Lesson 4: Remote Sensing Mars

Summary
This learning module and related laboratory exercise exposes students to remote sensing techniques utilized on Mars.

Learning Goals

Students will be able to:

- Apply the concepts of scale and context in remote sensing imagery.
- View THEMIS and HiRISE images and interpret major geomorphic features using Google Mars and associated homework activities.
- Understand how MOLA generates its image data by applying the fundamental equations in an experiment.

Context for Use
This learning module is meant for adaptation in an introductory earth science course and/or planetary science course. It is advised that the teacher compare Earth-based remote sensing instrumentation for context/reference such as LandSat 7.

Description and Teaching Materials
In-Class Activity
In-Class Activity 1: Scale and Context
In-Class Activity 2: MOLA simulation
Homework/Lab
Homework 1: Google Mars-Following Opportunity
Homework 2: Mars Image Analysis

Teaching Notes and Tips

1. The *In-Class Activities* can be utilized as homework as well. Students will have a lab-write up associated with the *MOLA simulation*.
2. For a large class size >20 you may either have a separate lab time/class for different sections or demonstrate the lab with the entire class and employ student participation.
3. We advise instructors to compare Earth-based remote sensing packages such as Landsat 7 for context.
4. In preparation for the MOLA simulation *In-Class Activity* instructors must gather a few materials (see the *MOLA simulation* for further clarification).

Assessment

- The *MOLA simulation* Lab write-up will assess the student's understanding of the MOLA instrument and MOLA's utility.
- The *Google Mars* homework will assess whether or not students can successfully navigate the Google Mars software and begin to interpret the data provided by Google Mars.

THE UNIVERSITY OF UTAH®

Sponsored by:
National Aeronautics
and Space Administration
NASA Award (NNX11AH29G)

NASA

Mars for Earthlings

References and Resources

1. THEMIS images url: http://themis.asu.edu/
2. LANDSAT 7 images url: http://landsat.gsfc.nasa.gov/images/
3. HiRISE 13 April 2011 YouTube video: http://www.youtube.com/watch?v=-U6-uYDtuSg
4. MRO/HiRISE All HiClips revisited (Feb 2012) YouTube Video: http://www.youtube.com/watch?v=YVDUQjJbjyc
5. MOLA images url: http://mola.gsfc.nasa.gov/index.html
6. Ping-Pong Lab (NASA): http://mola.gsfc.nasa.gov/pingpong.html

Mars for Earthlings

Homework 1
Remote Sensing_MFE
Google Mars-Following Opportunity

Objective: The purpose of this homework set is to get you familiar with different types of Mars remote sensing imagery and programs.

Google Mars-Following Opportunity

Directions/Questions:
Download Google Earth if you haven't already:
http://www.google.com/earth/download/ge/agree.html

In the icon list across the top of the window click on the planet with a single ring and a small dropdown arrow. The students should see options for Sky, Mars, and Moon. Click on Mars.

1. Name the 5 types of spacecraft imagery available through Google Mars.
   What do the 5 acronyms stand for?

   a.

   b.

   c.

   d.

   e.

Find Olympus Mons (see if the students can find it without typing the name in the "fly to" box).

2. What is the highest elevation according to Google (find the appropriate *Global Map Layer* in order to determine this information)?

3. In the *Global Maps Layer*, besides the *Visible Imagery*, which imagery gives the students the highest resolution of the volcano? Why is this the case?

Mars for Earthlings

Go to the *Rovers* and *Landers layer*

4. What are the current coordinates of these 3 lander sites?
   Phoenix Lander
   Viking 2 Lander
   Mars 3 Lander

5. Where did MER Opportunity Rover land? (i.e. what crater?)

   What crater did it visit next?

Look at the Burns Cliff panorama photo (camera icon, students may have to click on a couple to figure out the right one).

6. List 2 observations the students can make about the photo (colors, shapes, lineations, etc.)?

   Name 2 other craters the Opportunity rover explored.

   _____, _____

7. Write down two observations about what students see in the bottom/ centers of Victoria Crater. Can students name the features?

8. Using the Traverse Path layer of the MER Opportunity Rover, locate its position on Sol 1685 (sol= Mars day). What annotated feature (labeled named) is it nearest?