Earth Science Quick Study!

Dimensions of the Earth

- People have observed the stars for thousands of years.
- People have used the stars to find direction.
- People have used the stars to note the passage of time.
- Earth's coordinate system of latitude and longitude is based upon Earth's rotation and our observation or the Sun and stars.
- The equator and prime meridian are reference lines to latitude and longitude.
- The earth rotates on an imaginary axis.
- The earth rotates 15 degrees per hour.
- To people on Earth, this turning of the planet makes it seem as though the Sun, the moon, and the stars are moving around Earth once a day.
- Rotation provides a basis for our system of local time.
- Meridians of longitude are the basis for time zones.
- The Foucault pendulum provides evidence of Earth's rotation.
- The Coriolis effect provides evidence of Earth's rotation.
- Earth's changing position with regard to the Sun and the moon has noticeable effects.
  - Earth revolves around the Sun with its rotational axis tilted at 23.5 degrees to a line perpendicular to the plane or its orbit.
  - The North Pole is aligned with Polaris.
- Topographic maps represent landforms through the use of contour lines.
- Contour lines are isolines connecting points of equal elevation.
- Gradients and profiles can be determined from changes in elevation over a given distance.

Scientific Notation $5400 = 5.4 \times 10^3$

$.000081 = 8.1 \times 10^{-5}$

Density = concentration of matter

↑T, D↓ (indirect relationship) ← The way the graph looks

↑P, D↑ (direct relationship)

- less dense floats, more dense sinks
- same density will stay suspended in middle

mass = 13.5g volume = 4.2 ml

$D = \frac{m}{V}$

$= \frac{13.5g}{4.2ml}$

$= 3.124\ g/ml$

$= 3.1\ g/ml$ rounded (tenth)

KEY POINT - density does not depend on size or shape. No matter how you cut the clay, each piece will have same density.

rate of change:

1958 elevation was 3000 ft.

1998 elevation was 2920 ft.

rate of change = $\frac{\text{change in field value}}{\text{time}}$

$= \frac{3000ft - 2920ft}{40\ yrs}$

$= \frac{80\ ft}{40\ yrs}$

$= 2\ ft/yr$

deviation

wrong = 23.4g right 24.8g

$dev = \frac{d.f.a.v}{a.v.} \times 100$

$= \frac{24.8g - 23.4g}{24.8g} \times 100$

$= \frac{1.4g}{24.8g} \times 100$

$= 0.0564516 \times 100$

$= 5.64516$

$= 5.6\ \%$ (tenth)

oblate spheroid = shape of Earth ○ Looks like a circle ○.

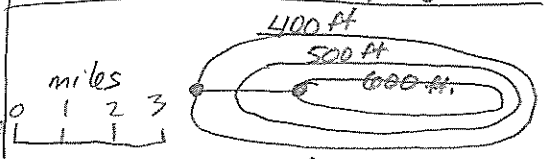
= Latitude ||| Longitude ½ 40° = 40°N Latitude

Field = what you've measured (elev, temp, pressure)

Contour interval = what you count by

steep gentle

stream → water flowing to the west. Cont. lines make a V that points in the opposite direction

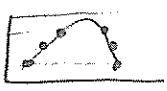


Gradient = $\frac{c.i.f.v}{distance}$

$= \frac{600ft - 400ft}{2\ miles}$

$= \frac{200\ ft}{2\ miles}$

$= 100\ ft/mile$

profile 

observation = using senses

inference = interpretation

Classification = grouping based on characteristics

mass = amount of matter (g)

volume = amount of space (ml or cm^3)

Minerals and Rocks

- Sediments of inorganic and organic origin often accumulate in depositional environments
- Sedimentary rocks form when sediments are compacted and or cemented after burial or as the result of chemical precipitation from seawater.
- Observation and classification have helped us understand the great variety and complexity of Earth Materials
- Minerals are the naturally occurring inorganic solid elements, compounds, and mixtures from which rocks are made.
- We classify minerals on the basis of their chemical composition and observable properties.
- Rocks are generally classified by their origin (igneous, metamorphic, and sedimentary), texture, and mineral content.
- Rocks and minerals help us understand Earth's historical development and its dynamics.
- Rocks and minerals are important to us because of their availability and properties
- The use and distribution of mineral resources and fossil fuels have important economic and environmental impacts.
- As limited resources, they must be used wisely.
- Physical properties of minerals are determined by the internal arrangement of atoms.
- Minerals can be identified by well-defined physical properties such as cleavage, fracture, color, density, hardness, streak, luster, and crystal shape.
- Chemical properties of minerals: The mineral Calcite bubbles with acid.
- Chemical composition and physical properties determine how minerals are used by humans.
- Minerals are formed inorganically by the process of crystallization.
- Crystallization is the result of specific environmental conditions: the cooling and solidification of magma
- Precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes.
- Rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure.

- Rocks are usually composed of one or more minerals.
- Rocks are classified by their origin, mineral content, and texture.
- Conditions that existed when a rock formed can be inferred from the rock's mineral content and texture.
- The properties of rocks determine how they are used and also influence land usage by humans.

Use Your Reference Tables ★★★

Color = can not tell a mineral by its color (except Sulfur) too many variations
cleavage = breaking along a smooth/flat plane
fracture = breaking unevenly
hardness = resist. to being scratched
streak = color of powder
luster = the way it reflects light

* most are made from the same 9 minerals. Those minerals are called rock forming min.

Igneous - were completely liquid + solidified
- some have vesicales (bubble holes)
- intrusive - cool underground slowly so they have time to form LARGE crystals.
- extrusive - cool above ground quickly so they form small crystals
- supercooling = glassy texture (obsidian)
- magma - below lava - above

Sedimentary - made of pieces, chemical, or biologic activities
- clastic = pieces (compression or cementation)
- chemical = evaporites + precipitates
- from deposition, put down horizontally ≡
- layering is a sedimentary word
- break the easiest
- only type to contain FOSSILS

Metamorphic - rocks that have been changed or recrystallized because of intense heat, pressure, or chemical activity.
- banded - layers of color
- foliation - mineral alignment — dense
- regional - deep, large area contact - small
- Parent Rock - what it used to be.
  limestone → marble granite → gneiss
  sandstone → quartzite

The Dynamic Crust

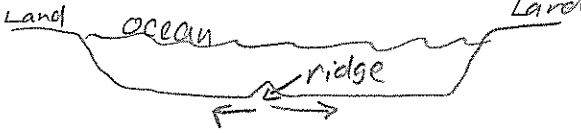
- As we look at Earth, we find clues to its origin.
- As we look at Earth, we find clues to how it has changed through nearly five billion years
- Earth's internal heat engine is powered by heat from the decay of radioactive material, residual (left over) heat from Earth's formation, and friction from plate tectonics.
- Heat flows within Earth's interior cause differences in density.
- Differences in density causes the changes explained by the theory of plate tectonics.
- The theory of plate tectonics includes earthquakes, volcanoes, and the deformation and metamorphism of rocks during the formation of young mountains.
- The Earth's internal structure includes the crust, mantle, inner core, and outer core.
- Properties of Earth's internal structure can be inferred from the analysis of the behavior of seismic waves (including velocity and refraction).
- Analysis of seismic waves allows the determination of the location of earthquake epicenters.
- Analysis of seismic waves allows the measurement of earthquake magnitude.
- Seismic wave analysis leads to inference that Earth's interior is composed of layers that differ in composition and states of matter.
- The outward transfer of the Earth's internal heat drives convective circulation in the mantle.
- Convective circulation in the Earth's mantle moves the lithospheric plates comprising the Earth's surface.
- The lithosphere consists of separate plates that ride on the more fluid asthenosphere.
- Lithospheric plates move slowly in relationship to one another.
- The slow movement of lithospheric plates create convergent, divergent, and transform plate boundaries.
- Lithospheric plate motions indicate that the Earth is a dynamic geologic system.
- These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.
- Compared to continental crust, ocean crust is thinner and denser.

Focus - point where earthquake happens
Epicenter - point on surface above focus
Lithosphere - crust + upper mantle
Subduction - when denser lithosphere dips into ground

- New ocean crust continues to form at mid-ocean ridges.
- Earthquakes and volcanoes present geologic hazards to humans.
- Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.
- Many processes of the rock cycle are consequences of plate dynamics.
- The production of magma (igneous rock formation and contact metamorphism) at both subduction and rifting regions.
- Regional metamorphism within subduction zones,
- The creation of major depositional basins through down-warping of the crust.
- Many of Earth's surface features are a consequence of forces associated with plate motion and interaction.
- Surface feature associated with plate motion and interaction are: mid-ocean ridges, rifts, trenches, subduction zones, island arcs, mountain ranges (folded, faulted, and volcanic), hot spots, and the magnetic and age patterns in surface bedrock
- Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution.
- Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.

P-waves - Primary - travels through everything - first to arrive
S-waves - Secondary - only through solids, second
E-quakes - "drop, cover and hold"
Tsunami - giant wave caused by e-quake - evacuate
DD cause CC cause PT
Faults: Normal, Reverse, Transform
Correlation - matching
Divergent - moving away - mid-ocean ridges
Convergent - coming together - mountains, e-quakes
Transform - sliding against - e-quakes, faults

PROOF of plate tectonics
- fitting together of continents
- fossils match up
- rocks match up
- e-quakes + volcanoes at plate boundaries
- mid-ocean ridges are moving apart



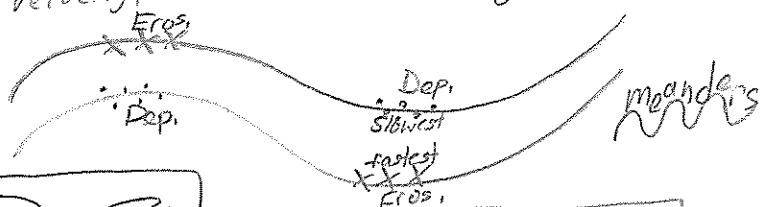
Surface Processes and Landscapes

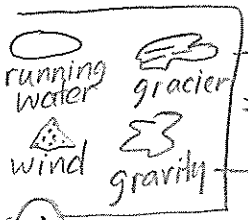
- Precipitation results from the external heat engine's weather system.
- Precipitation supplies moisture to the Earth's surface that contributes to the weathering of rocks.
- Running water erodes mountains that were originally uplifted by Earth's internal heat engine.
- Running water transports sediments to other locations, where they are deposited.
- Deposited sediments may undergo the processes that transform them into sedimentary rocks.
- Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.
- Climate variations, structure, and characteristics of bedrock influence the development of landscape features.
- Landscape features include mountains, plateaus, plains, valleys, ridges, escarpments, and stream drainage patterns.
- Weathering is the physical and chemical breakdown of rocks at or near the Earth's surface.
- Soils are the result of weathering and biological activity over long periods of time.
- Natural agents of erosion are generally driven by gravity.
- Natural agents of erosion remove, transport, and deposit weathered rock particles.
- Each agent of erosion produces distinctive changes in the material that it transports.
- Each agent of erosion creates characteristic surface features and landscapes.
- In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.
- The natural agents of erosion include:
- Streams (running water)
- Gradient, discharge, and channel shape influence a stream's velocity.
- Gradient, discharge, and channel shape influence the erosion and deposition of sediments
- Sediments transported by streams tend to become rounded as a result of abrasion.

Chemical weathering = warm + moist / physical weathering = cool + moist

- Stream features include V-shaped valleys, flood plains, and meanders.
- A watershed is the area drained by a stream and its tributaries.
- Glaciers (moving ice)
- Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock.
- Glacial features include moraines, drumlins, kettle lakes, Finger Lakes, and outwash plains.
- Wave action - Erosion and deposition cause changes in shoreline features.
- Shoreline features include beaches, sandbars, and barrier islands.
- Wave action rounds sediments as a result of abrasion.
- Waves approaching a shoreline move sand parallel to the shore within the zone of breaking waves.
- Wind - Erosion of sediments by wind is most common in arid climates and along shorelines.
- Wind-generated features include dunes and sandblasted bedrock.
- Mass Movement - Earth materials move downslope under the influence of gravity.
- Patterns of deposition result from a loss of energy within the transporting system.
- Patterns of deposition are influenced by the size, shape, and density of the transported particles.
- Sediment deposits may be sorted or unsorted.
- Sediments of inorganic and organic origin often accumulate in depositional environments

Frost Action - water freezes in crack, water expands when frozen, makes crack bigger
↑ surface area, ↑ weathering
↑ velocity, ↑ erosion ↓ velocity = ↑ deposition





Sorting - separating by size
- water + wind
- G + G are unsorted

Earth's History

- As we look at Earth, we find clues to its origin.
- As we look at Earth, we find clues to how it has changed through nearly five billion years
- As we look at Earth, we find clues to the evolution of life on earth.
- Impact events have been correlated with mass extinction and global climatic change.
- Impact craters can be identified in Earth's crust.
- Earth's early atmosphere formed as a result of the outgassing of water vapor, carbon dioxide, nitrogen, and lesser amounts of other gases from its interior.
- Earth's oceans formed as a result of precipitation over million of years.
- The presence of an early ocean is indicated by sedimentary rocks of marine origin, dating back about four billion years.
- Earth has continuously been recycling water since the outgassing of water early in its history.
- The evolution of life caused dramatic changes in the composition of Earth's atmosphere.
- Free oxygen did not form in the atmosphere until oxygen-producing organisms evolved.
- The pattern of evolution of life-forms in Earth is at least partially preserved in the rock record.
- Fossil evidence indicates that a wide variety of life-forms has existed in the past.
- Fossil evidence indicates that most of these forms have become extinct.
- Human existence has been very brief compared to the expanse of geologic time.
- Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations.
- The characteristics of rocks indicate the processes by which they formed.
- The characteristics of rocks indicate the environments in which these processes took place.
- Fossils preserved in rocks provide information about past environmental conditions.
- Geologists have divided Earth history into time units based upon fossil record.

- Age relationships among bodies of rocks can be determined using principles of original horizontality, super position, inclusions, cross-cutting relationships, contact metamorphism, and unconformities.
- The presence of volcanic ash layers, index fossils, and meteoritic debris can provide additional information.
- The regular rate of nuclear decay (half-life time period) of radioactive isotopes allows geologists to determine the absolute age of materials found in some rocks.

Relative Age = compares younger/older
- Superposition - youngest at top
- Younger than the rocks that they alter: intrusion, extrusions, folds and faults,

Fossils - naturally preserved remains or impressions of once living things
- Hard parts are preserved

Index Fossils - used to identify a specific age. ① brief period of time ② wide geographic area ③ easily distinguished * volcanic ash too

Correlation = matching up rock layers to see which is younger/older.

outgassing = gas produced from chemical processes

orogeny = process of mountain building

unconformity = buried erosional surfaces
- gaps in the rock record

Absolute age - actual age

isotopes - elements that have a different than usual number of neutrons

half-life - time required for one-half of an elements atoms in a sample to change into the decay product.

How old is this rock? ◯ 25% U^{238} / 75% Pb^{206}

① How many ½ lives have past? 2

② How many yrs per half life? 4.5×10^9 (on ESRT)

	0	1	2	3
I	100	50	25	12½
D	0	50	75	87½

③ multiply 4.5×10^9 × 2 = 9.0×10^9 yrs old

Meteorology

- Temperature variations within the atmosphere cause differences in density.
- Differences in density within the atmosphere cause atmospheric circulation.
- Atmospheric circulation is affected by Earth's rotation.
- The interaction of these (radiation, conduction, evaporation, convection, density differences, atmospheric circulation, and Earth's rotation) results in the complex atmospheric occurrence known as weather.
- Precipitation results from the external heat engine's weather system.
- Earth systems have internal and external sources of energy, both of which create heat.
- Transfer of heat energy within the atmosphere, the hydrosphere, and Earth's interior results in the formation of regions of different densities.
- Density differences between regions results in motion.
- Weather patterns become evident when weather variables are observed, measured, and recorded.
- Weather variables include: air temperature, air pressure, moisture (relative humidity and dewpoint), precipitation (rain, snow, hail, sleet, etc.), wind speed, wind direction, and cloud cover.
- Weather variables are measured using instruments such as thermometers, barometers, psychrometers, precipitation gauges, anemometers, and wind vanes.
- Weather variables are interrelated.
- Temperature and humidity affect air pressure and probability of precipitation.
- Air pressure gradient controls wind velocity.
- Air temperature, dewpoint, cloud formation, and precipitation are affected by the expansion and contraction of air due to vertical atmospheric movement.
- Weather variable can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmospheric cross-sections, and computer models.

- Atmospheric moisture, temperature and pressure distributions, jet streams, wind, air masses and frontal boundaries, and the movement of cyclonic systems and associated tornadoes, thunderstorms, and hurricanes occur in observable patterns.
- Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.

Sunshine = insolation
↑ cloud cover during day = cooler temp.
↑ cloud cover at night = warmer temp.
dark + rough surfaces absorbs heat faster
↑ Pressure = fair weather, blue sky
↓ Pressure = stormy weather
Warm air can hold more water vapor
Moist air is less dense than dry air.
Land Breeze - Night from Land to Sea
Sea Breeze - Day from Sea to Land
Air flows from high to low pressure.
Coriolis = N. Hem = curves to right due to rotation
Precipitation removes dust/dirt/pollution from the atm.
Synoptic - looking at the total picture
isobars - connect points of equal elevations
isotherms - connect points of = temp.
isolines - connect points of = values.
Air mass - large region of air with same moisture + temperature
Fronts - boundaries between air masses
cold - pushes warm air up precipitation
warm - warm air forced up precipitation
Stationary - cold / warm precipitation
occluded - when a cold air mass runs into another cold air mass, warm air ↑ precip.

	Tornado	Hurricane
	-small -Couple minutes -over land -faster winds -spring/summer	-large -couple weeks -over water -slower winds -summer/fall -lose energy on Land

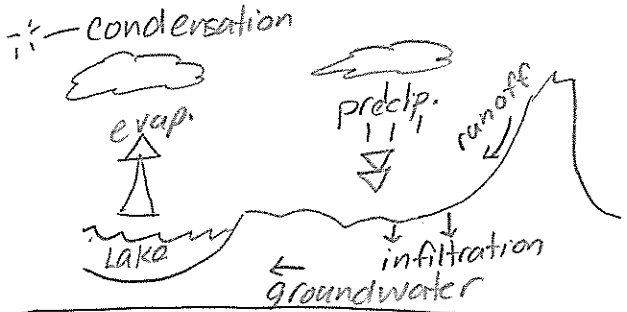
(6) anti-cyclone H cyclone L

Water, Energy, and Climate

- During Earth's one-year period of revolution, the tilt of its axis results in changes in the angle of incidence of the Sun's rays at a given latitude.
- The changes in the angle of incidence of the Sun's rays at a given latitude cause variation in the heating of the surface
- The variation in heating of the surface of Earth produces seasonal variations in weather.
- Approximately 70% of Earth's surface is covered by a relatively thin layer of water.
- The constant recirculation of water at and near Earth's surface is described by the hydrologic (water) cycle.
- Water is returned from the atmosphere to Earth's surface by precipitation.
- Water returns to the atmosphere by evaporation or transpiration from plants.
- A portion of the precipitation becomes runoff over the land or infiltrates into the ground.
- Infiltrated water becomes stored in the soil or groundwater.
- Groundwater is water below the water table.
- Soil capillarity influences these processes.
- The amount of precipitation that seeps into the ground or runs off is influenced by climate, slope of the land, soil, rock type, vegetation, land use, and degree of saturation.
- Porosity, permeability, and water retention affect runoff and infiltration.
- Earth may be considered a huge machine driven by two engines, one internal and one external.
- Internal and external heat engines convert heat energy into mechanical energy.
- Earth's external heat engine is powered primarily by solar energy and influenced by gravity.
- Nearly all the energy for circulating the atmosphere and oceans is supplied by the Sun.
- As insolation strikes the atmosphere, a small percentage is directly absorbed, especially by gases such as ozone, carbon dioxide, and water vapor.
- Clouds and Earth's surface reflect some energy back to space.
- Earth's surface absorbs some energy.
- Energy is transferred between Earth's surface and the atmosphere by radiation, conduction, evaporation, and convection.
- Average temperatures on Earth are the result of the total amount of insolation absorbed by Earth's surface and its atmosphere and the amount of long-wave energy radiated back to space.
- Throughout geologic time, ice ages occurred in the middle latitudes.
- Average temperatures may have been significantly warmer at times in the geologic past.
- Periods of warmer and cooler temperatures suggests that Earth had climate changes that were most likely associated with long period of imbalances of its heat budget.
- Global climate is determined by the interaction of solar energy with Earth's surface and atmosphere.
- The energy transfer between solar energy and the Earth's atmosphere and surface is influenced by dynamic processes such as cloud cover and Earth rotation, and the positions of mountain ranges and oceans.
- Seasonal changes can be explained using concepts of density and heat energy.
- Seasonal changes include the shifting of global temperature zones, the shifting of planetary wind and ocean current patterns, the occurrence of monsoons, hurricanes, flooding, and severe weather.
- Insolation (solar radiation) heats the Earth's surface and atmosphere unequally due to variations in:
- The intensity caused by differences in atmospheric transparency and angle of incidence, which vary in time of day, latitude, and season.
- Characteristics of the materials absorbing the energy such as color, texture, transparency, states of matter, and specific heat.
- Duration (length of time) varies with seasons and latitude.

Water, Energy, and Climate (continued)

- The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's surface occurs as the result of radiation, convection, and conduction.
- Heating of the Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing wind and ocean currents.
- A location's climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges.
- Temperature and precipitation patterns are altered by:
- Natural events such as El Niño and volcanic eruptions
- Human influences including deforestation, urbanization, and the production of greenhouse gases such as carbon dioxide and methane



↑ slope, ↑ runoff, ↓ infiltration

Porosity = % of open space (same por. ▫▫▫ = ▫▫▫)

↑ Porosity = ↑ infiltration

Permeability = ability of water to flow through

Capillarity = attractive force between water + soil, works against gravity

↓ particle size, ↑ capillarity

↑ vegetation, ↑ infiltration

Runoff = when more comes down than can soak in

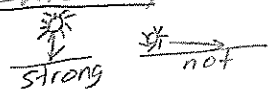
= when ground is already saturated

= too steep, frozen

Stream Discharge = volume of water

Insolation = sunshine = solar radiation = short wave radiation

Intensity of Insolation = how strong



Duration of Insolation = length of time

June 21 - most hours

Dec. 21 — least hours

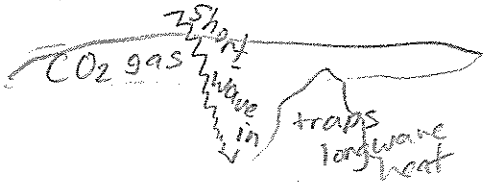
Specific heat = amount of energy it takes to raise one cm^3 one degree C

Water has a ↑ S.H. That's why it takes so long to heat up,

Terrestrial Radiation = long wave = ground = infrared

Earth always gives off terrestrial rad.

Green House Effect



↑ CO_2 - deforestation
- burning fossil fuels
- ↑ population

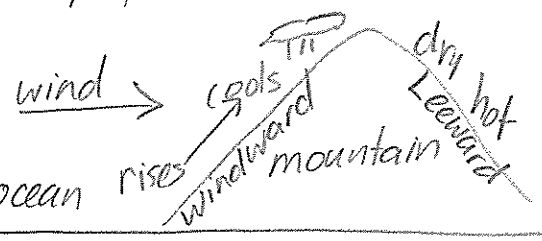
Climate = long term weather; moisture, temp.

↓ latitude, ↑ temperature

Bodies of water moderate climate

↑ elevation, ↓ temperature

Orographic Effect



radiation = energy moving through air

conduction = energy moving from one atom to another

convection = energy moving because of density differences

evaporation - liquid to gas water gains 540 cal/gram.

condensation - gas to liquid water loses 540 cal/gram.

The Earth in Space

- The Earth and celestial phenomena can be described by principles of relative motion and perspective.
- People have observed the stars for thousands of years.
- People have used the stars to find direction.
- People have used the stars to note the passage of time.
- People have used the stars to express their values and traditions.
- As our technology has progressed, so has understanding of celestial objects and events.
- Theories of the universe have developed over many centuries.
- Although to a casual observer celestial bodies appeared to orbit a stationary Earth, scientific discoveries led us to the understanding that Earth is one planet that orbits the sun.
- The sun is a typical star in a vast and ancient universe.
- We now infer an origin and an age of the universe.
- We now infer and evolution of the universe.
- We speculate about the future of the universe.
- As we look at Earth, we find clues to its origin.
- Most objects in the solar system are in regular and predictable motion.
- The regular and predictable motions of the objects in the solar system explain such phenomena as the day, the year, seasons, phases of the moon, eclipses, and tides.
  - Gravity influences the motions of celestial objects.
  - The force of gravity between two objects in the universe depends on their masses and the distance between them.
- Nine planets move around the Sun in nearly circular motion.
  - The orbit of each planet is an ellipse with the Sun located at one of the foci.
  - Earth is orbited by one moon and many artificial satellites.
- The earth rotates on an imaginary axis.
- The earth rotates 15 degrees per hour.
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- The changes in the angle of incidence of the Sun's rays at a given latitude cause variation in the heating of the surface
- The variation in heating of the surface of Earth produces seasonal variations in weather.
- Seasonal changes in the apparent positions of constellation provide evidence of Earth's revolution.
- The Sun's apparent path through the sky varies with latitude and season.
- The large percentage of water on Earth's surface responds to the gravitational attraction of the moon and the Sun with a daily cycle of high and low tides.
- The universe is vast.
- The universe is estimated to be over ten billion years old.
- The current theory is that the universe was created from an explosion called the Big Bang.
- Evidence for the Big Bang includes:
  - Cosmic background radiation
  - A red-shift (the Doppler effect) in the light from very distant galaxies.
- Stars form when gravity causes clouds of molecules to contract until nuclear fusion of light elements into heavier ones occurs.
- Fusion releases great amounts of energy over millions of years.
- The stars differ from each other in size, temperature, and age.
- Our Sun is a medium-sized star.
- Our Sun is within the Milky Way Galaxy.

The Earth in Space

(continued)

- The Milky Way Galaxy is a spiral galaxy of stars.
- Our galaxy contains billions of stars, and the universe contains billions of such galaxies.
- Our solar system formed about five billion years ago from a giant cloud of gas and debris.
- Gravity caused the Earth and the other planets to become layered according to density differences in their materials.
- The characteristics of the planets of the solar system are affected by each planet's location in relationship to the Sun.
- The terrestrial planets are small, rocky, and dense.
- The Jovian planets are large, gaseous, and of low density.
- Asteroids, comets, and meteors are components of our solar system.
- Impact events have been correlated with mass extinction and global climatic change.
- Impact craters can be identified in Earth's crust.

Red Shift - moving away Blue - towards

Galaxies = elliptical spiral irregular

Stars $H_2 \rightarrow He_2$ produces energy

- form when gravity pulls gases in
- stop shining when no He left

Milky Way - our solar system

Meteor - object falling through the atm.

Rotation - spinning on axis

Revolution - moving around (S) (E)

Eccentricity = how oval an orbit is

$Ecc = \frac{dbf}{1oma} = \frac{1.2cm}{2.1cm} = .57$

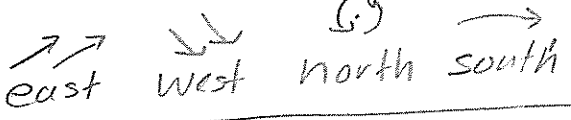
If answer = 1 then straight line
= 0 then circle

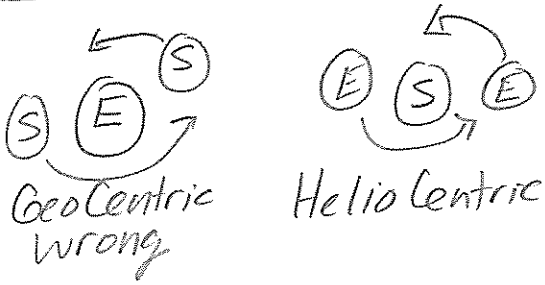
Celestial Object = object in sky

Celestial Sphere = dome of air above you

Celestial Objects = appear to move E → W

At night





GeoCentric
wrong

HelioCentric