**Activity Sheet Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lesson 5 Date \_\_\_\_\_\_\_\_\_\_\_\_**

# Density as a Relationship Between Mass and Volume

# Part 1 – Same Volume but Different Mass

# DEMONSTRATION

Your teacher placed a copper and an aluminum cube on a balance. Even though the cubes are the same size and shape, the copper has a greater mass than the aluminum. Both cubes are solid and are not hollowed out anywhere inside. The copper cube is made up of only copper atoms and the aluminum cube is made up of only aluminum atoms.



1. **Look at the drawing of the copper and aluminum cubes and their atoms.**

**If copper atoms are a little larger than aluminum atoms, fewer of them can fit in the same volume. How can a copper cube be heavier than an aluminum cube?**

1. **The density of a substance like copper or aluminum is its mass divided by its volume (how much space it takes up).**

**Density = mass/volume or D = m/v.**

**Which is more dense, copper or aluminum? How do you know?**

1. **Calculate the density of a cube using the following information:**
	* **Each side is 4 cm long.**
	* **The mass of the cube is 128 g.**

**Show your work.**

**Part 2 - Different Volumes but Same Mass**

# DEMONSTRATION

#

Think about the longest, middle-sized, and shortest rods your teacher showed you. All these samples have the same mass, but their volumes are different.

1. **Predict the densities of each sample by writing a phrase from the box on the line next to each sample.**

Most dense, Least dense, Medium dense

**Based on mass and volume, explain why you think each rod is either the most dense, least dense, or in-between:**

# EXPLAIN IT WITH ATOMS & MOLECULES

# A chart of the periodic table  Description automatically generated

# The difference in density between the small, medium, and large rods can be explained based on the atoms and molecules they are made from. Refer to the chart of atomic size and mass to answer the following question about each substance.

1. **Polyethylene is made of carbon and hydrogen atoms. Polyvinyl chloride is also made of carbon and hydrogen atoms, but also has chlorine atoms.**

**Look at the size and mass of these atoms in the chart to explain why polyvinyl chloride is more dense than polyethylene.**

 

1. **Brass is made of copper and zinc atoms. These atoms are pretty heavy for their size, but they are also packed together differently than the molecules of the plastics. How does the way these atoms pack together help make the brass more dense than the plastics?**

# TAKE IT FURTHER

# A close-up of a chart  Description automatically generated

1. **Based on the *Atomic Size and Mass* chart, a calcium atom is both bigger and heavier than a sulfur atom. But a piece of solid sulfur is more dense than a solid piece of calcium. In fact, sulfur is about 2 g/cm3, and calcium is about 1.5 g/cm3.**

**Based on what you know about the size, mass, and arrangement of atoms, explain why a sample of sulfur is more dense than a sample of calcium.**

**Part 3 – Same Material but Different Volumes**

In previous lessons, you measured the mass of three rods of the same material but different lengths. You also measured the volume of those same rods using the water displacement method.

1. **Look at your data and record the mass and volume of each of the three rods you measured from Lessons 3 and 4.**
2. **Then use the formula D=m/v to calculate the density of each of the three rods.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Color of Cylinder(Gray, Silver, or Orange) | Length of Cylinder (cm) | Average Mass (g) | Average Volume (cm3) | Density (g/cm3) |
|  | \_\_\_\_\_\_cm | \_\_\_\_\_\_g | \_\_\_\_\_\_cm3 | \_\_\_\_\_\_g/cm3 |
|  | \_\_\_\_\_\_cm | \_\_\_\_\_\_g | \_\_\_\_\_\_cm3 | \_\_\_\_\_\_g/cm3 |
|  | \_\_\_\_\_\_cm | \_\_\_\_\_\_g | \_\_\_\_\_\_cm3 | \_\_\_\_\_\_g/cm3 |

**2. You should notice a TREND in the “Density” column for the three rods. What is it?** **Why do you think this happens?**

1. **Make a graph of the mass and volume of the 3 same-colored rods you measured. Draw the best-fit line you can between the three points. Use your “Graphing Checklist” to makes sure everything is included and in the right location!**

**Put Volume on the x-axis, and Mass on the y-axis.**



1. **Does the straight line on the graph make sense when you look at the values for mass and volume for each rod? Explain:**
2. **The blocks in the illustration are all made from the same material. Calculate the density of each block. Do your results make sense? Explain.**
3. **If you took a sample of aluminum foil from the roll in your kitchen and you found its density to be 2.7 g/cm³, what would you expect the density of a much larger sample to be? Explain:**
4. **Do you think the density of the blob material in the Lava Lamp changes after the Lava Lamp is turned on? Explain.**