Wind-Driven Ocean Currents

Overview

Students will (1) create a model ocean over which wind will be blown, and (2) observe the relationship between wind and ocean surface *currents*.

Concepts

- Ocean surface currents are mostly caused by wind. Ocean currents can also be caused by differences in the *salinity* and *temperature* of water.

Materials

- Clear, shallow, glass baking dish or clear tray
- Food coloring
- Cereal bowl (or finger bowl)
- Petri dish or small shallow bowl
- Assortment of waterproof objects with irregular shapes
- Map of ocean currents (optional, see Links section)
- Map of global wind patterns (optional, see Links section)
- Towels

Preparation

This activity is best completed in small groups. Make sure that the simulated ocean containers (glass baking dish or clear tray) are shallow, otherwise it is difficult to see the bottom counter currents. Have extra towels for water spillage.

In step 3, you can use any bowl or object that sticks above the water. In step 4, you can use any small bowl or other object that is short enough to be below the water line.

Teachers may wish to demonstrate this for the entire class by placing the clear "ocean" container on an overhead projector and adjusting the focus of the projector as needed.

Procedure

Engagement

Ocean currents are caused by several environmental factors. Differences in salinity and in temperature can cause water to flow. Wind also moves water. Winds blowing for long periods of time can cause currents. In the following activity, you will have the chance to observe how water moves as wind blows across it.

Activity

1. Carefully fill the clear tray with water. Do not fill it completely to the top. Let the water settle.
2. Place a drop of food coloring at one end of the tray and gently blow across the tray. Observe and sketch what you see happening at the surface of the water and along the bottom of the dish. Are your sketches different from each other? If so, how are they different? Where do the currents move most rapidly? What happens to the water as it moves away from the wind source?

3. Gently place the cereal bowl upside down in the center of the glass tray. Make sure that the bowl sticks out of the water. If it does not, lower the water level in the tray and try again. The bowl represents an island. Add a drop of food coloring in front of the island and gently blow across the tray. Observe and sketch what happens to the food coloring in front and back of the island. What effect does the island have on the current? Is the current stronger in front of or behind the island? How can you tell?
4. Remove the cereal bowl. Change the water if the food coloring added during Step 3 makes it difficult to see additional drops. Add a petri dish that is completely below the water line. The petri dish represents a submarine island. Add a drop of food coloring between you and the submarine island and blow across the tray. Observe and sketch what happens to the food coloring. How are these results different from those obtained for the island in step 3?
5. Repeat the procedure but use objects of irregular shapes. Are the currents more or less complex with the odd-shaped objects? Explain.
6. Do the currents always move in the direction of the wind? If not, what factors might influence the direction of movement? How do bottom currents differ from top currents? Why?

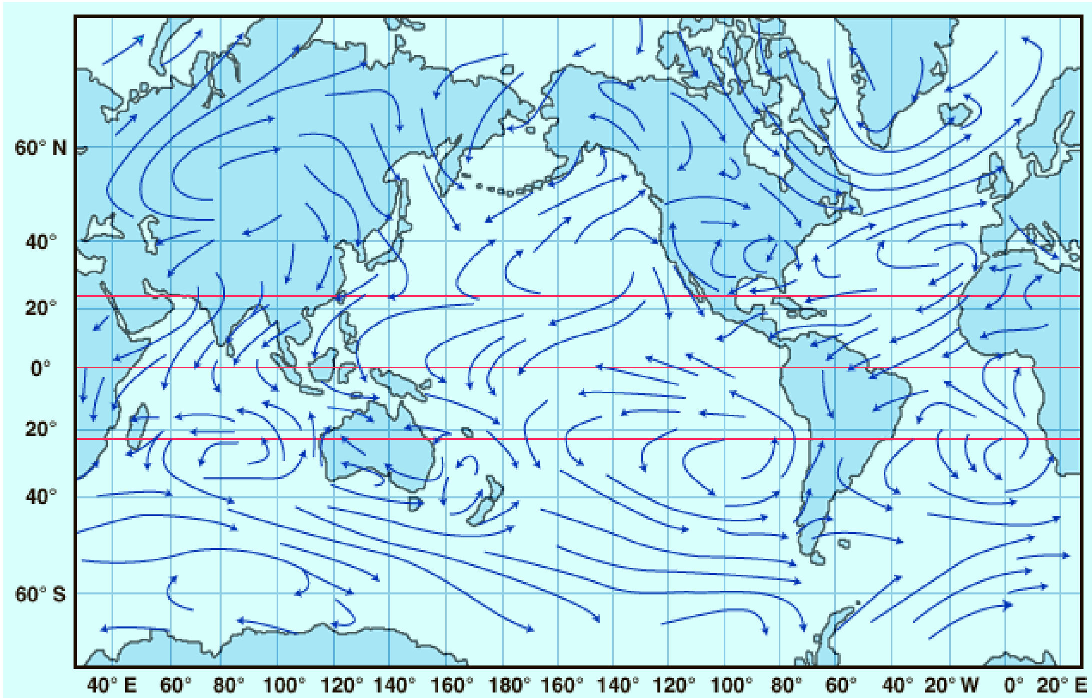
Explanation

Winds create ocean currents, just as your breath created currents in your simulated ocean. Wind-driven ocean currents are complicated by many external factors including Earth’s rotation, the presence of landmasses, and seafloor topography. The complex patterns of ocean currents are also influenced by the salinity and temperature of the ocean itself.

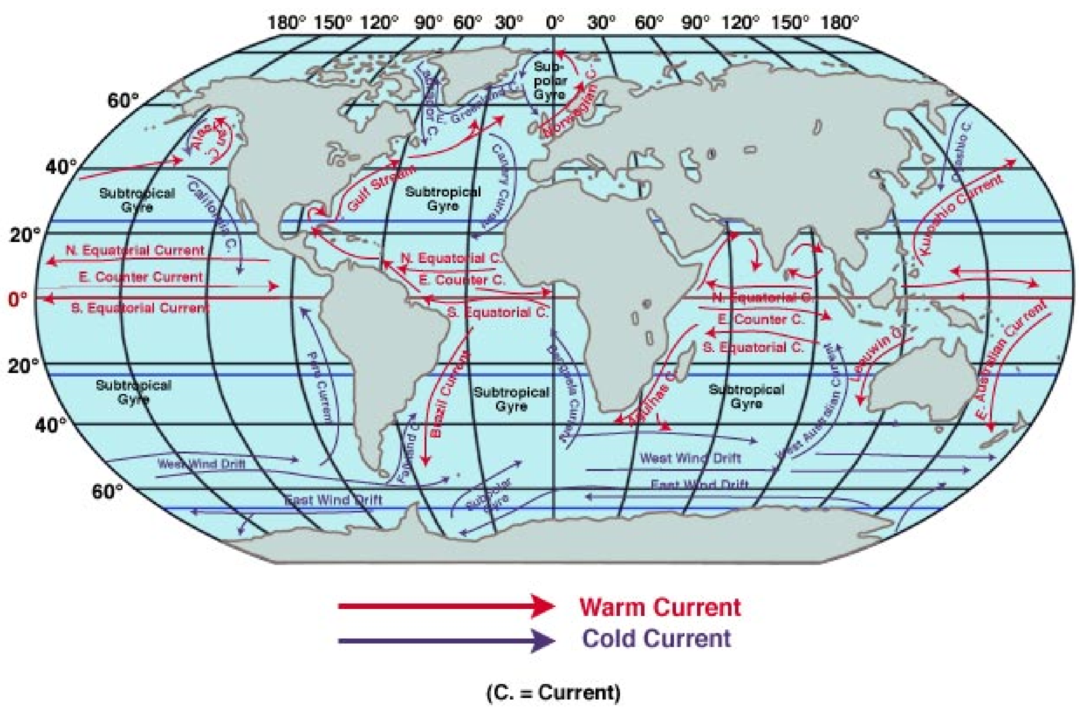
Ocean circulation patterns influence climate and living conditions for plants and animals, even on land. Ocean currents affect everything from the routes taken by ships to the distribution of plants and animals in the sea.

Extension

As you might expect, flow in the ocean can be very different than flow in the lab. This is because it is very difficult to model the motion, viscosity, and geometry of Earth’s oceans in a simple experiment. To see the real world effect of winds on ocean circulation, compare a map of wind patterns and a map of surface currents [Fig. 1]. Do these patterns look similar to one another? Then compare the maps of wind patterns [Fig. 1a] and *geostrophic* ocean circulation in the upper 1,000m of the oceans [Fig. 2]. Are these patterns similar? Can you guess why or why not?



a) **Global wind patterns**.



b) **Global wind-driven surface ocean current patterns**.

Figure 1. **Global wind and surface current maps** for January. Note the similarities and differences between large-scale wind and current patterns.

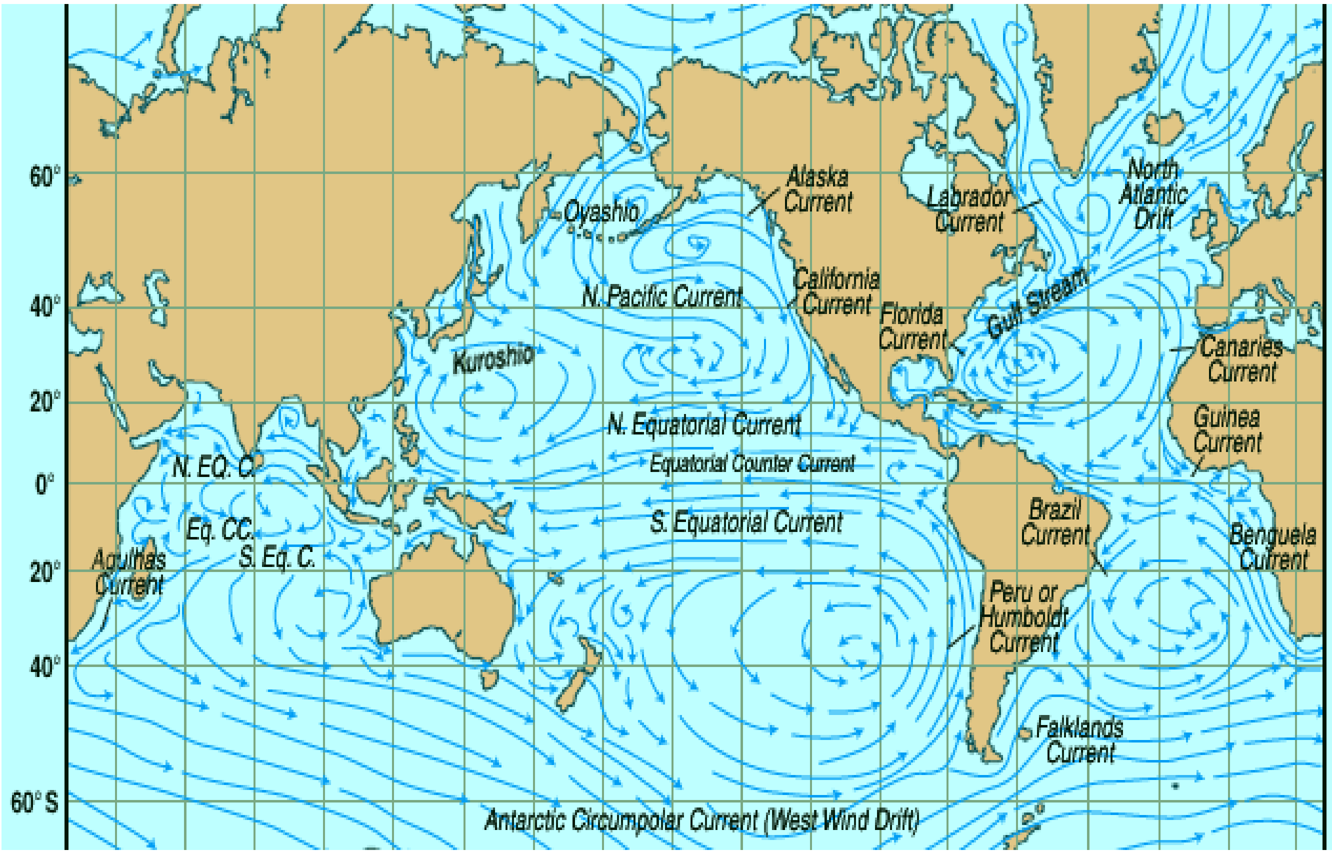


Figure 2. **Global geostrophic currents.** Geostrophic currents in the upper 1,000 meters of Earth's oceans.

Links to Related CD Activities, Images, and Movies

Movie of *How the Coriolis force affects wind and ocean currents*

Activity *Salinity and Deep Ocean Currents*

Activity *Temperature and Deep Ocean Currents*

Vocabulary

current *geostrophic* *salinity*

temperature

Source

Adapted from Kolb, James A. *Marine Biology and Oceanography, Grades Seven and Eight*. Marine Science Center; Marine Science Project: For Sea. Poulsbo, Washington.