

# CURIOSITY AT HOME

## BOATS AFLOAT



*Using the Engineering Process of Design, Test, and Redesign, explore buoyancy and gravity by designing a boat.*

### MATERIALS

- Aluminum foil
- Scissors
- Shallow plastic or glass container (preferably clear)
- Pennies, metal washers, or any other small weights
- Water
- Science notebook or paper
- Something to write with

### PROCEDURE

- Copy the table below in your science notebook or create your own.

Trial #	Boat Design	Does it Float?	# of Pennies Carried	Observations
1	Flat sheet of aluminum foil			
2				
3				
4				
5				

- Fill the shallow container at least halfway with water.
- Cut three to four 5 in. x 5 in. sheets of aluminum foil.
- Try floating a flat sheet of aluminum foil on the water. Observe what happens. Record your results in your chart in your science notebook.
- Can the aluminum foil sheet hold any weight? Add a penny or two to find out.
- **Design Challenge:** Build a boat that as hold as much cargo (pennies) as possible.
  - Think about the boats you have seen.
  - Using a 5 in. x 5 in. sheet of aluminum foil, design and build a boat that can carry as much cargo (pennies) as possible.



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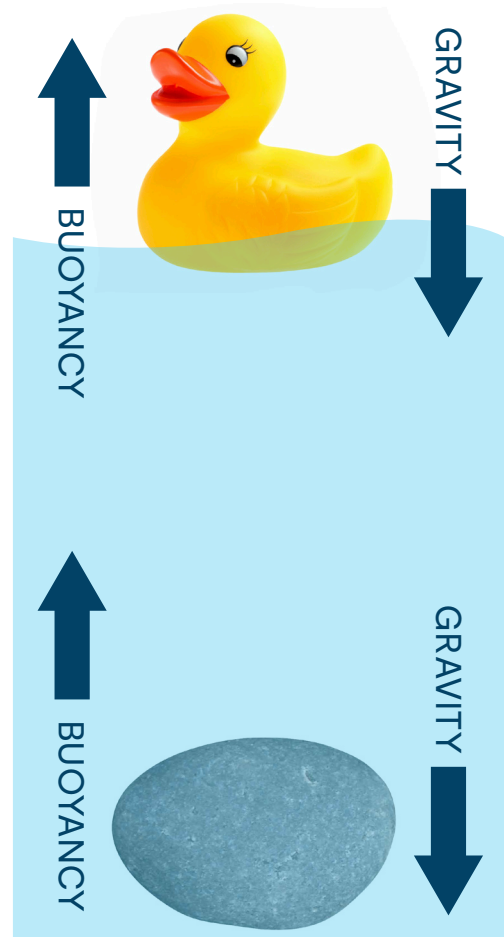


- Test your design.
  - Place your boat in the water to see if it floats.
  - Add pennies until the boat begins to sink.
  - Record your results in the chart.
- Redesign based on what you've learned.
  - Redesign your boat to see if you can hold more cargo.
  - Things to think about:
    - ◇ Does the shape of the bottom of the boat change how much weight it can hold?
    - ◇ Does the shape of the bottom of the boat change how stable the boat is?
    - ◇ How does the placement of the weight affect the boat?
    - ◇ Are there materials that you could add to the aluminum foil to make the boat float better?

### WHAT'S HAPPENING?

When objects like your boat are placed in a liquid like water, two forces are acting on them. First is the downward pull of the force of gravity, which is measured by the object's weight. Second is the upward push of a force called buoyancy. **Buoyancy** is equal to the weight of the amount of liquid displaced, or pushed away, when the object is placed in the liquid. If the object weighs less than the weight of the liquid it displaces, it will float. If the object weighs more than the displaced liquid, it will sink.

To create enough buoyancy to float, heavy objects need to take up much more space than light objects. A metal boat may weigh a lot, but a large amount of the volume inside the boat is full of air, which weighs a lot less. The large surface area of the boat combined with the hollow space filled with air means the boat displaces enough water to have a high buoyancy, allowing it to float!



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### K-2 GRADE EXPLORATION

- How did you choose your boat's design?
- What were some changes you made to improve your design?
- What are boats used for?
- Are boats that are used for different things shaped differently (examples: boats that carry lots of people, boats for fishing, boats for pushing other boats)?
- Can you try another shape to see if it works better?



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### 3–5 GRADE EXPLORATION

- Are there materials that you can find to make a boat that carries even more pennies?
- Engineers design materials and objects to serve a certain purpose. What are four different ways that boats are used?
- How does their use affect how they are designed?
- On a separate piece of paper draw each boat design you tried. Under each picture write what you changed and why you made that change.



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### 6–8 GRADE EXPLORATION

- What are some of the criteria engineers must consider when designing cargo ships?
- What are some of the constraints or challenges engineers need to consider when designing cargo ships?
- How does the design of a cargo ship maximize how much cargo a boat can carry?
- How is this design different from boats that are designed for other purposes?
- What are the limitations or challenges of using aluminum foil to build a cargo ship? What are the advantages of using aluminum foil to making a cargo ship?
- Are there other materials that are available to you that would make your cargo ship be able to hold more cargo?
- Write down or explain to another person the process you went through in thinking through your design and redesign.



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