

Mars Public Mapping Project (MP)2

MP2

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Rate This Image: ★★★★★ STARS FOR MARS

Welcome to Mars Public Mapping Project

Scientists need your help!

Welcome to the Mars Public Mapping Project, or (MP) ² for short.

We're trying to identify the coolest images of Mars, and you can help. It's easy! Check out the image at left and rate it by clicking the star scale above: five stars = coolest.

(You can zoom and scroll around to see the full image using the controls, and a click on its ID number takes you to a page with more info about the image.)

For each star-click, you'll see a new image to rate, and you can keep clicking and rating new images for as long as you like.

Want to do more?

Sign Up I want to sign up.

Login I signed up already and want to log in.

Go Tag Let's go tagging.

TEACHER GUIDE



Arizona State University

MARS PUBLIC MAPPING PROJECT

(MP)2

Teacher's Guide

Goal: This activity is designed to generate an interest in planetary investigations through an authentic exploration of Thermal Emission Imaging System (THEMIS) visible images of Mars. This activity uses inquiry-based learning techniques based on the 5-E model of instruction.

Grade Level: 3 – 12 (lower grades can participate by rating images at a minimum)

Time Requirements: 2 – 4 class periods

Objectives: Students will:

1. Identify images of Mars that are interesting and visually appealing (cool!)
2. Develop a strategy for identifying different types of geologic features on Mars

Required Materials & Resources

- Computer lab for students to explore (MP)2 website (<http://mp2.mars.asu.edu>)
- *Mars Public Mapping Project Teacher Guide*
- *Mars Public Mapping Project Student Guide*

Other Useful Materials & Optional Resources

- Feature Identification Charts (<http://static.mars.asu.edu/uploads/FeatureIDChartsv2.pdf>)
- Website for locating and viewing specific THEMIS images of Mars: <http://themis-data.asu.edu>
- Extra Log Sheets to print off for students as necessary (provided at the end of this Teacher Guide)
 - Data Collection/*Exploration* Activity
 - Presentation of Observations/*Explanation* Activity
 - Image Observation Log

National Science Standards:

CONTENT STANDARD A: Science as Inquiry

CONTENT STANDARD D: Earth and Space Science

CONTENT STANDARD E: Science and Technology

Introduction to (MP)2

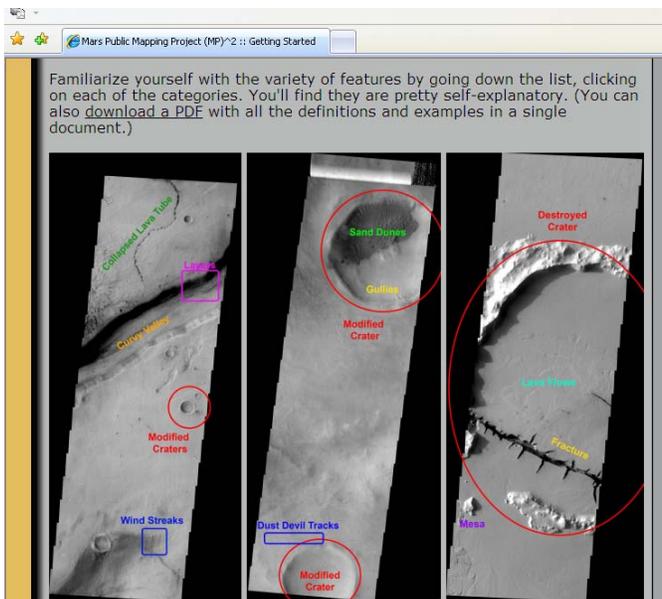
NASA has sent many spacecraft to Mars to help scientists investigate our neighboring planet. Pictures and other data that are sent back to Earth help us understand the history of Mars and why it is the way it is today. One spacecraft that has been orbiting Mars since 2001 is called the *Mars Odyssey* spacecraft. This activity uses images taken by a camera onboard this spacecraft called the Thermal Emission Imaging System or THEMIS. THEMIS is composed of two cameras, a visual camera (VIS) and an infrared camera (IR). This activity will focus on images taken of Mars with the VIS camera,

which takes pictures in a similar way as a digital camera. These visible images show us what the surface looks like -- the morphology (the shape) of the surface. The morphology of the geologic features we can see in these images tells us a lot about Mars.

The Mars Public Mapping Project, or (MP)2, has been designed to allow students, teachers, and the public to participate in helping scientists understand Mars. (MP)2 allows participants to help scientists in two ways.

1. Rating Images: Participants can help scientists identify cool images of Mars. There are thousands of THEMIS images of Mars, and scientists would like help in identifying those that are the coolest. Students even in younger grades can do this in class with the teacher, in class by themselves, or with their parents at home. Participating in this aspect of the program allows students of all ages to contribute to work being done by scientists. Cool images of Mars may tell scientists that a particular area is geologically interesting and perhaps that it should be studied in more detail.
2. Tagging Images: This task is a bit more involved and very important! Mars has many types of geologic features that you can observe in THEMIS images. (MP)2 asks participants to tag or identify different geologic features in each image. By tagging features in images, participants will help create global feature maps of Mars. These feature maps can help scientists better understand our neighboring planet Mars. As your students tag images, be sure they zoom in and out of each image. Some of these features are small and hard to see unless you zoom in and observe carefully!

The (MP)2 website provides background information on how to correctly identify geologic features in THEMIS images. The *Getting Started* link provides some written and visual information as well as links to Feature Identification Charts. As your students tag images they can also click on the specific geologic feature itself to see examples of what the feature looks like as well as information about the feature. The features are divided into 5 general categories: Craters, Layers, Valleys, Volcanic Features, and Wind Features.



Labeled geologic features in THEMIS images of Mars from the (MP)2 website (<http://mp2.mars.asu.edu>)

FEATURE IDENTIFICATION CHART		
Features Often Associated with Volcanoes		
Feature	An Example of this Feature	Description of Feature
Caldera		-A circular depression generally at the summit of a volcano -Considered a collapsed feature (magma comes up through a chamber and once the chamber is empty collapse can occur) -Sometimes called a central vent
Fissures		-Cracks that are found sometimes on the sides of volcanoes -Lava flows can be seen trailing away from these cracks indicating a fissure eruption
Lava Flows		-Formed by the eruption and flow of lava from a volcano -Flows can look "waxy" or "fingery" -You can often identify multiple lava flows in an image -Flows are raised features
Collapsed Lava Tubes		-Look similar to channels -Lava once flowed under ground through a "tunnel" and once the tunnel is empty these features often collapse -Some aren't completely collapsed and look like a chain of small craters

Example of a Feature Identification Chart

The website and links provide information that is useful to participants to assist them when identifying geologic features on Mars. It is important to thoroughly look at each image when tagging and identifying individual features. As participants tag features, they will have the option to choose Yes or No or Not Sure for any given feature. If they are not sure if a feature is there or not, they can simply choose the Not Sure option. Participants can also choose which categories of features to look for and tag. For example, if they chose to only look for features in the Volcanoes category and no others that is totally acceptable.

CREATING A LOG IN

As a teacher, you are able to monitor your students progress as they participate in (MP)2. As you sign up you can register multiple classes. The website will lead you through this process. For each class you will need to provide your students with a *Class Key* and *Class ID*. As students register using the appropriate *Class Key* and *Class ID*, they will appear on your class roster. To check student progress click on the ***Class Management*** link at the top of the page once you have logged in. This will allow you to see how much work your students may, or may not, be doing! You can have your students register and login as a single student or even as a pair of students. For pairs or small groups of students, have them choose a user name that will allow you to identify what students are in a particular group.

USING (MP)2 IN YOUR CLASSROOM

The Mars Public Mapping Project, (MP)2, is designed to be used both formally or informally in your classroom. As teachers, there are objectives you need to teach your students, which is why the 5E lesson, described below, was created. This formally written lesson allows you to use inquiry-based techniques to teach this lesson. You may also, however, consider having your students informally participate in this project. You may want them to enjoy looking at THEMIS images of Mars and just note down and log their progress as they go. If you wish to do this, feel free!! A suggestion for this somewhat informal use of the website is as follows:

1. Sign up each of your classes to participate and provide your students from each class with the *Class Key* and *Class ID*.
2. Have your students sign up using the appropriate *Class Key* and *Class ID* so they will appear on your correct class roster.
3. Have students rate and tag images.
4. Have students log image information as provided on the Image Observation Log provided at the end of this Teacher Guide (optional).

The more images students rate and tag, the more they will be helping Mars scientists. We encourage students, their families and anyone interested to get involved!

The above described set of steps may be applicable to students in the lower grades. Feel free to adjust this activity according to the level of your students.

Below is a description of the more formal inquiry based lesson you can use with your students.

5-E Model of Instruction

This activity is embedded within the **5-E model of instruction**. There are five phases: Engagement, Exploration, Explanation, Elaboration, and Evaluation. The 5-E model is a more structured version of guided discovery. Because there are specific concepts that teachers want students to know, activities

are structured in a step-by-step fashion, and therefore more materials are prepared in advance. This is, however, still considered to be inquiry-based learning due to the nature of the activities, the specific order that they occur, and how they are presented to students.

5-E Phase	General Description	(MP)2 Activity
<i>Engagement</i>	Teachers engage students in questions and probe for prior knowledge and conceptions.	KWL/Prior knowledge activity: <i>What do we know about geologic features on Mars?</i>
<i>Exploration</i>	Students prepare and conduct investigations to gather evidence.	Use of (MP)2 website with activity data collection sheets.
<i>Explanation</i>	Building on students' explorations and explanations, teachers formally present scientific terminology, concepts, and principles. Students, guided by the teacher, use new knowledge to construct scientific explanations and answer initial questions.	Presentations by students of their data gathering activities. Identification of geologic features seen in images. Students define scientific terminology.
<i>Elaboration</i>	Students apply new understandings to new problems.	Generate research question based on exploration of Mars THEMIS images.
<i>Evaluation</i>	Teachers and students use formal and informal means to assess new knowledge, understandings, appreciations, and abilities.	Students create posters diagramming and explaining a student-created THEMIS image defining common geologic features on Mars.

Table 1. 5-E model of instruction with general description and application to *Mars Public Mapping Project, (MP)2, activity.*

PROCEDURES FOR 5-E MODEL LESSON

Use the following procedure to implement the *Mars Public Mapping Project, (MP)2, Activity.*

1) Engage: Prior knowledge activity

What types of geologic features are found on Mars?

1. Have students work in pairs or small groups and have them brainstorm on what they think they know about geologic features on Mars. Have students fill out information in the first two columns of the KWL Prior Knowledge/*Engagement* Activity Chart in their student guide. Students can draw from their existing knowledge about geologic features on Mars.
2. After students have finished their individual discussions, return their attention to the whole group. Discuss student responses as a class. You can chart their responses on large chart paper (recommended so that you have a written, visible record during the activity) so that everyone can hear and remember students' ideas and questions.

What do we know about geologic features found on Mars?	What questions do we have about geologic features on Mars?	What have we learned about geologic features on Mars?

3. You will leave the last column blank for now. As students learn new information to answer their questions and/or correct their misconceptions you can add these new (accurate) ideas to the chart.

After you complete the *Engage* activity, students should read the background information sheet that will tell them a little bit about THEMIS and the Mars Public Mapping Project (MP)². It will also give them instructions on how to create a login and encourage them to read the information provided on the ***Getting Started*** page. This will give them additional information to use as they tag images. You should have them do this prior to gathering data for the *Explore* activity. Remember, you will first need to register your class on the (MP)² website. Once you register the class, be sure to note down the *Class Key* and *Class ID* to give to the students. They will need this information to register themselves in your class.

Suggestion: If you have students working in pairs you can have them create a user name that combines their first names. This will allow you to monitor their work.

2) Explore

Use of the Mars Public Mapping Project, (MP)², website along with data collection sheets.

1. Make sure students created their logins and have read the information on the ***Getting Started*** page. Students should follow the directions on their observation sheets.
2. Providing student groups with a copy of the Image Identification Charts is optional.
3. Ask each pair of students to look at 3-5 images minimum from the website. Images will randomly come up and should be different for each group. Students should log the following information:
 - a. Image ID #: This is the V# at the bottom of the image.
 - b. Image Rating: What did they rate the image?
 - c. Sketch of Image: A quick sketch of the image indicating features tagged.
 - d. Features found: Circle the specific features tagged in each image. (Students should be sure these features are included on their image sketch.
 - e. Most interesting feature: Students list which specific feature(s) they found most interesting? They should indicate what about that feature(s) is interesting?
4. Make sure students are zooming in and out of each image and scrolling around to identify as many features as they can.
 - a. By clicking on the image ID # under the image it will open a new web page that consists of the THEMIS image and image information/details. It provides another way for students to examine the image.

3) Explain

Presentations of a THEMIS image to the whole class by students; criteria defined for identification of the geologic features

1. Student pairs can show their favorite THEMIS image to the class by going to the <http://themis-data.asu.edu> website. You can put in a specific Image ID # to access and view any image.
2. Students should talk about 3 geologic features they saw in almost every THEMIS image they observed. They should discuss the criteria they used to identify these features and show them in their image.

3. During student presentations notes should be taken. These notes will reinforce the geologic vocabulary terms and criteria used to identify the features.

4) Elaborate

Generate a research question based on a specific geologic feature observed in THEMIS images. Elaborate on a plan to further research this feature.

1. Students will list two of the most popular (favorite) geologic features from the class presentations.
2. Students will select 1 of those geologic features and create a scientific question that would allow them to investigate that feature.
3. Students will develop a plan of what they need to know about the feature, how they would go about further investigating that feature and question, and where they might find information to assist them in their research.

5) Evaluate

Students create mini-posters diagramming and explaining a student-created THEMIS image that illustrates and defines criteria used to identify common geologic features.

1. Have students read the product descriptor and scoring rubric for their poster assessment before they start the *Evaluation* component of the lesson. (See the *Evaluation: Poster Session* description on the next page.)
2. Once students have completed their posters have them present or display their posters so that all students can look at and evaluate each other's work.
3. If you want students to give peer feedback you can give them Post-It notes to write on and leave with their classmates' posters or assign specific students to review specific posters.

Closure:

Revisit the KWL/Engagement Activity chart and discuss with students what they have learned. This will enable misconceptions to be corrected, questions to be answered, and newly learned information to be shared.

Extensions:

Suggested Extension 1: As students are observing images, have them plot the image locations on a MOLA elevation map of Mars. This will allow them to look for patterns in the features they are observing and their location on Mars.

Suggested Extension 2: After students give their poster presentations, have them vote on which question seems most interesting. Students can use this question for research and participate in the Mars Student Imaging Project (MSIP) <http://msip.asu.edu>.

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Evaluation: Poster Session

Student-created THEMIS image

Instructions:

Create a mini-poster diagramming and explaining a student-created “THEMIS” image of Mars. The image should illustrate and define the most commonly observed features based on the class presentations. The poster should include criteria for identifying these features.

1. Brainstorm with your partners on how to sketch your student-created “THEMIS” image. The image should be sketched to reflect actual THEMIS image characteristics. This includes the slight slant each image has (that reflects the rotation of the planet as the spacecraft is flying overhead) as well as its shape.
2. Clearly and neatly create your image and clearly label features. Criteria for identifying features should be included. You should also clearly identify the specific feature of interest for your created research question.
3. Include the research question you created to further investigate this feature on your poster.

Suggestions:

- A. Sketch a rough draft of your poster before finalizing your poster format.
 - B. Use the Rubric for Poster Assessment to understand how your poster will be evaluated.
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RUBRIC FOR POSTER ASSESSMENT

Exemplary	Image is accurately sketched with THEMIS image characteristics Key features have been appropriately labeled and criteria defined Question is clearly written & focuses on feature of interest Poster is neatly presented and logically organized No spelling or grammatical errors
Meets Standards	Image is somewhat accurately sketched with some THEMIS image characteristics Most key features have been appropriately labeled and criteria defined Question is somewhat clearly written & focuses on feature of interest Poster is somewhat neatly presented and somewhat organized Minimal spelling or grammatical errors
Partially Meets Standards	Image is sketched with few THEMIS image characteristics Few key features have been appropriately labeled and few criteria defined Question is not clearly written and does not focus on feature of interest Poster is poorly presented and disorganized Numerous spelling and/or grammatical errors
Redo	Image is poorly sketched with no THEMIS image characteristics Almost no key features have been appropriately labeled and no criteria defined Question is not included Poster is disorganized and sloppy Multiple spelling and/or grammatical errors

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Data Collection /*Exploration* Activity

Mars THEMIS Image Data	
Image ID#:	Image Rating:
Sketch of Image:	Circle the Geologic Features Identified: Craters: Preserved, Modified, Rampart Layers Valleys: Straight, Curvy, Gullies Volcanic: Lava Flows, Tubes, Cones Wind Related: Sand Dunes, Dust Devil Tracks, Wind Streaks
	Most Interesting Feature (please explain what makes it interesting): <div style="height: 100px;"></div>
Mars THEMIS Image Data	
Image ID#:	Image Rating:
Sketch of Image:	Circle the Geologic Features Identified: Craters: Preserved, Modified, Rampart Layers Valleys: Straight, Curvy, Gullies Volcanic: Lava Flows, Tubes, Cones Wind Related: Sand Dunes, Dust Devil Tracks, Wind Streaks
	Most Interesting Feature (please explain what makes it interesting): <div style="height: 100px;"></div>

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Presentation of Observations/*Explanation* Activity

Student Names	Three Identified Features	List Criteria Used To Identify Each Feature	Feature of Interest
	1. 2. 3.	1. 2. 3.	

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Image Observation Log

Image ID#	Circle Features Identified in Each Image	Image Rating and Optional Comments
	<p>Craters: Preserved, Modified, Rampart Layers</p> <p>Valleys: Straight, Curvy, Gullies</p> <p>Volcanic: Lava Flows, Tubes, Cones</p> <p>Wind Related: Sand Dunes, Dust Devil Tracks, Wind Streaks</p>	
	<p>Craters: Preserved, Modified, Rampart Layers</p> <p>Valleys: Straight, Curvy, Gullies</p> <p>Volcanic: Lava Flows, Tubes, Cones</p> <p>Wind Related: Sand Dunes, Dust Devil Tracks, Wind Streaks</p>	
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	<p>Craters: Preserved, Modified, Rampart Layers</p> <p>Valleys: Straight, Curvy, Gullies</p> <p>Volcanic: Lava Flows, Tubes, Cones</p> <p>Wind Related: Sand Dunes, Dust Devil Tracks, Wind Streaks</p>	
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