#1: OBSERVATION

- To witness using the 5 senses (hearing, tasting, touching, smelling, sight)
- Using an instrument to extend powers of observation
  - Ex- taking measurments (data)

#2: INFERENCE

- To interpret, predict or guess based on what you observe.

#3: Steps of the SCIENTIFIC METHOD

1. **Problem** .....(a question)
2. **Hypothesis** .....(your prediction)
3. **Materials** ..... (what you need)
4. **Procedure** .....(step by step plan)
5. **Observation**...(measurement, data, graph)
6. **Conclusion** .....(what you discover)
7. **Error** .....(where mistakes and outside factors effected results)

"**P**lease **H**elp **M**y **P**oor **O**ld **C**at **E**rnie"

#4: INDEPENDENT Variable

- The "I" change variable
- **MANIPULATED** variable
- What was changed before the experiment starts

#5: DEPENDENT Variable

- **MEASURED** change in experiment
- What you OBSERVE
- Collect DATA on
- Responds / reacts to the Independent Variable

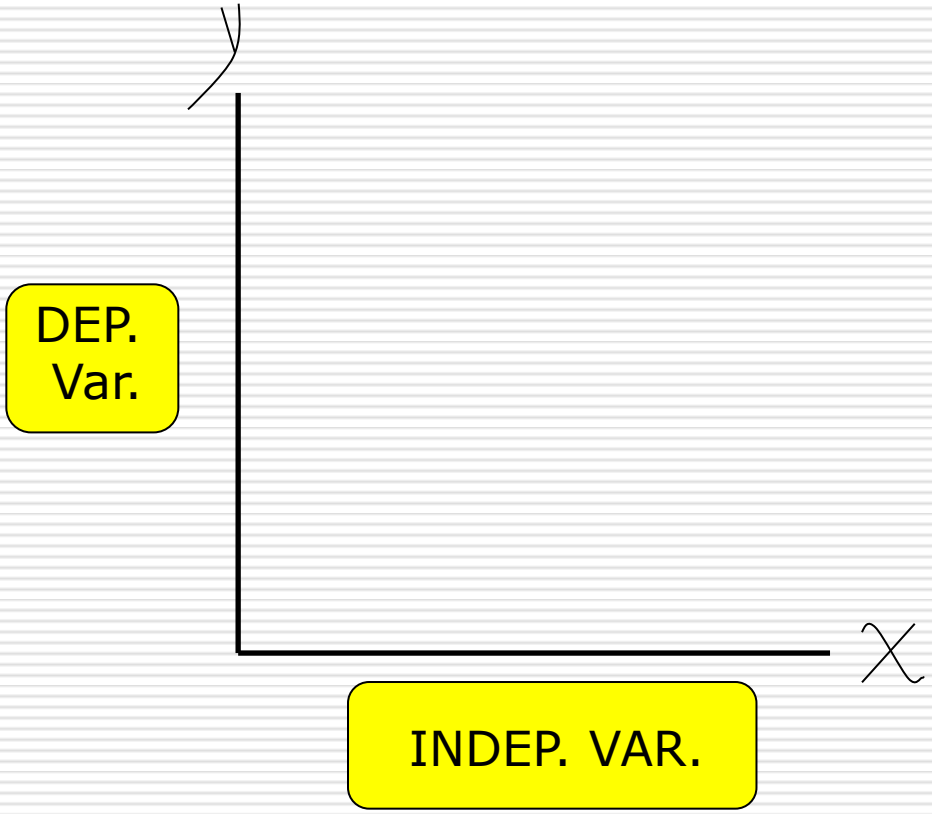
#6: Control Group vs. Experimental Group

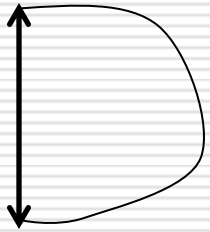
- The EXPERIMENTAL Group gets the Independent Variable. Can have multiple experimental groups

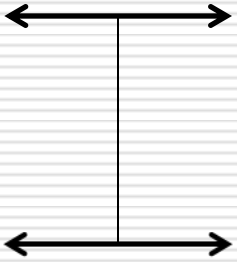
- **CONTROL** group is exactly the **same *minus*** *the* ***independent variable***

- You compare the results of the experimental group to the control group.

#6B: Graphing Variables







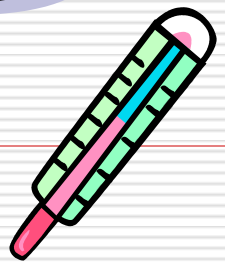
#7: Tools of Measurment

- Length: Ruler (cm)

- Volume: Graduated Cylinder (ml or cc)

- Mass: Triple Beam Balance

- Temperature: Thermometer



#8: MASS

- The amount of MATTER (**atoms and molecules**) in a substance.
- Measured in Grams (g)
- Mass is not Weight!
  - Weight is mass x gravity
  - An object has a downward force or weight due to it's mass and gravity
- Instrument -***TRIPLE BEAM BALANCE***

#9: VOLUME

- The amount of SPACE an object takes up
- Measured in cm^3 or ml
- Regular solid = LxWxH
- Irregular solids = water displacement method

#10: DENSITY

- **Amount of Mass per Volume**
- **# of grams (g) in a ml or cm^3 or cc**
- **D = M/V**
- **Units:**
  - **g/cc**
  - **g/ml**
  - **g/cm^3**

#10B: Density Facts

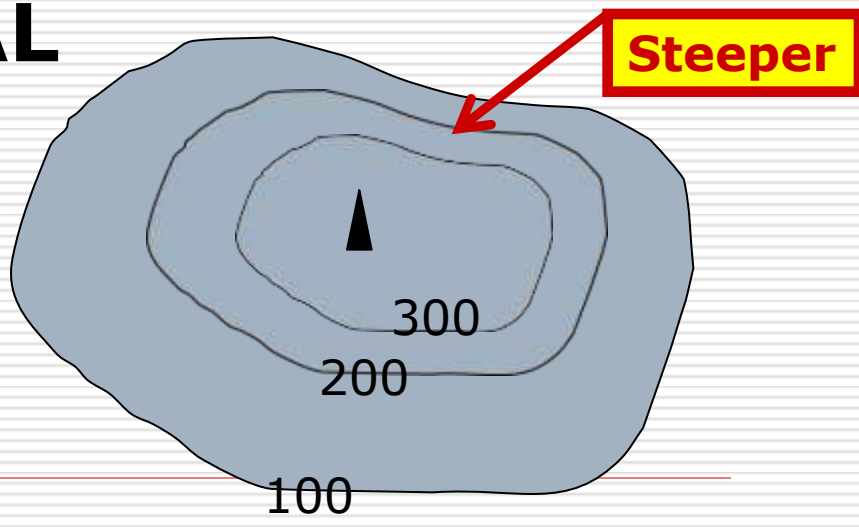
- Density never changes for a pure substance
  - It is a PROPERTY of matter
    - Ex- Aluminum is 2.7 g/cc
    - If you cut it in half each piece is still 2.7 g/cc
- Water is 1.0 g/cc
    - Greater then will sink
    - Less then will float

#11: Latitude and Longitude

- Latitude
  - Measures N and S of EQUATOR (0^o)
  - Lines are PARALLEL
  - Goes up to 90^o North and South
  - Divides Earth into Northern / Southern Hemisphere
- Longitude
  - Measures E – W of PRIME MERIDIAN (0^o)
  - Lines meet at the poles
  - 180^o (international date line) highest
  - Divides Earth into Eastern /Western Hemisphere

#11b: Topographic Maps

- Each line represents an **ELEVATION** or height above sea-level.
- Lines CLOSE = STEEP gradient
- The amount each line goes up is the **CONTOUR INTERVAL**
- Ex:BALD HILL
  - Contour Interval 100ft



#12: Mineral

- Occurs in Nature
- SOLID
- Inorganic (not from a plant or animal)
- Crystalline (forms crystals)
  - Atoms / Molecules bond in a regular pattern
- Regular Composition
  - EX- Halite (salt) is always NaCl

    Quartz is always SiO_2

#12B: Mineral Properties

- **CRYSTAL FORM-** (geometric shape of crystal)
- **HARDNESS-** (resistance to scratching)
  - Scale of 1-10 (talc-diamond)
- **STREAK-** (color of mineral as powder by rubbing a porcelain tile)
- **LUSTER** – light reflectiveness / shine
  - Metallic or Nonmetallic
- **CLEAVAGE**- mineral has blocky flat surfaces
  - **Fracture** – breaks irregular / no cleaveage

13: Rocks

- Aggregates (mixtures) of one or many ***MINERALS***

- Come from the solid outer layer of Earth
  - **LITHOSPHERE**
    - Aka "CRUST"

#14: IGNEOUS Rock

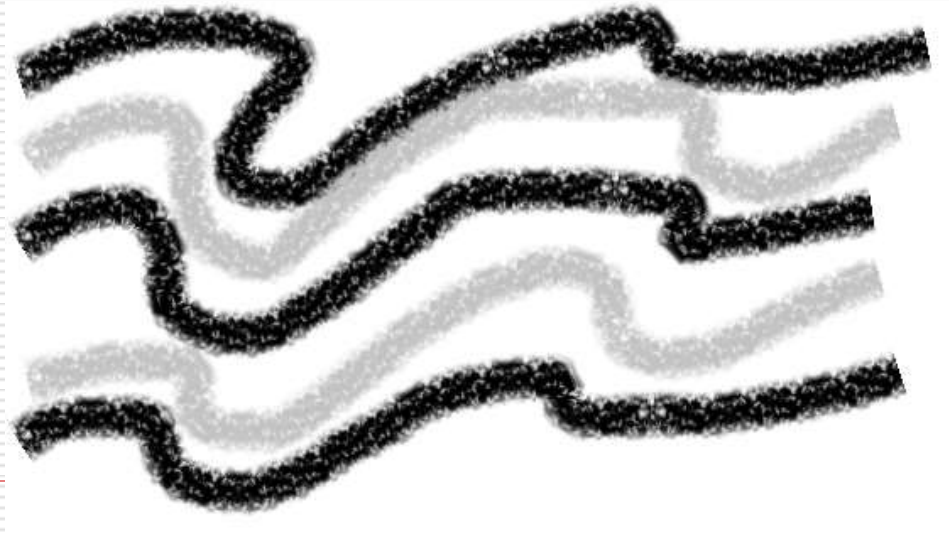
- Formed from COOLED / SOLIDIFIED molten (liquid) rock
  - **Magma** –
    - UNDERGROUND **INTRUSIVE**
    - cooled *SLOW -Big* Crystals
      - ***COARSE GRAINED***
  - **Lava**
    - VOLCANO **EXTRUSIVE**
    - *Tiny* Crystals – cools *Fast*
      - ***FINE GRAINED***
    - Can have "Gas Pockets"

#15: SEDIMENTARY Rock

- Layers of sand / mud or bits of rock sediment
  - **COMPACTED and CEMENTED**
    - At the bottom of lakes / seas / oceans
  - May have **FOSSILS**

#16: METAMORPHIC Rock

- Any rock changed or RECRYSTALLIZED by
  - **HEAT and PRESSURE**
    - Deep inside Mountain
      - Mineral Foliation / BANDING



#17: ROCK CYCLE

- Any rock can be changed into any other rock type
- Solid material of the Crust is continuously recycled:
  - **WEATHERED** into Sediment
  - **MELTED** into molten rock
  - **METAMORPHOSED** by **heat and pressure**

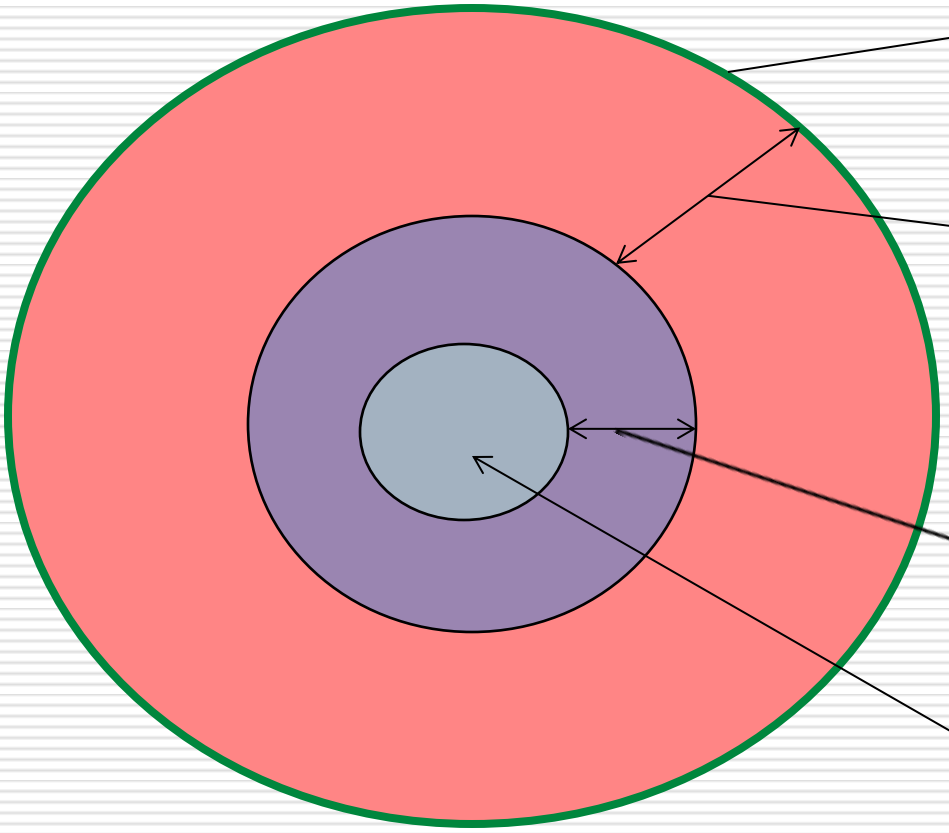
#18: WEATHERING

- **BREAK UP** of rock into smaller and smaller pieces / fragments (**sediment**):
  - **CHEMICAL WEATHERING-**
    - ***Acid Rain*** **dissolves Calcite** (Limestone and Marble)
    - **Oxygen** (rusts minerals with Iron)
  - **PHYSICAL WEATHERING-**
    - **Ice –** expands cracks rock**, "frost action"** *(potholes)*
    - **Waves / Rivers –** smooths and rounds
    - **Plants –** roots can lift and crack

#19: EROSION

- When Sediments are – TRANSPORTED / MOVED by:
  - **GLACIERS**
  - **RIVERS**
  - **WIND**
  - **WAVES**
- Driven by force of **GRAVITY**

#20 : Structure of Earth



Lithosphere /
"Crust"
- Solid Rock / Plates
- (apple skin)

Mantle- Soft but not melted
- (amorphous)
- Convection

Outer Core-
Liquid Iron

Inner Core –
Solid Iron and Nickel

#21: ASTHENOSPHERE

- Top of the Mantle
- Very soft and fluid rock
- Flows / **CONVECTION** Currents
- Moves the plates as they float on top

#22: Evidence of **Continental Drift**

- "Puzzle Fit" of continents shape
- Things MATCH when put back together
  - FOSSILS
  - MOUNTAINS
  - ROCK TYPES
  - Glacial / climate records
- SEA-FLOOR Spreading – youngest rock in the middle of ocean, older near continents

#23: Plate Tectonics

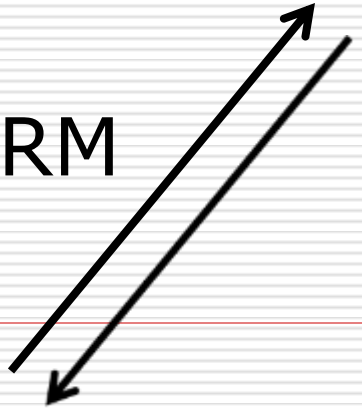
- The crust of the Earth is broken into sections – **PLATES**
- They shift and move as they ride atop the fluid / **Convecting MANTLE**
- Where the plates join form:
  - **VOLCANOES**
  - **MOUNTAINS**
  - **EARTHQUAKES**

#24 : Plate Boundaries

CONVERGENT

DIVERGENT

TRANSFORM

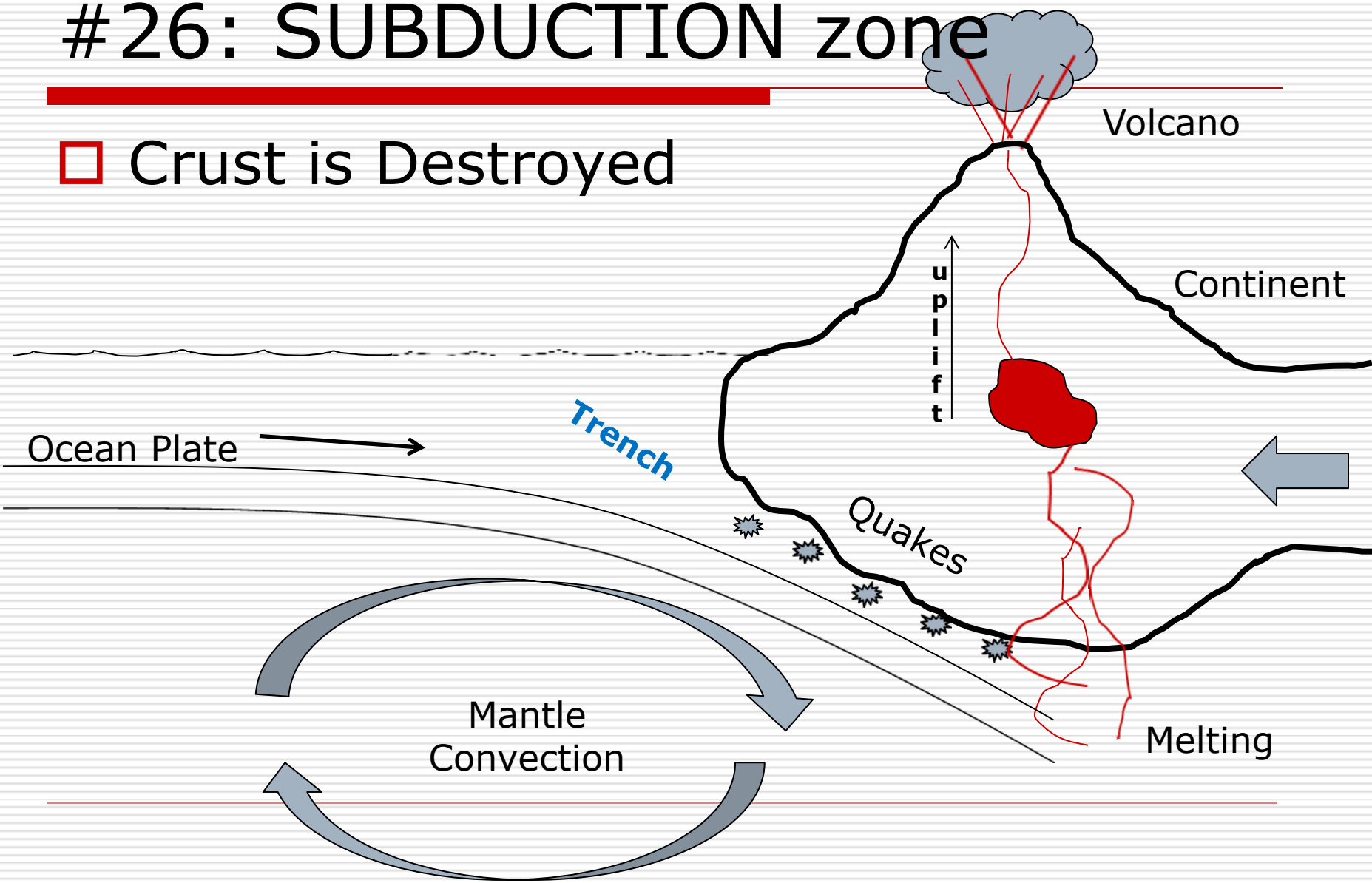


#25: “Ring of Fire”

- Ocean crust is being **Subducted** under the Continents by continuous **Convergence** all around the Pacific Ocean, which is lined completely by MOUNTAINS, EARTHQUAKES and VOLCANOES

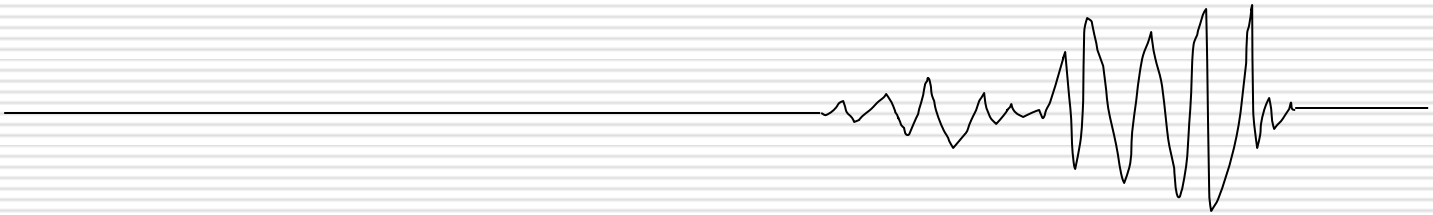
#26: SUBDUCTION zone

- Crust is Destroyed



#27 : Seismic Waves

- Waves of energy that travel through the entire Earth from Earthquake Faults.
- Measured by Seismograph readings

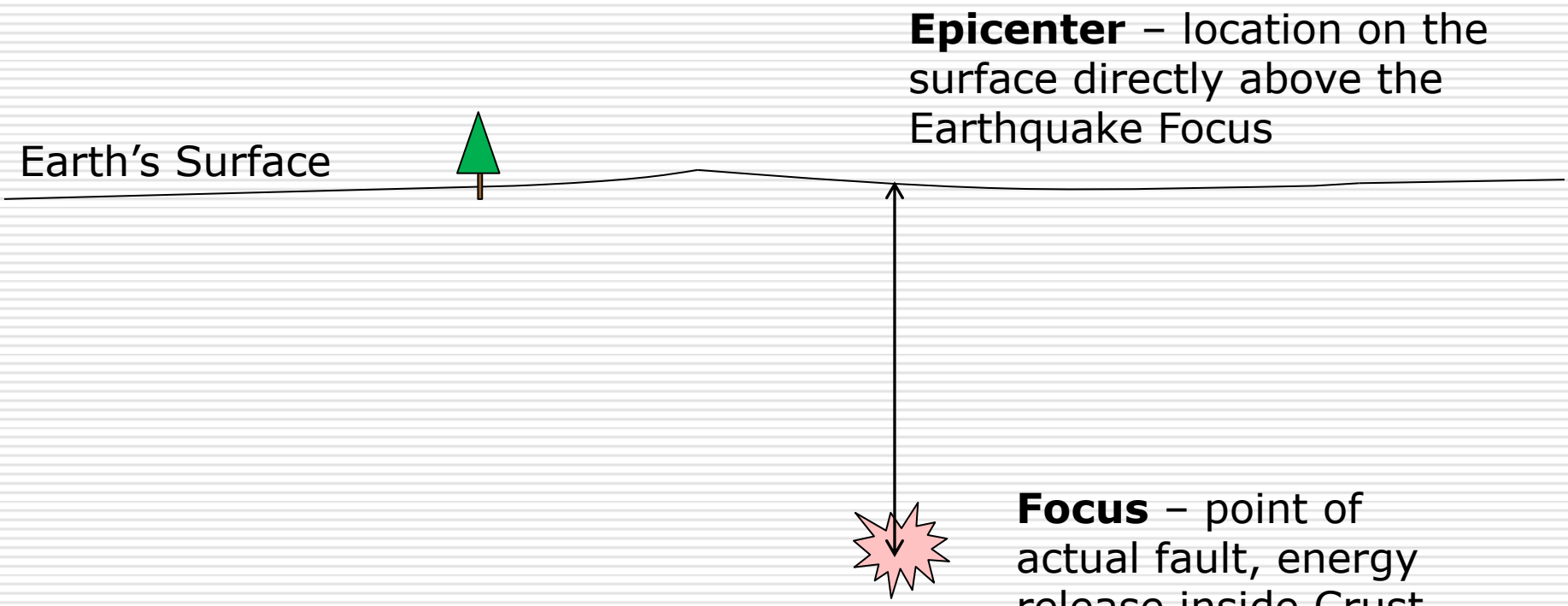


- Seismologist – study Earthquakes
- Tell us about Earth's interior
  - **Crust, Mantle, Core**

#28: Earthquake Scales

- Richter Scale
  - MEASURE OF ACTUAL ENERGY / POWER THE EARTHQUAKE RELEASED
- Mercalli Scale
  - MEASURES EARTHQUAKE POWER BY LEVEL OF DEVASTATION TO BUILDINGS AND STRUCTURES
  - FLAWED BECAUSE DISTANCE TO EPICENTER OF MAN MADE STRUCTURES NEVER THE SAME

#29: Focus / Epicenter



#30: Volcanic Winter

- When Volcanoes erupt, ASH (powdered rock) goes into the Atmosphere and spreads around the world, these particles reflect / blocks sunlight.

- Causes GLOBAL COOLING, drop in worldwide temperature

#33: Layers of the Atmosphere

THERMOSPHERE

MESOSPHERE

STRATOSPHERE

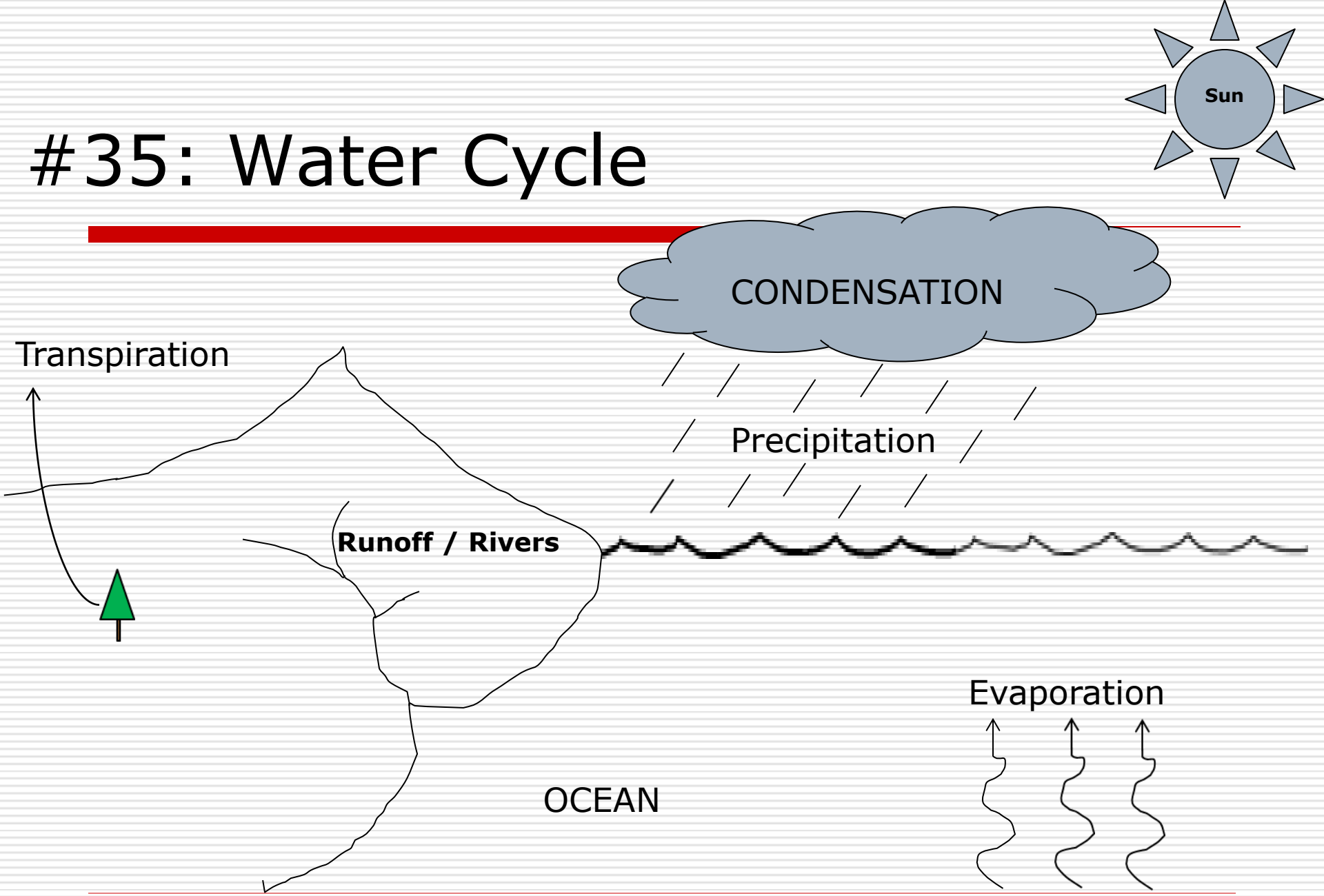
TROPOSPHERE

"**T**roy **S**ipped **M**ilk from his **Th**ermos"

#34: Heat Transfer

- **Convection** – currents from flowing fluids / warmer = less dense = rises
  - Fireplace warms the second floor of cabin
- **Conduction** – Contact / touch
  - Frying egg in pan
- **Radiation** – Direct path through space / out in all direction
  - Sun heating sand at beach

#35: Water Cycle



#36: Greenhouse Effect

- Radiation (light / "short-wave" energy) from the Sun hits Earth. Most of it gets absorbed by the surface.

- This makes the ground hot / this heat energy (long-wave) is released from Earth and absorbed by CO_2 and H_20 vapor in the air.

- **GLOBAL WARMING** – burning fossil fuels (oil, gas, coal) adds CO_2 and increases this effect

#37: Weather Variables

- **TEMPERATURE** - amount of HEAT energy the air has
  - **THERMOMETER**
- **HUMIDITY** – amount of WATER vapor in air
  - **PSYCHROMETER**
- **PRESSURE** – weight of air
  - **BAROMETER**

#38: How a CLOUD forms

- Warm air rises (less dense)
  - at a **FRONT**
- It expands and cools (below Dewpoint)
- CONDENSATION (gas to liquid) occurs
- The tiny droplets of water form on dust particles
  - **CONDENSATION NUCLEI**

#39: AIR MASSES

- From land / **dry** / CONTINENTAL → **c**
- From ocean / **wet** / MARITIME → **m**
- From north / **cold** / POLAR → **P**
- From south / **warm** / TROPICAL → **T**
- **mT** = wet and warm
- **mP** = wet and cold
- **cT** = dry and warm
- **cP** = dry and cold

#40: Dewpoint Temperature

- When air cools to the "Dewpoint Temperature," water vapor in the air will form tiny droplets

- ***CLOUDS*** **-**
  - **CONDENSATION point temperature**
  - Relative Humidity = 100%
    - Air is saturated / full of water vapor

#41: Relative Humidity

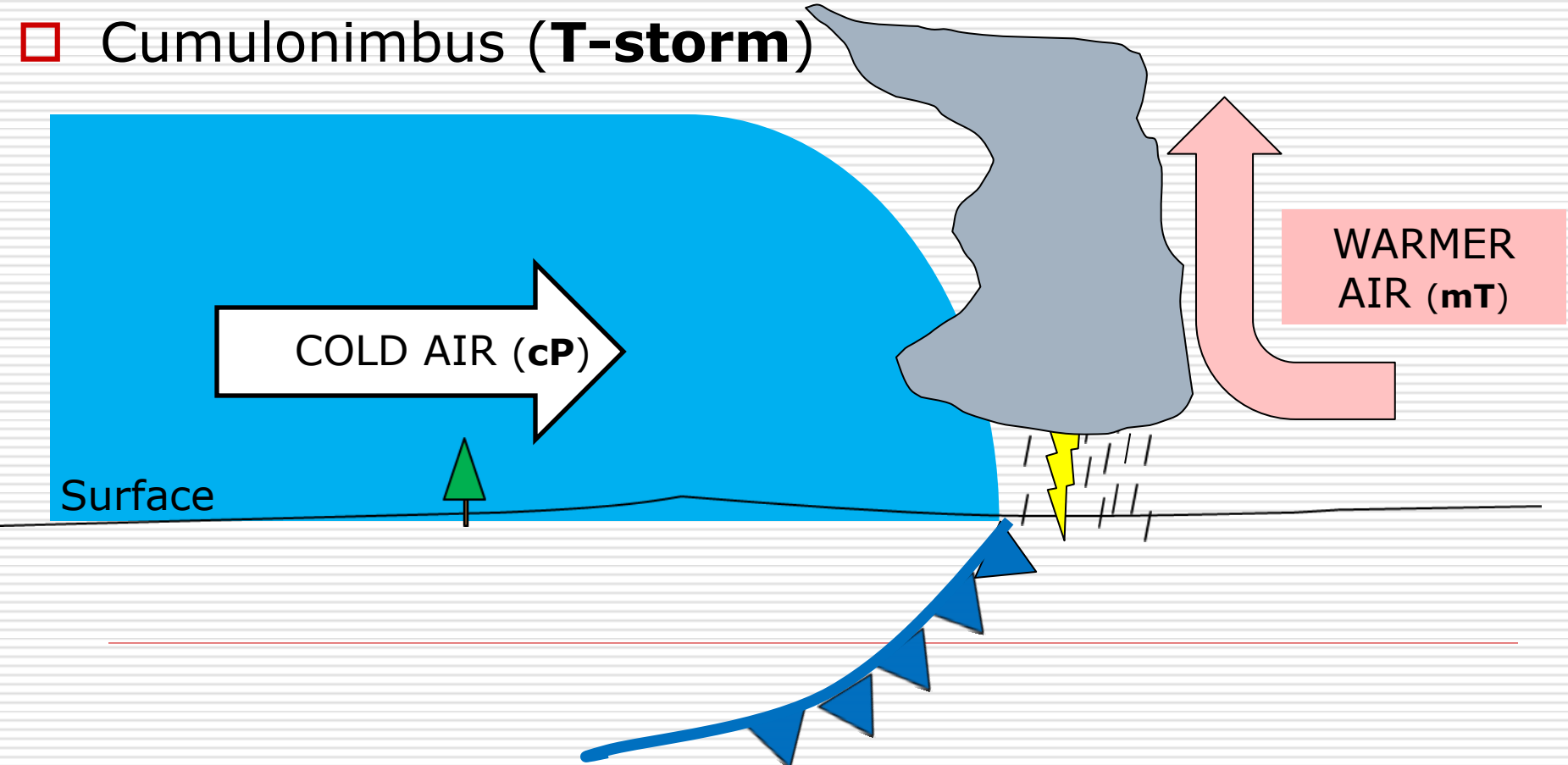
- Percentage of water vapor in the air
- Relative to temperature
  - **WARM AIR CAN HOLD MORE MOISTURE THEN COLD**
    - EX- 50% HUMIDITY AT 80^{O}F, becomes 100% IF THE AIR COOLS TO 60^{O}F

#42: **High Pressure vs. Low Pressure**

- HIGH Pressure
  - CLEAR / SUNNY / “HAPPY”
  - COOLER TEMPS
  - HEAVY / DENSE / SINKING AIR
- LOW Pressure
  - CLOUDY / RAINY / “LOUSY”
  - WARMER TEMPS
  - LIGHTER / RISING AIR
  - Occurs at **FRONTS**

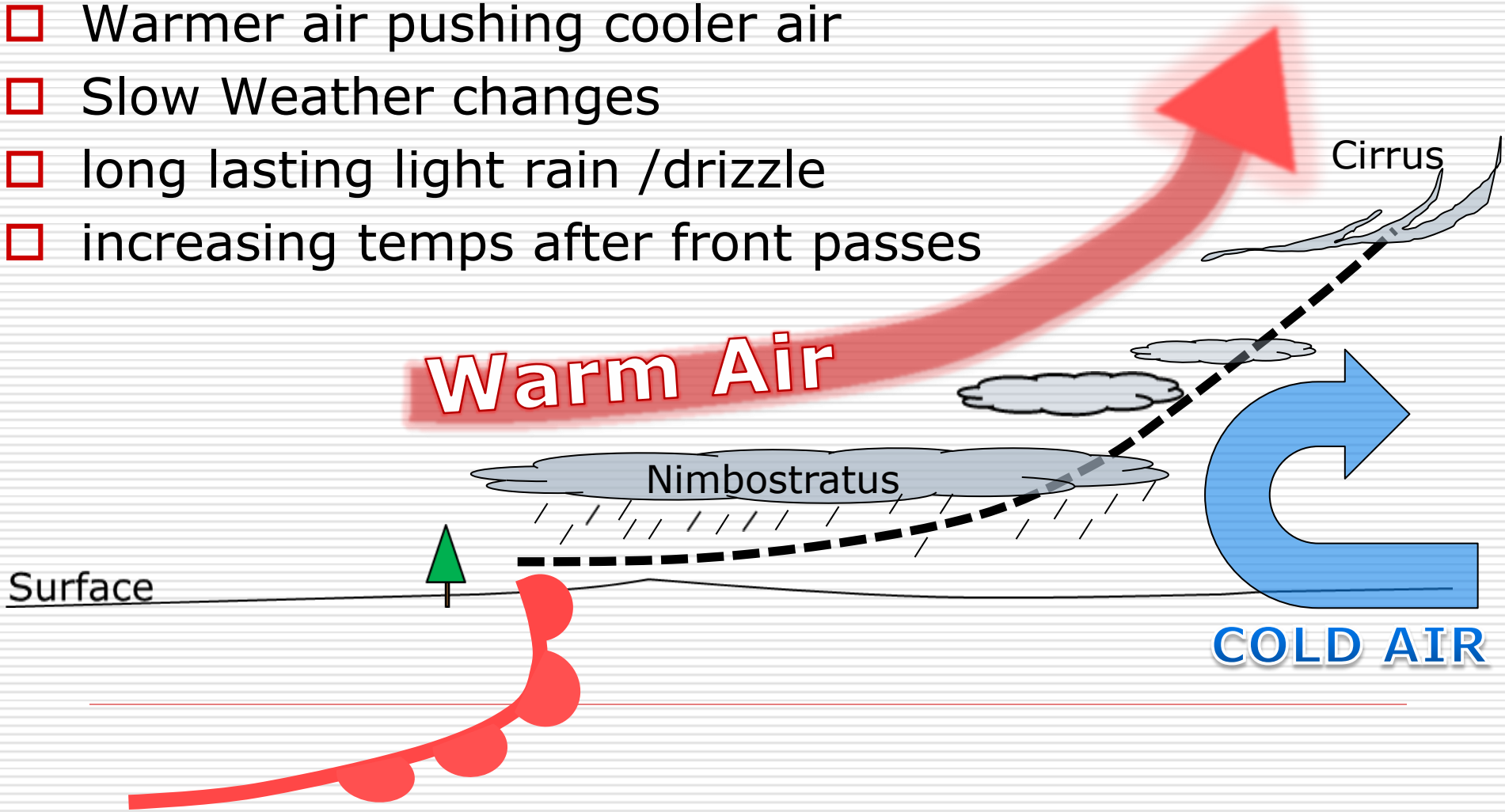
#43: Cold Front

- Colder air pushing warmer air
- Fast / Heavy Rain for short time /decreasing temps
- Cumulonimbus (**T-storm**)



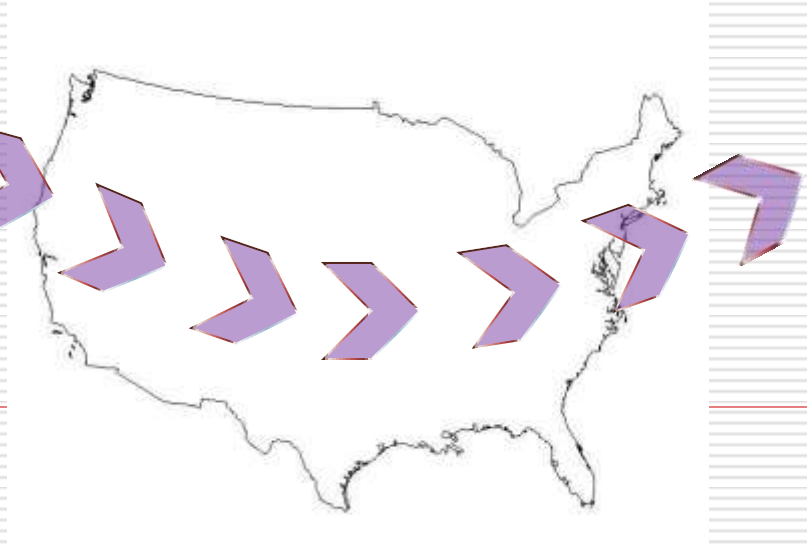
#44: Warm Front

- Warmer air pushing cooler air
- Slow Weather changes
- long lasting light rain /drizzle
- increasing temps after front passes



#45: "Jetstream"

- River of air
- High up in the Atmosphere
  - (stratosphere)
- **Moves all <u>Weather / storms</u>**
  - **WEST to EAST** (in U.S.)



#46: GRAVITY

- Attractive force between 2 masses
- The **LARGER** (size) and **CLOSER** (distance) the STRONGER the Gravity

#47: Rotation vs. Revolution

- Rotation – Earth spinning on axis
  - CAUSES DAY/ NIGHT = 24 HRS
  - *SUNRISES* ***EAST*** */ SETS* ***WEST***

- Revolution – orbit of Earth around Sun
  - 365.25 Days
  - Earth is tiny bit closer to Sun in Winter!

#48: Terrestrial vs. Jovian Planets

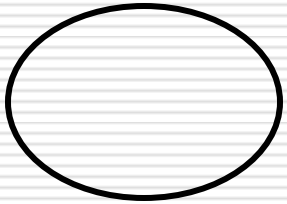
- Terrestrial (inner)
  - Small
  - Rocky
  - Dense
  - Close to the Sun
  - Small/Fast orbit
  - Mercury,Venus, Earth, Mars

- Jovian (outer)
  - Large
  - Gaseous
  - Low Density
  - Far from Sun
  - Large / Slow orbit
  - Jupiter, Saturn, Uranus, Neptune

49: Shape of Orbits

- Planetary orbits are slightly oval shaped or **ELLIPSES**
  - This is how we are ***closer to the Sun in Winter***

  - Orbital Velocity is also faster when closer
- **BUT!** The eccentricity is slight and when drawn to scale looks circular
  - **Always pick the circle on test**



#50: Cause of Seasons

1. 23.5° **tilt** of Earth's Axis

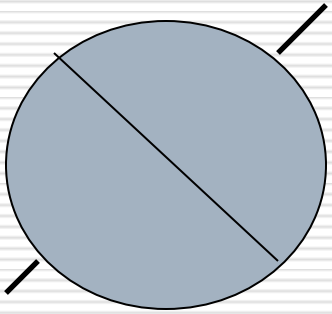
   WINTER-more slanted rays / shorter days= COOLER

   SUMMER- longer days / more direct rays= HOTTER

2. **Revolution** (orbit) of Earth around Sun

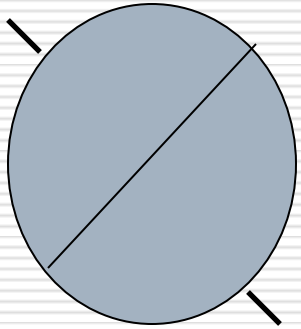
#51 Summer:

- North Pole tilts at the Sun
  - SUMMER SOLSTICE / June 21st
  - First day of summer / Longest day of the year
  - N. Hemisphere has most **DIRECT RAYS**



#52 WINTER:

- North Pole <u>tilts AWAY</u> from SUN
  - **Winter SOLSTICE** / Dec. 21st
  - First day of winter / Shortest day
  - N. Hemisphere gets INDIRECT rays (slanted)



#53 EQUINOX

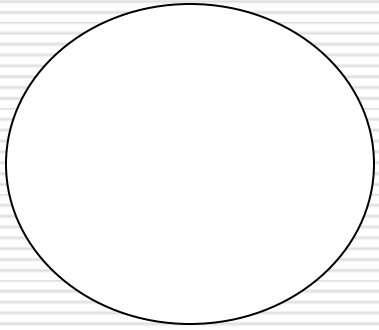
- Equal DAY / NIGHT, 12hrs / 12hrs
  - Everywhere on EARTH!
- Axis is sideways / perpendicular to Sun
- September and March 21st
  - Starts **Spring / Fall**

#54 Why do we see phases of the Moon?

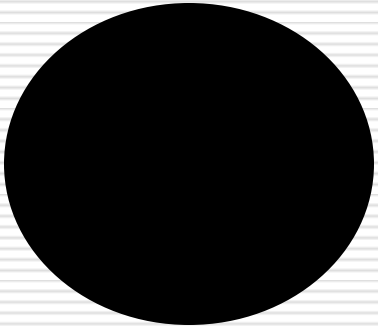
- The Moon is always ½ lit by Sunlight
- As the Moon orbits/ revolves Earth we see different amounts of this half as our angle of view changes
- The Moon takes a MONTH to revolve
  - It grows into a FULL Moon and shrinks away every 30 days / every orbit

#55 FULL Moon vs. NEW Moon

- FULL
  - Opposite SUN
  - See Whole Circle

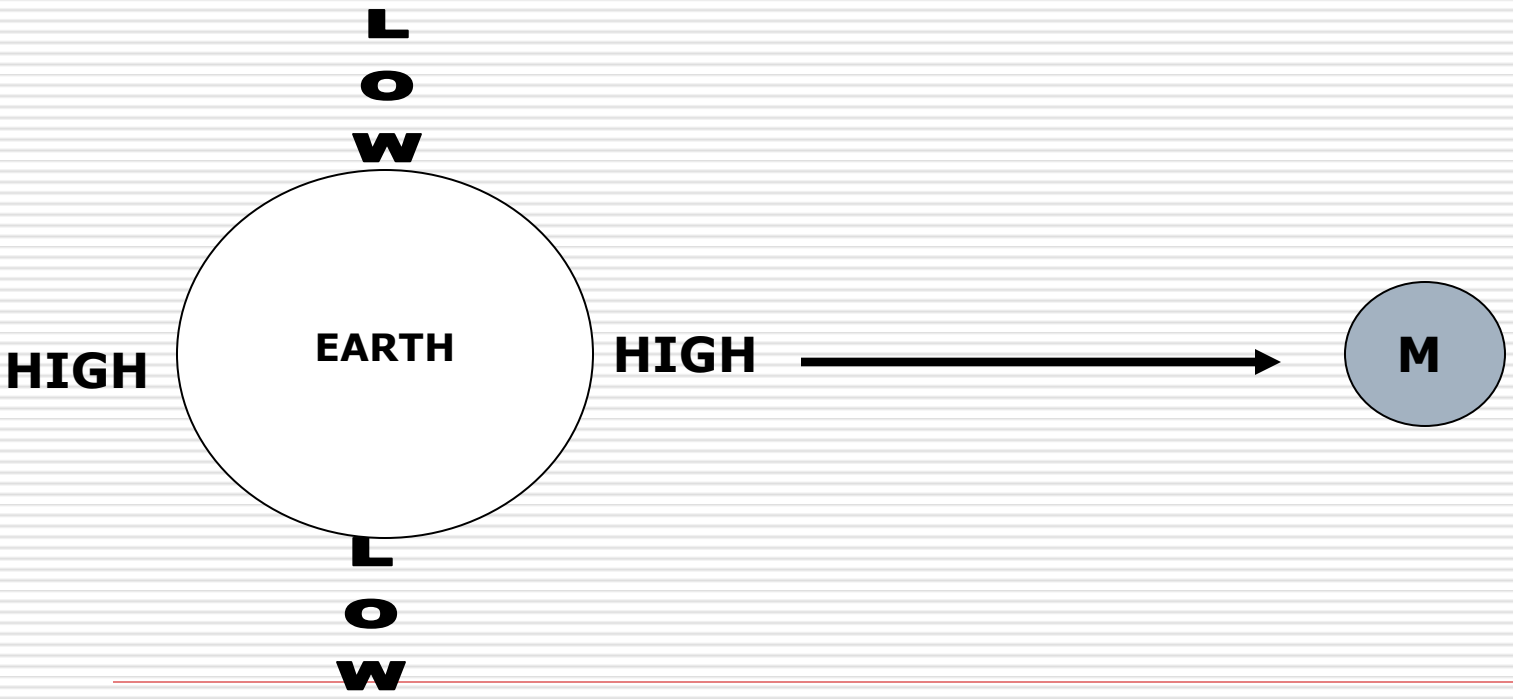


- NEW
  - Between Sun and Earth
  - See NOTHING!



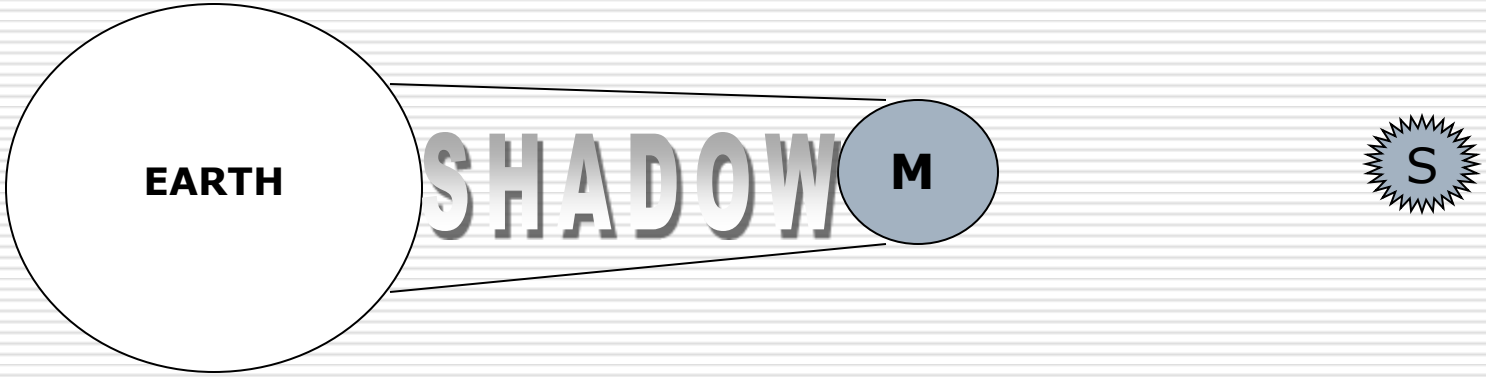
#56 TIDES

- Rise and fall of sea-level from Moon's gravitational pull on the Earth.



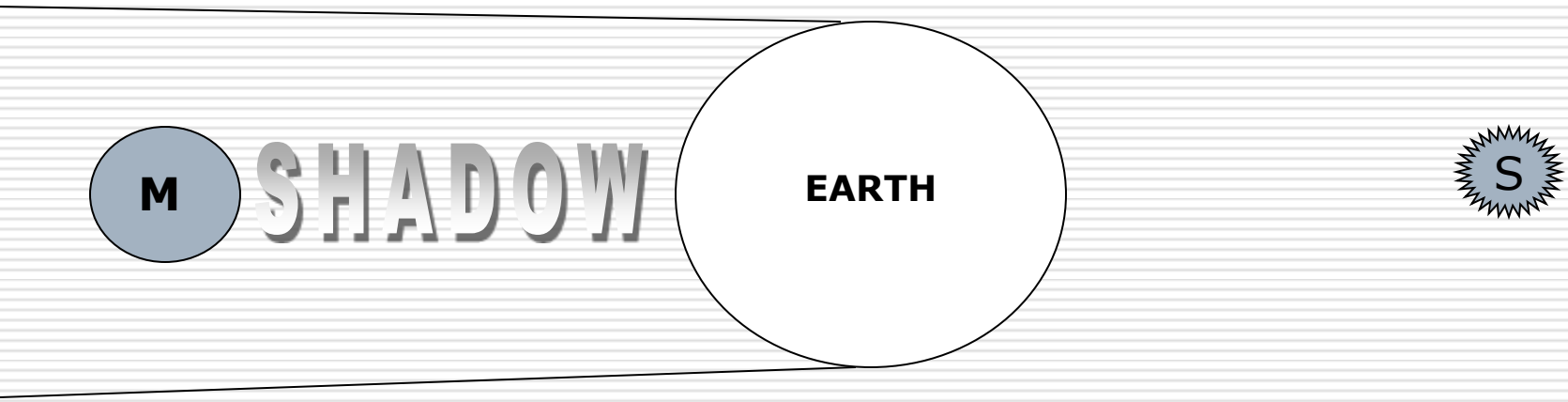
#57 Solar Eclipse

- New Moon blocks Sun



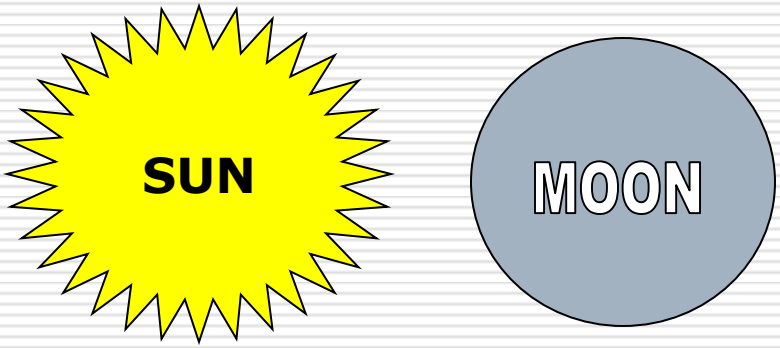
#58 Lunar Eclipse

- Earth blocks Full Moon



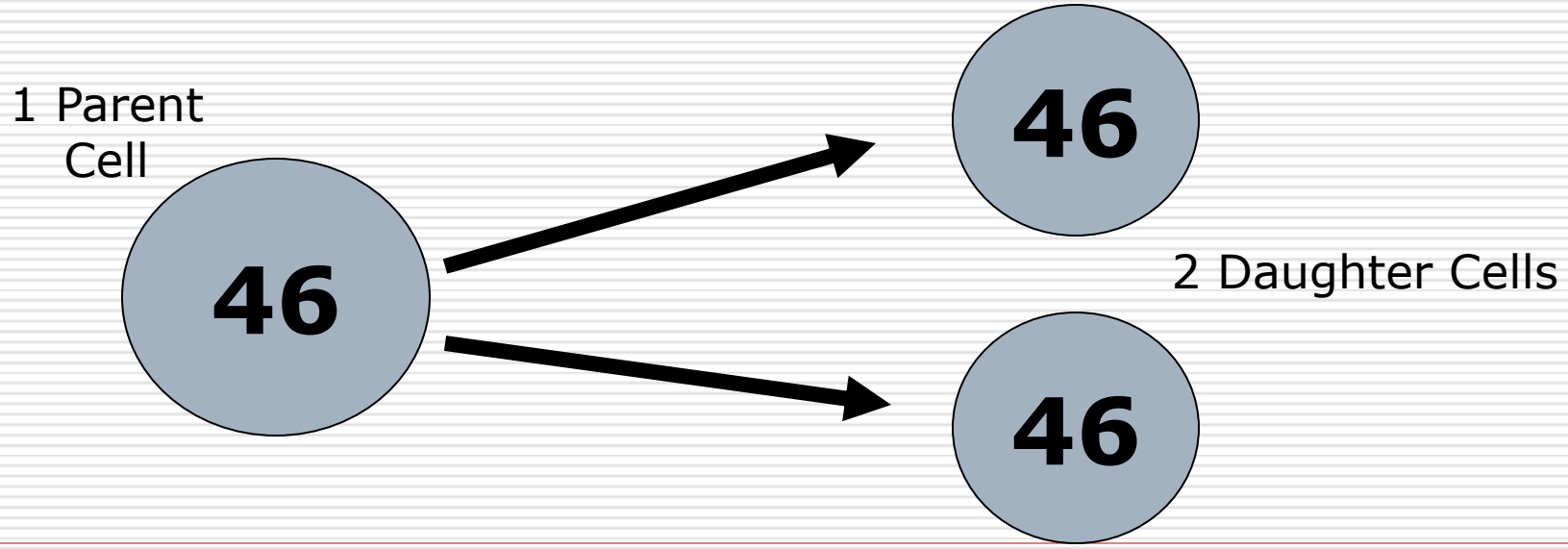
#59:
Apparent Size of Moon and Sun

- The Moon and Sun are about the same size in our sky because, although the Sun is millions of times larger, it is millions of times farther away.



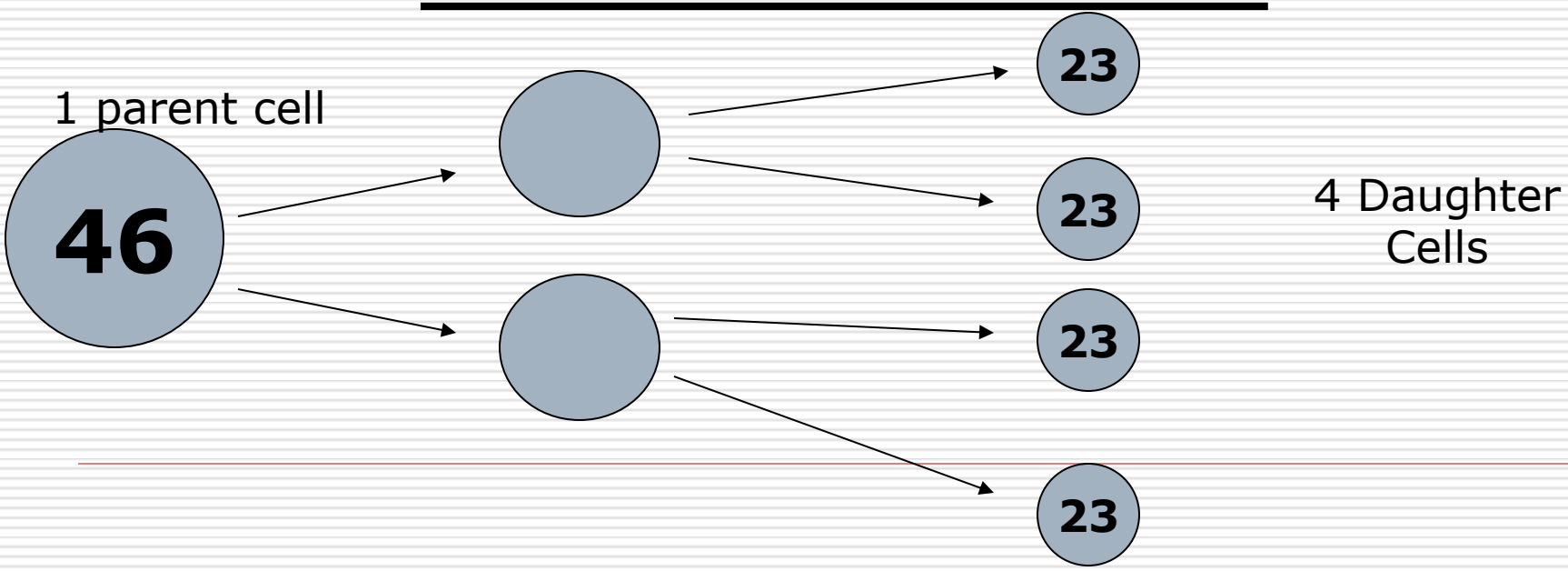
#60: Mitosis

- Body Cell Division (skin, blood, muscle, bone, etc…)
- Cell splits one time
- Human Body cell has 46 chromosomes



#61: Meiosis

- *Sex Cell Division, in **GONADS** (testes, ovaries)*
- Gametocyte Cell splits two times makes 4 sex cells
- Each has **½ the Chromosomes**



#62: GONAD

- **Sex Organs**
  - Plant
    - Cones (big=female, tiny=male)
    - Flower
      - Male → Anther
      - Female → Pistil
  - **Animal**
    - **MALE → TESTIS**
    - **FEMALE → OVARIES**

#63: Types of Reproduction

- **SEXUAL**: 2 organisms (plant / animal) create a new organism mixing their DNA (sperm and egg)

- **Asexual**: (NON SEXUAL) one organism makes a genetic clone / copy of itself
  - Ex- Fission (mitosis) – ameoba, bacteria
    Budding – hydra, yeast
    Spores – fungus (mold, mushrooms), Ferns

#64: GAMETE

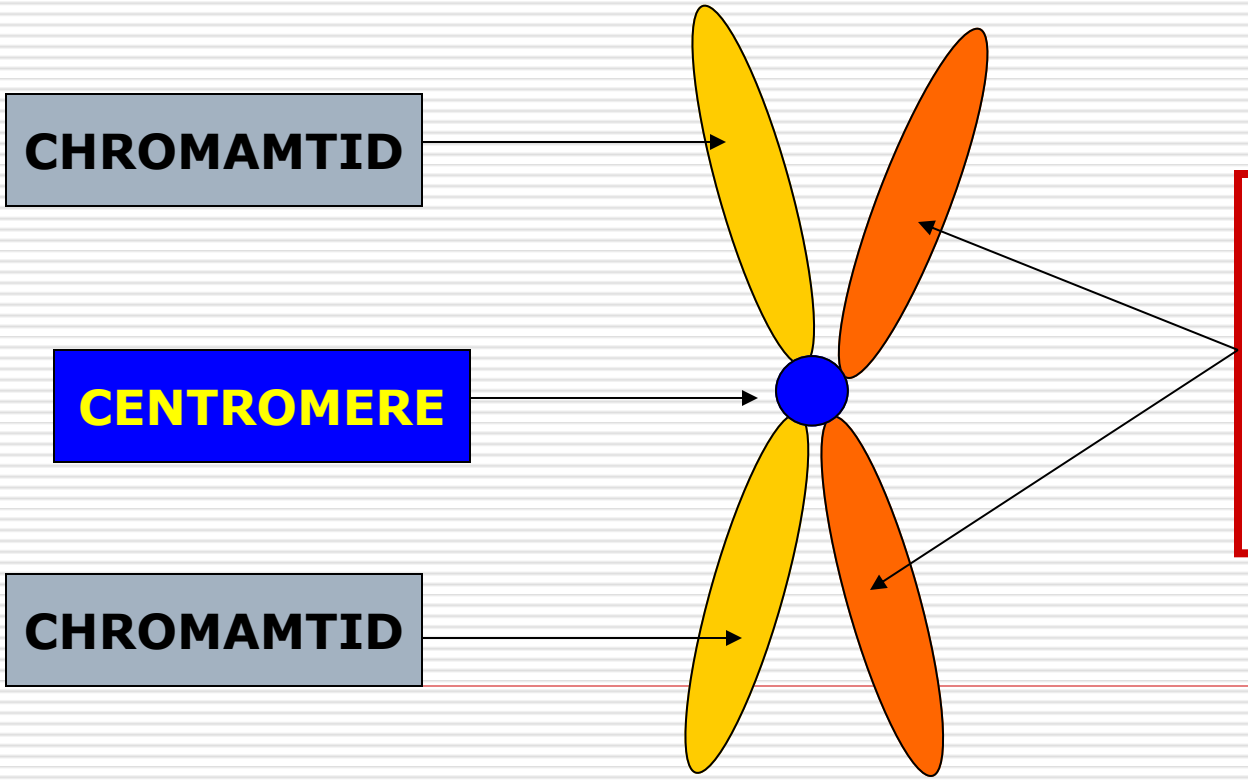
- **Sex CELLS**
  - made by Meiosis
  - Combine to make a new organism
  - Have ½ the Chromosomes of the body cells
    - **MALE = Sperm**
    - **FEMALE = Egg / Ovum**

#65: Gametocyte

- ***Cell*** inside the GONAD **that will** ***MEIOSIS*** (double split) to **make** a ***Gamete*** (sperm and egg)
  - Male – Spermacyte
  - Female - Oocyte

#66: Chromosome

Coiled up Package of DNA / 46 in Human Cells



Sister Chromatids:

Copied Pair of chromosomes during MITOSIS for new cell

#67: DNA Base Pairs

- The genetic code that controls all traits
- Are the steps in the "twisted ladder"
- ADENINE ⟷ bonds with ⟷ THYMINE
- GUANINE ⟷ bonds with ⟷ CYTOSINE

#68: Dominant Gene

- Trait that powers over the Recessive trait
- Always a **CAPITAL LETTER**

#69 Recessive Gene

- Trait that is covered by Dominant
- Will only show in a person's appearance when paired with another recessive gene
- Always shown by a **lower case letter**

#70: Alleles

- The two GENES that you have for a trait
- One from each parent
  - CAPITAL LETTERS FOR DOMINANT GENES
  - lowercase letters for recessive genes

#71: Genotype

- The GENE pair (alleles) for a trait
- Two Parents = two Letters

#72: Phenotype

- The trait (gene) that actually shows in a person's appearance

#73: Homozygous (pure)

- **Genotype** with two of the same genes for a trait
- EXAMPLE:
  - **BB** – Homozygous (pure) dominant
  - **bb -** Homozygous (pure) recessive

#74: Heterozygous (hybrid)

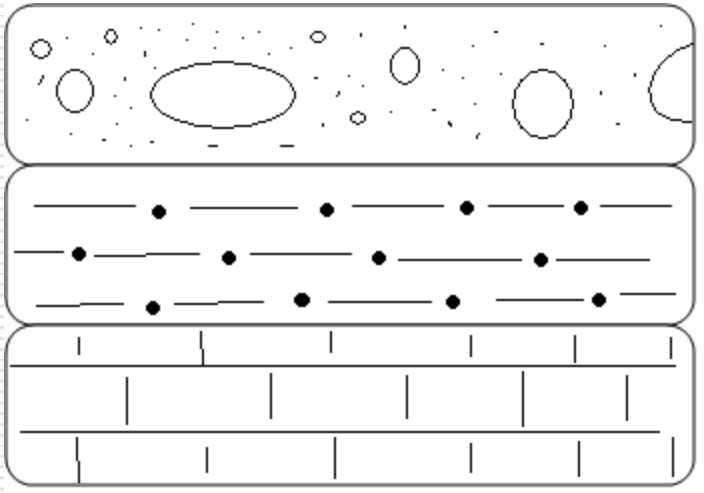
- Genotype with a Dominant gene from one parent and a Recessive from the other

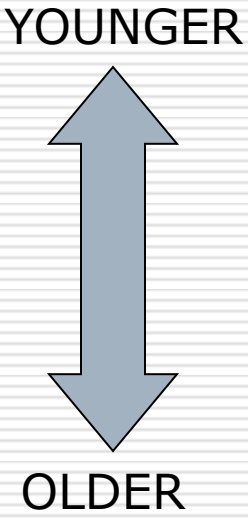
- The Phenotype will always be the Dominant gene

  - Ex - **Bb**

75: Superposition

- In layers of Sedimentary Rock the **<u>Older layers are below the Younger</u>**
- "RELATIVE DATING"





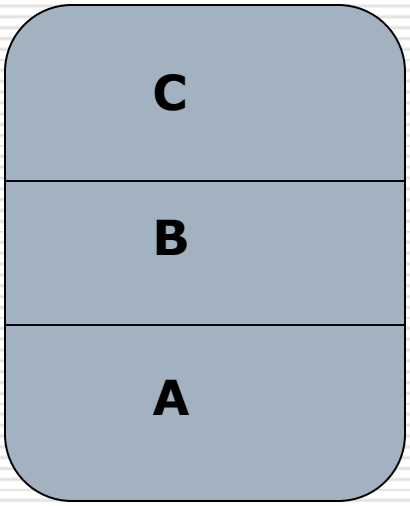
#76: INDEX FOSSIL

- A fossil of a plant or animal that lived all over Earth for a short period of time.
- Makes a good time marker / tells you the age or geologic period a rock formed
- EX: Dinosaurs lived during the Mesozoic era (120-65 MYA, million years ago) a dino fossil indicates that the rock formed in that time

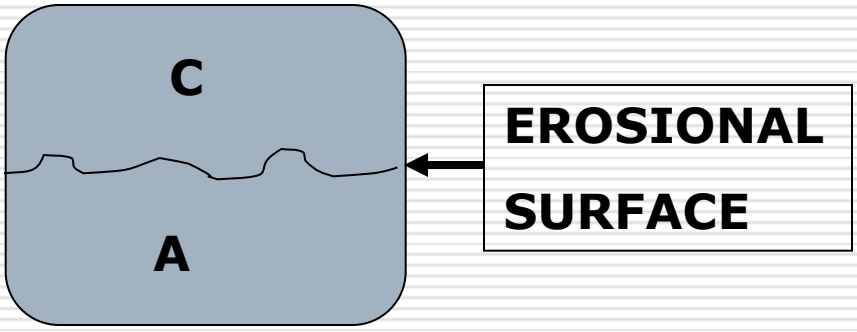
#77: UNCONFORMITY

- When layers of rock are missing / a "gap" in time / these ***layers are eroded away***

- Should Be:



Looks Like:



#78: Geologic Time Scale

- Earth's History / broken down into
  - Eons
    - Eras
      - Periods
        - Epochs

Based on the Life that existed / **FOSSIL RECORD**

Each ERA ends with a Major *Mass* ***EXTINCTION*

#79: Evolution

- The change in life over time

#80: Variation

- Differences from one individual to another within a population of a species.

#81: Adaptation

- **Variation / Trait** that helps the individual survive more in it's environment

- Ex; Snowshoe Hair's large Paws helped it run faster across snow, Giraffe's Neck allowed it to reach higher leaves

#82: Natural Selection

- Process by which **EVOLUTION** occurs

- In nature, individual organisms within a species that have, **ADAPTATIONS**, traits that help them to survive will-
  - **Live longer**
  - **Reproduce more**
  - **Pass on their Genes/ DNA/ Traits**

#83: Mutation

- **DNA** of an organism is **changed**

- A **NEW gene** in Genetic Code
  - (A-T, C-G) = "base pairs" pattern is altered

- usually bad, sometimes can create an adaptation

#84: HOMOLOGOUS Structure

- Evidence of EVOLUTION
- Suggests a **COMMON ANCESTOR**
- Same Structure / Different Function
- EX: Hand of a Human and Flipper of a Dolphin have the same bones, but different functions

#85: Vestigal Structure

- A body part that is slowly DISAPEARING over millions of years
- As the species evolved, it no longer has a use for it
- EX:
  - Human appendix and tailbone
  - Leg bones of snakes
  - Eyes of a cavefish