بسم الله الرحمن الرحيم

In the Name of Allah, the Most Gracious, the Most Merciful

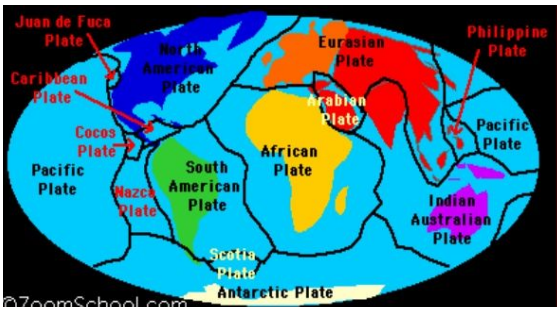
2.1.2 Geologic Era

ERAS	TIME PERIOD (millions of years ago)	MAJOR EVENTS Geological	MAJOR EVENTS Biological
Paleozoic (ancient life)	600 – 225	- Periods of mountain building - The Appalachians formed - Periods when large parts of North America were covered by shallow seas	- Explosion of life Forms—largest diversity of life ever known - Age of fishes - First plants and animals appear on land - Fossils present Mass extinction
Mesozoic (middle life)	225 – 70	- Pangaea—supercontinent that was shaped like a C - hot, tropical climate - dryer than Paleozoic, more deserts than wetlands - lower sea levels= more landmasses to roam	- Age of dinosaurs and reptiles - both plants and animals reached GIANT proportions Mass extinction
Cenozoic (recent life)	65 – now	- Continents move apart - Volcanic activity builds mountains like the Himalayan - By the end of this era, Earth entered an Ice Age	- Age of mammals - LARGE mammals (some birds are 7 feet tall!) - Growth of vegetation- trees, shrubs, grass, flowers Possible mass extinction???

The eras ended due to mass extinction.

2.2 Plate Tectonics

- *Continental Drift to Plate Tectonics Theory by Alfred Wegener:*
  - In 1915, Wegener proposed the idea that all the continents were connected in a protocontinent called Pangaea which occurred 300 million years ago after which it started to drift apart into the places they are right now
  - His four main pieces of evidence were:
    1- the continents fit together perfectly, specifically South America and Africa
    2- fossils match on both sides of the Atlantic
    3- geologically, mountains have the same features on both sides of the Atlantic
    4- ice sheets covered places that are warm today, like India, Africa, and Australia
- *The three types of tectonic movement are*
  - Convergent: when plates come together, with one sliding underneath the other, usually creating mountains
  - Divergent: when plates move apart from each other, pressing downwards, ultimately pressuring the magma upward and out of a volcano
  - Transform: when plates slide next to each other, causing the ground to rumble and create earthquakes



- There are seven major plates of the Earth: African, Antarctic, Eurasian, Indo-Australian, North American, Pacific, and South American
- Fault lines are where two tectonic plates meet. There is one major fault line in Canada, which is on the West Coast. Many earthquakes occur in this area

2.3 The Rock Cycle

- *Key Terms:*
  - The rock cycle: the process of rocks changing over time
  - Erosion: the carrying of rocks away due to rain, freeze, wind, and running water
  - Weathering: the breaking down of rocks
  - Sediment: small pieces of rock, like mud and sand
  - Molten rock: called magma when beneath the Earth's surface; lava when above
- *The three types of rocks are:*

- Igneous: Formed when molten rock cools down and hardens. There are two types of igneous rocks:
  - Intrusive/Plutonic: form when magma enters an underground chamber, cools very slowly, and forms rocks full of crystals below the Earth's surface
    - Example: granite, diorite, and gabbro
  - Extrusive/Volcanic: form when lava cools down quickly at or above the Earth's surface
- Sedimentary: form when rocks erode and crumble little by little. These bits of rock (sediment) end up in streams and flow down from mountains. These sediments settle at the bottom of the river/ocean. Over time, layers of different rocks settle at the bottom of the oceans. New rocks form from these layers of rocks.
  - Example: sandstone
- Metamorphic: rocks that were originally sedimentary or igneous but changed in some way due to the movement of the Earth's crust. When the crust moves, the rocks are squeezed hard, and the heat causes the rock to change. The chemical composition of the rocks does not change from the pressure; however, the mineral structure and physical properties undergo change.
  - Example: gneiss, marble, schist

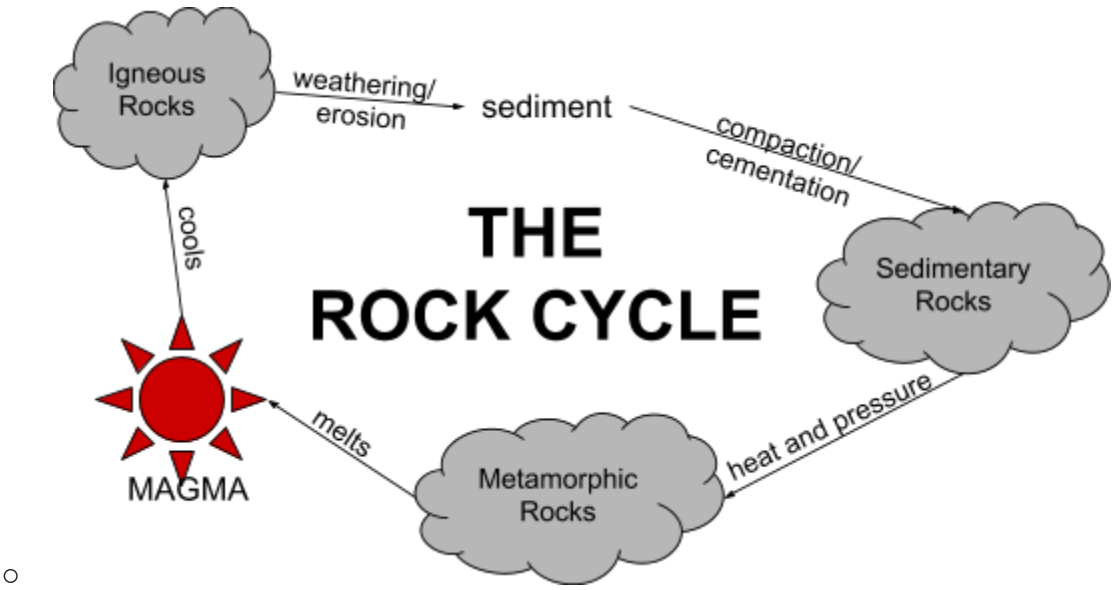
➢ *Rocks are broken down by:*

- Weathering: the breaking down of rocks
- Erosion: the carrying away of rocks due to rain, freezing, wind, and water flow
- Melting: rocks return to the mantle by subduction. Intense pressure → heat = new rock
- Mechanical erosion: the breaking down of rocks by mechanical processes like freezing and thawing, and tree and plant growth

➢ *How weathering and erosion occurs:*

- Acid rain: its when chemicals in the air combine with precipitation.
- Leaching: its when water soaks into the soil, and picks up chemicals
- Wave action: its when waves tumble rocks.
- Fast-moving water: it's when rocks get picked up and carried when water runs swifty.
- Glaciers: its when large sheets of ice pick up large rocks, scrape bedrock Ctrkl
- Precipitation/floods: Heavy rains that can cause floods which move and break rocks.

➢ *The Rock Cycle in a nutshell:*



2.4.2 Glaciation of Canada

- *Key Terms:*
  - Glacier: a massive blob of ice on land
  - Accumulation: gradual gathering ;build up (if melting happens faster than accumulation= glacier appears to retreat)
  - Ablation: melting of the glacier
  - Sublimation:
- *About glaciation:*
  - Glaciation peaked 20 000 years ago
  - Took thousands of years to form
  - They advance=get larger; and retreat=get smaller
  - Thousands of meters thick
  - Changes landscape
  - Used to cover all of Canada except the highest peaks
- *How do glaciers move?*
  - Pressure underneath glacier + gravity = moving of glacier
  - As snow and rain accumulate, the ice moves. The movement of the ice makes it ablate
  - If ablation happens faster than accumulation, the glacier retreats
- *Types of glaciers:*
  - Alpine: movement is mainly due to gravity
    - Examples: Rocky Mountains, Himalayas
  - Continental: movement is mainly due to their own weight

        - Examples: Greenland, Antarctica

➢ *Features of glaciers:*

- U-shaped valley: Glaciers pass through jagged mountain valleys and the ice
- (and rocks embedded in it) make them smooth and u-shaped after ice retreats.
- Striation: Rocks are carried in the bottom of a glacier acting like cutting tools because they carve long grooves in the bedrock as they move. The direction of these grooves show which way the glacier travelled.
- Till: material made up of anything, (whether small rocks or huge boulders)
- Till plain: glaciers carry till and once the ice melts, a layer of till is left behind. It's flat and has rich deep soil which makes it great for farmland.
- Spillway: glaciers have huge amounts of water that flow away and that carves out wide deep valleys. Once the ice melts, a tiny stream is left behind known as a "misfit" stream.
- Moraine: once a glacier retreats, ridges of till left either at the front or sides of a glacier.
- Terminal Moraines: is formed at the front end of the glacier and shows how far it has advanced.
- Drumlin: Egg-shaped hills that usually occur in clusters (groups). SO, streamline forms of Drumlins produced by glaciers move over till; the moulding of the till (boulder clay) forms the egg shape.
- Erratic: A large rock (boulder) which is carried by the ice to a spot where it is dropped.
- Esker: A long curvy ridge of sediments deposited by water flowing under a glacier. Esker marks former beds of meltwater streams and they are discontinuous because streams deposit sediments only in certain places along their course. Let me clarify this
- Eskers are like long ridges made from the flow of water beneath glaciers. They form as the glaciers move.

2.5 Earthquakes

➢ *Key Terms:*

- Fault: a boundary between two continental plates
- Slip fault: plates rubbing against each other sideways (transform)
- Rift fault: plates moving apart from each other (divergent)
- Subducting fault: the sliding of a plate under another plate (convergent)
- Epicenter: the center where the earthquakes are felt
- Focus: the center of where the earthquake happens
- Seismic waves: shock waves from earthquakes

- Richter scale: a scale used to measure the intensity of an earthquake
- Tsunami: a tidal wave due to activity in the water, like earthquakes or volcanoes

➢ *What are earthquakes?*

- Shaking or trembling due to sudden release of energy
- Sometimes associated with the breaking or faulting of rocks
- Occur in places where plates slide against each other (the transform boundary)
- Largest earthquake recorded was 9.5 in Chile in 1960

➢ *Difference between the epicenter and the focus:*

- Focus/Hypocenter: the point WITHIN the Earth where faulting begins (which is the center of where the earthquake happens)
- Epicenter: the point directly ABOVE the focus ON the Earth's surface (which is the center of where the earthquake is felt)

➢ *Where do earthquakes occur & how often?*

- 80% of earthquakes occur in the circum-Pacific belt
- Most happen due to transform and convergent activities
- More than 150 000 earthquakes are felt every year

➢ *Economic & Social Impacts of Earthquakes:*

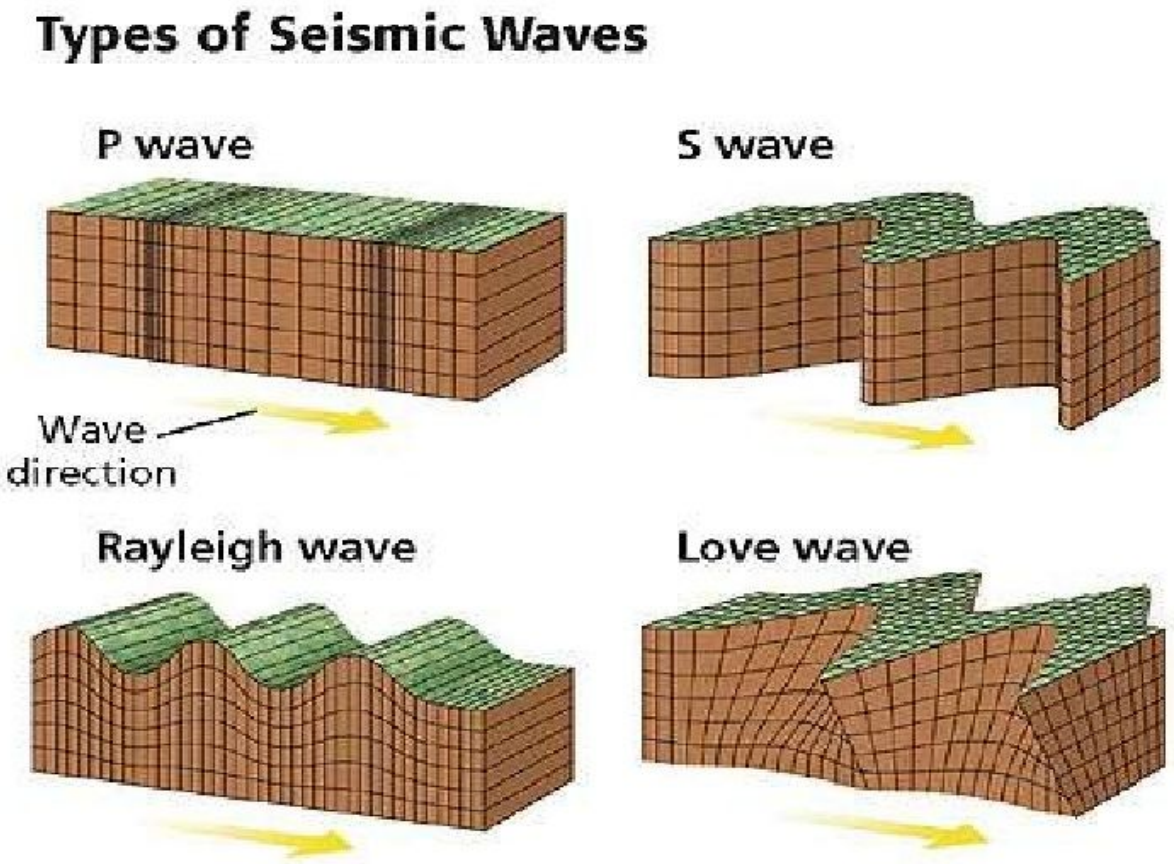
- Collapse of buildings
- Fire
- Tsunami
- Ground failure

➢ *How Are Earthquakes Recorded?*

- Seismographs record earthquakes
- The farther away from the seismograph, the bigger distance between the P and S waves. By locating where the waves begin, we can find the focus
- Earthquake Triangulation: we use triangulation to locate the epicenter. The point where the three circles intersect is the epicenter (like how GPS work)
- Earthquakes are measured based on intensity and magnitude:
  - Intensity:
    - Measures damage done and people's reaction to the earthquake
    - Isoseismal (type of line) show areas with equal intensity
  - Magnitude:
    - The Richter scale measures total energy released by earthquakes
    - Independent of intensity

➢ *Seismic Waves:*

- Seismic waves are energy from earthquakes that travel in waves
- Two types of waves
  - Body waves: move through the Earth's solid body
    - Primary (P-waves): fastest waves, travels through all states of matter, compressive waves; material moves in direction of waves
    - Secondary (S-waves): slower waves, travel through solids only, shear waves; material moves perpendicular to wave movement
  - Surface Waves
    - Raleigh
    - Love



2.6 Volcanoes & Tsunamis

➢ Volcanoes are mountains with openings from which magma, gases, and ash reach the surface of the Earth

- Magma is melted rock BENEATH the Earth's surface; magma AT or ON the surface is called lava
- *How are volcanoes formed?*
  - When magma from the upper mantle reaches the surface
  - Once it reaches the surface, it erupts (it's lava now)
- *Stages of Volcanoes*
  - Active: recently erupted, possibility of erupting soon
  - Dormant: not erupted for long, possibility of erupting in future
  - Extinct: erupted long time ago, no possibility of erupting in future
- *Categories of Volcanoes*
  - Cinder Cone: circular or oval cones, explosive eruptions form cone-shaped hills, most common type
  - Composite: steep-sided, composed of layers of volcanic rocks, high-viscosity lava
  - Shield: bowl/shield-shaped in the middle, long slopes due to basaltic lava flows, *basalt lava flows from these volcanoes are called flood basalts*
- **Tsunamis**: enormous tidal waves caused by disturbances in water like earthquakes and volcanic eruptions
- *How do tsunamis form?*
  - Tsunamis form when underwater earthquakes occur, causing the seafloor to snap upwards, which ultimately lifts water above it. Gravity pulls this water down which creates waves
  - Wavelength: distance between two wave peaks
  - Amplitude: height of waves
  - As waves comes closer to land, the wavelength decreases and the amplitude increases (distance between waves decreases and height of waves increases) which results in HIGH tidal waves

2.8 Climate

- *Key terms:*
  - Weather: Day to day conditions in a given location. (Factors such as temp, wind, direction, etc)
  - Climate: Long term patterns of weather in a given location, averaged over a minimum of 30 years.
- *4 major types of climate in Canada:*
  - Dry: Canada has a few deserts
  - Warm/ Moist: warm and humid summers, mild winters

- Cool/ Moist: Over 70% of canada has this climate, warmest version (humid with warm summers
- Polar: cold and dry climate, permanent ice and tundra are always present, four months of the year have above freezing temperatures

➢ *Factors That Affect Climate (LOWERN/LOWNER)*

- <u>Latitude:</u>
  - The further the location is away from the equator, the colder the climate
  - Countries far away from the equator receive the same amount of the sun's energy as countries near it
  - In countries far from the equator, the sun's rays cover a larger area.
- <u>Ocean Currents:</u>
  - The temperature of the current affects the air because if the current is hot, the air becomes warmer because the warm air rises (it's less dense) and the cold air ----- what
- <u>Wind and Air Mass:</u>
  - An airmass is a large cloud -like body of air and the location of the air mass will determine its characteristic and content. Winds carry these masses of air all over the globe. Air masses formed over oceans impact weather conditions on land. For example, air masses formed over oceans collect moisture and then move on land, where this moisture becomes precipitation.
- <u>Elevation:</u>
  - Higher elevation=colder temperatures since air gets thinner the higher you go
  - Lapse rate=rate at which temperature increases or decreases
- <u>Relief:</u>
  - Mountains act as barriers to the movement of air masses
  - There is more precipitation in elevated areas since the air moves up the side of the mountain and begins to cool which creates rain
- <u>Nearness To Water:</u>
  - Large bodies of water take longer to warm or cool
  - As such, they moderate hot temperatures in the summer and cold temperatures in winter

➢ Greenhouse Gases:

- Gases in the air like carbon dioxide, water vapour, and methane
- The atmosphere needs these gases since it regulates temperatures

- Excessive emissions of greenhouse gases means that more heat is trapped and temperatures increase, thus resulting in CLIMATE CHANGE
- Human activities (like excessive use of fossil fuels and deforestation) plus greenhouse gases= global warming
- Solution: Minimize carbon sources and use alternative energy like wind power, hydroelectric power, solar power
- Carbon Sinks: any reservoir that holds the carbon emitted into the atmosphere like trees, ocean water, and plants/algae. Most important carbon sinks are ocean and plant life. Prevent pollution which affects phytoplankton.

2.11 Soil and Vegetation

➢ Soil: The surface layer of earth composed of minerals, air, moisture, bacteria and organic waste.

➢ Soil formation factors:

- Leaching is a recurring problem in soil.
- This means the downward movement of water in the soil that dissolves its chemical nutrients and brings crucial minerals down.

➢ **Calcification**

A problem where the evaporation of moisture brings up chemical nutrients and minerals from below to then create a rich topsoil.

This is a problem as to much of nutrients and minerals is poisonous for plants

- **Minerals**:
  - minerals are composed from parent material(the original larger size of rocks that the minerals descends from.)
  - These minerals are a crucial component of soil as it adds essentials for plants. Such as calcium and potassium.
  - Minerals also trap on the moisture of soil.
- **Air**: air is a crucial component of soil as all vegetation requires air around the roots. This air lies between soil particles and is also in the tunnels made by insects like worms.
- **Moisture**: Water is important to soil as it, dissolves chemical nutrients and erodes the rocks needed in soil. It also helps further decompose organic matter.
- **Bacteria and organic material**: Needed as the when bacteria decomposes the organic material, they release a standard nutrient rich substance
  - Humus(the dark nutrient filled substance that gives soil its fertile colour.)
- Without one of these components, a substance is not soil.

Vegetation:

Natural vegetation is vegetation that does not require and is not disturbed by human maintenance.

There are 7 main natural vegetation here in Canada

- **It's important to know that the more south we go the more warmer, and more moist it gets(more precipitation)**

Tundra

- Polar climate
- Dry and cold area of mostly land
- Snow, ice and permafrost is present
- The active layer(top layer) of permafrost does melt in the short summer
- Sparse vegetation such as shrubs,molasses and short almost dead grass

Boreal and Taiga Forest (practically the same but taiga Forest comes first)

- The taiga Forest is south of the tundra so there's a slight change of temperature slightly more warm
- This allows the growth of coniferous trees(evergreens)
- **Special thing about coniferous trees**
    - **They're sap is like antifreeze**
    - **Their waxy needles and thick bark trap in moisture**
    - **Needles photosynthesize when there are sunny days**
    - **The flexible needles and branches shed off snow**
    - **The long deep roots reach the sparse amount of nutrients that lie deep below**
    - **Acidic needles**
- Due to the fact that the majority of the two forests have coniferous trees, the soil is acidic and leaching is also recurrent

Mixed Forest

- South of the Boreal forest in Eastern Canada
- Consists of coniferous and deciduous trees
- Used for the lumbering industry
- Is a transition zone from the boreal forest to the deciduous forest
- Fertile soil suitable for farming→ humus is created from all the leaves

Deciduous Forest:

- Composed mainly of deciduous trees like aspen and spruce trees
- Due to which the soil is rich in nutrients and organic nutrients (decomposition of leaves equals organic nutrients or humus)
- Lots of precipitation
- This make the soil fertile and rich

- For this reason several areas is being taken for agricultural and urban resource

Grassland

- Mainly in the Prairies (Saskatchewan, Manitoba, Alberta)
- Climate is dry for most plants to live
- Examples of vegetation is there are shrubs, cactuses and short of long grass
- Important to note that because the place is so dry, the grass heads are dead but the roots are alive
- Land used mainly for grazing animals like cattle
- The long grass is good for growing grains and oil seeds
- Rich black soil created from humus (from ze dead grass)

Cordillera Vegetation:

- Vegetation varies, it changes with altitude.
- Temperature are warmer in the valleys than in mountain
- Grasses and cactuses grow in the dry, hot valleys and soils are similar to the prairie grasslands
- Forests of coniferous trees grow on longer slopes
- The vegetation on the higher slopes of the mountain ranges is similar to the tundra

West Coast Forest:

- West coast of Canada grow lush forests of Douglas Fir, Spruce, red cedar, and western hemlock
- Heavy rainfall and mild climate provide excellent growing conditions
- Trees have played a crucial role in B.C forest industry
- The lush vegetation provides a lot of plant materials to make humus.