Topic 4 – The Oceans (pgs. 410 – 430)

70% of the Earth's surface is covered by the Oceans.

The oceans are in constant change. Surface water and water deep down on the bottom of the ocean floor, is constantly moving across the surface of the Earth, affecting climate, and the diversity of life.

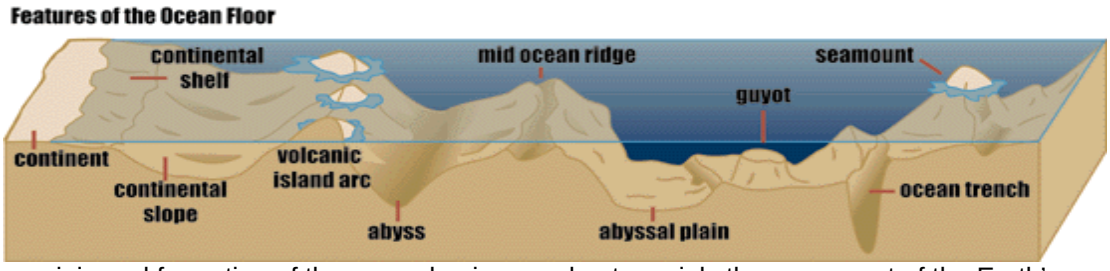
A Sea Full of Salt

Ocean water is salty. 1kg of ocean water contains about 35g of dissolved salts (35ppt). The most common salt is sodium chloride, but other salts are also present. The measure of the amount of salts present in a given amount of a fluid is called **salinity**. The salts end up in the oceans because as water moves across the land, salts are dissolved in the freshwater and then deposited eventually in the ocean. Another source of chemicals in ocean water is volcanoes. The lava and gases that erupt from these volcanoes on the floor of the ocean add more chemicals directly into the water, whereas the volcanic eruptions on land add chemicals into the atmosphere, which are then distributed through the atmosphere, eventually falling back to the Earth with precipitation – landing in the oceans.

Ocean Basins

The oceans form the largest ecosystem on the Earth. Most of the ocean is pitch-black because light can only penetrate about 100m. Scientists have been able to map out the floor of the ocean with sophisticated instruments, so we can 'see' what it is like.

A Journey On The Ocean Floor



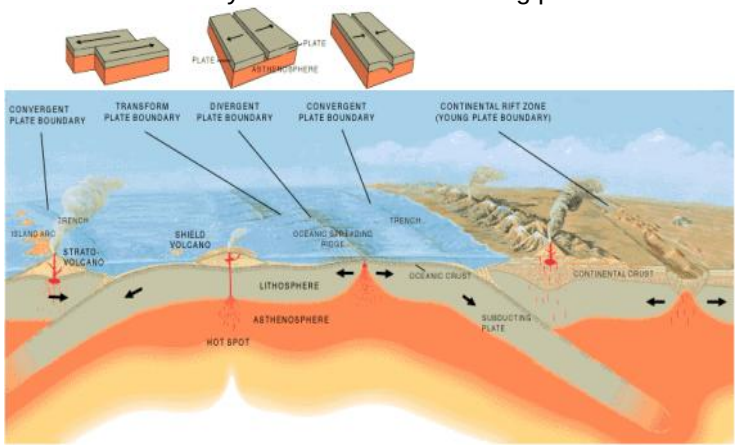
The origin and formation of the ocean basins are due to mainly the movement of the Earth's tectonic plates.

(**Grade 7 – Planet Earth**)

The Theory of Plate Tectonics explains how the **lithosphere** (crust of the Earth) is in pieces and these pieces (*plates*) are moving because of **convection currents** in the **magma**.

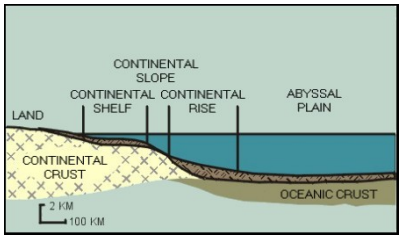
Some of these plates are *moving toward* other plates, some are *moving away* and some are *moving in opposite directions* beside each other.

This illustration shows how features on the ocean floor were formed by the action of the moving plates.



Continental Shelf and Slope

Ocean basins do not begin at the coastline, but many kilometres out at sea.



The **continental shelf** is the submerged part of a continent and stretches out from the coast 30 - 300km or more. These shelves gradually slope away from the land before dropping steeply at the edge of the shelf. From the edge of the shelf, the **continental slope** (usually less than 200km wide) plunges 3km at a steep angle to the ocean floor (**abyssal plain**).

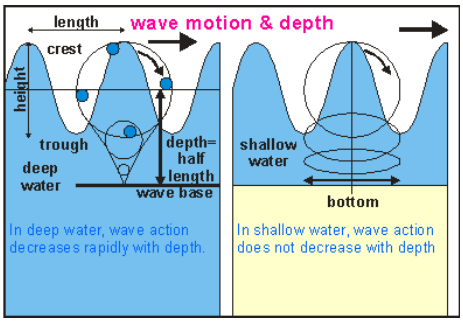
Ocean Waves

Waves are surface movements ***"a disturbance, or variation transferring energy progressively from point to point in a medium"*** occurring whenever a force comes in contact with water. A boat on the surface of the water will cause a **'wash'** or 'wave action' - which can affect other objects in the water, as well as the shoreline.

There are different kinds of waves:
http://members.aol.com/nicholashl/waves/waves.htm

Causes of Water Waves

Most waves are caused by the wind (a force). Stronger forces cause larger waves. As ocean waves move closer to the shore their bottoms drag on the ocean floor and their tops rise and break onto the shore (causing damage by their force).
http://gpc.edu/~pgore/Earth&Space/waves-tides-currents.html



The Movement Of Water Waves

Waves are changes in patterns that move along the water's surface. Although waves can move a very long distance, the water doesn't move - it acts as the medium for the 'wave action' to occur. Within each wave the particles of water move in a circular motion. Waves begin on the open sea. The smooth waves near the shore are caused by winds and storms far out at sea and are called **swells**.
All about waves (animations): http://id.mind.net/~zona/mstm/physics/waves/partsOfAWave/waveParts.htm
Water Waves (dynamics of movement): http://www.fluidmech.net/tutorials/ocean/w_waves.htm

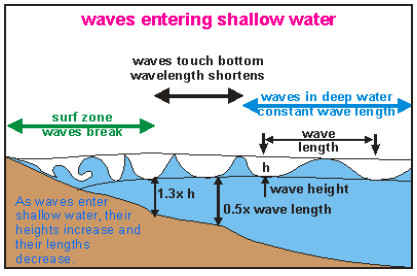
Tsunamis are very large waves caused by undersea earthquakes, seabed slides, or large volcanic eruptions. They occur approx. every 5-15 years but have no definite pattern and cannot be predicted.
http://www.es.flinders.edu.au/~mattom/IntroOc/notes/figures/animations/pngtsunami.gif

Tsunamis means **'harbour wave'** .

Breaking Waves

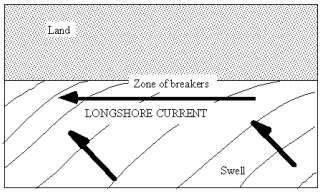
As waves get closer to the shore, the illustration shows what happens. Waves that collapse on the shore are called **breakers**.

Surfers use these forward motions of the crest to ride a wave to shore.



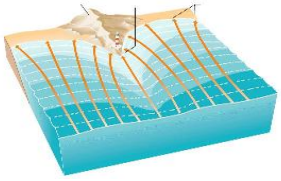
How Waves Change Shorelines

The force of waves crashing against a shoreline can cause changes to the shape of the shoreline, whether it is hard rock or soft rock. Erosion and deposition reshapes the shoreline dramatically. Waves collide with the shoreline at slight angles, creating a **longshore current**, which carries the sediment along the shore, redepositing it on its journey.



Erosion - animation showing the formation of a cliff
http://www.eng.vt.edu/fluids/msc/my_pages/ocean/w_waves.htm

Sea caves and **arches** can be formed by the action of waves eroding rock along the shore

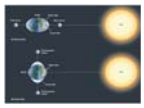


How Beaches Are Formed

The type of rock that the shoreline is made of will determine if it will have a sandy beach or not. Rock fragments eroded along the shore rub against each other and get polished and smoothed into tiny pebbles or grains of sand. If the shoreline is steep and rocky, these fragments of sand get washed back to sea. If the shoreline has a gentle slope, then a beach can be formed by the deposition of these tiny fragments of sand. Most fragments of sand are quartz, but also are made up of an assortment of other minerals, shells and coral. Waves are changing the shores constantly and as a result many beaches have had to have **sea walls**, **breakwaters, jetties** and **barriers** built to prevent the sand from being washed back to sea.

Tides

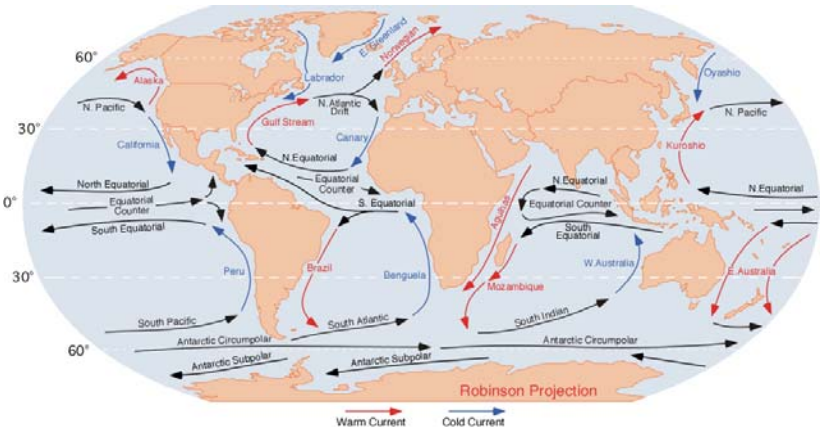
The water level along the coast of continents changes constantly. This water level is called a **tide**. **High tide** is the highest level the water will reach on shore, while **low tide** is the lowest level it will reach onshore. Usually there are two high tides and two low tides each day. The largest tidal movements are **spring tides**, whereas the smallest tidal movements are called **neap tides**. The difference in level between high tides and low tides is called **tidal range**.



(Click on image to see full view)

What Causes Tides? The gravitational force of the moon and the rotation of the Earth on its axis cause tides.
Animation http://www.pbs.org/wgbh/nova/venice/tides.html

Ocean Currents

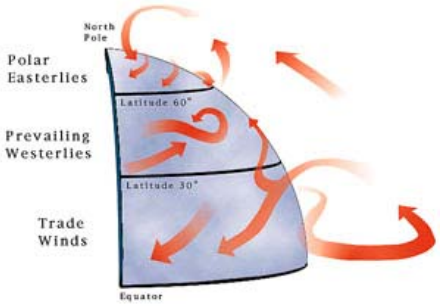


Surface Currents (WINDS)

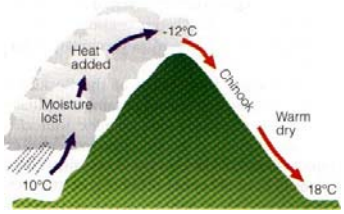
Currents of water are driven by winds. The steady flow of ocean currents results from major wind patterns.

There are three factors that influence the direction of winds and surface currents:

- Uneven heating of the atmosphere (convection)
- Rotation of the Earth (bending)
- The continents (deflecting)

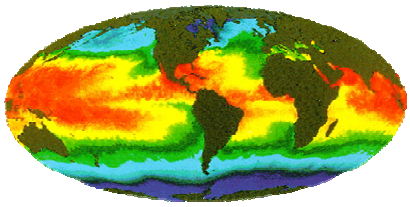


A **Chinook** is a *warm dry* wind crossing the mountains from west to east.

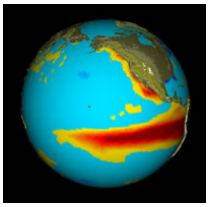


Ocean Temperature and Currents

The temperature of the ocean current not only affects the air temperature, but they also affect the amount of precipitation that an area receives. Almost all of the heat in the ocean comes from the Sun. Temperature varies throughout the ocean, getting much colder as you go deeper.



El Niño



Warm air (warm currents) hold more moisture than cold air (cold currents).

Ocean and Climate

The currents that affect Labrador and Scotland are surface currents. If they start near the equator (like the North Atlantic Current does), they are warm. If they start near the North Pole, they carry very cold water (like the Labrador Current does). When the current flows to their respective shores, they can influence the climate of the land.

Warm and Cold Currents

Warm ocean currents transfer heat to the atmosphere. Water has a very high **heat capacity** – meaning it takes a long time to heat up and a long time to loss heat. Large bodies of water act as heat reservoirs in the winter, remaining relative warmer than the nearby land. This difference in temperature can affect the convection currents producing breezes that can alter the processes of evaporation and condensation near the shoreline. A cold current can do the opposite.

Topic 4 Review
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WRAP-UP p. 431

>>>> A good review of Topics 3 – 4 in this Unit <<<<