Lunar Rock Identification

Purpose: To identify lunar rocks based on the percentage of specific minerals that make up each sample.

Credits:

Original idea by Gordon Eskridge, AESP NASA Pub. *Exploring the Moon* contributions by Albert Byers, AESP

Materials: (makes 9 samples)

2 packages of clay
Sewing beads
- White 840 ea.(longer than wide)
- Brown to Black 180 ea. (almost square)
- Green 180 ea. (almost round)
- Black (almost square) required only to make mare basalts 100 ea.

9 air tight containers (1/2 cup)

Engage

Geologists are scientists who study the formation, structure, history, and processes (internal and on the surface) that change Earth and other planetary bodies.

Rocks and the **minerals** in them give geologists key information about the events in a planet's history. By collecting, describing and classifying rocks, we can learn how the rocks were formed and what processes have changed them.

Geologists classify rocks into three types:

Igneous - rock formed when magma cools and hardens either below the surface (for example, granite) or on the surface during volcanic events (for example, basalt).

Sedimentary - rock formed by the collection, compaction, and cementation of min-eral grains, rock fragments, and sand that are moved by wind, water, or ice to the site of deposition.

Metamorphic - rock formed when heat and/or pressure deep within the planet changes the mineral composition and grain size of existing rocks. For example, metamorphism changes limestone into marble.

We find all three rock types on Earth's surface and the rocks are constantly changing (recycling), very slowly because of heat, pressure, and exposure to weather and erosion.

The Moon's surface is dominated by igneous rocks. The **lunar highlands** are formed of **anorthosite**, an igneous rock predominantly of calcium-rich **plagioclase feld-spar**. The lunar **maria** are made of layers of **basaltic lava**, not unlike the basaltic flows of the Columbia River Plateau or of Iceland. The orange glass found on the Moon's surface is another product of volcanic activity. Moon rocks are not exposed to weather nor are they eroded by wind, water, or ice. The Apollo astronaut's footprints are as fresh as the day they were made.

National Aeronautics and Space Administration

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Procedure for Making Mock Lunar Samples:

1. To make an Anorthosite sample, count out 360 beads that are white (longer than wide) and 20 brown to black (almost square) beads and 20 green (almost round) beads. Knead these beads into a ball of clay (2 sections). Divide this thoroughly mixed clay into thirds. Place these mock Lunar samples into an air tight container.

2. To make a Norite sample, count out 240 beads that are white (longer than wide) and 140 brown to black (almost square) beads and 20 green (almost round) beads. Knead these beads into a ball of clay (2 sections). Divide this thoroughly mixed clay into thirds. Place these mock Lunar samples into an air tight container.

3. To make a Troctolite sample, count out 240 beads that are white (longer than wide) and 20 brown to black (almost square) beads and 140 green (almost round) beads. Knead these beads into a ball of clay (2 sections). Divide this thoroughly mixed clay into thirds. Place these mock Lunar samples into an air tight container.

Explore:

Scientists use a thin slice method to identify a rock. The crystals on the surface of the slice are classified and then the amount of each mineral is determined . A rock is then identified by the percent of each crystal found in the sample.

1. From the Rock ABCs Fact Sheet determine the mineral crystal that is represented by each of the beads used.

2. Take one of the mock Lunar samples and gently split it in half. Count the number of each type crystals (beads) and record that number on the data sheet. Each side of the split mock Lunar sample is considered a mock thin slice.

3. Knead the halves back together again and divide the mock Lunar sample again at another spot and repeat step 2.

4. Repeat step 2 to get a minimum of 6 mock thin slices. Remember, in actual classification work samples rarely have the exact percent make up as indicated by the text book.

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DATA SHEET

	Plagioclase	Pyroxene	Olivine	Ilmenite
Mock Thin Slice	Number of Beads	Number of Beads	Number of Beads	Number of Beads
1				
2				
3				
4				
5				
6				
Total Number of Beads				
Percent of Mineral				

Explain:

1. The percentages you have calculated above best represent which highland rock: Anorthosite, Norite, or Troctolite? _____
2. Was your mock Lunar sample a good representative of that type of Moon rock?
3. If no, what could you do to get better results or is this a noncharacteristic sample?
4. With the remaining clay, make up samples of the mare basalts and try to classify those samples using a copy of the same data table.

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Lunar Rock Fact Sheet

What are minerals?

Minerals are naturally occurring solids that have definite chemical compositions and are crystalline. Crystals are individual pieces of minerals. The most important characteristic of crystals is the orderly internal arrangement of atoms. This internal order causes the beautiful crystal shapes.

MINERAL	ELEMENTS	APPEARANCE IN MOON ROCKS
Plagioclase feldspar	calcium (Ca), aluminum, silicon (Si), Oxygen (O)	off white to translucent grayish; usually occurs as grains longer than they are wide.
Pyroxene	iron (Fe), magnesium, (Mg), calcium (Ca), silicon (Si), oxygen (O)	Brown to black; grains usually longer than wide in mare basalts, almost square in highland rocks.
Olivine	iron (Fe), magnesium (Mg), silicon (Si), oxygen (O)	Greenish; usually occurs as almost round crystals.
Ilmenite	iron (Fe), titanium (Ti), oxygen (O)	Black, elongated to almost square crystals.

What are rocks?

Rocks are naturally occurring solids composed of one or more minerals. At least two abundant minerals usually occur in a rock, along with several others. The minerals are intergrown in intricate ways that depend on how the rock formed. Rocks are classified on the basis of the abundance of the minerals they contain, sizes of individual crystals, and the process that formed the rocks.

Mineral abundances (percents) in Moon rocks

	Plagioclase	Pyroxene	Olivine	Ilmenite
Highland rocks				
Anorthosite	90%	5%	5%	0%
Norite	60%	35%	5%	0%
Troctolite	60%	5%	35%	0%
Mare basalts				
High-titanium	30%	54%	3%	13%
Low-titanium	30%	60%	5%	5%
Very low-titanium	35%	55%	8%	2%

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