

**SEARCHING FOR EVIDENCE OF WATER ON MARS**

(Developed by: Ted Latham, teacher - Watchung Hills Regional High School, Warren NJ)

**OBJECTIVE: To identify various geological land forms on Mars' surface, similar to those found on Earth, that suggest water once existed on this planet and helped to transform its surface.**

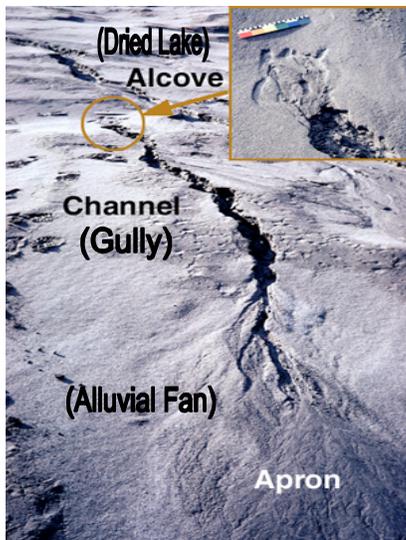
Water is everywhere on Earth and it is constantly reshaping the Earth's **crust** through both mechanical and chemical interactions. As water moves from higher to lower elevations, rock and soil may be slowly and gently carried away forming **gullies** down the sides of hills, and deposited in fan shaped structures called **alluvial fans** at their bottoms. **Dendritic streams** flow into **meandering rivers** across the surface, sometimes cutting deep **gorges** into the crust such as the Grand Canyon. Flash floods may spill out over the banks of lakes, violently flooding and pushing large quantities of matter across hundreds of square miles of land. **Sediments** are deposited in horizontal layers into the lowest depths of the oceans. The oceans continue the distribution of rocks and minerals through wave action along the beaches and in deep currents along the ocean floors. The frozen water in **glaciers** and our **polar ice caps** periodically expand pushing large sheets of ice across continents that rip apart mountains and move massive amounts of rocks for many miles, gouging the Earth's surface in the process.

As the water flows on, or as the climate of an area changes, the water may dry up revealing a variety of **land forms** such as dry riverbeds and gullies, dunes, and sedimentary layers of rock thrust upwards forming the tops of mountains where they were once at the bottoms of oceans. To future generations of geologists these land forms may serve as evidence that water once existed in that area.

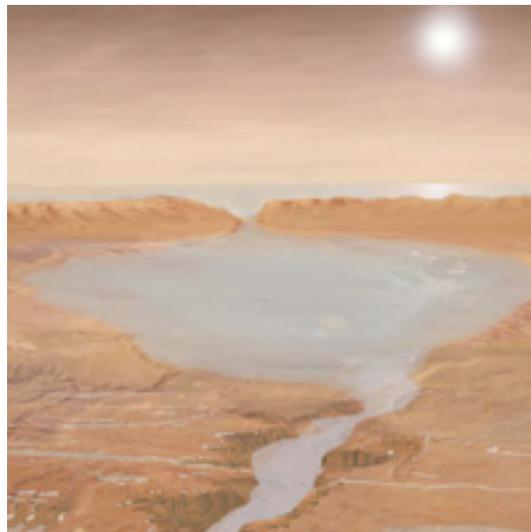
Imagine that you are flying in an airplane over some dry part of the Earth's surface and look down and take a picture of the land forms that are shown below. There is no water to be seen anywhere, but the land forms suggest that water once flowed in this area. With some imagination, and your knowledge of the erosive forces of water, you could construct a hypothetical picture of what this scene may have looked like when there was water in this area.

The rounded alcove at the top of the hill suggests that a lake once existed there, spilling out its water creating an ancient meandering river that cut a gully into the hill's slope and finally depositing sediment at the bottom of the hill in an alluvial fan. An artist has taken these ideas and reconstructed what this area might have looked like in the painting to the right.

**Current photograph of Earth land form.**



**Artist's conception of what this area looked like in the past with water added.**



Similar to the scenario we just described on Earth, NASA's Mars Reconnaissance Orbiter "MRO" (shown to right and launched in 2005) is taking detailed pictures of the Martian surface that are helping planetary geologists find land form evidence to confirm the past or present existence of water on its surface. CRISM, or Compact Reconnaissance Imaging Spectrometer for Mars, is an instrument on MRO that is searching for traces of past and present water on Mars. Before we evaluate previously taken photographs of Mars' land forms, let's get to know a little more about land forms on the Earth's surface for later comparison to those found on Mars.



Using a classroom references such as a geology text, dictionary, encyclopedia, or Internet, define the following land forms that exist as a result of liquid or solid (ice) water flowing across the surface of the Earth's crust. Houghton Mifflin's "Geology Link" provides a good geology glossary on the Internet at:

<http://college.hmco.com/geology/resources/geologylink/glossary/s.html>

1. Land Form -
2. Meandering River -
3. Dendritic Streams -
4. Sedimentation -
5. Ice Erosion (or Glaciation) -
6. Gully Erosion -
7. Flood Plains -
8. Alluvial Fans -
9. Canyon -
10. Crust -
11. Alcove -

Pictorial examples of the **land forms** found on Earth that you have just defined are shown below. Compare the pictures to your definitions so that you can understand how each land form was created by the flow of water or ice across the Earth's surface.



**Meandering River  
(the Nile River)**



**Dendritic Streams  
(Yemen)**



**Canyon  
(Grand Canyon USA)**



**Sedimentation  
(Morocco)**



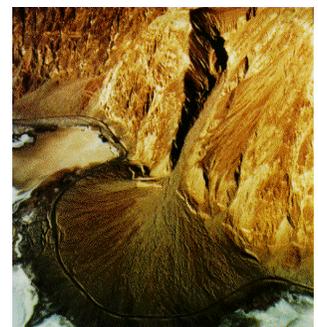
**Ice & Water Erosion  
(Andes in Chile)**



**Gully Erosion  
(Andes in Chile)**

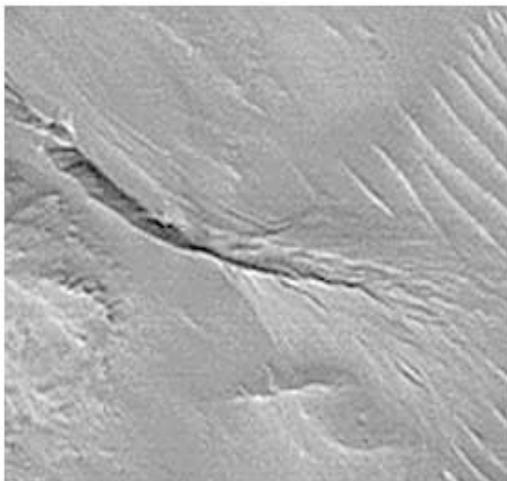


**Flood Plains  
(Chile)**



**Alluvial Fan  
(Andes)**

Now on to Mars! A single photograph showing several land forms on Mars' surface is shown below. On this photograph point out and write the names of land forms that you think are similar to those found on Earth that provide evidence that water once existed on this part of the planet. Be a planetary artist and draw a picture of this scene, including water, as you can imagine it in the past .

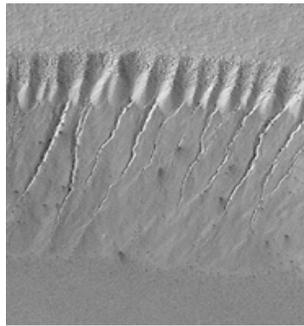


The six photographs shown below are of land forms taken from a satellite orbiting Mars. Compare these photographs to the land form photographs and the definitions for the land forms that we have studied on the Earth. Identify the kind of land form shown in each picture by name and explain why you made that choice. Your choices are:

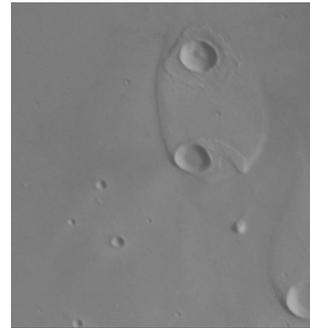
- Meandering River**
- Dendritic Streams**
- Sedimentation**
- Ice Erosion (or Glaciation)**
- Gully Erosion**
- Flood Plains**
- Alluvial Fans**
- Canyon**



**Land form:** \_\_\_\_\_  
**Explanation:**



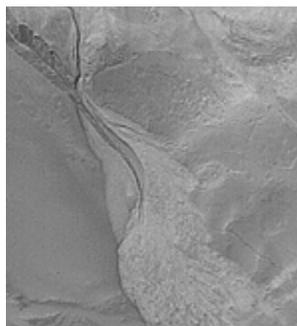
**Land form:** \_\_\_\_\_  
**Explanation:**



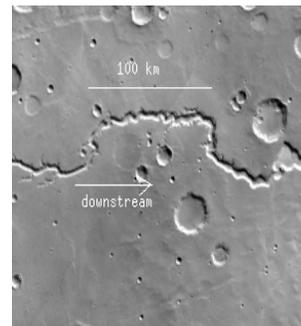
**Land form:** \_\_\_\_\_  
**Explanation:**



**Land form:** \_\_\_\_\_  
**Explanation:**



**Land form:** \_\_\_\_\_  
**Explanation:**



**Land form:** \_\_\_\_\_  
**Explanation:**

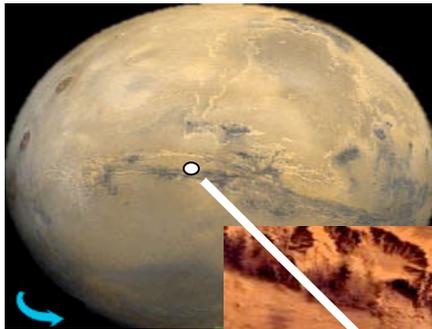
Taking on the role of a Mars Planetologist, lets help NASA search for land forms on the surface of Mars that provide additional evidence for the existence of past or current water flow on the Martian surface. Locate the "**Clickable Atlas of Mars**" on the Internet. When you find this website it should look like the screen shown to the right.



The URL for "**Clickable Atlas of Mars**" is at:

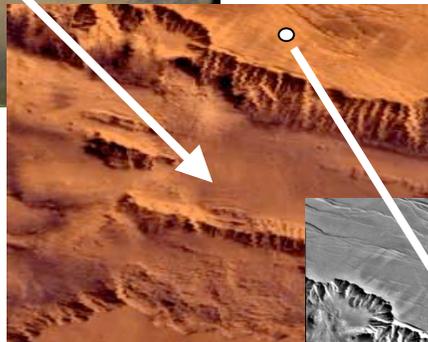
<http://www.roving-mouse.com/planetary/Mars/Atlas/clickable-globe.html>.

The blue arrows at the bottom of the Martian globe allow you to spin the glob to see all sides of the planet. When you decide on a side of Mars that you would like to explore, follow the instructions and example below to discover the land forms that will confirm the past or present possibility of water on Mars.

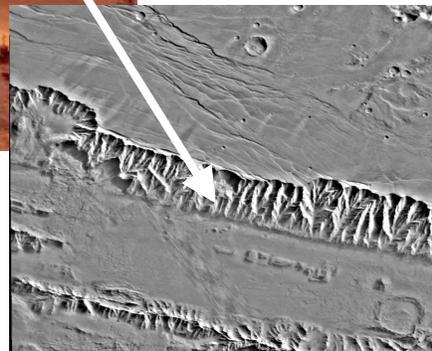


Click on blue arrow to rotate Mars.

STEP 1 - Click on any point on the globe and zoom in on the area of interest. Clicking on the dot in this location zooms in on a close-up of the area shown in the middle picture.



STEP 2 - Clicking on any point in the middle picture zooms you in even closer to the land forms on Mars.



STEP 3 - Make a PRINT of this picture if you think you see land forms that offer evidence of past or current water flow.

In the last photograph above there are land forms that suggest that water flowed to make canyons, and then water flowed down the canyon walls to make gullies with alluvial fans at the bottom of the canyon walls. Some land forms show evidence for massive flooding in the upper part of the picture. Writing their analysis of the land forms found in their own photographs, each student should share this information in an oral report to the class, and then display it on a bulletin board titled **SEARCHING FOR EVIDENCE OF WATER ON MARS.**

For further research on finding evidence for water on the surface of Mars, check out these NASA Web sites:

**The Case of the Missing Mars Water** tells us all about the clues suggesting that liquid water once flowed on Mars, raising hopes that life could have arisen there, but the evidence remains inconclusive and sometimes contradictory. All this at [http://science.nasa.gov/headlines/y2001/ast05jan\\_1.htm](http://science.nasa.gov/headlines/y2001/ast05jan_1.htm)

**Making a Splash on Mars** tells us about a planet that's colder than Antarctica and where water boils at ten degrees above freezing, how could liquid water ever exist? Scientists say a dash of salt might help. This Web site may be found at <http://science.nasa.gov/headlines/y2000/ast29jun%5F1m.htm>

**Sedimentary Mars** is a Web site featuring new Mars Global Surveyor images and how they reveal sedimentary rock layers on the Red Planet that may have formed underwater in the distant past. This is at [http://science.nasa.gov/headlines/y2000/ast04dec\\_2.htm](http://science.nasa.gov/headlines/y2000/ast04dec_2.htm)

**Mars Exploration** from NASA's Jet Propulsion Laboratory provides current information about Mars exploration missions and educational opportunities for students and teachers at <http://mars.jpl.nasa.gov/>