DENSITIES OF COMMON MINERALS

INTRODUCTION

Density is one of several intrinsic physical properties of minerals that relate to the composition of the mineral and to the pattern in which the mineral's atoms are arranged. "Intrinsic" means that the property is the same for the mineral no matter what the size or shape of the sample.
The ***density*** of a mineral is the ratio of its ***mass*** to its ***volume***. It is a measure of how much "stuff" is squeezed into the amount of space the mineral occupies.

OBJECTIVE:

Students will measure and compare the densities of minerals.

THE ACTIVITY

MATERIALS REQUIRED

- One 1-2 liter graduated cylinder with gradations of no larger than 10 mL
- Scale capable of weighing about 1-200 grams
- Samples of several different identified minerals of various densities, as large as will fit in the graduated cylinder without getting stuck (up to 200 grams). These should be numbered or identified by mineral name.
- Reference materials: Internet, mineral field guide books, charts of physical properties

PROCEDURE (student directions)

1) Estimating relative density
   a) You can estimate the density of minerals by using your senses of sight and touch. You should be able to determine the relative density of some common minerals by comparing their sizes (estimated by sight) to how heavy they feel in your hand. You have an assortment of several different minerals available to you. Handle the samples to get an idea of how dense each one is, or how heavy each mineral feels for its size. Arrange the different mineral samples in a line on the table according to their relative densities, from least to greatest. Record your results by sample number, or mineral name.
2) Measuring mineral density
   a) Now you will check your estimate of the relative densities of the minerals by measuring the density of each mineral. The way you measure density is to divide the mass or weight of a sample by its volume. Written out, the formula for calculating density is:

$$D = M/V$$

where D = density (g/mL), M= mass (g), and V=volume (mL)

b) The mass of each sample is measured using a balance or electronic scale. The volume of each sample can be measured by the amount of water displaced by the sample in a graduated cylinder.

   i) Measure the mass (in grams) of each mineral sample available to you. Record your mass on a chart.

   ii) Half-fill a large (1 to 2-liter) graduated cylinder with water. Carefully note the volume of the water and record that volume (use units of milliliters (mL)). One after another, carefully drop each mineral sample into the cylinder and record the level of the water in the graduated cylinder after each sample is added. Calculate the volume of each sample by subtracting the initial water volume from the volume after the sample was added. Record the volume of each sample on your chart in milliliters (mL).

   iii) Divide each sample's **mass** by its **volume** to get the **density** of each mineral. Record the density of each sample on your chart in grams per milliliter (g/mL).

c) How does your density data compare to your estimate of the relative density of the minerals? Compare your results to those obtained by other groups for the same mineral samples. If there are differences in the densities for the same mineral, suggest reasons for the variation. What could you do to increase the accuracy of the density you determined for each mineral?

3) In reference books, charts, or Internet, look up the physical properties of the minerals you have. How closely do your calculated densities match the **specific gravities** given for the minerals?

   a) When you look up a mineral in a field guide, on a mineral identification chart, or on the Internet, you will see the **specific gravity** of the mineral listed as one of its physical properties. **Specific gravity** is a ratio of the density of a mineral sample to an equal volume of water. Since water's density is about 1 gram per milliliter at room temperature, the specific gravity of each mineral is about equal to its density divided by one (1).

$$\text{Specific Gravity (SG)} = (\text{density of substance})/(\text{density of water})$$

EVALUATION (student directions)

What are some reasons why your values may differ from the true specific gravities of the minerals?

OTHER OPTIONS (elaboration)

- How might density be used in mineral exploration? How might density be important in common uses for the mineral?

- In your reference materials, find the chemical composition of each mineral you have (the elements that make it up).
- Find the elements for each mineral on a Periodic Table of the Elements. Describe the relationship between atomic masses of the elements in each mineral and the density of each mineral. In addition to the atomic masses of the elements, what other factors affect the density of a mineral?