

# Waves, Currents, Tides

## "Motion in the Ocean"

Review the properties of water and include the differences of pressure and the increase of pressure with depth in the ocean – adaptation of animals.

Mt. Everest – 8848 meters – Marianas Trench – 10915m

Magnetic anomalies – switch every ? # years

HANDOUT ON THE OCEAN BASINS, names of oceans and trenches

You are responsible to know the major ocean basins – oceans and seas, continents and plates.(p. 22 and 33 in text).

**Remember:** Solar radiation leads to winds, differences in temperature and salinity.

## Ocean Temperatures –

– Four thermal zones exist for surface waters – Polar, Cold Temperate, Warm Temperate and Tropical.

– Temperatures decrease with increased depth and zone of great difference is called the thermocline and occurs with seasons and thermal zones.

## Waves –

– Are a series of **undulating energy forms** that move through water, water stays in same place except for breaking waves. Wave moves the particles of water in an orbit or a circular motion – current moves water in direction.

– Propagation of waves – start from a transfer of energy – wind and geologic disturbance (landslide, earthquake and volcanoes).

**Wind waves** – develop under wind. Changes in air pressure cause friction on surface producing ripples. Ripples change with velocity and duration of wind blowing – **fetch** – is the distance or span of water over which the wind blows, and for how long it blows.

**Seismic waves or tsunamis** – when seismic activity sends a wave of great wavelength which can become huge (tall) when it ‘feels bottom’ as it arrives in shallow water.

Measurements of a wave –

**Height** –vertical distance from the **trough** to the **crest**

**Wavelength** – horizontal distance from crest to crest

**Period** – time for two successive crests to pass a certain point

**Swells** – when wind waves leave area of fetch or wind velocity decreases and settle into patterns of rounded crests and troughs of similar size.

**Surf** – waves break when the depth of the water is half the period – or distance between crests.

**Surge** – in shallow water when water particle in orbit can't make a circle and circle is compressed into back and forth motion.

Size, direction and frequency of waves affect beaches and the organisms that inhabit them.

**LOCALLY** – heavy northern winter swells, more moderate summer tropical storms.

**WINDS** – driven by solar energy. Patterns of global winds are affected by **heat** rising, the sinking of cold air and the rotation of the earth. Winds are affected by these processes and are most constant at the equator =Trade winds– Easterlies (15 degrees N), then the Westerlies (mid latitudes, W to E) and then the polar easterlies. Net E-W movement of water in tropics, water piles up there, thermocline is depressed as water heats up.

**Coriolis Effect** – Currents flow clockwise in the Northern Hemisphere and counter-clockwise in the Southern Hemisphere due to the **Coriolis Effect**. because of the rotation of the earth, when an object moves horizontally along a horizontal surface it appears to veer right in the north and left in the south. Strongest at the poles and not present at the equator.

**Effect on currents** –Wind blows on water and causes it to move. Due to coriolis effect water moves at an angle to the wind and causes circular motion and gyres (15-45 degrees). **It deflects large-scale motion like winds and currents.**

**CURRENTS** – direction of flow of a body of water. **THEY ARE COMPLEX**  
**Surface currents** –affected by wind patterns, usually penetrate no deeper than 200-300m

**World Ocean Currents** –

- Movement of water by wind: equatorial currents.
- Deflection off land coastal boundary currents Eastern and Western Boundary  
California Current and Gulf stream.
- After water piles up, needs to go somewhere: **counter currents**.

Add the water movement together: great ocean **gyres**. Driven by wind, heat, and displaced water.

**Local current and conditions** – Along the west coast of North America we have the California Current which brings cold waters from the Arctic.  
Coriolis pushes water offshore (west) when NW winds blow, bringing deep water up = upwelling

**El Nino** –and **la Nina** = ENSO: El Nino Southern Oscillation Event (trans pacific linkage of atmospheric pressure systems). Winds and currents pushing West relax, water moves back eastward along the equatorial counter current. This brings warm waters, moisture and rain and introduced organisms to our waters. It also suppresses the upwelling, driving down productivity and creating havoc in our food webs. Similar effect in South America. Opposite effect in W pacific (drought).

Vertical water movements: **sinking** and **upwelling**.

**TIDES** – are a long period wave. Imperceptible in the open ocean and visible at the coast.

caused by **gravitational pull** and **centrifugal force**.  
Tide day is 24hrs and 50 minutes due to time it takes moon to rotate around the earth.

High tide – when the crest reaches the coast

Low tide – when the trough "

Energy for this wave comes from the gravitational attractions – sun and moon

Behavior and magnitude come from:

a.) gravitational attractions

b.) ocean basin topography

SPRING TIDES = During full and new moons – bulge greatest – moon + sun pull together.

NEAP TIDES = During first and third quarter bulge is smaller as it bulges all over earth –  
MOON RULES.

With land masses in the way – tides have to work around the ocean basins.

Semidiurnal tides: 2 highs, 2 lows of equal size every 24 hours and 50 minutes.

Diurnal: One high and one low every 24:50.

Mixed semidiurnal: 2 highs and 2 lows of different size every 24:50.

More terms:

Tidal range – vertical distance between high and low

Tidal amplitude: 1/2 the tidal range

Mean High Tide: Average high tide level

Mean Low Tide: Average low tide level

Ebb and Flood tide : currents associated with tides in estuaries and harbors – ebb=out

Slack tide: occur at the high and low points in estuaries and harbors and are times when there is little water movement in and out of the basin.

### **LOCAL TIDES:**

Mixed Semidiurnal – as is most of the West Coast of the Pacific. Means there are 2 highs and 2 lows per day and associated with and dependant upon the relative position of the sun to the earth and moon.

Range – approximately 6 feet from -2 to +4 feet above and below the mean

Greatest during SPRING when sun –moon – earth are aligned

Least during NEAP – quarters.

### **Tide effects on animals:**

adaptations to dessication, salinity etc

induces rythmicity in animals

breeding and feeding patterns