



boats floating in the harbor

WRAP-UP

To wrap-up the investigation, bring your students together for a group discussion to help them understand why and how they achieved their results. It is important to share results so that everyone has a clear picture of what happened. To help you facilitate the discussion, review the explanation in “The Why and The How” using the Group Discussion questions as a guide.

Group Discussion

Explain to students that scientists learn from each other through discussion, and they build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their experiments, they will now come together as a group to share their results and make conclusions about the investigations they’ve conducted. Have students record their final results and the explanation in their journals.

- What did you learn about water from this investigation?
- What have you learned about an object’s ability to float in water?
- What variables did we use in this investigation?
- What surprised you?
- What new questions do you have?
- What did you like about this activity?

The “Why” and the “How”

There are several things working together to make each object float or sink. The surface of water

acts like an elastic band or skin, caving in slightly when an object touches the surface. When a high-density object (like a marble) is placed in water, it breaks the surface tension of the water. Some of the water rises and is then pushed aside or “displaced”.

No two objects can occupy the same space at the same time. The water has to make room for the clay boat by moving out of the way, so the water level rises. If you weigh the ball of clay that sank, you will find that the clay weighs more than the water it displaced.

The thing to remember about floating is that the object must displace an amount of water which is equal to its own weight. So, let’s imagine that you have a wooden boat that weighs 20 pounds. When you lower that boat into the water, the boat will move down into the water until it has displaced or moved 20 pounds of water out of the way. That means that 20 pounds of water are pushing back up on the boat, causing it to float. In this investigation, the more weight, or cargo, added to the boat, the more water it displaced.

The ball of clay that sank earlier in the lesson will float once its shape is changed to give it enough surface area. The clay boat has more contact with the surface of the water, making it more stable so that it does not tip over easily. **Buoyancy** is the ability of an object to float – an upward force (in this case, the water) pushes up on the object (the clay boat), and **gravity** makes the weight of the clay boat push down on the water.

Curriculum Match-Up

- Graph the number of items that it took to sink your clay boat.
- Repeat the investigation using aluminum foil in place of clay, or pennies in place of marbles or paperclips.
- Have students rework the clay into a few different-shaped boats to see which model will carry the most marbles.
- Add salt to the water and try the investigations again. Are the results different? What do you observe?
- Discuss why objects seem lighter in water than they do on dry land.
- Research how a ship’s crew knows just how much cargo a ship can hold.

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References:
Adapted from information from the U.S. Office of Naval Research

Above Water: Buoyancy & Displacement

Learning Objectives

Students will:

1. Conduct experiments to find out how objects stay afloat in water.
2. Document the relationship between **surface tension**, **buoyancy**, **density** and **displacement**.
3. Demonstrate how shape, size, and type of material affect an object’s ability to remain buoyant.

Vocabulary Ventures

buoyancy
density
displacement
force
gravity
surface tension

Water plays such an important role in our lives that we could not live without it. We drink, bathe, clean, and cook with water. Can you think of some other ways that we use water?

You may have seen objects like styrofoam or wood float on water. But have you ever seen concrete and steel float?

The reason that a steel ship can float is because the ship is made of more than just steel. If you put a solid steel ship in the water, it would sink, but ships are designed with an air floor called a “hull”. Air is very light and less dense than steel. The air trapped inside the ship’s hull lowers the overall density of the ship, helping it float.

So, while steel is dense and heavy enough to fully submerge the ship



freighter with a heavy load

in water, the trapped air has a lower density than steel and is light enough to keep the ship from sinking. If there is not enough air in the ship’s hull, and the ship sinks too low in the water, some of the water could spill in over the sides of the ship, displacing the air and increasing the overall density of the ship. This

is why ships sink if they are tipped to one side.

Today, you’re going to learn how special properties of water help objects float!

Time Needed to Conduct Investigation

This investigation has three parts.

Organize and set up materials: 10 minutes

Introduce the lesson: 5 minutes

Conduct the investigation: 20 minutes

Student journaling/group reflection: 10 minutes

Total time: 45 minutes

Investigation: Shape It!

Materials

For groups of two or three
Student journals and
writing tools

Part 1

- Medium to large (shoebox size or larger) plastic container with a wide, open top filled with water
- ½ stick of modeling clay per student (from a 1 lb. package)

Part 2

- Paperclips (one box per group)

Part 3

- Marbles (one bag per group)

Part 1 Float Your Clay

GET READY!

1. Divide students into groups of two or three.
2. Ask students to mold their ½ stick of modeling clay into a ball.
3. Ask students to think about how they can get their ball of clay to float in the water.

PREDICT

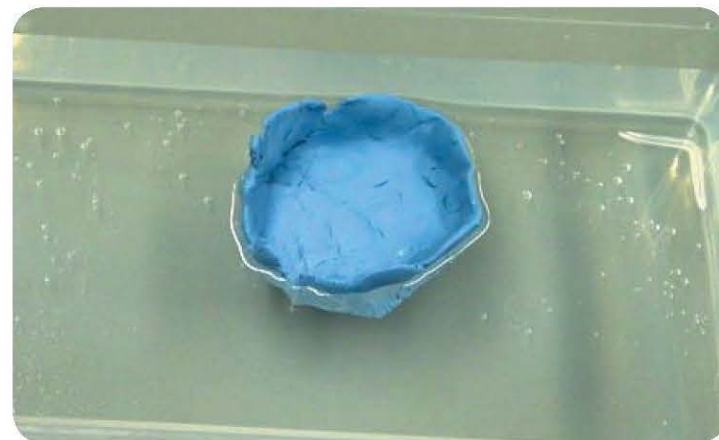
Before students place their ball of clay in the water, they should make some predictions.
Will the ball of clay float, or will it sink? Why?

PROCEDURE

1. Have the students place their ball of clay into the water and make observations.
2. After several tries, have the students make predictions and suggestions about how to shape the clay differently so that it will float.



TIP
If needed after 5 minutes, assist students in shaping their boats to float. Show students how to shape a boat by forming sides and hollowing out the inside.



clay boat

OBSERVE

Ask students to make and record their observations of the following:

- What happened after you placed your re-shaped clay in the water?
- What do you notice about the shape of your molded clay?
- How is this clay different from the original ball of clay?

Part 2 How Many Paperclips Can You Float?

Once students get their clay boats to float, distribute the paperclips.

PREDICT

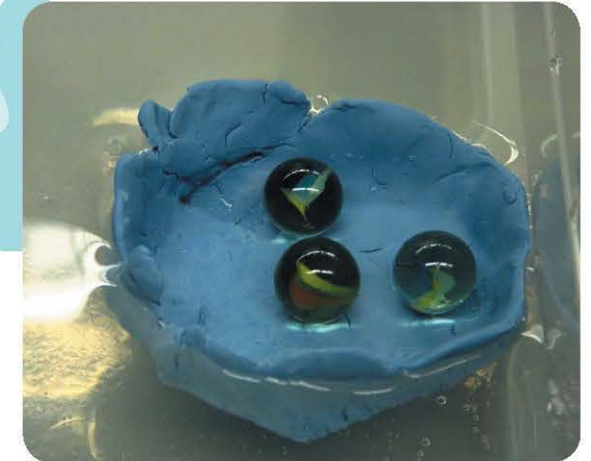
Have students record their predictions in the student journals.
How many paperclips will the boat hold before it sinks?

PROCEDURE

1. Have students *slowly* begin placing paperclips into the clay boat.
2. Remind students to count the number of paperclips and make observations about the water level as they drop the paperclips into the boat.
3. They should continue adding paperclips until their clay boat sinks and record the number of paperclips used.



boat with paperclips



boat with marbles

Part 3 How Many Marbles Can You Float?

Students will continue using their clay boats for part of this investigation. Distribute the marbles, and ask students to predict and record the number of marbles the boat will hold before it sinks.

OBSERVE

As students begin to *slowly* add the marbles one at a time until the boat sinks, have them make the following observations:

- What effect do the marbles have on the boat?
- What do you notice about the water?
Answer: the water level is rising as more marbles are placed in the boat.
- How many marbles did it take to sink your boat?
- Do the results differ between the paperclips and the marbles? If so, why do you think this happened?