Determining Density

Overview:

During this lesson students use introductory geologic techniques to identify rock samples. While learning these techniques, students discover how to determine density. Students also learn to associate some rocks with elements found in Earth's different layers.

Objectives:

The student will learn:

- the major elements present in each of Earth's layers;
- that certain rocks can be identified as containing elements in each of Earth's layers;
- basic geologic tools used to differentiate among rock and element types; and
- how to determine density.

Materials:

- Bar magnets
- Balance scales
- String
- Three kinds of rock samples: pegmatite, peridotite, and magnetite
- Graduated cylinder with enough water to cover rock samples
- Student Worksheet: "Determining Density"
- Student Worksheet: "Rock Identification"

Cultural Tie

'Ulu Maika is a traditional Hawaiian game in which a circular flat rock is rolled along a playing field. It is a test of strength, with players trying to roll their rock the furthest. When choosing and fashioning the rocks, the density is very important. A denser rock will roll further.

Answers to Student Worksheet:

Determining Density:

Answers will vary, teacher should verify that students' math calculations are correct.

Rock Identification:

Sample Rock	Rock Sample "X"	Rock Sample "Y"	Rock Sample "Z"
Rock Type	Magnetite	Pegmatite	Peridotite
Color	Dark Metallic	Pink to Gray	Dark Green/Black
Density	High (5.1-6.5 g/cm^3)	Low (<3 g/cm^3)	Med (3.1-3.3 g/cm^3)
Magnetism	Yes	No	No
Earth's Layer	Core	Crust	Mantle

Determining Density

Activity Procedure:

1. Explain that during this lesson, students will use introductory geologic techniques to identify and differentiate among rock samples. Explain that the rock samples students test today can be identified with elements present in each of Earth's layers.
2. Divide students into groups. Distribute rock samples X, Y, and Z, balance scales, bar magnets, and graduated cylinders with water. Distribute the Student Worksheet: "Rock Identification" and the Student Information Sheet: "Determining Density" to each student.
3. Help students identify which rock samples contain elements found in Earth's core, mantle, and crust by assisting them in performing each of the following three tests on each rock sample.
   a. Test #1: Color—Test described on the Student Worksheet: "Rock Identification."
   b. Test #2: Density—Test described on the Student Instruction Sheet: "Determining Density."
   c. Test #3: Magnetism—Test described on the Student Worksheet: "Rock Identification."

Note: Rock Sample "X" is Magnetite; "Y" is Pegmatite; "Z" is Peridotite

Notes: Geologists often use the measurement specific gravity, which is the ratio of the density of a sample compared to the density of water. In order to find specific gravity divide the density of the sample by the density of water (1 g/cm^3). For example, if the density of a rock is 4.5g/cm^3, divide 4.5g/cm^3 by 1 g/cm^3. The specific gravity would be 4.5. Since specific gravity is a ratio, it does not have any units.

The core of Earth is composed of iron and nickel. Magnetite (iron oxide) is used in this lab as an example of a dense, iron rich compound that is magnetic.

Inquiry Extension: Bring a local rock to the classroom and calculate its density. Ask students what will happen to the density if the rock is broken into pieces. Wrap the rock in newspaper so the excess newspaper forms a handle. Go outside and hit the newspaper-wrapped rock with a hammer to break it up. Find the density of the pieces.

Optional Discussion Topic: Students will not be able to measure the density of pumice using this method. Why? Because pumice is lighter than water. It floats! Pumice is volcanic foam.

Name: _____ **Student Worksheet**

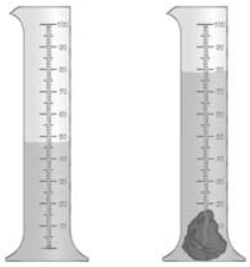
Determining Density

Directions: Complete the activity described to fill in the data tables below.

1. Place a rock on the pan of the balance to measure the mass of the rock. Record the mass of the rock in Data Table 1.

Data Table 1

Rock	Mass (grams)
Rock X	
Rock Y	
Rock Z	



2. Fill a graduated cylinder approximately 1/2 full and record the volume of water in Data Table 2. This is the initial volume.

3. Attach a string to the rock sample and lower it into the graduated cylinder. The water will rise. Record the volume of water with the rock submerged in the water. This is the final volume.

Conversion: 1 ml = 1 cm^3

4. Repeat steps 1 through 3 for each of the two remaining rocks. Be sure to record your measurements in Data Table 2.

Data Table 2

Rock	Initial Volume	Final Volume	Volume of Rock (cm^3)
Rock X			
Rock Y			
Rock Z			

5. Find the volume of each rock sample by subtracting the initial volume from the final volume. Use this formula for each rock sample: *Final Volume – Initial Volume = Volume of Rock (cm^3).*

6. Find the density of each rock sample by dividing the mass of the rock by the volume of the rock. Use this formula for each rock sample: *Mass (g) ÷ Volume (cm^3) = Density (g/cm^3).*

Data Table 3

Rock	Mass (g)	÷	Volume (cm^3)	=	Density (g/cm^3)
Rock X		÷		=	
Rock Y		÷		=	
Rock Z		÷		=	

Name: _____ **Student Worksheet**

Rock Identification

Directions: Use the chart below to help identify which rock samples contain elements found in Earth's core, mantle, and crust.

Rock Type	Pegmatite	Peridotite	Magnetite
Color	Pink to Gray	Dark Green to Black	Dark Metallic
Density	Low	Medium	High
Magnetism	No	No	Yes
Earth's Layer	Crust	Mantle	Core

Before identifying each rock sample, test it in three ways. Write the results in the chart below. Remember, the color of the rock can be misleading!

Sample Rock	Rock Sample "X"	Rock Sample "Y"	Rock Sample "Z"
Rock Type			
Color			
Density			
Magnetism			
Earth's Layer			

Test #1: ***Color***: Write the color of each rock sample X, Y, and Z, in the chart above.

Test #2: ***Density*** (*Use the "Determining Density" Instruction Sheet*)

Compare the density of each rock sample X, Y, and Z, then record the results in the chart above. Which of the sample rocks has the highest density? Which of the sample rocks has the lowest density? Which of the sample rocks has a medium density that lies between the other two?

Test #3: ***Magnetism***: Use a bar magnet to determine which of the three rock samples is magnetic.

Identification #1: ***Rock Type***: After performing Tests #1 - 3, write the name of each rock in the first row of the chart above.

Identification #2: ***Earth's Layer***: For each sample, write the layer of Earth in which elements contained in the rock sample can be found.

