Densities of common minerals

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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.

Nevada State Science Education Standards addressed (see the Nevada State Department of Education website for the standards http://www.nde.state.nv.us/sca/standards/standardsfiles/science/): 10.4.1, 10.5.1, 10.8.1, 21.5.1, 21.8.1, 21.3.2, 21.5.2, 21.12.2, 22.8.1, 22.5.2, 23.8.1, 23.8.2, 23.12.2, 23.5.4, 23.8.4, 23.12.4, 23.12.7, 23.12.8, 24.8.1, 24.8.4, 24.5.6

Materials needed:

One 1-2 liter graduated cylinder with gradations of no more 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).

Reference materials: Internet, mineral field guide books, charts of physical properties

Estimating relative density

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 size (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.

Measuring mineral density

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)

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.

Procedure:

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

Half-fill a large (1-2-liter) graduated cylinder with water. Carefully note the volume of the water and record it (use units of milliliters (mL)). 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).

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).

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?

Specific Gravity of minerals

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).

Specific Gravity (SG) = (density of substance)/(density of water)

Look up in reference books, charts or Internet, the physical properties of the minerals you have. How closely do your calculated densities match the specific gravities given for each mineral?

Analysis of results

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

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. Is there any apparent 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 might affect the density of a mineral?

What are some applications in industry or daily life where differences in the density of different materials might be useful?

Nevada State Science Standards addressed by this activity

Physical Science

1.0: Forces and Motion

1.7.4
Investigate and describe the density of solids, liquids, and gases.

2.12.1
Investigate and describe intrinsic (color, odor, density) and extrinsic (e.g., size, mass, volume) physical properties of matter.

Earth and Space Science

10.8.1
Investigate and describe how rocks and minerals have different properties and characteristics

10.12.1
Investigate and describe how rocks and minerals have different characteristics that reflect their origins and use.