

# Properties of Matter

## Cluster One: DENSITY

### Inquiry #2: DENSITY IS A PROPERTY OF MATTER

(4 instructional periods)

**Concepts:** “A pure substance has characteristic properties, such as density, which is independent of the amount of the sample” (NSES, pg. 154). “Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society” (NSES, pg. 17). “Equal volumes of different substances usually have different masses” (AAAS, pg. 78).

**Objective:** Students will be able to calculate the density of a solid. Students will be able to explain that the density of a substance is independent of sample size.

**Summary:** In groups, students will determine the mass and volume of several objects of different sizes and shapes that have the same composition. They will discover a relationship between mass and volume - density - that is consistent for all objects that are composed of the same substance. They will graph their data to further emphasize that density is independent of sample size. They will watch a CD-ROM sequence about Archimedes and explain how he used density to solve a problem.

**Teacher Background:** Students usually have difficulty understanding that the density of a substance is a characteristic property that is independent of the size of the sample. They need to be given many opportunities to observe that an increase in the mass of a substance is always proportional to an increase in the volume of the same substance and that a decrease in the volume of the substance is always proportional to a decrease in the mass of the same substance.

The graphs of each of the different substances - wood, aluminum, rubber, and plastic - will have different slopes. The slope of each line is equal to the density of that substance. This ratio of mass to volume is a direct relationship. As the mass increases, the volume increases proportionately. As the volume increases, the mass increases proportionately. The density is consistent for the wood and consistent, though different, for the aluminum, plastic, and rubber.

#### Equipment

- 8 balances (school supplied)
- 8 clear plastic rulers
- 8 small displacement vessels (DV) (run soap with warm water through new DV before using)
- 8 100ml beakers (school supplied)
- 8 100ml graduated cylinders (school supplied)