

## Coasts to Currents

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<b>Strand</b>	Interrelationships in Earth/Space Systems
<b>Topic</b>	Investigating ocean currents
<b>Primary SOL</b>	5.6 The student will investigate and understand characteristics of the ocean environment. Key concepts include b) physical characteristics.
<b>Related SOL</b>	5.1 the student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which b) estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools; i) inferences are made and conclusions are drawn. 5.6 The student will investigate and understand characteristics of the ocean environment. Key concepts include a) geological characteristics; c) ecological characteristics.

### Background Information

Global ocean currents help to regulate the world’s climate and have important effects on marine life. They are composed of deep ocean currents and surface currents.

A current refers to the motion of the water. A current is like a river within the ocean, flowing from one place to another. These currents are caused by differences in water temperatures, differences in water density, and by wind. Currents are responsible for a vast amount of movement of the water found in the Earth’s oceans.

Deep ocean currents are created by differences in water density. Saltier (denser) water sinks and displaces water that is warmer and less salty and dense. The deep, dense water moves slowly across the ocean floor and eventually rises in warmer latitudes. These currents are connected, and are sometimes called the ocean “conveyor belt.” One circuit can take 1,000 years to complete.

Surface currents are driven by the wind. Depending on the seasons and on climate fluctuations, the exact position of the surface currents varies. Warm water near the equator is pushed by normally strong winds toward the poles and begins to cool. In a few regions, such as the North Atlantic, cold, salty water sinks to the ocean floor. This water then travels in the deep ocean.

The Gulf Stream is a powerful warm current that flows in the Atlantic from the tip of Florida, up the coast of the United States, and then over to Europe. The Gulf Stream has a large impact on the climate of the eastern U.S. and Western Europe. It makes Western and especially Northern Europe warmer than they otherwise would be.

The Gulf Stream is one of the strongest ocean currents known. It is essentially a 40-50 mile wide current that runs through the Atlantic Ocean, but its breadth and speed can categorize it more accurately as a river. Like all other currents throughout the world, the Gulf Stream is formed by the sun, the wind, and the water.

The Gulf Stream can affect local storm systems that form or meander off the coast. The weather systems can intensify, feeding off the warmer water of the Gulf Stream below them. Hurricanes and tropical storms gain strength when passing over the warmer waters.

The Gulf Stream is also unique because its warm waters make it a home for countless species of fish and wildlife. The vast range of species, particularly larger fish, attracts charter boats and fishermen from all over the world.

Before the colonization of North America, early explorers and sailors were aware of the Gulf Stream and documented the unusual warm current that they encountered, starting with Ponce De Leon in 1513. Credited with discovering the Gulf Stream, Ponce De Leon noted that while traveling through the Atlantic, they were pushed along, backwards, by a current that was more powerful than the wind. By 1516, the existence of the Gulf Stream was widely known and accepted as part of the Atlantic navigational routes.

### Materials

- Internet access and research materials about the ocean currents and the Gulf Stream
- 8 2-liter bottles of room temperature water
- 8 small marbles or weights
- 4 clear water tanks, between one and five gallons each
- 8 small canisters with no lids (such as medicine containers)
- 4 graduated cylinders (500 mL)
- Hot water supply
- Very cold water supply (*Note: Keeping ice cubes in the water supply is fine, but do not have students put the ice cubes themselves in the tank.*)
- Blue and red food coloring
- Science journals or plain white drawing paper for each student
- Red and blue colored pencils for each student

### Vocabulary

*current, Gulf Stream, density*

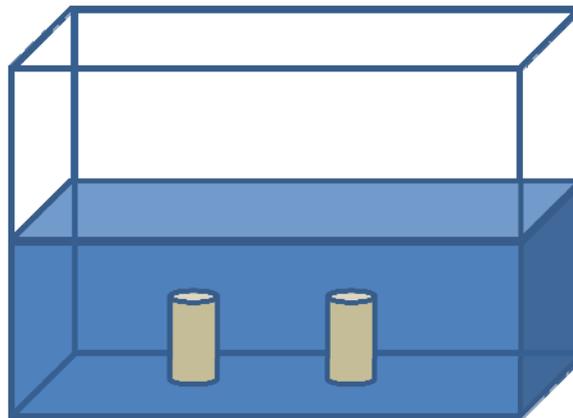
### Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

#### *Introduction*

1. Divide the class into teams of two. Have one half of the class conduct research about ocean currents and one half of the class conduct research about the Gulf Stream. Tell teams to be prepared to share at least three facts about how the currents and the Gulf Stream occur, at least three interesting facts about each, and at least one question that was not answered for them during their research.
2. When the teams share their facts, record them on the board.
3. Explain to the students that the Gulf Stream is a huge current and that they will be doing an activity that shows what currents are and how they are formed as well as why the Gulf Stream is important to people living along the East Coast.

*Procedure*

1. Group students into four groups. Give each group of students a set of materials.
2. Each group of students will measure 4,000 mL of room temperature water and pour it into their tank, using the 500 mL graduated cylinders. (*Note: The amounts might need to change based on the size of the tanks that you have available to you. Students will need to be able to have enough water in the tanks so that the canisters will be covered completely with the room temperature water, with about four to five inches of water on top of them once they are submerged so that the students can see the movement of the colored hot and cold water.*)
3. Tell the groups to take the small canisters and place one marble or weight in each.
4. In one canister, students will place three drops of red food coloring and then fill it to the top with hot water.
5. In the second canister, students will place three drops of blue food coloring, and fill it to the top with cold water.
6. Students should pick up the red canister and carefully place it into the tank until it sits on the bottom of the tank.
7. Students should pick up the blue canister and carefully place it into the tank until it sits on the bottom of the tank.



8. Have each group *gently* blow across the tank for at least 15 seconds to determine if wind affects the current.

*Conclusion*

1. Students should observe what is happening to each of the canisters.
2. Each student should draw a picture of what he or she observed. Have students color the blue and red currents from each of the canisters and label them as warm and cold water currents.
3. Conclude with a discussion on why the hot water rises and the cold water sinks. Have them explain why they think the wind might affect the currents. Finally, ask students to talk about the Gulf Stream and its importance to the inhabitants on the East Coast.

## Assessment

- **Questions**
  - Why does the cold water sink and the warm water rise or stay on the top? Explain.
  - Does wind affect the currents? Explain.
- **Journal/writing prompts**
  - Discuss why the Gulf Stream is important to the people who live along the East Coast.
  - Discuss the factors that might change the flow of ocean currents.
  - Have the students draw their conclusions in their science journal.
- **Other**
  - Assess students' knowledge on the basis of the "Conclusion" discussion and the illustrations in the students' science journals or white drawing paper.

## Extensions and Connections (for all students)

- Have students visit the National Oceanic and Atmospheric Administration (NOAA) Web site to view satellite images of the Gulf Stream. Students can use the data to determine the rate of the current and temperature of the water.

## Strategies for Differentiation

- Create a graphic or video to demonstrate the Gulf Stream Current on a world map.
- Currents can be drawn on a world map to demonstrate flow of currents.
- Explore the meaning of density by relating it to the types of milk (skim, whole milk, etc.) in their cereal. Have students explore density using different types of milk with varied cereal to draw conclusions and explain the class experiment.
- Create a flip book to review vocabulary with term, definition, and visual.
- Allow students to research surface ocean currents and explain why they think the currents flow the way they do. Have students teach the class about one of the important current related topics to draw students in by interest.