The ocean is constantly moving. This movement carries water, heat, nutrients, pollutants and organisms. This circulation can have a profound impact on marine organisms as well as earth's climate and weather.

Lesson 5 - Standards
Md: Analyzes ecology as interrelationships of biotic and abiotic factors and explains the transfer of matter and energy within ecosystems.
Md.7: Analyzes the factors that limit the amount of life a given environment can support (e.g., energy, oxygen, minerals, rate of nutrient cycling).
Md.8: Analyzes the ways in which the physical environment (e.g., currents, tides, waves, weather) influences the structure of marine communities.
Global Winds

Ocean circulation can occur at the surface or three dimensionally into the depths of the ocean. Surface currents are caused by wind that is generated by the movement of air from an area of high pressure into an area of low pressure.

Winds do not simply go in straight paths north and south. Instead, winds curve due to the rotation of the earth on its axis. This bending of the air is called the Coriolis Effect.

To understand the Coriolis Effect, imagine a record playing spinning. If you were to take a pen and place it in the middle of the record, as the record is moving, try to draw a straight line down to the edge of the record. Due to the movement of the record, the line will curve in the opposite direction of the movement of the record.
Circular ocean currents called gyres are created by global wind patterns, and as a result of the Coriolis Effect.

Surface currents, driven by the winds, may go as deep as a few hundred meters. In contrast, the larger and deeper currents are caused by differences in density (caused by temperature and salinity differences).
Water in the ocean is layered by differences in density caused by variations in temperature or salinity. Although there are actually many layers, we often focus on three principal layers.

The surface layer (Epipelagic Zone), the intermediate layer (Bathypelagic Zone) and the deep layer (Abyssopelagic Zone). Water at the bottom is typically colder and denser than the upper layers.

In the intermediate layer, there is a quick transition between warm surface water and the cold water below.

This transition is called a thermocline.
Water that is warmed at the equators will rise to the surface and move toward the poles. There, the water cools, and sinks to the depths and then moves back toward the equator. This circular motion is referred to as the Great Ocean Conveyor. It takes about 4,000 years for water to make the full cycle. This conveyor of water is critical in regulating the earth’s climate.

The circulation and movement of ocean water serves another important role. Under normal conditions, east to western trade winds situated along the equator pushes warm water down, forcing the colder nutrient rich water from the bottom to rise to the surface in a process called upwelling. The nutrients brought up from seafloor feed many fish and life forms.
The ocean conveyor does not stay uniform. It varies in its strength and position. These changes, or oscillations, can cause changes in global weather. Two very well-known oscillations are El Niño and La Niña.

Under normal conditions, water from the west coasts of North and South America move toward the West Pacific Ocean and provide an important source of nutrients, derived from upwelling, for fish off the coasts of Australia, Indonesia, and especially Peru.

In an El Niño, sea surface temperatures along the Equatorial Pacific are warmer than usual. This causes an increase in rainfall and flooding in the U.S. and Peru.

Conversely, an El Niño results in droughts and fires in the W. Pacific. Trade Winds diminish, disrupting thermocline circulation and reduces upwelling of nutrients to the sea surface that feed many fish species.

In a La Niña, sea surface temperatures along the Equatorial Pacific are colder than usual. Opposite climate variations from El Niño occur, where increases in rainfall in Australia and Indonesia may lead to flooding.

La Niña causes fluctuations of rainfall and seasonal temperatures across various regions of North America.