

Buoyancy: Sink or Float? Lesson Guide

Lesson Guide | Description

Instructor: Tisha Dewitt Grade Level: K - 3 Subject: Science/STEM

Students will investigate buoyancy and gravity by making predictions and testing which household items will sink or float in water.

Wonder Why:

Have you ever wondered why a penny sinks in water, but a huge ship can float?

Goal:

Students will use the Engineering Design Process to design and build a boat with the largest mass that will float.

Lesson Guide | Lesson Guide Agenda

Lesson Guide Agenda:

- ✤ <u>Vocabulary</u>
- ✤ <u>Archimedes</u>
- ✤ <u>Materials List</u>
- Activity Instructions
- Engineering Design Process
- ✤ <u>Discussion</u>
- ✤ <u>How it Works</u>
- ✤ <u>Challenge!</u>
- Additional Resources
- Oklahoma Academic Standards

Lesson Guide | Vocabulary

<u>Buoyancy</u> – A force on an object making it rise or move upwards.

<u>**Gravity</u>** – A force that pulls or attracts things toward the center of the earth.</u>

Density – An object's ratio of mass to volume.

<u>**Displacement</u></u> – When an object is placed in water, it pushes the water over and causes the water to rise. This is known as Archimedes Law.</u>**

Lesson Guide | Archimedes

Archimedes and Buoyancy

- Archimedes was a physicist, mathematician, astronomer, inventor and engineer.
- Many of his inventions, theories and concepts are still in use today.
- Perhaps his best-known achievement was his "Eureka" moment, when he discovered the principle of buoyancy.



A statue of Archimedes in a bathtub demonstrates the principle of the buoyant force. Located at Madatech, Israel's National Museum of Science, Technology and Space in Haifa. (Image: © Andrii Zhezhera/Shutterstock)

Buoyancy: Sink or Float?

Materials Needed:

Large clear container of water Ruler Scissors 2 – 6x6 inch pieces of aluminum foil 40 Pennies Pencil "Sink or Float?" Worksheet Watch the "Buoyancy: Sink or Float?" video before continuing to the challenge!

Be sure to print the "Sink or Float?" worksheet found on HomeRoom to follow along with this lesson.

If you have any questions throughout this lesson, please email <u>teachers@oerb.com</u>. We would love to hear from you!

Lesson Guide | Activity Instructions



Let's Get Started!

Activity 1 Instructions:

- 1. Print the "Sink or Float?" worksheet found on HomeRoom.
- 2. The items tested in the video lesson include: a rock, golf ball, tennis ball, pencil, metal spoon, plastic spoon, sponge and aluminum foil.
- 3. Write the names of the objects to be tested on the worksheet in column 1.
- 4. In column 2 "Predict" by writing (S) for sink and (F) for float next to each object.
- 5. In column 3 write exactly what happened when the object was tested S or F?

It's okay if your prediction wasn't correct! A prediction is what you <u>THINK</u> will happen before you test.

Activity 1 Instructions:

- 5. Test the first item (rock). Write rock in column 1.
- 6. Predict S or F and write it in column 2.
- 7. Put the rock in the container of water.
- 8. Did it float or sink? Write the results S or F in column 3.
- 9. Repeat steps 6 8 for each of the objects on the worksheet.

Activity 2: STEM – Engineering Design Process

Design 2 aluminum foil boats using the Engineering Design Process. Be sure each boat has a different shape and design!

Lesson Guide | STEM - Engineering Design Process



Activity 2 Instructions:

- 1. Draw two different boat designs on the "Sink or Float?" worksheet.
- 2. Build each boat according to these designs using only aluminum foil for the material.
- 3. Make a prediction on the worksheet about which boat will hold the most pennies without sinking.
- 4. Place Boat 1 in the water.
- 5. Gently place one penny at a time on Boat 1. Be sure to distribute the weight evenly.
- 6. Continue to do this until water gets into the boat.
- 7. Remove the boat from the water and count how many pennies the boat held prior to sinking. Record how many pennies it held in the worksheet data table.

Activity 2 Instructions:

- 8. Place Boat 2 in the water.
- 9. Gently place one penny at a time on Boat 2. Be sure to distribute the weight evenly.
- 10. Continue to do this until water gets into the boat.
- 11. Remove the boat from the water and count how many pennies the boat held prior to sinking. Record how many pennies it held in the worksheet data table.

Now let's discuss the results of this experiment!

Lesson Guide | Discussion

Discuss the Results!

- 1. Was Boat 1 or Boat 2 more buoyant? Did you make some interesting observations?
- 2. How many pennies was each boat able to hold?
- 3. Did it matter how or where you placed the pennies?
- 4. What shape worked best?
- 5. What could you change to make your boat hold more weight?
- 6. Did your boat tip over before it sank? If so, what design changes could you make to correct this?
- 7. Why do pennies float when placed in the boat, but sink when placed directly into the water?

How it Works!

- In order for an object to float, the weight of the boat has to be less than the weight of the water the object is displacing or pushing aside. There are two primary forces acting in this science investigation.
- The first force is gravity. Gravity is trying to pull the aluminum foil and pennies downward. The force of buoyancy is pushing the boat up toward the surface.



Gravity

How it Works!

- The gravitational force is determined by the mass of the aluminum foil and the weight of the pennies in the boat. The force of buoyancy is the weight of the water displaced by the boat.
- The boat will continue to float as long as the force of buoyancy is greater than the force of gravity, and the boat weighs less than the amount of water the boat is displacing.
- Just like the household items tested earlier, as long as the amount of water displaced by the object was greater than the weight of the object, the object floated. If the weight of the object was more than the amount of the water displaced, the object sank. When gravitational force is less than the buoyancy force, an object float.

How it Works!

ARCHIMEDES PRINCIPLE



Lesson Guide | Challenge

Challenge!

Build a better boat!

Using another piece of foil, can you improve your design to hold even more pennies?

Predict and test your new and improved boat.

WANT TO WIN A PRIZE?

Share pictures or a short video of your boat design with us by emailing <u>teachers@oerb.com</u> and on Facebook/Instagram by tagging us @oerbok.

Be sure to include your name, grade, school, and teacher!

The teacher with the most student submissions will win a \$100 Amazon Gift Card!

Check out these additional resources!

- 1. Science | State Department of Education https://sde.ok.gov/science
- 2. "<u>Who Sank the Boat?</u>" by Pamela Allen <u>https://www.youtube.com/watch?v=ZpFWuHSDFtQ</u>
- 3. Buoyancy: What Makes Something Float or Sink? <u>https://www.youtube.com/watch?v=nMlXU97E-uQ</u>

K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2-2 Crosscutting Concepts: Cause and Effect – Simple tests can be designed to gather evidence to support or refute student ideas about causes.

K-PS3-1 Crosscutting Concepts: Cause and Effect – Events have causes that generate observable patterns.

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute and describe the difference.

K-LS1-1 Crosscutting Concepts: Patterns – Patterns in the natural and human designed world can be observed and used as evidence.

1-PS4-1 Crosscutting Concepts: Cause and Effect – Simple tests can be designed to gather evidence to support or refute student ideas about causes.

1-LS1-1 Crosscutting Concepts: Structure and Function – The shape and stability of structures of natural and designed objects are related to their function(s).

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2-PS1-2 Students who demonstrate understanding can: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-PS1-2 Crosscutting Concepts: Cause and Effect – Simple tests can be designed to gather evidence to support or refute student ideas about causes.

3-PS2-1 Students who demonstrate understanding can: Plan and conduct investigations on the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-1 Crosscutting Concepts: Cause and Effect – Cause and effect relationships are routinely identified.

3-PS2-3 Crosscutting Concepts: Cause and Effect – Cause and effect relationships are routinely identified, tested, and used to explain change.

To learn more about the Oklahoma Academic Standards for Science click <u>here</u>.