

2.0 Water in its various states affects Earth's landforms and climate.

Water exists in all three forms on the Earth: solid, liquid and gas. It is found underground, on the surface and in the air. Water affects living and non-living things within the Earth's environments.

2.1 Waves and Tides

Waves and tides are just two examples of how water moves on the Earth. Waves are movements on the surface of water. Tides are the regular rising and falling of very large bodies of water.

What Is A Wave?

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>

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.

All about waves (animations): <http://id.mind.net/~zona/mstm/physics/waves/partsOfAWave/waveParts.htm>

Water Waves (dynamics of movement): http://www.eng.vt.edu/fluids/msc/my_pages/ocean/w_waves.htm

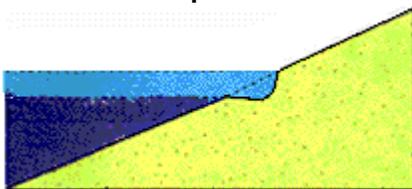
Causes of Water Waves

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).

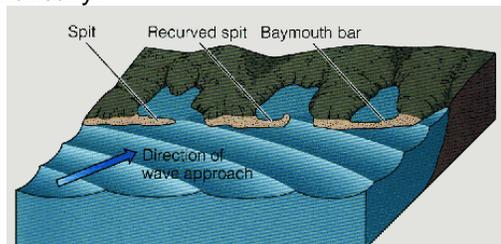
Effects of Waves On Shorelines

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** can reshape the shoreline dramatically.



Erosion – animation showing the formation of a cliff
http://www.fluidmech.net/tutorials/ocean/w_waves.htm



What are Tsunamis? <http://www.es.flinders.edu.au/~mattom/IntroOc/notes/figures/animations/pngtsunami.gif>

When an earthquake occurs on the ocean floor, a huge damaging wave can be created. These waves are called **tsunamis** (which means 'harbour wave').

What are Tides?

The water level along the coast of continents changes constantly. This water level is called a **tide**.

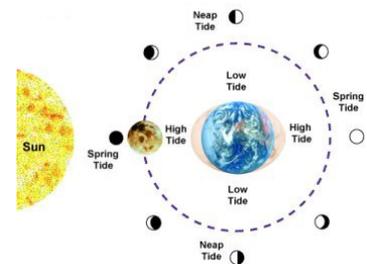
High tide is the highest level the water will reach on shore, while low tide is the lowest level it will reach onshore. Usually there are two high tides and two low tides each day.

What Causes Tides?

The gravitational force of the moon and the rotation of the Earth on its axis cause tides.

Animation

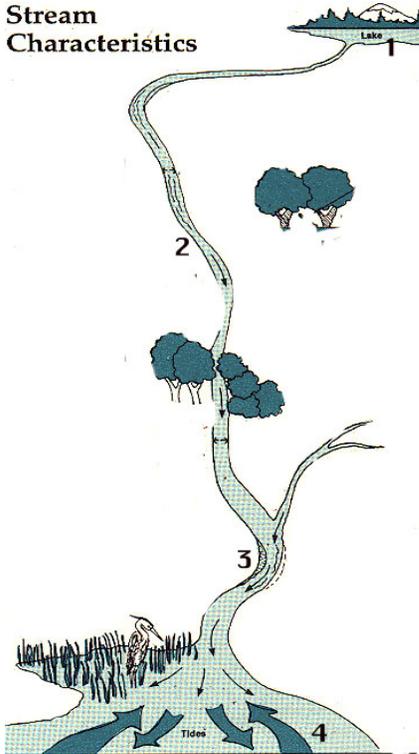
<http://www.pbs.org/wgbh/nova/venice/tides.html>



2.2 Erosion and Deposition

Stream characteristics help scientists understand where different organisms live in a stream and how they might be affected by human activities. Engineers use these characteristics to plan projects such as dams and bridges.

Stream Characteristics



A **stream profile** is a description of its characteristics, including flow rate, steepness of stream's bed, erosion rate of its banks.

The **source** of a river may be high in the mountains, where a glacier is melting. As small streams form together into one **channel**, the volume and speed of the river grows. In the early stages, the river is flowing very quickly and usually fairly straight. As the river reaches lower elevations it begins to slow, causing curves to form (**meanders**), until it reaches a fairly flat **flood plain** and the sediment it has picked up is deposited in a fan-shaped deposit called a **delta**.

Erosion and Deposition

Moving water is a powerful force. When water wears away rock the fragments are carried as sediment and deposited elsewhere. A river's sediment-load is the amount of **water-borne** materials (rock, soil, organic matter) it carries. The faster the river flows, the more water-borne materials it can carry. As it slows these water-borne materials are deposited as sediment.

Topography Website: <http://education.sdsc.edu/optiputer/teachers/shapingtopography.html>

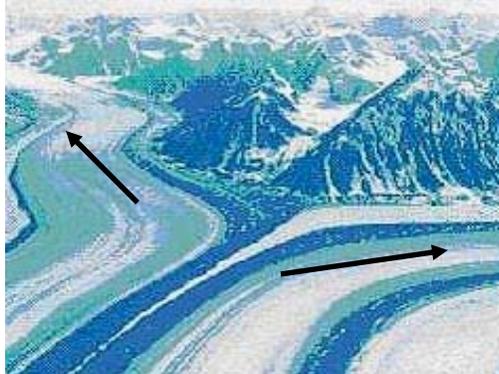
Chemical Weathering

Erosion of the landscape can also occur as a result of chemicals in the water. These chemicals can eat away rock forming caves and sink holes.

What Makes A Watershed?

A watershed is all the area of land that drains into one main lake or river. It can contain many smaller streams, rivers and even lakes, which all eventually drain into a larger lake, sea or ocean. The location of the highest land on the continent determines the direction that a watershed drains. This high land is called the **Continental Divide**. In North America it is in the Rocky Mountains.

On the west side of the divide, the rivers all flow into the Pacific Ocean.



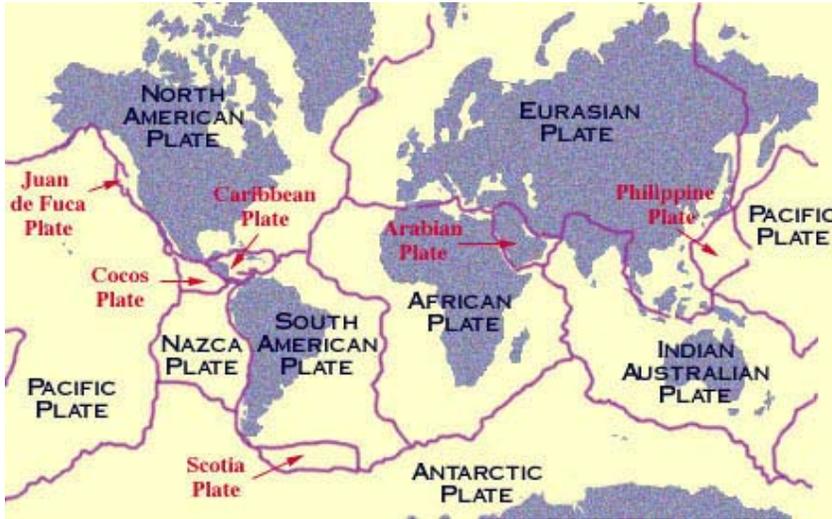
On the East side of the divide, the rivers flow into either the Arctic Ocean or the Atlantic Ocean.

Streams and Drainage Systems: <http://www.tulane.edu/~sanelson/geol111/streams.htm>

2.3 Processes That Shape Ocean Basins and Continental Drainage

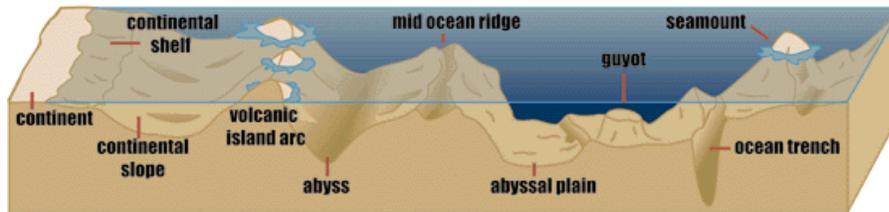
The Earth is in a constant state of change.

Processes That Form Ocean Basins

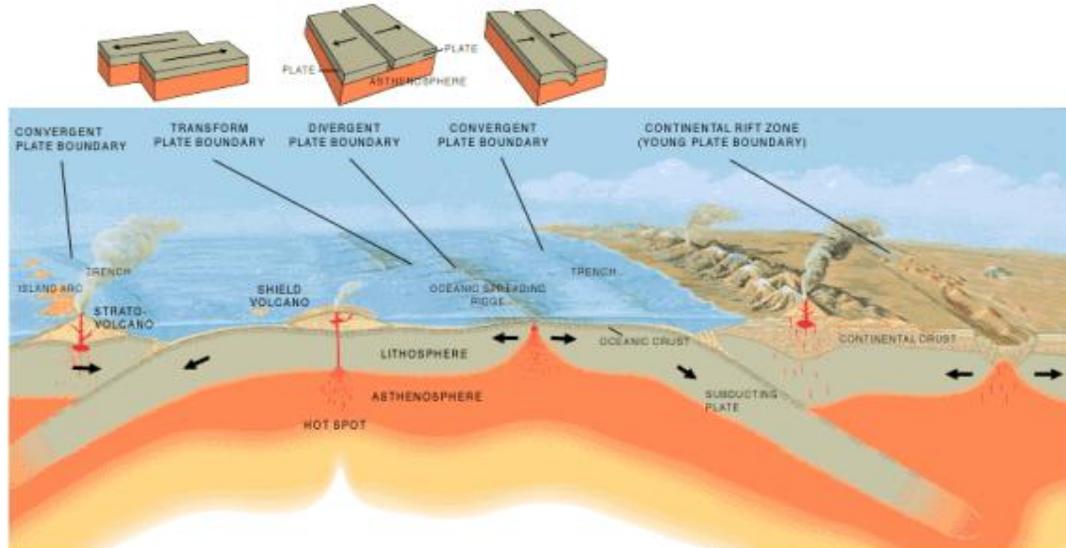


The **Theory of Plate Tectonics** (you learned about in Grade 7) explains how the lithosphere (crust of the Earth) is in pieces and these pieces are moving because of convection currents in the magma. Some of these plates are moving toward other plates, some are moving away and some are moving in opposite directions beside each other.

Features of the Ocean Floor



This illustration shows how the features on the ocean floor are formed.



Continental Drainage Systems

The changing lithosphere affects the drainage patterns of the continents. The Continental Divide marks the division whereby the rivers drain west and east from the divide. Continental drainage systems were also created and are affected by the movement of ice.

Glaciers

Large bodies of moving ice are called **glaciers**.

Those covering large areas of land are called **continental glaciers** or **icecaps**. Continental glaciers cover Antarctica and Greenland. Glaciers also form high in the mountains and move through valleys between mountain peaks. These are called **valley glaciers**. As glaciers move, pieces of rock – embedded in the ice help to shape the landscape by gouging out chunks of the land as the glacier moves.

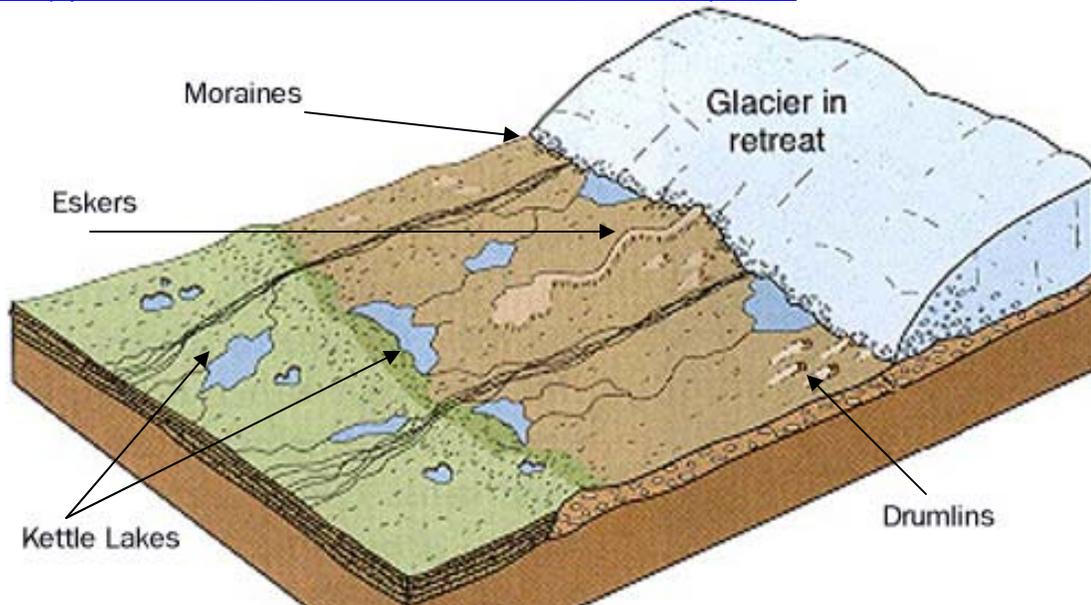
Glacial movement depends on the climate. In colder climates, little melting occurs and the glacier continues to grow or move forward (this is called an **advancing glacier**). If the climate is warmer, the glacier melts faster than it grows and leaves the rocks, soil and large boulders it once contained. These glaciers are called **retreating glaciers**.

As glaciers advance or retreat, they create specific **glacial features** across the landscape.

Both of these sites about **Glaciers** have actual photographs of the features that a glacier creates.

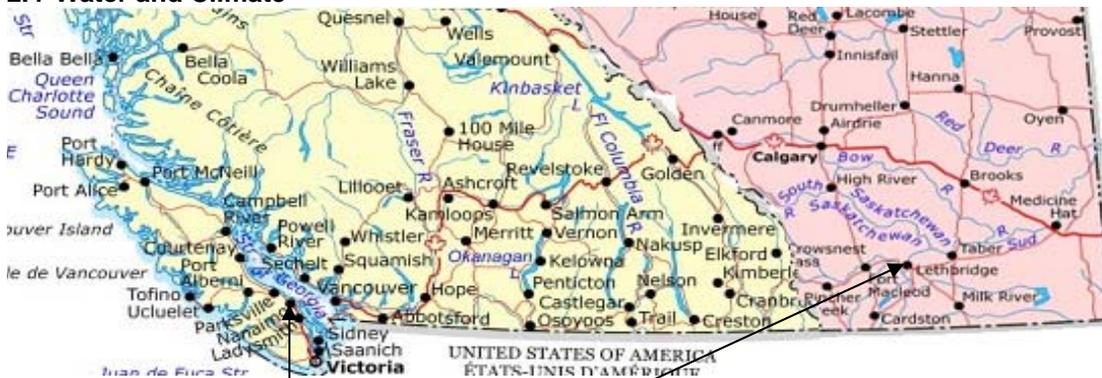
http://www.glacier.rice.edu/land/5_glaciallandforms.html

http://oz.plymouth.edu/~sci_ed/Turski/Courses/Earth_Science/chp5.html



This is another glacial feature, an **erratic** - and can be seen just outside Calgary, near Okotoks, AB.

2.4 Water and Climate



Nanaimo, B.C. and Lethbridge, AB share the same latitude, but their climates are very different. The primary reason for the difference is the fact that Nanaimo, BC is close to the Pacific Ocean, and Lethbridge, AB is not near a large body of water.

Climate

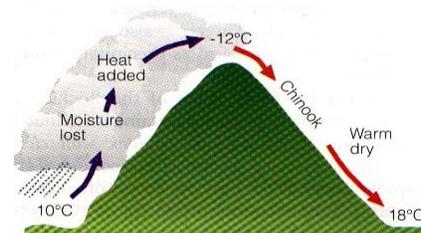
Climate is the average weather measured over a long period of time. The two cities have very different climates.

The Effect Of Large Bodies Of Water On Climate

Large bodies of water, like the ocean and the Great Lakes (in Ontario), influence the weather and the climate in their regions. Water holds the heat longer than most substances and so cities that are close to large bodies of water have warmer climates. The main effect that water has on climate is that *extreme temperatures are less likely to occur in cities near large bodies of water* (Nanaimo), because water heats up and cools down very slowly – whereas in places where there is not very much water (Lethbridge), the land heats up quickly and cools down quickly – and that is where the extremes are felt.

The Rocky Mountains have a major influence on Lethbridge's climate

The **rain shadow** that is created by the Rockies makes the climate very dry in Southern Alberta.



Current Events

Ocean currents can also affect climate. Currents are streams of water that move within a larger body of water. They can be caused by:

- Wind
- Salinity differences in the water
- Temperature differences in the water
- Earth's rotation

Currents and Climate

Currents cause water to move from place to place. Surface currents are caused by steady winds. 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 flow to their respective shores, they can influence the climate of the land.

Ocean Currents and Precipitation

The temperature of the ocean current not only affects the **air temperature**, but they also affect the **amount of precipitation** that an area receives. Warm air (warm currents) hold more moisture than cold air (cold currents).