Eureka – Archimedes Principle Worksheet 2 Name___________________________

Discovering buoyant force (volume of water displaced) and calculating what displacement volume is needed to float a boat.

Your group will need: 1 scale, 1 graduated cylinder, collection of plastic bottle boats filled with various materials (water, oil, glass marbles, and steel marbles), 1 sheet of aluminum foil, 1 worksheet per student, and results from Part I.

You will need to record the densities for all of the material you have (some of these values you can get from the data that other groups calculated).

Material: __Water____ Density: ___1 g/cm^3______

Material: ____________ Density: ________________

Material: ____________ Density: ________________

Material: ____________ Density: ________________

Measure the weight of each of the boats and record it below:

Material: __Water____ Weight: ________________

Material: ____________ Weight: ________________

Material: ____________ Weight: ________________

Material: ____________ Weight: ________________

Put the water filled boat into the graduated cylinder and record the displacement here.

Displacement Volume: ___________________

How does this compare with the volume of water in the boat?

____

Now predict how much water each of the other boats will displace.

Material: ____________ Displacement Volume: ________________

Material: ____________ Displacement Volume: ________________

Material: ____________ Displacement Volume: ________________

Explain your predicted amounts. What is your reason and how did you arrive at this?

____

____

____

Now put each boat in the graduated cylinder and record the displacement here.

Material: ___________ Displacement Volume: _______________

Material: ___________ Displacement Volume: _______________

Material: ___________ Displacement Volume: _______________

Did it agree with your predictions? __________ Why do you think it did or did not?

____

Calculate the apparent density of the boat hull under water (weight of boat/displacement volume). Note: this is the average density of the boat hull, air, and inner material.

Material: __Water____ Displacement Volume: _______________

Material: ___________ Displacement Volume: _______________

Material: ___________ Displacement Volume: _______________

Material: ___________ Displacement Volume: _______________

How does this quantity compare to the density of water? Why is this?

____

Will the displacement change if your boat is floating upright or lying on its side? Why?

____

Try floating the boat in both orientations. What are the displacement volumes?

____

Now measure the volume of the aluminum foil sheet and record this below.

Length: _______ Width: ________ Height: _________

Volume: __________________________

Density (from part 1): ________________

Does the aluminum foil sheet float?

____

Now fold the aluminum sheet into a boat hull shape and put on the water.

Does it float? _________ Why does it float now?

____

Final Project

Your group can now calculate the displacement of some big ships (car ferry, wheat barge, or oil tanker). Using resources (internet, engineering book or information from teacher), gather necessary data for design parameters for your ship. Calculate the displacement volume for your ship for dry weight (empty) and maximum load. Assuming a barge bottom (rectangular or trapezoidal) calculate the dimensions of the hull below the water line. Present the group findings to the class. **SHOW ALL WORK and EXPLAIN how understanding these principles of materials can help engineers in the design of a boat.**