

# Lecture 7

Earth Science

# Earth Systems

**Atmosphere:** mixture of gases surrounding Earth

**Hydrosphere:** Earth's oceans, lakes, rivers, ice

**Lithosphere:** solid rocky outer layer of Earth

**Biosphere:** living things on Earth

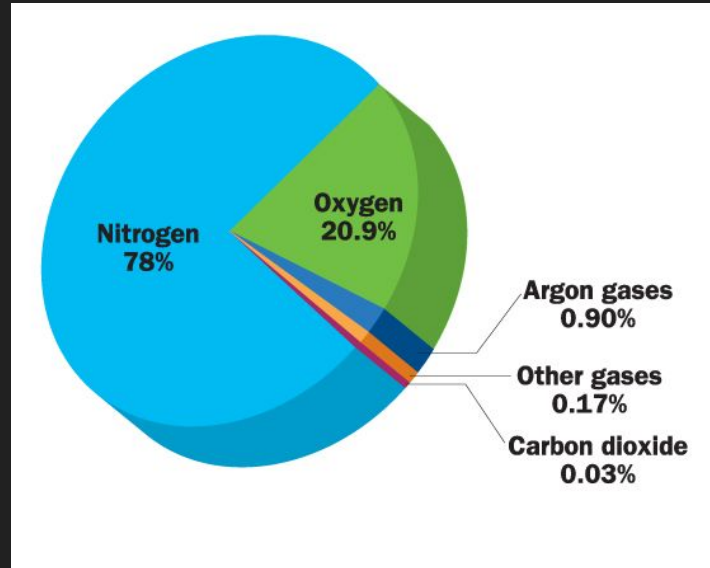


Atmosphere/Hydrosphere

# Atmosphere

Envelope of gases that surrounds Earth

## Composition of Gases



# Layers of Atmosphere

## 4 Main Layers

**Troposphere:** Sea Level to 12 Km - Weather

**Stratosphere:** 12-50 Km - Ozone layer - Jets

**Mesosphere:** 50-80 Km - Meteoroids burn

**Thermosphere:** Above 80 Km

**Ionosphere:** Radio Waves, Aurora Borealis

**Exosphere:** Satellites orbit



# Weather

Refers to the temperature, humidity, air pressure, cloudiness and rainfall at any given time

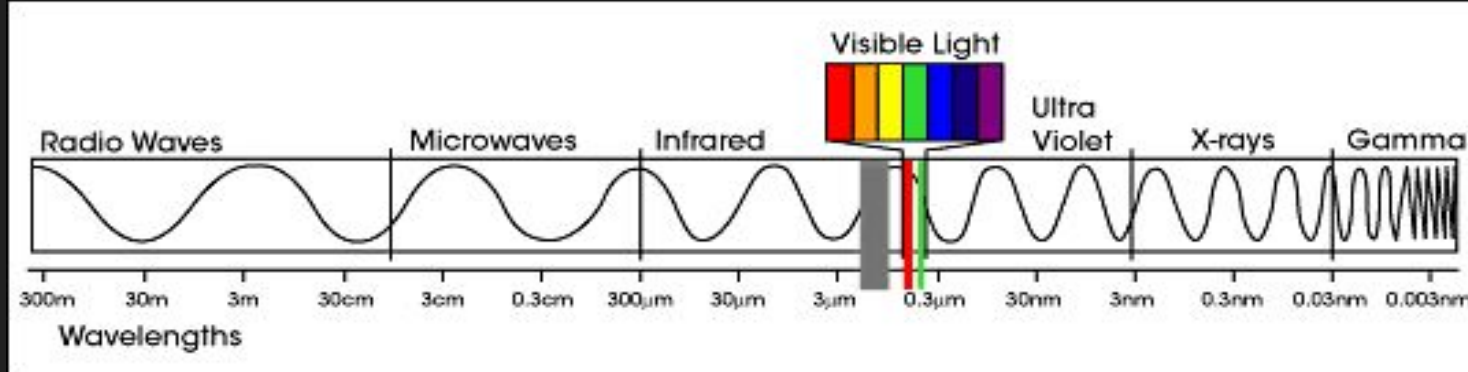
**Climate:** summary of weather conditions over a period of years

**Meteorology:** study of weather and weather patterns

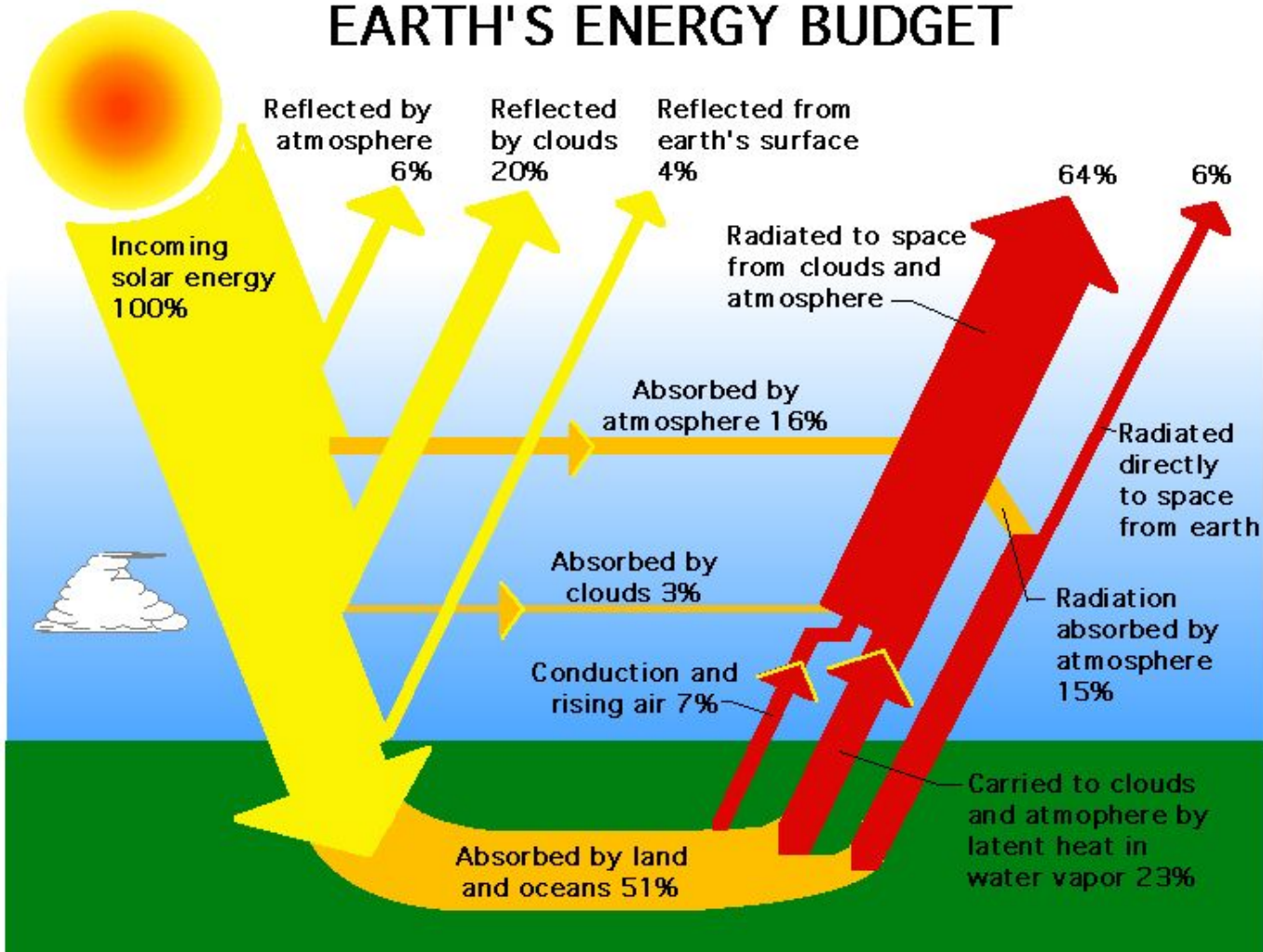
# Energy In the Atmosphere

Energy travels to Earth as electromagnetic radiation from the Sun, most is reflected back from Earth's surface

99 % of solar radiation is UV, visible light and Infrared radiation



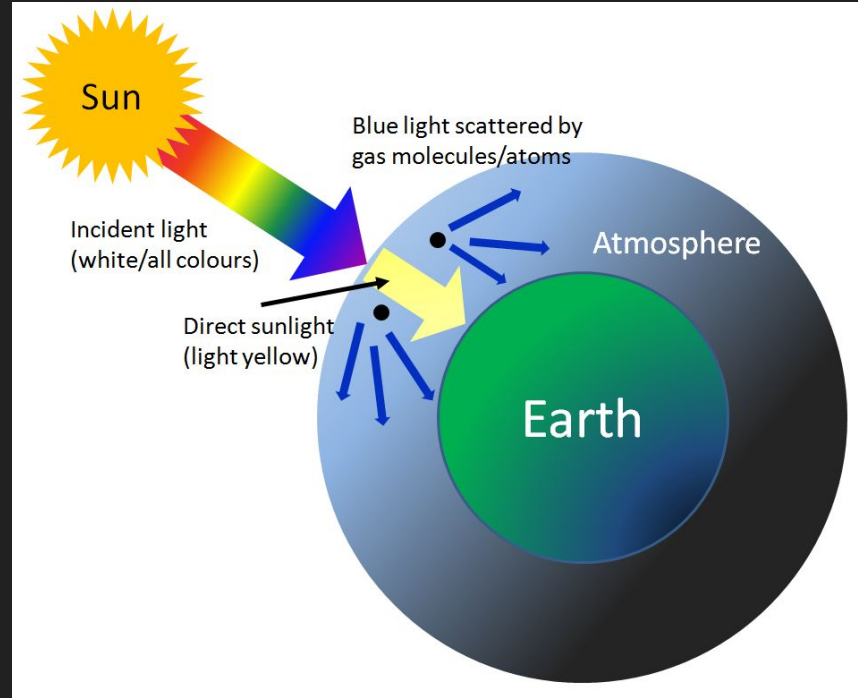
# EARTH'S ENERGY BUDGET





# Why is the sky blue?

As visible light passes through our atmosphere it is reflected and scattered by the particles and gases in the the atmosphere. The reflected wavelength is blue.



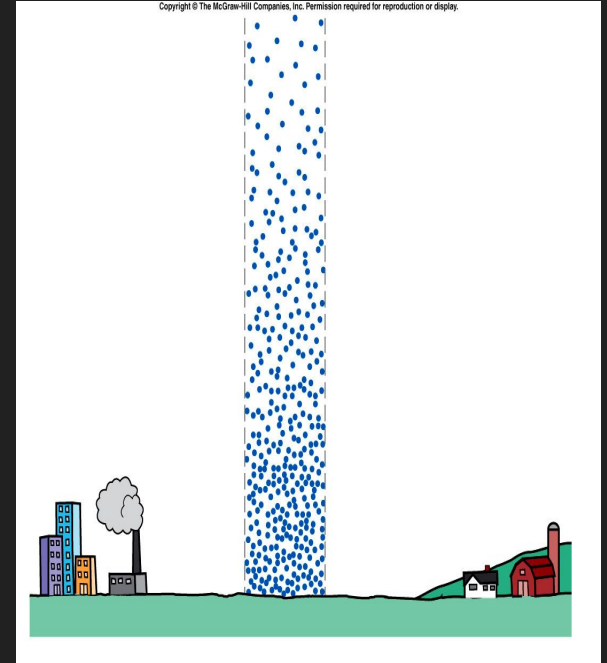
# Practice

- 1) What are the 4 systems of Earth?
- 2) What is the atmosphere? What are the 2 main gases?
- 3) What layer of atmosphere do we live in?
- 4) Where does the Earth get its energy?
- 5) Why is the sky blue?

# Air Pressure

**Weight of column of air pushing down on area**

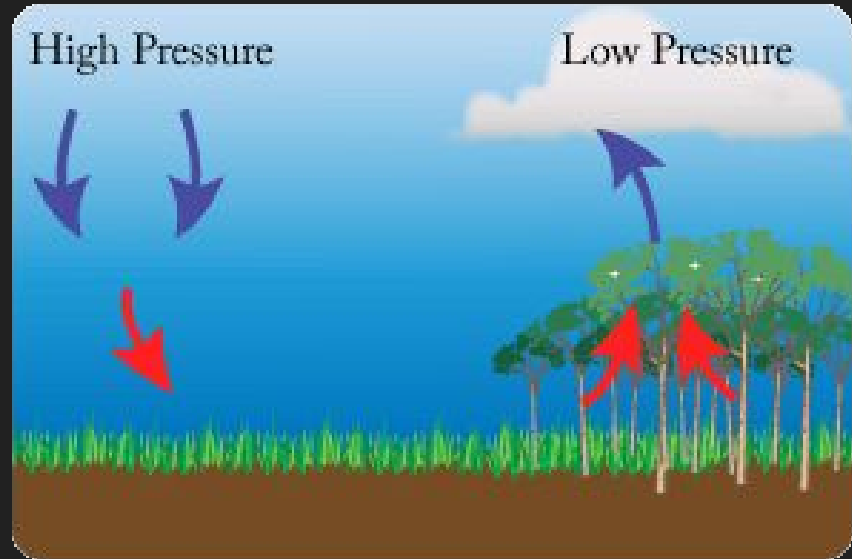
As altitude increases, air pressure decreases



# Wind

Movement of air from high pressure to low pressure.....Convection Current!

As warm air rises, the air pressure close to Earth's surface decreases.  
When cool air sinks, air pressure close to Earth increases.

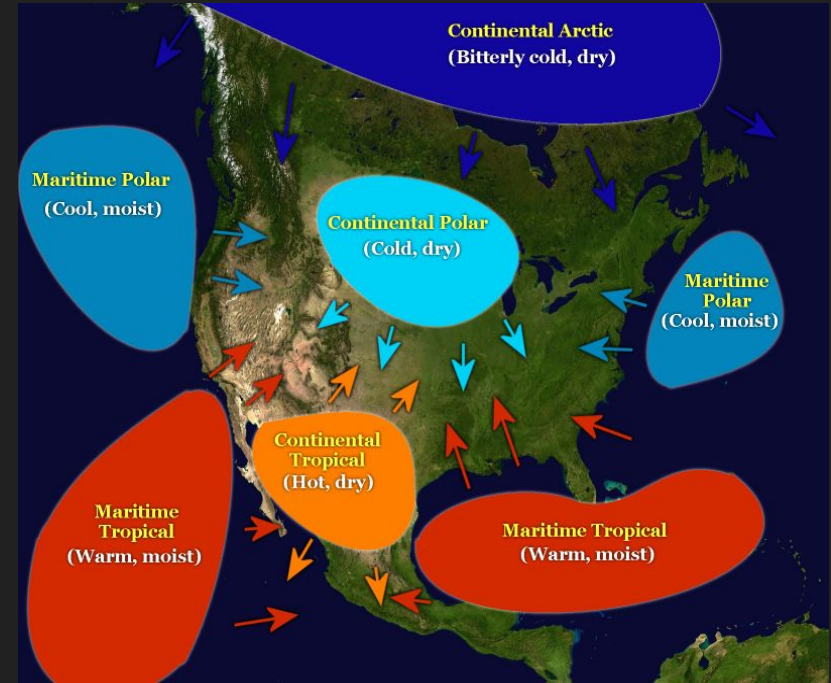


# Air Masses

**Large Isolated bodies of air that have consistent characteristics such as temperature and humidity**

Get their characteristics from the surface over which they develop

Weather prediction in US depends largely on following the movement of air masses



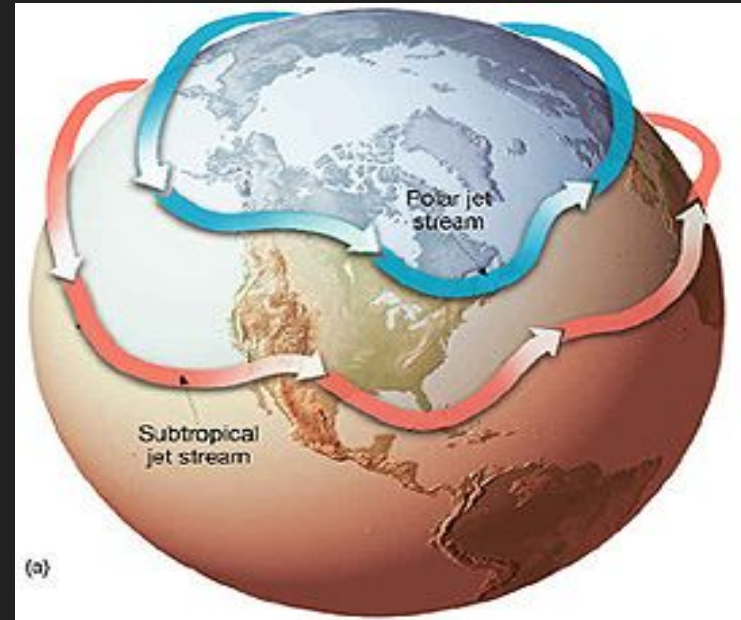
# How Air Masses Move

**Jet streams**- narrow, strong band of continuous air currents encircling the globe several miles above earth.

Travel in a snake like fashion from west to east

2-3 jetstreams in each hemisphere.

Also by winds called **Westerlies** and **Trade Winds**

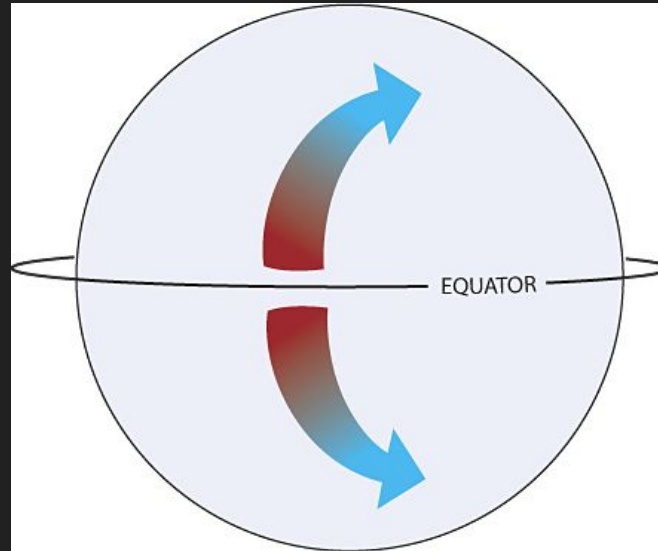


# Coriolis Effect

**Because Earth rotates, wind doesn't follow a straight path**

**Northern Hemisphere:** wind curves to the right

**Southern Hemisphere:** wind curves to the left



# Practice

- 1) What is air pressure?
- 2) What cause wind?
- 3) What is an air mass?
- 4) How do air masses move?
- 5) What is the Coriolis Effect?



# Humidity

## Amount of water vapor in the air

Warm air can hold more water vapor

**Saturation:** the maximum amount of water vapor the air can hold

**Dew point:** temperature at which the air can no longer hold all water vapor, Condensation happens



# Clouds

When air reaches its dew point, water vapor condenses to form water droplets. These small droplets come together to form larger droplets that form clouds.

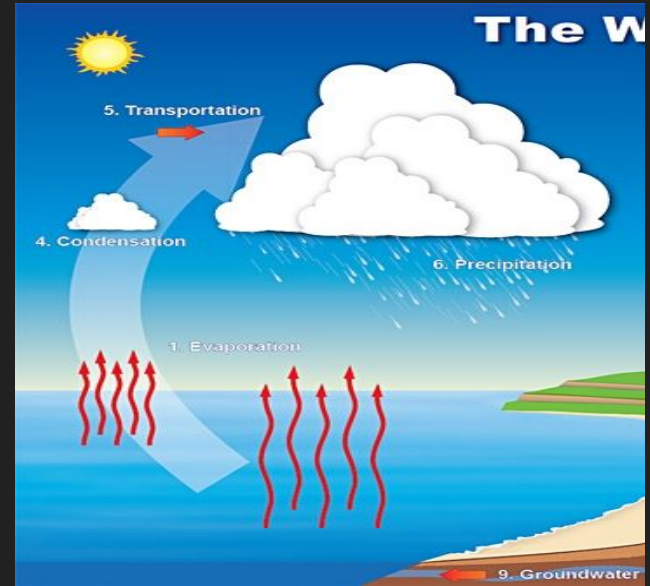
When clouds form close to earth = **Fog**

**Seeding:** Silver Iodide

Crystal structure mimics ice

Water attaches, condenses, rains

Only works if clouds are present



# 3 Types of Clouds

**Cirrus**



High  
Wispy

**Cumulus**



Low  
Fluffy

**Stratus**



Flat  
Signal Rain

# Precipitation

**Rain:** most common form of precipitation. Air cools, water vapor condenses, clouds can't hold the liquid, rain

**Hail:** formed when layers of ice are formed around a small piece of ice the keeps getting blown back into the cloud

**Snow:** water vapor converted directly into ice crystals



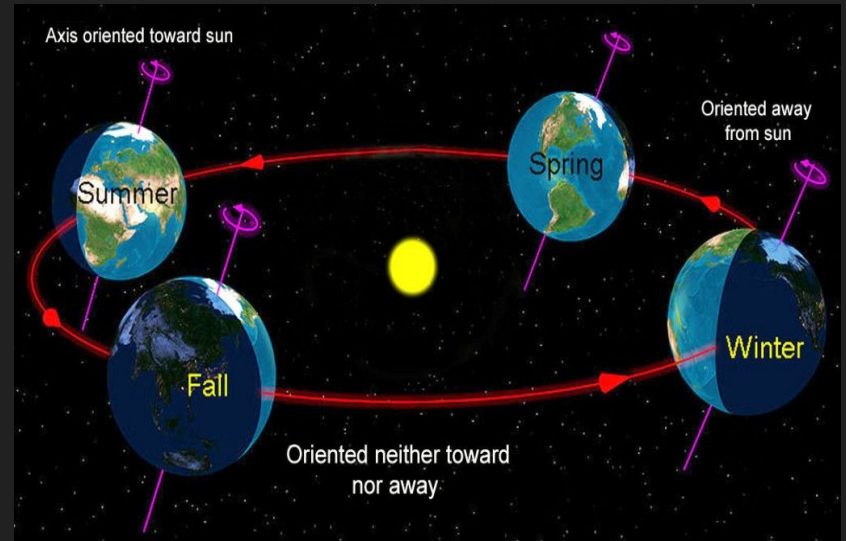
# Seasons

Changes in the amount of solar radiation received at different latitudes during different times of the year due to the tilt of Earth's axis

Tilt- 23.5 degrees

One hemisphere receives more direct sunlight than the other

Light arriving at angle delivers less energy than perpendicular beam

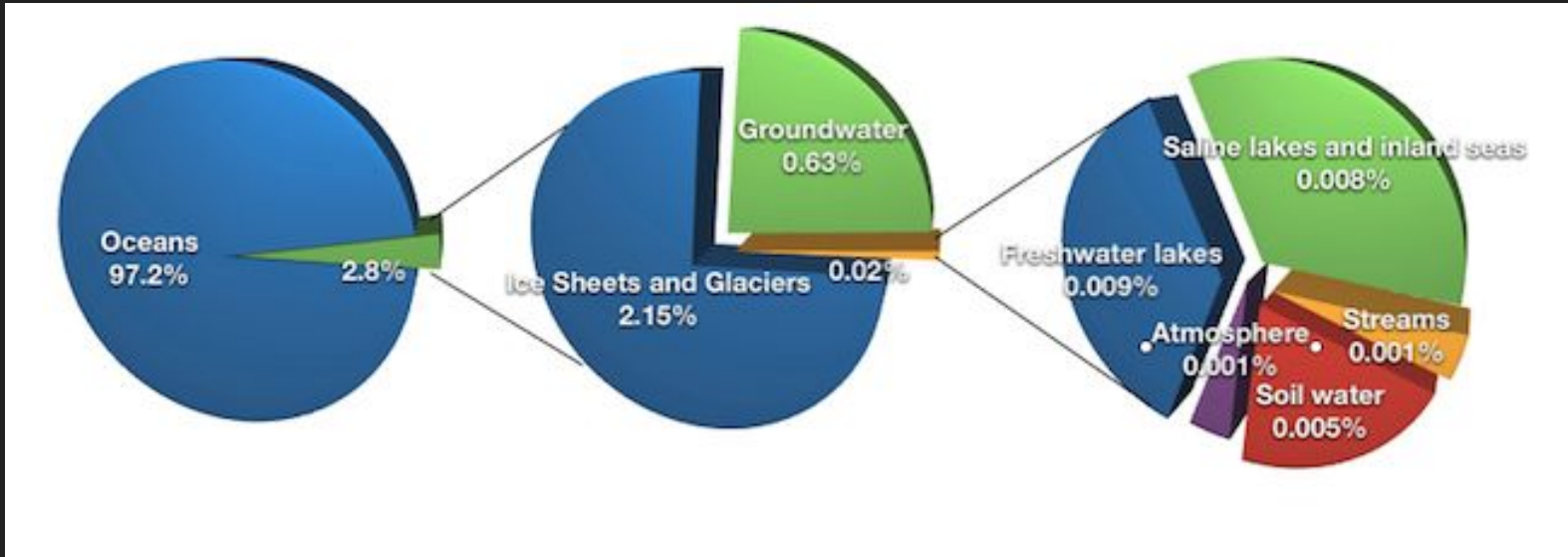


# Practice

- 1) What is humidity?
- 2) How do clouds form?
- 3) What is fog?
- 4) What are the 3 main types of clouds?
- 5) Why does it rain?
- 6) What causes seasons?

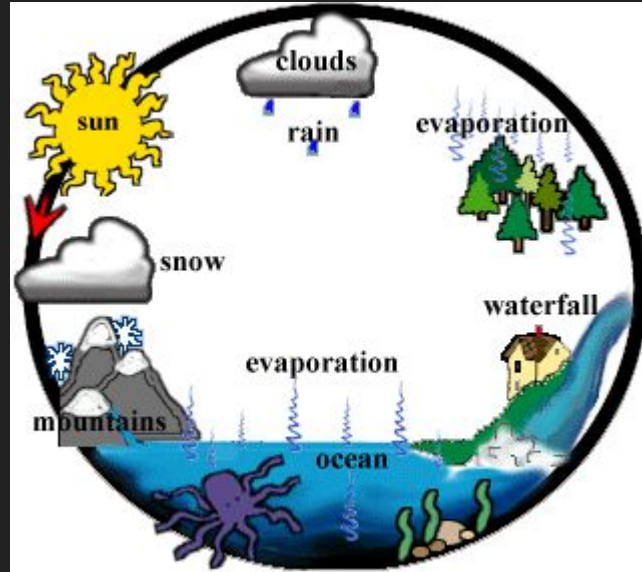
# Hydrosphere

Over 70% of the Earth's surface is covered by the ocean and seas



# The Water Cycle

Evaporation



Condensation



Runoff

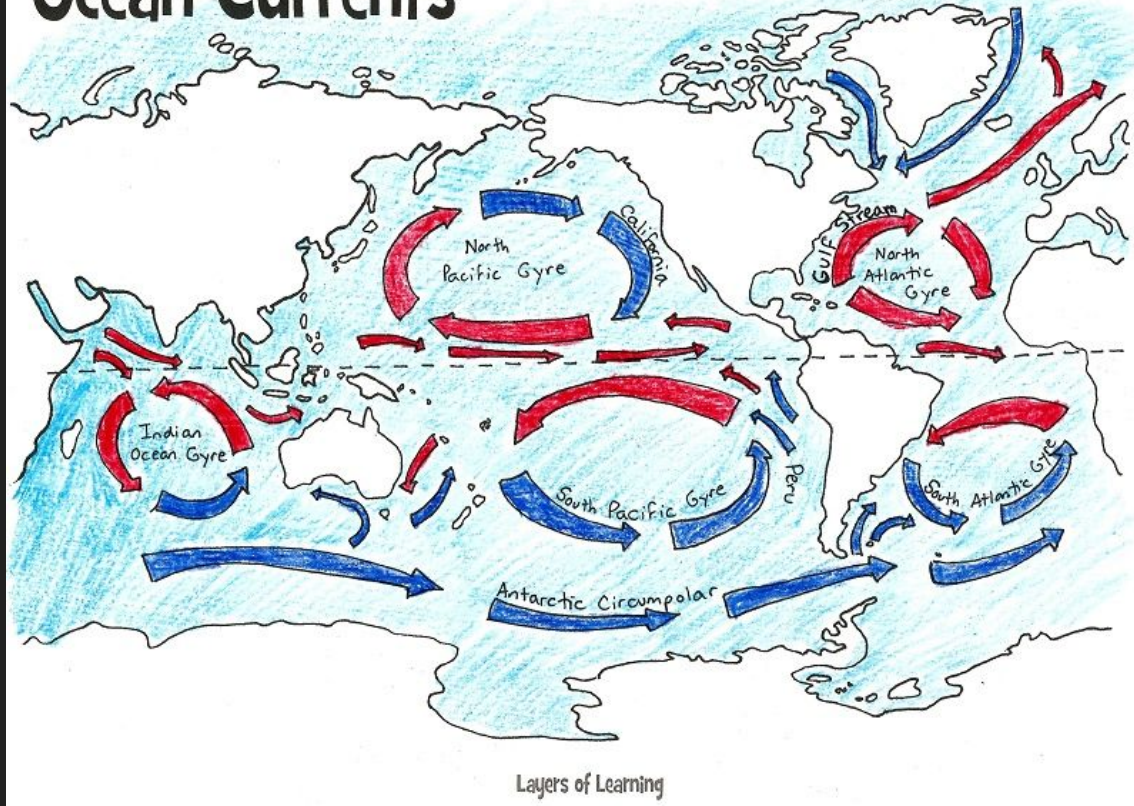


Precipitation





# Ocean Currents



Oceans Currents transport water, nutrients, animals, plants and even ships from place to place

**Gyre:** wind driven ocean currents

Oceans are great reservoirs of heat and currents move that heat around the globe

# Practice

What is a hydrosphere?

What are the steps of the water cycle?

Where is most of Earth's water found?

What is a gyre?

What do ocean currents do?

# Evolution of Earth

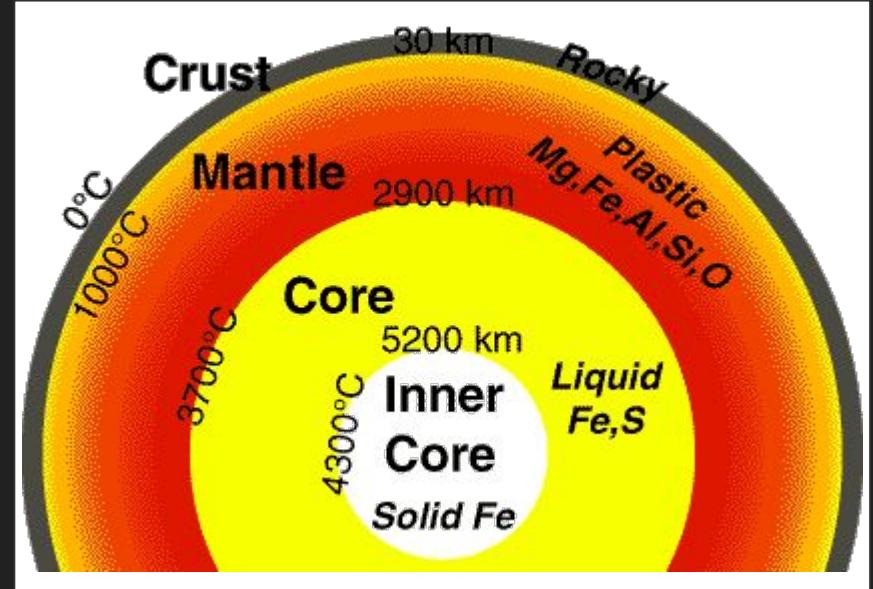
# Earth's Layers

**Crust** - thin rocky layer

**Mantle**- solid, molten nearest the core  
“Plastic”- partly melted rock that flows

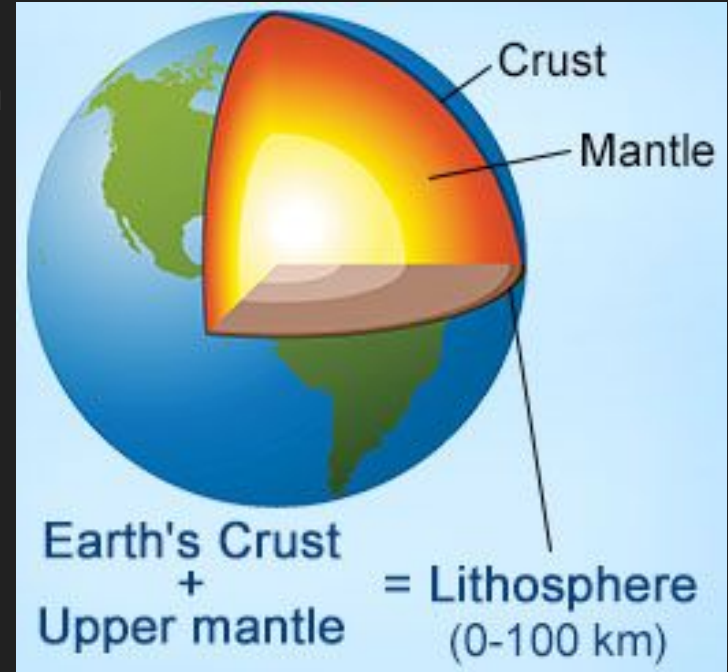
**Outer Core**- mostly iron, liquid

**Inner Core** - solid, iron

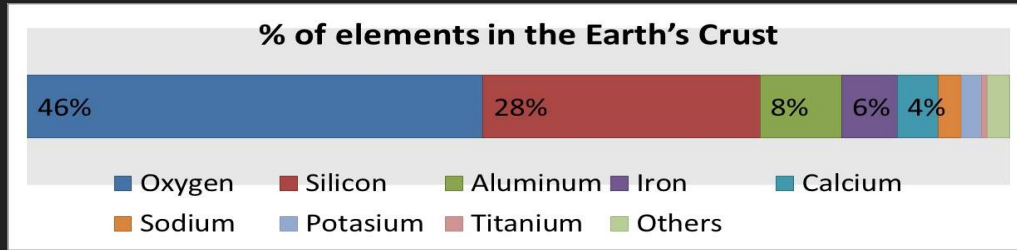


# Lithosphere

Crust and the outermost part of the mantle  
Make up a shell of hard rock mostly 50- 100 km  
thick.

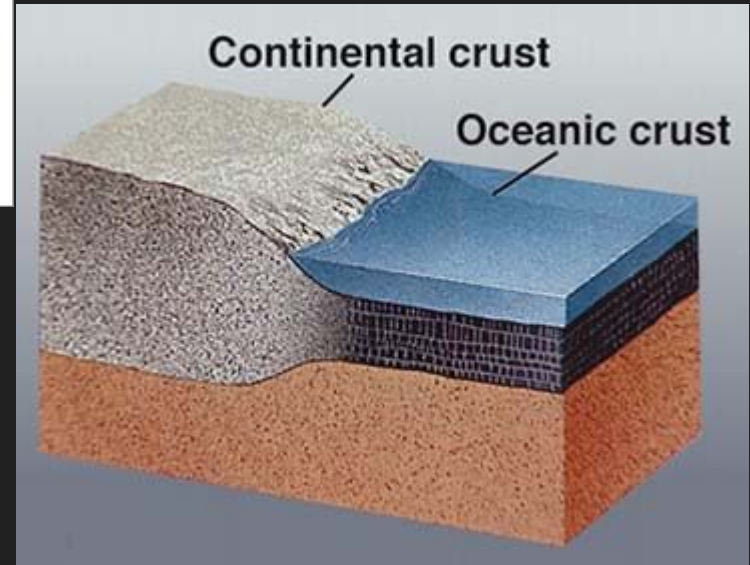


# Earth's Crust



**Oceanic Crust** is made of igneous rock called Basalt, under that, is Gabbro. Thinner and denser than Continental crust

**Continental Crust** is made of an igneous rock resembling granite



# Minerals

Substances of which rocks are composed. They have a crystal structure and a definite chemical composition



Quartz



Mica

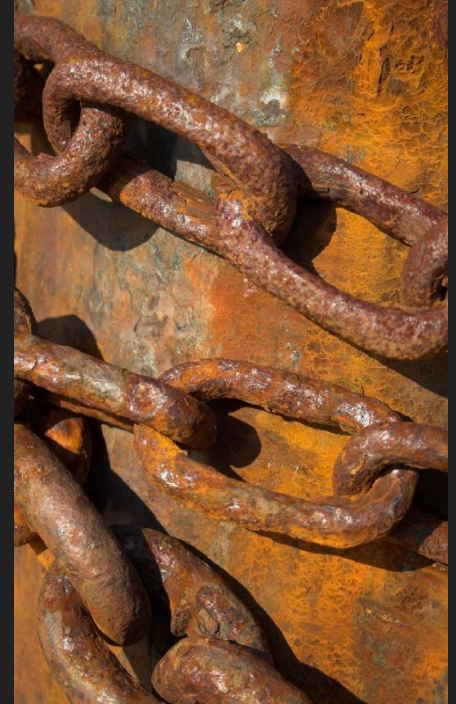


Clay



Calcite

# Chemical Weathering



## **Chemical Weathering:**

Disintegration of rock and building materials by chemical reactions (mostly water and the substances dissolved in it)



# Mechanical Weathering



## **Mechanical Weathering:**

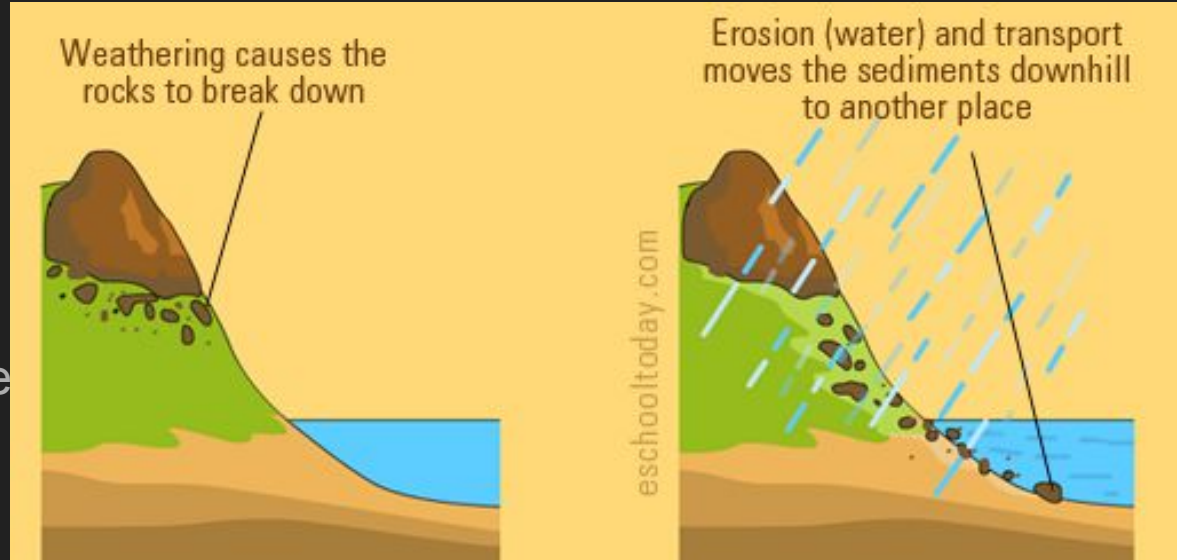
Breaking up big rocks into little ones by water, wind, glaciers

# Erosion and Deposition

**Erosion** is the movement of weathered materials from one place to another

This material is called **sediment**

**Deposition** is the process of depositing sediment into layers at the bottom of a body of water or dragged by a glacier.



# Practice

What are the 4 layers of Earth?

What is the lithosphere?

What is the most abundant element in the crust?

What is a mineral?

What are the two types of weathering?

What is deposition?

# Rocks

**Natural, solid mixture of particles**

## Types of Rocks

**Igneous** - rocks that have cooled from a molten state (granite)

**Sedimentary** - rocks that consists of materials derived from other rocks (limestone/sandstone)

**Metamorphic** - igneous or sedimentary rock that has been changed by heat and pressure deep under the Earth (marble)

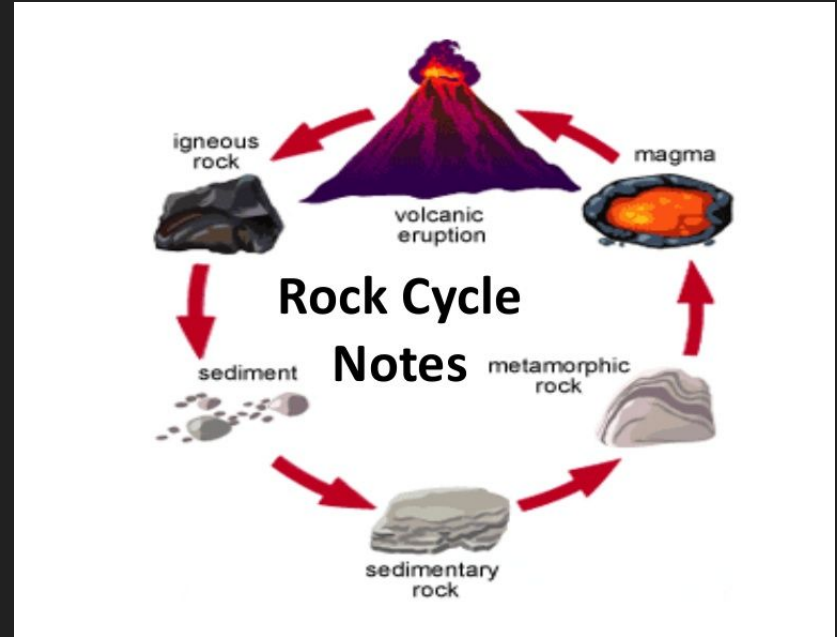


# Rock Cycle

**Series of processes that change one rock into another**

There are many different pathways through the rock cycle

Takes thousands to millions of years

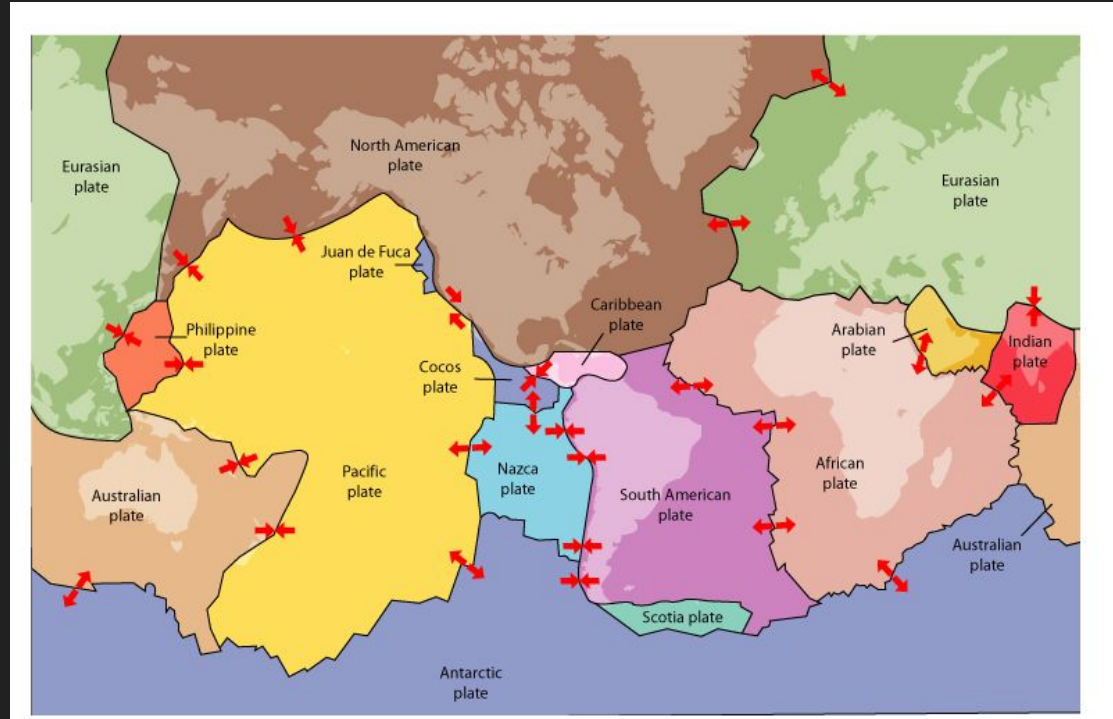


# Tectonic Plates

Large pieces of broken  
Lithosphere that move

Boundaries of plate can be  
found in areas that have:

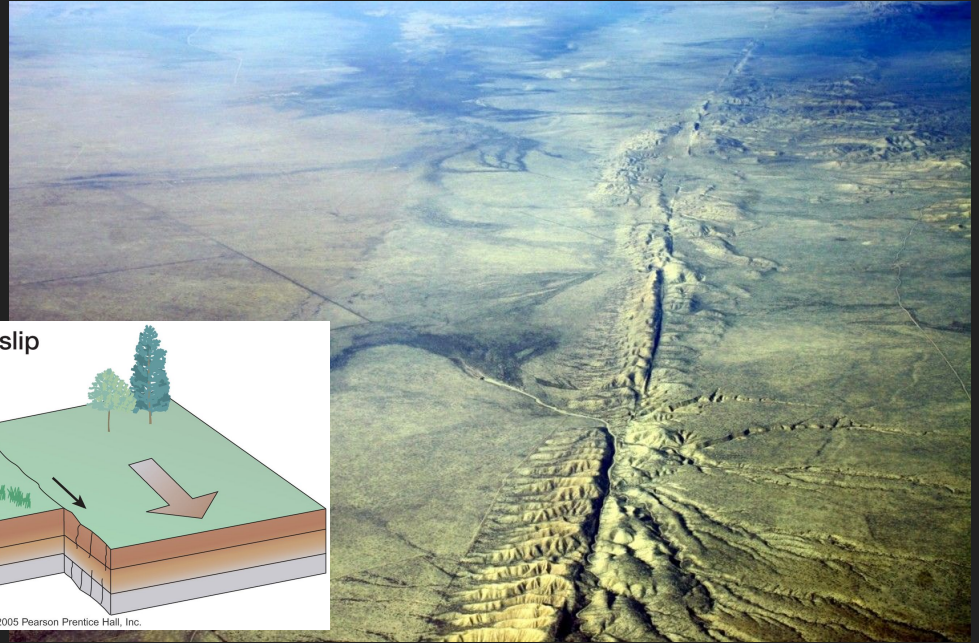
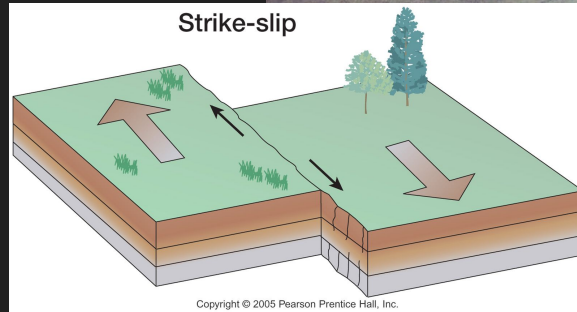
Mid-Ocean Ridges  
Earthquakes  
Volcanoes



# Earthquake

Sudden movement of solid rock along fractured surfaces called **faults** near the Earth's surface (Tectonic Plate Boundary)

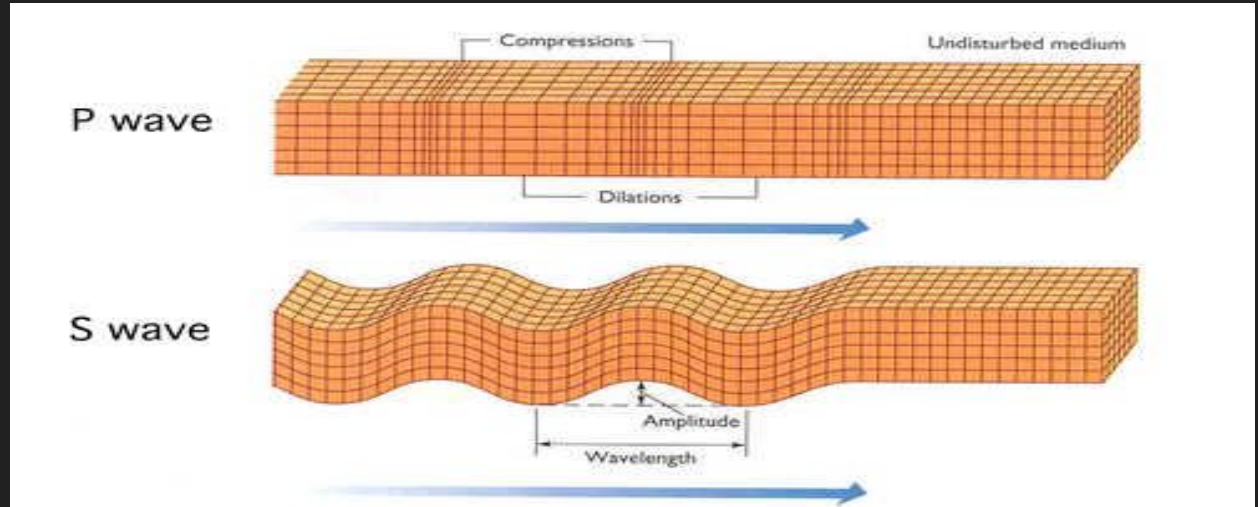
San Andreas Fault is a **Strike-Slip Fault** plates slide past each other



# Earthquake Waves

P Waves: longitudinal  
(push /pull)

S Waves: transverse  
(shake)





# Practice

What are the 3 types of rock?

What is a tectonic plate?

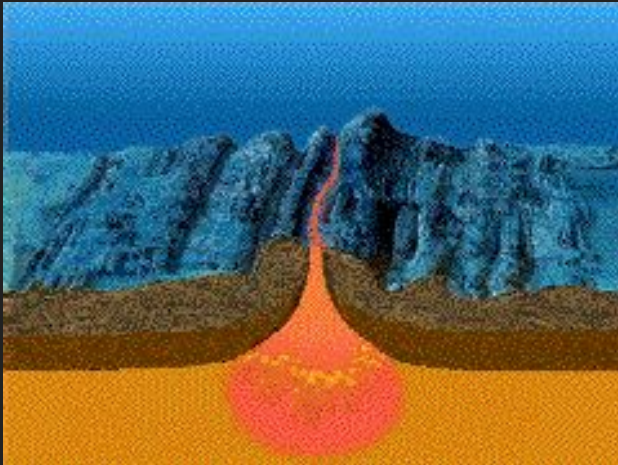
What is an earthquake?

What kind of fault is the San Andreas Fault? How does this fault move?

What are the 2 types of waves an earthquake produces?

# Mid Ocean Ridges

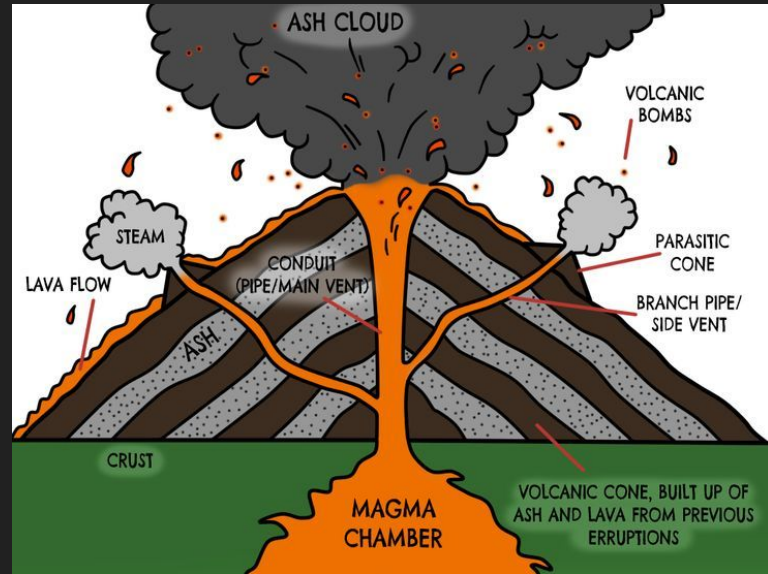
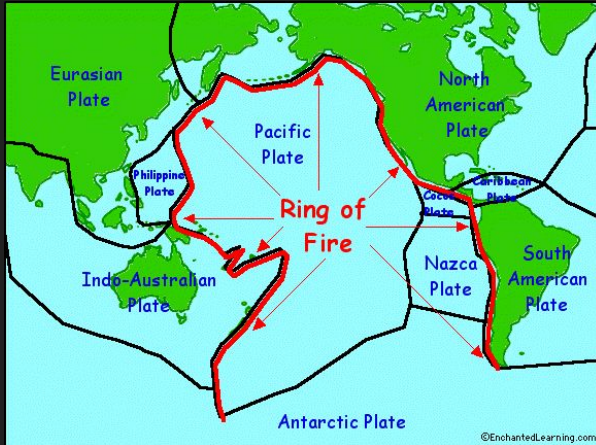
Underground mountain ranges, created between tectonic plates when magma flows through the crust



# Volcanoes

Rupture in the crust that allows magma, volcanic ash and gases to escape the magma chamber below the surface. Volcanoes on Earth exist because of the tectonic plates.

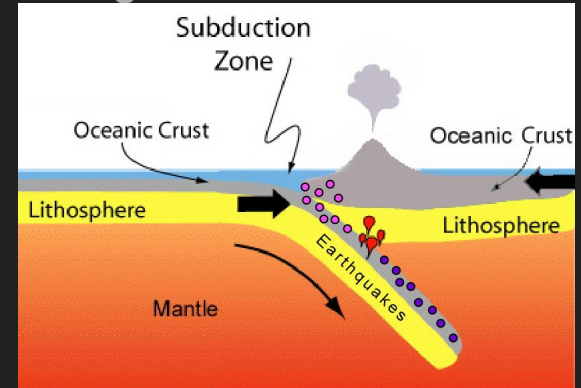
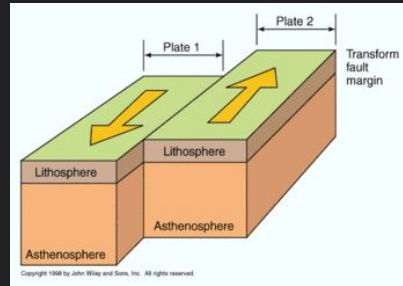
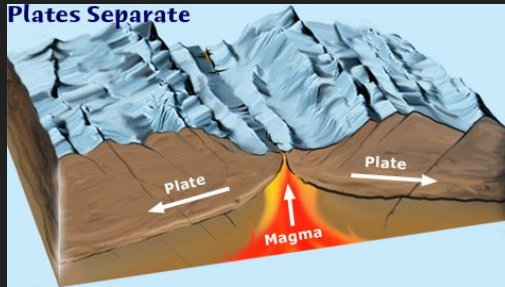
**Ring of Fire** area where many volcanoes and earthquakes occur along the boundary of the Pacific Plate



# Plate Movement

Tectonic Plates can move in 4 ways

- 1) Plate moves apart with molten rock rising to form new ocean floor
- 2) One plate can slide under another and melt in a subduction zone
- 3) Two plates can collide and buckle to form a mountain range
- 4) Plates can slide past each other along a fault (EQ)



# Continental Drift

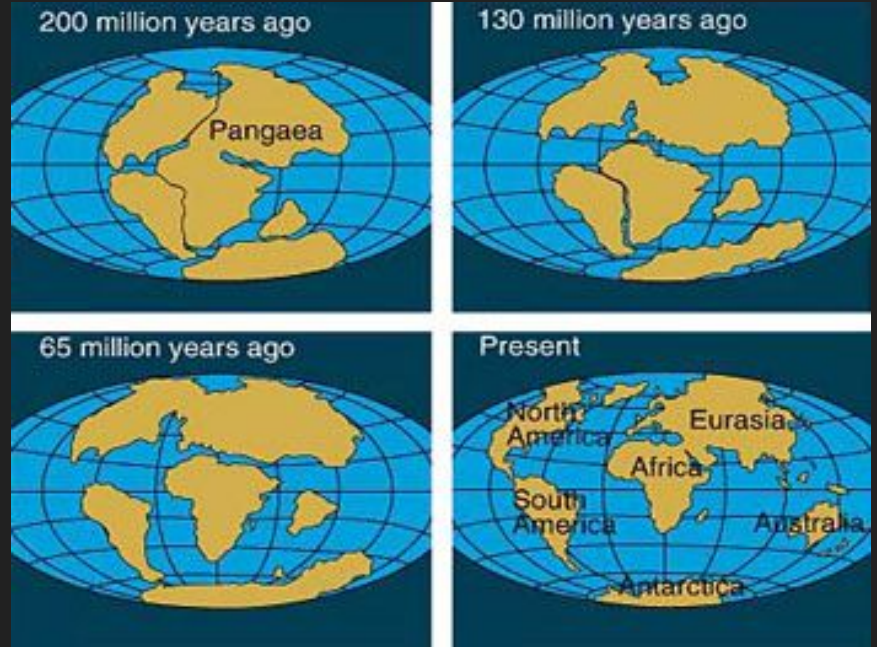
Continents move very slowly, over millions of years

Initially the hypothesis was rejected

Evidence:

→ Plate Tectonics!

- 1) Fossil Record
- 2) Sedimentary rock record
- 3) Continents are like puzzle pieces



# Practice

What is a mid ocean ridge?

What is a volcano?

What is “The Ring of Fire”?

How do mountains get made?

What is continental drift?