Grade Level: 6-8
Time Estimate: 1-2 days

OCEAN CURRENTS / INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content, and hands on activities to help students learn all about ocean currents. Students will learn what ocean currents are, what causes them, and the different types of currents.

Part 1. What is an Ocean Current?
Part 2. What Causes Currents?
Part 3. The Global Ocean Conveyor Belt
Experiment 1. Thermohaline Circulation

Goals & Objectives

The students will:
• Learn what an ocean current is;
• Learn what causes ocean currents;
• Learn the different types of ocean currents;
• Learn why currents are important.

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

// STANDARDS

This lesson aligns with the following TEKS:
Grade 6 Science: 1A, 2A, 2B, 2C, 2D, 2E, 3A, 3D, 4A, 4B, 12E
Grade 7 Science: 1A, 2A, 2B, 2C, 2D, 2E, 3A, 3D, 4A, 4B, 8B, 12A,
Grade 8 Science: 1A, 2A, 2B, 2C, 2D, 2E, 3A, 3D, 4A, 4B, 10A, 11A, 11B, 11D

This lesson aligns with the following Next Generation Science Standards:

MS. Weather and Climate– MS-ESS2-6

Science and Engineering Practice
Developing and Using Models
• Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. (MS-ESS2-6)

Disciplinary Core Ideas
MS-ESS2-6: The Role of Water in Earth's Surface Processes
• Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

MS-ESS2-6: Weather and Climate
• Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
• The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

Crosscutting Concepts
System and System Models
• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

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.

OCEAN CURRENTS / VOCABULARY

Current - A body of water moving in a definite direction.

Density - The calculated mass per unit volume of a substance.

Estuary - The tidal mouth of a large river, where the tide meets the stream.

Jetty - A small pier or landing stage that boats can dock. Also a breakwater constructed to protect or defend a harbor, stretch of coast, or riverbank.

Nutrient – A substance that provides the nourishment that is essential for the growth and the maintenance of an organism.

Rip Current - A relatively strong, narrow current flowing outward from the beach through the surf zone and presenting a hazard to swimmers.

Sandbar – A long, narrow sandbank, especially at the mouth of a river.

Temperate - Relating to or denoting a region or climate characterized by mild temperatures.

Thermohaline Circulation - A type of current that is driven by differences in water densities and temperature.

Tides - The alternate rising and falling of the sea, usually twice in each lunar day at a particular place, due to the gravitational attraction of the moon and sun.

Water Column – a conceptual column of water from the surface of a sea, river or lake to the bottom sediments.

OCEAN CURRENTS / 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
There are only two types of ocean currents: surface currents and deep water currents.
Answer: True

2. True or False
Sharks are not affected by ocean currents.
Answer: False

3. What causes thermohaline circulation?
- **a.** Differences in the salinity of two different areas of water.
- **b.** Differences in the temperature of two different areas of water.
- **c.** Both a and b

Answer: c

4. Ocean currents are caused by
- **a.** Wind
- **b.** Gravity
- **c.** Earthquakes
- **d.** All of the above

Answer: d

5. Where do gyres occur?
- ***a.*** At the equator
- **b.** Near the poles
- **c.** Both a and b
- **d.** None of the above

Answer: a

Name: _____

Date: _____

OCEAN CURRENTS

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

1) True or False

There are only two types of ocean currents: surface currents and deep water currents.

2) True or False

Sharks are not affected by ocean currents

3) What causes thermohaline circulation?

a. Differences in the salinity of two different areas of water.

b. Differences in the temperature of two different areas of water.

c. Both a and b

4) Ocean currents can be influenced by?

a. Wind

b. Gravity

c. Earthquakes

d. All of the above

5) Where do gyres occur?

a. At the equator

b. Near the poles

c. Both a and b

d. None of the above

Grade Level: 6-8

OCEAN CURRENTS / LESSON PLAN

PART 1. WHAT IS AN OCEAN CURRENT? **5-10 mins**

The ocean is in constant motion due to currents. A current a body of water that is moving in a definite direction. There are two types of currents: surface currents and deep water currents. Surface currents occur in the top 400-meter portion of the water column and account for 10% of all of the water in the ocean. Deep water currents are located below the 400-meter portion of the water column and account for 90% of all of the water in the ocean.

Dangerous Currents

Rip currents may form near jetties, piers, and low spots or breaks in sandbars. This type of current is localized (not on a global scale) and flows away from the shore line. These currents typically break apart not too far from the shore and are usually no more than 25 meters wide. Rip currents have dangerous speeds up to 2.4 meters per second (8 feet per second!), but generally are one to 0.61 meters per second (2 feet per second).

These high speeds can catch swimmers and surfers off guard and kill an average of 100 people in America each year! This is why it's always important to swim at lifeguarded beaches. Lifeguards are not only trained to trained rescue swimmers in need, but also to monitor water conditions and post warnings to inform beach goers of when it is safe to swim.

PART 2. WHAT CAUSES CURRENTS? **10-15 mins**

Currents are natural phenomena that result from ocean tides, wind, and something called thermohaline circulation. (1) Tides are the alternate rising and falling of the sea, usually twice in each lunar day at a particular place, due to Earth's gravitational attraction of the moon and sun. Currents that result from tides are located near shore along the coasts of bays and estuaries. Currents caused by tides are the only type of current that can be predicted because they have regular patterns that follow the Earth's rotation. (2) Global winds influence currents near the ocean's surface to build up and move in the same direction that the wind is blowing. (3) Thermohaline circulation, often referred to as the ocean's "conveyor belt", creates currents that are driven by differences in water densities (due to salinity and temperature). Water that is more dense (colder and/or saltier) sinks below water that is less dense.

PART 3. THE GLOBAL OCEAN CONVEYOR BELT **10-15 mins**

The global ocean conveyor belt moves *a lot* of water *very slowly*. The conveyor belt connects major surface currents and deep water currents in the Atlantic, Indian, Pacific, and Southern Oceans and is largely responsible for moving nutrients throughout the oceans. This movement of water and nutrients is set in motion when deep water forms in the North Atlantic (1), sinks, moves south (2), circulates around Antarctica (3), and then moves northward to the Indian, Pacific, and Atlantic basins (4) (Figure 1). As the cold, salty water sinks, it carries oxygen to the deep parts of the ocean allowing organisms to thrive. Ask the students what they think would happen to these organisms if the conveyor belt slowed down or stopped?

Figure 1. A simplified version of the global conveyor belt.
Image Credits: US Global Change Research Program, Thomas Splettstoesser

The global ocean conveyor plays a highly significant role in regulating Earth's climate. It transfers heat gained from the sun from ocean to ocean. The exchange of the warm and cold water balances the uneven distribution of the sun's heat that reaches the Earth's surface.

In what ways does the movement of warm and cold water affect climate? Some parts of the world, such as northern Europe, experience a more temperate climate thanks to the warm waters brought from other parts of the world. Overall, the planet experiences les extreme climates. Again, as the students what they think would happen if the global ocean conveyor belt slowed down or stopped?

Grade Level: 6-8

Time Estimate: 45 minutes

OCEAN CURRENTS
/ EXPERIMENT 1. THERMOHALINE CIRCULATION

INTRODUCTION

Ocean currents affect the Earth's climate and the cycling of nutrients. Deep-ocean currents are driven by differences in the water's density; and density depends on the water's temperature (cold water is denser than warm water) and salinity (saltier water is denser). Students will demonstrate this concept in the following experiment.

MATERIALS

- Food coloring - blue and red
- Ice cube tray
- Saltwater
- Cups - one for a demonstration to the whole class or one per small group or pair of students.
- Freshwater - hot and cold
- Small spoon or stirrer
- Pipettes or droppers
- Plastic bins (size of a shoebox) - one for a demonstration to the whole class or one per small group or pair of students.

INSTRUCTIONS

Prep: Use the ice cube tray to freeze cubes of blue-colored saltwater. Freeze three cubes for each plastic bin.

1. Fill the plastic bins 3/4 full of cold freshwater. Allow the water to settle before beginning. Use this time to explain the experiment to the students. They are about to place the blue, saltwater ice cubes into the freshwater in the bins. If you like, ask the students to record their predictions about what will happen in a notebook or on the board.
2. Add three blue, saltwater ice cubes to the far right side of the freshwater bin. Ask the students to make observations - record them in a notebook, on the board, or even draw their observations.
3. Fill the cups with very hot water. Advise the students to be very cautious. Add 3 drops of red food coloring and mix thoroughly.
4. Again, ask students to predict what will happen when the red hot water is added to the bins. Record their predictions about what will happen in a notebook or on the board.
5. Use pipettes or droppers to slowly add drops of the red hot water to the bin. Ask the students to make observations - record them in a notebook, on the board, or even draw their observations.

Cold water is denser than warm water, but in this case the cold water is also salty, making it very dense. The red, hot water is less dense and floats on top of the cold, dense bottom water. This is a model of thermohaline circulation, like the global ocean conveyor belt.