

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.

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-wao000_qM

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



Mars for Earthlings

Homework 1

Views & Missions in Space_MFE
A Mission Comparison

Purpose: Students will explore past exploration of Mars and discuss the increase in sophistication of investigation and resolution of data over century and decadal scales.

Preparation:

Make sure students have Google Earth installed on their computers. Students will need internet access. The videos comprise about 15 minutes of watching time. Parts 1 & 2 might take about 30 minutes each.

Introduction

Space exploration is an iterative process; current exploration builds on the knowledge and technological breakthroughs of past missions, which allows for further improvements to spacecraft and instruments. This process is best illustrated by comparing two wildly successful missions: Viking launched in 1975, and MSL (Mars Science Laboratory) launched in 2011.

Part 1

Watch the following videos then have the students answer the following questions:

- Viking Missions to Mars:
<http://www.youtube.com/watch?v=ggjD3i7efKU>
 - 7-Minutes of Terror:
<http://www.youtube.com/watch?v=h2I8AoB1xgU>
 - MSL Curiosity Entry, Descent, Landing:
<http://mars.jpl.nasa.gov/msl/mission/timeline/edl/>
1. What are some of the complicating factors with landing spacecraft on the surface of Mars?
 2. How is the entry and landing of Viking similar to Curiosity?
 3. How does the entry and landing differ?
 4. What is the students' favorite component to Curiosity's landing procedure (EDL)?
 5. How were the landing sites for Viking 1 and 2 selected? How does this differ for the landing site selection for MSL?



Mars for Earthlings

Part 2

Discuss the increase in resolution and available data

As imaging/data collection capabilities increase, our ability to comprehend geologic features increases. Consider this through the next activity.

Exploration of historic maps available through google earth

1. Open Google Earth
2. Click on the planet icon in the toolbar and select Mars (alternatively, go to top tool bar and click “View” → “Explore” → “Mars”) to switch to Google Mars.
3. In the “Layers” panel to the lower left, click on the arrow by “Historic Maps” to expand the layer options and check the circle next to “Giovanni Schiaparelli - 1890” (make sure that the global maps layer circle is unchecked).
 - A. What are some general observations regarding this map?
 - B. What are the prominent features?
4. Click on “Giovanni Schiaparelli” in the layer options to access information about this map.
 - A. How and when did he make this map?
 - B. What do the students think the linear features are in this map?
5. Now click on the arrow by “Global Maps” to expand the layer options, and check the circle next to “Viking Color Imagery”.
 - A. What are the similarities between the historic maps and the global mosaic from spacecraft data?
 - B. How do the historic maps differ from the global mosaics?

“Face on Mars”

Go to this website: <http://www.msss.com/education/facepage/face.html>

1. How does lighting direction influence the appearance of the “Face”?
2. How does the “Face” seem to change when viewed under higher-resolution imagery?
3. Does it still look like a face under higher resolution?



Mars for Earthlings

Questions

Based on the discussion of historic global maps and the “Face on Mars”, answer the following questions:

1. How does the increase in resolution affect our understanding of geologic landforms?
2. How does this relate to the scientific process in general?

