

SINK OR FLOAT

Many young people like splashing around in water and **A CLASSIC STEM ACTIVITY IS CHALLENGING THEM TO DISCOVER TYPES OF OBJECTS THAT SINK OR FLOAT.** This month Andy the Science Wiz adds his take on this activity with a twist that gets young people thinking. The best thing about this simple activity is that it can be done at a moment's notice with materials you most likely already have on hand.

WHAT IS DENSITY?

Density is a measurement of how tightly the molecules in a substance are packed together. Density is calculated by dividing an object's size (volume) by its weight (mass). Molecules in dense substances are packed together very tightly. For example, imagine two blocks of the same size, one made of gold and one made of cheese. Although the blocks are exactly the same size, the gold block weighs more because the molecules in the gold are bigger and packed together more tightly. Therefore, a block of gold is denser and weighs more than a block of cheese.

WHAT CAUSES AN OBJECT TO FLOAT?

When an object is lowered into water, its weight pushes down on the water and pushes some of the water aside. The weight of the water pushed aside pushes back on the object with an equal and opposite force. This force is called buoyancy. An object will float when its weight and size pushes aside, or displaces, enough water to equal its weight. Objects that are denser than water usually sink because they cannot push aside enough water to keep them afloat. Objects that are less dense than water usually float because they push aside less water to equal their weight.

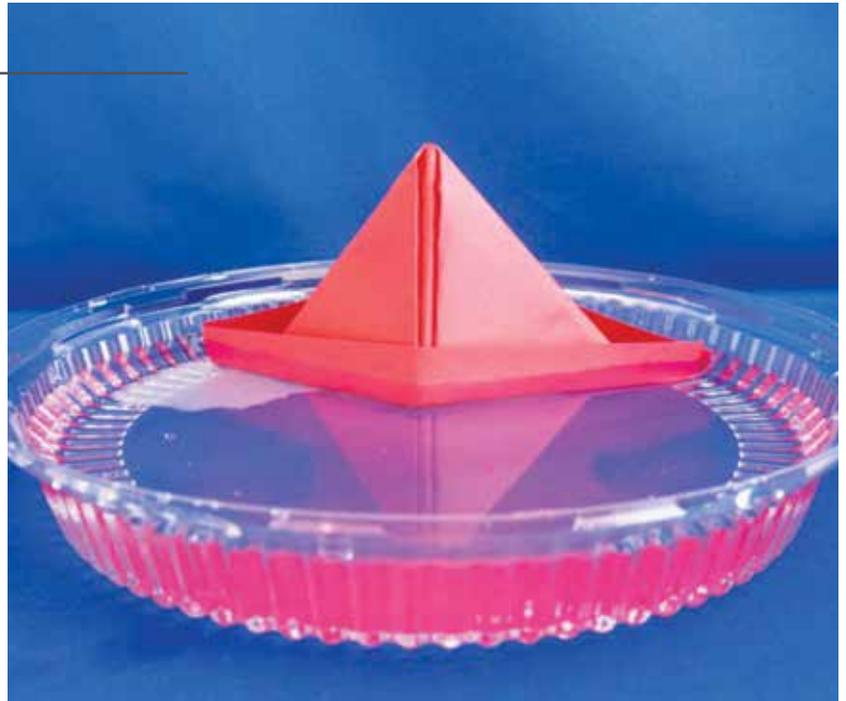
HOW CAN A BOAT MADE OF STEEL FLOAT?

Boats are often made from materials that are denser than water and able to carry heavy cargos. These boats use their shape to stay afloat. Boats are designed as huge hollow tubs. This shape allows the weight of the boat to push aside as much water as possible. Even though the hull may be made from dense, heavy steel, the hollow shape means that it is mostly air on the inside, making the average density very low. The shape and low density of modern boats means that even big, heavy steel boats can displace enough water to hold up their weight. The largest ship in the world is the Prelude floating liquefied natural gas (FLNG) facility. Weighing 600,000 tons, the Prelude has to displace 600,000 tons of water to stay afloat. To do this, it was built 1,601 feet long and 243 feet wide to ensure that its density is low enough to enable it to float.

BUOYANCY: An upward force equal to the weight of water that an object displaces. | **DENSITY:** A measurement of how tightly the molecules in a substance are packed together. | **FLOAT:** To rest at the surface of water. | **SINK:** To move downward, to settle at the bottom of a container of water.

engage

- ?** **Do liquids have weight?** *Yes. For example, a bucket filled with water weighs a lot more than an empty bucket. One gallon of water weighs about eight pounds.*
- ?** **What kinds of objects float?** *Young people's choice.*
- ?** **What kinds of objects sink?** *Young people's choice.*
- ?** **Why do some objects float and some objects sink?** *Young people's choice.*



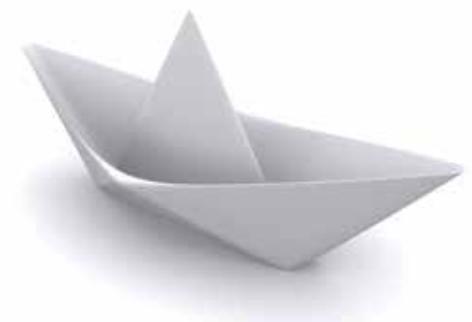
what YOU WILL NEED

FOR THE GROUP:

- !** **Selection of materials that can get wet to use to test for buoyancy, examples include:**
Toys • Plastic or paper cups • Plastic or paper bowls • Pencils • Stones • Pieces of wood • Balls • Marbles • Pieces of Styrofoam™ • Metal bolts • Paperclips • Aluminum foil
- !** **Disposable aluminum foil pans** *(deep enough so sunken items can be easily retrieved from the depths)*
- !** **Non-hardening modeling clay**
- !** **Variety of craft supplies, including craft sticks, aluminum foil and clean, empty juice boxes**
- !** **Paper towels**
- !** **Small bowl**
- !** **Paper or plastic cup**
- !** **Water**
- !** **Large sheet of paper**
- !** **Markers**

& before YOU BEGIN

1. **Fill each disposable aluminum foil pan with water.**
2. **Fill a paper or plastic cup to the brim with water.**



EXPLORE & EXPERIMENT

- 1 Create a display** of the objects you have collected to test for buoyancy.
- 2 Use a large sheet of paper to create a table with three columns.** Label one column “Object”, the second column “Prediction”, and the third column “Result”.
- 3 Ask the group for a volunteer to be a recorder.** Have the volunteer write the name of each object from the collection in the “Object” column. Invite the group to predict whether each object will sink or float. Have the volunteer record the predictions on the chart next to the name of each object in the column labeled “Prediction”.

OBJECT	PREDICTION	RESULT
Golf Ball	Float	Sink
Racket Ball	Sink	Float

- 4 Have young people share the collection of objects** and take turns placing the objects, one at a time, into the water to test if they sink or float. Instruct young people to record the results in the “Result” column of the chart next to the name of the corresponding object.
- 5 When all the items have been tested, ask young people to name the kind of objects that sink and the kind of objects that float.** Ask the group the following question: Is there a rule that can be made about objects to predict whether they will sink or float?
- 6 Explain that, in general, objects that are heavy for their size, or denser than water, sink.** Objects that are light for their size, or less dense than water, will float.
- 7 Pass out ping-pong size balls of clay** to several young people.
- 8 Ask the group to predict** if the balls of clay will sink or float.
- 9 Instruct young people to take turns placing the balls of clay in the water** to test if they sink or float. Have them discuss the results and compare to their predictions.
- 10 Place the cup filled with water in an empty aluminum foil pan and show it to the group.** Ask the group to predict what will happen if you place a ball of clay into the cup.
- 11 Place a ball of clay into the cup.** Invite young people to share their observations. The ball will sink and water will overflow into the pan. Explain that when an object is placed in water it pushes water out of the way. The water does not want to move and pushes back on the object. The object will float when the weight of the water pushed aside equals the weight of the object. The object will sink when it is heavier than the amount of water it pushes aside.

EXPLORE & EXPERIMENT (continued...)

- 12** **Have young people collect the balls of clay.** Challenge them to work together in small groups to change the balls of clay into a shape they think will float. Allow adequate time for each small group to transform the clay and test in the pan of water.
- 12** **Invite young people to share the shapes they created.** Have them explain why they think the clay floated as that shape. Explain to the group that the clay needs to be a bowl or boat shape in order to float. The clay will have a greater chance of floating the thinner the walls and the larger the hollow of the bowl shape.
- 12** **Share with young people that an object floats when it displaces enough water to equal its own weight.** When shaped as a bowl, the clay becomes larger and pushes more water out of the way. The average density of the clay lessens because it includes the air that is below the waterline. The combination of air and clay means the density of the clay in a bowl shape is a lot less than the clay shaped as a ball. Now the clay is less dense and pushes on enough water to hold it up and allow it to float.



make THE CONNECTION

TELL YOUNG PEOPLE THE STORY OF ARCHIMEDES AND HIS EUREKA MOMENT. Search online or use one of the links below to find the story. Explain to young people that the story is probably not true as it was written 200 years after Archimedes died, but it has endured because it is funny to think about and explains the science perfectly.

- <http://www.english-for-students.com/Eureka-Eureka.html>
- <http://www.longlongtimeago.com/once-upon-a-time/great-discoveries/eureka-the-story-of-archimedes-and-the-golden-crown/>
- <https://www.youtube.com/watch?v=ijj58xD5fDI>



EXTEND & EVALUATE

Challenge young people to use craft items to create boats that float. Clean, empty juice boxes with the straw hole sealed with tape make a fantastic waterproof boat hull. Craft sticks adhered together make great rafts. Straw raffia can be used to make a reed-type boat like the ones used by ancient Egyptians. Aluminum foil can be used to make tankers. Young people can test their boat designs by placing pennies or washers on their boats and counting how many the boats can hold before sinking.