Comprehending Currents I

Wind-Driven Ocean Currents

Adapted from NASA's "visit to an Ocean Planet" Curriculum
http://topex-www.jpl.nasa.gov/education/activities.html

Currents in the ocean are important because they transport heat and nutrients from one part of the ocean to another. 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. Currents move water north, east, south and west, and up and down through the depths of the ocean.

There are two major types of currents in the ocean: **wind-driven currents** and **density-driven currents**. Currents in the surface (top 100 m) of the ocean are caused mostly by the wind as it blows across the ocean.

Materials

• Clear, shallow, glass baking dish or clear tray

• Food coloring

• Cereal bowl (or other small bowl)

• Petri dish or small shallow bowl

• Assortment of waterproof objects with irregular shapes

• Towels

• Small hand-held fan (optional)

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.

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.

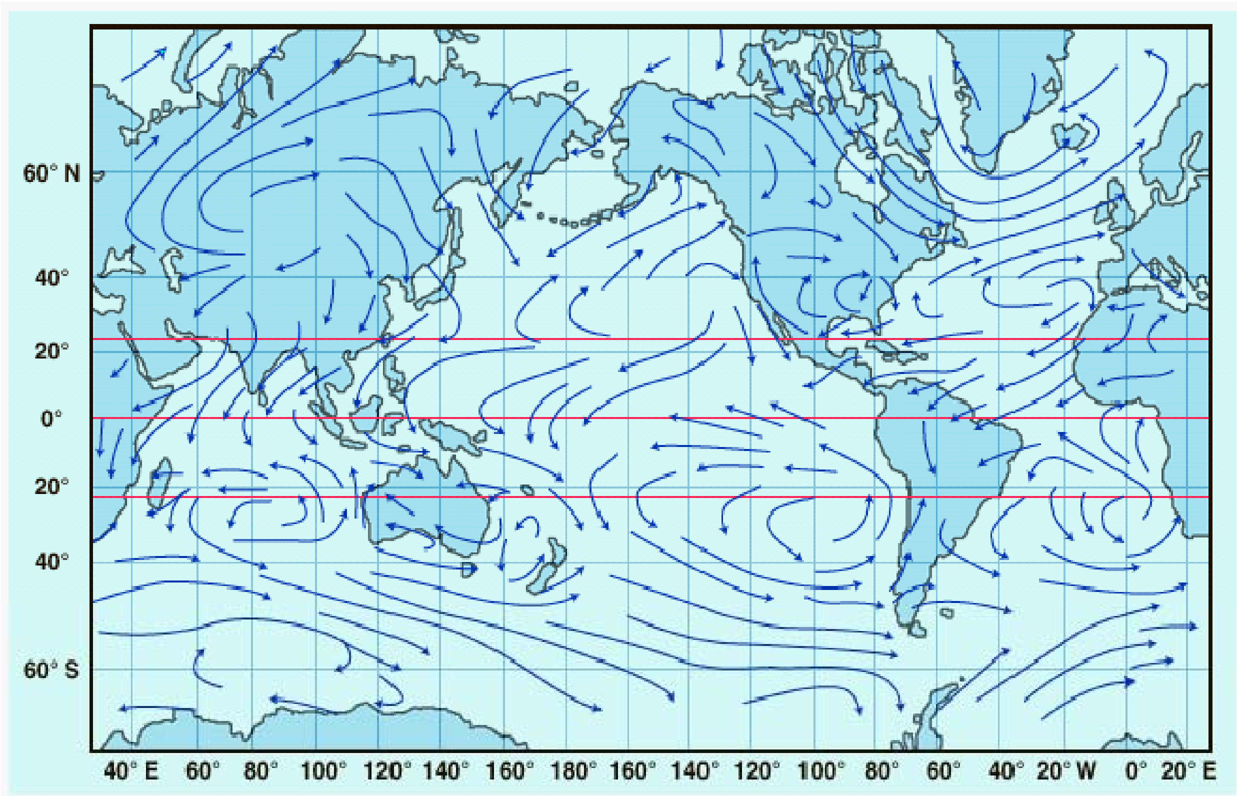
Simulating Wind-Driven Currents

1. Carefully fill a 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 on the water or use a small fan to generate wind. 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. What do you notice about the currents when they encounter oddly shaped? Explain.
6. Do the currents always move in the direction of the wind? If not, what factors might influence the direction of movement?

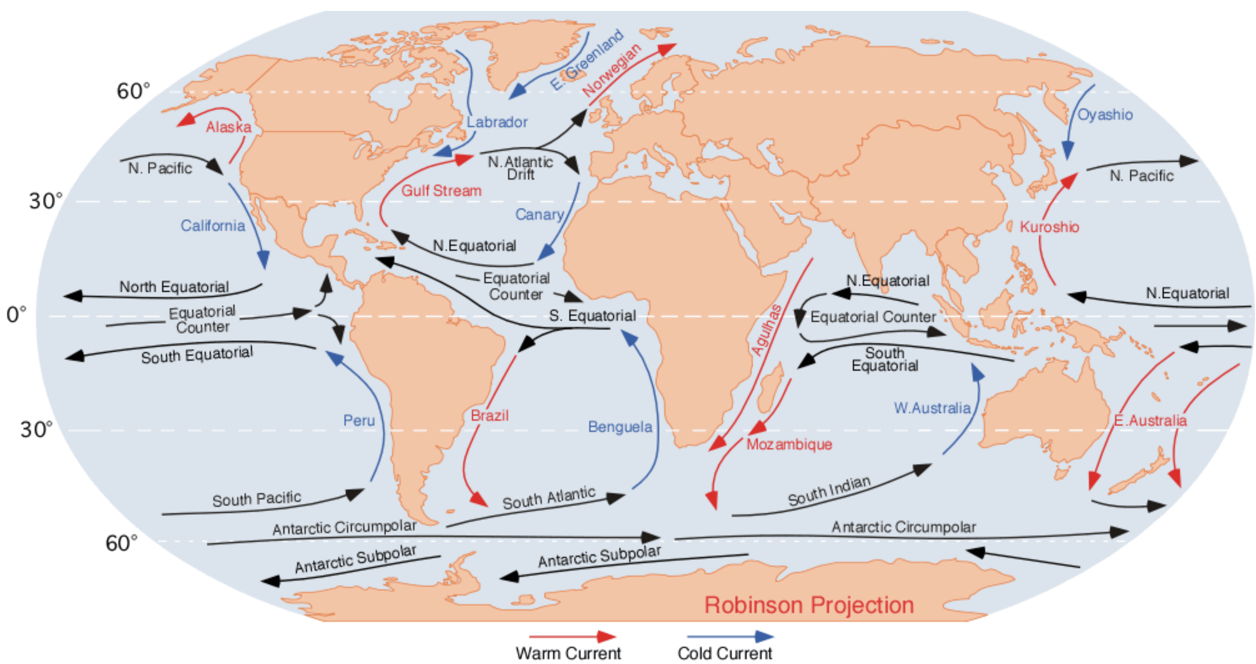
Wind-Driven Currents in the Ocean

Look at the two figures on the next page. In the top figure, the arrows show the direction of the wind, in the bottom figure, the arrows show the direction of the surface currents. Both figures are from the month of January.

- What are the similarities between the winds and the currents? What are the differences?
- What do you notice about the direction of currents in the Northern Hemisphere, what about in the Southern hemisphere? (see "Coriolis Effect" below for explanation)
- Which parts of the currents are cold, which are warm? What do you think accounts for this phenomena?



A) Global Wind Patterns



B) Global Ocean Surface Currents

The Coriolis Effect

An explanation for curvature of winds and currents

The "Coriolis Effect" refers to the apparent deflection of the path of an object as it travels in a north or south path on the rotating earth. The object itself is actually moving in a straight line but because the Earth is rotating underneath the object, it appears to curve to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. This is true of everything from rockets to currents in the ocean.

View an animation of the Coriolis Effect at:
http://www.eoascientific.com/campus/earth/multimedia/coriolis/view_interactive

Coriolis Demonstration

You can demonstrate the Coriolis Effect in your classroom using a globe. If you have a chalkboard globe, use that, if not, you can use dry-erase markers on a plastic globe (be sure to wipe off the markers fairly quickly) or tape paper onto the globe and use a pencil. Start at the north pole and draw a line toward the equator as someone rotates the globe to the right (counterclockwise, the direction the earth rotates). What happened to your line? Does it resemble the wind and ocean currents? Now start at the south pole and draw towards the equator on the rotating globe. What happens to the line?