



## Problem Solving & Design Penny Barge

**Background:** Buoyancy is a difficult concept to comprehend. People often ponder how a ship made of heavy steel could possibly float. Experiencing buoyancy through application can help with comprehension of this concept.

**Objectives:** *By making a penny barge from limited materials, students will learn to calculate surface area and volume, and witness buoyancy and Archimedes Principle in action as they attempt to sink the vessel.*

**Assignment/Design Brief:** Design and construct a floating container to be tested in class to hold as many pennies as possible before capsizing or sinking. Construction may only be out of cardboard and masking tape.

1<sup>st</sup> Stage: Provide 3 different design sketches with measurements. Provide surface area and volume calculations for three different penny barges for next class. Treat the barge weight as zero as you will not have built one yet to weigh. Simply calculate the volume of the barge, find the weight of that volume of water, and determine how many pennies weigh that much.

2<sup>nd</sup> Stage: Determine the best design to construct and produce the penny barge to bring to class. Complete the calculations to determine the number of pennies. Be sure to weigh your barge before starting calculations.

### **Specifications:**

- Container must support pennies as load for testing.
- Container calculations must be completed at the start of class to be considered for competition.
- Container must have an open top.
- Container must float to be tested.

### **Limitations:**

- Container may only be constructed of cardboard, and masking tape with tape for joints of materials. **You may coat the container with one layer of masking tape.** More than one layer will disqualify you.
- Total surface area of all cardboard used, even flaps and tabs may not exceed 144 in<sup>2</sup> surface area.
- Containers may not be tall enough to rest on the bottom of the test tank.

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**Testing:** Calculate the number of pennies needed to sink your container. Record this number on the chart provided in class. The container will be tested in basin provided in lab. Testing will consist of floating your container and then loading it with pennies until it capsizes or sinks. Place half the amount of expected penny load into the container prior to placing in test tank. The rest of the pennies must be counted on the way into the container. Retrieve pennies and dry them off. Record penny number on chart provided in class.

### Notes:

- Containers not ready (not constructed, pennies not calculated) to test at the beginning of class on the due date will be ranked in a separate bracket and receive no higher than a “C” (80) when tested. This means calculations for pennies must be complete.
- Containers that exceed the 144 square inches of material must be reproduced without exceeding 144 square inches of material. Containers in this category will be ranked in separate bracket mentioned above.
- Containers may be disassembled for proof of materials after testing is completed.

**Assessment:** Grades will be assigned according to penny barge rank in your class only.