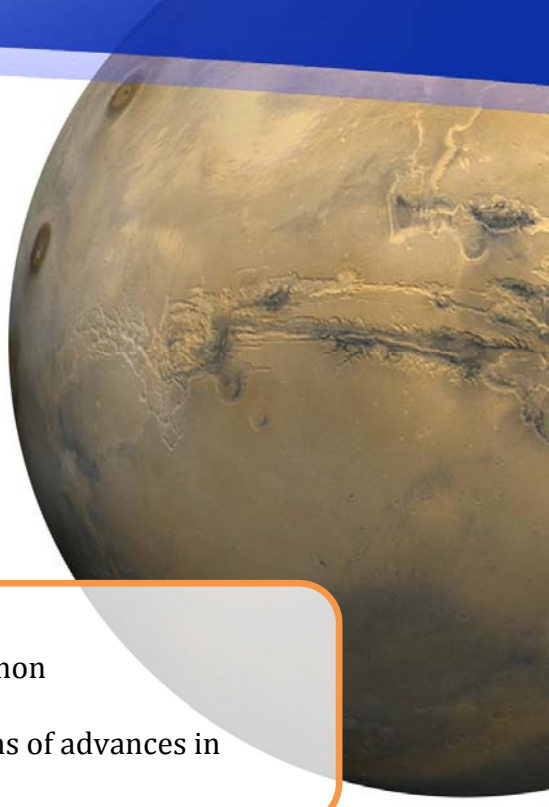
Lesson 3: Views & Missions in Space



Summary
This learning module compares early and recent missions to Mars as well as familiarizes students with a common instrument used in NASA mission payloads.

Learning Goals

Students will be able to:

- Familiarize themselves with mass spectroscopy, a common instrument aboard NASA missions.
- Compare the Viking and MSL-Curiosity missions in terms of advances in technology.

Context for Use
This learning module is meant for adaptation in an introductory Earth science course and/or planetary science course. Students will only need prior basic knowledge of Mars to understand the significance of sophisticated technology.

Description and Teaching Materials
In-Class Activity
In-Class Activity 1: Measuring "the tiny"
Homework/Lab
Homework 1: Viking vs. MSL-Curiosity

Teaching Notes and Tips

1. *Homework 1* may be used as an *In-Class Activity* if desired.
2. If your institution has a mass spectrometer in-house, schedule a visit for the class to view the instrument. Most lab mass spectrometers are at least 10x's bigger than spectrometers used on rovers and/or satellites orbiting Mars.

Assessment
Each In-Class Activity and Homework set has its own measure of assessment/evaluation.

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Mars for Earthlings

References and Resources

1. Image File: Views and Missions in Space
2. Mass Spectrometer YouTube video: http://www.youtube.com/watch?v=_L4U6ImYSj0
3. Viking Mission Documentary: http://www.youtube.com/watch?v=ggjD3i7efKU
4. Curiosity Rover trailer: http://www.youtube.com/watch?v=mNVZ6cJYYcY
5. MSL Curiosity 7 minutes of terror: http://www.youtube.com/watch?v=h2I8AoB1xgU

Mars for Earthlings

In-Class Activity 1
Missions to Mars_MFE
Measuring "the tiny"

Purpose: Determine a method to detect elements of interest (water and/or life-indicating) on Mars and become familiar with mass spectrometer devices on Mars-bound missions.

Preparation:
1. Display a periodic table
2. Bring any type of rock to class
3. Internet connection

Resources:
NASA Mass Spec Video: http://www.youtube.com/watch?v=_L4U6ImYSj0

Engage
Display a picture of the periodic table and ask students the following questions:
1. What are the differences between the elements of C, K, and O?
2. How could you measure their differences strictly from a principle standpoint?
3. As students provide answers, make sure they understand that an element's mass is its most unique feature (charge is not).

Explore (Corresponds with "measuring the tiny" in the student version)
Ask students to brainstorm a method, in teams, that would measure how much of each element was present in the rock you brought to class.
1. Can they turn this method into an instrument? What are the pros and cons/challenges?
2. Could they use this instrument to detect elements on Mars? Why or why not? What are the engineering design challenges?

Explain
Watch the following NASA Mass Spectrometer Video:
http://www.youtube.com/watch?v=_L4U6ImYSj0

Elaborate
Send students on a treasure hunt or provide the specific link where they can do secondary research. Possibly discuss the value of research as a scientific tool. What are the priorities of payloads of various Mars orbiters and rovers? How do the priorities affect whether one could house mass spectrometer instruments?

Possible links include:
Mars Science Laboratory Spectrometer:
http://mars.jpl.nasa.gov/msl/mission/instruments/spectrometers/sam/

Mars for Earthlings

NASA Mass Spectrometry 101:
http://www.nasa.gov/multimedia/podcasting/mass_spectrometer101.html

Evaluate

What elements would NASA like to detect to infer the possibility of extraterrestrial life? After watching the NASA Mass Spectrometer video, ask students how the methods or instruments they brainstormed compare to NASA's methods.

Ask students to describe how Mass Spectrometry works.
Students can watch this video (note the large size of this instrument)
http://www.youtube.com/watch?v=J-wao0O0_qM

Why is it so difficult to get Mass Spectroscopy instruments on NASA robots or probes?