EARTH SCIENCE

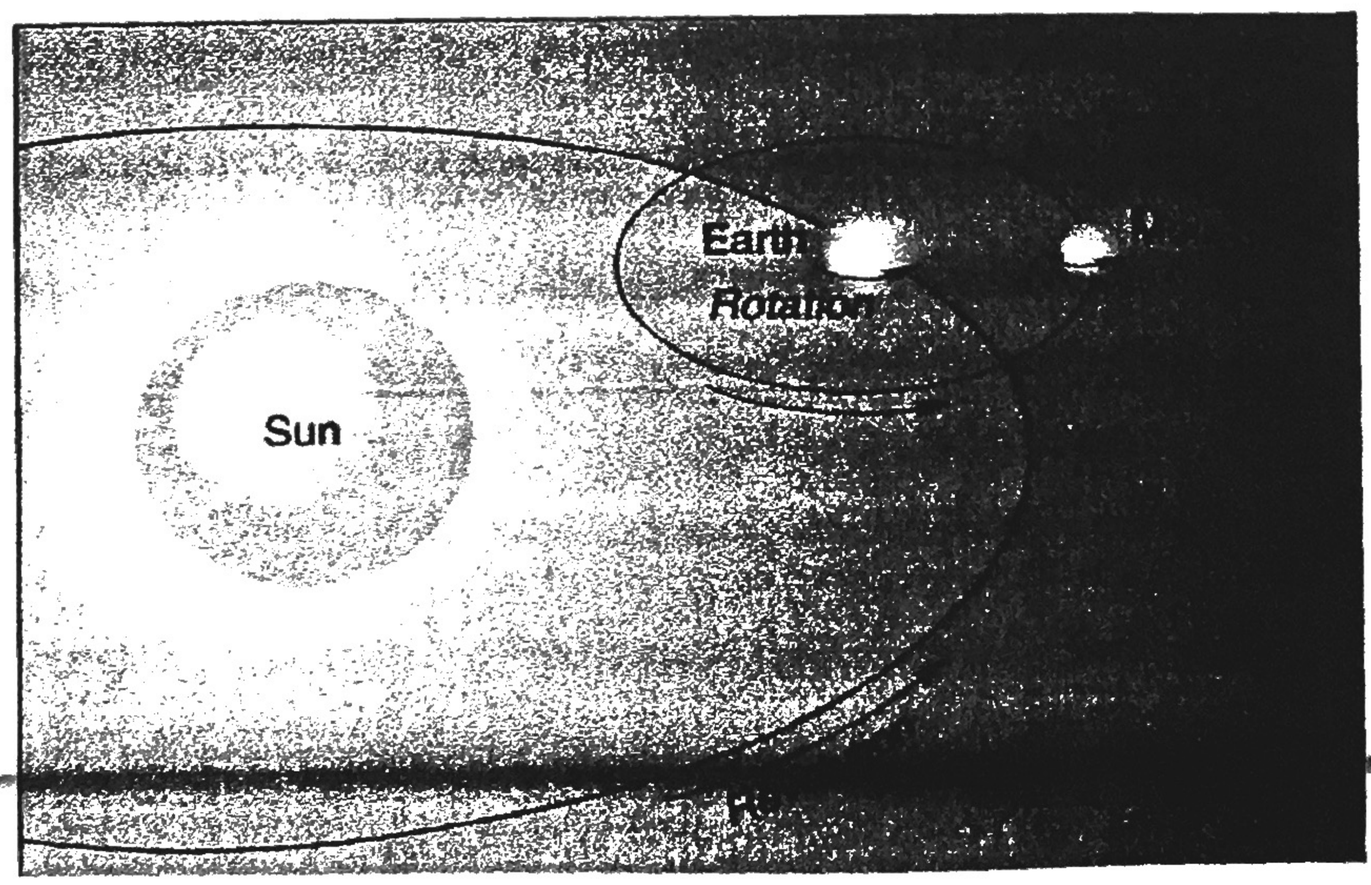
REGENTS REVIEW

Name: _____

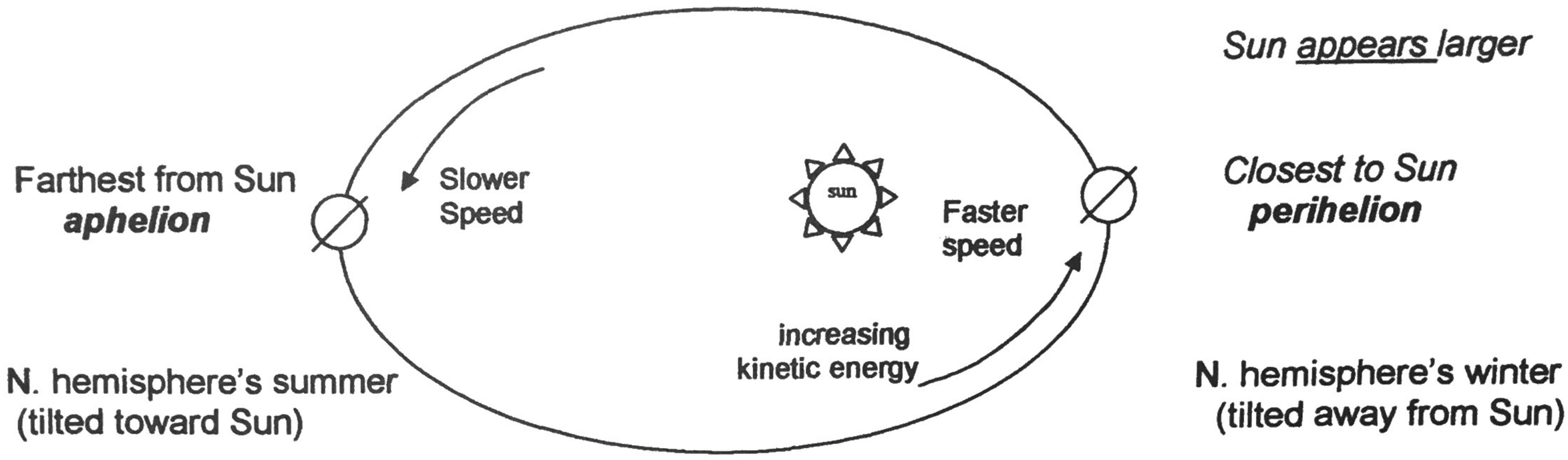
Exam Date :_____ Time: _____

Location: _____

- Different shapes/sizes of the same material have the same density at the same temperature and pressure. $D = \frac{m}{v}$
- As pressure increases, density increases.
- As temperature increases, density decreases.
- Most Earth materials are <u>most dense in the solid phase</u> and <u>least dense in the gas phase</u>
- Water is an exception. It is least dense as a solid (ice) because water expands when it freezes
- Water is most dense at 4°C, when it is a liquid.
  - Substances greater than the density of water (1 g/cm^3) sink.
  - Substances less than the density of water float.
- Most changes in the environment are cyclic.
- The true shape of the Earth is an ***oblate spheroid.*** (slightly flattened at the poles)
- The ***best model*** of the Earth's shape is a ***sphere.***
- Latitude measure distances north and south of the equator
- The altitude of Polaris (North Star) equals your latitude. Polaris is located using the pointer stars of the big dipper.
- Longitude measures distances east and west of the Prime Meridian.
- Longitude is based on observations of the sun.
- The Earth *rotates (spins)* west to east (in 24 hours at 15° / hour = one day)
- Evidence the Earth rotates:
  - Foucaults pendulum – appears to change its direction of swing
  - Coriolis Effect – deflection to the right in the northern hemisphere
- Due to Earth's rotation, the sun and all celestial objects (stars, moon, etc) ***appear*** to move in an arc across the sky from east to west. (example: the Sun rises in the east and sets in the west)
- Circumpolar constellations never set but appear to move in circles around the pole.
- The Earth *revolves* around the sun counterclockwise (in 365 ¼ days = one year)
- Due to Earth's revolution, some constellations are only visible during a particular season (depends on Earth's position in its orbit).



- Earth is closer to the sun in winter (perihelion); the sun appears larger
- The closer a planet is to the sun the faster it orbits
- Gravitational attraction between two objects is greatest when their masses are large and they a close together

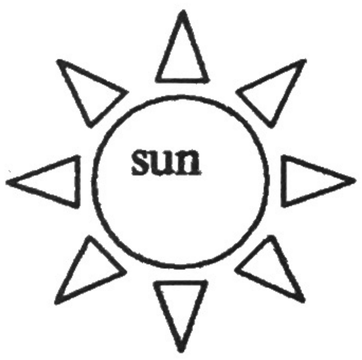


- Geocentric – Earth-centered universe, Heliocentric – Sun-centered universe
- Our Solar System is sun-centered (heliocentric)
- Our solar system consists of our Sun; the nine planets, and all the other objects that revolve around our sun (comets, asteroids).
- The sun is the largest object in our solar system
- Sun is composed mainly of hydrogen and helium (converts hydrogen to helium in its core)
- Milky Way galaxy (spiral shaped) –consists of several billion stars; contains our solar system
- Universe is everything, all matter, in existence

Universe → Milky Way → solar system → Sun

Most massive & oldest ⟶ *least massive & youngest*

- According to star spectra, the universe is expanding (red-shift)
- Planets in our solar system orbit the sun:



Asteroid belt

Mercury, Venus, Earth, Mars, | Jupiter, Saturn, Uranus, Neptune, Pluto

Inner Planets — Outer Planets

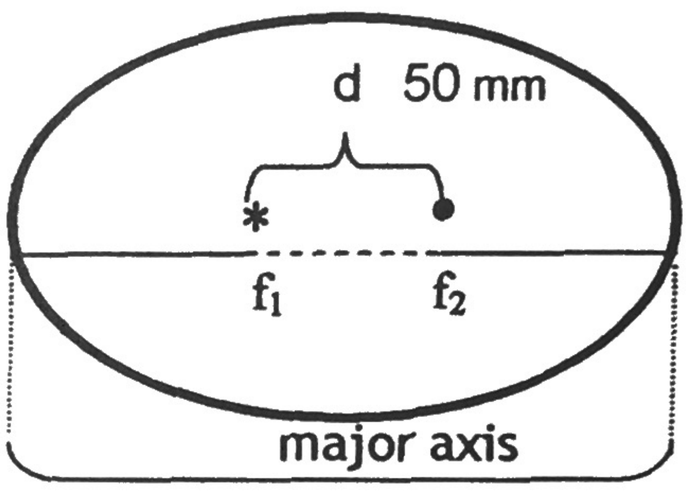
Terrestrial (rocky) -smaller , denser

Jovian –"gas giants " *(except Pluto)*

- The planets' orbits are elliptical (not perfect circles)
- An ellipse is a closed curve around two fixed points, called foci. The orbits of all planets around the Sun are ellipses
- Eccentricity is the *out of roundness* of an ellipse. (values 0 to 1, one being most eccentric)

$$\text{eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}} \qquad \text{example : } \frac{d}{L} = \frac{50}{90} = .55 \text{ } \textit{(no units)}$$

f_1 and f_2 are the foci



L 90 mm

- The moon has phases because of the angle at which we view its surface. (half is always lit)
- It takes 29 ½ days for the moon to go through all its phases (lunar month)

Phases of the Moon

New Moon *Waxing* → **Full Moon** *Waning* → *New Moon*

- The moon is waxing when more of lighted portion becomes more visible from Earth
- The moon is waning when less of lighted portion becomes more visible from Earth

- Tides are caused by the pull of gravity by both the moon and the Sun.
- The moon's gravitational force has a greater tide causing effect because the moon is closer to Earth than the sun.
- Spring tides are unusually high or low tides that occur when the moon is in the new and full moon phase.
- Neap tides are moderate high and low tides that occur during the quarter moon phases
- A lunar eclipse occurs when the moon moves into Earth's shadow. The sun, Earth, and moon line up with the Earth in the middle (occurs in the full moon phase).
- A solar eclipse occurs when the moon passes directly between the Earth and the sun. Moon blocks sun (occurs during new moon phase).
- Seasons occur because of ***Earth's tilt*** as it ***revolves around the sun***.

Summer solstice:

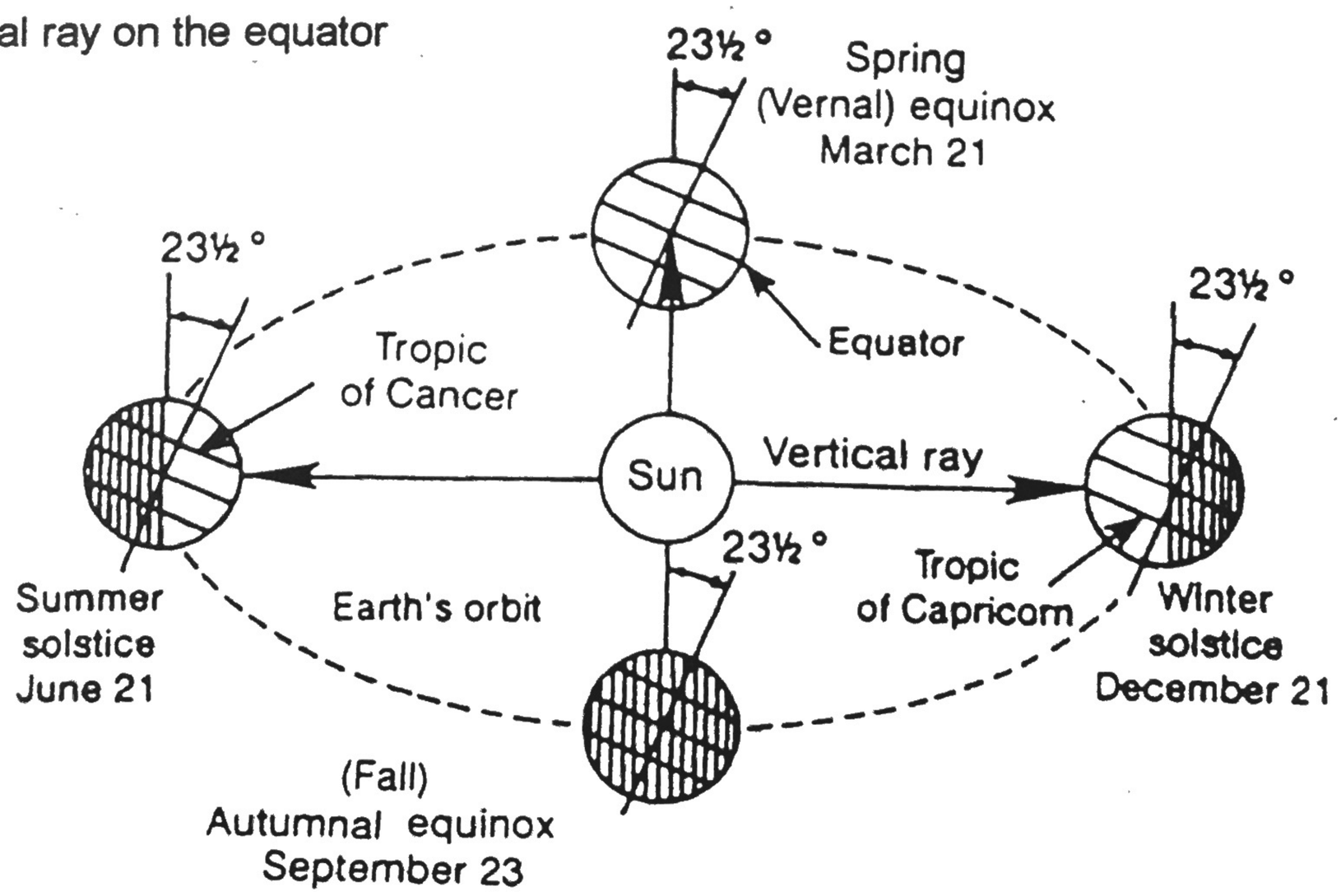
- June 21st
- 15 hours of daylight (sun is at its highest noon altitude, *solar radiation most intense*)
- Sun rises north of east, sets north of west
- vertical ray on 23 ½° north (Tropic of Cancer)

Winter solstice:

- December 21st
- 9 hours of daylight (sun is at it lowest noon altitude, *solar radiation least intense*)
- sun rises south of east, sets south of west
- vertical ray on 23 ½ ° south (Tropic of Capricorn)

Equinoxes: ***Spring Equinox*** – *March 21 and* ***Fall Equinox*** – *September 23*

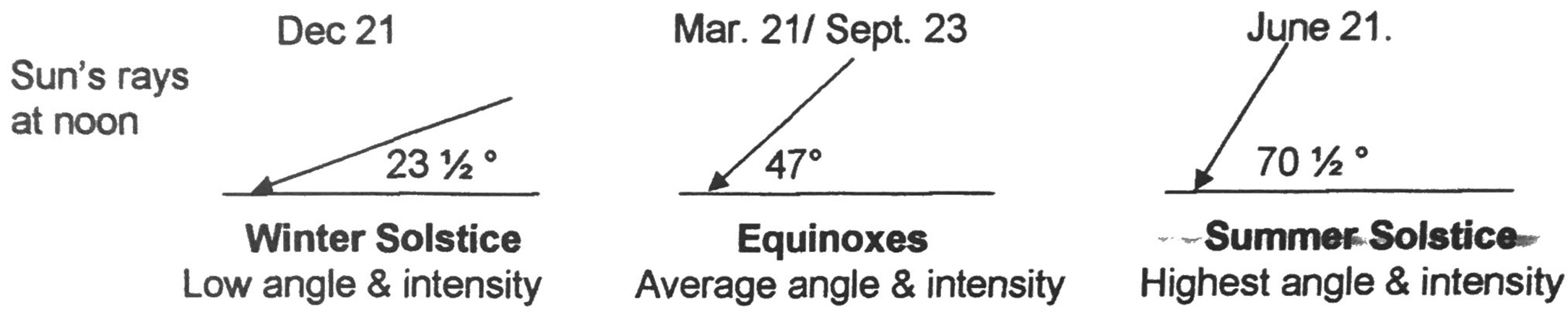
- 12 hours of daylight
- sun rises due east and sets due west
- vertical ray on the equator

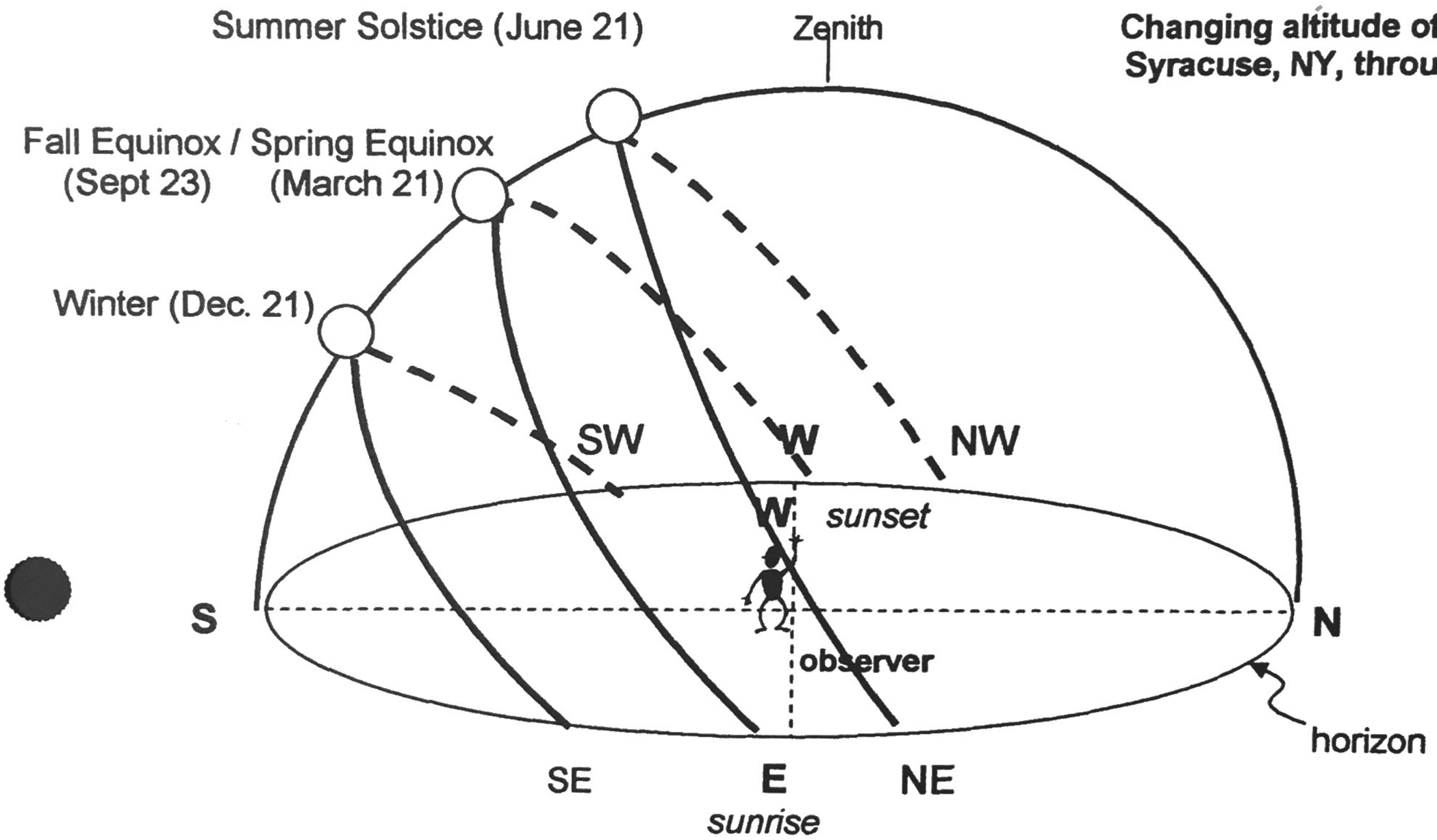


Earth's positions relative to the sun on the dates of the seasonal changes.

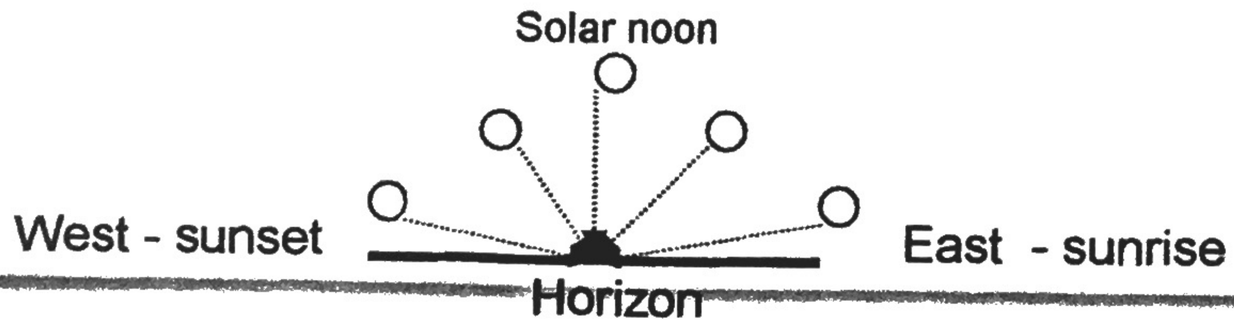
- The equator always has 12 hours of daylight

- The duration of Insolation (**in**coming **sol**ar radi**ation**) is greatest in the summer
- The angle of insolation (angle the sun strikes Earth's surface) is greatest in the summer



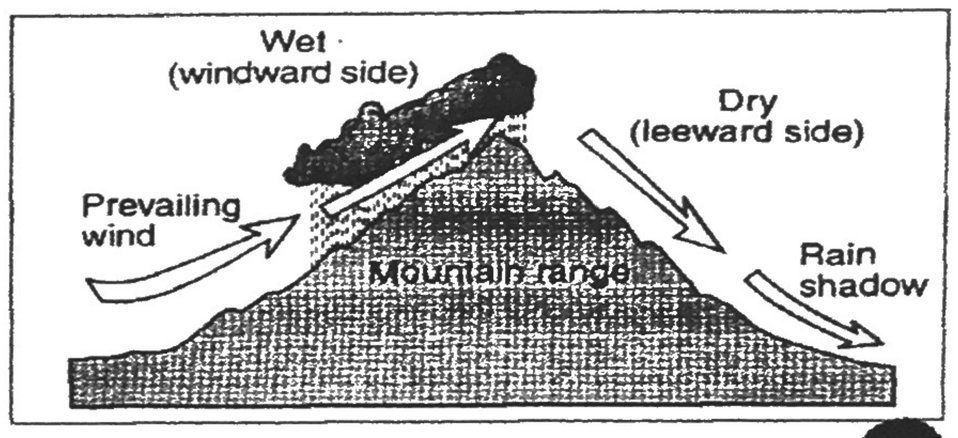


- **Zenith** - point on the celestial sphere that is directly above an observer on Earth's surface.
- **Altitude** - distance of a celestial object, in degrees, above the observer's horizon.
- **Solar noon** - highest altitude of the sun for the day and never at zenith outside the tropics.
- The longer the Sun's daily path across the sky, the longer the period of daylight.
- The length of day varies with the seasons.
- The lower the altitude of the sun, the longer shadow it casts.
- In a given day, the sun's angle of insloation increases from sunrise to its solar noon position, then begins to decrease from solar noon to sunset.



- Hottest part of the day is after 12 noon (time lag).
- Hottest part of the year is after June 21st (time lag).
- Good absorbers of heat energy are good re-radiators
- Dark colors absorb and re-radiate heat better than light colors.
- Soil absorbs and re-radiates heat better than water.
- Water bodies moderate temperatures
- Inland locations have greater ***temperature ranges*** (difference between high and low temp.)
- Isolines connect equal values (isotherms → temperature; isobars → air pressure)
- The closer the lines are, the steeper the gradient
- Objects absorb short visible wavelengths (as well as infrared) but re-radiate only the longer infrared wavelengths.

- Carbon dioxide, water vapor, and methane are "greenhouse" gases: they absorb heat energy and warm the atmosphere.
- Air cools as it rises.
- Orographic effect (adiabatic changes)
  - rising air cools and condenses, precipitation occurs
  - compressing sinking air is dry



- Climate is the average surface temperature and precipitation for a region
- Latitude has the greatest affect on climate
- <u>Conduction</u> – energy moves molecule to molecule through collision
- <u>Convection</u> – energy moves through fluids (liquids & gases) due to density differences
- <u>Radiation</u> – energy moves through space (vacuum) *examples*: light, infrared
- As air temperature increases, air pressure decreases.
- As moisture content increases, air pressure decreases.
- Air pressure decreases with altitude.
- <u>Highs</u> are cool and dry, <u>Lows</u> are warm and wet.
- Wind is named for the direction it is ***coming from.***
- Wind is due to air pressure differences.
- Winds move from a high pressure region to a low pressure region.
- Energy moves from source to sink (high to low)

H → **L**

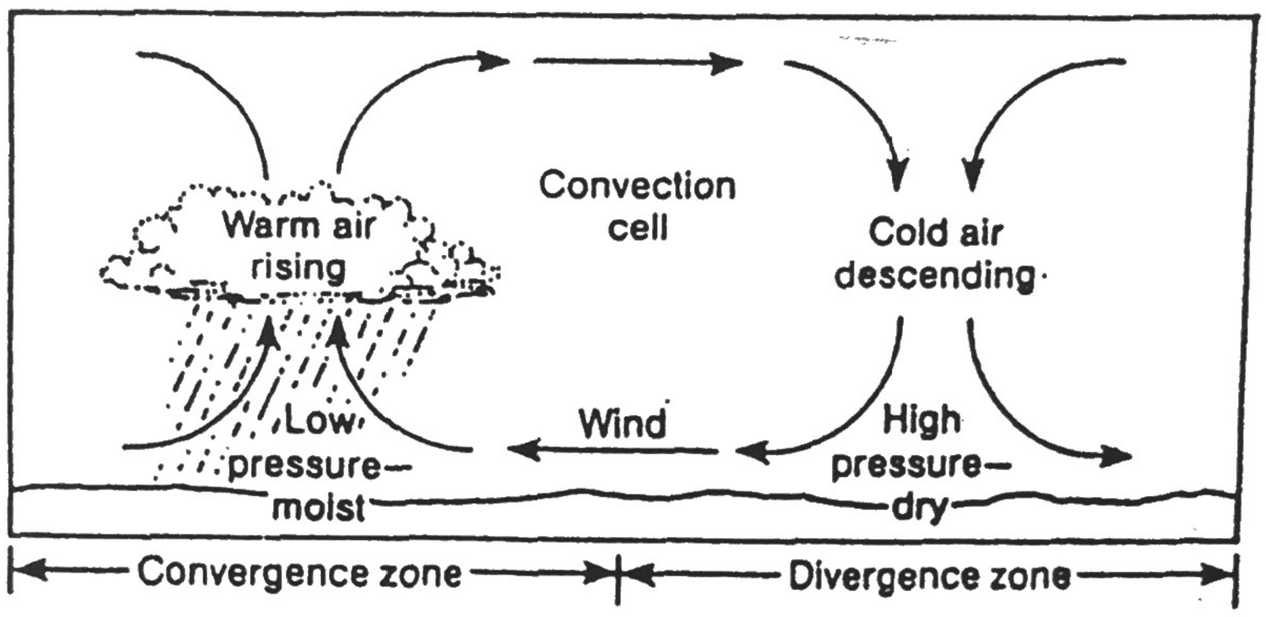
Cool, dry air
more dense
sinks

warm, moist air
less dense
rises

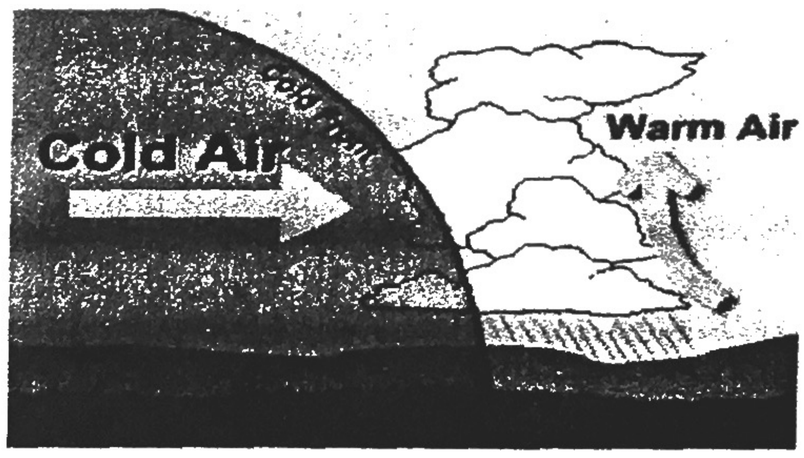
- The air moving from high to low pressure follows a spiraling route, outwards from high pressure and inwards towards low pressure.
- **Lows** are regions of convergence (winds move inward counterclockwise) - cyclone
- **Highs** are regions of divergence (winds move outward clockwise) - anticyclone

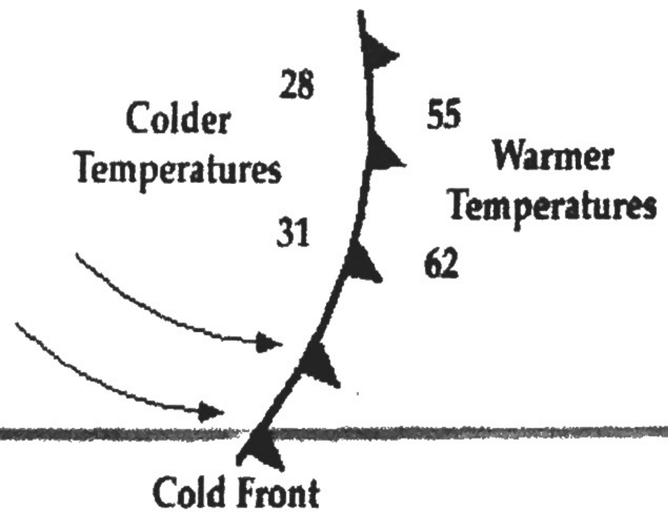
top view

side view

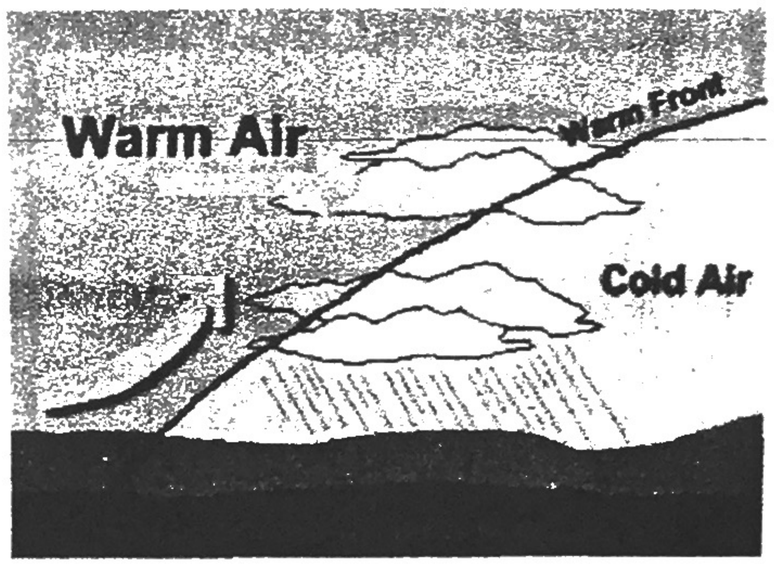


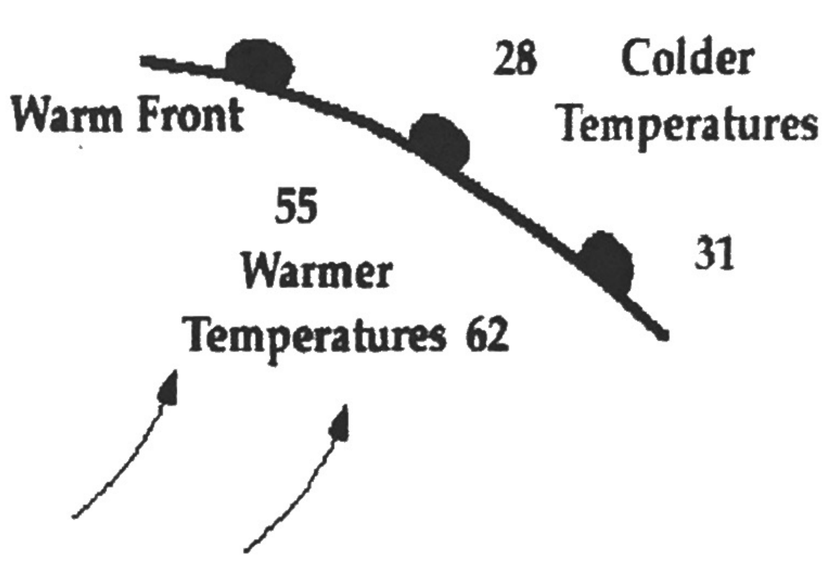
- The closer air temperature is to dew point temperature, the greater the chance of precipitation.
- Weather moves from west to east across the United States.
- Air masses are huge bodies of air in the troposphere
  - within an air mass **temperature**, **humidity** and **air pressure** are fairly uniform
  - characteristics of an air mass depend on where it formed (source region)
- Fronts are boundaries between air masses of different temperatures
- <u>Cold front</u>: leading edge of colder air replaces warmer air (precipitation at the front)
- Cold fronts move the fastest



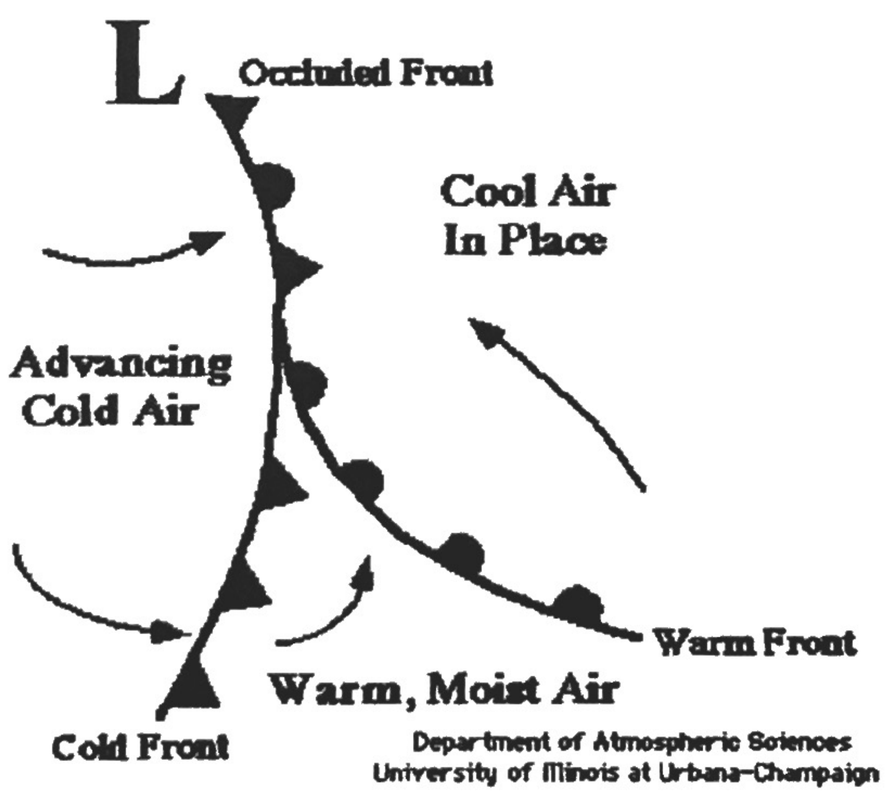


- Warm front: leading edge of warmer air replaces colder air (precipitation ahead of the front)

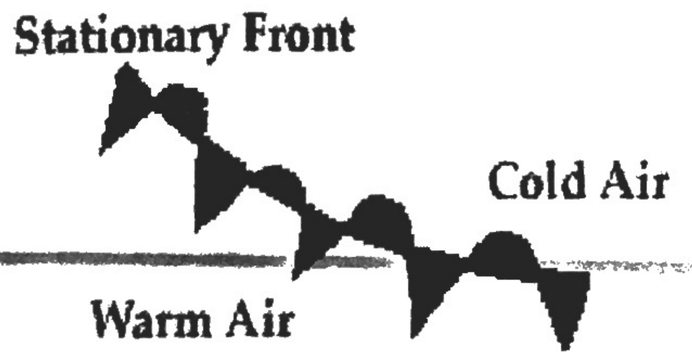




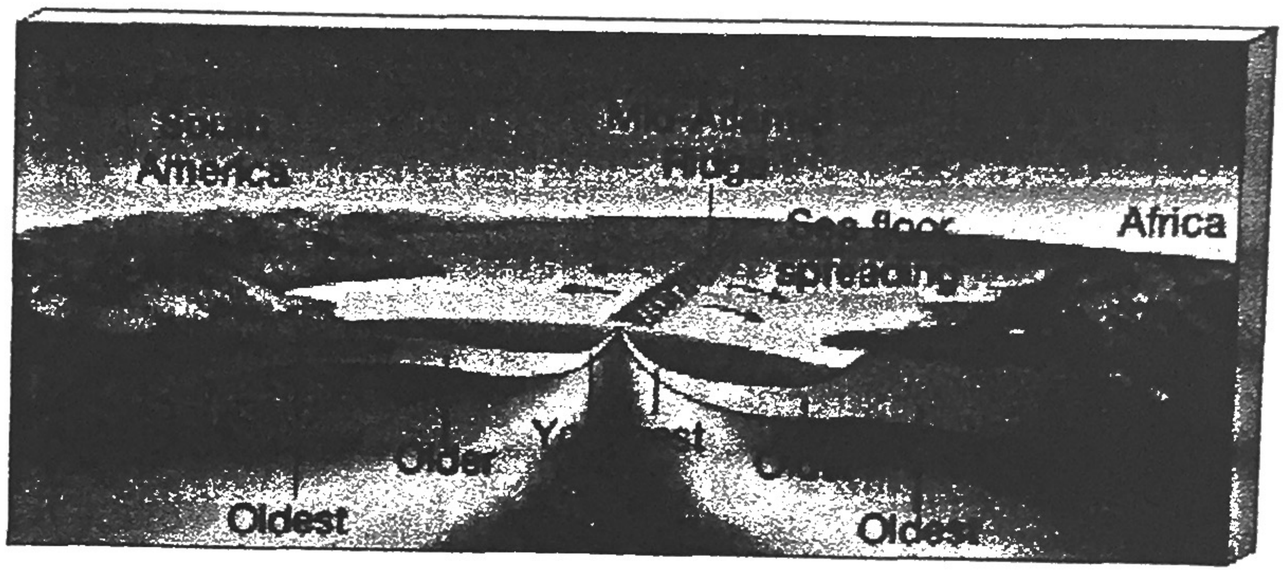
- Occluded front: when a cold front catches up to a warm front



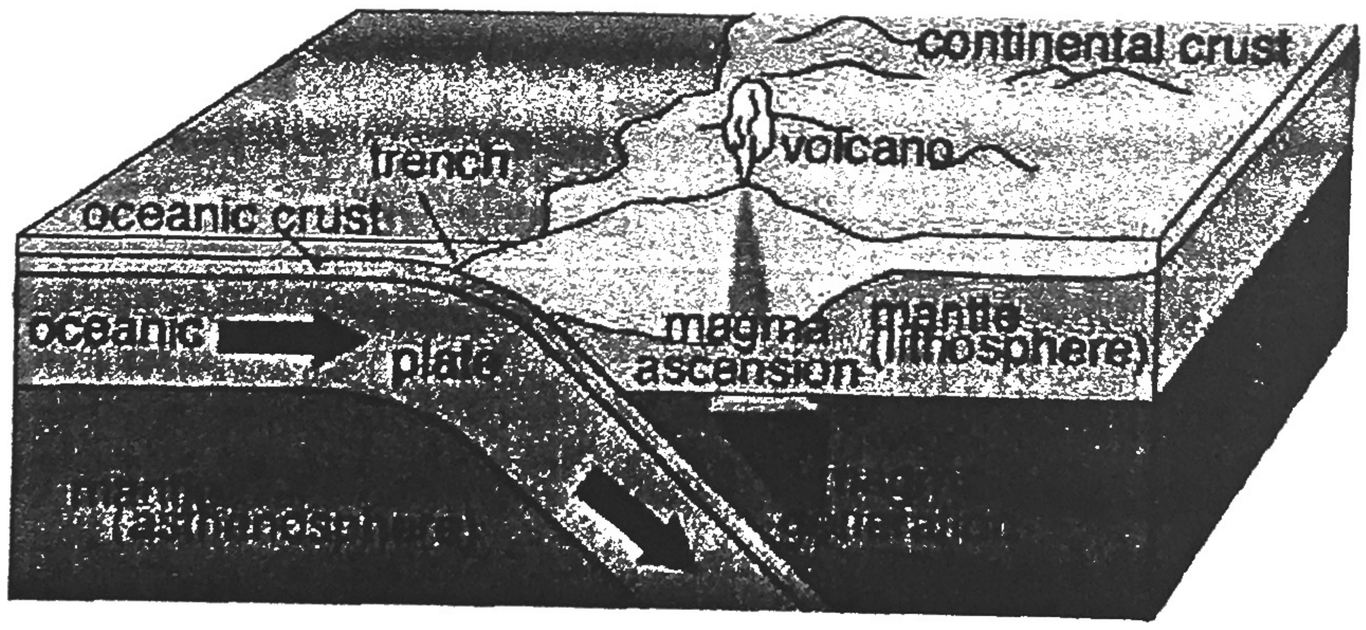
- Stationary Front: A front that is not moving



- Chemical weathering occurs mostly in warm, humid climates
- Physical weathering occurs mostly in cold, humid climates (good for frost wedging)
- When a rock is broken into smaller pieces, surface area increases and weathering rate increases
- Soil is the product of weathering
- Isostasy – earth's crust in equilibrium.
- Dynamic equilibrium means balance
- Convection currents in the mantle move the plates.
- Mountains form by uplift, folding and faulting
- Mid-ocean ridges (diverging plates, sea-floor spreading) – crust is created

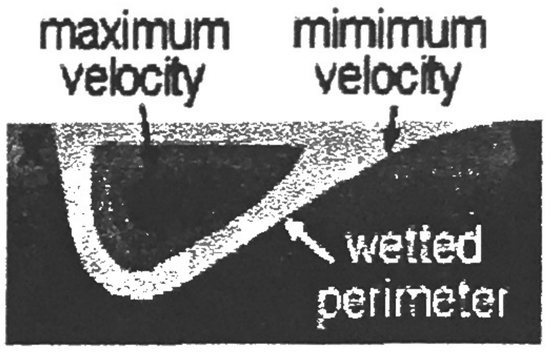


- Trenches (converging plates, subduction) – crust is destroyed

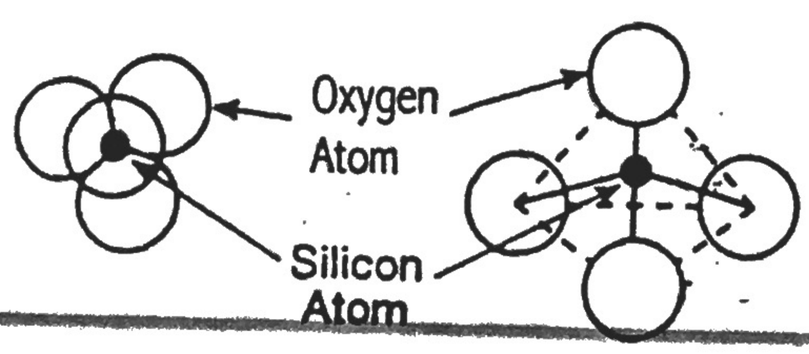


- Most earthquake and volcanic activity occur along plate boundaries
- P– waves are faster than S– waves.
- P– waves travel through solids and liquids, while **S**– waves only go through **s**olids.
- Need three seismograph stations to locate an epicenter.
- In undisturbed strata, the bottom layer is the oldest.
- Intrusions and faults are younger than the rock they are in.
- Index fossils are good time markers (widely spread, lived a short time)

- Porosity (the amount of holes) ***does not*** depend on particle size.
- Permeability (connection of holes) ***does*** depend on particle size: as particle size increases, permeability increases.
- Capillarity (movement of water upward) increases when particle size decreases
- Ep (potential evaporation) depends on temperature.
- **Maximum storage is 100 mm**
- Deficit: Storage = 0 and Precipitation is less than Ep.
- Surplus: Storage = 100 and Precipitation is greater than Ep.
- Usage: Storage is greater than 0 and Precipitation is less than Ep.
- Recharge: Storage is less than 100 and Precipitation is greater than Ep.
- Gravity is behind all erosion. (running water, glaciers, mass wasting – except wind erosion)
- Streams are the number one agent of erosion.
- Stream velocity depends on slope and discharge.
- Velocity of the water is greater on the outside of meander bend.



- Heavy, dense, round particles settle out first in water.
- Graded bedding (vertical sorting) – biggest sediments on the bottom.
- Glacial sediments are unsorted and scratched. Glaciers create U- shaped valleys.
- Stream deposits are sorted, round, and smooth. Streams create V – shaped valleys.
- Sedimentary rock characteristics: strata, flat layers, fossils may be present, rock fragments
- Igneous rock characteristics: cooled quickly → small crystals, glassy, or vesicular
  cooled slowly → large crystals
- Metamorphic rock characteristics: banding, distorted structure, platy mica crystals
- Mineral properties depend on internal arrangement of atoms.
- Silicon – oxygen tetrahedron is the basic unit.



- Arid landscapes → steep slopes
- Humid landscapes → smooth, rounded slopes
- Uranium – 235 dates old rocks
- Carbon –14 dates recent, once living objects
- Temperature or rock size ***does not*** change the half-life of a substance
- Always try to eliminate two answers.
- Memorize the "Dreaded 13".
- Use complete sentences for the constructed response questions (CRQ)
- Know how to read and interpret in Earth Science Reference tables.
- When in doubt, see if the reference tables can help you.
- **USE THE REFERNCE TABLES !**

The 13 Dreaded Earth Science Facts

1. If you cut an object into pieces, you **do not** change its density.
2. The altitude of Polaris equals your latitude.
3. The Coriolis Effect deflects things to the right in the northern hemisphere.
4. Condensation: water vapor changing to liquid water (remove heat)
5. Boiling: liquid water changing to water vapor (add heat)
6. There is **no** change in temperature during a phase change.
7. Low pressure: wet weather (warm)
8. High pressure: dry weather (cool)
9. Weather moves west to east across the United States.
10. Porosity **does not** depend on particle size.
11. Potential evapotranspiration (ep) depends **only** on temperature.
12. Minerals have different properties because of the way their atoms are arranged.
13. Marine (sea) fossils on mountain tops indicate that the land has been uplifted.