Name:_____ Period:_____

Density Boat Lab

Background Information

Density is the ratio of mass per unit of volume. This property deals with how closely packed the mass is in an object. To calculate density, it is: Density = mass/volume. The units can be either g/cm^3 or g/mL. Remember that mass is the amount of matter in the object and it is different from weight because it does not depend on gravity. Volume is the amount of space something takes up or its size.

Density in pure metals can be used to identify the metal you might have. Different metals have specific densities if they are pure samples. So if you had a mystery metal sample, you could determine what metal it is by comparing it to the known densities of pure metals. The Greek mathematician Archimedes, discovered this principle. In his famous legend, he used water displacement to find the volume of a supposed pure gold crown. The King had asked him to figure out if the crown was really pure gold.

Archimedes weighed the crown and divided that weight by the crown's volume to find the ratio of mass to volume for the crown. Next, he used a sample of pure gold and found its mass to volume ratio. He compared the two ratios and found that they were not equal. Therefore, his results demonstrated the crown in question was not pure gold.

In order for an object to float, the density of that object must be less than the density of water. If you know that 1 mL of water weighs 1 gram, you can figure out that the density of water is equal to 1 g/mL.

Background Questions:

1. Based on Archimedes' findings, explain how he used ratios and densities to determine the gold crown was a fake.

2. There are two same sized cubes, both with a volume of 8 cm^3, but one was made of gold and had a mass of 154.4 g and the other was made of silver and had a mass of 84 g. Which one has a greater density? Show work!

3. Why can the units of density be either g/cm^3 or g/mL?

Purpose:

To construct a boat out of aluminum foil that will hold the greatest mass.

Procedures:

1. With your 1st piece of aluminum foil, construct a boat, using any design that you choose, and any amount of aluminum foil that you choose.

2. Use the balance to determine the mass of your boat. Record this in Table 1.

3. Once you are ready to test your boat, start with 1 penny and gradually add in 1 penny at a time until your boat sinks. Please test this 1st design in your testing bin at your table. Record all observations.

4. Once completed testing your 1st boat design, obtain another piece of aluminum foil and redesign your boat.

5. Use the balance to determine the mass of your boat. Record this in Table 2.

6. With a Sharpie, write yours and your partner's names and period on the bottom/side of the boat. Please turn this boat in to Ms. Che for testing. You may do your own testing at your table if you wish, but if you break your boat, you will **NOT** be given another sheet of aluminum foil.

Table 1:_____

Boat Design	Mass (g)	Maximum # of Pennies Held	Observations
1			
2			

Conclusion Questions:

1. Will an object with a mass of 500 grams sink or float in water? Explain your answer.

2. A liquid (not water) has a mass of 40 g when its volume is 30 mL. Will an object with a mass of 90g and a volume of 60 mL sink or float in the liquid? Show your work!

3. Liquid A has a mass of 130 g when its volume is 90 mL. Meanwhile, liquid B has a mass of 70 g when its volume is 60 mL. Does liquid A float on liquid B or does liquid B float on liquid A? Show your work!

4. Which is heavier, a pound of lead or a pound of feathers? Explain your answer.

5. Which is denser, a pound of lead or a pound of feathers? Explain your answer.

6. Explain why the liquids in a salad dressing settle back into their original order after they were shaken up.

7. Give an example of three objects that are very similar in size but have very different densities. Explain how this is possible.

8. If you wanted to calculate the density of the boat, how could you do so? Be specific!

9. Did you change the design of your boat from trial 1 to trial 2? If so, what changes did you make. Were these changes effective (did the 2nd design hold more pennies?)