Determining Density

The density of an object is its mass divided by its volume. But how does the density of a small amount of a substance relate to the density of a larger amount of the same substance? In this lab, you will calculate the density of one marble and of a group of marbles. Then you will confirm the relationship between the mass and volume of a substance.

Collect Data

1. Use the table below to record your data.

Data Table

Mass of marble (g)	Total mass of marbles (g)	Total volume (mL)	Volume of marbles (cm^3)	Density of marbles (g/cm^3)

MATERIALS

- 100 mL graduated cylinder
- water
- 8 to 10 glass marbles
- paper towels
- metric balance
- graph paper

2. Fill the graduated cylinder with 50.0 mL of water. If you put in too much water, twist one of the paper towels and use its end to absorb excess water.
3. Measure the mass of a marble as accurately as you can (to at least one-tenth of a gram). Record the marble's mass in the first column of the table. Write the same value in the second column.
4. Carefully drop the marble into the tilted cylinder, and measure the total volume. Record the volume in the third column. Fill in the rest of the row.
5. Measure and record the mass of another marble. Add the masses of the marbles together, and record this value in the second column of the table.
6. Carefully drop the marble into the graduated cylinder without removing the previous marble. Complete the row of information in the table.
7. Repeat steps 5 and 6, adding one marble at a time. Each time, add the mass of the marble to the total mass from the row above. Stop when you run out of marbles, the water no longer completely covers the marbles, or the graduated cylinder is full.

Analyze the Results

8. Examine the data in your table. As the number of marbles increases, what happens to the total mass of the marbles? What happens to the volume of the marbles? What happens to the density of the marbles?

9. Graph the total mass of the marbles (y-axis) versus the volume of the marbles (x-axis) in the grid on the next page. Is the graph a straight line or a curved line?

Draw Conclusions

10. Does the density of a substance depend on the amount of substance present? Explain how your results support your answer.

Coin Operated

All pennies are exactly the same, right? Probably not! After all, each penny was made in a certain year at a specific mint, and each has traveled a unique path to reach your classroom. But all pennies are similar. In this lab you will investigate differences and similarities among a group of pennies.

MATERIALS

- 10 pennies
- metric balance
- a few sheets of paper
- 100 mL graduated cylinder
- water
- paper towels

Procedure

1. If necessary, trade some pennies with another group to make sure that you have pennies from several different years.
2. Use the metric balance to find the mass of each penny. Round off the values to the nearest 0.1 g. Record the mass of each penny in Data Table 1 below.
3. On an overhead projector or the board, your teacher will make a table that is marked in 0.1 g units. Make a mark in the correct column of the table for each penny you measured.

Data Table 1

Penny	1	2	3	4	5	6	7	8	9	10
Mass (g)										

4. Separate your pennies into two piles based on the class data. Place each pile on its own sheet of paper.
5. Measure and record the mass of each pile. Write the masses in Data Table 2 below.
6. Fill a graduated cylinder about halfway with water, and determine the volume as precisely as possible. Record the volume of the water in the table.
7. Carefully place the pennies from one pile in the graduated cylinder. Measure and record the new volume in the table.

Data Table 2

Pile	Volume of water (mL)	Volume of water + pennies (mL)	Volume of pennies (cm^3)	Density (g/cm^3)
1				
2				

8. Determine the volume of the displaced water by subtracting the initial volume from the final volume. This amount is equal to the volume of the pennies. Record the volume of the pennies in the table.
9. Carefully remove the pennies from the graduated cylinder, and dry them off. Refill the graduated cylinder until it is half full again.
10. Calculate the density of the pile. To do this, divide the total mass of the pennies by the volume of the pennies. Record the density in the appropriate space in the table, and then write it in the table on the overhead projector or chalkboard.
11. Repeat steps 7 through 10 for the other pile of pennies.

Analysis

12. How is it possible for the pennies to have different densities?

13. What clues might allow you to separate the pennies into the same groups without experimentation? Explain.