



Is life on Mars possible and could humans establish settlements there?



Investigation Overview

Humans will, within the next few decades, travel to Mars to explore the red planet. Those first explorers will become the 21st century's Christopher Columbus. Their primary objective will be to explore for evidence of life. This investigation allows students to become explorers. Students use images of Mars (those used in Investigation 3) to locate regions in which to search for evidence of life and to build future settlements.

Time required: One or two 45-minute sessions

Materials/Resources

Briefing and Log (one copy of each per student or group)

Figures 1-6:

- transparency copies of the images (one copy to project using an overhead projector), or
- paper copies of the images (one copy per student or student group), or
- computer projector to project the image from this CD for the entire class

Content Preview

Evidence of water on Mars raises the possibility of life on that planet. Does Mars have suitable sites for future human settlements? NASA images of physical features on Mars are being used to explore that question.

Classroom Procedures

Beginning the Investigation

1. Ask students where else in our solar system humans might be able to live. Give them time to consider what conditions and resources would be required to support human habitation. Ask students to choose the planet that they consider best capable of supporting human life in future settlements and explain their choice.
2. Have students read the **Briefing** and follow the procedures suggested there. Students will make a list of the important factors and resources that are needed to sustain human life on Earth and identify those areas with large populations.

Geography Standards

Standard 4: Places and Regions

The physical and human characteristics of places

- Analyze the physical characteristics of places.

Standard 18: The Uses of Geography

How to apply geography to interpret the present and plan for the future

- Demonstrate an understanding of the spatial organization of human activities and physical systems and be able to make informed decisions.

Geography Skills

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.

Developing the Investigation

3. Have students locate where on Mars future explorers may search for evidence of past life. With water as a major component of life on Earth, students should mention this factor when deciding where to search for life on Mars. The students also identify locations that could be suitable for human settlements on the red planet. Have students record their answers on the **Log**.

Concluding the Investigation

4. Have students continue their discussions on human choices for settlements that have been made in the past and may be made in the future. For example, the American pioneers of the 19th century risked their lives to move westward. Will future pioneers risk their lives to settle on other planets?

Background

NASA uses satellites and remote sensing to study Earth as well as other planets in our solar system. Mars is the most popular target of study because it is the most Earth-like planet. Mars is relatively close to Earth. There is clear evidence of water on the surface, and the planet has been studied and written about by humans for over a century. A number of factors limit the habitability of Mars. It has a very thin atmosphere, little oxygen, and very cold temperatures. Nonetheless, NASA hopes to send the first humans to Mars

within the next couple of decades. A greater understanding of the red planet is necessary before humans are sent. Before NASA sent humans to the Moon from 1969 to 1972, years of research were needed to locate suitable landing sites for the lunar explorers. Likewise, NASA will also spend many years of researching suitable landing sites for future human explorers and future human settlements.

Evaluation

Students are not required to identify locations on Mars for this investigation. For reference, each image used is identified below.

- Figure 1: Olympus Mons Volcano (the largest known volcano in our solar system)
- Figure 2: Ancient river valley network in the Southern Margins Tharsis Montes Plateau
- Figure 3: Arres Valles ("Twin Peaks" Mars Pathfinder landing site)
- Figure 4: Yuty crater
- Figure 5: 3D image of the north polar region
- Figure 6: South Candor Chasma canyon (part of the Valles Marineris canyon)

Resources

NASA Spacelink

<http://spacelink.nasa.gov/>

Mars Millennium Project

<http://cass.jsc.nasa.gov/education/MarsMillennium>

Lunar and Planetary Institute

<http://cass.jsc.nasa.gov/lpi.html>

NASA *Exploring Earth from Space* Lithograph Set and Instructional Materials (LS-1999-05-001-HQ)

NASA *Our Mission to Planet Earth* Educator's Guide (EP-1997-12-292-HQ)



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Background

Based on the factors and resources needed to sustain life on Earth, you will determine where on Mars future explorers (maybe *you*) may search for evidence of life, past or present. Scientists have discovered that water flowed on Mars. The presence of ice caps on the poles is clear evidence that water once existed on the red planet. Water is only one major resource essential for life on Earth. Could the presence of water be a factor in locating a suitable site to search for life on Mars? What are some of the other factors and resources needed to sustain life on Mars?

Before NASA sent humans to the Moon, years of research were needed to locate suitable landing sites for the lunar explorers. Likewise, NASA will also spend years finding suitable landing sites for future human explorers and future human settlements. In this investigation, you will also identify locations for possible future human settlements on the red planet.

Objectives

Upon completion of this investigation, you will

- identify factors and resources that are needed to sustain life on Earth,
- identify and locate regions on Mars that would be likely areas to search for evidence of past or present life, and
- identify and locate regions of Mars that would be suitable areas for future human settlements.

Procedures

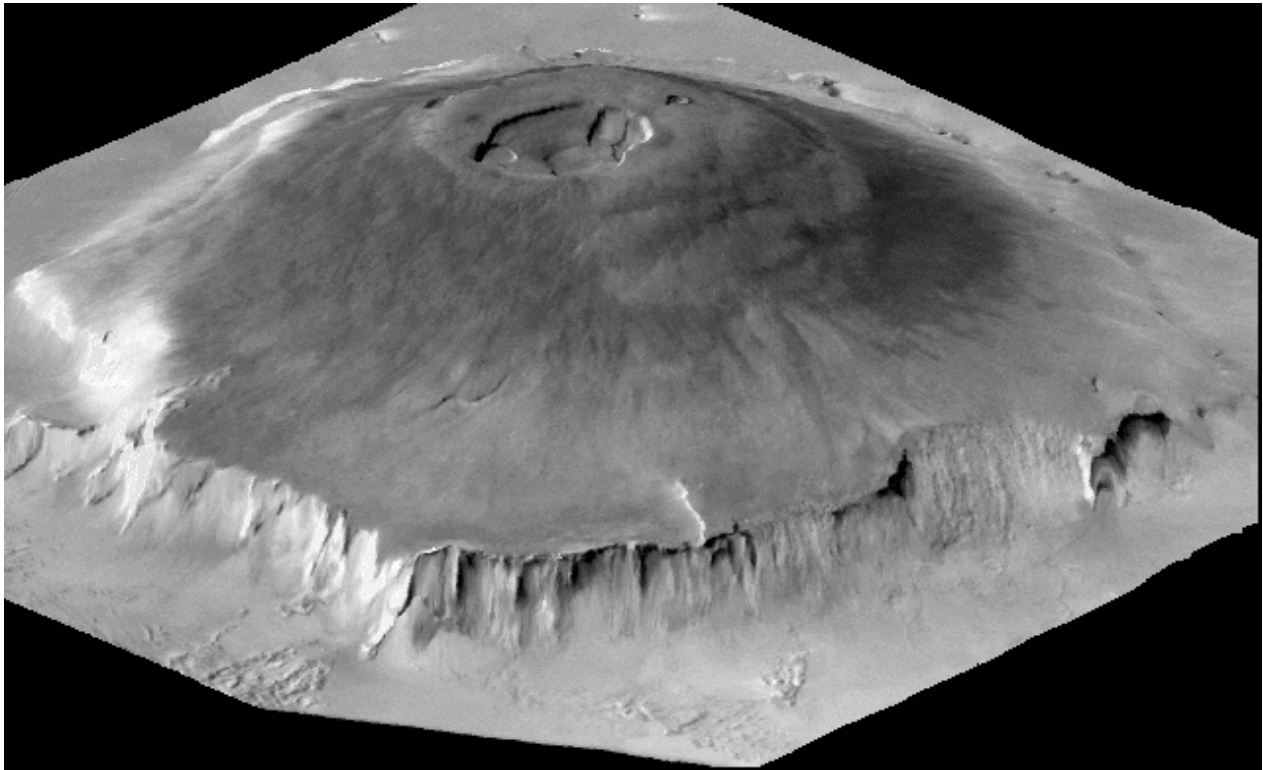
1. Prepare a list of factors and resources that are needed to sustain life here on Earth. Two examples are a moderate climate and water.
2. Prepare a list of some of the most populated regions of Earth and give reasons why they are densely populated (for example, available fresh water).
3. Each figure in this investigation is of a region on Mars. Observe the figures and identify those that could be promising areas in which to search for evidence of life. Check the appropriate box and write your reasons for your answer on the chart provided. Be prepared to discuss and explain your answers.
4. In addition, observe the images and identify those that may be good areas for future human settlements. Check the appropriate box and write your reasons for your answer on the chart provided. Be prepared to discuss and explain your answers.



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 1: Olympus Mons Volcano



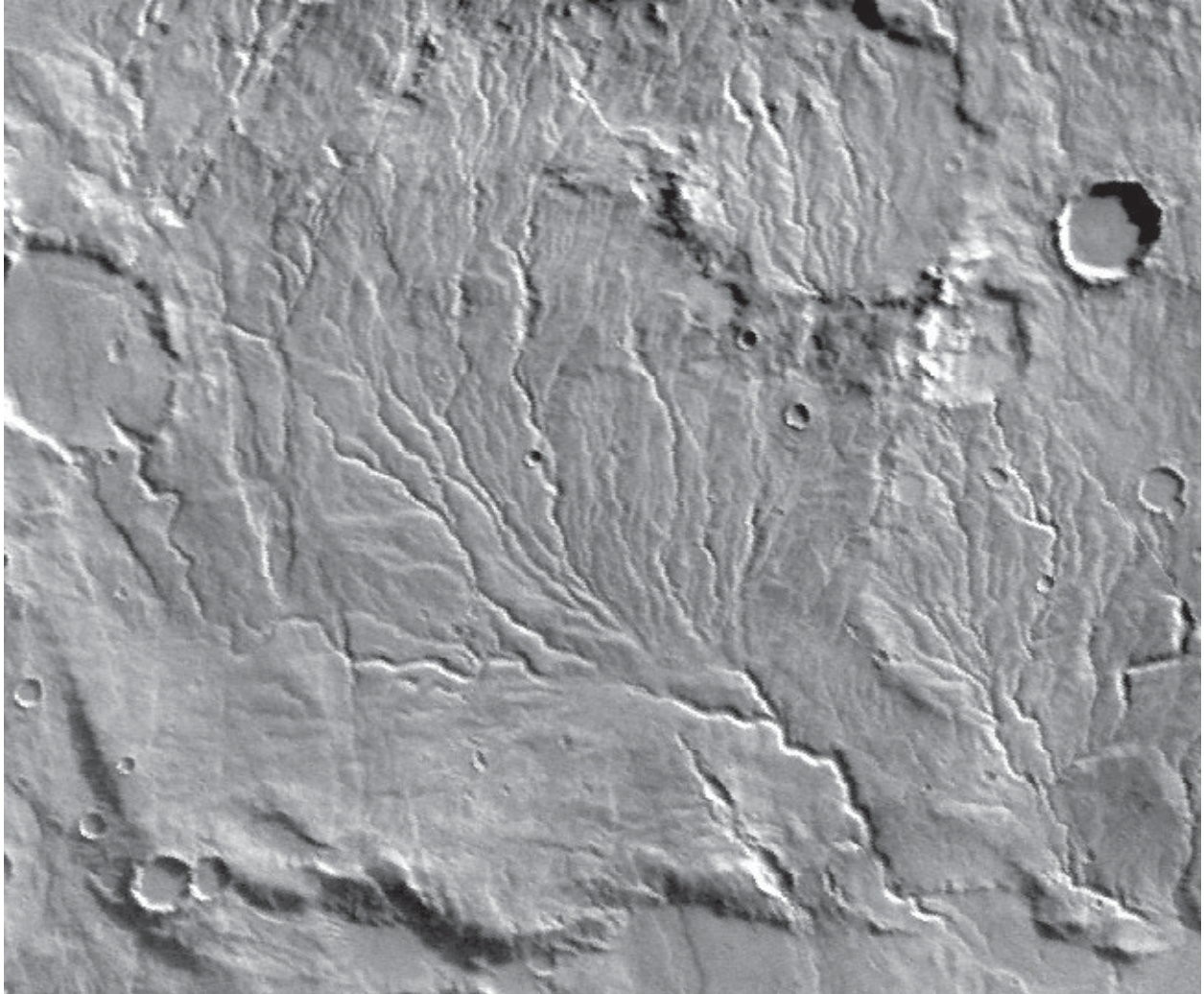
3D mosaic image of Olympus Mons Volcano on Mars from the Viking 1 and 2 Orbiters (1976)
Source: <http://pds.jpl.nasa.gov/planets/gif/mar/olympers.gif>



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 2: Ancient river valley network



River valley system of Arrego Valles along the southern edges of the Tharsis Montes plateau
(as imaged by the Viking Orbiter, 1976)

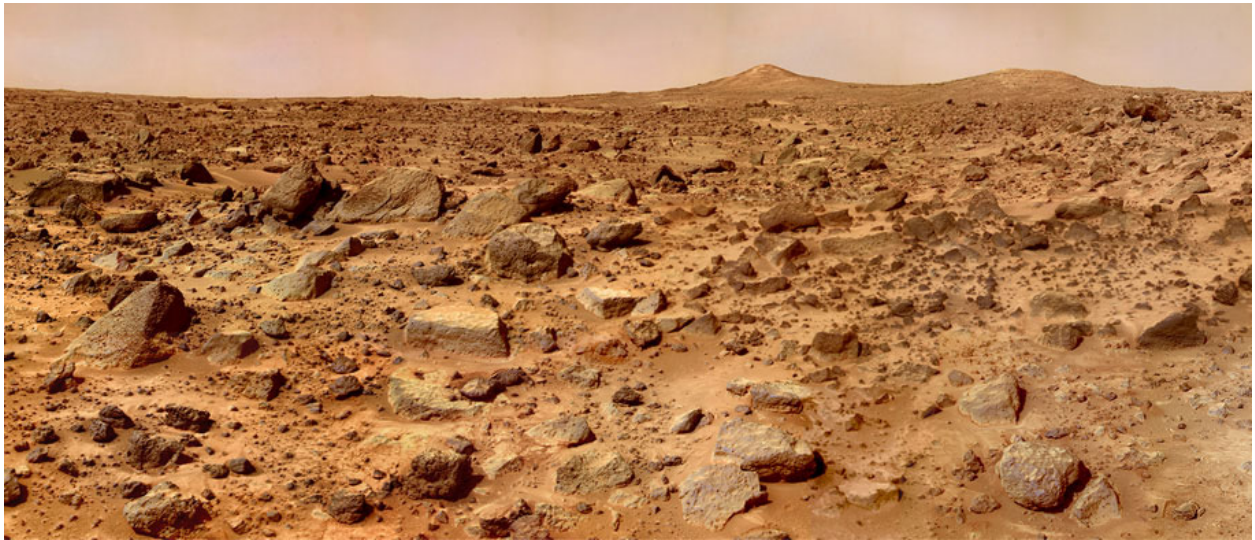
Source: http://www.lpi.usra.edu/images/slif/slif_s05.gif



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 3: Twin Peaks



Twin Peaks region on Mars as imaged by the Mars Pathfinder Lander on July 7, 1997
(the peaks are 1–2 kilometers away from the camera)

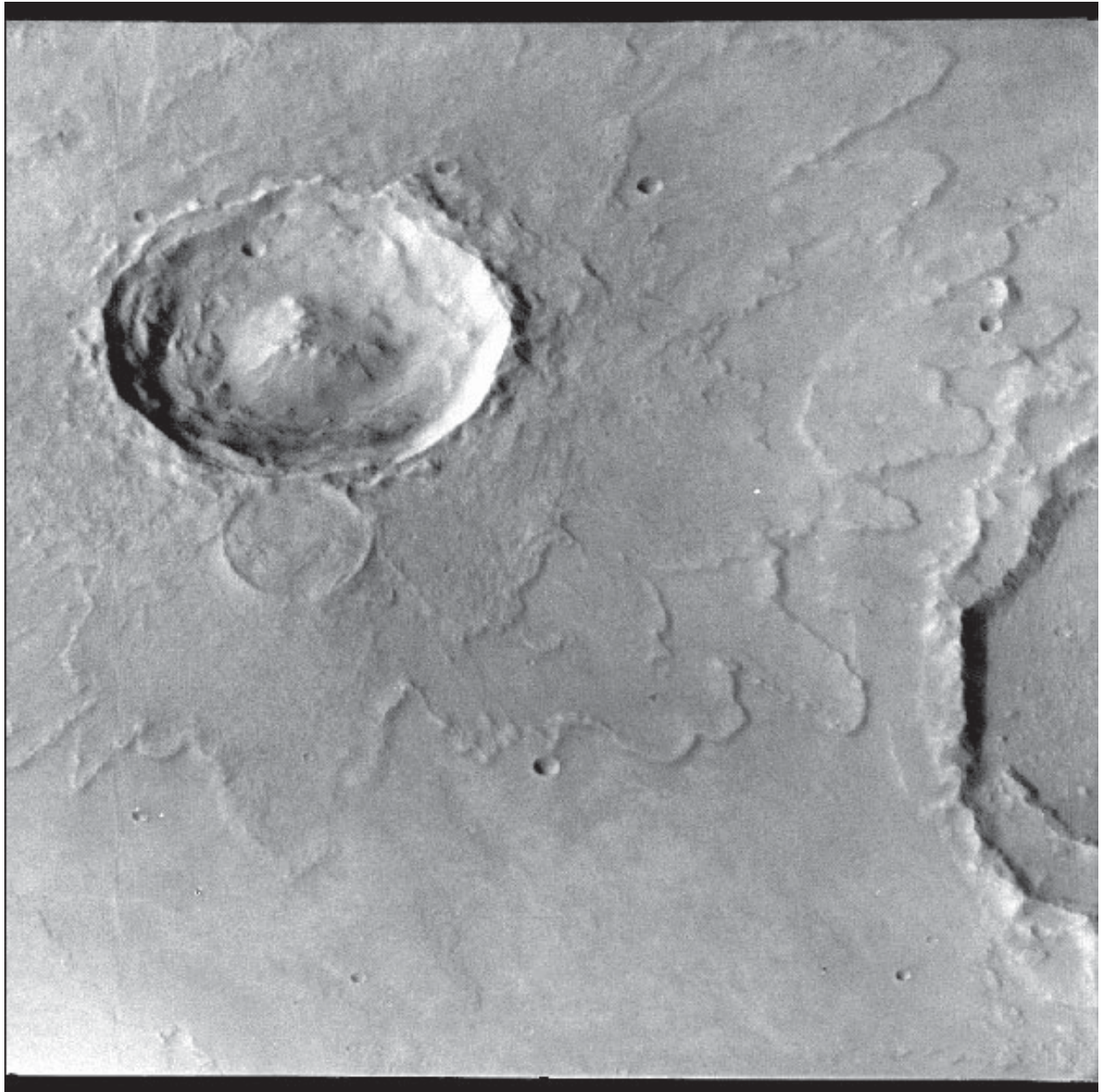
Source: http://mars.jpl.nasa.gov/MPF/ops/81007_full.jpg



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 4: Mars crater



Yuti Crater on Mars as imaged by the Viking Orbiter (1976)
(the crater is 18 kilometers in diameter)

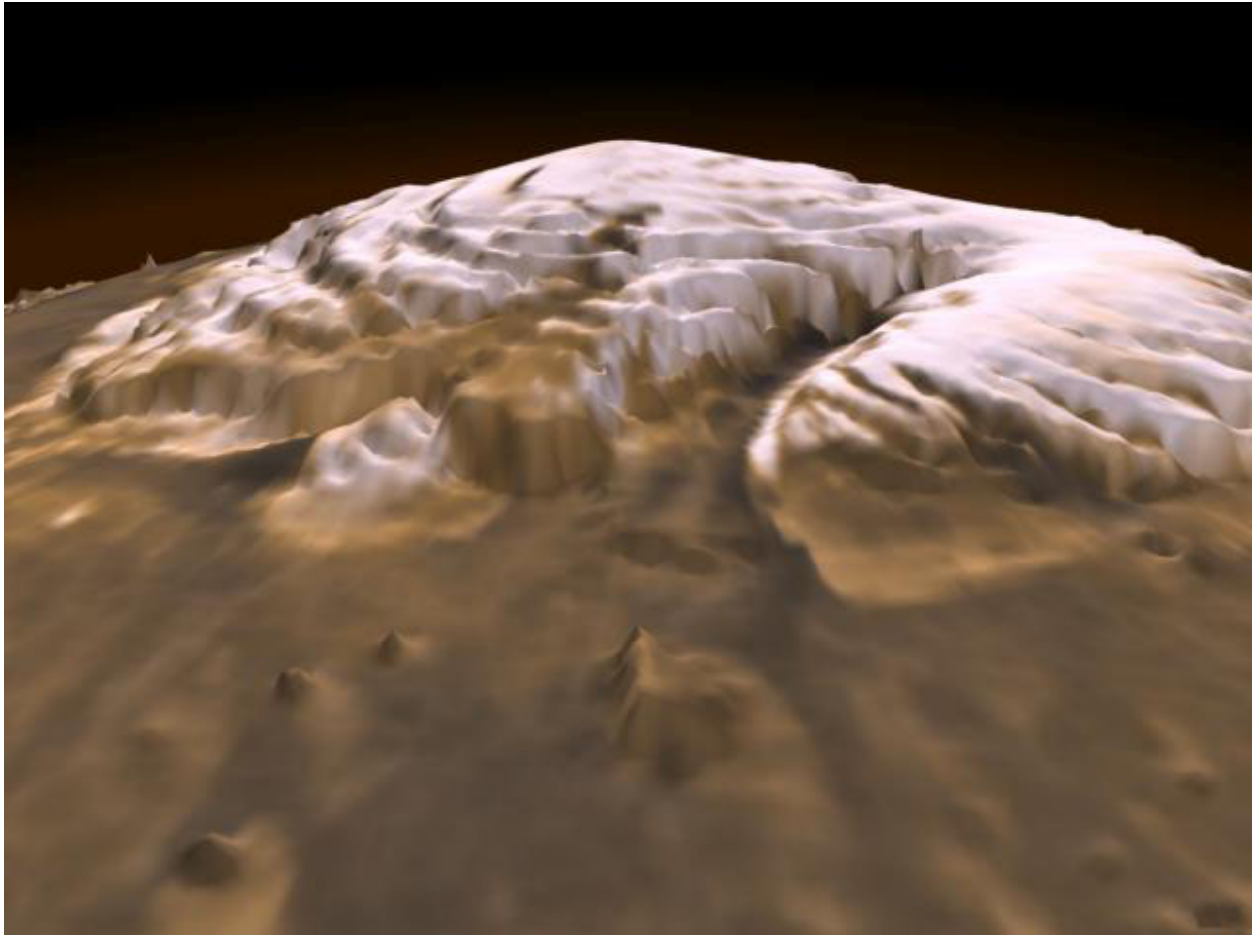
Source: http://cass.jsc.nasa.gov/images/sred/sred_s28.gif



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 5: Mars North Polar ice cap



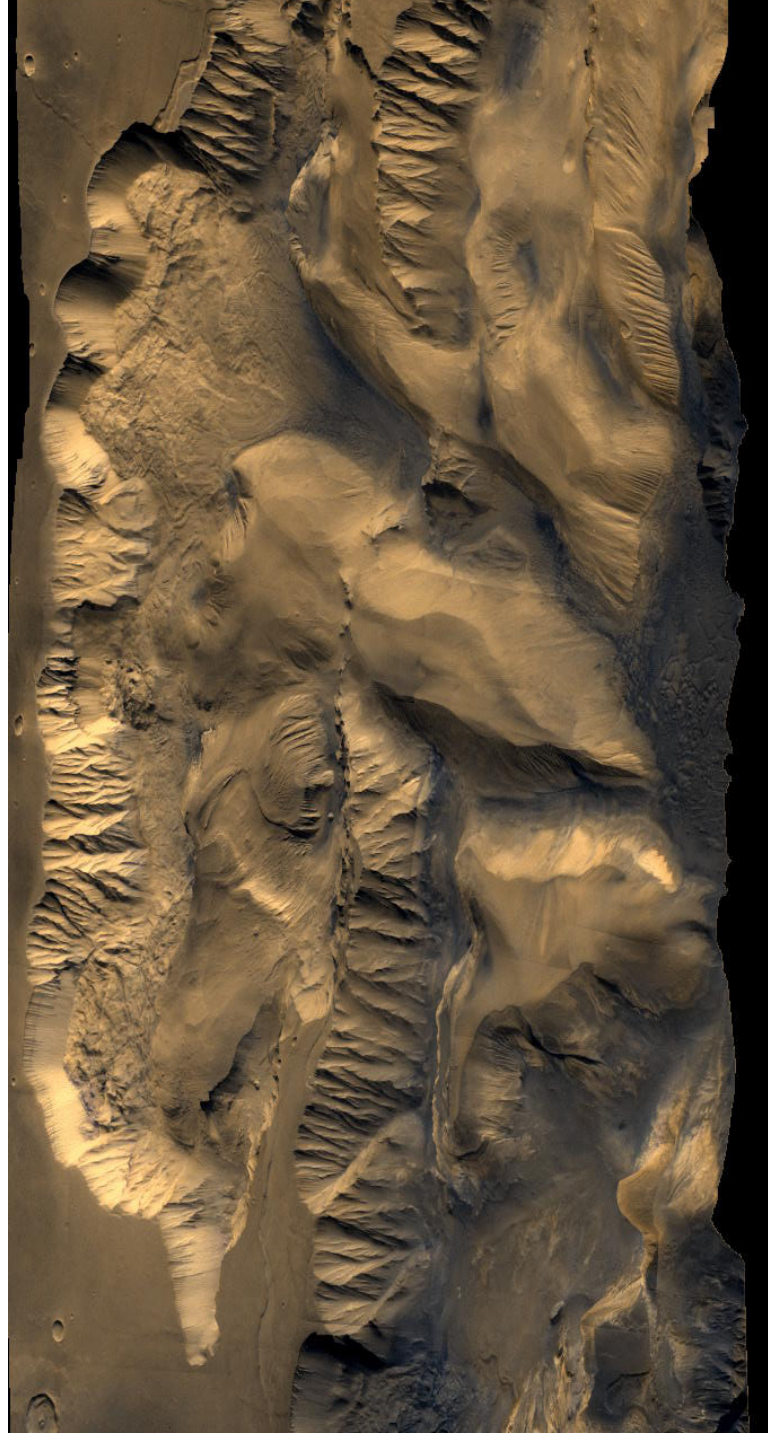
3D view of the North Polar Region on Mars from the Mars Orbiter Laser Altimeter (MOLA) 1998
Source: http://tpwww.gsfc.nasa.gov/tharsis/agu_f98.html



Module 2, Investigation 4: Briefing

Is life on Mars possible and could humans settle there?

Figure 6: Mars canyon



South Candor Casma in Valles Marineris on Mars (a mosaic from Viking 1 and 2 Orbiters in 1976)
Source: <http://pds.jpl.nasa.gov/planets/jpeg/mar/southcan.jpg>



Module 2, Investigation 4: Log

Is life on Mars possible and could humans settle there?

Image	
Figure 1: Olympus Mons Volcano	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>
Figure 2: Ancient River Valley Network	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>
Figure 3: Twin Peaks (Pathfinder Landing Site)	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>
Figure 4: Mars Crater	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>
Figure 5: Mars North Polar Ice Cap	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>
Figure 6: Mars Canyon	Life? Yes <input type="checkbox"/> No <input type="checkbox"/>
	Human Settlement? Yes <input type="checkbox"/> No <input type="checkbox"/>