

# Sink or float - facilitator guide

## Learning objectives:

- Determine how mass, volume, and shape affect an object's ability to float.
- Develop an understanding of density.
- Explain why boats float.

## Materials

### Per group:

- 3 plastic containers
- Water
- Salt
- Oil
- 4-5 "everyday" objects (e.g. pencil, eraser, piece of cork, coin, etc.)
- Three objects that are the same shape and size, but different masses:
  - Plastic egg with rocks inside so it's heavier than the egg and aluminum foil of the same shape and size (use tape to seal so water can't get inside)
  - Hard-boiled egg
  - Aluminum foil crumpled into the size and shape of the egg
- Three objects that are the same mass and shape, but different volume:
  - Small rock (egg-shaped)
  - Aluminum foil ball that weighs the same as the rock, crumpled into a ball
  - Superball
- Clay or plasticine (mold into different shapes with the same mass and approximately the same volume)
- Candle

In addition to the materials for the students' experiment, the following materials are used for a demonstration at the end of the activity to help solidify the explanation:

- bottle
- funnel

- water
- oil
- syrup

## Tips

- Have towels on hand to dry the objects.
- Prepare ahead of time:
  - hard boil the eggs
  - form aluminum foil balls
  - create the mixture of water, oil, and syrup (for demo)
- Wash after the activity to be reused:
  - rocks
  - plastic containers
  - superballs
  - candles
  - other reusable objects
  - clay or plasticine

## Procedure

- ENGAGE** the students to see what they already know. Possible questions to ask:
  - What objects do you know float or sink?
  - Are you surprised that boats float?
- Introduce to scientific method, tell the students that we will discover why objects sink or float. Key points:
  - We will do experiments in the same way as scientists do (prediction, experiment, hypothesis)
  - It's important to change only one thing at a time (mass, volume, shape) and to make one hypothesis in each experience. At the end of the activity, we will analyze all our findings and make one general hypothesis.
- EXPLORE:** Do everyday objects sink or float? Give everyday life objects to the students so that they can check if they float or sink in a container in water. They should make predictions before every attempt and record their predictions and each result in a table:

Object	Prediction		Trial 1		Trial 2	
	Sink ?	Float ?	Sink ?	Float ?	Sink ?	Float ?


4. Suggested questions to ask during/after this part of the activity:
  - a. Which objects float? What do they have in common?
  - b. Which objects sink? What do they have in common?
  - c. Were your predictions correct? Why or why not?
  - d. Is there consistency in the way an object behaves?
  - e. What factors can influence whether an object sinks or floats?
5. **EXPLORE:** Tell students that now we are going to explore in detail some of the factors they think might affect whether an object sinks or floats. Ask: Why do certain objects float and other sink in water? Have each group tell the class what they think, and write their ideas on the board. Lead them to the following criteria: volume, mass, shape
  - a. NOTE: students may come up with other ideas; this is fine, but they may not necessarily be explored in this experiment. Still write them on the board.
6. Give each group one container to fill with water, and the objects to test. Help students prepare their experiment and have them test one factor at a time.
  - a. Ask them which criteria they are testing. Ask how they picked out the materials to test and how they decided to set up the experiment.
  - b. They will experiment with objects by varying only one of the criteria at a time. They make predictions before experimenting and they try to draw a conclusion from their experiments.
  - c. Have them record their results in a table (see student worksheets for examples)
7. Ask the students to summarize their findings as a class. Questions to ask:
  - a. How does the mass/volume/shape affect whether an object floats or sinks?
  - b. In what form does the plasticine float the best?
  - c. Can you explain why boats float?
8. **EXPLAIN:** All three factors (mass, volume, and shape) affect whether an object can sink or float. If an object is heavy, but has a large size, then it might still float, while a lighter object that is very small might sink. The mass and volume can be combined into a concept called density: density is higher if the mass is higher, and smaller if the volume is larger. Denser objects are more likely to sink. But the shape also makes a difference: this is why boats can float even if they are made of metal which is more dense than water. The water pushes up on the bottom of the boat. What would happen if we loaded up the boat too much? (Answer: if

the boat is completely filled with something that is more dense than water, it will sink.)

- a. For older students, it may be appropriate to write the equation  $\text{density} = \text{mass}/\text{volume}$ .
  - b. The force of a fluid that pushes up on objects in a fluid is called the buoyancy force. It is due to the fact that the pressure is larger the deeper in the fluid, which creates a net upward force on the object.
9. **ENGAGE:** Ask the students how they think the results will change if they use salt water or oil. Questions to ask:
- a. Is it easier to float in the ocean or a lake?
  - b. What happens when oil and water are mixed together?
10. **EXPLORE:** Give each group 2 more containers (so they have three containers total, which will contain water, salted water, and oil). Have them make the salted water with the salt given (5 tbsp for 750 mL of water).
11. Have students repeat their mass and volume experiments with salt water and oil.
- a. NOTE: Do NOT have the students use the clay/plasticine in the salt water or the oil. For the salt water and oil experiments, they should study only the mass and/or volume.
12. As a class, have students summarize their findings. Questions to ask:
- a. In which liquid do objects float the best?
  - b. Do you think the same volume of oil is heavier or lighter than water? What about the same mass of oil - does it have the same or different volume than water?
13. **EXPLAIN:** Salt water and oil have different *density* than fresh water - if you have the same *volume* of water, salt water, and oil, the salt water is heavier than the water, which is heavier than the oil. This affects how well different objects float in the different liquids. (Or: if you have the same *mass* of water, salt water, and oil, then the salt water will have the smallest *volume* - it takes up less space - followed by the water, and finally the oil.)
14. **Demonstration:** What happens if we put different liquids in the same container? Do the following as a demonstration in the front of the class.
- a. Add oil into a bottle (use a funnel)
  - b. Add water to the bottle and let the class observe what happens.
  - c. Add syrup to the bottle and let the class observe what happens.
  - d. Explain why this happens, referencing the evidence the students collected during the experiment.