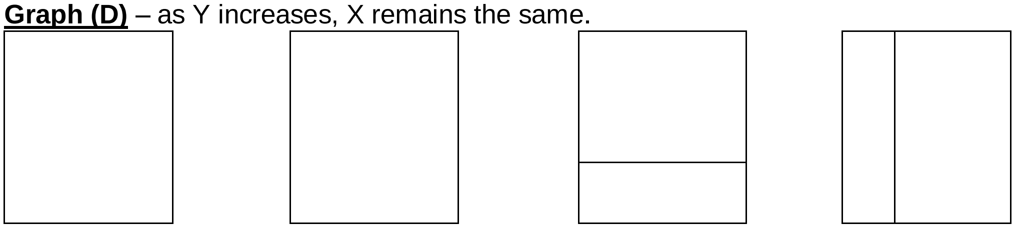
Regents Earth Science Final Review – Part 1

Percent Error (*Percent Deviation)* = calculating how far away your measurement is from the accepted standard, calculated as a percentage.

$$\text{Percent Error} = \frac{\text{Accepted value} - \text{Measured value}}{\text{Accepted value}} \times 100$$

Interpreting graphs: Graphs express relationships between the values shown on the graph. The "X" axis is the horizontal axis and the "Y" axis is the vertical axis.
Common relationships expressed in graphs:
Graph (A) – as X increases, Y increases **(a direct relationship)**
Graph (B) – as X increases, Y decreases (sloped the opposite way, would be as X decrease, Y increases) **(an inverse relationship.**
Graph (C) – as X increases, Y remains the same.
Graph (D) – as Y increases, X remains the same.



(A) direct | **(B) inverse** | **(C) As x increases, y remains same** | **(D) As y increases x remains same**

Density = the mass of a cubic centimeter of a substance (g/cm^3) = mass /volume
***Each substance has its own density (assuming temp and pressure are kept constant). The accepted density of aluminum is 2.7 g/cm^3
*****DENSITY DOES NOT CHANGE WITH THE SIZE OF THE SAMPLE!!!!!**
The density of aluminum is 2.7 g/cm^3 whether you have a tiny piece of aluminum or a piece the size of the room.
*****The density of liquid water is 1.0 g/cm^3** (1 cm^3 = 1 mL). Anything less dense than this will **float** in water. Anything more dense than this will **sink** in water. **Ice floats in water because ice is less dense than water.**
Factors that affect density:
- **phase of matter**. Most substances are most dense in the solid state, less dense in the liquid state and least dense in the gaseous state. ***The big exception to this is water.*** Water is most dense in the liquid phase at 4ºC.
- **temperature**. Generally, the higher the temperature, the lower the density.
- **pressure**. Generally, the higher the pressure, the greater the density.

****This image will help you in figuring out how to solve density problems:** $\frac{M}{d\,V}$
Simply cover up whichever value you need to calculate and the other two are shown in their proper placement, be it to multiply or to divide.

Dynamic Equilibrium = when there is a state of balance because opposing forces are proceeding at equal rates. For example, when erosion and deposition in a stream are occurring at equal rates, there is no net gain or loss of material.

Cyclic changes are events that are continually repeated and are predictable.
Examples of cyclic changes:
- the monthly cycle of the phases of the Moon
- the yearly cycle of the seasons
- the daily cycle of sunrise and sunset
- the 11 year cycle of sunspot activity

Oblate spheroid = the actual shape of the Earth. Earth is a **nearly perfect sphere** but is **slightly flattened** at the poles and **slightly bulging** at the equator. *** Pick the "perfect circle" diagram as best representing Earth's true shape! The bulging and flattening are very, very slight.

Evidence that the Earth is spherical:
- **photographs from space** show a spherical Earth
- **altitude of Polaris (North Star)** depends on the observer's latitude (northern hemisphere only). If you are at the North Pole, Polaris is directly overhead (90º angle above the horizon at 90º North latitude). If you are on the equator, Polaris is located on the horizon (0º above the horizon at 0º latitude).
- **observations of the way ships at sea seem to disappear and reappear:** When a ship is traveling away from the observer, toward the horizon, it disappears bottom first, top last. When a ship is approaching the observer from the horizon, it reappears top first, bottom last.
- **shape of the Earth's shadow on the Moon during a <u>lunar</u> eclipse:** The Earth casts a curved shadow on the Moon during a lunar eclipse.

Astrolabe is an instrument used to find the angular altitude from the horizon to the position of a heavenly body. Sailors used astrolabes to figure out their latitude, since the altitude of Polaris above the horizon in degrees is equal to the latitude of the observer (northern hemisphere only).

<u>**Locating positions on Earth's surface:**</u>
Equator = an imaginary line that circles the Earth halfway between the North Pole and the South pole. This is the line of **0º latitude**.
Latitude = distance north or south of the equator, measured in degrees. The equator lies at 0º latitude, the North Pole at 90ºN latitude and the South Pole at 90ºS latitude.
Longitude = imaginary lines drawn around the Earth from the North Pole to the South Pole. A line of longitude is called a **meridian.**

Topographic maps show the shape of the Earth's surface by the use of **contour lines**.
Contour interval = the stated difference in elevation between contour lines on a topographic map.
****Where contour lines are close together, the slope of the land is <u>steep</u>.
****Where contour lines are far apart, the slope of the land is <u>gentle</u>.
Hachured lines are contour lines with little marks on them. They indicate areas of the land that go lower where one might expect the land to go higher. For example, hachured lines would indicate a crater at the top of a mountain.
**** **"V"s** in contour lines always point toward the higher elevations. Vees usually indicate the upstream direction of river flow. Rivers always flow from higher elevations to lower elevations.
A **benchmark** is a site whose elevation has been measured precisely. Benchmarks are indicated by a little "x" next to the number.

<u>**Geocentric Model**</u>**:**
- is **Earth-centered**; Earth is at the center of the universe; the Sun, the planets and all the stars circle the Earth.
- proposed by **Ptolemy** about 2000 years ago.
- the stars, the Sun and all the planets are located on transparent "spheres" that revolve around the Earth from east to west once each day.

<u>*Observations explained by the geocentric model:*</u>
- the daily apparent motions of the Moon, the Sun and the stars

<u>*Observations NOT explained by the geocentric model:*</u>
- cannot predict exactly the future motions of the planets.
- cannot explain the change in direction of a pendulum's swing **(Foucault pendulum)**.
- cannot explain the **Coriolis Effect** – the curving of the paths of projectiles, winds and ocean currents.

<u>**Heliocentric Model:**</u>
- is **Sun-centered;** The Sun is located at the center of the Solar System and does not move. The planets circle around the Sun.
- proposed by **Copernicus** in 1543; added to and modified by **Tyco Brahe** and **Johannes Kepler**.

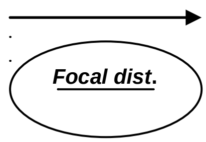
<u>*Observations explained by the heliocentric model:*</u>
- the apparent daily motion from east to west of all celestial objects around the Earth (is due to the **rotation** of Earth on its axis, completed once every 24 hours).
- explains the eastward motion of the Sun through the stars.

- can predict accurately the motions of the other planets; states that each planet travels in its own orbit around the Sun.
- explains the changing **apparent diameter** and the changing **apparent brightness** of the Sun and the planets; as Earth orbits around the Sun, its distance from the Sun and from each of the planets varies. For example, the Sun *looks larger* in the *winter* because Earth is *closer* to the Sun in winter than at any other time of the year.
- explains the motions of the **Foucault pendulum** and the existence of the **Coriolus effect**. Both are caused by the rotational movement of the Earth.

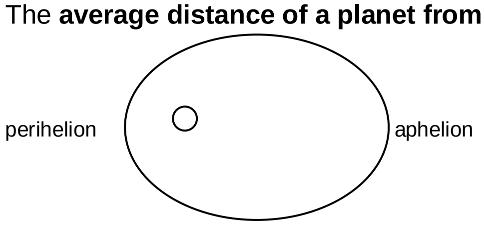
. Kepler worked out a mathematical formula to calculate how flattened any elliptical orbit is. He called this flattening the orbit's **eccentricity**:

$$\text{Eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

length of major axis (from circumference to circumference through the focal distance)



The **average distance of a planet from the Sun** is equal to one-half the length of the major axis of its orbit.



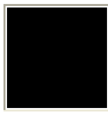
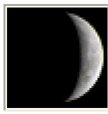
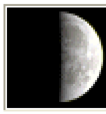
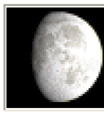
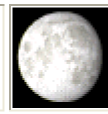
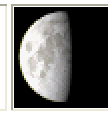
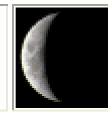
perihelion = when the planet is nearest to the Sun (early January for Earth)
aphelion = when the planet is farthest from the Sun (early July for Earth)

Seasons:

- Are the result of the Earth's location in its path around the Sun, the tilt of the Earth's **axis** (23.5°) and the **angle of insolation** (angle at which the Sun's rays are striking the ground.) The **angle of insolation** is greatest for the northern hemisphere in June, lowest for the northern hemisphere in December.
- Seasons are reversed in the northern and southern hemispheres. That is, when the northern hemisphere is having winter, the southern hemisphere is having summer.
- At the **autumnal equinox** (about Sept. 21) and the **vernal equinox** (about March 21,) daylight lasts for about 12 hours all over the world.
- The greatest number of hours of daylight in the northern hemisphere occurs at the **summer solstice** around June 21. For the NY area, there is about 15 hours of daylight on this day.
- The shortest number of hours of daylight in the northern hemisphere occurs at the **winter solstice** around December 21. For the NY area, there is about 9 hours of daylight on this day.
- The number of hours of daylight varies cyclically and therefore predictably throughout the year.

Phases of the Moon:

- **Phases** = the cyclical changes in the apparent shape of the lighted portion of the Moon. One half of the Moon is always facing the Sun, but the lighted portion of the Moon is NOT always facing the Earth.
- The only part of the Moon that we can see is the portion that is both lighted by the Sun *and is facing towards the Earth*.
- A **solar eclipse** occurs when there is a **new moon phase** (the entire unlighted half of the Moon is facing the Earth and the Moon is passing in between the Sun and the Earth.) The Moon appears to block out the Sun as the Moon passes between the Sun and the Earth. This is rare, because all three bodies do not line up exactly very often.
- A **lunar eclipse** occurs when the Earth passes in between the Sun and the **full moon phase**. The Earth's shadow blocks out the Moon, causing the full moon to disappear and reappear.
- It takes about 29.5 days for the Moon to complete one orbit around the earth. That is why it takes about 29.5 days for the Moon to complete its cycle of phases.

							
New	Waxing Crescent	1st Qtr	Waxing Gibbous	Full	Waning Gibbous	Last Qtr	Waning Crescent

The right side of the Moon appears first (waxing phases). The left side of the Moon vanishes last (waning phases)

Regents Earth Science Review – Part 2

Potential Energy = stored energy or energy of position. For example, if you increase the altitude of an object, you increase its potential energy.

*** Potential energy is greatest when an object is at its highest point above the Earth.

Kinetic Energy = the energy of motion. Kinetic energy is greatest when an object is moving the fastest, or when its molecules are moving the fastest.

*** Kinetic energy is increases when an object is moving faster or when an object is heated.

*** **There is an inverse relationship between the amount of potential energy and the amount of kinetic energy. As potential energy increases, kinetic energy decreases and vice versa.**

Thermal Energy = the total potential and kinetic energy that can be released as heat from a substance or an object.

Measuring Kinetic Energy

- A **thermometer** measures **temperature**, which is the average kinetic energy of the molecules (particles) in a substance or object.
- **Absolute Zero** (0^o Kelvin, -273^oCelsius) is the point at which there is a total absence of heat. At absolute zero, there is no molecular movement at all. There is no temperature "colder" or lower than absolute zero!!!!!

Methods of transfer of heat energy:

Radiation is energy transfer by means of electromagnetic waves. It is the only method of heat transfer that can travel through empty space (a vacuum,) but it is not limited to traveling through empty space.

Conduction is energy transfer through solids, from molecule to molecule. Metals are particularly good conductors of heat energy.

Convection is the way energy travels through fluids (liquids and gases). The warmer (more energetic) molecules spread apart, becoming less dense and rising. The cooler molecules (which are closer together and therefore more dense) move to take the place of the molecules that have risen. This sets up a circular pattern of warmer molecules rising and cooler molecules falling. Uneven heating of the Earth's atmosphere and oceans causes winds and ocean currents to form.

Electromagnetic Energy is the form of energy we receive from the Sun. It is energy that travels in the form of *electromagnetic waves*, usually by the process of radiation.

Electromagnetic Waves vary in ***wavelength*** and ***frequency***.

The **Electromagnetic Spectrum** is composed of all the wavelengths of e.m. energy from the longest (radio waves) to the shortest (gamma rays). (See the Reference Tables.)

Visible Light = the part of the e.m. spectrum that can be perceived by our eyes. Our eyes perceive the different wavelengths of the visible spectrum as different colors. The visible portion of the e.m. spectrum males up only a tiny part of the entire e.m. spectrum.

Reflection = bounced off, as light bounces off a mirror.

Refraction = scattered, bent, slowed down, shifted to lower wavelengths, as happens when light enters the thicker portions of the atmosphere nearer to Earth's surface. Refraction of sunlight causes the sky to appear "blue."

Absorption = taken in – as when the sand on the beach gets hot on a summer day. The energy that is absorbed is usually ***reradiated*** as electromagnetic energy of longer wavelengths (infrared,) if the object that absorbed the radiation becomes warmer than its surroundings.

**** A good absorber is a good re-radiator.

Changes in Phase:

- occur when enough heat energy is added or subtracted.
- **Melting** is a phase change from solid to liquid.
- **Freezing** is a phase change from liquid to solid.
- **Evaporation** is a phase change from liquid to gas.
- **Condensation** is a phase change from gas to liquid.
- **Sublimation** is a change of state from a gas directly to a solid or from a solid directly to a gas, without passing through the liquid phase.

***** THERE IS NO TEMPERATURE CHANGE DURING A PHASE CHANGE!!!

Atmospheric Pressure is a measure of the force exerted by the atmosphere. Changes in atmospheric pressure are caused by changes in the density of the air.

*** **Warmer air** is *less dense* → **lower atmospheric pressure**
*** **Cooler air** is *more dense* → **higher atmospheric pressure**
*** **Wetter (more humid) air** is *less dense* → **lower atmospheric pressure**
*** **Dryer (less humid air)** is *more dense* → **higher atmospheric pressure**

- **Relative Humidity** is a measure of the percentage of moisture saturation of the air. Relative humidity is measured with an instrument called a **psychrometer,** which tells us the **wet bulb and dry bulb temperatures**. We then use the **Relative Humidity Chart** in the *Reference Tables* to calculate the relative humidity. Relative humidity tells us how much moisture the air *is currently holding* as compared to how much moisture the air *could hold at that temperature*. A relative humidity of 80% would mean that the air is holding 80% as much moisture as it could hold at that temperature.

*** **Air temperature** determines the air's capacity to hold moisture.
*** **Warmer air** can hold *more moisture*.
*** **Cooler air** can hold *less moisture*.

A relative humidity of 100% means that the air is holding the maximum amount possible at a particular combination of air temperature and air pressure.

Absolute Humidity is **not** a weather factor! **Absolute Humidity** is the percentage of the entire atmosphere that is composed of water vapor. ***This is always less than 1%***

Wind direction tells you the direction the wind ***is coming from***.

The **Coriolis Effect** causes the planetary wind belts to curve, generally to the right in the northern hemisphere and to the left in the southern hemisphere. The Coriolis Effect is a result of the Earth's rotation; the atmosphere lags as the Earth rotates.

High Pressure = cool, dry air

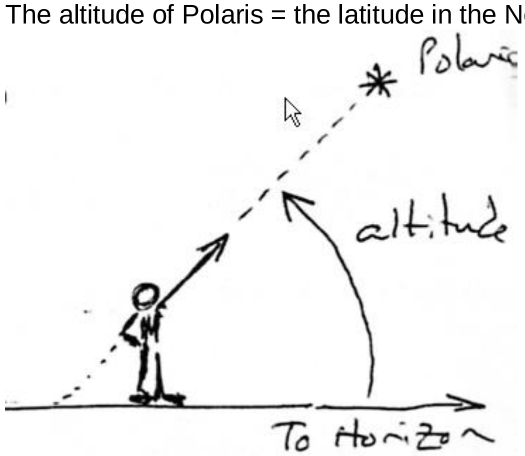
Air moves out and clockwise

Low Pressure – warm, moist air

Air moves in and counterclockwise

****Winds blow from high pressure to low pressure

The altitude of Polaris = the latitude in the Northern Hemisphere.



Potential Evapotranspiration (Ep) = temperature; higher temp = higher Ep

O_3 (ozone) absorbs ultraviolet (UV) radiation.

CO_2 (carbon dioxide) absorbs infrared radiation (heat) and causes global warming.

Porosity is unaffected by particle size.
Larger particles are more permeable; they let water pass through more quickly (faster rate, less time.)
Capillarity (water retention) is most effective between smaller particles

Spring Equinox ~ March 21 Fall Equinox ~ September 21
(Equinox = equal day and night)
Summer Solstice ~ June 21 (longest day of year in Northern hemisphere)
Winter Solstice ~ December 21 (shortest day of year in Northern hemisphere)

***The equator has about 12 hours of daytime every day of the year.

Emergency Preparedness steps:
For all “disasters”: learn first aid, prepare a first aid kit, prepare an emergency supplies kit, make a family emergency plan, plan escape routes, evacuate low-lying areas.

Regents Earth Science Final Review – Part 3

<u>Physical weathering</u> = changes in the size, shape and/or state of a rock, but **not** in chemical composition. No new substances are formed.

Agents of physical weathering:

- Frost action (repeated cycles of freezing and thawing; water expands when it freezes, breaks rocks)
- Plant roots
- Burrowing animals
- Abrasion (usually in streams)
- Wind

<u>Chemical weathering</u> = a change in the chemical composition of the rock caused by reactions with water, chemicals in the environment and with the atmosphere. New substances form as a result of chemical weathering.

Agents of chemical weathering:

- Water
- Oxidation (Rusting)
- Acid rain

***** Whether physical or chemical weathering is most important in an area depends on the climate of the area.** Generally, chemical weathering is dominant in warm, moist climates, while cooler climates have more physical weathering than chemical weathering.

Soil is a mixture of weathered rock and organic components, (**humus)** such as dead roots, leaves, etc.
Soil horizons are the three distinct layers that form in a mature soil.
<u>Soil horizons:</u>

- **Horizon A** = the uppermost layer (at the surface). The A horizon is usually the layer richest in **humus** (organic matter). Water, air, burrowing animals, bacteria, plant roots are present. Some minerals have been dissolved (**leached**) by water in this layer.
- **Horizon B** = the layer just beneath Horizon A. Horizon B is poor in organic matter, but is enriched by materials leached from Horizon A.
- **Horizon C** = the layer below Horizon B and just above the bedrock. Horizon C is made up of bedrock in various stages of decomposition and weathering.

<u>Types of soils:</u>

- **Residual soil** is soil that remains on top of the bedrock upon which it formed. It has <u>not</u> been transported (moved).
- **Transported soil** is soil that has been moved by one or more agents of erosion. Transported soils have a different composition from that of the bedrock upon which they rest.
-

<u>Agents of erosion:</u>
<u>Liquid water erodes (transports sediments) by:</u>

- **Solution** = particles that have dissolved in the water, forming a clear, transparent mixture. The particles in a solution are too small to be filtered out.
- **Suspension (colloids)** = tiny particles which have not dissolved, but do not settle out when the water is left standing. Suspended particles may be filtered out.
- **Flotation** = sediments of low density that are light enough to float.
- **Traction =** the largest, heaviest particles of sediment roll or bounce along the stream bed as they move.

<u>Gravity</u> is the most important agent of erosion. Gravity is the underlying mechanism for most types of erosion (sediment transport.)

Velocity of a stream:

- depends upon the <u>gradient</u> (change in elevation over distance) of the stream and the <u>discharge</u> (amount of water flowing) of the stream.
- determines the size of the particles that the stream can transport; there is a <u>direct</u> relationship between the velocity of the stream and the sizes of the particles able to be transported. The faster the flow of the stream, the larger the particles it will be capable of transporting.
- Rivers make V-shaped valleys
- Rivers produce sorted deposits; larger, denser particles are deposited first as river slows down.

Erosion by wind:

- occurs mainly in arid (dry) areas; sand particles blowing around cause abrasion; wind transports these particles.

Erosion by ice:

A **glacier** is a large mass of moving ice.

- Glaciers make U-shaped valleys.
- Deposits are unsorted (all different sizes mixed together.); called glacial till. Glacial land formations include esker, drumlin, cirque.
- **Outwash plain** is sorted deposits produced by glacial meltwaters forming rivers. North shore of L.I. is rocky because glaciers stopped here; outwash rivers carried finer material (sand) to south shore.
- **Ice ages** periods of widespread continental glaciation.
- There have been four ice ages in the NY area in the past million years (Pleistocene)
- Glaciers formed Long Island (between 20,000 – 12,000 years ago.)
- **Striations** are parallel scratches in bedrock caused by abrasion as the ice carried particles over the bedrock.

<u>Rates of Deposition</u> (how fast material is deposited) are affected by:

- Particle size (larger settle more quickly)
- Particle shape (flatter settle more slowly)
- Particle density (denser settle more quickly)
- the faster the water, the fewer particles that will settle\

Vertical sorting: Particles are deposited in layers, from largest in the bottommost layer to the smallest in the topmost layer. (Example: bunch of stuff dumped into a lake all at once settles this way.)

Horizontal sorting: As a river slows, particles drop out from largest to smallest along the riverbed.

Base level: This is the lowest level a river can reach before it stops flowing (usually sea level, but not necessarily).

Gradient: This is the change in height over distance traveled. Generally, erosion proceeds faster in areas of high gradient; deposition takes place in areas of low or no gradient.

Dynamic equilibrium: This is when the rate of erosion is equal to the rate of deposition, so there is no net change in the level of the sediments.

Oceans and coastal processes:

- **Oceans** cover nearly 71% of Earth's surface, to an average depth of 4 kilometers (3 miles).
- **Waves near the shore** and **longshore currents** (currents parallel to shoreline) change the land at the edges of the oceans.
- ***Waves out in the deep ocean do **not** carry water along; the wave of energy simple passes through the water that is there.

Landscape Development:

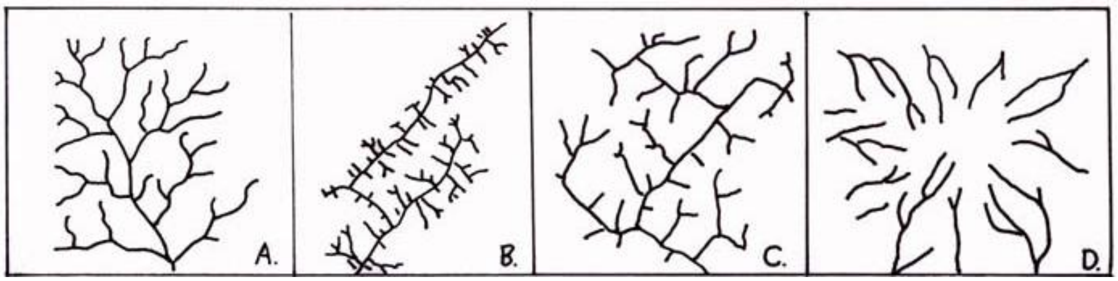
***** A **landscape** is a region on the Earth's surface in which the physical features of the region are related by a common origin. Examples of landscapes include mountains, plateaus, plains.

Mountain landscapes: greatest changes in elevation; steep gradients; fast-flowing streams; commonly underlain by metamorphic rock, igneous rock, or folded sedimentary rock. (Rocky Mountains)

Plateau landscapes: are relatively "flat," but have greater elevations than plains; are the product of uplift; have deep valleys; commonly underlain by horizontal sedimentary rock layers. (Colorado Plateau, Allegheny Plateau.)

Plains landscapes: are relatively "flat" and at low elevations; gentle slopes; low gradients; underlain by flat layers of sedimentary rock; have meandering streams with wide floodplains.

Stream drainage patterns are determined largely by the type of bedrock underlying an area.



- **(A) Dendritic drainage** has a tree-like, branching pattern. Dendritic drainage patterns form where bedrock is made of flat-lying layers of uniform composition. There are no specific areas of weakness in the rocks.
- **(B)Trellis drainage** is a rectangular pattern of streams that usually forms in an area where rocks have been folded. The incompetent layers erode away to form parallel valleys; the more competent layers form parallel ridges.
- **(C) Rectangular drainage** is when streams flow and join at right angles. It forms when there are specific areas of weaker and more resistant rock layers that promote the formation of this pattern.
- **(D) Radial drainage** is a pattern of streams radiating from a central area, such as down the sides of a volcano or a rounded hill. There is little difference in rock competence (weakness/strength) in the area.
- **Annular** drainage resembles radial, but is a pattern of streams in concentric circles. It forms on mountains where there is a great difference in the competence of the exposed rock layers.

Landscape maturity depends on the portion of the land that has been worn down to **base level** (lowest possible elevations in the area).

Maturities of landscapes:

- **Youthful landscapes** have high elevations, steep hill slopes, high gradients and narrow, fast-running streams. There may be waterfalls and rapids. Soils are immature. Rivers are downcutting their channels.
- **Mature landscapes** are more rounded and have lower elevations with gradual hill slopes. Stream valleys are broad, rivers have meanders and have developed floodplains. Streams have begun to deposit some of their sediments.
- **Old age landscapes** have had most of the land eroded down to near base level. The area is mostly flat, but there may be a few hills. Streams have a very low gradient, wide floodplains and many meanders. Soils are thick and well-developed. Streams are depositing much of their sediments.
- **Rejuvenated landscapes** form when an existing landscape is uplifted, causing slopes to increase in gradient and causing streams to begin downcutting again.

Regents Earth Science Final Review – Part 4

<u>Plate Tectonics</u> is the theory that the earth's crust is composed of about a dozen "puzzle pieces" called **plates**. These plates shift, causing crustal changes such as volcanoes, earthquakes and mountain building along the edges of the plates. Edges are located along the west coasts of North and South America, along the Mid-Atlantic Ridge in the Atlantic Ocean, all around the edges of the Pacific Ocean, etc.

Plate Tectonics is driven by convection currents in the upper mantle. Hotter material moves upward causing divergent plate boundaries. Convergent boundaries occur at side of plate opposite the divergent boundary.
Convergent Plate Boundaries are places where two or more tectonic plates are crashing together. Example: The Pacific and North American plates are crashing into each other all along the west coast of North America.
Divergent Plate Boundaries are places where two or more tectonic plates are spreading apart.
The **Mid-Atlantic Ridge** is a divergent boundary.

Evidence of plate movement:

- matching 250 million year old rocks and fossils found along the west coast of Africa and the east coast of South America.
- edges of South America and Africa "match" in shape
- rocks get progressively older on each side of Mid-Atlantic Ridge as you travel east or west of the Ridge.
- earthquakes, mountain building and volcanoes along the edges of the plates show that there is movement and that heat is escaping.

Movement occurs along **faults** (breaks in Earth's crust.)

Earthquakes happen when rocks get stressed by movement of tectonic plates, and finally break, causing movement along a fault.

- Most earthquakes happen in subduction zones (convergent boundaries) at plate edges. Pacific Ring of Fire (outlines Pacific Ocean) has most of world's earthquakes and active volcanoes.
- Earthquakes produce P-waves and S-waves.
- P-waves travel faster and arrive first.
- S-waves travel slower and arrive after P-waves.
- Closer to the earthquake: P-wave and S-wave arrival times are closer together.
- Farther from the earthquake: more time elapses between the arrival of the P-waves and the S-waves.

A **focus** is the place underground where the actual movement along a fault occurred during an earthquake.
An **epicenter** is the location at Earth's surface just above the focus.

Damage from earthquake depends upon:

- nearness to epicenter (closer, more damage)
- type of rocks underlying area (igneous, metamorphic are stronger → less shaking; sedimentary are weaker → more shaking.)
- whether **tsunami** results (giant ocean waves from earthquake in ocean)
- whether or not buildings have been built to withstand quakes.

Earthquake Disaster Preparation:

- Evacuation plan
- Conduct drills in the home; have a family meeting place
- first aid kit
- supply of water, food, battery-operated radio, flashlights, supply of cash, special items for infant, elderly, or disabled family members

Pangaea is the name scientists have given to the "supercontinent" that existed about 250 million years ago, when all of Earth's major landmasses were joined together.

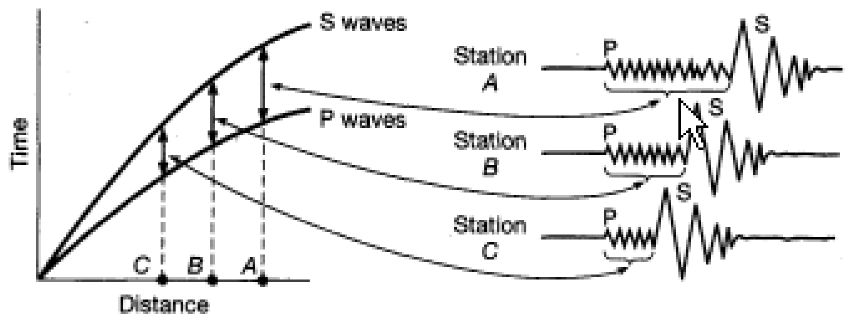
<u>How to find the epicenter and the distance to the epicenter of an earthquake:</u>

To find the distance of the station from the epicenter of a quake:

1. Turn to page 11 in the *Earth Science Reference Tables* to see the chart called **"Earthquake P-wave and S-wave Travel Time."**
2. Note the arrival time of the P-waves and/or the S-waves. Find the difference between the two arrival times by subtracting the P-wave arrival time from the S-wave arrival time. Express the difference in minutes and seconds, such as 6:40 = 6 minutes, 40 seconds.
3. On a clean sheet if paper, mark the interval along the time travel scale on the vertical axis of the Time Travel Graph.
4. Slide the marks you made on the edge of the paper along the P- and S- curves of the Time Travel Graph until the marks are touching both curves.
5. Follow the marked edge of your paper down to the horizontal axis of the graph to find the distance from the epicenter. The distance is expressed in thousands of kilometers.

To find the location of the epicenter of an earthquake:

1. Perform the above procedures for three different station locations.
2. Using the calculated distance from the epicenter for **each** of the station locations, draw a circle around each of the stations, using the station as the center of the circle, and the distance of the station from the epicenter as the radius of the circle.
3. Find the place where **all three circles intersect**. This is the location of the epicenter of the quake.



(a)

(b) North America

Figure 9

Regents Earth Science Final Review – Part 5

Rocks = the substances that make up the solid part of the Earth's crust; are usually a mixture of minerals.

Minerals = naturally occurring, inorganic crystalline substances. Each mineral is a different compound or single element. Minerals are identified by their **physical** and **chemical properties**.

Physical and Chemical Properties of Minerals

A. Physical Properties

- **Color** = the color of the whole piece. (Unreliable; many minerals are same color.)
- **Streak** = the color of the powdered mineral. Rub mineral on streak plate.
- **Cleavage and Fracture** = the way in which a sample of mineral splits or breaks.
  Cleavage = breaks with parallel flat sides; Examples: halite – cubic cleavage; calcite – rhombic cleavage)
  Fracture = breaks irregularly (no parallel flat sides.) Examples: Quartz, pyrite, magnetite.
- **Hardness** = a mineral's ability to resist being scratched.
  Soft (hardness 1 – 2.5) can be scratched with fingernail (mica, talc, gypsum)
  Medium (hardness 3-5.5) cannot be scratched with fingernail and will not scratch glass (feldspar, fluorite)
  Hard (hardness > 5.5) cannot be scratched with fingernail and will scratch glass (quartz, diamond)
- **Luster** = the way that the mineral "shines" or reflects light.
  Metallic = shines like metal (galena, pyrite)
  Nonmetallic = does not shine like a metal. Could be glassy, (quartz) dull (red hematite)

Chemical Properties = how a mineral reacts with other substances. For example, in the **acid test**, a few drops of HCl (hydrochloric acid) are put on a sample of the mineral. If there is a reaction, and **bubbles of carbon dioxide** (CO_2) form, then the mineral is probably **calcite**.

FORMATION OF ROCKS:

Rocks are classified according to the way that they formed. There are three major categories of the ways rocks can form:
Igneous Rocks form when melted (molten) rock cools down and becomes solid.
Sedimentary Rocks form when particles of weathered and eroded rocks become cemented together, from the remains of plants or animal, or from minerals which form in water.
Metamorphic Rocks form when other types of rocks become changed by heat, pressure, and/or chemically active fluids, **but have not been melted**. (If they do become melted, they become **igneous rocks** when they cool off again.

Study pages 6 and 7 in the Reference Tables to learn how igneous, sedimentary, and metamorphic rocks are classified.

Earth history compressed into one year

Jan. 1	Beginning of Earth
Feb. 21	Life evolved
Oct. 25	Complex organisms w/shells
Dec. 7	Reptiles appeared
Dec. 25	Dinosaurs went extinct
Dec. 31, 11 pm	Homo sapiens appeared
Dec. 31, 11:58:45 pm	Last glacial ice age ended

Radioactive Dating utilizes the known radioactive decay rates of certain isotopes of elements to get the **absolute age** of an object, measured in years.

HALF-LIFE

A **half-life** is the amount of time required for **half** the amount of a given sample of a radioactive element to decay into its decay product.
***** IT DOES NOT MATTER HOW BIG THE SAMPLE IS! During a half-life, HALF the amount of the radioactive sample will decay into its more stable product. NOTHING CAN CHANGE THE AMOUNT OF TIME IT TAKES FOR A HALF LIFE FOR A CERTAIN RADIOACTIVE ISOTOPE TO DECAY TO ITS STABLE PRODUCT! The length of time it takes for a half-life to pass depends upon which radioactive element it is. (See p. 1 of Reference Tables)

In an "undisturbed" sample:
*** After ONE half-life, half of the original sample of radioactive isotope will be left.
After TWO half-lives, one-fourth of the original radioactive sample will be left.
After THREE half-lives, one-eighth of the original radioactive sample will be left.
After FOUR half-lives, one-sixteenth of the original radioactive sample will be left
After FIVE half-lives, 1/32 of the original radioactive sample will be left.
……and so on
At each step, a proportionate amount of stable decay product will also be present in the sample.

***Radioactive isotopes are "good" for dating time periods of up to six or seven half-lives. After this amount of time, there is little to none of the original radioactive isotope left in the sample. This is why C^{14} can only date a sample to 50,000 years old and no older. Other, more long-lasting isotopes would have to be used for dating something older than that.