

Grade Level: 3-5

Time Estimate: 1-2 days

BUOYANCY /INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content, and hands-on activities to help students learn and understand the concept of buoyancy. Students will explore what makes something float and how sharks in ocean are able to maintain their buoyancy. Students will hypothesize whether certain objects will float or sink with a hands-on activity.

Part 1. What is Buoyancy?

Part 2. Volume, Surface Area, and Density

Part 3. Sharks and Buoyancy

Activity 1. Float a Boat!

Activity 2. What Floats?

Goals & Objectives

The students will:

- Define buoyancy;
- Learn how volume, surface area, and density relate to buoyancy;
- Learn the adaptations that sharks have that help them maintain their buoyancy.

// STANDARDS

This lesson aligns with the following TEKS:

Grade 3 Science: 1A, 2A, 2D, 2F, 3A, 3D, 4B, 5A, 10A

Grade 4 Science: 1A, 2A, 2D, 2F, 3A, 3D, 4B, 5A, 10A

Grade 5 Science: 1A, 2A, 2B, 2C, 2D, 2F, 3A, 3D, 5A, 10A

This lesson aligns with the following Next Generation Science Standards:

4. Structure, Function, and Information Processing 4-LS1-1

Science and Engineering Practice

Engaging in Argument from Evidence

- Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). (4-LS1-1)

Disciplinary Core Ideas

4-LS1-1 Structure and Function

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (4-LS1-1)

STEM

This lesson plan aims to assist teachers in implementing a STEM-based program into their classroom while inspiring the next generation of explorers, scientists, and stewards of the ocean. Based on real science and the Global Shark Tracker™, this lesson is intended to promote environmental awareness and to prepare students for STEM careers.

Helpful Tips

1. The content in this lesson is related to OCEARCH and the Global Shark Tracker. Spend a few minutes getting familiar with the website and the tracker if you have not done so already. The Global Shark Tracker is also available as an app for iPhone and Android.
2. This lesson plan is designed to be adaptable to suit your specific needs. Use the entire lesson plan or just parts of it. This material can be expanded to be an entire unit or condensed for just one day in the classroom.
3. Vocabulary words will be underlined as they appear in the lesson plan. A complete list of vocabulary words is included as well.
4. Answers to questions and prompts for discussions will appear in italics.
5. Optional activities and content (side notes) will appear in a box. Use these to enhance your lesson and adapt it to suit your needs!
6. Have questions for OCEARCH Expedition Leader, Chris Fischer? Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to Chris and the OCEARCH crew!
7. Email all questions about this lesson to info@OCEARCH.org.

BUOYANCY / VOCABULARY

Adaptation - A characteristic that helps an organism survive in its habitat.

Buoyancy - The ability of something to float in air, water, or another fluid.

Density - How compact something is.

Displace - To take over a place where something else was.

Float - To rest or move on or near the surface of a liquid without sinking.

Force - A push or a pull on an object.

Physics - The study of nature and properties of matter, motion, and energy.

Surface Area - The total area of the surface of an object.

Volume - The amount of space that a substance or object occupies or fills.

BUOYANCY / PRE-LESSON ASSESSMENT

Use the following true/false and multiple-choice questions as an introduction/warm-up to the lesson topics. You can do this in a verbal or written format, as a game, individually, or as a whole class! A handout is provided if you wish to hand the questions out in a quiz format.

The questions do not need to be graded. They are intended to give the students an idea of what they will be learning and to see what they already know.

1. True or False

Buoyancy is the ability to float in water.

Answer: True

2. True or False

Sharks do not have adaptations to maintain their buoyancy.

Answer: False

3. Who first discovered buoyancy and named its principles it after himself?

- a. Archimedes
- b. Isaac Newton
- c. Galileo

Answer: a

4. What adaptations help fish, including sharks, maintain their buoyancy?

- a. Air sacs
- b. Large livers
- c. Both a and b
- d. None of the above

Answer: c

5. Which of the following objects do you think would float?

- a. Bowling ball
- b. Soccer ball
- c. A brick
- d. A penny

Answer: b

Name: _____

Date: _____

Buoyancy

Select the correct answer(s) to each of the following questions.

1) True or False

Buoyancy is the ability to float in water.

2) True or False

Sharks do not have special adaptations to maintain their buoyancy.

3) Who first discovered buoyancy and named its principles it after himself?

- a. Archimedes
- b. Isaac Newton
- c. Galileo

4) What adaptations help fish, including sharks, maintain their buoyancy?

- a. Air sacs
- b. Large livers
- c. Both a and b
- d. None of the above

5) Which one of the following objects

do you think would float?

- a. Bowling ball
- b. Soccer ball
- c. A brick
- d. A penny

BUOYANCY / LESSON PLAN

PART 1. WHAT IS BUOYANCY? 2-5 mins

In physics, buoyancy is the upward force on an object immersed in a fluid which allows the object to float. If the buoyant force exceeds the weight of the object, then the object will float. If the weight of the object exceeds the buoyant force, then the object will sink. This concept is known as Archimedes' Principle.

Archimedes was a Greek mathematician who discovered this principle while he was taking a bath! He filled a tub nearly to the top and when he climbed in, some of the water overflowed and spilled on the floor. This gave Archimedes an idea! Through further experimentation, Archimedes figured out that if the weight of the object being placed in the water is less than the weight of the water it displaces (the water that spilled on the floor), the object will float.

PART 2. VOLUME, SURFACE AREA, AND DENSITY 5-10 mins

In general, heavy objects sink and light objects float. However, this is not always the case. After all, large ships such as the M/V OCEARCH float!

Ask the students to list other objects that float. Record their answers on the board. What do these objects have in common? Size? Material? Let's learn what factors determine whether or not an object sinks or floats.

Volume

Volume is the amount of space an object or substance fills or occupies. A soccer ball takes up the same amount of space as a bowling ball, so the two have the same volume. However, the soccer ball will float because its volume is mostly air while the bowling ball's volume is solid. Ships are heavy, but their hulls are hollow and full of air which allows them to float.

Surface Area

Buoyancy is a force that pushes upward on objects. The more surface area the object has for the force to push up on, the greater chance it will float and the more weight it can hold.

Density

Density plays an important role in the buoyancy of an object. Density is essentially an object's mass per unit of volume. Objects with a high mass with a certain volume have a high density, while objects with a small mass with the *same* volume have a low density. Density determines if an object sinks or floats in a fluid. If the object's density is greater than the fluid's, the object will sink. And if the object's density is less than the fluid's, the object will float. Ships are designed and constructed to be less dense than water so that they do not sink!

Optional Teacher Demonstration (10-20 minutes)

You will need a large bowl or container, an orange, and water. Fill the container with water. Place the orange in the water and watch what happens. Now peel the orange and place it back in the water. What happens now? An unpeeled orange floats on the surface of water because the peel is full of tiny air pockets, which lowers its density (mass to volume ratio). By peeling the orange, its density increases causing it to sink!

PART 3. SHARKS AND BUOYANCY 5-10 mins

Sharks have many amazing adaptations to help them survive and thrive in the ocean. They have specialized teeth for their diets, they have perfectly hydrodynamic bodies for swimming, they have incredible senses, and so much more. They also have an unusual adaptation that helps them stay buoyant in the water.

Sharks have a large, oily liver unlike any other animal on the planet. This special organ serves two purposes. Just like other animals, its liver helps with digestion. But that's where the similarities end. A shark's liver is filled with an oily substance, called squalene that helps with buoyancy – or floating. How does this work?

A shark's body is naturally denser than water, so it *should* sink. Sharks do not have an air bladder like other fish to keep them buoyant. Instead the oil in the liver, which is less dense than water, keeps the shark from sinking to the ocean floor. Have you ever tried pouring cooking oil in water? What does it do? It floats!

BUOYANCY

ACTIVITY 1. FLOAT A BOAT

INTRODUCTION

Using their basic knowledge of buoyancy, density, surface area, and volume students will design and make a foil boat. They will test their boat's ability to float using pennies. The student that gets the most pennies in their boat without it sinking wins!

MATERIALS

- Large plastic rectangular bin or container to hold water
- Water
- Aluminum foil cut into 10x10 squares
- Lots of pennies or other small lightweight objects

INSTRUCTIONS

1. Fill the large container with about 3-4 inches of water.
2. Give each student a piece of foil and instruct them to turn it into a boat. They will need to remember everything they learn about buoyancy and why some objects float and others sink. They do not want their boat to sink!
3. When the students have finished making their boats, they should take turns in small groups testing their boat in the water. Students whose boats sink, should make adjustments to their boat's design and then test again.
4. Students whose boats successfully float should then start adding pennies one by one to their boats. Students should count the pennies as they add them and keep going until the boat sinks.
5. Instruct students to record the number of pennies their boat held on a piece of paper.

TIPS

To make the activity more exciting, make it a game and whoever gets the most pennies wins a small prize. Also, you can have the students write the number of pennies that their boat was able to hold up on the board for everyone to see.

BUOYANCY

ACTIVITY 2. WHAT FLOATS?

INTRODUCTION

Students will experiment with different types of object and determine if they float or not. Students will then determine why they float or not.

MATERIALS

- Large container (like a 10 gallon fish tank or storage bin) filled halfway with water
- Nail
- Sponge
- Piece of wood
- Bottle cap
- Plastic utensil
- Aluminum can (one empty and one full)
- Piece of aluminum foil (one flat and one balled up)
- Orange (one peeled and one unpeeled)
- Any other classroom/household objects

INSTRUCTIONS

Give each student an object to test. As a class, make a hypothesis on whether or not the object will float and then place the object in the water. Students should record the results on their Buoyancy handout (provided below).

TIPS

This activity works best as a class demonstration. You should have enough test objects so that each student will have something to test. If you need to add more items, you can use just about anything as a test item.

Buoyancy - Sink or Float?

Test the following objects to see if they sink or float! Mark the outcome in the table below.

Object	Sinks	Floats
Nail		
Sponge		
Piece of Wood		
Bottle Cap		
Plastic Utensil		
Aluminum Can (empty)		
Aluminum Can (full)		
Piece of Aluminum Foil (balled up)		
Piece of Aluminum Foil (flat)		
Orange (peeled)		
Orange (unpeeled)		

Which object surprised you the most? _____

What do the floating objects have in common? _____

What do the sinking objects have in common? _____
