

Mars – Geographical Features – V2.01

ASTR 1010

NAME: _____

Overview:

In this activity you will use elevation maps and images of the surface of Mars to compare its geography to Earth. As part of this process you will also explore evidence to support the claim that Mars had flowing water in the past.

Objectives:

After completing this activity, students will be able to:

- Interpret elevation and topographical maps.
- Understand what “sea level” means with respect to elevation maps.
- Use elevation maps to determine the direction of water flow.
- Discuss geographic evidence for past water flow on Mars.
- Explain how surface smoothness and cratering relate to past volcanic activity.

Definitions

Here are some terms from lecture that we will be using today in lab:

- **Elevation Maps:** Geographic maps that have been color coded so that different colors indicate different vertical elevations. White, red, and orange colors typically indicate high elevation areas such as mountains or plateaus. Black, blue, and green colors typically indicate low elevation areas such as valleys or craters.

Part 1. Elevation Maps of Georgia and Mars

To understand elevation maps, you will start by looking at the geography of Georgia and the surrounding southeast region. Open the Elevation Map of Georgia: found here:

<https://en-us.topographic-map.com/maps/ec/Georgia/>

Notice the color bar to the right of the map. Higher elevations are shown in white, red, and orange. Lower elevations are shown in green and blue. This is the coastal plain. The lowest elevation is **sea level**. Clicking anywhere on the elevation map will tell you the elevation at that point, measured in feet (ft). Use this to answer the following questions.

1) Click on several spots around Atlanta. What is the typical elevation, in units of feet? You do not have to be exact; an estimate will do. Hint: it will probably help to zoom in first.

2)What is the typical elevation around Savannah, GA?

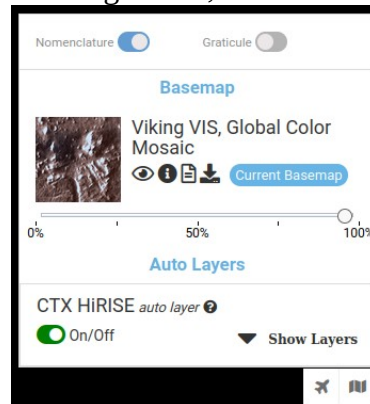
3)Now click on anywhere in the Atlantic Ocean. What is the elevation? With this in mind, if you have an elevation of 500 feet, what is that specifically saying?

Part 2. From Martian Summits to Canyons

Now, you will explore **Mars**! An interactive map of Mars is found here:

<https://trek.nasa.gov/mars/>

You are welcome to do the short tutorial, although it's not necessary. First, note that you can **zoom** in and out using the mouse or the + and – buttons in the lower left. The **Home** icon resets your view. Now click on “Basemaps” which is the lower-right icon, and turn on “Nomenclature”

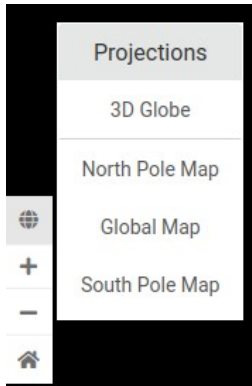


4)What is the latitude and longitude of the Alpeus Colles? It is located near Hellas Planitia, you will need to zoom in, and then click on Alpeus Colles to get the values.

5)Next, if you click on the “Menu” in the top-right corner, you will see a number of calculations we can perform. Click on “Calculate Distance” and then choose “Line”. Calculate the distance of the north polar cap – i.e. the northernmost part of the planet. To do this, draw a line from the leftmost of the map to the rightmost, and again make sure to do this at the top near Vastitas Borealis. What distance do you get? Hint: you can click on the line to remove it, get the distance, or resize it.

6)Now calculate the distance around the equator (roughly around the Tharsis Volcanic Region). What value do you get? Is this surprising?

If you look at the north polar cap, it looks enormous – it certainly looks like it spans the entire diameter of the planet. The reason this looks so large is because when you produce a map you take a three-dimensional object (in this case Mars) and project it unto a two-dimensional map. Fortunately, we can examine Mars in 3D! Click on “Projections” in the lower-left and then “3D Globe”.



7) Examining Mars in 3D, we see that there are a number of geographical features that are actually larger than the north polar cap. Find one of them, and then calculate the distance. Which feature did you choose and what is the size?

The top-left icon is “Data” if you click on that you will notice there are over 2000 entries!

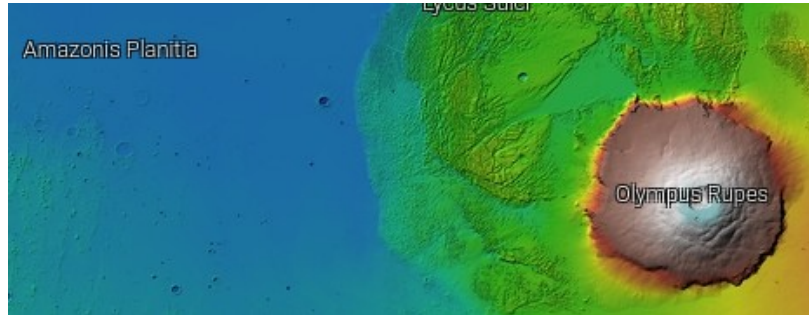
8) Search for “Viking 2”. You will be zoomed-in to where Viking 2 landed. Note that the Viking 2 spacecraft was not mobile. However, there are three locations related to the spacecraft. Why is that?

Go back to the Data icon, and search or scroll down for “MGS MOLA and Mars Express HRSC, Color Hillshade Blend”. When you find it click on it, and then scroll down the tab until you find “Add”. Click on Add. Now that we have color, it is far easier to see the differences in elevation. The highest mountain in the Solar System is known as Olympus Mons, which is actually a dormant volcano. The map may confusingly show Olympus Rupes, which is actually a group of cliffs on Olympus Mons.

9) Calculate the size of Olympus Mons. To do so, calculate the distance from the leftmost to rightmost points. And also from the northernmost to southernmost points. In essence, you will put a + across the volcano. Then multiply the two numbers and you will get the total **square km** of the volcano.

10) Now let us compare your answer with Georgia. The state is roughly 370 km wide and 480 km top to bottom. Calculate the square km and note that this is an overestimation since Georgia is not a perfect rectangle. Now divide your answer to Q9 by what you just calculated. About how much larger is Olympus Mons than the entire state?

Now imagine hiking from the Amazonis Planitia to the summit of Olympus Mons. To calculate elevation, click on Menu (top-right), then “Calculate Elevation Profile”. Note that you can move along the Elevation Chart which is generated, and it will tell you the elevation at each point. You will notice that the lowest point is below zero, which on Earth is sea level. Mars does not have any oceans. However, there is a defined zero point (known as the “datum”), and like Earth, there are geographical features below this point.



11) What would be your total elevation gain hiking from Amazonis Planitia to the summit of Olympus Mons? Note that “elevation gain” is the total height you gain from your lowest point to peak. You will probably want to zoom in on Olympus Mons to get a more precise measurement.

12) Now locate the lowest elevation on Mars – which is shown as a vibrant dark-purple color. Produce an elevation profile for this region, along its length. About how many km below the datum is the lowest point?

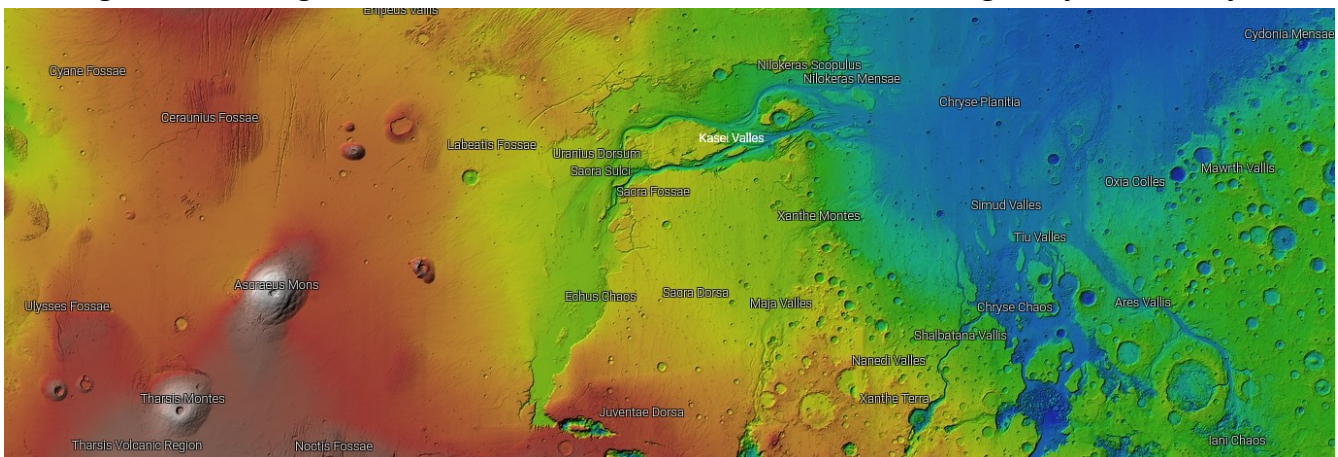
13) The highest peak in North America is “Denali” with a summit elevation of 20,310 feet. If you dropped Denali at the lowest point on Mars, would you still be able to see the peak? Assume you were looking straight ahead and were at an elevation of zero.

Part 3. Water on Earth and Mars

Water has shaped the geography of both Earth and Mars. A topographic map, such as this:

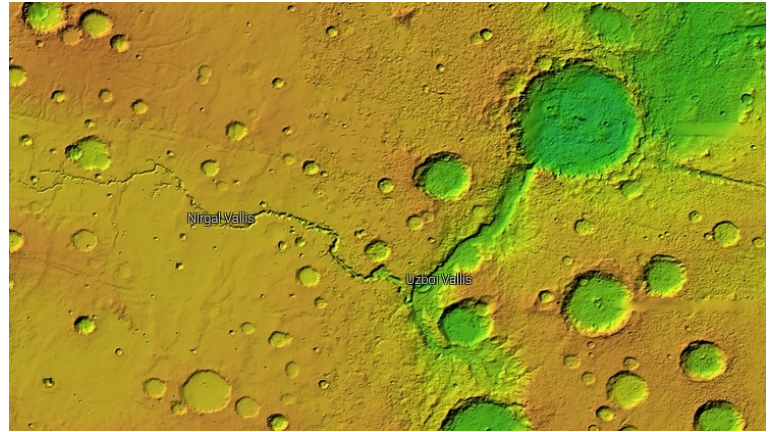
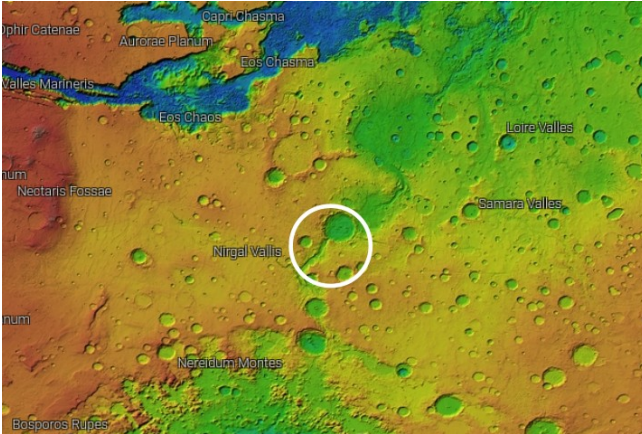
<https://en-us.topographic-map.com/maps/e8i3/Vinings/>

shows that the Chattahoochee River flows from north to south, as indicated by the lower elevation blue areas. Rain from higher elevation areas such as Smyrna and Sandy Springs flows downhill into the Chattahoochee River. This flow of water from high elevations to low elevations has eroded the surface, creating channels along the river. Now, locate the Kasei Valles, which are a giant system of canyons.

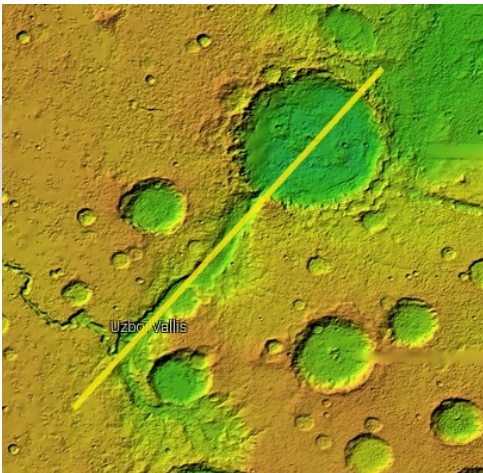


14) Did the Kasei Valles floodwaters flow from west to east (left to right) or east to west (right to left)? Explain your reasoning.

Now we will zoom in to the Uzboi Vallis –



Create an Elevation Chart across the Uzboi Vallis and through the crater as shown below. If you click on the Elevation Chart it will show you the elevation at each point as you traverse across the region.



15) Based upon the Elevation Chart, explain if you believe water flowed into the crater, or out of the crater?

16) Click on the home icon to reset the map. Examine the Tharsis Volcanic Region. Why is it so much smoother, less cratered than much of the region to the South? Hint: water certainly could have played a role, but there was undoubtedly something else at work as well.

17) There is substantial evidence Mars did indeed once have oceans. Based upon the geographic features, explain where you believe these oceans may have existed, and why?