**10.3 – The Effect of Ice on Water Systems**

Background

* **The greenhouse effect**
	+ The atmosphere above Earth consists of many layers of gases that extend upwards for many kilometers.
		- These gases occur naturally and are mostly a mixture of nitrogen and oxygen.
	+ Some of the energy from the Sun (that which is not reflected back into the atmosphere) is absorbed by the Earth.
		- How much is absorbed depends on what is at the surface.
			* Land or Water
			* Dark or Light
				+ E.g: Asphalt pavement is a dark covering
	+ What is not absorbed is reflected back into the atmosphere.
		- Greenhouse effect: Gases in the lower atmosphere can trap this radiation, warming the air in a manner similar to a greenhouse.
			* Without this naturally occurring effect, Earth would be uninhabitable.
				+ Too hot in the day time and too cold in the night time
	+ In addition to nitrogen and oxygen, carbon dioxide and methane are present in lesser amounts in atmospheric gases.
		- Human activities are increasing the concentration of these gases
			* Thus the greenhouse blanket of gases is increasing in concentration
				+ This means that the greenhouse effect is increased and that increases the temperature of the air above Earth.
* **Climate Change**
* Environment Canada defines it as a shift in the average weather that a region experiences.
	+ Scientists measure and monitor a region’s climate by using data from,
		- Temperature
		- Precipitation
		- Storm frequency and duration
		- Wind patterns
	+ When discussing trends in climate change, there are average trends (long term / over several years) and seasonal trends.
		- An example of a seasonal trend could be the change in the amount of precipitation received by an area from one season to the next.
		- However, average trends are what the scientists are concerned with.
			* The impact of these trends can be positive or negative on the ecosystems in a region.
			* There can also be an impact of the economy of a region.

**Useful Information**

* Ice age: Usually misunderstood and misused
	+ Geologists define Ice age as a series of
		- Interglacial Periods - long warming periods when glaciers and ice sheets recede
		- Glacial Periods - when glaciers and ice sheets expand
		- During both periods ice continues to exist at Earth’s poles.
		- We are currently in an interglacial period within the same very long ice age
		- Scientists believe that the last glacial period ended more than 11,000 years ago *(not the last ice age).*
* Many (but not all) scientists today believe that human activities since the mid-1900s have accelerated a warming trend in climate.
	+ Climate Change according to IPCC (International Panel on Climate Change)
		- Rise in sea level during the latter half of the 20th century
		- Changes in wind patterns affecting,
			* Extra tropical storm tracks
			* Temperature patterns
		- Increased temperature of extreme,
			* Hot nights
			* Cold nights
			* Cold days
		- Increased risk of,
			* Heat waves
			* Area affected by drought since 1970s
			* Frequency of heavy precipitation events

**Introduction**

* Scientific evidence states that earth has been created more than 4.5 billion years ago.
* Earth’s climate is constantly changing.
* When Earth’s climate cools, the temperature drops and ice begins to form.
* This results in glaciers and ice sheets growing larger.
* These time periods are called “Glacial Periods”.
* However, the last ice sheet expansion took place about 10 000 years ago.
	+ It hit North America and there are evident signs of glaciation. (p. 298, Fig. 10.21)

**Factors affecting mountain glaciers and ice sheets**

* Glaciers are created when the temperatures are below freezing and snow falls.
	+ If this kind of weather continues, the glaciers continue to grow larger and spread.
* If the temperatures begin to rise, the glaciers will start to shrink.
	+ The snow will turn into rain at high temperature.
* The glaciers that are melting are said to be receding or retreating. (p. 299, Fig. 10.23)
* **Weather’s effects on ice**
* Glaciers regularly go through short periods of shrinking and growing.
	+ Theses rapid changes are caused by normal seasonal difference in weather.
		- Eg. Think of a ski trip that got cancelled in the middle of January because warm or rainy weather melted the snow and ice.
* When unusual weather hits a place for a long while it affects the size of the glaciers in that area.
* **Climate’s effects on ice**
* In a lot of parts of the world glaciers have been receding at a steady state.
* The Arctic ice is also melting fast.
* Scientists blame this on the increase of temperatures.
* Human activities that put more carbon dioxide and other harmful gases into the air are claimed to be part of the reason that temperatures are rising.
* When these gases build up, they get trapped in the earth.
	+ Then the atmosphere heats up.
		- This is called the greenhouse effect.
* None of this is certain, as the Antarctic ice sheet has also been growing in some areas.

**How ice changes affect water systems**

* When mountain glaciers grow bigger in size it means that there is even less water in the world’s oceans, atmosphere and other water systems.
* Scientist say that since nearly a third of the planet was covered in a thick sheet of ice during the last expansion, sea levels were about 100 m lower than they are now.
	+ Laurentide ice sheet covered all of Canada during the last expansion. (p. 300, Fig. 10.24)
* The sea level increases when ice sheets shrink.
	+ This increases the water level and decreases the salinity of the water.