

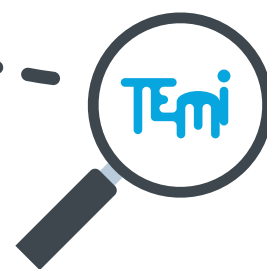
TEmi



Face on Mars



CLASSROOM SCIENCE ACTIVITY TO
SUPPORT STUDENT ENQUIRY-BASED LEARNING



This classroom-tested teaching plan uses the four innovations of the TEMI project, as detailed in the Teaching the TEMI Way (TEMI, 2015).

You should read this companion book to get the most from your teaching. The **TEMI** techniques used in this teaching plan are: **1)** productive science mysteries, **2)** the **5E model** for engaged learning, **3)** the use of presentation skills to engage your students, and **4)** the apprenticeship model for learning through gradual release of responsibility. You might also wish to use the hypothesiser lifeline sheet (available on the **TEMI** website) to help your students document their ideas and discoveries as they work.

To know more about **TEMI** and find more resources www.teachingmysteries.eu

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teachingmysteries.eu

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Face on Mars

What's the mystery?

Almost forty years ago something funny happened around Mars. NASA's Viking 1 spacecraft was orbiting the planet, snapping photos of possible landing sites for its sister ship Viking 2, when it spotted the shadowy likeness of a human face. An enormous head about 3km from end to end seemed to be staring back at the cameras from a region of the Red Planet called Cydonia.

There must have been a degree of surprise among mission controllers back at the NASA's Jet Propulsion Lab when the face appeared on their monitors. What is this enigmatic face on the surface of Mars?



DOMAIN(S)

Physics.

SUBDOMAIN KEYWORDS

Optics, Technology, Imaging, Geology, Astronomy, Planetary Sciences.

AGE GROUP

14 to 18 years old.

EXPECTED TIME FOR THE MYSTERY

45 min.

SAFETY/SUPERVISION

No need.

Disclaimer: the authors of this teaching material will not be held responsible for any injury or damage to persons or properties that might occur in its use.

PREPARATION AND LIST OF MATERIALS

Internet

LEARNING OBJECTIVES

- » Learn about Mars and its surface
- » Learn how images work
- » Learn about image resolution
- » Learn how technologies advances
- » Learn some media skills, live interviewing techniques



Guidance notes for teachers

THE 5E MODEL



Engage CAPTURE STUDENTS' ATTENTION

Back in the 70s astronomers took this picture of the region of the surface of Mars called “Cydonia”. NASA scientist Gerry Soffen described it as a “trick of light and shadow”.

What is this image?

What can we learn from it?

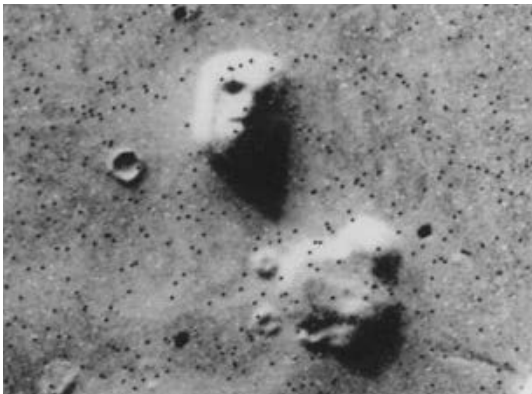


IMAGE 1. The “Face on Mars” was one of the most striking and remarkable images taken during the Viking missions to the red planet. Credit: NASA

Aks the students:

- » What can you identify on it?
- » What do you think astronomers thought about it at that time?

The “Face on Mars” has since the 70s been a pop icon. It has starred in a Hollywood film, appeared in books, magazines, radio talk shows –even haunted grocery store checkout lines for 25 years! Some people think the Face is *bona fide* evidence of life on Mars– evidence that NASA would rather hide, say conspiracy theorists. Meanwhile, defenders of the NASA budget wish there was an ancient civilization on Mars.

Students will explore this mystery through a mock-up interview. They will then discuss and present differing viewpoints about the Mars Face, using a “man on the street” TV or radio interview format. The information below will give the necessary narrative to the activity and can be used at any time to guide students through the activity.



Explore COLLECT DATA FROM EXPERIMENTS

Although few scientists believed the Face was an alien artefact, photographing Cydonia became a priority for NASA when Mars Global Surveyor arrived at the Red Planet in September 1997, eighteen long years after the Viking missions ended.

So on April 5, 1998, Mars Global Surveyor flew over the Face and snapped a picture ten times sharper than the original Viking photos. Thousands of anxious web surfers were waiting when the image below first appeared on a JPL website, revealing ... a natural landform. The “Hype” suffered a blow! There was no alien monument after all. See **IMAGE 2** on the next page.

But not everyone was satisfied. The Face on Mars is located at 41 degrees North Martian latitude where it was winter in April '98 – a cloudy time of year on the Red Planet. The camera on board MGS had to peer through wispy clouds to see the Face. Perhaps, said skeptics, alien markings were hidden by haze.

Mission controllers made preparations to look again, but it's not easy to photograph the region. The Mars Global Surveyor is a mapping spacecraft that normally looks straight down and scans the planet like a fax machine in narrow 2.5km-wide strips and it didn't fly over the Face very often.

Nevertheless, on April 2001, a cloudless summer day in Cydonia, the spacecraft Mars Global Surveyor drew close enough for a second look.



IMAGE 2. Highest-resolution view of the "Face on Mars", photographed by Mars Global Surveyor. Credit: NASA

They captured an extraordinary photo using the camera's absolute maximum resolution. Resolution quantifies how close objects can be to each other and still be seen as individual objects. Each pixel in the 2001 image spans 1.56 m, compared to 43 m per pixel in the best 1976 Viking photo!

If there were objects in this picture like airplanes on the ground or Egyptian-style pyramids or even small shacks, you should have been able to see them. And of course the image didn't look like a face anymore. What the picture actually shows is the Martian equivalent of a butte or mesa landforms, which are common on our planet. Butte or Mesa are isolated hills with steep, often vertical sides and a small, relatively flat top.



Explain

WHAT'S THE SCIENCE
BEHIND THE MYSTERY?

In July 2006, the European Space Agency's Mars Express also obtained a series of images that show the famous Face on Mars located in Cydonia region. The data with a ground resolution of approximately 13.7 m per pixel.

Cydonia is littered with mesas like the Face, but these don't look like human heads and therefore they have attracted little attention from the public. Scientists have studied them carefully, however,

using a laser altimeter data. The laser altimetry data are perhaps even more convincing than overhead photos that the Face is natural, rather than alien-made. 3D elevation maps reveal the formation from any angle, unaltered by clouds, lights and shadow. There are no eyes, no nose, and no mouth!

Cydonia is located in the Arabia Terra region on Mars and belongs to the transition zone between the southern highlands and the northern plains of Mars. This transition is characterized by wide, debris-filled valleys and isolated remnant mounds of various shapes and sizes.

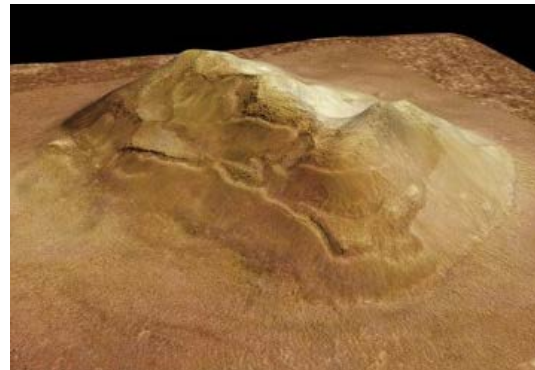


IMAGE 3. A view showing the so-called 'Face on Mars' located in Cydonia region. The image shows a remnant massif thought to have formed via landslides and an early form of debris apron formation. Credit: ESA/DLR/FU Berlin (G. Neukum), MOC Malin Space Science Systems.

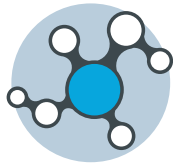


IMAGE 4. A perspective view showing the 'Face on Mars' located in Cydonia region. Credit: ESA/DLR/FU Berlin (G. Neukum)

The mesas of Cydonia are of great interest to scientists because they lie in a very interesting part of Mars. Some scientists think the northern plains are all that's left of an ancient Martian ocean. If so, Cydonia might have once been beachfront property.

GUIDANCE NOTES FOR TEACHERS

The planet Mars is a special place, it reminds us of home. One day we are going to go there. That's why the Face on Mars was so popular: it reinforced that connection. But even without an alien monument, there will be plenty for future explorers to do. Climbing the mesas of Cydonia –if that's where we start– will be just the beginning.



Extend

WHAT OTHER RELATED AREAS CAN BE EXPLORED?

Perhaps the best way to further unravel the mysteries of Mars would be to send a geologist to investigate. Astronomers even prepared a trail map to hike this mesa! The start and midsection of the hike would be easy, with some steep flanks in between. It would take about two hours to reach the summit of the Face. From there the view would be spectacular. To the south the ground would slope upwards, toward the highlands. To the north the terrain would descend toward the plains. Looking around you would see a barren landscape dotted with buttes, mesas, and impact craters.

Climbing to the “nose” of the Face on Mars (FoM):

Starting to the SOUTH, away from the FoM, the hike begins with a walk to the scree slopes at the south base of the feature, and then moves to the right (east) around the base of the FoM, and then to the NNW up to a breach in the feature about midway through the eastern middle. At this point there is a passage up the east flank of the feature, and the hike takes this route, passing between the two ridge-like prominences that outlie the eastern “battlements” of the FoM... then the hike traverses a smoother patch before it turns and skirts the

summit region before finding a circuitous path to the upper reaches of the FoM (where there is a flat, bright circular patch about 100 m in diameter).

Unmasking the Face on Mars wasn't easy! But astronomers have done it by virtue of their hard work and technology development, with better and better resolution instruments.



Evaluate

CHECK THE LEVEL OF STUDENT SCIENTIFIC UNDERSTANDING

To evaluate the students' understanding of the mystery, the teacher can ask the simple question: What's the Face On Mars? Students should be able to explain that this is just a geological feature similar to the Earth's small butte or mesa landforms. I.e., isolated hill with steep, often vertical sides and a small, relatively flat top.

Teachers can also ask further questions, like:

- ① How did scientists explain the Mars Face in the 70s?
- ② Why should you take plenty of oxygen and water if you plan to climb the Mars Face?
- ③ What is a mesa?
- ④ Where is the Mars Face?
- ⑤ Do you think that the Mars Face is exotic? Why?
- ⑥ Which is the best picture of the Face? Why?
- ⑦ Why do some people think that the Mars Face is evidence of life on Mars?
- ⑧ What is an altimeter?
- ⑨ What is resolution?

THE 5E MODEL

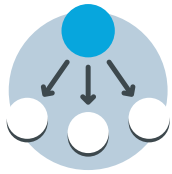


Showmanship

TIPS ON HOW TO TEACH AND PRESENT THIS MYSTERY

This is a mystery to explore. Students will discuss and present differing viewpoints about the Mars

Face, using a “man on the street” TV or radio interview format.



GRR

TEACHING SKILLS USING GRADUAL RELEASE OF RESPONSIBILITY

Through the interview mock-up students will have the opportunity to explore different roles in the process of knowledge acquisition.



Resources

Teachers can show the ESA video about the region: http://www.esa.int/Our_Activities/Space_Science/Mars_Express/Cydonia_s_Face_on_Mars_in_3D_animation



Face on Mars

STUDENT WORKSHEET

Almost forty years ago something funny happened around Mars. NASA's Viking 1 spacecraft was orbiting the planet, snapping photos of possible landing sites for its sister ship Viking 2, when it spotted the shadowy likeness of a human face. An enormous head about 3km from end to end seemed to be staring back at the cameras from a region of the Red Planet called Cydonia. There must have been a degree of surprise among mission controllers back at the NASA's Jet Propulsion Lab when the face appeared on their monitors.

What is this enigmatic face on the surface of Mars?



Engage

WHAT'S INTERESTING?

Task: First, find a person to work with. Decide who will be the reporter and who will be the person interviewed (the "interviewee").

Next, choose what background and profession the person interviewed will have. The possibilities are limitless -- scientist, barber, teacher, cosmetologist, cosmologist, rock climber, rapper, printer, physician, actor, driver, or diver! It could be anything (appropriate to your school setting of course!) Check the script outline below. You are welcome to improve it, and certainly do add the needed information and opinions. Practice it once, and then perform as requested by your teacher.

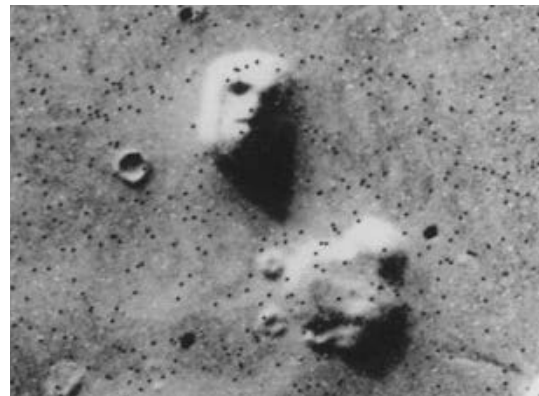
Reporter: Hello, my name is _____ and I am speaking to you directly from _____. I am going to ask just a regular person on the street about that famous Mars Face.

Interviewee: Hi! Is that a TV camera? Am I going to be on TV?

Reporter: Why yes. I have a couple of far-out questions to ask you but first, can you tell the people at home your name and what you do for a living?

Interviewee: Answer.

Reporter: Great! Now, could you tell us what you think of the Face on Mars?



Interviewee: Answer.



Explore

WHAT'S HAPPENING?

Task: **Reporter:** Do you believe that the Mars Face proves that life has been on Mars?

Interviewee: Answer.

Reporter: That's interesting. Why do you believe that?

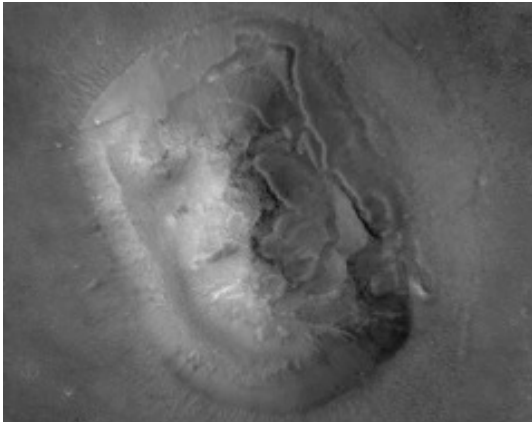
Interviewee: Answer.



Explain

WHAT'S CAUSING IT?

Task: Show image:



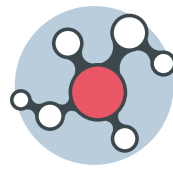
Reporter: How would you explain the photos of the Face?

Interviewee: Answer.

Show both pictures together.

Reporter: How would you explain the difference between these 2 photos of the Face on Mars?

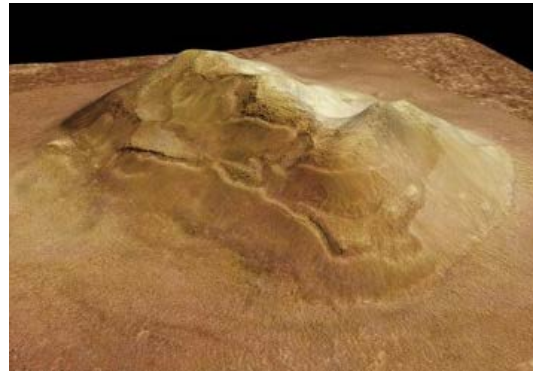
Interviewee: Answer.



Extend

WHAT'S SIMILAR?

Task: **Reporter:** Look at this more recent image. Do you find any similarities?



Interviewee: Answer.



Evaluate

WHAT'S MY UNDERSTANDING?

Task: **Reporter:** So, in the end, what do you think is this "Face on Mars"?

Interviewee: Answer.

