Mapping Density of Rock Samples

Goal: Explore the physical properties of rocks of Virginia and determine their point of origin. Investigate volume, mass, and density with rocks found across the 5 regions of Virginia.

Objectives

Knowledge- Students learn the common rocks of Virginia, how to identify them, their locations, and how to locate them on a geologic map.

Skills-Students use scientific equipment (balance, graduated cylinders, calculators) to determine the density of rock samples.

Values- Student appreciate that Virginia has a variety of rocks that have a multitude of uses.

Grade(s): 5th

Special Safety: Glass Vinegar Vials may break.

VA Standards addressed:

Math: 5.2, 5.5b , 5.8a, 5.9b

Science: 5.1 a, b, g; 5.7

Social Science: VS.2, USi.2d

Materials:

- Class region map (Appendix 9) and Post-It notes
- Slightly dyed water (to make reading the graduated cylinders easier)
- Large copy (at least 11" x 17") of simplified geologic map of Virginia (William and Mary Geology)
- Electronic balance or scales (one per table)
- For each student pair:
    - One 250 mL graduated cylinder with water
    - Rock Table Sheets (Appendix A)
    - Student datasheets (Appendix B)
    - Pencils
    - Graduated cylinder instructions (Appendix C)
    - Sample descriptive words sheet (Appendix D)
    - Large Geology Map (Appendix E)
    - Sets of small fragments of rock from different regions of Virginia (one set per table, each set with at least 4 samples; enough samples for each pair to have at least one sample. We obtained samples from our Soil & Water Conservation District Office, Luck Stone in Virginia, and by reaching out to state parks, etc.)
    - Hand lenses
    - Calculators (optional)
    - Nail and vinegar (optional)

Sedimentary sandstone can be composed of various types of rock sediment. Most sandstones are feldspar or quartz but can also be composed of calcite, mica, or hematite, for example. The three sandstones we used for our density lab are composed of different sediments and thus, have different densities!

Setup:

- Place rock sets (4 samples per set, with matching Rock Tables), two 250 mL graduated cylinders, one scale, one datasheet per pair of students, one graduated cylinder instruction sheet, one sample descriptive words sheet, one nail & vinegar, two beakers with slightly tinted water, and two pencils at each table.
- Set up a table with large simplified geologic map of Virginia with Post-It labels.
- Divide students into teams of 2.

Instructional Strategy:

This activity focuses on science process skills. During instruction, allow time for students to use their problem solving skills and process skills. Some examples are provided below:

A. Inquiry: Tell students: We will be observing and identifying rock and mineral types from across Virginia. Why should we learn about rocks of our area (Ask students to brainstorm reasons for learning about rock types and uses as well as connect to careers, if applicable)?
   1. Density is one of the ways that rocks can be compared to one another. *Ask*: Are all rocks the same weight? Are all rocks used for the same purposes? Use examples, as needed, such as granite versus chalk. Which one is harder, can they be use for the same purpose? Sci 5.1, 5.7
   2. *Ask*: What materials are on your tables? What are they used for?
      i. Graduated cylinders- Measure Volume (in mL)
      ii. Scale- Measure Mass (in grams)

B. Investigation: Before beginning the investigation, explain to students that one of the goals of the activity is for them to use scientific reasoning and problem solving skills and that trial and error is an important step in any scientific research. Instructors may need to help troubleshoot: use of the scales, how to determine the difference in water levels, and how the volume can be determined using the differences in the water's volume.
   1. Each pair will read through their datasheet (Appendix B) to examine and investigate the following:
   2. Describe/diagram the physical properties of the rock (can use the Appendix D to generate ideas).
   3. Use balance/scale to find the mass of a rock sample.
   4. Determine how to use the graduated cylinder to find the rock's volume (see Appendix C). This can be done multiple ways! Allow students time to explore various solutions.

      Examples scenarios of volume measurement challenges:

      i. Students may place the rock into the graduated cylinder without the water and read 15 mL at the top of the rock. Remind students that the rock would have to take up every space of the bottom of the cylinder to make the rock 15 mL.

      ii. Students may place the rock into the graduated cylinder then pour all of the water into the cylinder while reading the mL. This reading would be the total amount of volume in the cylinder and not the volume of the rock.

      iii. Students may pour all of the water into the graduated cylinder (above any mL readings) then place the rock into the graduated cylinder and estimate how much the water increased. Math 5.5b

      iv. Remind students that accuracy and precision are part of the science process. How can we be sure we know exactly how much the water level increased? Gently remind them that they do not have to use all of the water.

5. Next, students use their data sheets to calculate the rock's density once the volume and mass have been found. Providing examples of various objects that have different masses, volumes and densities are helpful. Allow students time to work through the process and problem solve! VS.2, USI.2d

C. Mapping: Once student pairs have completed the above investigative tasks, ask them to use the Rock Tables (Appendix 1) to identify their rock.

1. Next, they locate their rock on the BIG geology map and mark and label its distribution on the class map (Appendix E) using Post-It labels.
2. Explore the characteristics of the regions and the rock types (physiogeography). [Physiography or physical geography is the study of the land features and processes that created them.]

D. Conclusion: Ask students to compare their rocks to other rocks.

1. As time allows, each pair can examine at least one more rock.
2. Discuss: What are some of the physical characteristics (e.g., color, shape, texture, etc.) you learned about rocks of Virginia?
3. Connect: Where do we get the rocks we use for different purposes in our lives? (e.g., Roads, countertops, building materials, jewelry, etc.)

Extension: Place rocks examined in order of lowest to highest density.