Highs and Lows
Floods and Flows

Planetary Mapping

Investigator Packet

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Overview: Planetary scientists can say a lot about a planet’s history by looking at a map of its surface. They examine the features to understand the geologic activity that has occurred, look for patterns, determine the order in which events happened – and formulate questions for further exploration. They use maps to select locations on the planet’s surface to investigate those questions. Maps are critical for identify targets for rovers, human exploration, and future colonies.

Your Challenge: As a team, develop a good understanding of the features and geologic history of the planet by answering the questions presented in this Investigator’s Packet. At the close of the project, your team will propose a scientific question that could be answered by a rover or astronaut expedition and will identify the best and safest place to go to answer that question.

What scientific question do you have?
Where is the best place to on the planet to address this question?
Where would the safest place be to land a rover or an astronaut to address this question?

Start:
What particular type of picture do you think this is? _________________________

What do you think is represented by the different colors? _______________________

_________________________________
Terms to Know

**Topographic Map** – a map that shows natural and human-made features of an area in a way that shows their relative positions and elevations. Topographic maps often show contour lines (lines of equal elevation).

**MOLA Map** – a color-coded topographic map of Mars’ surface obtained from laser altimeter measurements taken by the Mars Orbiter Laser Altimeter 1997-2000.

**Crater** – large depressions in a planetary surface caused by impactors, such as asteroids or comets. Craters typically are circular in shape and have raised rims.

**Channel** - the bed where a natural stream of water (or lava) runs, or ran. Channels can be straight or sinuous.

**Volcano** – usually a large conical structure forming at a vent in the surface of a planet through which magma and gases erupt. The conical feature builds up from the ejected material.

**Lava** – molten rock that flows on the surface of a planet (magma is molten rock that is still inside the planet).

**Early bombardment** – a period early in the history of the Solar System during which asteroid impacts were very frequent. Very large craters were created on the planets at this time, caused by large impactors. While impacts still occur today, they are less frequent and smaller.

**Fault** – a break in a planet’s surface, along which blocks of the surface move relative to one another.
Question Set 1 - Observing Patterns & Mapping

1. This is a map of which planet? ________________________________

2a. What do the colors on the map key signify? ________________________________

2b. What physical features are represented by all topographic maps? ________________________________

3a. Where on this picture is north located? ________________________________

3b. What about south? ________________________________

4. Where do you think the equator is located? ________________________________

5. Where do the red, orange & yellow colors tend to occur? ________________________________

6. What about the greens and blues? ________________________________

7. The tans and whites? ________________________________

8a. Which colors represent higher terrain? ________________________________

8b. Lower regions? ________________________________

9. How do you know? ________________________________

10. What patterns do you observe? ________________________________

Check your answers with your teacher!
Question Set 2 - Analysis & Synthesis

1. What “type” of map is this? ______________________________________________

2. What color are the mountain tops? ________________________________________

3a. Do any of the colors signify water? _______________________________________

3b. If not, what does the color blue signify? __________________________________

4. Refer to the “Terms to Know” and explain what feature is represented by the darkest blue area.

   ______________________________________________________________________

5. What would have caused the darkest blue area to be in a location separate from the large light blue areas?

   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

6. What indications of past or present flowing water do you observe?

   ______________________________________________________________________
   ______________________________________________________________________

   Use your writing utensil to mark the possible directions of the flows.

7. Which areas (colors) of the map look rough? ______________________________

8a. What makes the area rough? ___________________________________________

8b. What do you think caused the roughness?

   ______________________________________________________________________
9a. How would you describe the surfaces downslope from the highest peaks (rough or smooth)?
_____________________________________________________________________

9b. Do these surfaces have many craters on them? __________________________

10. What might have caused the smoothness; why might this area not be cratered?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

11a. What kind of geologic features are the highest mountains? ________________

11b. Why do you think that?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

12. What is the feature just to the east of the mountains that looks like an east-west gash in the surface of the planet?
_____________________________________________________________________
_____________________________________________________________________

Check your answers with your teacher!
Questions Set 3 - Drawing Conclusions

1. How could smooth surfaces on Mars become rough? ________________________
   _______________________________________________________________________

2. How could rough surfaces on Mars have been smoothed out? _________________
   _______________________________________________________________________

3. There is a big difference in the character of the northern part of Mars and the
   southern part. What could have caused the northern terrain to become smooth?
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

4. Which do you think is older, the red rough terrain or the blue smooth terrain? ____
   _______________________________________________________________________

5. What are your reasons? ________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

6. Which do you think is older, the rough red terrain or the smooth red terrain (around
   the mountains)? ________________________________________________________
   _______________________________________________________________________

7. What are your reasons? ________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

Check your answers with your teacher!
To Mars!

Decide as a team what scientific question you have about Mars. Based on your investigations, this could be a geologic question, but it could also be another question that can be answered by the scientific process.

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

To what location will you send the rover or astronaut to gather information that will address your question?

Latitude: _____________________________________________________________

Longitude: ___________________________________________________________

Why did you choose this site?

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
Wrapping Up

The MOLA map you just used to determine your landing site was one of the same maps used by NASA scientists and engineers to determine the landing sites of Spirit and Opportunity in the recent MER Mission to Mars. Spirit landed in Gusev Crater, located at 14.57° South and 184.53° West. Opportunity landed on Meridiani Planum, located at 1.95° South and 5.53° West.

Based on your study of the MOLA topographic map of Mars, describe its topographic features and the geologic processes you think may have caused them. Based on your observations, describe how the red planet has changed through time.

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