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Ocean–Currents

The branch of science known as oceanography is the study of the ocean and it has four major areas of specialization: geological, chemical, physical, and biological. Physical oceanography focuses on the motion and physical properties of ocean waters. Some of the ocean movements that physical oceanographers study include waves, tides and ocean currents. Ocean currents can be visualized as rivers flowing on a relatively fixed path through ocean waters. Ocean currents are strong enough forces that they are independent of the state of the wind and other weather effects at any given point in time.

Surface Currents

Surface currents run at or near the surface of the ocean. While the statement that surface currents are independent of the wind direction and wind speed is true, they are defined by the pattern of the prevailing winds that occur on planet Earth. There are three major wind belts that influence oceanic surface currents. The Prevailing Westerlies are winds that blow from west to east between 35 and 65 degrees latitude in the Northern and Southern Hemispheres. The Trade Winds blow from east to west between the equator and 30 degrees of latitude north and south. Finally the Polar Easterlies surround the North and South polar regions.

Surface currents end up with a circular motion and a circular ocean current is called a gyre. Surface currents follow the direction of the prevailing wind but eventually reach the vicinity of a continent. The currents in the Northern Hemisphere turn right and run parallel to the continent; turn right again to cross the ocean again; and reach the opposing continent. Currents in the Northern Hemisphere always turn right to form a circular motion while currents in the Southern Hemisphere always turn left. Gyres in the Northern Hemisphere move in a clockwise direction and a counterclockwise direction in the Southern Hemisphere.

There are five gyres that move surface water in the ocean: North Pacific Gyre; South Pacific Gyre; North Atlantic Gyre; South Atlantic Gyre; and Indian Ocean Gyre. Look at a map of the world's ocean divisions to determine for yourself why the Indian Ocean has but one gyre. The northern and southern gyres are separated by an equatorial countercurrent. The result of the circular motion of a gyre is that warm equatorial water is carried towards the poles and cold polar water

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is carried towards the equator. The Antarctic Circumpolar Current moves in a continuous easterly direction around the continent. There are no other continents to create a gyre from this current. The motions of all these currents modulate the temperature of the ocean and influence climate patterns.

Gulf Stream

Segments of gyres are given individual names. For example, the North Pacific Gyre is divided into four components: the North Equatorial Current travels east to west across the Pacific Ocean in the vicinity of the equator; the Kuroshia Current travels from south to north along the east coast of Asia; the North Pacific Current travels west to east across the ocean to North America; and the California Current runs north to south along the western coast of North America.

Even though the Kuroshia Current is off the east coast of Asia, it forms the western leg of the North Pacific Gyre. It is an example of a western boundary current. Western boundary currents bring warm equatorial water to the poles and are swift, narrow and deep. The California Current is an example of an eastern boundary current that brings colder water to the equator. Eastern boundary currents are slower, wider and shallower than their western counterparts.

The largest western boundary current is the Gulf Stream, one of the components of the North Atlantic Gyre. The Gulf Stream originates in the Gulf of Mexico and travels south to north along the Atlantic Coast of the United States to Newfoundland, Canada where it joins the North Atlantic Current. Climatologists estimate that the warm water that the Gulf Stream eventually brings to Great Britain raises the average air temperature there about nine degrees Fahrenheit. While the Gulf Stream brings climate improvement to Europe, it is the spawning ground for the hurricanes that affect the Caribbean and southern parts of the United States.

Deep Ocean Currents

Water moves in fixed patterns not only on the surface but also in the depths of the ocean near the bottom. Processes called downwelling and upwelling are an important part of deep ocean currents. These processes are related to the physical properties of the ocean water at predictable points in the ocean, especially water temperature, density and salinity, the amount of salt in the water. When surface

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water becomes denser, or heavier, than the water below it, the surface water sinks. This is downwelling. Downwelling then creates a deep water current that runs along the ocean floor.

When the density of the water in the deep current decreases, upwelling occurs; that is, the less dense water rises to the surface. Upwelling zones are typically found along coastlines where the influx of fresh water from rivers affects the density of ocean water. Deep ocean currents run north and south in the Atlantic Ocean and primarily east and west in the Pacific and Indian Oceans.

Deep water currents are responsible for mixing deep and surface waters in the ocean. The nutrient-rich water from the bottom of the ocean is circulated and provides resources for marine life. This movement of water through deep ocean currents is called the oceanic conveyor belt.

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Circle True or False after analyzing each of the following statements.

1. True False Ocean currents can be visualized as rivers flowing on a relatively fixed path through ocean waters.
2. True False At any given point in time ocean currents are dependent on the state of the wind and other weather effects.
3. True False Prevailing Westerlies and Polar Easterlies are names of deep ocean currents.
4. True False Surface currents end up with a circular motion and a circular ocean current is called a gyre.
5. True False Gyres in the Northern Hemisphere move in a clockwise direction and a counterclockwise direction in the Southern Hemisphere.
6. True False Eastern boundary currents bring warm equatorial water to the poles and are swift, narrow and deep currents.
7. True False The largest western boundary current is the Gulf Stream, one of the components of the North Pacific Gyre.
8. True False The Gulf Stream is the spawning ground for the hurricanes that affect the southern parts of the United States.
9. True False The processes of downwelling and upwelling are related to the physical properties of the ocean water, especially water temperature, density and salinity.
10. True False Deep ocean currents run north and south in the Pacific Ocean and primarily east and west in the Atlantic and Indian Oceans.

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Answers

1. True
2. False
3. False
4. True
5. True
6. False
7. False
8. True
9. True
10. False