

## ROVERQUEST: Greetings from Gusev

### EDUCATIONAL OBJECTIVE:

This activity will place students in the role of scientists as they use observational and critical thinking skills to analyze and hypothesize about an image of Mars. Students will determine what they think to be scientifically interesting by making visual observations and rank their observations in order of importance.

### REAL-WORLD APPLICATION:

This activity follows along with the way Mars scientists look at images from a lander on Mars. As they study an image, they look at even very smallest details to try to learn about the history of that area on Mars.

### BACKGROUND:



How do scientists look at images that are sent back from another planet and determine what is interesting and needs further investigation? Mars rover scientists do this very task during surface mission operations. Each day, rovers will send to Earth new images that the science team

must examine. These images will allow the scientists to think of hypothesis that relate to help the science team decide what to study and determine what experiments they will conduct.

### PROCEDURE:

1. After the students choose what type of scientist they desire to represent, have them gather in working groups. These groups can either be a mix of different disciplines or the same disciplines.
2. Have the students observe an image of Mars (current images available on the Mars Program homepage-see URL listed under materials) and make observations on their student worksheet as to what they can see within the image.
3. Have the students prioritize their observations as to what they think is scientifically Interesting using the grid system (e.g. small rock - I,74).
4. Have the students form hypothesis as to what they are seeing. For instance, what is the story of why it looks like it does? Have them evaluate if they have enough information to form a hypothesis. If not, what is missing?
5. Have the students think of ways these hypothesis

### Grade Level

5-12

### Time Frame

1 class period  
(~45 minutes)

### Materials Needed

#### Per student or team of 2-4 students

Image of Mars - either printed out or viewed on the Internet (available at [Mars Exploration Rover Mission](http://marsrovers.jpl.nasa.gov) site)

*Note: This image will also be used for another activity in RoverQuest.*

#### [Student Worksheet](#)

Clear overlay that has at least 1" grid so students can identify features using a quadrant system. The image itself can also be produced to have a grid.

Magnifying glasses if available

#### **Optional:**

[Press release](#) for this Mars image

Laminated images of the surface of Mars and Vis-à-vis pens to mark areas of interest

### Downloads

[Student Worksheet](#) 

### Vocabulary

- ripples or small dune forms
- albedo
- lag deposit or armored surface

might be tested (e.g. further observations, using instruments on the rover, etc.)

### ASSESSMENT:

Students can be assessed on the completion of the Greetings from Gusev worksheet, participation in group or class discussions and/or a presentation of their observations of the Spirit landing site.

### Science Contributions from Mars Exploration Rover Team Members:

Dr. Doug Ming - Mineralogist, Johnson Space Center  
 Dr. Mark Lemon - Atmospheric Sciences, Texas A & M  
 Dr. Robert Anderson - Geologist, Jet Propulsion Laboratory

### ADAPTATIONS / EXTENSIONS:

- Overhead transparency of image so you could conduct this lesson with the entire class
- Compare the Mars Pathfinder Landing site in Ares Vallis to that of the Spirit Lander in Gusev Crater. Image can be found at:  
<http://marsprogram.jpl.nasa.gov/MPF/ames/ames-pres.html>
- Look at areas on Earth that would be analogs to what we are seeing on Mars (e.g. Antarctic dry valleys, summit of Mauna Kea volcano in Hawaii)

- mantled rock  
 - vesicles  
 - secondary craters

### More Resources

- Mars Exploration Rover [mission overview](#)  
 - Mars Exploration Rover [science overview](#)  
 - Mars Exploration Program [goals](#)  
 - Mars Exploration Rover [mission objectives](#)

### Credits & Feedback

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### National Science Education Standards:

#### A. As a result of their activities, all students should develop the abilities necessary to do scientific inquiry:

1. Identify questions that can be answered through scientific investigations.
2. Conduct a scientific investigation.
3. Use appropriate tools to analyze and interpret data.
4. Develop descriptions and explanations using evidence.
5. Think critically and logically to make the relationships between evidence and explanations.
6. Recognize and analyze alternative explanations.
7. Communicate scientific procedures and explanations.

#### D. As a result of their activities, all students should develop an understanding of:

1. Structure of the Earth system
2. Earth's history

**G. As a result of their activities, all students should develop an understanding of:**

1. The nature of science



3. Based on your observations of this image, identify any features (like rocks, hills, soils, sky, etc.) you can see in the image. Make a list of these items, listing the number of the grid the feature is found in. Use the back of this sheet if necessary.

a. Grid # \_\_\_\_\_ Feature:

b. Grid # \_\_\_\_\_ Feature:

c. Grid # \_\_\_\_\_ Feature:

d. Grid # \_\_\_\_\_ Feature:

e. Grid # \_\_\_\_\_ Feature:

f. Grid # \_\_\_\_\_ Feature:

4. Choose the top 4 features that you think are the most interesting **(for any reason)**. List them the order with number 1) being the most interesting.

1) Grid # \_\_\_\_\_ Feature:

2) Grid # \_\_\_\_\_ Feature:

3) Grid # \_\_\_\_\_ Feature:

4) Grid # \_\_\_\_\_ Feature:

5. Choose the top 4 features in this image that you think are the most interesting **scientifically**.

1) Grid # \_\_\_\_\_ Feature:

2) Grid # \_\_\_\_\_ Feature:

3) Grid # \_\_\_\_\_ Feature:

4) Grid # \_\_\_\_\_ Feature:

6. How do the list in question #4 and the list in question #5 compare? Are they the same? Why or why not

7. Pick out one of the features you chose and write a description of what you are seeing. Describe it as well as you can, looking at all the details of this feature.

Grid #\_\_\_\_\_ Feature:

8. Looking at this image, how do you think this feature was formed?

9. Do you think you have enough information to create a hypothesis? If not, what other information would you need?