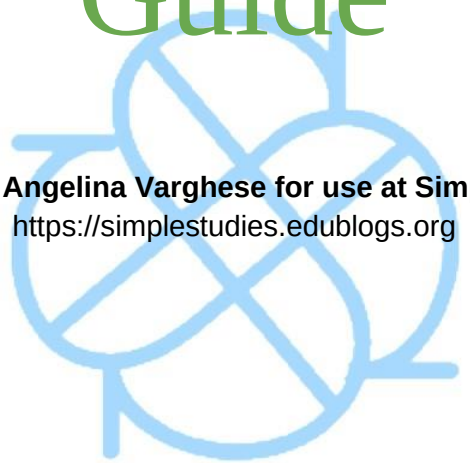
Earth Science Study Guide



Created by Angelina Varghese for use at Simple Studies
https://simplestudies.edublogs.org

Angelina Varghese

1 PROLOGUE

Graphical Relationships

Graph relationships - states the relationship between the X (independent) and Y (dependent) variables. When stating the relationship, sentences begin with ‘as’.

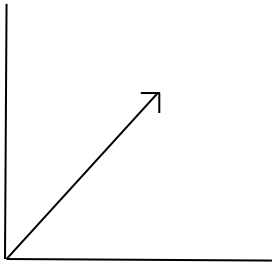
Variable - factors that can possibly change the outcome of an experiment.

Controlled Variable - a factor that is kept constant throughout an experiment.

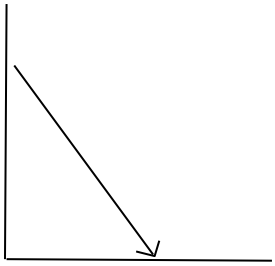
Independent Variable - a factor that is purposely changed in an experiment to alter the outcomes.

Types of graphs - the four commonly used graphs in Earth Science are direct relationship graphs, indirect relationship graphs, cyclic relationship graphs, and static relationship graphs.

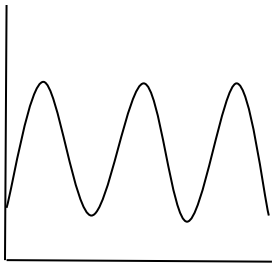
Direct Relationship - a positive correlation between variables; as the independent variable increases, the dependent variable increases as well.



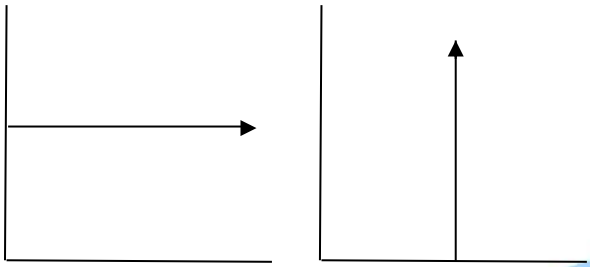
Indirect Relationship - a negative correlation between variables; as the independent variable increases, the dependent variable decreases.



Cyclic Relationship - a repetitive pattern between variables; as the independent variable increases, the dependent variable increases and then decreases forming a continuous repetition.



Static Relationship - as one variable is changing, the other remains constant. These graphs are usually represented with vertical or horizontal lines (common with density).



Percentage Error - the difference between the measured value and accepted/known value, divided by the accepted/known value and multiplied by 100%.

$$\frac{\text{Measured Value - Accepted Value}}{\text{Accepted Value}} \text{ X } 100\%$$

Rate of Change - the rate in which one quantity changes in response to another quantity.

$$\frac{\text{Change in value}}{\text{Time}}$$

Observation, Inference & Prediction

Observation - information collected using the five senses of sight, hearing, touch, taste, or smell.

Quantitative Observation - information that is measurable or countable.

Qualitative Observation - information that is describable and not measurable.

Inference - an interpretation made on observations to give it full meaning.

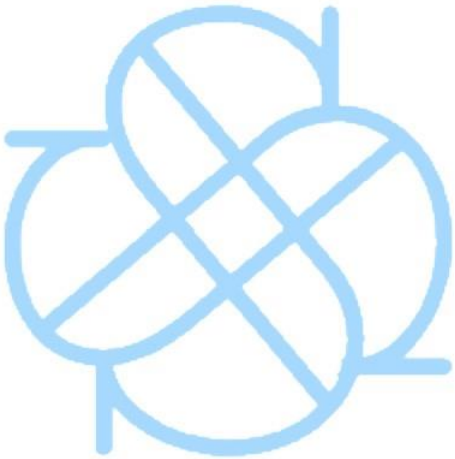
Prediction - an inference based on observations that indicate what will happen in the future.

Hypothesis - a prediction made with limited evidence that is tested with an experiment.

Experiment - a scientific procedure held to test or prove a given hypothesis.

Analysis - an explanation made after evaluating and comparing observations.

Conclusion - the summary of an experiment after testing the hypothesis.



Density, Mass & Volume

Density - the measure of mass per unit of volume.

$$\frac{\text{Mass}}{\text{Volume}}$$

Angelina Varghese

Density of Water - 1g/ml

Objects that float on water - less that 1g/ml

Objects that sink in water - more than 1g/ml

Matter - objects that have a mass and volume.

- ☆ Solid, Liquid, and Gas are the three states of matter which are differentiated with speed of molecular motion and distance between molecules.

- ☆ Solids have the least molecular speed and distance between each other, whereas gas has the highest molecular speed and the molecules are spread wide.

- ☆ When a substance is heated, the molecular motion and distance increases; when it is cooled, the molecular motion decreases and distance decreases as well.
- ☆ Solid matter is the densest while gases are least dense.

Kinetic Energy - measure of the vibration and motion of molecules.

Temperature - measure of average kinetic energy of particles in a substance.

- ☆ **Increase** in temperature is an **increase** in volume, which **decreases** Density.
- ☆ **Decrease** in temperature is a decrease in volume, which **increases** Density.

Heat - the transfer of energy from a higher temperature to a lower object.

Contraction - the decrease in volume of a matter which can be effects of temperature or pressure.

Expansion - the increase in volume of a matter which can be effects of temperature or pressure.

Mass - the amount of matter possessed by an object; usually measured in grams.

- ☆ Mass **DOES NOT** change whether the substance is heated or cooled.

Volume - the amount of space an object takes up; usually measured in cubic centimeters or millimeters.

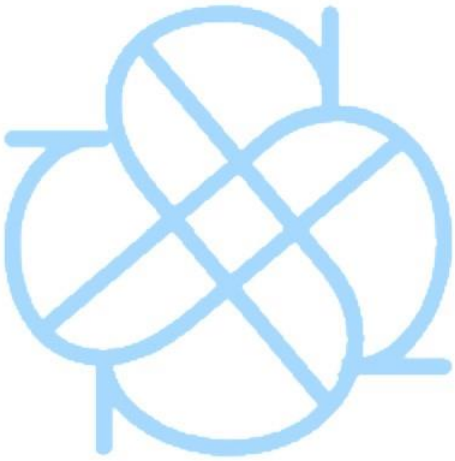
- ☆ When a substance is heated, the volume **increases** due to the increase in molecular motion which ultimately increases the space between molecules.

- ☆ When a substance is cooled, the volume **decreases** due to the decrease in molecular motion which ultimately decreases the space between molecules.

Atom - The smallest unit of matter that contains the same properties as a larger fraction of that matter.

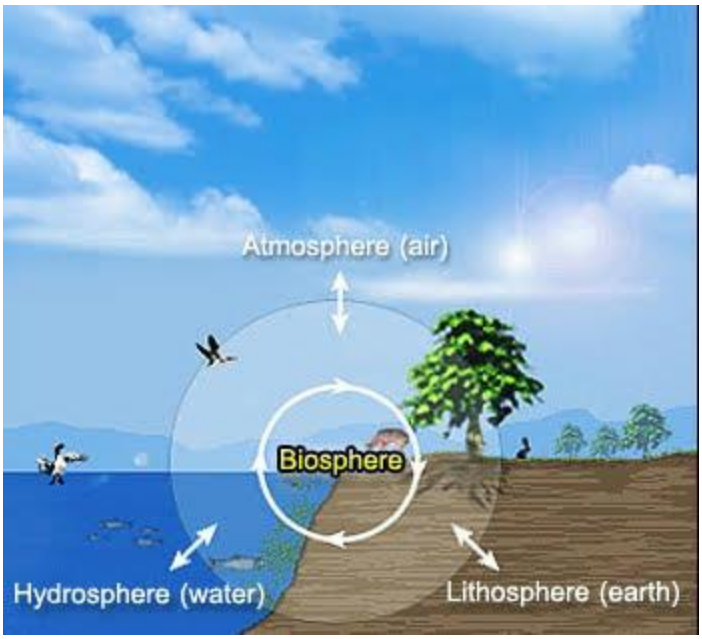
Element - Matter that is made up of solely one kind of atom.

Molecule - Atoms that are chemically bound together and have all the chemical properties of the compound molecule.



2 MAPPING

Spheres of Earth



https://sites.google.com/site/1geohist/unit-2-the-earth-s-surface-lithosphere-and-hydrosphere/theearthsstructure

Geosphere - rocky part of Earth that is mostly solid and extends from the center of the Earth to the surface; divided into crust, mantle and core.

Cryosphere - made up of all the frozen water on Earth; includes all ice, sea ice, glaciers, ice shelves and icebergs

Atmosphere - is mostly made of invisible gases that surround the Earth, extending from the surface outward to 600km

Hydrosphere - the part of Earth that is liquid water, including freshwater in lakes, rivers and marshes, salty oceans and rain and water droplets in clouds

Biosphere - made up of living things and the areas where they are found., the rocks, soil, oceans, lakes, rivers and lower atmosphere all support life

Lithosphere - the solid outer section of Earth, which includes Earth's crust, as well as the underlying cool, dense, and rigid upper part of the upper mantle.

Troposphere - the lowest layer of Earth's atmosphere where most types of clouds are found and where all weather occurs.

Composition of Earth's Crust, Hydrosphere, and Troposphere

Element (symbol)	Crust		Hydrosphere	Troposphere
	% by mass	*% by volume*	*% by volume*	*% by volume*
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.48		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

Earth's Coordinate System

Equator - an imaginary line around the Earth forming the great circle that is equidistant from the north and south poles

Latitude - an imaginary line around the Earth parallel to the equator. Measures distance North and South of the Equator.

Longitude - an imaginary great circle on the surface of the earth passing through the north and south poles at right angles to the equator. Measures distance east and west of the Prime Meridian.

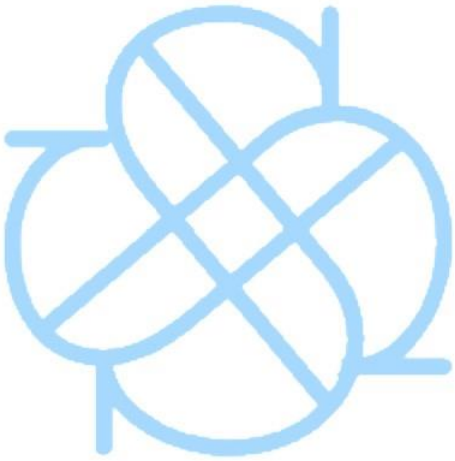
- ☆ The Earth rotates 15 degrees per hour.
- ☆ There are 24 time zones on Earth.

Prime Meridian - The meridian, designated at 0° longitudes, which passes through the Royal Observatory at Greenwich, England.

International Date Line - the line of longitude that marks where each new day begins, centered on the 180th meridian

Polaris - the North Star located above the Earth's North Pole. The angle of Polaris and the Horizon is equal to the latitude of the Observer.

Elevation- the vertical distance measured above sea level.



Mapping Skills

Topographic Map - a map that shows the surface features of a given area along with the elevation using contour lines.

Contour Line - lines on a topographic map that connect points and represent equal elevation.

Contour Interval - the distance of elevation between each contour line on a topographic map.

Index Contour - A bolder and darker contour line that appears every other 5th line.

Map Scale - symbols that help measure the distance on a map.

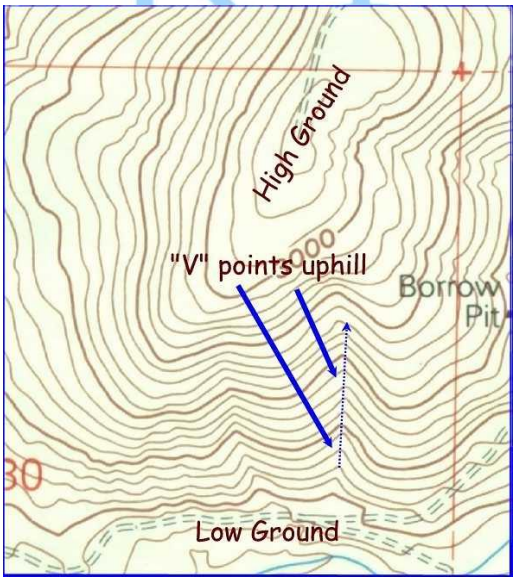
- ☆ Longitudes and latitudes appear on the corners and sides of maps.
- ☆ Degrees are divided into 60 smaller units to represent minutes; the smaller units are further divided into 60 more units to represent seconds.
- ☆ Buildings appear as black's squares; Churches appear as black squares with crosses and schools appear with black squares with flags.
- ☆ Contour lines NEVER cross, but do merge on occasions.
- ☆ The closer contour lines are, the steeper the slope and vice versa.

Topographic Profile - the side view of a portion of a topographic map.

Gradient - the average slope; change in field value divided by distance.

Benchmark - an area on a topographic map where the elevation is known exactly.

Rule of V's - the V shape formed by contour lines when it crosses a stream; it points uphill which means that any river flows in the opposite direction of the V.

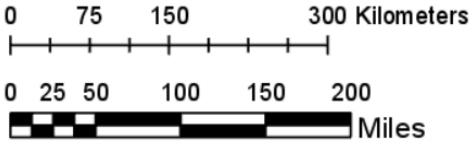


https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.therockerbox.com%2Fhow_to_use_a_map_5.htm&psig=AOvVaw313Uoy2ZHzRlHsP8WCwlOn&ust=1594583719384000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIiQ-rX9xeoCFQAAAAAdAAAAABAD

Maps in Earth Science

- ☆ Soaps are maps that show the amount of rainfall or snow.
- ☆ Isobar maps are maps that show air pressure.
- ☆ Topographic maps show elevation lines or contour lines.

☆ Map scales are found at the bottom of the map and used to find distance between points.



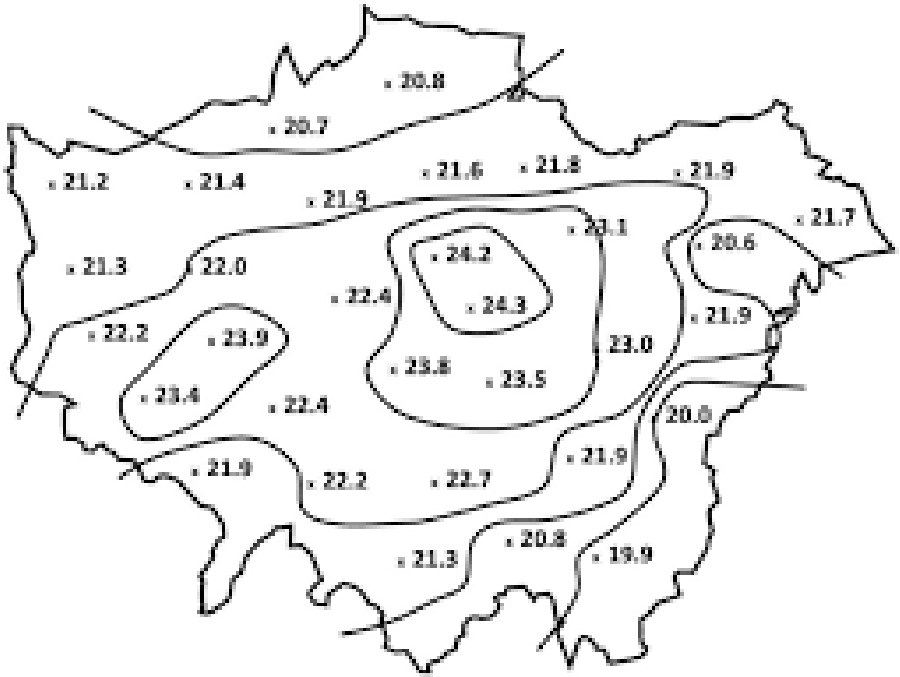
https://pro.arcgis.com/en/pro-app/help/layouts/scale-bars.htm

☆ A field map is any map where a measurable value can be collected. These types of maps are used in every area of science.

☆ Examples of field maps include maps that display magnetic fields, temperature, rainfall, snowfall, and elevation fields.

Laws for Constructing a Field Map:

1. Isolines MUST connect points of equal value and MUST extend to the edge of the map. If the value is on the map, the line must pass through it, or else, it must pass through an estimate/imaginary point for the value.
2. Isolines are gentle, curving lines. They can never be straight, sharp lines with corners.
3. Isolines are always closed curves or loops even though the map may not always show the full picture.
4. Isolines can NEVER cross or touch. This would mean that the line has two different values.
5. Isolines run parallel to each other. Remember, they never touch.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.rgs.org%2FCMSPages%2FGetFile.aspx%3Fnodeguid%3D257b3df6-a41b-47d6-889b-66f6108879c9%26lang%3Den-

GB&psig=AOvVaw0zgq2SIq6uNHRlJDZet2X0&ust=1595024483319000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCLjnhrn0uoCFQAAAAAdAAAAABAD

3.1 ASTRONOMY

The Universe

Universe - all existing matter that is considered to be spread out in a diameter of 10 billion light years; makes up space as a whole.

Asteroid - a piece of rock that is similar to the material formed into planets; usually found in asteroid belts.

Big Bang Theory - a theory that states that approximately 13.8 billion years ago the universe was formed with an explosion that expanded a single point.

Celestial Object - any object outside or above Earth's atmosphere.
Comet - a relatively small extraterrestrial body consisting of a frozen mass that travels around the sun in a highly elliptical orbit.

Doppler Effect - change in the apparent frequency of a wave as the observer and source move away from each other.

Eccentricity - ratio of the distance between the foci to the length of the major axis; defines the shape of a planet's elliptical orbit.

Focus/Foci - for an ellipse, one of the two points for which the sum of the distances to any point in the ellipse is a constant. A satellite orbiting the Earth moves in an ellipse that has Earth at one focus.

Galaxy - a collection of star systems; the Galaxy Earth exists in the Milky Way.

Gravitation - the movement downward resulting from a gravitational attraction.

Impact Center - oval-shaped depression with a raised rim formed by a meteorite, asteroid, or comet colliding with a solid surface.

Impact Event - the collision of comets, asteroids, and meteoroids, or any other type of celestial body.

Inertia - the tendency of a body to maintain in a state of rest or uniform motion unless acted upon by an external force.

Jovian Planet - planets that are huge gas giants and have a relatively low density. These include Jupiter, Saturn, Uranus, and Neptune.

Terrestrial Planet - planets that are closer to the Sun and generally denser and rocky. These include Mercury, Venus, Earth, and Mars.

Luminosity - Measures how bright the star will be in relation to the sun if all stars were the same distance from the observer.

Meteor - any of the small solid extraterrestrial bodies that hits the Earth's atmosphere.

Milky Way Galaxy - the name of galaxy; a spiral galaxy that contains about 400 billion stars.

Moon - any natural satellite of a planet.

Nuclear Fusion - the combination of the nuclei of small atoms to form larger nuclei; releases energy.

Red Shift - the change of wavelength of light due to an object moving away from the observer.

Blue Shift - the change of wavelength of light due to an object moving closer to the observer.

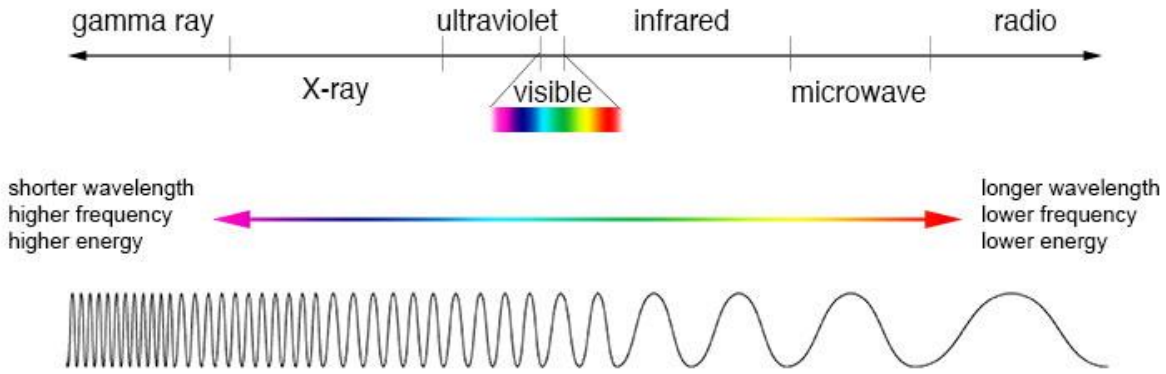
Hierarchy of the Universe

Angelina Varghese

The universe is everything. It is expanding as seen by longer wavelengths of light to the red end of the spectrum.

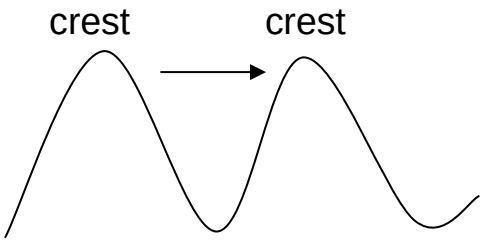
Universe ⟶ Galaxies ⟶ Stars ⟶ Solar Systems

Electromagnetic Spectrum

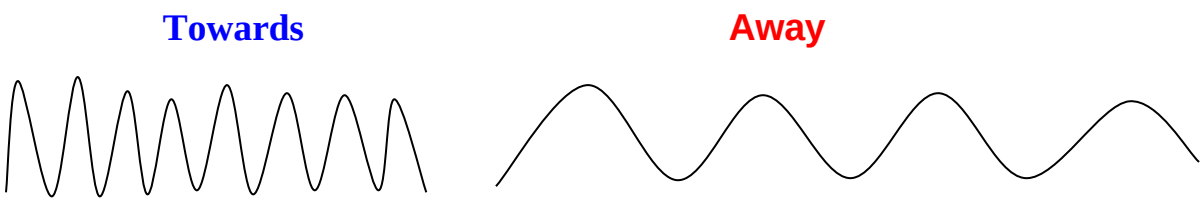


https://www.google.com/url?sa=i&url=https%3A%2F%2Fimagine.gsfc.nasa.gov%2Fscience%2Ftoolbox%2Femspectrum1.html&psig=AOvVaw1gUeEcLjMhjt3RxPLpkyZs&ust=1594717359695000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCLjJhqLvyeoCFQAAAAAdAAAAABAD

Wavelength - the distance from one wave crest to another.

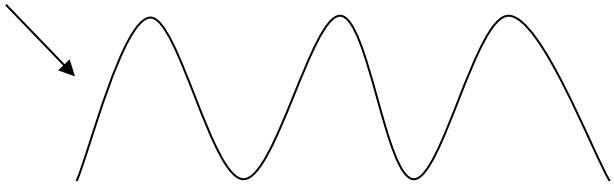


Doppler Effect - when sound waves or light waves are stretched out or compressed based on whether the source is moving towards or away from an observer.



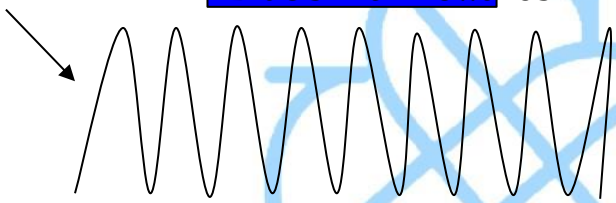
Red shift - Away

LONGER wavelength



SHORTER wavelength

Blue shift - Towards



Angelina Varghese

Stars

Stars - balls of gas that perform fusion (nuclear explosion); hydrogen fuses into helium

H+H → He

Constellation - group of stars that form a pattern in the night sky

Stellar Parallax - a measure of stellar distance.

Magnitude - a number given to celestial objects to express its relative brightness.

Light Year - the distance light travels in one Earth year

Binary Star - one of two stars revolving around a common center of mass under their mutual gravitational attraction.

Visual Binaries - pairs of stars in which the members are far apart enough to be resolved telescopically.

Absolute Magnitude - the apparent brightness of a star if it were to be viewed from a distance. This value is used to compare the true brightness of stars.

Apparent magnitude - the brightness of a star when seen from Earth.

HR Diagram - Hertzsprung-Russell Diagram that plots the temperature of stars against their luminosity.

Main sequence Stars - starts in its early stage that are positioned from the upper left to lower right of an HR diagram; includes majority of the stars.

Red Giant - a large, cool star with a high luminosity that occupies the upper right of an HR Diagram.

Supergiant - very large, bright stars.

Angelina Varghese

Nova - a star that increases thousands of times in brightness before fading.

Nebula - a large cloud of dust and gas in space.

Bright Nebula - interstellar clouds of gas and dust where stars are born or have died; formed by ultraviolet radiation from hot stars.

Emission Nebula - a gaseous nebula that derives its visible light from fluorescent or ultraviolet light.

Reflection Nebula - a dense dust cloud in interstellar space that is illuminated by starlight.

Interstellar Dust - dust and gas found between stars.

Protostar - a cloud that contracts of gas and dust with enough mass to form a star.

White Dwarf - a small, hot dim star that is the product of the center of an old star.

Neutron Star - a star that has collapsed under its own gravity; composed of entirely neutrons and has extremely high density.

Pulsar - a spinning neutron star that produces radio waves.

Black Hole - an object in space whose gravity is so strong that light can escape through.

Spiral Galaxies - a flattened, rotating galaxy with pinwheel-like arms of interstellar material and young stars winding out from its nucleus.

Barred Spiral Galaxies - a galaxy that has straight arms extending from its nucleus.

Elliptical Galaxies - a galaxy that is round or elliptical in it's outline.

Irregular Galaxies - a galaxy that lacks symmetry.

Galactic Cluster - a system of galaxies containing several to thousands of member galaxies.

Local Group - a cluster of about 20 galaxies to which our galaxy belongs.

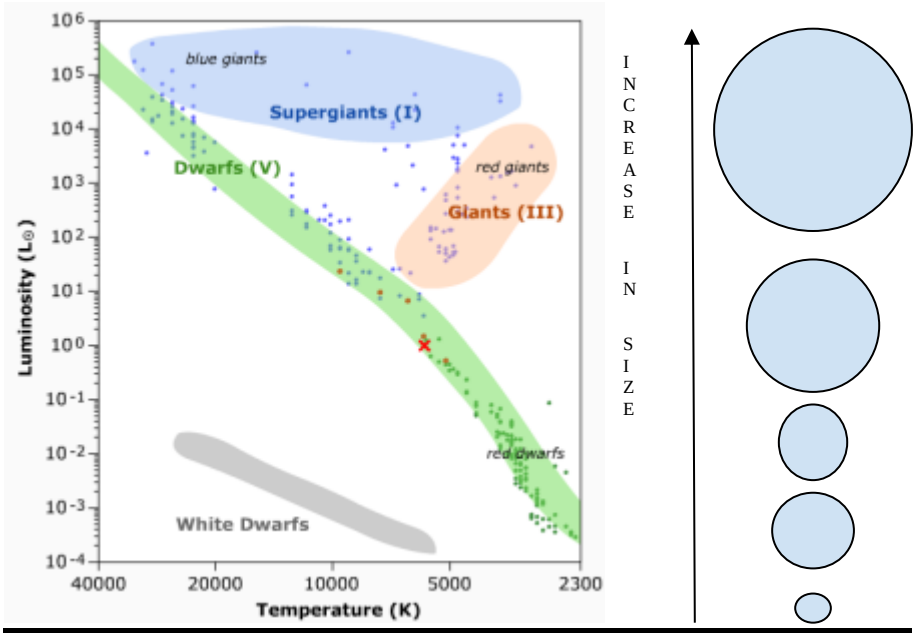
Degenerate Matter - when electrons are displaced inward from their regular orbits around an atom's nucleus.

Angelina Varghese

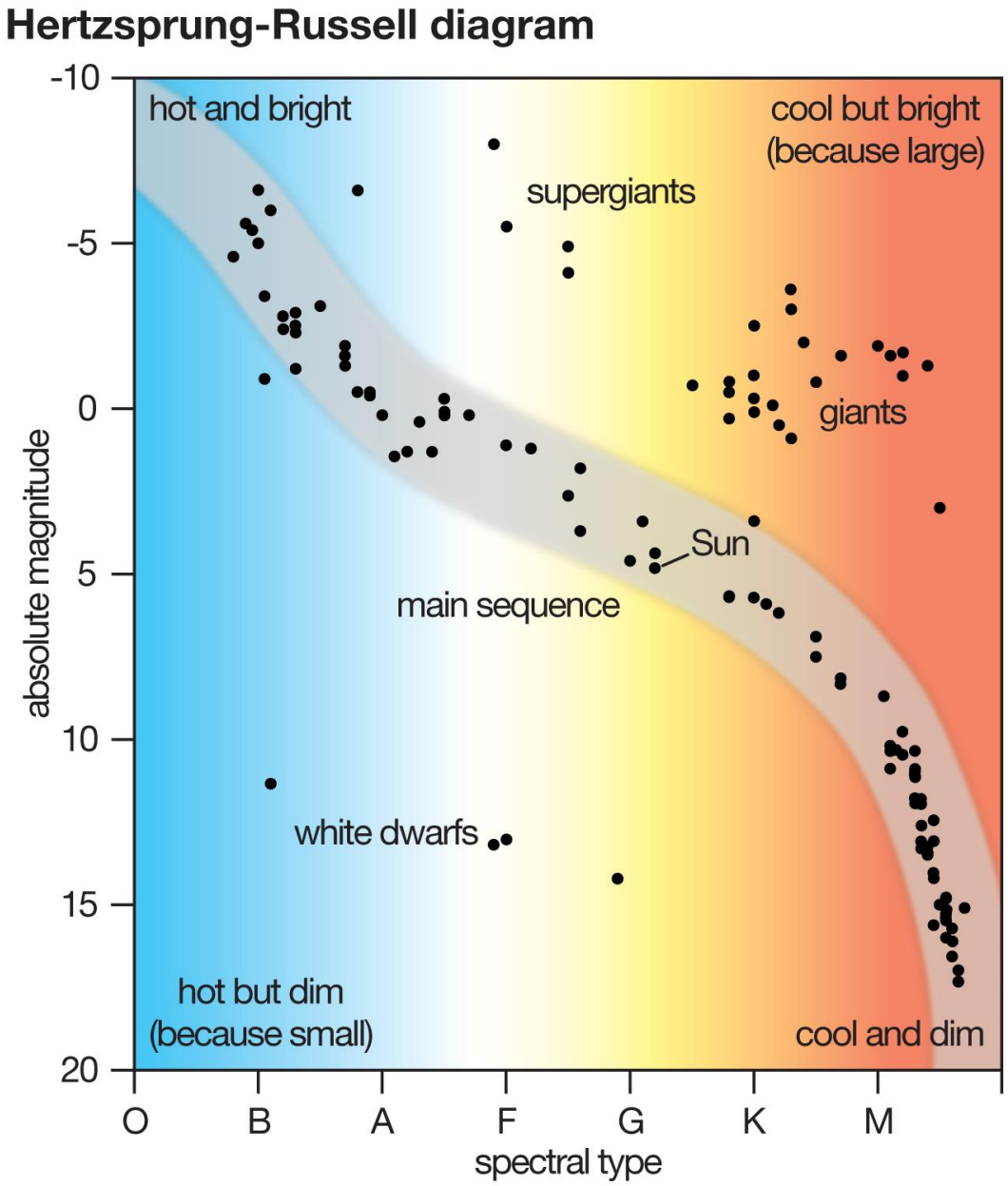
Cepheid Variable - a star whose brightness varies periodically because it expands; a type of pulsating star.

Pulsating Variables - a variable that changes/pulsates in size and luminosity.

Eruptive Variable - star that can vary in brightness.



https://astro.unl.edu/naap/hr/hr_background3.html

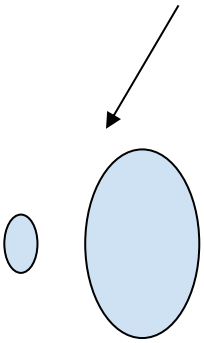


https://www.britannica.com/science/Hertzsprung-Russell-diagram

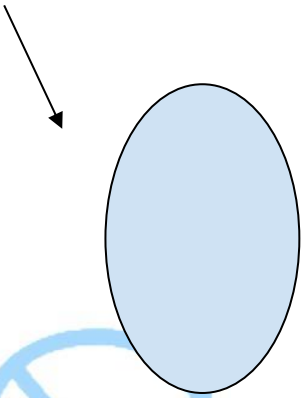
Angelina Varghese

A Star's Life Cycle

Stage 1: **Main Sequence** Where 90% of all stars are found and fuse hydrogen. Gas (nebula) in space collects by gravity until fusion starts.
Stage 2: **Giants & Supergiants** This is the intermediate state where the stars have moved off the main sequence and grown in size.



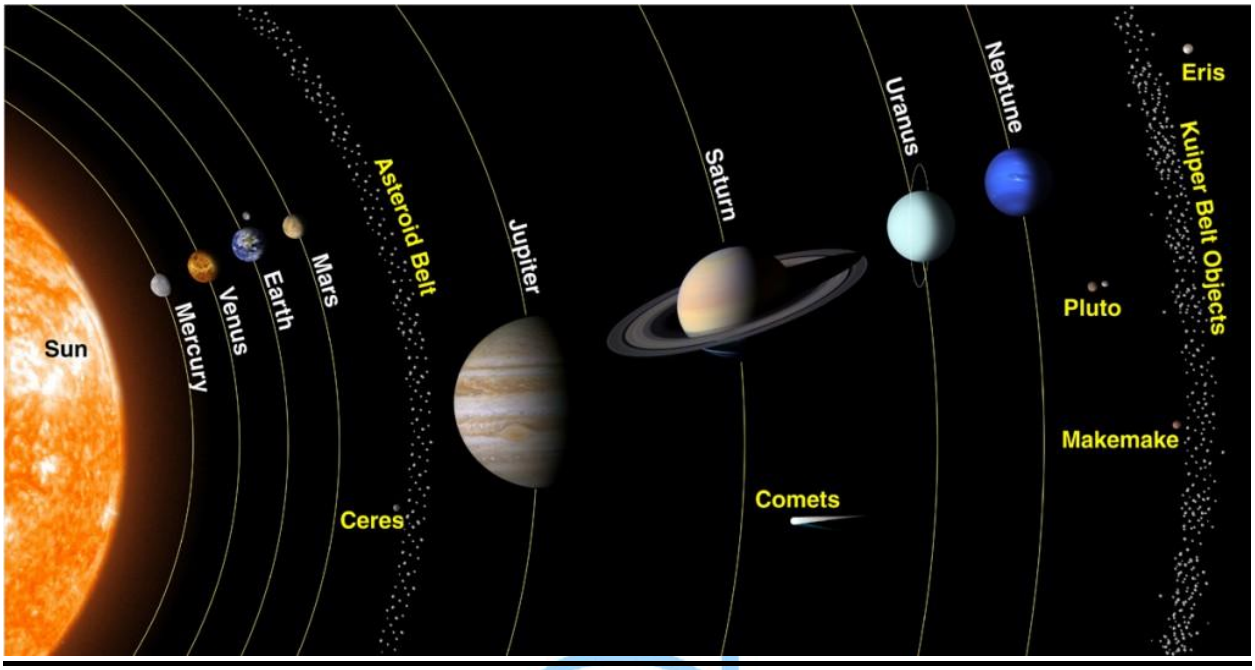
Stage 3: **White Dwarfs**
Small to medium stars; these are dead stars that have blown off their outer parts into the planetary nebula.



Stage 3: **Massive Stars**
these blow up in explosions called supernova leaving behind a black hole.

The Solar System

Angelina Varghese



https://www.google.com/url?sa=i&url=https%3A%2F%2Ftheplanets.org%2Fsolar-system%2F&psig=AOvVaw3nldD3QwWPBlIzNyX9Zdtb&ust=1594900681598000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCNC7kJiaz-oCFQAAAAAdAAAAABAK

https://phys.org/news/2019-06-chance-asteroid-earth-september.html

→ Asteroid - a small, rocky body that orbits the sun or is found in asteroid belts.

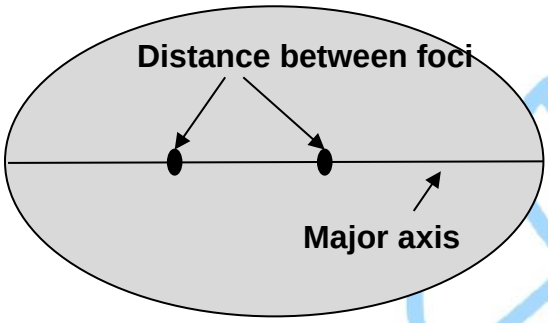
https://nineplanets.org/comets/

→ Comet- a small, icy body that moves around in space and has a visible tail due to gasses and dust.

Angelina Varghese

https://www.businessinsider.com/mystery-meteor-reportedly-explodes-21-kilotons-above-us-military-base-2018-8?r=UK&IR=T

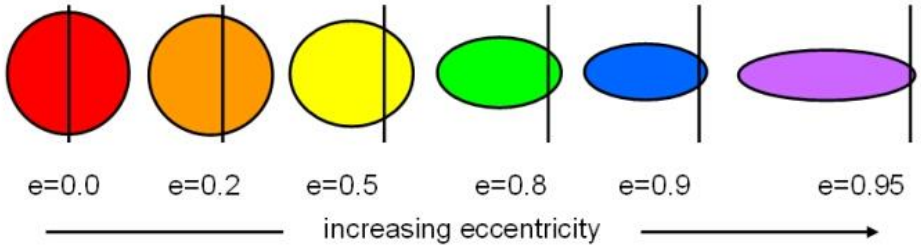
→ Meteor- a small, rocky body that enters the Atmosphere in flames and the vaporizes.



- ☆ Eccentricity is a measure of. a planet's elliptical orbit.
- ☆ The higher the number, the more elliptical the orbit The lower the number, the more circular the orbit is.
- ☆ No planet, asteroid, or comet revolves in a perfect circle. Every orbit is called an Ellipse.

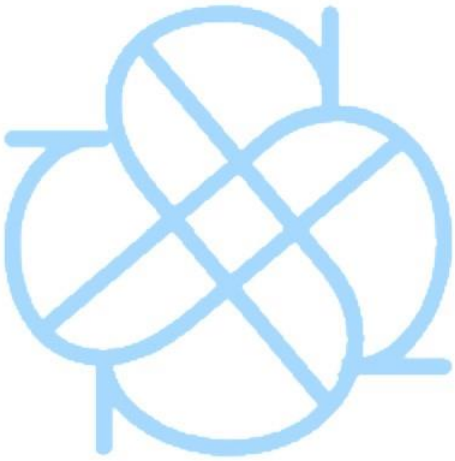
$$\frac{\text{Distance between foci}}{\text{Length of major axis}}$$

- ☆ Eccentricity is a number between 0and 1.0 is circular and 1 is the most elliptical.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fastronomy.swin.edu.au%2Fcosmos%2FO%2FOrbital%2BEccentricity&psig=AOvVaw2a10FrXjQYtQGYE9HHueCn&ust=1594901801954000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCPj3yLKez-oCFQAAAAAdAAAAABAJ

Aphelion - the slowest orbit which is far from the sun and has low gravity.
Perihelion - the fastest orbit point with high gravity.



3.2 ASTRONOMY

Rotation - the circular motion of an object when it turns around an internal axis about a point in space.

Revolution - When an object circles an external axis.

Circumpolar - stars that reside above the horizon, which means that they never or rise.

Constellations - a group of stars that from figures in the sky,

Polaris - the North Star; a star which indicates the north and almost always holds its position while the northern skies turns around it.

Foucault pendulum - a pendulum that swings in a constant direction that changes according to Earth's rotation.

Apparent motion - when viewing celestial objects from Earth, it appears as though the objects are moving against the typical direction.

GPS - Global Positioning System, uses satellites in space to find your phone, cars, e.g.

Heliocentric - the theory/belief that the Sun is the center of the universe.

Geocentric - the theory/belief that the Earth is the center of the universe.

Horizon - the skyline that separates the Earth from the sky.

Zenith - the imaginary point which is above a particular location on the celestial sphere

Tilt - to be learning towards one side, like how Earth has a 23.5-degree tilt on its axis.

Axis - an imaginary line that passes through Earth's center and the North and South poles.

Duration of insolation - the amount of daylight hours.

Tropic of cancer - 23.5 degrees north, latitude

Tropic of Capricorn - 23.5 degrees south, longitude.

Angle of insolation - the angle at which the Sun's ray strikes Earth.

Ellipse - an elongated circle, or oval shape of an orbit.

Eclipse - the partial or total blocking of one object in space by another.

Major axis - the longest diameter of an ellipse.

Minor axis - the shortest diameter of an ellipse.

Gravity - the force of attraction between masses in the universe.

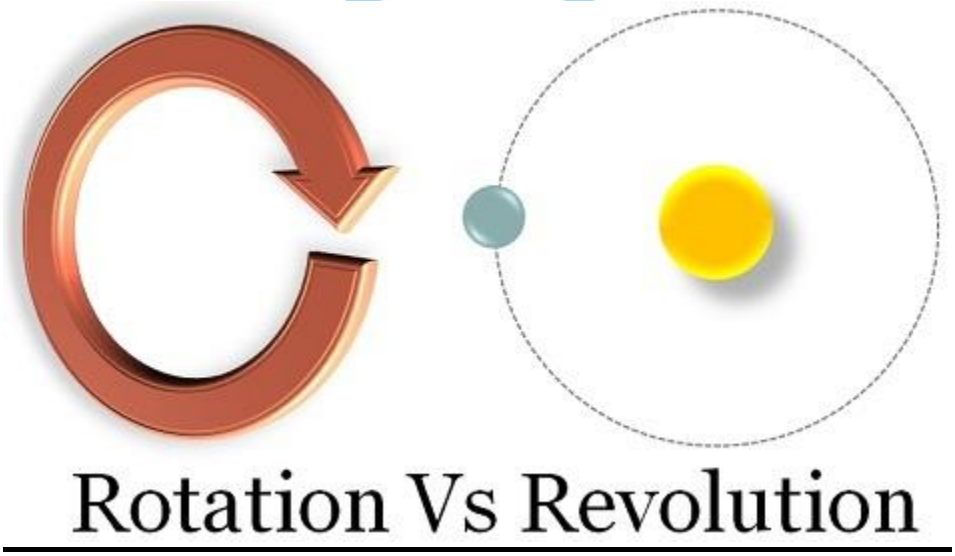
Angelina Varghese

Equinox - the first day of spring or fall when the sun is directly over the equator.

Solstice - the time that Earth's poles are pointing at the greatest angle towards or away from the Sun.

Tide - the periodic rise and fall of the sea level due to the gravitational pull caused by the moon.

Earth's Motion



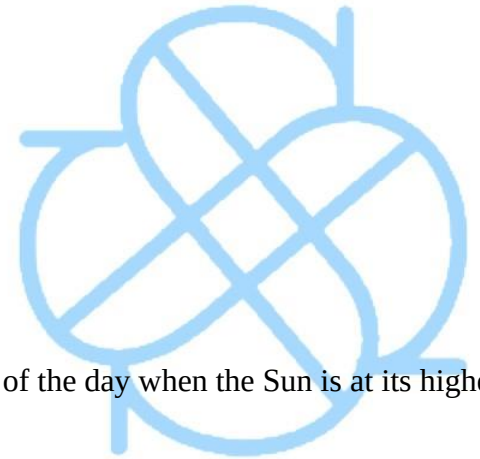
https://www.google.com/url?sa=i&url=https%3A%2F%2Fkeydifferences.com%2Fdifference-between-rotation-and-revolution.html&psig=AOvVaw1-qfh4DZwBbjg2J735E-op&ust=1594897137000000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKjayYWNz-oCFQAAAAAdAAAAABAD

Angelina Varghese

- ☆ Rotation refers to Earth's circular motion or spinning that causes day and night.
- ☆ The rate of rotation determines how many degrees the stars and sun will move across the sky per hour.
- ☆ Rotation takes place from WEST to EAST (west is EARLIER and east is LATER)
- ☆ Earth rotates 15 degrees each hour, which creates the 24 time zones. Each time zone consists of 15 degrees.

- ☆ Revolution refers to the movement of Earth around the Sun on its axis
- ☆ Also called orbiting
- ☆ Revolution is responsible for **years**, **seasons**, and **constellations.**

https://www.google.com/url?sa=i&url=https%3A%2F%2Fquizlet.com%2F283061755%2Fearths-rotation-flash-cards%2F&psig=AOvVaw2XIRWywVzqzAu1ioMLl-oi&ust=1594897755951000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCNDdlKaPz-oCFQAAAAAdAAAAABAD



Time Zones on Earth:

- ☆ Solar noon is the time of the day when the Sun is at its highest point in the sky for an observer.
- ☆ Longitude lines separate time zones and measure East and West hemispheres.
- ☆ The Prime Meridian is the 0-degree longitude that separates the East and West hemispheres.
- ☆ The International Date Line is located at 180 degrees and marks the beginning of a new day.
- ☆ When the sun shines directly on the Tropic of Cancer (June 21) it marks the first day of summer, or summer solstice, which is also the longest day.
- ☆ When the sun shines directly on the Tropic of Capricorn (December 21) it marks the first day of winter, or the winter solstice, which is also the longest day.
- ☆ September 21 = Fall
- ☆ March 21= Spring

Longitude & Latitude:

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.quora.com%2FHow-many-differences-between-longitude-and-latitude-do-we-have&psig=AOvVaw3LODrlf4LOl2wjXq6llzI6&ust=1594902529077000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCPDJzoyhz-oCFQAAAAAdAAAAABAD

Latitude and longitude is a coordinate "address system" to determine the location of any point on Earth.

1. Latitude

- Lines that measure North or South
- Also called parallels
- Measures from 0 degrees (equator) to 90 degrees.

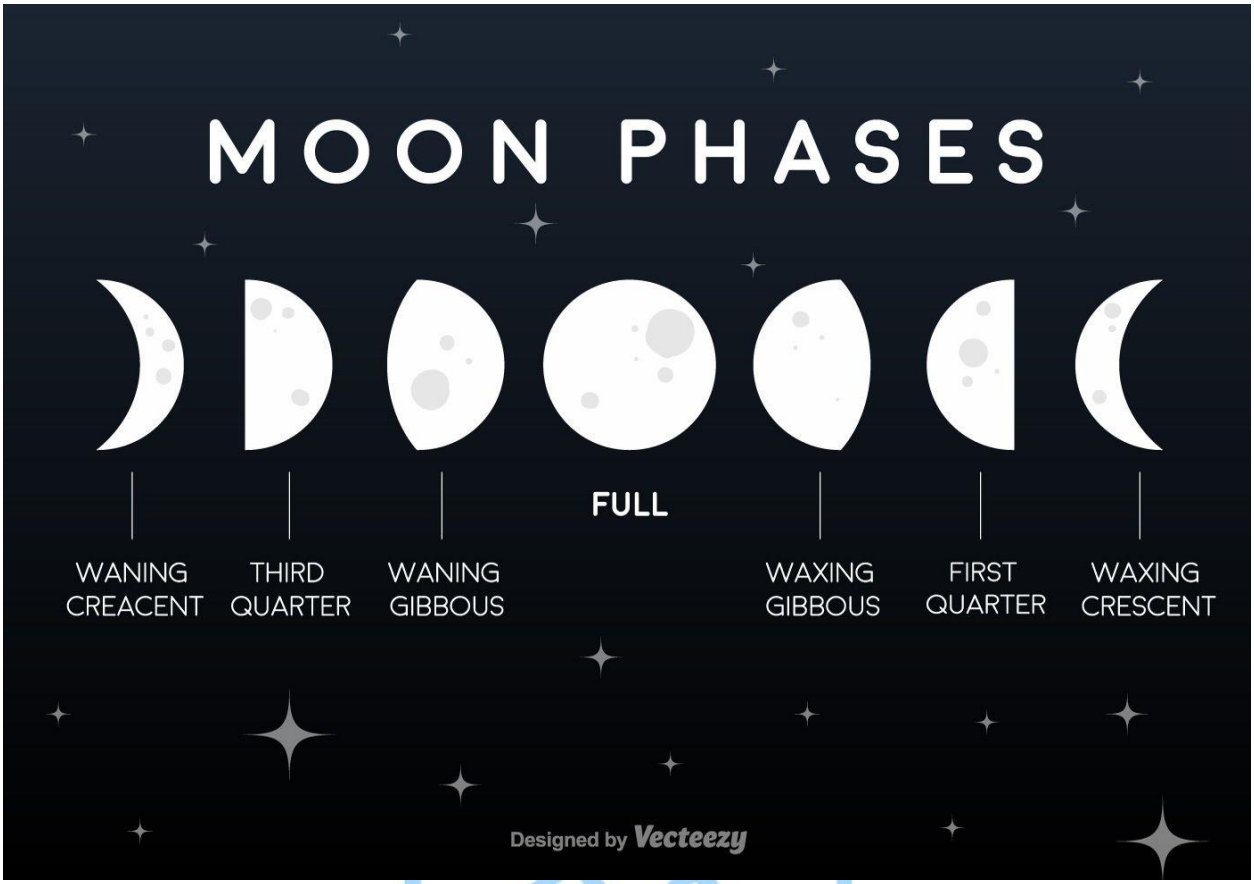
2. Longitude

- Lines that measure East or West of the Prime Meridian
- Called meridians at 15 degrees apart
- These lines establish time zones.

Angelina Varghese

Moon

- ☆ Why do we always see the same side of the Moon?
- The period of rotation and the period of revolution are the same: 29.5 days.
- ☆ So, one rotation is one day and one revolution is one year.
- ☆ The moon has no atmosphere so the skies apply black.
- ☆ The moon is always 50% illuminated by the Sun, but we do not always see that amount lit from Earth because the Moon revolves around the Earth.
- ☆ The moon rises about 50 minutes later each day since it has moved about 13 degrees since its previous moonrise, delaying the moonrise the following day.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F2111131059262410%2F&psig=AOvVaw2Uh6dRn0t8ogMOfm4-R6ZL&ust=1594898327560000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCJi7rLWRz-oCFQAAAAAdAAAAABAD

Waning - the moon is getting lighter every night; getting closer to a full moon.

Waxing - the moon is getting darker; getting closer to a new moon.

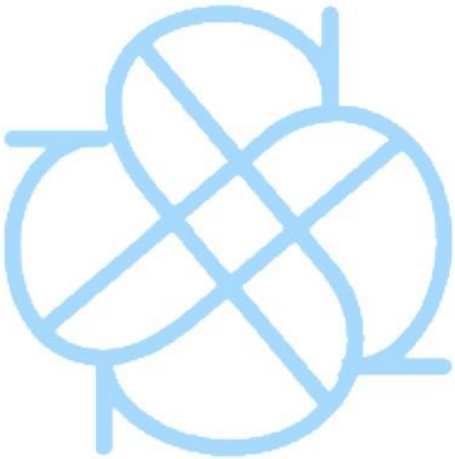
Crescent - the moon is lit by less than half.

Gibbous - the moon is lit by more than half.

- ☆ The Sun and Moon's gravitational pull causes the tides.
- ☆ Most locations experience two high and low tides each day.
- ☆ Spring tides have a greater tidal range than neap tides because the Sun, Earth, and Moon are aligned.
- ☆ Spring tides occur during the new and full moon and have the largest difference in water level between high and low tides.
- ☆ Neap tides occur during the 1st and 3rd quarter and have the smallest difference in water level between high and low tides.

Angelina Varghese

- ☆ Tides are the highest during a full moon.

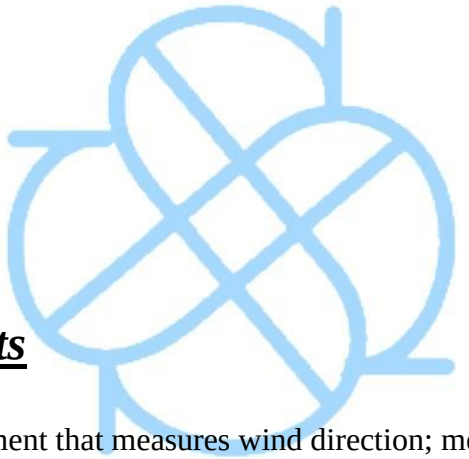


4 METEOROLOGY

Weather

- ☆ Meteorology is the study of atmosphere and focuses on weather processes and forecasting.
- ☆ Forecast is the prediction of future weather with the use of weather instruments. Weather forecasting was not available before the 1950s.
- ☆ Climate is the change in atmosphere over a long period while weather is something that can change pretty often.
- ☆ The Sun provides almost all of earth's energy and when this energy evaporates water, clouds are formed which are responsible for precipitation; this energy also provides heat which affects surface and atmospheric temperature.

- ☆ Weather is the result of heat, Earth's air, and water' the difference in Earth's surface causes uneven heating in the atmosphere and heat redistributes this.
- ☆ Weather usually moves in all directions.
- ☆ In the United States, it moves from the west to east often because that is the direction that the jet stream blows.
- ☆ Jet Streams are fast flow, narrow air currents in our atmosphere.



Weather Instruments

Wind Vane - a weather instrument that measures wind direction; measured in cardinal directions.

Barometer - a weather instrument that measures atmospheric pressure; measured in millibars.

Anemometer - a weather instrument that measures wind speed; measured in knots.

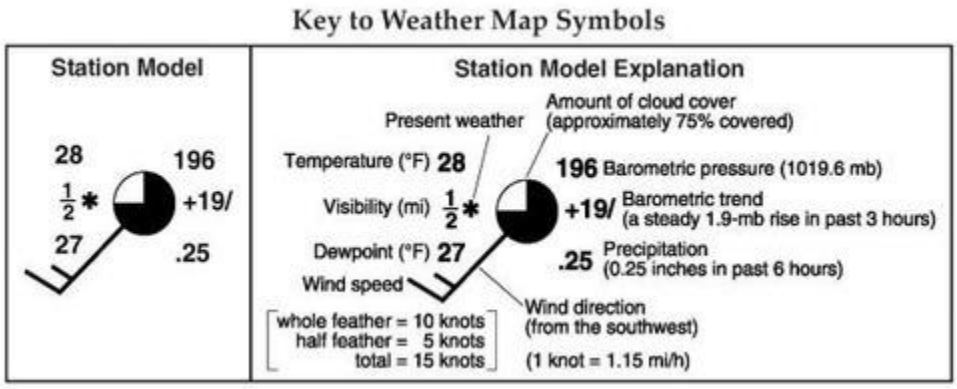
Hygrometer - a weather instrument that measures humidity; measured in percentage.

Thermometer - a weather instrument that measures temperature; measured in Kelvin, Fahrenheit, and Celsius.

Rain Gauge - a weather instrument that measures precipitation; measured in millimeters.

Station Models

- ☆ A station model is a symbolic illustration which shows the weather conditions over a specific area.
- ☆ It includes the temperature, present weather, visibility, dew point, wind speed, amount of cloud cover, barometric pressure, barometric trend, precipitation, and wind direction.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fquizlet.com%2F255806332%2Fweather-station-model-quiz-flash-cards%2F&psig=AOvVaw2PyCVJSq65si-5YTMW6vzV&ust=1595056266408000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIil_efd0-oCFQAAAAAdAAAAABAD

Moisture

- ☆ Moisture is a product of evaporation; it is the water vapor diffused into the atmosphere.
- ☆ Temperature, exposure of the surface area, and other substances present in the liquid affect evaporation rates.
- ☆ **Coagulation** is the process in which the atmosphere is naturally cleaned. Droplets and aerosols attract and act as a natural phenomenon to clear the air of pollutants.
- ☆ **Humidity** is the amount of water vapor or moisture present in the air.
- ☆ In warmer temperatures, water molecules in the air move quicker and don't easily condense. In cooler temperatures, water molecules in the air move slower and condense easily.
- ☆ **Relative humidity** represents the percentage of water vapor in air. When air temperature changes, so does the humidity.
- ☆ **Dew point** indicates the temperature at which water evaporates and moisture is formed. The higher the dew point, the higher the moisture content.
- ☆ As temperature and the dew point get closer together, the air becomes closer to saturation. Therefore, the chances of precipitation increases.
- ☆ The humidity is higher in warmer weather conditions than cool weather conditions.

- ☆ The higher the temperature, the more capable it is to hold water vapor. As air warms, the capacity increases, as it cools, the capacity decreases.
- ☆ When warm air is forced upward, expanded, and cooled, clouds are formed. When the air cools, the water vapor needed for saturation decreases and the relative humidity increases.
- ☆ These water molecules consensus into tiny droplets, and when the cloud is saturated enough, it is suspended in the form of precipitation.
- ☆ Clouds are classified by **shape** and **height** which are determined by temperature, pressure, and humidity.
- ☆ Some extend higher than others which are low and flat; some more dense and the other thin.
- ☆ The main types of clouds are **Stratus** (formed at low altitudes and associated with rain and snow), **Cumulus** (puffy with flat bases and found higher up), and **Cirrus** (fibrous and curly clouds made of ice crystals; indicate storms).

Pressure and Wind

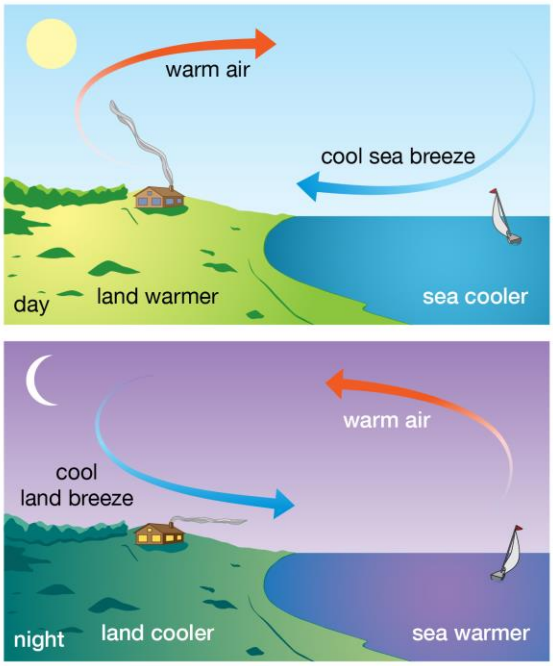
- ☆ Wind is the horizontal movement of air caused by the difference in pressure.
- ☆ Wind is named after the direction it blows from.
- ☆ The movement of wind is caused by the uneven heating of Earth; This is due to a low pressure system.
- ☆ When warm equatorial wind rises above the surface and moves to the poles, cool air moves to the surface and towards the equator at the same time.
- ☆ Warm, expanding air has low atmospheric pressure. Cooler air is denser and tends to sink, bringing about high atmospheric pressure.
- ☆ Wind results from air moving from regions of high pressure to regions of low pressure.

Sea Breeze:

- Land heats up faster than water because land has a lower specific heat.
- Radiation and conduction from the land's surface heat the air over land. The heated air expands and becomes less dense which causes it to rise.
- The result is a breeze that comes from the water to replace the rising air over the land.
- Sea breezes are light winds that blow from the water to the land. The breeze will continue throughout the evening

Land Breeze:

- At night time, land cools off faster than water because it has a lower specific heat.
- When the land cools, the air above also cools.
- The air over the water is now warmer than the air over the land, so the air above the water begins to rise.
- This causes the wind to change direction (blows from land to water)

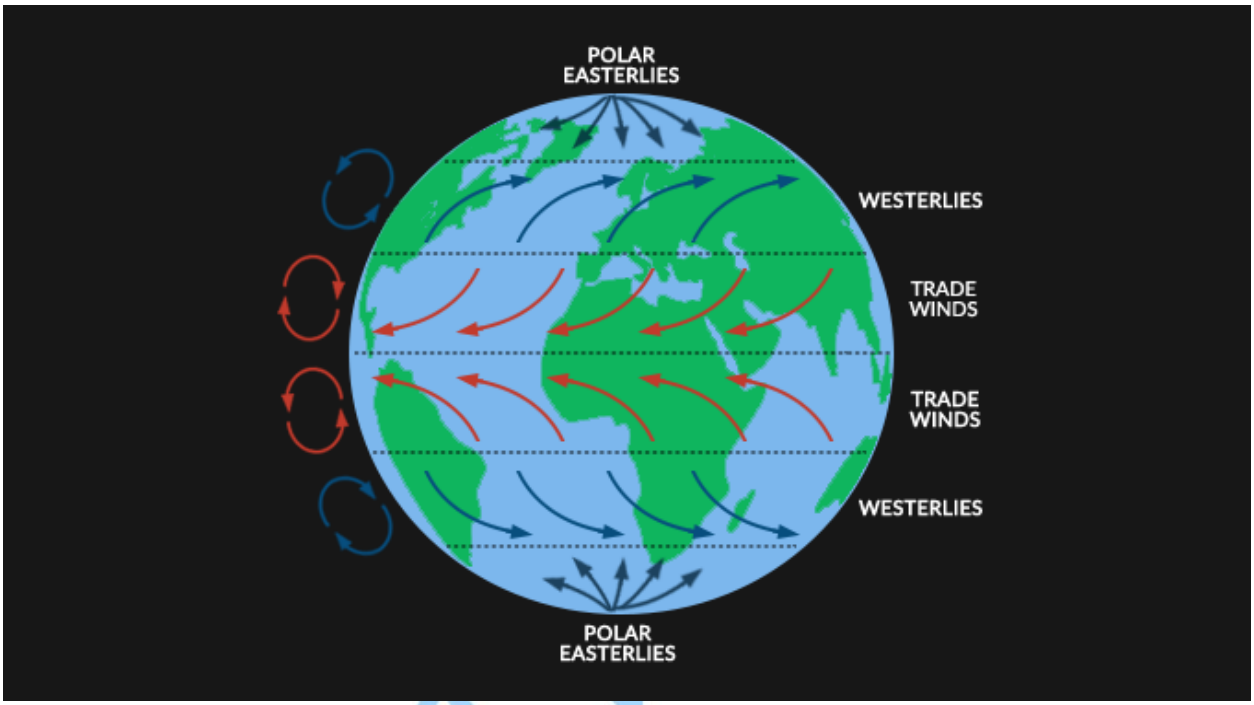


© 2014 Encyclopædia Britannica, Inc.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.tes.com%2Flessons%2FxJsssQTfzfcszQ%2Fconvection-currents&psig=AOvVaw2GexH8_rsaPc45Hf0uErFt&ust=1595062767090000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCOjgjID20-oCFQAAAAAdAAAAABAK

Coriolis Effect:

- The tendency of an object moving across the Earth to move in a curved path.
- Due to the Earth's rotation, the paths in the Northern Hemisphere curve right and paths in the Southern hemisphere curve left.
- The Coriolis effect causes wind directions to be altered.
- Wind moves **away** from a high pressure area in a **clockwise** pattern.
- Wind moves **toward** a low pressure area in a **counterclockwise** pattern.
- Prevailing winds flow from high to low pressure and are deflected by this effect.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fearthhow.com%2Fcoriolis-effect-air-circulation%2F&psig=AOvVaw1__FuwNIa0aOhLz0kKVthn&ust=1595062066073000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCNjSzLLz0-oCFQAAAAAdAAAAABAD

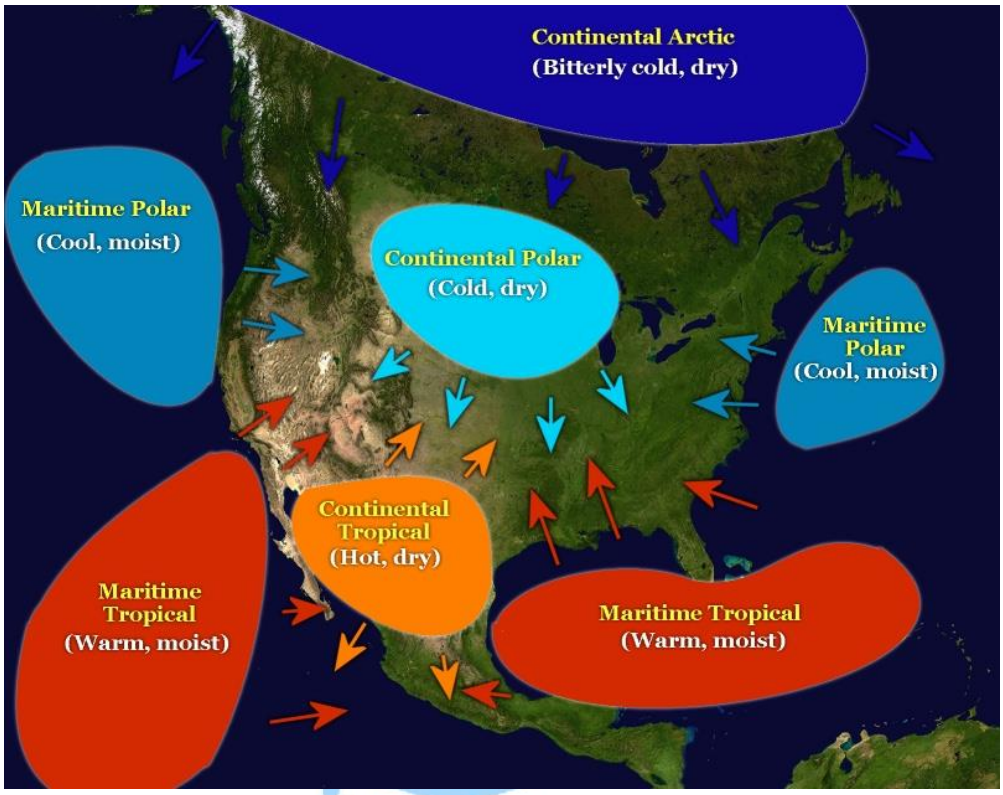
- Pressure is caused by the weight of the atmosphere pushing down.
- The higher the altitude, the lower the pressure.
- The higher the temperature, the higher the pressure.
- Low pressure is associated with clouds and precipitation along with temperature changes.
- High temperature is associated with dry and clear weather with a stable temperature and sunshine.

Air Masses and Fronts

Angelina Varghese

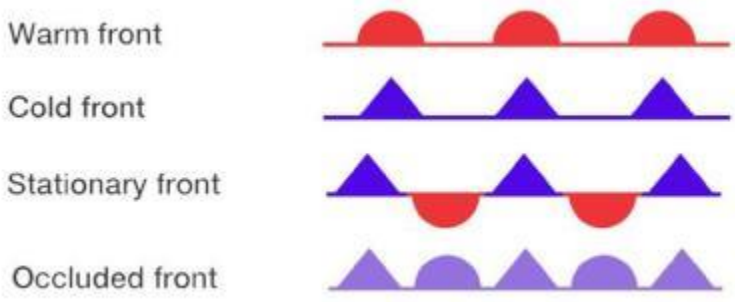
- Air masses are large bodies of air that have properties similar to the part of where they develop.

1. **cA (Continental Arctic)** - cold, dry air masses formed in the arctic and antarctic regions.
2. **cP (Continental Polar)** - cold, dry air masses formed over dry lands.
3. **cT (Continental Tropic)** - hot, dry air masses formed over deserts and plains.
4. **mT (Maritime Tropic)** - hot, humid air masses.
5. **mP (Maritime Polar)** - cold, humid air masses.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.thinglink.com%2Fscene%2F759783420237709314&psig=AOvVaw0Efidw7j8nOt-OiMWWbN0D&ust=1595064520685000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIiTz8X80-oCFQAAAAAdAAAAABAT

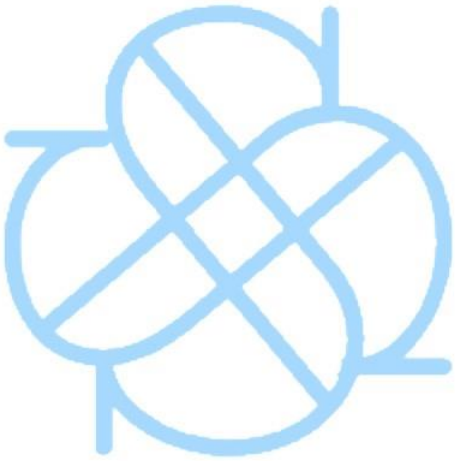
- A boundary between two air masses has different moisture levels, temperature, and density. This is called a front.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.studyblue.com%2Fnotes%2Fnote%2Fn%2Fatmospheric-air-masses-and-

fronts%2Fdeck%2F6300630&psig=AOvVaw0MLomvsccdhEmVzx9d3m_y&ust=1595063348674000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCPD5kJb40-oCFQAAAAAdAAAAABAI

1. Warm Front - when a cold air mass is advancing into a warm air mass from southwest to northeast.
2. Cold Front - when a warm air mass is advancing into a cold air mass.
3. Stationary Front - a front where neither the cold air mass or warm air mass is strong enough to advance, so the air shows no change.
4. Occluded Front - warm air gets trapped between cold air masses. The warm air is cut off from the air and pushed upwards as the temperature increases. It causes storms and precipitation.



5 MINERALS AND ROCKS

Minerals

Mineral - a naturally occurring, inorganic solid with an orderly crystalline structure and a definite chemical composition.

Silicate - a mineral that contains silicon and oxygen and usually more than one other element

Sulfate - any mineral that is an anion contains the element sulfur. It is formed when mineral rich waters evaporate.

Sulfide - any mineral that is a chemical compound and contains the element sulfur. It is formed with thermal or hot-water solutions.

Oxide - minerals that contain oxygen and one or more elements, which are usually metals.

Halide - minerals that contain a halogen ion and one or more other elements.

Carbonate - minerals that contain the elements carbon, oxygen, and one or more elements other than metallic elements.

Native Element - group of minerals that exist in a relatively pure form.

Streak - color of a mineral in powder form.

Luster - used to describe how light is reflected from the surface of a mineral. (e.g. metallic luster)

Crystal Form - visible expressions of a mineral's internal arrangement of atoms. The arrangement of the atoms controls the shape of the mineral.

Cleavage - tendency of a mineral to break along flat and even surfaces.

Fracture - tendency of a mineral to break uneven.

Hardness - measure of the resistance of a mineral of being scratched.

Igneous - rocks formed from the melting of magma; can be either intrusive or extrusive.

Metamorphic - rocks formed under either heat or pressure (sometimes both)

Sedimentary - rocks formed from sediments being compacted or cemented.

Sediment - rock fragments that have been transported to a different location due to wind, water, or gravity.

Chemical Sedimentary Rocks - sedimentary rocks formed from chemicals dissolved in water; included rock salt and travertine that are types of limestone.

Organic Sedimentary Rocks - sedimentary rocks that are composed of the remains of living organisms. Includes fossils and coal.

Angelina Varghese

Intrusive - rock that forms below Earth's surface; usually igneous rocks.

Extrusive - rocks that form above Earth's surface; usually igneous rocks.

Magma - body of molten rock found at the depths of Earth.

Lava - magma that reaches Earth's surface.

Rock Cycle - a model that illustrates the origin of the three basic rock types and the relations of Earth's materials and the processes carried.

Weathering - the disintegration and decomposition of rock at or near Earth's surface due to rain, wind, ice, sunlight, and plants.

Compaction - a process by which sedimentary rocks are squeezed together by the weight of overlying materials driving out the water.

Cementation - solidification of sediments by the deposition of dissolved minerals in tiny spaces between sedimentary particles.

Foliated - a metamorphic rock with a texture that gives the rock a banded or layered appearance.
Non-foliated - a metamorphic rock that does not exhibit a banded or layered appearance.

Clastic - sedimentary rocks that are composed of rock fragments cemented together.

Deposition - the natural process of adding transported sediments to landform.

Erosion - the transport of fragments of rock by forms of water or gravity.

Lithification - the compaction and cementation of sediment into rock.

Metamorphism - a solid state change in an existing rock due to high pressure or temperature that creates a metamorphic rock.

Texture - the sizes, shapes, and positions of the grains in a rock.

Igneous Rocks

Igneous rocks are a product of magma- a hot liquid made of melted minerals- when it is cooled down and forms crystals. These types of rocks form underground (intrusive) or on Earth's surface (extrusive) where mama usually cools down quickly.

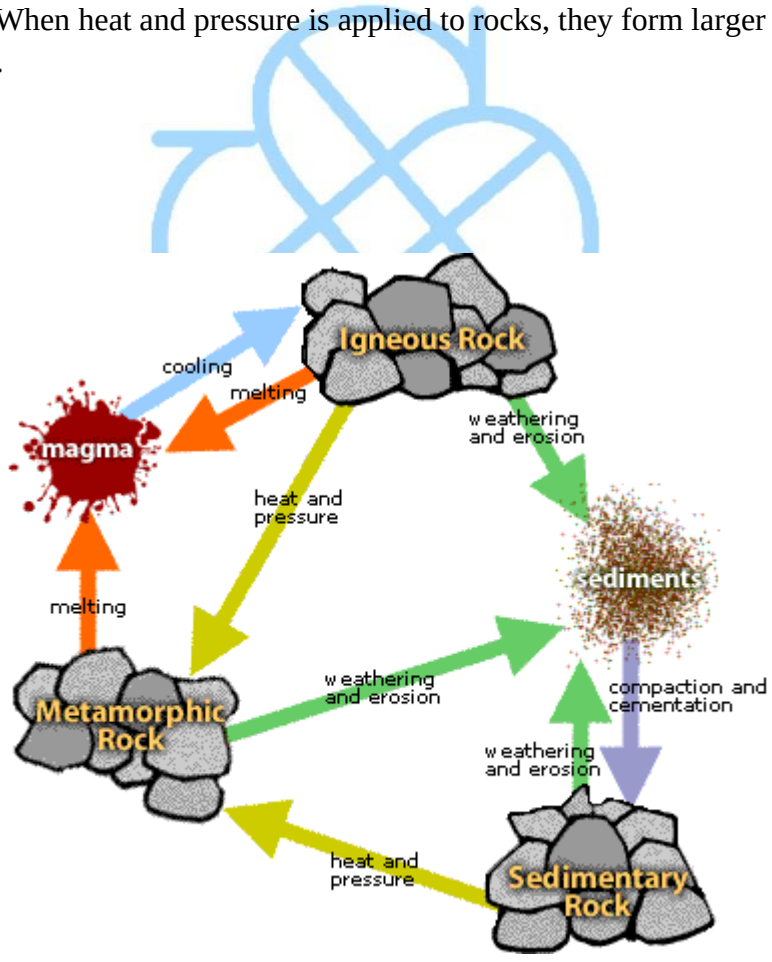
Sedimentary Rocks

Sedimentary rocks are formed as a result of cementation and compaction of sediments. Sediments are pieces of rocks that have been broken down as a result of wind or water. Over time, sediments are cemented together to form layers within a sedimentary rock.

Metamorphic Rocks

Metamorphic rocks are formed as a result of heat and/or pressure. Heat can be derived from pressure (pushing your hands together very hard and feeling the heat), friction (rubbing your hands together to feel the heat) or radioactive decay (the process that gives us nuclear power that makes electricity). When heat and pressure is applied to rocks, they form larger crystal called metamorphic rocks.

Rock Cycle



https://www.google.com/url?sa=i&url=http%3A%2F%2Fwww.cotf.edu%2Fete%2Fmodules%2Fmsese%2Fearthsysflr%2Frock.html&psig=AOvVaw3GuZh98ZV0XZxuvDW0a20-&ust=1594709815746000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCLi7ia3ZyeoCFQAAAAAdAAAAABAD

Angelina Varghese

The rock cycle consists of a group of changes from:

1. **Igneous to sedimentary or metamorphic**

- The effect of weathering or erosion on igneous rocks results in the formation of sediments, which later form sedimentary rocks due to compaction and cementation.
- When heat or pressure is applied to an igneous rock, it changes into a metamorphic rock over time.

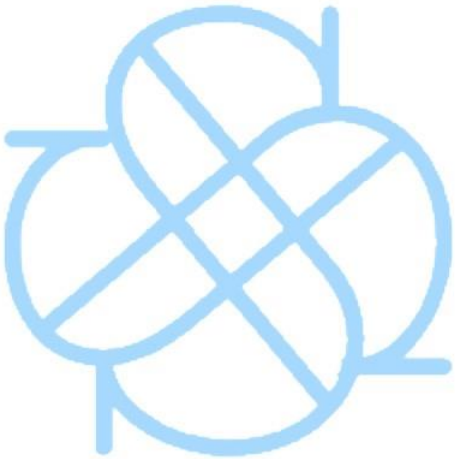
2. **Sedimentary to metamorphic or igneous**

- When heat or pressure is applied to a sedimentary rock, it changes into a metamorphic rock over time.
- The effect metamorphism on sedimentary rocks formed metamorphic rocks. When further melted into magma and then cooled, the rock changes into igneous.

3. **Metamorphic into sedimentary or igneous**

- The effect of weathering and erosion of metamorphic rocks is the formation of sediments. When these sediments are compacted and cemented, sedimentary rocks are formed.
- When melted, metamorphic rocks change into magma, which when cooled down forms igneous rocks.

Angelina Varghese



6 WATER CYCLE

Hydrology

Accumulation - a process in which water is collected in various water bodies.

Condensation - a process where tiny water droplets are formed as a result of water vapor cooling;

Angelina Varghese

Droplets - tiny masses of water.

Evaporation - the process in which water vapor is formed as a result of liquid heating up; liquid to gas.
Precipitation - any form of water falling down to the Earth's surface.

Evapotranspiration - the combination/result of evaporation from land and transpiration from plants.

Transpiration - Water loss from plants, soil and trees through as water gets evaporated.

Groundwater - masses of water formed under the Earth's surface.

Hydrologic Cycle - the continuous movement of water, in all forms, on and above Earth's surface.

Infiltration - a process in which water is absorbed into surfaces and sub-surfaces through pores and cracks.

Permeability - the level of ability of liquid to flow or pass through a given material.

Capillary - the movement of water through narrow pathways without any assistance.

Runoff - The movement of water on Earth's surface; causes flooding.

Surface Water - masses of water found above Earth's surface.

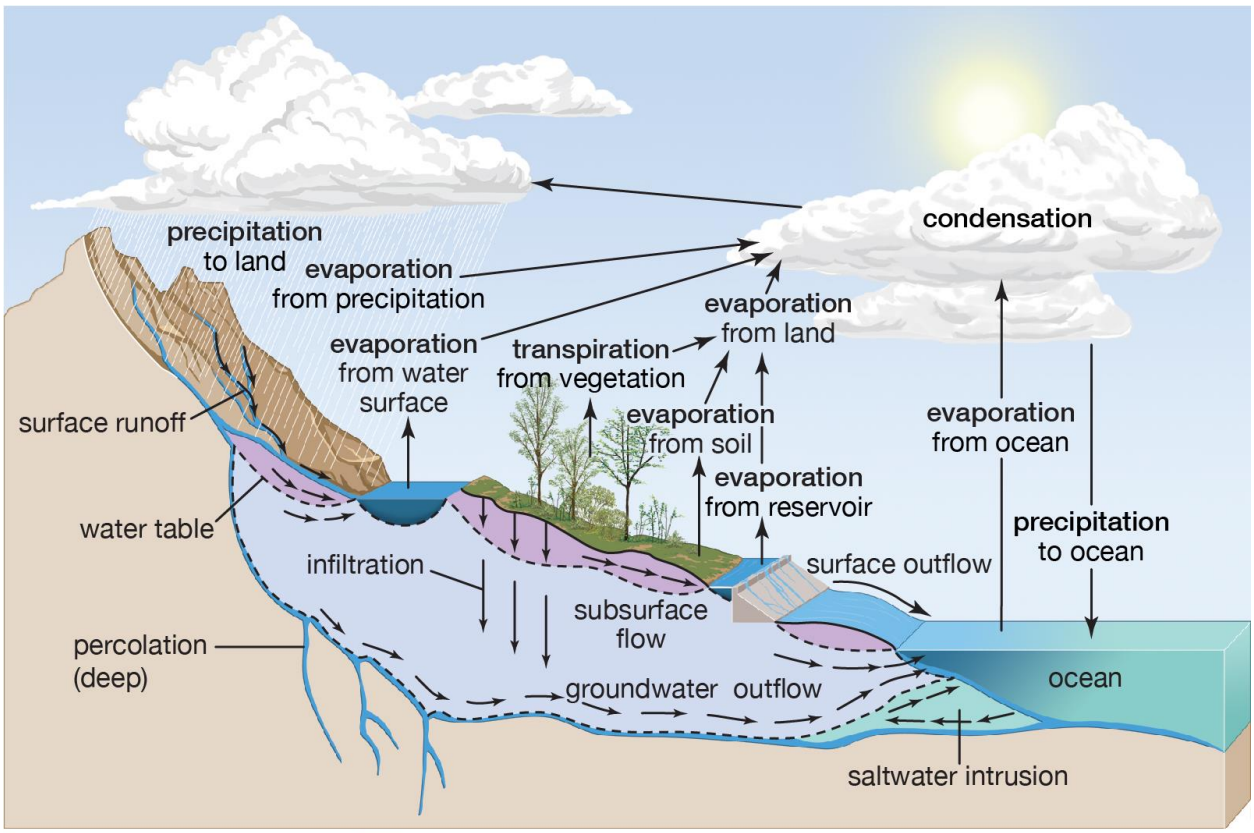
Alluvial Fan - triangle-shaped deposits of various sediments that are formed by erosion which are of practical and economic importance.

Saturated - when something cannot hold any more water; reached the maximum capacity.

Dew - the condensation that occurs on the surface when the air is cooled.

Relative Humidity - the amount of water vapor in air.

Angelina Varghese



\https://www.google.com/imgres?imgurl=https%3A%2F%2Fcdn.britannica.com%2F89%2F62689-050-BD53B2F5%2Fwater-hydrologic-cycle-land-surface-atmosphere-ocean.jpg&imgrefurl=https%3A%2F%2Fwww.britannica.com%2Fscience%2Fwater-cycle&tbnid=HY5zQpnqv5VJsM&vet=12ahUKEwiYs8XZ5M7qAhVpieAKHUfyDH0QMygAegUIARDOAQ..i&docid=HqQ71t0yX4ymzM&w=1600&h=1159&q=hydrologic%20cycle&ved=2ahUKEwiYs8XZ5M7qAhVpieAKHUfyDH0QMygAegUIARDOAQ

Main Steps in the Hydrologic (water) Cycle:

1. Evaporation

- When water from the surface turns into vapor, it is returned to the atmosphere in a gaseous state. These water bodies on the surface can include oceans, lakes, rivers, reservoirs, e.g. Evaporation from oceans is 80% and occurs in warmer conditions.

2. Transpiration -

- another form of evaporation that takes place when water droplets from plants and soil turn into water vapor and is returned to the atmosphere. Takes up 10% of all evaporation.

3. Condensation -

- The water vapor that is now present in the atmosphere cools down and frames masses of water droplets called clouds.

Angelina Varghese

- This takes place at the dew point, when the water in the air is saturated and needs to cool down.

4. Precipitation -

- The clouds that are formed now hold water droplets and when they are saturated, precipitation occurs. This returns water to on and below Earth's surface. Precipitation occurs in forms of rain, snow, and hail.

5. Runoff

- The water from precipitation is returned to the surface, flows along land and is later collected in various water bodies.

6. Infiltration

- Water returned from the atmosphere can also be absorbed by the surface, through pores and cracks. This downward movement of water through soil and rocks causes it to get filtered along the way. This water is later returned to water bodies as well.

☆ This cycle is repeated again and again. Basically, it is a continuous pattern that maintains the movement and collection of water.

7 WEATHERING, SOIL, AND MASS WASTING

Weathering

Weathering - the decomposition and disintegration or wearing away of material at or near Earth's surface.

Mechanical Weathering - breaking down rock into smaller pieces through:

1. **Frost wedging** - expansion of freezing water by 9%
2. **Salt crystal growth**
3. **Thermal expansion**
4. **Sheeting** - generates layers and exfoliates domes.
5. **Biological activity** - burrowing animals, organisms, and plants growing in cracks.

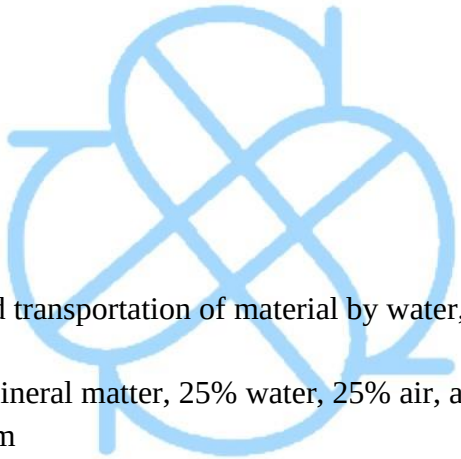
Chemical Weathering - breaking down the internal structure of a rock by removing or adding elements. Water plays an important role in weathering; Why?...

1. Oxygen dissolved in water oxidizes material
2. Carbon dioxide dissolved into water forms carbonic acid and then alters the material

- ☆ **Weathering of potassium feldspar produces clay minerals, soluble salt, and silica in solution.**
- ☆ **Weathering of silicate minerals produces insoluble iron oxides and clay minerals.**
- ☆ **Advanced mechanical weathering aids chemical weathering by increasing the surface area.**

Factors that affect rates of Weathering:

1. **Rock Characteristics**
2. **Climate**
3. **Differential weathering**



Soil

Erosion - the incorporation and transportation of material by water, wind, ice or gravity.

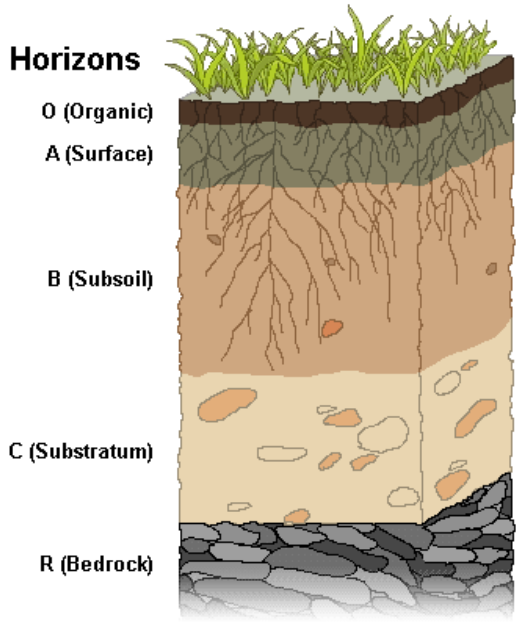
Soil - a combination of 45% mineral matter, 25% water, 25% air, and 5% organic matter that is an interface in the Earth System

Regolith - rock and mineral fragments that support the growth of plants.

Residual Soil- when parent material is already in the bedrock.

Transported Soil - when parent material has been carried from elsewhere and deposited.

Soil Horizons - the zones or layers of soil.



https://en.wikipedia.org/wiki/Soil_horizon

Soil Textures - a reference to the sizes of particles present in the soil: (largest to smallest)

4. **Sand**
5. **Silt**
6. **Clay**

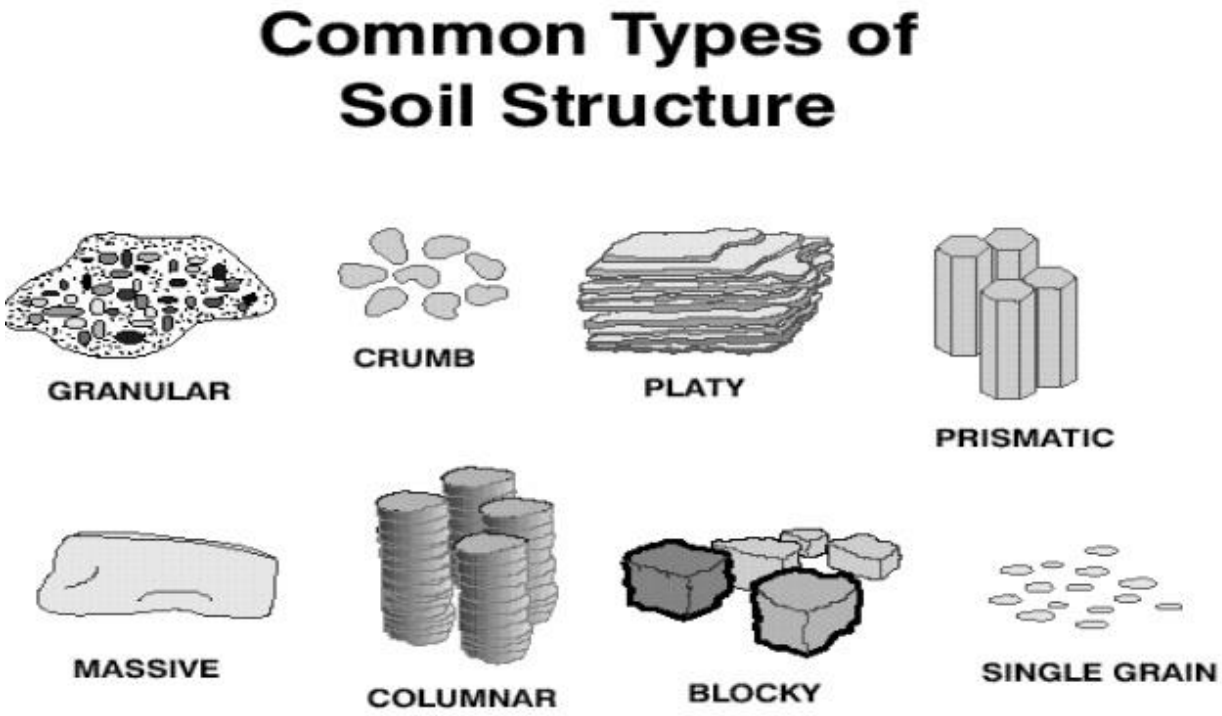
Controls of Soil Formation:

1. **Parent materials**
2. **Time**
3. **Climate**
4. **Plants and animals**
5. **Topography**

Soil Structure - the structure product of the soil particles bound together:

1. **Platy** - flat and plate-like units that are generally laid horizontally causing plates to overlap.
2. **Prismic** -long, vertical units with the tops shaped like a prism. They are bounded by flat or rounded vertical faces.
3. **Blocky** - block-like units that consist of six or more flat or slightly rounded surfaces.
4. Massive - no apparent structure; soil particles cling together with no uniform masses.
5. **Columnar** - units that are similar to prisms but have normally rounded edges. These are bounded by flat or slightly rounded vertical faces.

6. **Crumb** - small, porous units that are weakly bounded.
7. **Granular** - spherical or polyhedral units that are small, porous and strongly bounded.
8. **Single grain** - no apparent structure; soil particles exist as individuals, not bounded to form aggregates.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.slideshare.net%2FeAfghanAg%2Fsoil-texture-and-structure&psig=AOvVaw0vUSo7eA2vSnCfozH7VY3P&ust=1594728654522000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCOCsjKqZyuoCFQAAAAAdAAAAABAD

Mass Wasting

Mass Wasting - the downslope movement of rock and soil due to the controlling influence of gravity.

Mass Wasting triggers:

1. **Saturation of water**
- Water adds weight and destroys cohesion between particles.
2. **Over steepening of slope**
- Over steepened slopes are unstable; a stable slope is called the angle of response.
3. **Removal of anchoring Vegetation**
4. **Ground vibrations from earthquakes**

Mass Wasting types are defined by the material involved, what is moved, how it moves, and how fast it moves.

Types of Movement - fall, slide, and flow.

Forms of Mass Wasting:

1. **Slump** - rapid movement along a curved surface, along over steepened slopes.
2. **Rockslide** - rapid movement of blocks of bedrock down a slope.
3. **Mudflow** - rapid movement of debris that is often confined to channels. This is an issue in dry areas with heavy rain.
4. **Earthflow** - rapid movement on hillsides in humid regions where water saturates the soil.
5. **Creep** - slow movement of soil downhill which causes poles and fences to tilt.

Liquefaction - a special type of earthflow that is sometimes associated with earthquakes.

Angelina Varghese

8 PLATE MOVEMENT

Continental Drift - a theory that explains the relative displacement of continents through geologic time

Pangea - a supercontinent that broke apart during the Paleozoic Era and drifted to the positions that we observe today

Plate tectonics - a theory in geology that says that the Earth's crust is composed of a mosaic of large, slowly moving plates

Lithosphere - the thinnest and the most rigid of the earth that contains all the rocks beneath the oceans (oceanic crust) and on the continents (continental crust)

Asthenosphere - a layer of soft, partially molten rock that lies below the rigid lithosphere (crust)

Divergent Boundary - a zone in the earth's crust along which tectonic plates are separating

Rift valley - in the oceans, a deep central fracture found along the crest of the mid-ocean ridge. On land it is an elongated valley that overlies a region of stretching crust

Mid-Ocean Ridge - a submarine mountain chain found along divergent plate boundaries where new oceanic crust is actively forming

Sea-Floor Spreading - a theory that explains how new oceanic crust is forming by the convective upwelling of magma at mid-ocean ridges and how it then moves away at rates of 1 to 10 centimeters per year

Convergent Boundary - a zone in the earth's crust along which tectonic plates are colliding

Subduction Zone - an elongated region where colliding plates force one crustal plate below resulting in deep ocean trenches and chains of mountains or volcanoes

Transform Boundary - a zone within the Earth’s crust along which tectonic plates are sliding past each other

Hot Spot - a relatively fixed but isolated region of volcanic activity that is marked by a trail of extinct volcanoes

Plate Tectonics

Angelina Varghese

- ☆ About 260 million years ago, the continents were joined together in the supercontinent **Pangaea**. About 225 million years ago, Pangaea began to break apart. Ever since then, the continents have moved to their now present locations.
- ☆ The Earth's crust and upper mantle is broken into sections called plates which move around on top of the mantle due to **Convection Currents**.
- ☆ Heat energy from the Earth's core spreads outwards which causes tremendous amounts of heat in the asthenosphere, resulting in **Convection Currents**.
- ☆ These currents cause hot materials to rise and expand and cool materials to sink and contract.

Types of Crust:

1. **Oceanic Crust** - plates that float below oceans. These plates are thinner, desert, composed of basalt, and are high in iron content.
2. **Continental Crust** - plates that float below continents. These plates are thicker, less dense, composed of granite, and are high in silica content.

Types of Plate Boundaries:

1. **Divergent** - plates that move away from each other.
2. **Transform** - plates that slide past each other.
3. **Convergent** - plates that move towards each other.

Divergent Plates

- ☆ Divergent plates move away from each other to form divergent boundaries. As these plates move apart, new materials come up to fill that space.

Oceanic Divergent Boundaries:

- ☆ This activity takes place on oceanic crusts.
- ☆ Formed at the Mid-sea ocean ridge.
- ☆ When a divergent boundary develops on land, two slabs of Earth's crust slide apart. A deep valley called a rift valley forms along the divergent boundary.
- ☆ Can often cause shallow earthquakes or volcanoes.

Continental Divergent Boundaries:

- ☆ This activity takes place on continental crusts.
- ☆ Forms at the rift zones, volcanic mountain ranges to split by a rift valley, or where basalt flows.
- ☆ Can often cause shallow earthquakes or volcanoes.

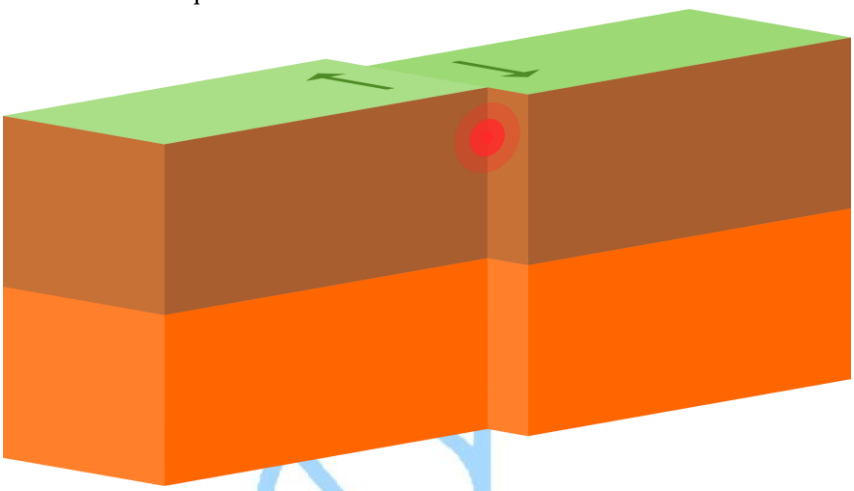
☆ ***Transform Plates***

☆ Transform plates slide past one another to form transform boundaries. These plates can move in the same direction, but at different speeds.

☆ Features:

- Possible earthquake scars.
- Often no features visible.

☆ Often causes extensive earthquake activities.



https://www.google.com/url?sa=i&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FTransform_fault&psig=AOvVaw2hCOSfAjreXDcPRA8XSkUf&ust=1594936888299000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCICU6Imh0OoCFQAAAAAdAAAAABAD

San Andreas Fault:

https://www.google.com/url?sa=i&url=https%3A%2F%2Fnerdist.com%2Farticle%2Fsan-andreas-fault-earthquake-odds-increase-ai-model-forecast%2F&psig=AOvVaw1jddsbjp3qslekQXoHqyqP&ust=1594936947264000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCODN9rKh0OoCFQAAAAAdAAAAABAD

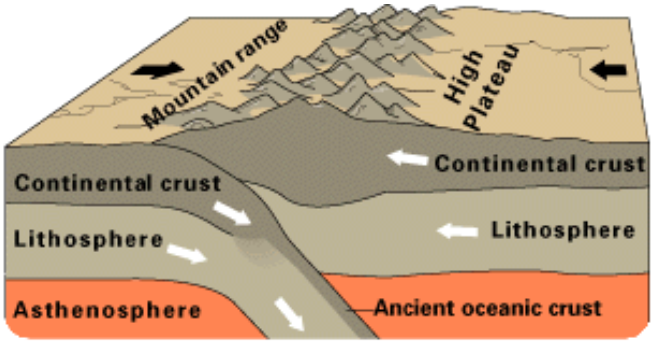
Convergent Plates

☆ Convergent plates move towards each other to form convergent boundaries.

☆

Continent-Continent Collision

- ☆ Two continental crust come together with force and collide and material gets pushed upwards.
- ☆ Usually from large mountains and cause extensive earthquakes.

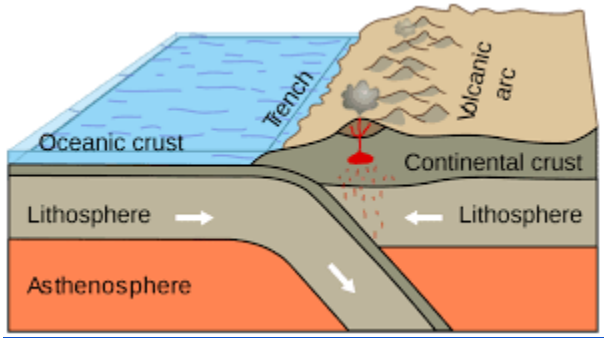


Continental-continental convergence

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.ck12.org%2Fearth-science%2Fcontinent-continent-convergent-plate-boundaries%2Flesson%2FContinent-Continent-Convergent-Plate-Boundaries-HS-ES%2F&psig=AOvVaw2ABU0SuZllZjzjFCdpraaW&ust=1594936833649000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKip9u6g0OoCFQAAAAAdAAAAABAD

Continent-Oceanic Collision

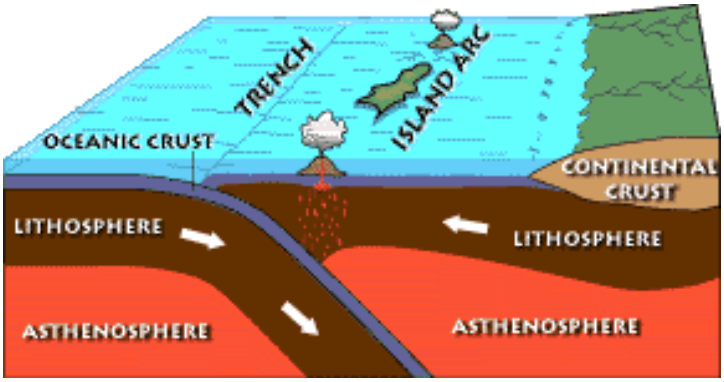
- ☆ One continental and one oceanic plate collides and the denser plate is overridden by the less dense plate.
- ☆ Results in deep earthquake activity, subduction of oceanic plates, and explosive volcanism.



https://www.google.com/imgres?imgurl=https%3A%2F%2Fdr282zn36sxxg.cloudfront.net%2Fdatastreams%2Ff-d%253A42169ca183d2b623c849bb176d060e86c6f07f1a67e157667c621686%252BIMAGE_TINY%252BIMAGE_TINY.1&imgrefurl=https%3A%2F%2Fwww.ck12.org%2Fearth-science%2Focean-continent-convergent-plate-boundaries%2Flesson%2FOcean-Continent-Convergent-Plate-Boundaries-HS-ES%2F&tbnid=8SqfnTqj8xqmDM&vet=12ahUKEwjYsLSQoNDqAhXINt8KHVqYD00QMygAegUIARCoAQ..i&docid=wDJ0P-Rdh-3WvM&w=800&h=448&q=oceanic-continental%20convergent%20boundary&ved=2ahUKEwjYsLSQoNDqAhXINt8KHVqYD00QMygAegUIARCoAQ

Oceanic-Oceanic Collision

- ☆ Two oceanic crusts come together with force and collide and the denser plate will sub duct under the less dense plate.
- ☆ Results in deep earthquake activity, subduction of oceanic plates, and explosive volcanism.



https://sites.google.com/site/hazards244/plate-boundaries-1

Angelina Varghese

9 GEOLOGIC HISTORY, CORRELATION AND RADIOACTIVE DECAY

Relative Dating - any type of method that determines whether an event or object is older or younger than other events or objects

Law of Superposition - in undisturbed rock layers, the oldest rocks are on the bottom and the youngest rocks are on the top

Principle of Original Horizontality - layers of sediment that are generally deposited in a horizontal position

Principle of Cross Cutting Relationships - a fault or intrusion is younger than the rock it cuts into

Unconformities - gaps in the rock record created by erosion or non-deposition

Inclusions - pieces of one rock unit that are contained within one another

Fossil - a preserved remnant or impression of an organism that once lived in the past

Radioactivity - a process that occurs when a nucleus decays and emits matter and energy

Parent Isotope - the original radioactive particles, unstable

Daughter Isotope - the stable isotope produced by the radioactive decay of the parent isotope

Half-Life - length of time required for half of the radioactive atoms in one sample to decay

Absolute Dating - any method of measuring the age of an event or object (in years)

Radiocarbon Dating - a chemical analysis used to determine the age of organic materials based on their content of the radioisotope carbon-14

Geologic Time Scale - a record of the geologic events and life forms in Earth's history.

Eon - the largest division of geologic time

Angelina Varghese

Geologic Era - a subdivision of geologic time that divides an eon into smaller units of time. The Phanerozoic Eon is divided into three time frames: The Paleozoic, Mesozoic, and Cenozoic represent the major stages in the macroscopic fossil record.

Geologic Period - a segment of geologic time that subdivides the geologic eras into smaller chunks of time

Geologic Epoch - a segment of geologic time that subdivides the geologic periods into smaller chunks of time. Only happen in Cenozoic Era

Precambrian - the oldest Era, 88% of the timeline, little life, anaerobic bacteria, first photosynthesizing bacteria made Oxygen

Mass Extinction - an event during which many species become extinct during a short period of time

Paleozoic - an era occurring between 542 million and 251 million years ago, which is characterized by the advent of fish, insects, and amphibians

Mesozoic - a middle era of Earth's history, during which Pangaea broke apart, dinosaurs appeared, and reptiles were the dominant life forms.

Cenozoic - an era that began about 66 million years ago and continues today, known as the "Age of Mammals"

Geologic Time

Periods of Geological Time:

1. **Cambrian (540-489 million years ago)**

- Phanerozoic Eon
- Paleozoic Era
- Included Burgess shale fauna, earliest fishes, earliest trilobites, and extinction of many primitive marine organisms.

2. **Ordovician (489-444 million years ago)**
- Phanerozoic Eon
- Paleozoic Era
- Included invertebrates and Earth's first coral reefs.

3. **Silurian (444-416 million years ago)**
- Phanerozoic Eon
- Paleozoic Era
- Included earliest insects, earliest land plants and animals, and abundant fish.

4. **Devonian (416 – 360 million years ago)**
- Phanerozoic Eon
- Paleozoic Era
- Included earliest amphibians and plant seeds, earliest forests, earliest ammonoids and shark, abundant fish, and the extinction of many marine organisms.

5. **Carboniferous (360 – 300 million years ago)**
- Phanerozoic Eon
- Paleozoic Era
- Included abundant amphibians, large number of seed ferns and scale tees, and extensive coal-forming forests.

6. **Permian (300 – 250 million years ago)**
- Phanerozoic Eon
- Paleozoic Era
- Included abundant reptiles, mammal-like reptiles, and mass extinction of many land animals and marine organisms (trilobites).

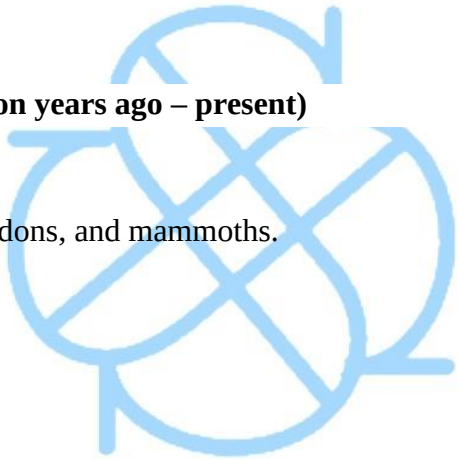
7. **Triassic (250 – 201.6 million years ago)**
- Phanerozoic Eon
- Mesozoic Era
- Included earliest mammals, earliest dinosaurs, and mass extinction of many land animals and marine organisms (trilobites).

8. **Jurassic (201.6 – 145.5 million years ago)**
- Phanerozoic Eon
- Mesozoic Era
- Included earliest birds and abundant dinosaurs and ammonoids.

9. **Cretaceous (145.5 – 65.5 million years ago)**
- Phanerozoic Eon
- Mesozoic Era
- Included earliest flowering plants and diverse bony fish, and mass extinction of dinosaurs, ammonoids, and many land plants.

10. **Tertiary (65.5 – 2.6 million years ago)**
- Phanerozoic Eon
- Cenozoic Era
- Large carnivorous mammals, abundant grass, earliest grasses, and modern groups of mammals.

11. **Quaternary (2.6 million years ago – present)**
- Phanerozoic Eon
- Cenozoic Era
- Include humans, mastodons, and mammoths.



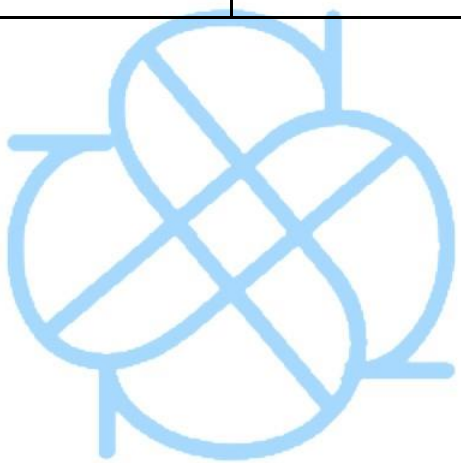
Radioactive Dating

- ☆ Radioactive elements can be used to find out how long ago that a fossil organism lived.
- ☆ Radioactive dating is a process in which you use radioactive elements to derive the age of fossil organisms.
- ☆ Radioactive elements give off particles and energy as they decay. So the decay can be measured at a fixed rate.
- ☆ The decay is measured in a unit called half-life.

- ☆ Half-life is the amount of time needed for half of the radioactive element to decay.
- ☆ By measuring the amount of radioactive element in a fossil, the number of half-lives of the element is found.
- ☆ This is then used to calculate the actual age of the fossil.

Common Radioactive Elements used for Radioactive Dating:

Radioactive Element	Half-life
Rubidium-87	*50 billion years*
Uranium-238	*4.5 billion years*
Potassium-40	*1.3 billion years*
Carbon-14	*5,770 years*



Examples:

1. If a fossil contained one-half as much carbon-14 as when the organism first formed, how old is the fossil?
   5,770 years old.

→ {Remember, the fossil only contained half the original amount of carbon-14, so the other half was decayed. The amount of time it takes carbon-14 to decay half its amount is 5,770 years. Therefore, the fossil is 5,770 years old.}

2. If a rock contained one-half as much carbon-14 as when the organism first formed, how old is the rock?
   2.6 billion years.

→ {Remember, the fossil only contains one-fourth the amount of potassium-40, so it went through a half-life twice. When the first half decayed, it took 1.3 billion years. When the remaining half decayed (leaving 0ne-fourth), it took 1.3 billion years more. Therefore, in total it took 2.6 billion years.}

3. If 10g of uranium-238 are present now, how much will be left in 4.5 billion years? How much in 9 billion years?
   5g in 4.5 billion years and 2.5g in 9 billion years.

→ {Remember, 4.5 billion years is the half-life of uranium-238, which means half of the element has been decayed. Therefore, half of 10g is 5g. 9 billion years adds another 4.5 billion years, so another half-life has passed. The half of the remaining uranium-238 has been decayed. Therefore, the half of 5g is2.5g.}