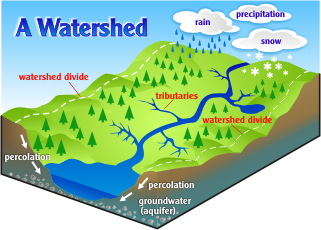
**Earth and Space**

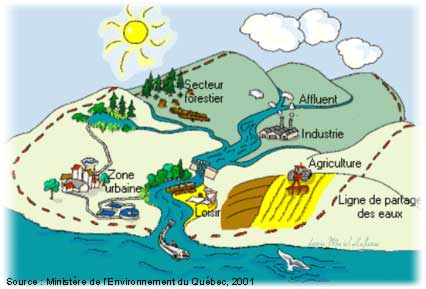
**The Hydrosphere**

* more than 2/3 of earth is covered by water
* underground (liquid), in the atmosphere (gas) and glaciers (solid)
* Earth = the Blue Planet
* the layer of water = the hydrosphere
* S, L and G
* only 2.5 % is freshwater and 79% of that is frozen in glaciers
* freshwater is found on the continents as opposed to the oceans
* fresh water is found in rivers, lakes and groundwater

**Watersheds**

* are **catchment areas** or **drainage basins**
* an area of land whose lakes and rivers all empty into the same larger body of water
* there are natural **boundaries** called watershed **divides**





* the natural slope of the land causes the water to flow in the same direction
* 3 main watersheds in QC: 1) St. Lawrence River

2) Hudson Bay

3) Ungava Bay

**Factors that slow down or speed up water flow in a watershed**

* topography or the shape, slope and terrain
* geology or the type, depth and structure of rock
* climate or the rain or snowfall, winds and temperature
* vegetation or the density and diversity of plant life
* agricultural, industrial and urban development

**Why are Watersheds so important?**

* Humans use the rivers or streams contained in a watershed for drinking water, irrigation, transportation, industry and recreation.
* They provide habitat for plants and animals.
* The rivers drain into lakes and into the ocean.
* They are a beautiful part of the natural world.

**Water Contaminants**

* may be naturally occurring or man-made
* chemical contaminants include nitrogen, bleach, salts, pesticides, metals, toxins produced by bacteria, and human or animal drugs
* biological contaminants are organisms in water--microbes or microbiological contaminants
* find their way into the water supply from different sources
* indirect sources include contaminants that enter the water supply from soils/groundwater systems and from the atmosphere via rain water
* soils and groundwater contain the residue of human agricultural practices (fertilizers, pesticides, etc) and improperly disposed of industrial wastes and waste

**Oceans**

* there are 5 = Pacific, Atlantic, Indian, Arctic and Southern
* seas are closer to coastlines e.g. Mediterranean Sea

``Many people use the terms "**ocean**" and "**sea**" interchangeably when speaking about the **ocean**, but there is a **difference between** the two terms when speaking of geography (the study of the Earth's surface). **Seas** are smaller than **oceans** and are usually located where the land and **ocean** meet.`` Wikipedia

**Factors that influence water T**

**Depth**

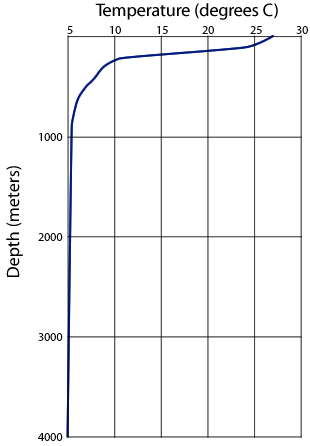
**Seasons**

**Latitude**

**Salinity**

1. **Depth**

* sunlight penetrates and warms the upper layer
* the highest layer is a mixed layer
* the depth varies depending on wind, tides and turbulence
* water T falls rapidly below the **200 m** mark
* the **thermo-cline layer** = 200-1000 m = **transition zone**

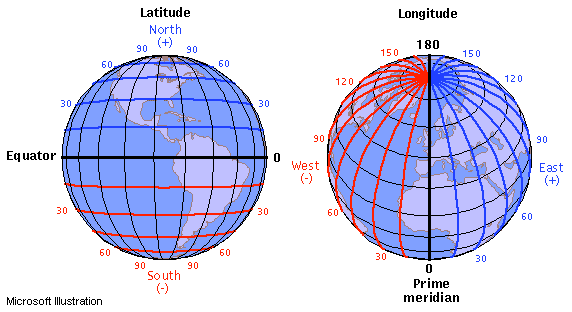


* deep water
* ocean floor

2**. Seasons**

* in the winter the oceans loses some of its heat energy it stored during the summer
* **water** loses heat more slowly than land (**high** specific heat capacity)
* therefore seasonal differences are less pronounced at sea

3. **Latitude**



* at the equator the average temperature is 25 - 28 oC
* in temperate zones i.e. us in Montreal the average temperature is 12-17 oC

4.  **Salinity**

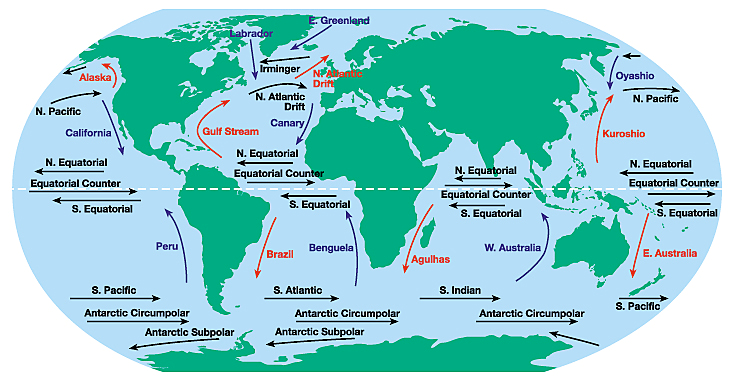
* seawater pounds against the rocks of the lithosphere and dissolves salts
* rivers and groundwater dissolve salts and carry the salt to the ocean
* 3.4 - 3.7 % m/v salinity
* is a measure of the amt of salt dissolved
* at the poles, **melting ice dilutes** it to 3 %
* at the Red Sea evaporation increases concentration to 4 %

**Ocean Circulation**

* water is constantly moving hence we have waves and tides
* ocean current is the movement of seawater in a certain direction
* there are **surface currents** and **subsurface** currents
* ocean circulation is the combined effect of all the currents

**Surface Currents**

* are wind-driven
* move **horizontally** first 400 m below



* Quebecers have the **Gulf Stream = very important for our weather!!!!!!**

**Subsurface Currents**

* at a depth greater than 800 m winds no longer have an effect
* there are variations in density of water layers
* the denser the water the deeper it sinks--below water that is less dense
* **density** varies with **T**
* the colder the more dense \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* there are variations in salinity
* the higher the salinity the more dense \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* salty water tends to sink below less salty water

**Salinity Experiments**

https://www.youtube.com/watch?v=t4kJUmt7rjc

**Experiment 1**

**Experiment 2**

**Thermo-haline Circulation**

* surface and subsurface currents form a “conveyor belt”
* this moves water around the world
* it is responsible for major transfers of heat
* it lessens the difference btw the equator and other locations = yay for us!

**The Cryosphere**

* where water is found as a solid
* pack ice, glaciers, frozen lakes and rivers, snow, ice in permafrost

**Pack Ice**



* Arctic and Antarctica
* huge slabs of ice **on surface** **of the water** and crash into each other
* smaller, free-flowing pieces = **ice floes**
* ice expands and contracts with the seasons
* in the winter = 12 million square kilometers
* signs of weakening because of global warming
* major problem in the summer especially for animals

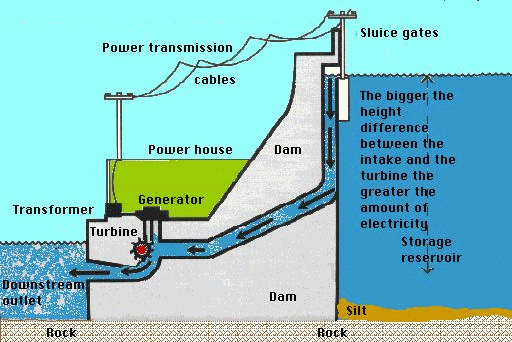
**Glaciers**

* **do not float on water!!!!!!!!!!!!!**
* **they lie on land!!!!!!!!!!!!**
* some on mountain peaks
* Greenland and Antarctica are the most impressive
* large ones are **ice caps and ice sheets**
* they contain **79 % of freshwater**
* snow accumulates on surf of glaciers and compacts to ice
* pieces of ice break off on the sides = **icebergs**
* global warming = melting of ice = slippery around and under glacier therefore less stable
* **ice falling into ocean increases water level**
* sea level locations in danger
* thawing increases freshwater into Norwegian Sea--**mixes** with Gulf Stream
* less saline = less dense = less sinking = slowing of ocean currents therefore climate change

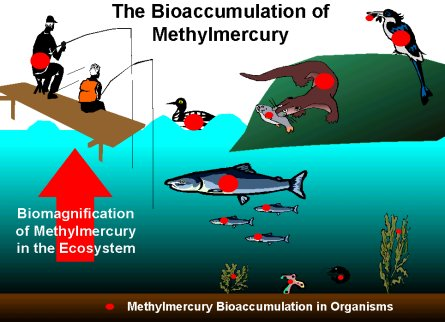
**Energy Resources**

* the force of moving water represents a tremendous source of energy
* hydraulic energy

**Water from Rivers and Waterfalls = Hydroelectricity**



* rate of flow of rivers in QC generates our electrical energy
* a dam is built
* the dam gates are opened
* the water rushes into large pipes that lead to the turbine
* the force of the water spins turbines which are connected to alternators (generators) that convert the mechanical E to electric current
* depends on renewable resources
* impacts environment because
* bioaccumulation of methyl-mercury as it moves through food chains and food webs



**Waves and Ocean Currents**

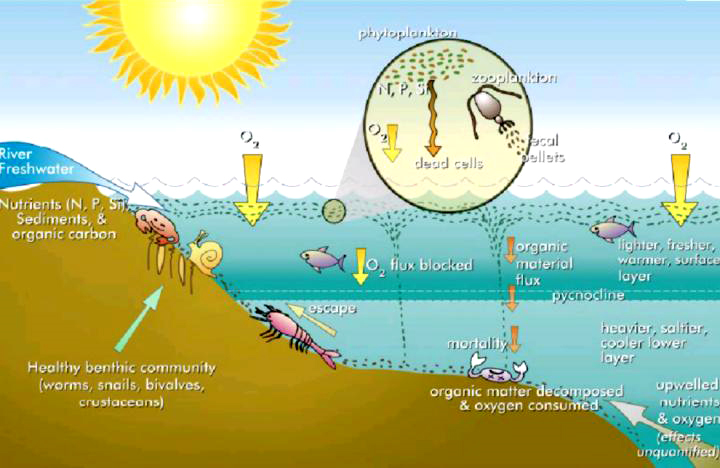
* buoys that rise and fall with waves creating movement that turns turbines
* underwater turbines

**Pollution and Degradation**

* human activities = domestic, industrial, agricultural or navigational
* endangers quality of drinking water, health of ecosystems and beauty
* factories discharge warm water into rivers = raises the T and reducing the concentration of O2 = **thermal pollution**

**Contamination and Eutrophication of Natural Waters**

* different sources of pollution
* point sources -- traced to a well-defined site
* rain is loaded with atmospheric contaminants from factory smokestacks hundreds of km in any direction
* living organisms can degrade certain contaminants and therefore maintain balance
* the health of LOs depends on temperature, oxygenation and chemical composition of the water
* some contaminants are not biodegradable e.g. plastics
* pollution = unbalanced ecosystem
* contaminants accumulate
* the more toxic and concentrated the more harmful
* farming activities = excess fertilizers and pesticides run off into rivers and lakes = increase algae growth = **eutrophication**



E**utrophication**

* excess fertilizer runs off into a water supply
* algae blooms--blocks off sunlight--plants die
* natural waters lose their O2 because of an excessive accumulation of organic matter and nutrients
* dead algae sink to bottom and are decomposed by bacteria
* the bacteria use lots of O2 to decompose the algae

**Threats at Sea**

* approx. 6 million tonnes of petroleum are discharged into oceans every year
* mostly off-shore drilling (only a bit from accidental oil spills)
* oil tankers clean out their reservoirs in the open sea
* hydrocarbons float on the water’s surface and pollute the coastlines
* coat the bodies of marine animals and poisons them
* it can take years for pollutants to decompose