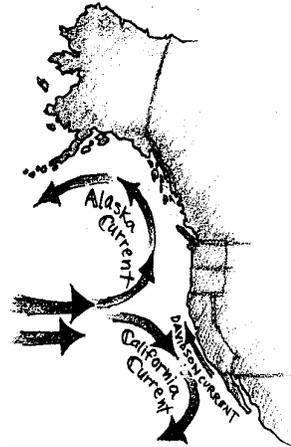


Currents: Moving Water

Key Concepts

1. Currents are large-scale water movements in the sea.
2. Currents affect living organisms by influencing food supply, water temperature and weather patterns.
3. The three main causes of currents in the ocean are:
 - wind
 - earth's rotation
 - density differences in ocean waters



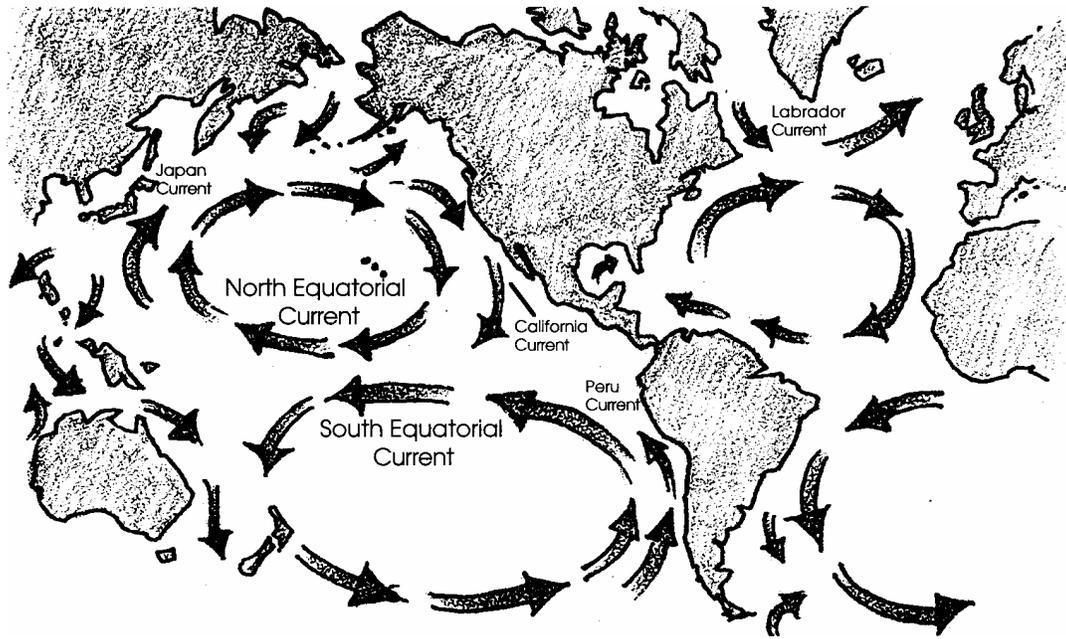
Background

Currents are large-scale water movements that occur everywhere in the ocean. The surface currents are driven by winds, while deep subsurface currents are driven by density differences in the ocean water. Ocean currents transport heat from the equator toward the poles, thereby partially equalizing surface temperatures over the earth. Ocean currents, winds, and weather patterns are closely linked. Currents can affect the food chain by transporting nutrients and plankton from one area to another. Fish congregate in high plankton areas to feed, attracting larger predators such as tuna, birds and marine mammals (and humans!).

Wind Driven Currents

The ocean and atmosphere of the earth are heated unevenly by the sun. More heating takes place at the equator than at the poles. This difference in temperature at the equator and the poles causes warm air to rise along the equator, and cold air to sink at the poles. Rising and sinking air creates wind, as adjacent air masses move in response.

Wind blowing over long distances of ocean tends to drag surface water along with it. The rotation of the earth causes oceanic wind patterns to create large circular currents, or gyres. The “bending” caused by the earth’s rotation is called the Coriolis Effect. In the northern hemisphere the gyres flow clockwise, in the southern hemisphere gyres flow counterclockwise. These large wind-driven currents are year-around, constant patterns.



Density Currents

At the North and South Poles, ocean water is cooled by the polar ice caps and by the lack of sun. Very cold, dense water sinks and flows along the bottom of the ocean toward the equator. Antarctic bottom currents flow past the equator into the northern hemisphere. These polar bottom currents are very slow moving. It may take 600 years for Antarctic bottom water to reach into the northern hemisphere. This very cold water is full of oxygen and is the primary source of oxygen in the deep sea.

At the equator, waters warmed by the tropical sun rise, expand, and flow out away from the equator. Remember that the atmosphere is moving in much the same pattern, also due to unequal heating by the sun.

El Niño

Normal wind and current patterns in the Pacific ocean create a flow of water near the equator that moves from the coast of the Americas toward the west. Every few years this pattern of wind and currents changes. For reasons that are only beginning to be understood, the Trade Winds die down and become weak. The westward-flowing equatorial current slows and is pushed aside by the equatorial counter-current running in the opposite direction. This means that lots of warm, nutrient-poor water moves east along the equator from the western Pacific. This warmer water reaches the coast of South America, pushing the Peru current further south.

Many organisms cannot tolerate warmer water. Plankton die from lack of nutrients in the warm water. Fish, such as anchovies, that feed on plankton, scatter to find food somewhere else. The food chain is disrupted by this change in ocean currents.

Because this event often happens during the Christmas season, the people of South America have named it “El Niño”, or “the child”. El Niño is devastating to the fishing industry of coastal countries such as Peru. Environmental effects of El Niño including a rise in sea level and modified weather patterns can reach all the way to the United States.

Key Words

current - large-scale movement of ocean waters

density - mass per unit volume of a substance. More dense seawater tends to sink, less dense seawater tends to rise in the ocean.

El Niño - weather related change in oceanic wind and current patterns

gyres - large circular ocean currents caused by wind and rotation of the earth.

hydrometer - instrument used to measure density or specific gravity of a liquid.

nutrients - essential minerals for life: similar to “vitamins”

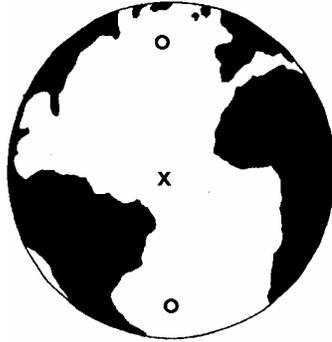
salinity - measure of the quantity of dissolved salts in seawater

upwelling - process by which water rises from a lower depth usually bringing nutrients with it.

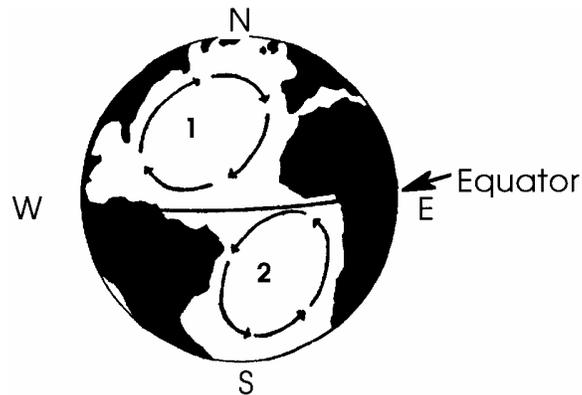
veer - a tendency to bend in one direction

Answer Key

1. A “river” of water within the sea is called a current.
2. One force that moves ocean waters is the direct rays of the sun which provides more heat to the seas near the equator. Warm tropical seas expand, rise and move away from the equator.
3. This world map is correctly marked:



4. **Saltwater**/freshwater is more dense (“heavier”). The correct answer is in bold print.
5. The deepest water in the oceans is warm/**cold** and “light”/“**heavy**”. The correct answers are in bold print.
6. This map is correctly labeled:



7. Three factors important in causing currents are:
- a. differences in density of the water
 - b. the earth's rotation
 - c. wind
8. Three ways in which currents affect living things may be chosen from the following:
- a. hinder or facilitate movement
 - b. determine where plants and animals can live
 - c. determine the course of ships
 - d. affect the migration and settling of people
 - e. affect the climate of the land near which they pass.