Going Up, Going Down

(Adapted from an activity included in the Educator's Guide for the NASA SciFiles™ video program "The Wacky Water Cycle." Used by permission.)

Organizing Topic Investigating the Ocean Environment

Overview Students investigate the movement of warm and cool ocean currents.

Related Standards of Learning 5.6b

Objectives

The students should be able to

explain the formation of ocean currents and locate the Gulf Stream.

Materials needed

Clear glass casserole dishes
Tap water
Hot tap water
Small waterproof zip bags
Clip clothespins or small clamps
Two different colors of food coloring
Small rocks
Ice cubes
Thermometers
Science journals
Copies of an ocean currents map, such as that found at
http://www.physicalgeography.net/fundamentals/8q_1.html

Instructional activity

Content/Teacher Notes

Thermohaline circulation is the name for currents that occur when colder, saltier (denser) water sinks and displaces water that is warmer and less salty and dense. In a cycle known as the *global conveyor belt*, 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 back towards the equator and begins to rise to replace the water that is being pushed away from the equator by the winds. This cool water rising to the surface is known as *upwelling*. This entire process, which may take a thousand years to complete, helps regulate the climate of the Earth as heat is transported from the equator to the polar regions and cooling water is transported to the equator.

During a period of El Niño, the winds along the equator are weaker than usual and may actually blow in the opposite direction. Warm water begins to pile up along the nearby coasts. Where the ocean is warm, more clouds form and more rain falls. Normal weather patterns around the world are therefore disrupted by this change in ocean temperature.

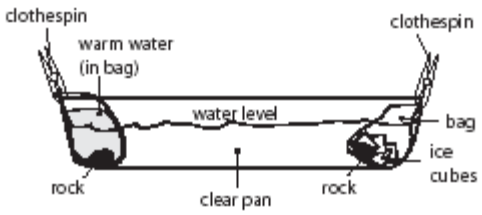
NASA collects satellite data to measure the sea surface and temperatures and uses the data to make maps of the ocean. From these maps, scientists can monitor the speed and direction of ocean currents.

Introduction

1. Ask students whether they have ever heard of the Gulf Stream. If so, what do they think it is? Write their responses on board. Explain to 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. The activity will also help them see why the Gulf Stream is important to people living along the East Coast.

Procedure

1. Put the students into small groups, and give each group a set of materials.
2. Have each group fill a casserole dish with room-temperature tap water and let the pan rest for a while so that the water settles and comes closer to room temperature. While this is happening, have them place a small rock in each of two plastic bags.
3. Have the groups fill one of their bags with hot water from the faucet (CAUTION: not scalding!), seal it, place it in one end of the glass dish, and use a clothespin to clip it in place (see diagram).
4. Have the groups fill their other bag with ice cubes, seal it, put it in the dish opposite the warm water bag, and use another clothespin to clip the bag to the dish.



5. Now, tell the students to carefully add 4 drops of food color to the water next to the bag of hot water and 4 drops of a different color to the water next to the bag of ice cubes. Have them observe the movement of the colors in the water for several minutes and then record their observations and illustrate them in their science journals.
6. Have a student in each group gently blow across the top of the water surface, and have all students observe what happens to the colored waters and record their observations.
7. Have another student blow across the top of the water from the other side and all students observe and record.
8. Have the groups repeat steps 2–7 and measure the temperature at the surface and bottom of the warm end of the dish at each step. Have them record the temperatures and explain what is happening.

Observations and Conclusions

1. Have the student groups explain what happened to the water near the colder end of the pan and what happened to the water near the warmer end of the pan.
2. Ask: “When you began to blow across the water, adding ‘wind power’ to the water currents, how did they change? Why?”
3. Discuss the factors that might change the flow of ocean currents. Include a discussion of how changes in the ocean currents affect the Earth.

Sample assessment

Assess students' knowledge on the basis of the "Observation and Conclusion" discussion and the notes and illustrations in the students' science journals.

Follow-up/extension

Have students use a map of ocean currents, such as the one found at http://www.physicalgeography.net/fundamentals/8q_1.html. Have them notice the difference in current flow between the northern and southern hemispheres, and discuss the reasons for this difference. To demonstrate this phenomenon and help students learn more about Coriolis effect, use the experiment "Round and Round We Go" found in the NASA SciFiles™ episode "The Case of the Phenomenal Weather" (see "Resources").

Have students examine satellite image maps of ocean temperatures and make their own edible ocean map by using colored gelatin and lemon sherbet. For directions, see http://spaceplace.nasa.gov/en/kids/topex_make1.shtml.

Have students use the Websites listed below to research some key information about the ocean.

Resources

BlueFrontier Oceans for Life. National Geographic. http://www.nationalgeographic.com/seas/. Features many classroom activities.

Bridge: Sea Grant Ocean Science Education Center. Virginia Institute of Marin Science. http://www.vims.edu/bridge/. Offers many ocean-related resources.

"The Case of the Phenomenal Weather." *NASA SciFiles ™.* http://scifiles.larc.nasa.gov/educators/index.html?p=episodes/guides. Click "Archives" — "2001–2002 Season" — "The Case of the Phenomenal Weather – Download the Full Guide."

"The Case of the Wacky Water Cycle." *NASA SciFiles ™.* http://scifiles.larc.nasa.gov/educators/index.html?p=episodes/guides. Click "2003–2004 Season" — "The Case of the Wacky Water Cycle – Download the Full Guide."

The Gulf Stream Voyage. The Stevens Institute of Technology: Center for Improved Engineering and Science Education (CIESE). http://www.k12science.org/curriculum/gulfstream/index.shtml.

Ocean Planet: Interdisciplinary Marine Science Activities. Smithsonian Institution. http://smithsonianeducation.org/educators/lesson_plans/ocean/main.html.

Science and Technology Focus — Oceanography. Office of Naval Research. http://www.onr.navy.mil/focus/ocean/default.htm. Contains some great resources on oceanography and astronomy.

Surface Ocean Current Map. PhysicalGeography.net — Fundamentals of Physical Geography. http://www.physicalgeography.net/fundamentals/8q_1.html.