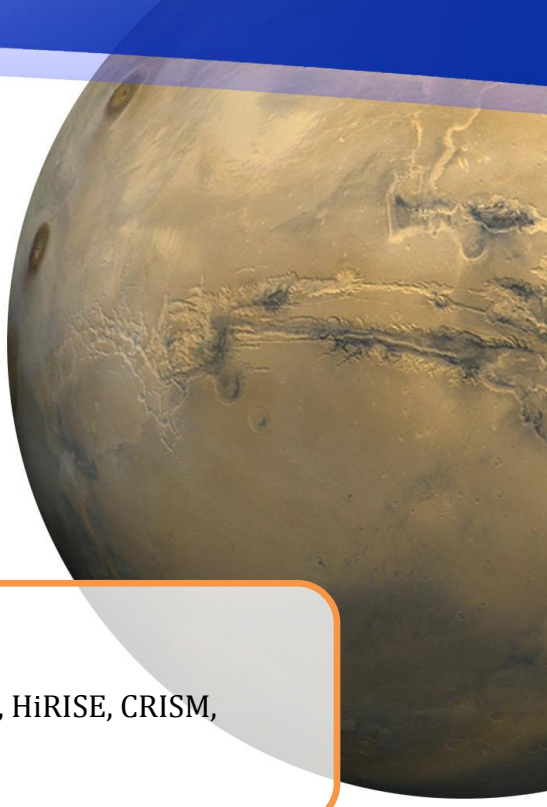
Lesson 1: Welcome to Earth and Mars



Summary
This introduction will expose students to Mars imaging software platforms so that students may become familiar with their navigation and imagery products.

Learning Goals

Students will be able to:

- Navigate and use both Google Mars and JMARS.
- Become familiar with imagery collections available (e.g., HiRISE, CRISM, THEMIS) via the above software programs.

Context for Use
This learning module is meant for adaptation in an introductory earth science course and/or planetary science course. The *In-Class Activities* can be easily adapted for homework when desired.

Description and Teaching Materials
In-Class Activity

In-Class Activity 1: Mars Analogs

Homework/Lab

Homework 1: Google Mars
Homework 2: Exploring Gale Crater
Homework 3: JMARS- Mawrth Vallis "Potential landing site"
Homework 4: Meet the Scientist- Who studies Mars?
Homework 5: Having fun with Mars programs

Teaching Notes and Tips

1. Before assigning Homework 1 or 2 spend some time exploring both Google Mars and JMARS with the students for a "first pass" exposure.

Assessment

- Methods of assessment are within each individual *In-Class Activity* and *Homework*.

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References and Resources

1. Image File: Welcome to Earth and Mars
2. JMARS Website: http://jmars.asu.edu/
3. Google Earth Free download: http://www.google.com/earth/index.html

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In-Class Activity 1
Intro to Mars_MFE
Mars Analogs

Purpose: Observe and rank potential Earth analogs for Mars planetary study.

Preparation:
1. Print off student exercise
2. Use .ppt image file for class

Resources:
Intro to Mars Image File

Engage
What is an analog?
1. What do students think scientists mean by an "earth analog" in the context of studying Mars?
2. As an example, why is the komodo dragon considered an "analog" for a dinosaur?

Explore
Present the following regions as potential analogs for Mars (via Intro to Mars Image File):
- Atacama Desert
- Death Valley, CA
- John Day Formation, Oregon
- Southern Utah
- Antarctic Dry Valleys

Ask students to consider their criterion for whether or not a region is a good analog. Discuss varying criteria as a class and determine the most appropriate definition of a good analog.

Explain
Have students investigate "vital statistics" of Mars via the internet (see Image File examples) such as: ambient temperature ranges, atmospheric composition, mineralogy, depositional environment, the absence of life, water, and geomorphic features.
Other example references: http://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html

Elaborate
As students discuss the various regions, have them provide the Earth data/statistics (similar to Mars) of these regions for comparison to Mars.

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Evaluate

Check off how important students think the following factors are in deciding whether this is a good analog to Mars (1-very important, 5-not important)

_____ Environment conditions, setting for deposits

_____ Geomorphic features (landscape expression)

_____ Type of water and its presence or absence

_____ Ambient temperature range

_____ Mineralogy

_____ Type of life, if present (extremophile or not)

_____ Rainfall

_____ Atmospheric composition

Note: it may be difficult for any Earth Analog to satisfy all the conditions of similarity to Mars

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Homework 1
Intro to Mars_MFE
Google Mars

Objective: Observe important features and "divisions" of the surface of Mars.

Introduction: This brief introduction will hone students' observation skills to notice features on the surface of Mars and some of the major natural landscape features.

Getting Started
Use the web version of Google Mars http://www.google.com/mars/
Notice that the map wraps (repeats), so students will want to crop the window so it just shows 1.

Exploring Mars
This initial flat plane projection map has 3 viewing options (upper right). The standard default is _____. Here, the colors represent the scale in units of _____. The other 2 viewing options are _____ and _____.

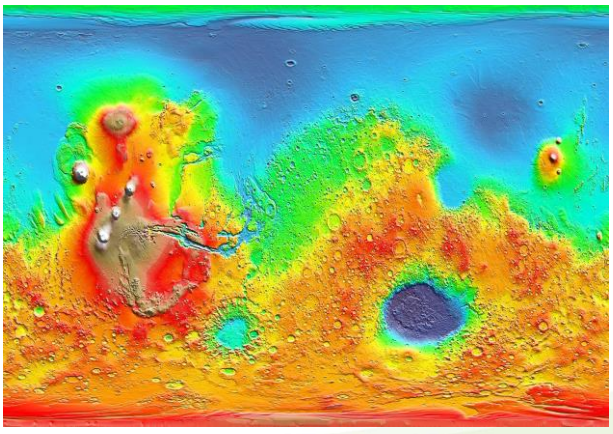
Click on Stories. What is the name of the Martian rift zone? _____ In the left column window, click on "glossary" and review the terms. A mountain is called _____ and a low plain is called _____. A high plain is called _____.

Click on Spacecraft. Why do the students think the spacecrafts were mainly in the "middle" of the planet?_____

Overall
Just looking at the color patterns & textures, if the students were dividing the planet into 2 parts, how would they be defined and what are their characteristics?

	Location	Characteristics
1.		
2.		

Draw the boundary line between the two parts and have the students discuss their answers with one of their classmates (as assigned) and compare thoughts.



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Homework 2
Intro to Mars_MFE
Exploring Gale Crater

Objective: To navigate, learn and utilize the tools offered within Google Mars.

Introduction: In order to accomplish this lab the students will need to download Google Earth 6 (http://www.google.com/earth/index.html). This lab will completely utilize Mars; all answers to questions can found by using the layers provided in the program. Some questions will be straightforward; however others will require students to use their own judgment and intuition.

Intro to Google Mars
Open Google Earth. In the icon list across the top of the window, click on the planet with a single ring button with a small dropdown arrow. The dropdown menu will provide options for Sky, Mars, and Moon. Click on Mars.

Searching the Layers Bar on the left:

1. Click on the drop down arrow for Global Maps.
    a. What map is used (checked/dotted) when Google Mars loaded (consult the Global Maps Layer)?

       What do the colors refer to?

    b. View the other Global Map types. Is there another the students prefer? (Why or why not?)

2. Click on the drop down arrow for Spacecraft Imagery.
    a. How many imaging devices are available?
    b. What are the image devices' names and what spacecraft are they aboard (click on each)?

    c. Which instrument/camera has the best resolution?

3. Make sure *Rovers and Landers* are checked before the students proceed.

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Exploring Curiosity's Landing Site

4. Type Gale Crater into the Search Box (Curiosity's landing site on August 5th, 2012).
    a. Is any imagery available right after it zooms in? Why or why not?

    b. Who is the crater named for and what is his/her nationality?
    c. What is the documented location of the crater?
        i. Center latitude
        ii. Center longitude
    d. What is the diameter size of the crater?

5. Zoom out (exit street view if necessary) until the MOLA colorized elevation map comes into better resolution. The students should see a swath of "***i***'s" in the upper left corner of Gale Crater.
    a. Find the landing site of the Curiosity Rover. It is marked with a flag icon. What was the location of its landing site (use the Google GPS coordinates)?

    b. Click on the Flag icon. What other landing sites were considered for Curiosity?

    c. Why do the students think that the majority of landing sites are crater locations?

6. Activate the HiRISE imagery in the Spacecraft Imagery Layer (red outlined rectangles should appear).
   HiRISE stands for _____
    a. Where are most of the HiRISE images taken?

    b. Why might the majority of images be in this location?

c. View the HiRISE image with the small *pink square box* labeled "Grand Canyon of Gale Crater" ESP_012195_1750 (located S of the landing site, where red line box appears as the students hover the mouse). Can they see the canyon? To download the image:
   i. In the information pane click on *observation information page* in blue (link)
   ii. This will bring up the HiRISE webpage. Scroll down to "Image Products" purple bar
   iii. Choose JPEG→ Grayscale → Map Projected
   iv. Paste the image here as a .jpg or sketch the image. Use an arrow and point to the location of the canyon. Use the space below to explain why this might be of interest to scientists.

7. Go through other images and information provided by Google Mars for Gale Crater. Write a convincing argument in 3-5 sentences on why Gale Crater was chosen as the landing site for MSL Curiosity.

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Homework 3
Intro to Mars_MFE
JMARS- Mawrth Vallis "Potential landing site"

Objective: To navigate, learn and utilize the tools offered within the software JMARS.

Introduction: In order to complete this lab the students need to register and download JMARS:

1. Go to webpage: http://jmars.asu.edu/
2. Click: Create New Account
3. Enter desired account information
4. Click: Request New Account (page should prompt them to check their email for password and further instructions)
5. Check email and click on link (or enter the link into their browser)
6. Click login and change password. The account should last 6 months.
7. Click on "Download JMARS" tab
8. Under section "JMARS Public Downloads" click "Cross-platform Java Webstart Installer"
9. Open installer: When JMARS opens the students will need to enter username and password.

For information about the software and great tutorial videos, go to https://jmars.mars.asu.edu/videotutorials. Make sure to watch Tutorial 1 to gain a brief introduction to the layout and use of the JMARS software. Alternatively, go to the JMARS homepage and explore the options under the "Tour of the JMARS user interface" and "Tour of the JMARS Layers" panels. Have fun exploring Mars and other planetary bodies.

Intro to JMARS
Have students open JMARS using their email/password. JMARS functions very much like the layers in Photoshop or GIS in order to view different image sets.

8. In the Layer Window, choose and press the button "Add New Layer" in the Main tab (other tabs at this point are: MOLA Shaded Relief NE, Lat/Lon Grid).
    a. Add the layer Nomenclature. With this layer open, the students can navigate to any feature on Mars by name.
    b. Activate/Open the Nomenclature tab. Keep all default boxes checked. Select Vallis in the *Selected Landmarks Types* menu.
    c. In the *Navigation* Menu select Vallis for *Landmark Type* and Mawrth Vallis for *Landmark*.
    d. Then press the *Go-To* button below. The software will automatically find and zoom to this location and label it.

e. What are the coordinates of Mawrth Vallis (place cursor/arrow over the red marker; the default color for the marker)?
f. Observe the terrain; have students explain why they think this area was considered as a landing site for MSL Curiosity (they may play around with the Zoom in the upper right of the viewing window, default is always 32).

9. Exploring Mawrth Vallis' relationship to other major Mars geologic/geographic features.

   Add a new layer: Choose by Instrument → MOLA → MOLA Shaded relief/Colorized Elevation → View Graphic data. **note, if students are having trouble seeing the labels, move the Nomenclature label to the top of the layer window.

   a. How does the colorized data help the students?

   b. Where is Mawrth Vallis in relationship to Vallis Marineris (they may need to using the Nomenclature tab to find Vallis Marineris)?

      Do they think these features are the same? Why or why not?

   c. Where is Mawrth Vallis in relationship to the large expanse of "blue space" in the Martian Northern Hemisphere?

      How could the students potentially interpret the 'blue space?' What about Mawrth Vallis?

10. Exploring the mineralogy of Mawrth Vallis.

There are several methods to explore the mineralogy of the Martian surface in JMARS. We will only explore one. *Note: Make sure you can see the Mawrth Vallis label. If not, drag the Nomenclature layer to the top of the Layer Window.

Using TES Mineral Maps: Add New Layer → Maps by Instrument → TES Mineral Map → Now select the following maps separately and explain their: spatial coverage, resolution and abundance of that mineral.

a. TES Hematite

b. TES Basalt Abundance

c. TES Carbonate Abundance (Bandfield 2002)

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Homework 4
Intro to Mars_MFE
Meet the Scientist-Who studies Mars?

Directions: Navigate to http://serc.carleton.edu/marsforearthlings/index.html and click on "Meet the Scientist". Answer the following questions:

Watch all the short clips (only 2 mins. each or less) and answer the following questions.

1. How is this group of profiled scientists DIVERSE?

2. Who are the scientists that study Mars? *Choose 5 scientists to profile.*
List the scientists' last name and the institution each scientist is associated with. Describe the goals of their research.

	Name	Institution	Research
a.			
b.			
c.			
d.			
e.			

3. What is interesting and relevant? Have students choose two of their favorite scientists from *Meet the Scientists*.

- What is the most interesting fact (or rumor) they can find when they Google their name?

	Name	Fact
a.		
b.		

- In their opinion, is their research relevant (use a scale from 1-10 with 10 being extremely relevant)? Have them give a brief statement to justify their answer.

	Name	Relevance
a.		
b.		

- Can their research be helpful in other fields? If so give example(s).

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	Name	Helpful
a.		
b.		

- If students were an investor/ philanthropist/ government official would they fund the scientist's research? What would they change or applaud in their research?

	Name	Fact
a.		
b.		

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Homework 5
Intro to Mars_MFE
Having fun with Mars programs

1. Directions: Navigate to NASA's Eyes on the Solar System http://eyes.nasa.gov/

Explore Mars, and click on the Spacecraft icon.
Name the 3 types/categories of Mars Missions and cite the newest (most recent/current) example of each:

	Mars Mission TYPE	Newest Example
a.	_____:	_____
b.	_____:	_____
c.	_____:	_____

Click on the Landing Sites icon (top bar on right). Which landing site was closest to the N Pole of Mars? _____

Explore several other planets. Which of the other Non-Mars planets did the students find most interesting? _____

Explain why, what was interesting to the students?:

_____
Note: The students can look at the planet in all kinds or orientations.

2. Directions: Navigate to NASA Spacecraft 3D (may work best on mobile, available in app store free download). The students may want to use the Augmented Reality target.

Take a picture of you and the Curiosity rover and email to you