**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_**

**Density of Solids Lab**

**Background Information:**

All matter has mass and volume. Mass is the *amount of matter* an object contains and volume is the *amount of space* the object occupies. The ratio of the amount of matter to the amount of space, or mass to volume, is the *density*. Density is the mass per unit volume for an object. If asked, “which weighs more, a pound of feathers or pound of lead?” many people answer incorrectly, stating “lead weighs more!” Most people are thinking in terms of density when answering this question, not mass (Matta et al, 2008). Density is an intrinsic property of matter, unique to each element or compound making up a substance. It depends on the mass of the particles in the substance as well as how closely those particles are packed together. If the particles have a relatively high mass or if the particles are packed very closely together, eliminating empty space, the density will be relatively high. Think of water vapor compared to liquid water. Of course, the liquid water would have a higher density than the same amount of water vapor because of the way the water molecules are distributed.

When both the mass and volume of a substance are known, the density can be calculated using the equation: D = M/V. In this equation, D is density, M is mass, and V is volume of the substance.

The mass of an object can be measured using an electronic or triple beam balance. The volume of a regularly shaped rectangular solid can be calculated by measuring its dimensions and multiplying the length by the width by the height. The purpose of this lab is to determine the density of a set of wooden blocks (various sizes) based on measurements of the mass and length, width, and height of each block, and by the graph of the mass over volume of several blocks.

Matta, M.S., Staley, D.D., Waterman, E.L., & Wilbraham, A.C. (2008). *Chemistry*. Boston, MA: Pearson Prentice Hall

**Pre-Lab Questions:**

1. How would the density of a liter of hot water compare to the density of a liter of cold water? Explain your answer.
2. Make a diagram comparing the arrangement of liquid gasoline and the arrangement of gasoline vapor. Show at least 4 or 5 gasoline particles in each diagram.

|  |  |
| --- | --- |
| Liquid Gasoline | Gasoline Vapor |

1. The length, width, and height of a brick are measured and recorded below. The mass of the brick is 2,500 g. Determine the density of the brick.

L = 18.5 cm

W = 9.6 cm

H = 8.1 cm

**Problem Statement:** Use the EDR to write a problem statement.

**Hypothesis:** Research how mass and volume of an object affect the density of the object using Discovery Ed techbook, Chemistry course, Process of Science, Measurement, Explore Tab, page 4. THEN, predict the effect of changing the volume (size) on the mass and density of wooden block, which are all made of the same type of wood. Follow the EDR.

**Design**

 **Materials:**

5 Various sized blocks of same wood

Triple Beam Balance

Ruler

 **Procedure:**

1. Choose a numbered block and record the number in the data table.
2. Carefully measure the length, width, and height of the block with the correct uncertainty.
3. Use the balance to measure the mass of the block and record the mass in grams with the correct uncertainty.
4. Choose another numbered block and repeat steps 1 -3. Continue with this process until you have measurements for 5*different* blocks. Be sure to have at least one small, medium, and large block.

**Results**

**Data Table: Length, Width, Height, and Mass of Five Wood Blocks**

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| **Block #** | **Length (cm)****+/- 0.05 cm** | **Width (cm)****+/- 0.05 cm** | **Height (cm)****+/- 0.05 cm** | **Mass (g)****+/- 0.005g** |
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**Data Processing and Presentation:**

**Calculations – Calculate the volume and density for each block.**Use the EDR to make sure your calculations are presented correctly.

1. Label: **VOLUME OF WOODEN BLOCKS**
2. Write a word formula for this calculation (use symbols or words): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Show the calculation for each block. Include units on your answers and put a box around each one.
4. Label: **DENSITY OF WOODEN BLOCKS**
5. Write a word formula for this calculation using symbols or words: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Show the calculation for each block. Include units on your answers and put a box around each one.
7. Calculate the average density of the wood blocks. Show label, word equation, work and answer with units.

**Graph:** Make a graph of mass and volume for the wooden blocks.

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**Final Calculations:**

1. Determine the slope of your line. Show all work on graph.
2. Calculate the **percent error between your calculated density and the slope density**.

% error = [(theoretical value – experimental value) / theoretical value] **x 100%**.

Use the *calculated* *average density* value as *theoretical* value and the *slope density* as *the experimental* value.

**Analysis and Conclusion Questions:**

1. Compare the *calculated* value for density with the *slope* of your line. Support with data.
2. Explain how the average density of the wood blocks would change if one of the wooden blocks was cut in half? Use ***your data*** to support your answer.
3. Discuss your hypothesis based on your results. (Include numbers)
4. Identify one logical source of experimental error.
5. Explain how that error affected your results.
6. Look at the graph of mass and volume at the right. Could this graph reflect measurements of the same type of wood that you used in this investigation? Explain your answer and include numbers.

