

# Lesson 5: Why Matter and Minerals Matter!

## Summary

This learning module and related laboratory exercise exposes students to the make-up of minerals and rocks on both Earth and Mars.

## Learning Goals

### Students will be able to:

- Observe different rock-forming minerals and explain their relationship with water.
- Use CRISM and HiRISE images to identify regions on Mars where aqueous conditions might have been present.

## Context for Use

This learning module is meant for adaptation in an introductory earth science course and/or planetary science course. Provide students with an introduction to the atom and the periodic table to provide context and a resource to understand mineral formation.

## Description and Teaching Materials

### *In-Class Activity*

In-Class Activity 1: Follow the water with minerals

### *Homework/Lab*

Homework 1: Identifying the clay: Endeavor Crater

## Teaching Notes and Tips

1. For *In-Class Activity 1* either (a) print off colored copies for students (b) have hand sample specimens of each mineral for students to observe or (c) use the image file to show students the minerals.
2. For a large class size >20 where you would like to use hand-specimens, have a scope attached to your projector so students may observe "up-close".

3. Become familiar with JMARS software prior to class (loaded on whatever machine you will be using for presentation), especially with viewing CRISM and HiRISE image stamps to discern mineralogy on Mars.
4. Students should have a working understanding of how to navigate and use JMARS prior to completing *Homework 1*.

## Assessment

Assessment is imbedded within each *In-Class Activity*.

## Mars for Earthlings

### References and Resources

1. Image File: [Matter and Minerals](#)
2. CRISM webpage: <http://crism-map.jhuapl.edu>
3. HiRISE webpage: <http://hirise.lpl.arizona.edu>



## Mars for Earthlings

### ***In-Class Activity 1***

Building Blocks: Matter and Minerals\_MFE

*Follow the Water with Minerals*

### **Purpose**

Observe various minerals and identify their connection to water using their chemical formulas and environments of formation.

### **Preparation**

1. Assemble mineral hand samples of: hematite, calcite, gypsum, olivine, feldspar, and kaolinite (or other smectite)
2. If hand samples are not available use the mineral images provided in the module [Image File](#)

### **Engage**

Show images and/or hand samples of a few of the minerals listed in *Preparation*. Ask students to quickly make a hypothesis as to which minerals indicate aqueous environments.

### **Explore**

- Ask students to indicate whether or not each mineral has an aqueous history of formation/precipitation.
- Once students determine the aqueous history have them connect the mineral to its most probable environment of formation.
- Ask students if they think that these minerals could have multiple environments of formation and why.

### **Explain**

1. As students work to identify, with sound reasoning, which minerals indicate an aqueous environment of formation describe the minerals in terms of their properties and general classification (i.e. sulfates, hardness, cleavage etc.).
2. Provide students a context of the environments of formation (shield volcano, desert playa, hot springs, pluton, altered volcanic tuff, coastal shelf) listed for students to connect each mineral to its most probable environment of formation. Should you desire, you could provide a PowerPoint slideshow of the environments.
3. Encourage students to list their reasoning for their answers.

### **Elaborate**

- Rank the minerals according to what students believe to be their relative abundance on Mars. Highest = most abundant on Mars, Lowest = least abundant on Mars
- Discuss with students their ranking system and their method behind the ranking.
- Share with students a Mars geologic map to give them an idea of the rock types across Mars (see link: [http://www.lpi.usra.edu/resources/mars\\_maps/1083/](http://www.lpi.usra.edu/resources/mars_maps/1083/)).



## Mars for Earthlings

### Evaluate

1. Evaluate student response as they interpret the images.
2. Can students recognize, from the chemical formulas of minerals, which minerals could indicate an aqueous environment? Observe this by their ranking and method of ranking in **Elaborate** and throughout the **Explore** sections.

