



National Optical Astronomy Observatory

Kitt Peak National Observatory • Cerro Tololo Inter-American Observatory • NOAO Gemini Science Center

Mapping the Surface of Mars

(Developed by the University of Arizona – Lunar and Planetary Lab – Mars Odyssey E/PO & HiRISE Science)

This activity is an opportunity for you to take what you already know about remote sensing and Mars and apply it to a set of images of Mars taken so recently that scientists haven't had a chance to take a close look at all of them! You will be looking at these images at the same time that other people all over the world are looking at them for the first time and discovering more about the red planet using higher resolution images than ever before.

Background

In the last activity you investigated geological features of Mars using data from the Mars Global Surveyor. The images for this activity were taken by two different spacecrafts. An older set of images were taken by the Viking Orbiters in the 1970s which took pictures from 1,500 km above Mars surface. A new set of images were taken by the High Resolution Imaging Science Experiment (HiRISE) aboard the Mars Reconnaissance Orbiter (MRO) which takes pictures from between 250 – 320 km above Mars surface. HiRISE was launched aboard MRO in August 2005 and has been sending back high resolution images of Mars since the fall of 2006. HiRISE is able to image Mars at several different scales down to 1 meter per pixel! Not all images are taken at the same scale so it will be important to look at the information about the images you receive with your image to know what how large the area of the image is. All images for this activity represent images taken at visible wavelengths.

Your class will be getting images from a specific part of Mars taken at different resolutions by cameras aboard the spacecrafts described above. You will notice your area has a letter and number code (E1, E2, W1, W2 etc.) The E means you have an area from the east part of Mars, the W means you have an area from the west part of Mars. Your job will be to investigate your part of Mars and report to other groups what you have discovered about your small section of the planet. You may want to think about both the scientific relevance of your site as well as safety concerns if you were to land a spacecraft there to investigate it further. You will be given a surface feature ID chart to assist you when you are trying to make out features on your Viking and HiRISE images. HiRISE images have all been taken within the last six months and have features that are currently being identified by scientists. Your role is to look at those images and try and figure out what scientists are looking at. At the resolution of HiRISE images you may be able to make out individual rocks! What clues will you look for? (Perhaps a shadow of a rock, sizes of features etc?) Think about how you might compare these images to those taken of your hometown from satellite pictures of Earth.



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Activity

You have a set of three images of Mars taken by different orbiting spacecraft. The first is a composite (a picture made up of many pictures) that was taken by the Viking Orbiters and is a data set called the Mars Global Digital Image Mosaic. This image represents the entire globe of Mars flattened, thus you are seeing the entire surface of Mars.

Mars Global Digital Image Mosaic (full picture of Mars)

- What kinds of features can you make out in this full image of Mars?
- Are they similar to structures you see on Earth? Which ones?
- Describe features that you cannot figure out?
- Make a comment about what you can say about Mars as a whole planet?

You can use your “Context Sheet” to find where your next image is from on Mars. Your next image was taken from a location marked on your composite image of Mars with a white rectangle and/or /diamond. This image was also taken by the Viking orbiters but is a higher resolution image, thus you have zoomed in on a specific place on Mars.

Using the surface feature ID chart and your knowledge from previous activities identify as many surface features as you can.

- What features can you make out in the zoomed in image that you could not make out in the composite image?
- What features can you make out on the global image of Mars that you cannot see in this higher resolution/zoomed in image?
- What are things that you cannot make out in the zoomed in image?

Again, you can use your “Context Sheet” to find where your next image is from on Mars. The next image was taken this year by the HiRISE camera. It is yet a smaller piece of the last image and its area is marked with a red square on the zoomed in image. Look at the caption on the “Context Sheet” to get information about where the sunlight is coming from in your image and the dimension of your image.

- What features can you make out in the HiRISE image?
- What do they look like?
- How large are they?



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To determine the actual size of features in the image, you will need to figure out a scale factor. To do this you will measure the width of your image in cm _____(A). Now look at the information about your image, what is the actual width of the area in km? _____(B) ? (Note, the dimensions given for each image include the whole image – including the black edging – be sure to measure the whole image)

You will divide the actual width by your measurement

$$\text{_____ (B) km} / \text{_____ (A) cm} = \text{_____ km/cm}$$

This gives you the scale factor of your image in km per cm. To figure out actual measurements of features on Mars you will measure your feature in centimeters and multiply that measurement by the scale factor you figured out. This number will give you the actual measurement of the feature on Mars in kilometers.

- Make a list of interesting features you see and their actual sizes.
- Can you think of features on Earth that are about the same size?
- Are those features on Earth man made or natural?
- What about features on Mars?

If you are able to look at this HiRISE image on a computer, you will be able to zoom in on interesting features on the image. You can even get a more detailed view by going to the website provided on your “Context Sheet” and downloading the highest resolution image. Alternately, you have been provided with additional sections of this image that have been enlarged so you can look at interesting features – you can look at your HiRISE context sheet so you know where the images are from on the image.

- What additional features do you see on the HiRISE image when you zoom in?
- Make a list of possible explanations for what might have caused the features that you see.

Compare features you see in each of these images to what you see in the LANDSAT images of your city on Earth.

- What features look similar?
- What features look different?
- Do you see any of the features that are the same on both planets?
- What other pieces of information would you need to know for sure?



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Characterize your piece of Mars using all the images you have of Mars.

- What information did each picture give you about your piece of Mars?
- What types of processes do you think shaped your part of Mars (wind, water, meteorites...)?
- What are some things that you could not figure out with these images that you would like to know?
- What would you need to get to answer those questions?
- What type of mission would you send to Mars to answer your questions?

Remote sensing information is not always certain. In this case you are only getting a snapshot of a section of Mars. What types of information could you use to better understand what you are looking at? Very little of Mars has been imaged from the ground. Unlike the Earth, it is very difficult to get to Mars and take pictures from the ground and only a small fraction of the planet has been imaged this way. This does not mean that questions about unobserved parts of Mars are not good questions. It is precisely those questions that drive scientists to send more robotic missions to Mars.

Now, it is time to decide what the most important information to report about your area of Mars.

- Make sure to report information that will help other groups understand your region of Mars so that they can compare their own region to yours. It is acceptable to report features and your best speculation as to what they are.
- Be sure to report your evidence and let your community of scientists discuss what you have found. Additionally, you may want to comment if you would like to send a robot to land on your part of Mars.
- What pieces of information do you need to think about when making this decision?