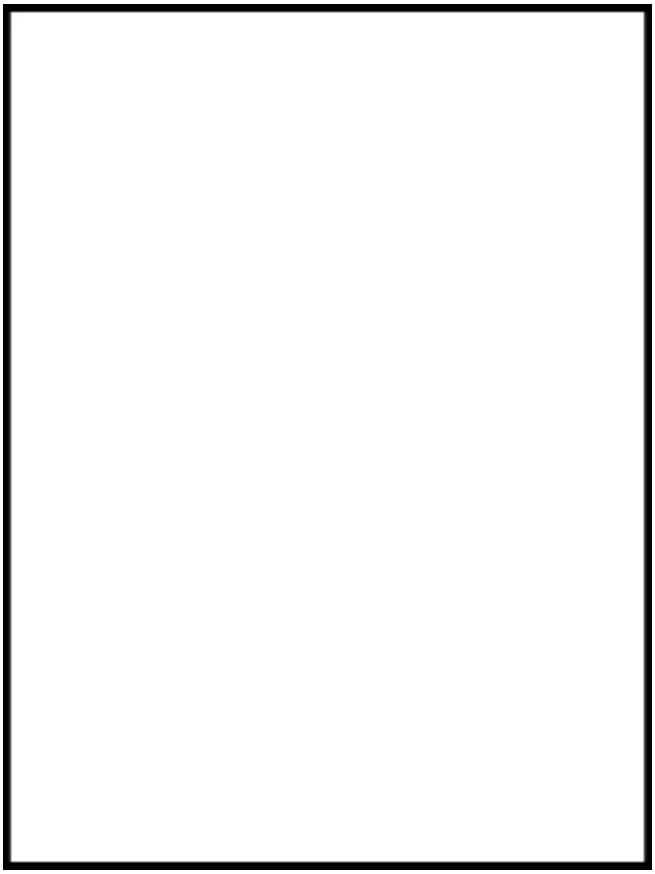

M-11
4.7 km
2.9 miles
Ares Valles

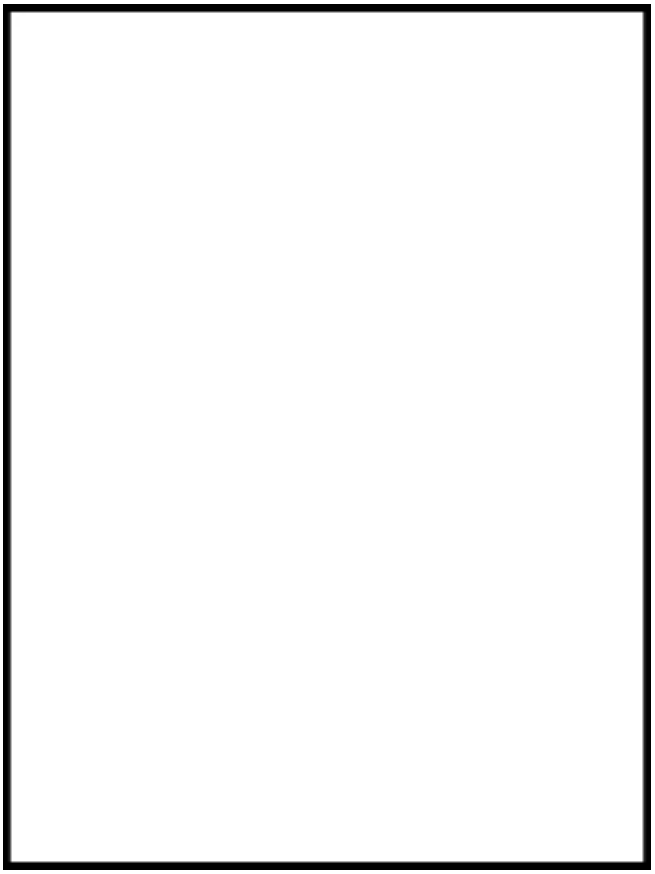

M-08
87 km
54 miles
Olympus Mons


M-10
250 km
157 mi
Martian Northern Hemisphere









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.