Ocean Currents & Waves

What are the Movements of Ocean Water?

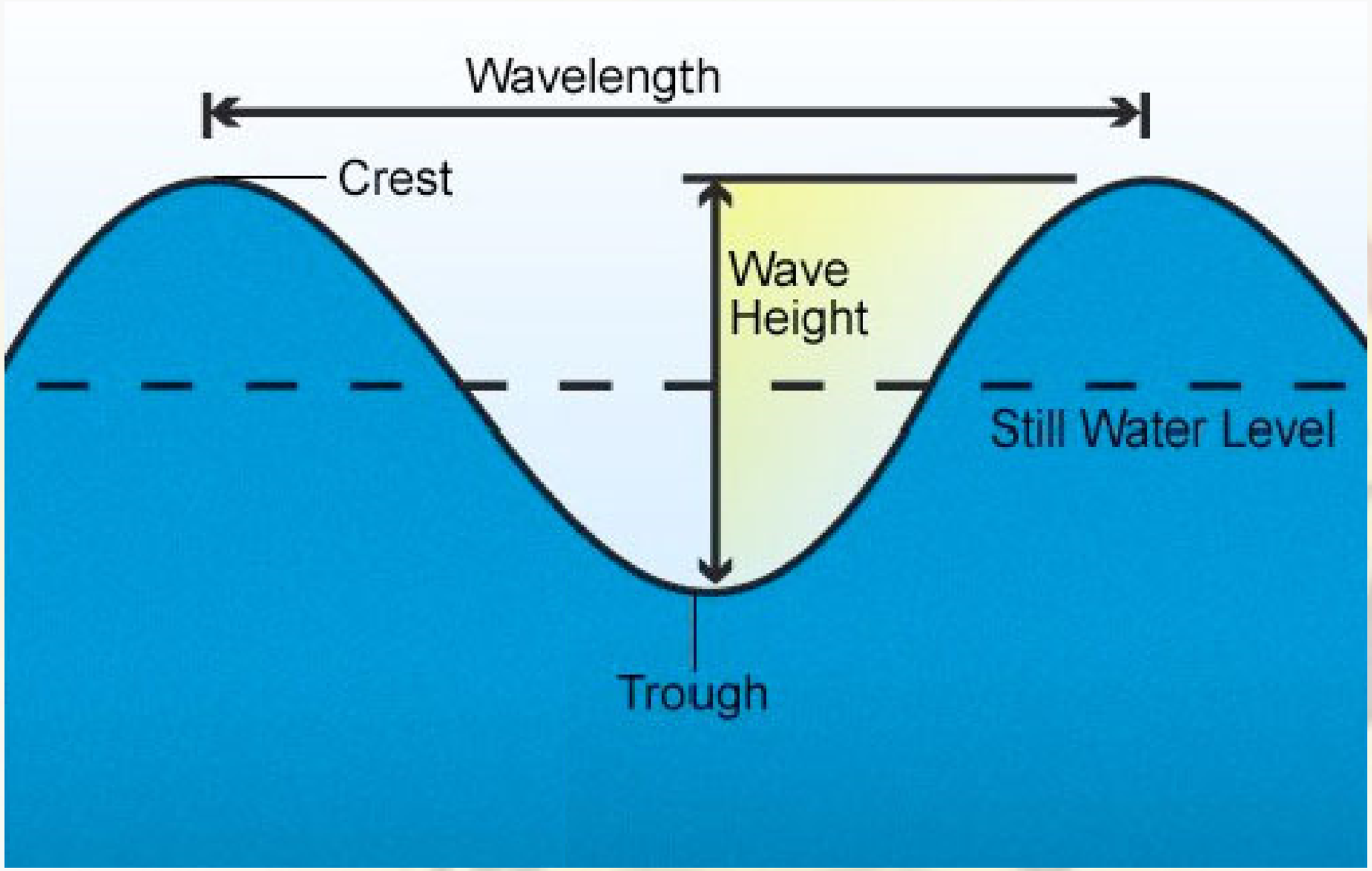
The movement of ocean water is constantly in motion. This is due to various physical characteristics and external forces. Ocean water movement can be classified into three major types:

- Waves
- Tides
- Ocean currents

Waves and ocean currents are horizontal movements of the water. Tides are vertical movements. The movement of ocean water is influenced by physical factors such as temperature, salinity, and density. External forces such as the sun, moon, and winds also impact ocean water movement.

Physical factors and external forces cause the water to move in different directions and speeds. This movement creates various patterns of currents and waves in the ocean.

- **Waves**
- Waves are nothing but oscillatory movements that result in the rise and fall of water's surface.
- Waves are a kind of horizontal movements of the ocean water.
- They are the energy, not the water as such, which moves across the ocean surface.
- This energy for the waves is provided by the wind.
- The size and strength of waves depend on factors like wind speed, duration, and fetch (the distance over which the wind blows).
- In a wave, the movement of each water particle is circular.
- A wave has two major parts: the raised part is called the crest while the low point is called the trough.



Properties of Ocean Waves

- Wavelength: The distance between two consecutive wave crests or troughs.
- Height: The vertical distance from the crest to the trough.
- Period: The time it takes for one wave crest to pass a fixed point.
- Speed: How fast the wave travels, determined by wavelength and period.

Formation of Ocean Waves

- Wind: The primary cause of ocean waves. Wind blowing over the surface of the ocean transfers energy to the water.
- Storms: Large storms can create very powerful waves, known as swells.
- Seismic Activity: Earthquakes and underwater volcanic eruptions can generate tsunamis, which are large, destructive waves.

Wave Behavior

- Breaking Waves: Waves become unstable and break when they approach shallow water.
- Refraction: Waves bend as they move from deeper to shallower water.
- Reflection: Waves bounce back after hitting a barrier or shore.

Currents are continuous, directed movements of water in the ocean or other large bodies of water.Types of Ocean Currents

- Surface Currents: Flow horizontally and are driven mainly by wind. Examples include the Gulf Stream and the Kuroshio Current.
- Deep Ocean Currents: Flow vertically and horizontally in the deeper ocean, driven by differences in water density due to temperature and salinity. Known as thermohaline circulation.

1. Surface Currents

Definition

- Surface currents are horizontal movements of ocean water that occur in the upper layer of the ocean, typically within the top 100 meters (330 feet).

Characteristics

- Driven by Wind: Primarily caused by prevailing winds, which push the water and create currents.
- Follow Wind Patterns: Generally move in patterns that correspond to the major wind belts of the Earth (e.g., trade winds, westerlies).
- Coriolis Effect: Deflected by the Earth's rotation, causing currents to turn to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Examples

- Gulf Stream: A warm, swift current that flows from the Gulf of Mexico up the eastern coast of North America.
- Kuroshio Current: A warm current that flows northward along the eastern coast of Japan.
- California Current: A cold current that flows southward along the western coast of North America.
- North Atlantic Drift: An extension of the Gulf Stream that continues to warm the North Atlantic Ocean.

2. Deep Ocean Currents

Definition

- Deep ocean currents are large-scale movements of water that occur below the surface layer, driven by differences in water density rather than wind.

Characteristics

- Driven by Density Differences: Changes in temperature (thermal) and salinity (haline) affect water density, causing denser water to sink and create a global conveyor belt of currents.
- Thermohaline Circulation: The global system of deep ocean currents driven by temperature and salinity gradients.

Examples

- Global Conveyor Belt: A system of deep ocean currents that circulates water around the globe. It involves the sinking of cold, dense water in polar regions and the rising of warmer water in other areas.
- Antarctic Bottom Water (AABW): Cold, dense water formed around Antarctica that sinks and flows along the ocean floor towards the equator.
- North Atlantic Deep Water (NADW): Dense water that forms in the North Atlantic Ocean and sinks, driving part of the global conveyor belt.
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Interaction Between Surface and Deep Currents

- Upwelling: Occurs when deep, cold water rises to the surface, bringing nutrients that support marine life. This can be driven by surface currents or other factors.
- Downwelling: Occurs when surface water sinks into the deeper ocean, which can affect deep ocean currents.

Causes of Ocean Currents

- Wind: Surface currents are primarily driven by wind patterns.
- Earth's Rotation: The Coriolis effect causes currents to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.
- Temperature and Salinity: Differences in water density lead to vertical and horizontal movement in the ocean.
- Tides: Gravitational pull from the moon and sun causes periodic rises and falls in sea level, affecting coastal currents.

Warm Ocean Currents

1. Trade Winds: Push warm surface water from east to west in the tropics.
2. Solar Heating: Direct sunlight heats surface waters in tropical regions.
3. Oceanic Circulation: Warm water moves poleward via gyres and the global conveyor belt.
4. Geographical Features: Coastal topography and ocean basin shape direct warm currents.
5. Atmospheric Interaction: High-pressure systems and weather patterns influence warm water movement.

- Gulf Stream: Flows from the Gulf of Mexico up the eastern coast of North America and into the North Atlantic.
- Kuroshio Current: Flows northward along the eastern coast of Japan.
- Brazil Current: Flows southward along the eastern coast of South America.
- Agulhas Current: Flows southward along the southeastern coast of Africa.
- North Atlantic Drift: An extension of the Gulf Stream that continues into the North Atlantic.
- East Australian Current: Flows southward along the eastern coast of Australia.
- Mediterranean Current: Flows out of the Mediterranean Sea into the Atlantic Ocean near the Gibraltar Strait.
- Alaska Current: Flows southward along the southern coast of Alaska.

Cold Ocean Currents

1. Polar Regions: Cold water from polar regions moves towards the equator.
2. Wind Patterns: Westerlies and other wind patterns push cold water southward or equatorward.
3. Upwelling: Cold, deep water rises to the surface in certain regions, cooling the surface.
4. Oceanic Circulation: Cold water flows from high latitudes towards lower latitudes via global currents.
5. Geographical Features: Ocean basin shape and coastal features influence cold water direction.

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- California Current: Flows southward along the western coast of North America.
- Peru Current (Humboldt Current): Flows northward along the western coast of South America.
- Canary Current: Flows southward along the western coast of the Iberian Peninsula and the Canary Islands.
- Labrador Current: Flows southward from the Arctic region along the coast of Labrador and Newfoundland.
- Antarctic Circumpolar Current: Encircles Antarctica and flows eastward around the continent.