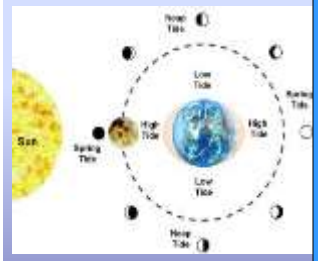
EARTH SCIENCE NC FINAL REVIEW

Concepts and Topics
For the NC FINAL
Earth Science Test

OCEANOGRAPHY

The Tides



Tides are the daily rise and fall of ocean water level caused by the moon's gravitational pull

2 high and 2 low tides occur daily

Spring—greatest tidal range because the moon, sun, and Earth are in alignment

Neap—lowest tidal range worldwide; happens during quarter moon phases

MORE OCEANOGRAPHY

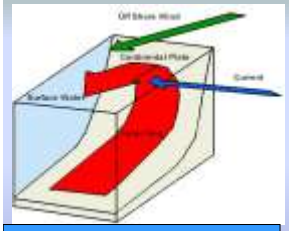
Waves are generated by the wind

The ocean is the largest reservoir of heat from the SUN…therefore, it drives most of the Earth's weather systems

Current systems are created by the Coriolis Effect and Wind. In the Northern Hemisphere, currents turn **clockwise** and warm water moves toward the poles and cold water moves toward the equator (**convection currents**)

Sea level can change. **Sea level rises** when polar ice caps melt and sea level goes down when more ice is created.

MORE OCEANOGRAPHY



Upwelling occurs when cold water sink and forces the water on the bottom to be pushed to the surface, resulting in cold bottom water rising to fill the gap. **This nutrient-rich water provides extreme amounts of food for fish**, therefore upwelling areas are known for rich biological activity.

Estuaries—areas where fresh water rivers meet salt water areas. The Chesapeake Bay is an example. There are variations in salinity (salt content) and diverse biological life.

MORE OCEANOGRAPHY

Salinity, Element Concentrations, and Density Currents

Salinity is the amount of salt in the water. Average salinity is 3.5%. Because of the salt, ocean water is denser than fresh water.

Concentration of elements in the ocean (contains 70 elements, here are the top 3):

55% chloride (from volcanoes)

31% sodium (from rivers)

4% magnesium

Density currents occur when dense seawater moves to a less dense area.

Cold water moves to warm areas

Water with salt is more dense. Evaporation or the formation of ice may cause the salinity of water to increase.

AND YET EVEN MORE OCEANOGRAPHY

Species types in the oceans and Oceanic Landforms

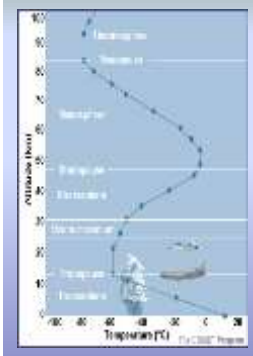
Pelagic Species—live in seawater

Benthic species—live on the bottom

Abyssal Plain—flattest area on Earth. Sediments fill any crevice immediately

Seamounts—underwater volcanoes **Atolls**—form around extinct volcanoes. Coral structures. **Continental slopes**—have canyons and extreme movement of sediment

THE ATMOSPHERE



Earth's atmosphere is **21% oxygen** and **78% nitrogen**

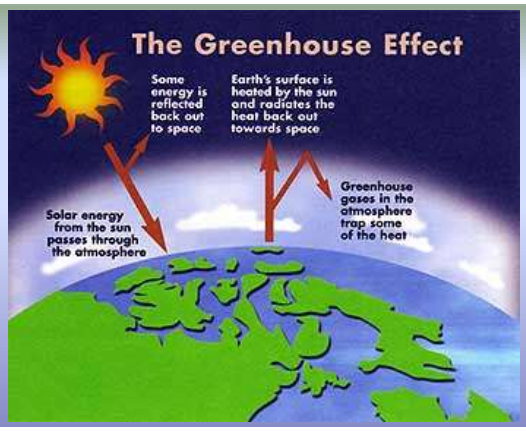
Human activities (cars, factories, burning land, coal) have increased carbon dioxide levels, causing a slight **greenhouse effect**

Water vapor and carbon dioxide help the Earth to retain heat and make it warmer

Burning fossil fuels also causes smog and contributes to acid rain

Venus has an extreme greenhouse effect due to carbon dioxide

Energy transfer in the atmosphere involves convection, radiation and conduction



WEATHER VS. CLIMATE

- **Weather**
  - Describes the day to day, moment to moment changes in the conditions of the atmosphere
- **Climate**
  - Describes the weather pattern for a given location over a period of many years

Factors affecting climate:

*Latitude—areas around the equator receive more of the sun's energy

*Elevation—how high is an area?

*Bodies of water—cold ocean currents cause colder climates

*Position relative to mountains

Prevailing Winds- the direction the winds are coming from

CLOUDS

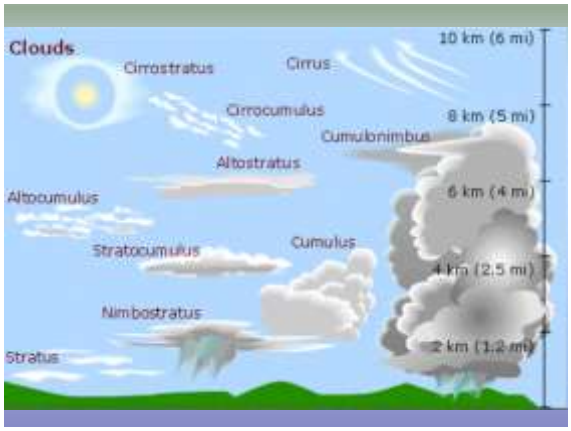
In order for clouds to form, air must be at its **dew point** (temperature at which air is saturated).

Water vapor condenses on small particles called condensation nuclei.

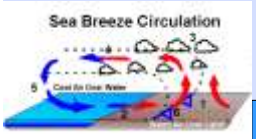
Cirrus—light, thin, feathery (fair weather clouds)

Cumulus—puffy white clouds

Stratus—low gray clouds



Coriolis effect—Earth rotation causes deflection of air in the atmosphere



WIND

Global wind patterns are caused by the unequal heating of the Earth creating convection currents.

Wind flows from High to Low Pressure

United States weather is controlled by **Prevailing Westerlies** and moves from west to east

Sea breezes—during the **day**, wind blows from the sea to the land because the air above the sea is colder (denser) and the air above the land is warm (less dense)

Land breezes—occur at **night**. Cool air above land moves out to over warmer water in the sea.

TORNADO

- **A tornado is a violently rotating column of air that usually touches the ground**
- **A rotating updraft of air in a thunderstorm cloud may form a spinning column called a mesocyclone, which eventually can touch down on the ground as a tornado**

The Fujita scale measures the wind speeds:

F0 (weak) to F5 (violent)

HURRICANES

Hurricanes are the largest storms on Earth. It moves with counterclockwise movement and winds reach up to more than 250 km/hr.

Hurricanes are areas of extreme low pressure that form over warm ocean water of at least 80 degrees.

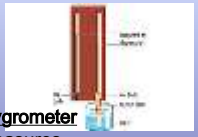
Intensity of hurricanes is measured on the Saffir-Simpson scale and is determined by sustained wind speeds

Category 1-5

WEATHER INSTRUMENTS

Sling psychrometer—measures relative humidity

Barometer measures air pressure



Hygrometer measures relative humidity

Anemometer measures wind speed

Wind vane shows wind direction

WEATHER MAPS

Pressure is reported by inches of mercury (28-32 inches) or in millibars. Millibars are reported as 1012.3, but on station models is done differently.

Weather moves from west to east in the US

Symbols for cold fronts, warm fronts, pressure and precipitation should be known

High pressure (H)=fair weather, circulates CW and air sinks

Low pressure (L)=bad weather, circulates CCW and air rises

Air from High pressure always moves to areas of Low pressure (gradients)

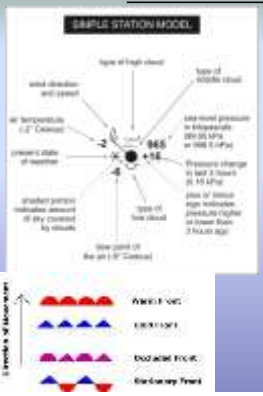
Cold Fronts—cold air invades warm air; rain and thunderstorms

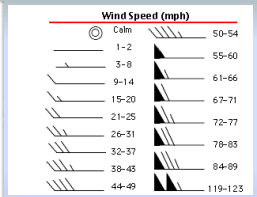
Warm Fronts—warm air invades cold air; steady rain

Isotherms—lines of equal temperature (like contours)

Isobars—lines of equal pressure (like contours)

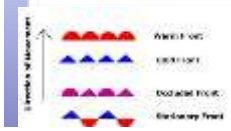
STATION MODELS





	Symbol		Symbol
Rain	●	Fog	≡
Drizzle	●	Thunderstorm	⚡
Shower	▽	Hail	▲
Snow	✳		

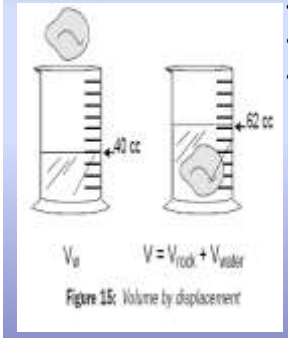
combinations of maps can be made, e.g. rain shower, snow shower



ENERGY RESOURCES ON EARTH

Energy Source	Advantages	Disadvantages
Oil	Efficient; can be converted into different types of fuel	Causes air pollution; risk of spills while drilling/transporting; nonrenewable
Natural gas	Available in US; clean	Difficult to store and transport; mostly nonrenewable
Coal	Abundant in US; inexpensive	Causes air pollution and acid rain; mining practices harmful to miners' health
Nuclear	Highly efficient; does not cause air pollution; inexpensive	Thermal pollution; radioactive waste; nuclear accidents
Hydroelectric	No air pollution; inexpensive; renewable	Not available in all areas; effects local ecology
Wind	No pollution; clean; inexpensive; renewable	Winds not always constant; not practical for large-scale
Solar	No pollution; clean; renewable	Expensive to convert into usable form

DENSITY

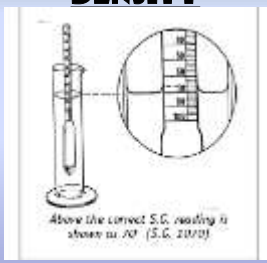


- **Density = M/V**
- **Density= Mass/Volume**
- Units = g/ml or g/cm^3
- To find the density of a rock
  - Use a triple beam balance to find mass in grams
  - Use water displacement to find the volume
  - Calculation is mass divided by volume

DENSITY (CONTINUED)

- An apple-sized piece of gold will have the same density as a piece of gold the size of a truck
- As the temperature of an object **increases, the density will decrease.**
  - **Convection currents** -warm material **rises** and cold material **sinks**
  - **Cold water sinks in warm water because it is more dense**

EVEN MORE DENSITY



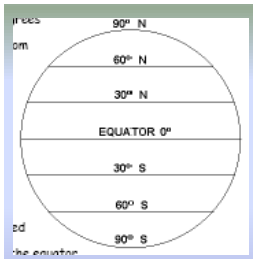
- Adding **dissolved solids** to material will also cause the **density to increase**
  - **Salt in ocean water causes ocean water to be more dense than fresh water**
  - A **hydrometer** is an **instrument that measures density of liquids**. The greater the density of the liquid, the higher the hydrometer (straw) will float.
- **Fresh water has a density of 1.0 g/mL. If an object sinks in water, its density is greater than 1. If it floats in water, its density is less than 1.**
- **The rock pumice floats in water. The planet Saturn would float in water.**

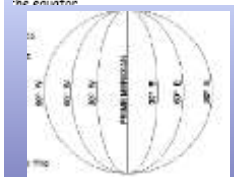
MAPPING AND SCALES

Skills needed:

- Using the map scale to calculate distance
- Calculating the contour interval
- Interpreting topographic features and contour profiles
- Latitude and longitude coordinates

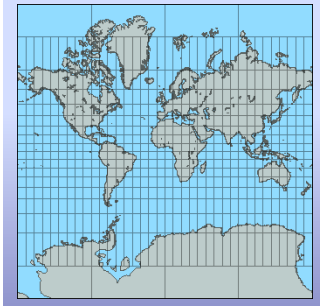
MAPS





- Latitude lines run parallel to the equator and are measured N and S.
- Longitude lines intersect at the poles and measure E and W.
- There are 60 minutes in one degree and 60 seconds in one minute.

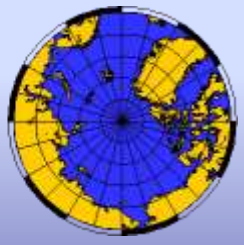
MERCATOR PROJECTION



Mercator maps have both latitude and longitude lines parallel. N and S latitudes are distorted.

GNOMONIC PROJECTION

Gnomonic (polar) maps can be used to plot the shortest distance between two points, but landmasses are distorted away from the center point.



POLYCONIC PROJECTIONS

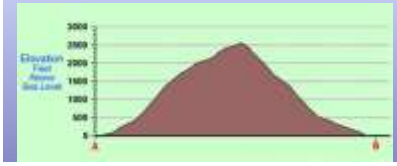
In a polyconic projection, the lines of latitude and longitude are curved slightly. They are especially useful for mapping large areas of land that fall in the middle latitudes.

TOPOGRAPHIC MAPS

- **Measure changes in elevation**
- **A profile is a side view of an elevation**
- **When contour lines are close together, the area is steep.**
- **Contour lines always point upstream (opposite of flow)**
- **Depressions or holes are identified by lines within a circle**
- **Valleys will have contour lines very spread apart**

TOPOGRAPHIC PROFILE

By transferring information from a topographic map to another sheet of paper, it is possible to draw a landform's profile, or shape.



MAP SCALES

- Map scale is the relationship between a unit of length on a map and the corresponding length on the ground.
- **Types of Map Scales**
  - **Verbal scale** expresses in words a relationship between a map distance and a ground distance. (*One inch represents 16 miles.*)
  - **A graphic scale**, or **bar scale** shows directly on the map the corresponding ground distance.
  - A **representative fraction**, or RF, shows the relationship between one of any unit on the map and one of the same units on the ground. (1:24,000)
  - In the above example, 1 cm on the map would equal 24,000 cm in reality on earth

A graphic scale

Theories of Earth Science

Some theories that are important to remember that deal with astronomy and historical geology.

Solar Nebula Theory

- This theory states that the nine (8) planets in our solar system formed as a result of our sun's formation.
- The sun formed as a result of condensing solar nebula.

Big Bang Theory

- The universe originated from the instant expansion of an extremely small agglomeration of matter of extremely high density and temperature.

Impact Theory of Moon Formation

- The moon formed about 4.5 billion years ago as a result of a collision between Earth and a planet-sized object.

1. Impact

2. Spewing Debris

3. Moon forming from rings

Dinosaur Extinction Theory

- **Iridium** layering indicates that a giant asteroid hit Earth about 65 million years ago and created atmospheric changes that caused sunlight to be blocked out, altering ecosystems and effectively killing off the dinosaurs.

ASTRONOMY

EARTH ASTRONOMY

•**Tilt**=23.5 degrees **(reason for the seasons)**

•Hemisphere tilted toward the sun has summer

•**Area around the equator get most of the direct sunlight**

•3rd planet from the sun (inner, rocky planet)

•**Orbit around sun (revolution)** is **elliptical**—365.25 day revolution causes yearly cycle and seasons—seasonal constellations and parallax proves this.

•**One rotation=24 hours—causes** day and night—Coriolis Effect (curving of winds) and Foucault pendulum are effects of rotation.

•**Earth's magnetic field** is caused by convection currents deep inside Earth.

MOON ASTRONOMY

•No wind, no water, no atmosphere on moon

•1/6th of the gravity of Earth

•**Rotation of moon** (27.3 days) = **Revolution of moon** (27.3 days)—therefore, we only see one side of the moon

•It takes 29.5 days to get through the 8 phases of the moon

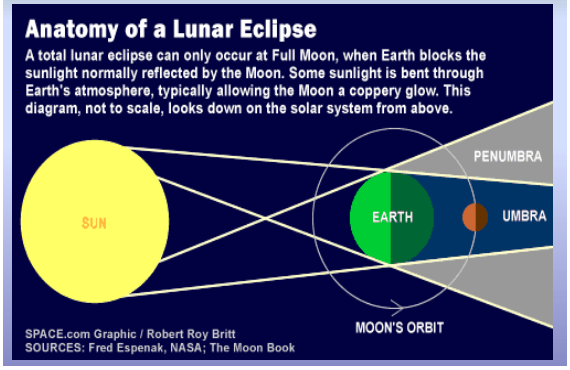
•**Lunar eclipses** occur when the moon is in Full moon phase the moon passes through Earth's shadow

•**Solar eclipse** occurs during the day when a new moon is present. The moon blocks the sun

•Moon's gravitational pull causes tides

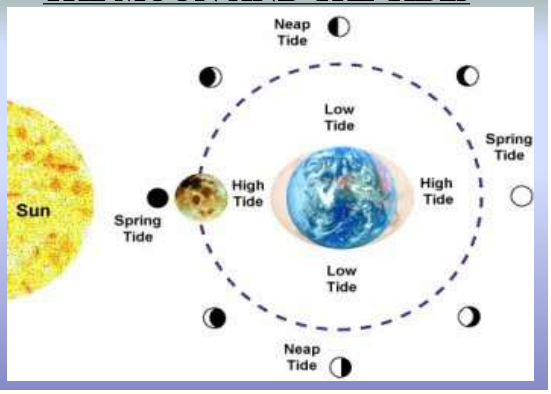
PHASES OF THE MOON

LUNAR ECLIPSE

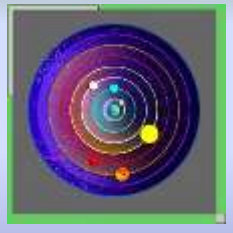


SOLAR ECLIPSE

THE MOON AND THE TIDES



HISTORICAL FIGURES IN ASTRONOMY



VS.

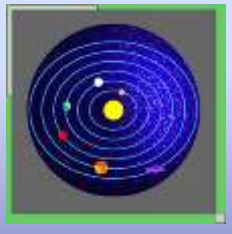
Geocentric Universe

•Ptolemy believed that Earth was center and everything revolved around it

Heliocentric Solar System

•Copernicus developed the model where planets revolve around the sun

KEPLER AND PLANETARY MOTION

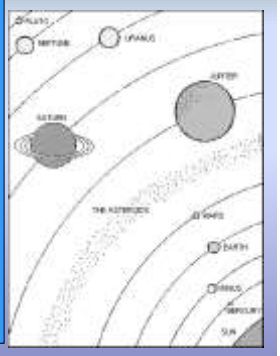


Kepler described the motions of planets as ellipses and described the velocity of planets (planets travel faster in their orbits when they are closer to the sun in their orbits)

PLANETS

Two types of planets:

- Inner are the closest to the sun and are terrestrial (rocky)
- Outer are the gas giants
- Pluto is the oddball
- The bigger the planet, the more gravitational pull
- **The closer the planet is to the sun, the higher the velocity of its revolution**

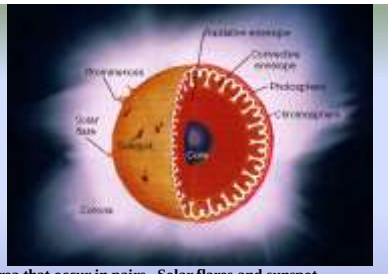


STARS AND THE SUN

* The sun is made of hydrogen gas.

- **Hydrogen is converted to helium in the fusion process**
- Our sun's life cycle:
  - Nebula—protostar—yellow main sequence star—Red Giant—White Dwarf—Black Dwarf

The Sun and its Layers



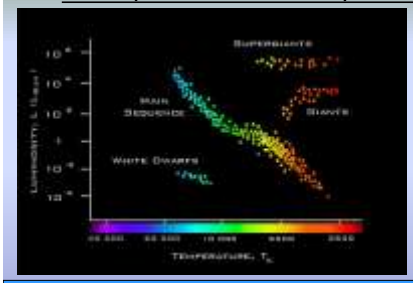
Sunspots—dark, cool area that occur in pairs. Solar flares and sunspot activity are increased every 11 years. Produces disruptions in electrical service on earth.

Corona—largest layer that is only visible during a solar eclipse

Photosphere—produces light **Chromosphere—produces color**

Core—most dense area where fusion takes place. Four (4) hydrogen atoms convert to one (1) helium atom, producing energy

STARS AND THE H-R DIAGRAM



Stars form by the condensation of gas

The original mass of a star determines its life cycle..if very massive, then will result in supernova and black hole...

H-R diagram shows temperature vs. luminosity (brightness)

Main sequence stars are actively fusing hydrogen into helium

OTHER ASTRONOMY STUFF

Galaxies:

1. **Spiral (pictured)**
2. **Elliptical**
3. **Irregular**

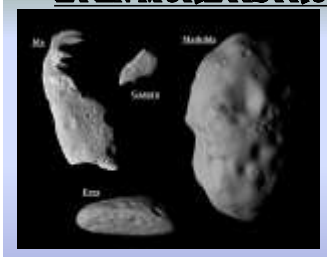
Milky Way is a spiral galaxy

Neil Armstrong, first man on moon, Apollo 11

Light year is a distance measurement. It is the distance light travels in one year.

Comets orbit the sun and are completely frozen like a dirty snowball. Originate in the Oort Cloud.

EVEN MORE ASTRONOMY STUFF



Asteroids are found in the asteroid belt, located between the orbits of Mars and Jupiter, and are rocky and made of metals.

Meteors— a.k.a. shooting stars

Meteorite—any rock found on Earth that came from space

Plate Tectonics

Boundaries, volcanoes, Earthquakes

Layers of Earth

Inner core is solid and made of iron and nickel

Outer core is liquid and made of Fe, N, and lighter elements

Mantle is largest layer and is plastic-like (asthenosphere)

Two (2) types of crust — continental (made of silicon and oxygen) and oceanic (made of iron and magnesium)

The Lithosphere

Ocean crust is more dense than continental crust and it always goes under the continental crust when they collide (SUBDUCTION ZONES)

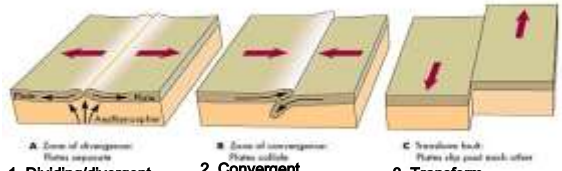
Ocean crust is younger than continental crust. Youngest area of ocean floor is at mid-ocean ridges

Ocean crust is thinner than continental crust

The lithosphere is the crust and the upper mantle. The lithosphere is divided into plates. The plates move because of convection currents (shown above). Convection is the major mechanism of energy transfer in the oceans, atmosphere, and Earth's interior.

Convection currents are when hot, less dense material rises, cools, becomes more dense and sinks.

Plate Boundaries



1. Dividing/divergent plates: Mid-ocean ridges, sea floor spreading, rift valleys, and volcanoes.

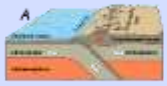
2. Convergent Boundaries: Subduction (as shown) & Collision (Mountain Building)

3. Transform Boundaries: Slide past each other. Earthquakes and strike-slip faults.

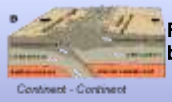
Most earthquakes and volcanoes are found on plate boundaries

Three (3) Types of Convergent Boundaries

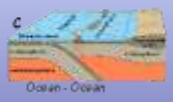
Convergent Plate Boundaries



Trenches, volcanic arcs and subduction zones. Ocean plates always go under continental plates (subduction).

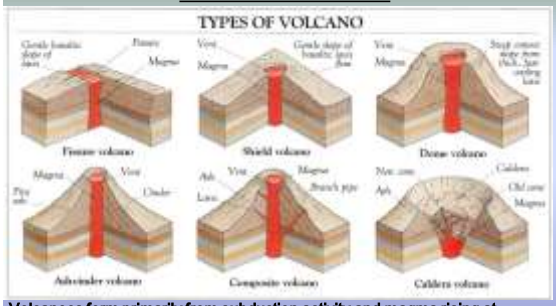


Folded mountains, thrust-block mountains



Trenches, subduction zones, volcanic island arcs

VOLCANOES



Volcanoes form primarily from subduction activity and magma rising at divergent plate boundaries. They are also produced by hot spots, which are mantle plumes of rising magma at the center of a lithospheric plate. Older volcanoes are further from a hot spot due to plate movement.

The viscosity of magma can influence the type of eruption.

EARTHQUAKES

Three (3) seismograph stations are needed to locate the epicenter of an earthquake

Earthquakes result when movement occurs along faults (breaks or cracks in the Earth's crust) and boundaries.

The epicenter is the point on the surface directly above the focus where energy is released.

P-waves (compression) travel faster than S-waves

S-waves (side to side) will not travel through liquid

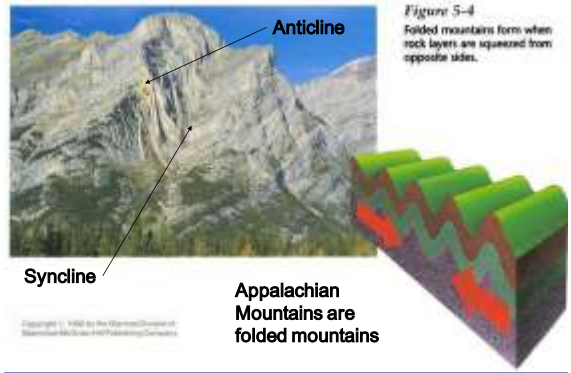
L-waves are surface waves and cause the most damage

Shadow zone is where no waves are received

Richter Scale measures magnitude (energy released)

Mercalli Intensity Scale explains the damage of an earthquake

MOUNTAINS



Appalachian Mountains are folded mountains

ROCKS AND MINERALS

Stratified (Layered) Sedimentary Rock

Foliated Metamorphic Rock, minerals align in stripes due to the heat & pressure that metamorphosed the rock

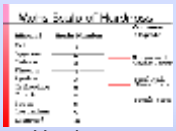
5 CHARACTERISTICS TO BE A MINERAL:

1. Naturally occurring
2. Inorganic
3. Has a definite (unchanging) Chemical composition
4. Has a Definite (unchanging) structure
5. Solid

Remember: Now I Can Define mineralS

PHYSICAL PROPERTIES OF MINERALS

You can identify minerals by their physical properties (tests)



Hardness

Streak

Cleavage or Fracture?

Magnetism

Fluorescence

Double Refraction (Calcite)

SPECIFIC MINERAL INFORMATION

Minerals are nonrenewable resources.

Silicates are the most abundant mineral group.

An ore is a material that is useful and profitable.

Pyrite (Fool's Gold)

Hematite Red/Brown Streak

Magnetite (magnetic)

High Density

Halite (Salt)

Graphite (pencil lead)

Sulfur (smell)

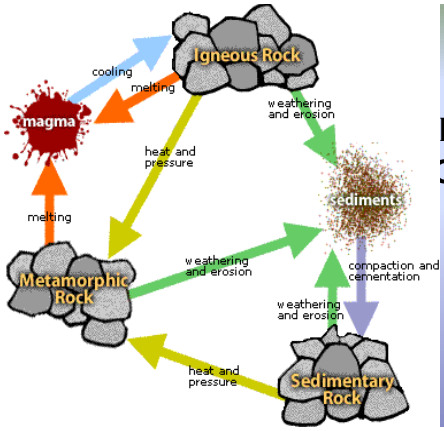
More Mineral Information

Gems are rare and beautiful. All share extreme hardness as a physical property.

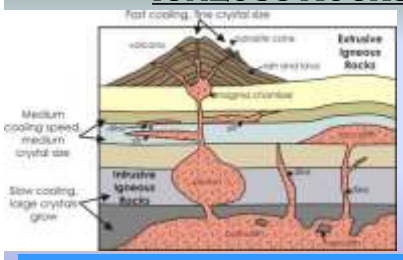
Calcite fizzes with acid and exhibits double refraction. It is the major mineral of limestone.

Quartz (made from Silica & Oxygen) is the major mineral of glass and sand.

Rock Cycle



Igneous Rocks



Igneous rocks form from the cooling and crystallization of molten rock (magma, lava)

Intrusive Igneous Rocks—slow cooling of magma inside the Earth. Coarse-grained texture **(large crystals) GRANITE**

Extrusive Igneous Rocks—quick cooling of lava outside the Earth. Small crystals and fine-grained texture. May look glassy or have holes present. **PUMICE, OBSIDIAN, BASALT**

Metamorphic Rocks

Metamorphic Rocks are formed from heat and pressure on existing rocks.

Contact metamorphism—small area in contact with an igneous intrusion "bakes" the rock and changes it.

Regional metamorphism—large area changed due to heat and pressure. Usually with mountains.

Foliated texture (shown)—bands or layers of minerals. SCHIST, SLATE, GNEISS

Nonfoliated texture—no layers. These rocks have made a complete atomic change. MARBLE, QUARTZITE

Sedimentary Rocks

Sedimentary rocks form from rock fragments or organic matter, or are formed by chemical precipitation. Weathering, erosion, cementation, and compaction are the processes of sedimentary rock formation. They build up in layers called strata, and fossils are found in them.

Types of Sedimentary Rocks

Clastic rocks—made of fragments of other rocks

Conglomerate (pictured)—rounded pebbles; Sandstone—sand; Shale—made of compacted clays

Organic rocks—made from past living sources

Limestone—microscopic sea animals; Coal (pictured)—fossilized swamp plant material

Chemical rocks—formed from precipitation or evaporation of liquids

Limestone—cave structures; Halides and Rock Salt (pictured)—evaporation of water

Weathering, Erosion, and Deposition

Mechanical Weathering -broken down Into pieces without a chemical change Frost (Ice) Wedging

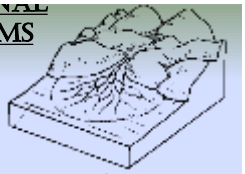
Chemical Weathering -changed into Something chemically different Example: Oxidation (rust)

Erosion—the breakdown and transport of Earth materials by wind, water, waves, gravity, glaciers. Erosion is greatest in high relief areas (steep). **Greatest agent of erosion is water**. Glaciers erode by plucking, wind erodes by abrasion and deflation, and gravity creates mass movements like slump, creep, mudflows, and rockslides.

Deposition—the dropping of Earth materials after energy of motion of agent of erosion decreases to the point where it cannot carry materials any longer. Deposition is greatest in low relief areas—flat and low and at sea level.

Depositional Landforms

DELTAS, where rivers end at larger bodies of water



ALLUVIAL FANS, at the base of Mountains

BARRIER ISLANDS are temporary

BEACHES AND DUNES, sand is continually moving

Sediment Sizes

Sediment comes in all sizes

256 mm and up	BOULDERS	GRAVEL
64-256 mm	COBBLES	
2-64 mm	PEBBLES	
0.0625-2 mm	SAND	
0.002-0.0625 mm	SILT	
0.002 mm and smaller	CLAY	

Sedimentary Rock Trivia:

*Limestone is the only rock formed in 2 different ways (chemical and organic)

*The 3 major rock resources of Virginia are Limestone, Coal, and Titanium

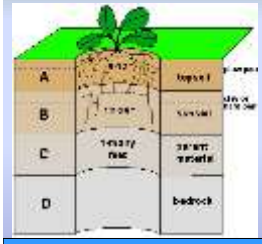
*Coal formation—PEAT changes to LIGNITE which changes to BITUMINOUS which changes to ANTHRACITE (the hardest coal)

Smallest—clay then silt then sand then gravels

Clay is the smallest, so it will settle out last. Gravel is the largest, so it will settle out first.

Sediments will settle out when there is no longer enough energy of motion to carry them.

Soil



A horizon -humus and dark in color (topsoil)

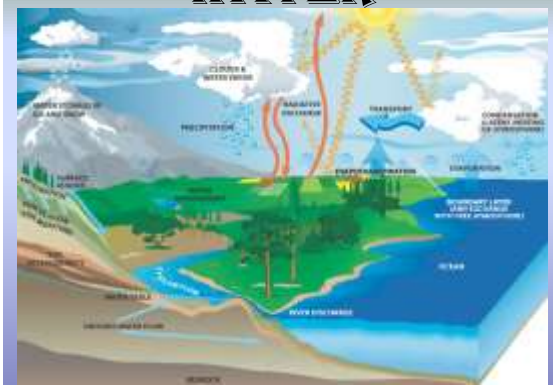
B horizon -lighter in color and leaching has brought minerals down from topsoil

C horizon -weathered parent material

Soil is formed from weathering of rock and from organic activity

Soil is loose fragments of rock and clay derived from weathered rock mixed with organic material (humus)

Water



Water, Continued

Most of the water on Earth is salt water (97%)

2% is locked up in the ice caps

1% is fresh water we can drink—most of this is found in the ground

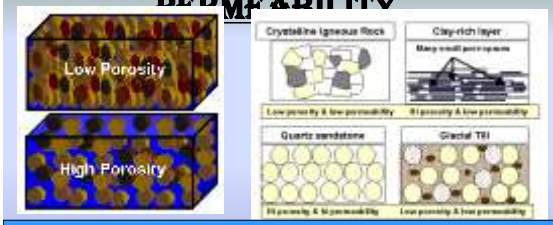
Earth's freshwater is renewable yet finite (the actual amount does not change)

Water Pollution—

Point Source (direct sources)

Non-Point Source (runoff)

Porosity and Permeability



Porosity—amount of pore space in a material. Materials made of rounded particles have a lot of pore space. Materials like clay that are flat and angular have less pore space. The amount of pore space is greater if particles are the same size rather than if mixed sizes are present.

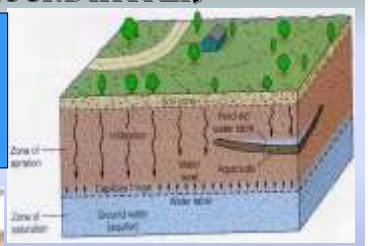
Permeability—the ability of a material to transmit water. Well-sorted (same size and shape) materials are very permeable (GRAVEL and SAND).

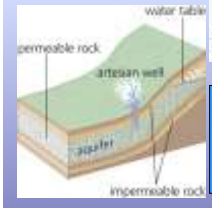
Impermeable—water does not pass through this material—clay packs are very flat, so even though there is pore space, the pores are not connected

Groundwater

Soil is considered the zone of aeration

Water Table is on top of the zone of saturation





Aquifer—layer of rock that stores and transports water freely

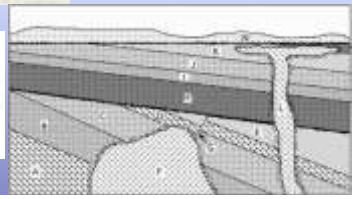
Karst Topography

Karst includes features like **caves, sinkholes, and streams** caused by moving groundwater.

Karst forms when Carbonic acid (CO_2 + H_2O) dissolves limestone and dolomite

Spring—where the water table meets the surface

Geologic History

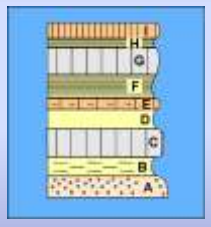


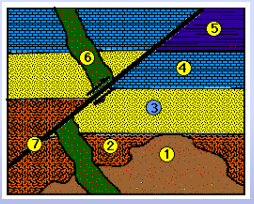
Fossils

- **Fossils can be preserved as**
  - **Molds**—cavity
  - **Casts**—3D replica of organism
  - **Original**—actual animal in **ice, amber, or tar pit**
  - **Petrified**—material is **replaced by minerals**
  - **Index fossils** -we date rock layers because these were very abundant, worldwide, and short-lived.

Relative Dating

Putting events in order or sequence without assigning an exact age.





Law of Superposition

In an undisturbed rock sequence, the oldest layers are on the bottom and get younger as you go up.

Law of Cross-Cutting Relationships

Igneous intrusion (and fault) is younger than the layers it cuts across

Absolute Dating

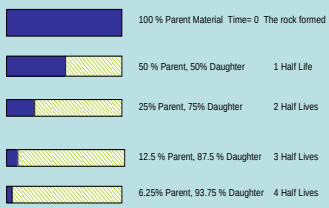
Placing an **exact age** on a material, usually through radioactive or radiometric dating

Carbon-14 dating is used for dating organic material up to 50,000 years old.

Uranium—dates the oldest rocks—up to 4.5 billion years

Half-life is the amount of time it takes for 50% of a radioactive parent isotope to break down into its stable daughter product

Half Life Example



Geologic Time

We break down Geologic Time into—Eras (largest division…ends with extinction events), Periods (based on Index Fossils), and Epochs (smallest…based on types of life and is found only in Cenozoic Era)

Precambrian Era—90% of all geologic history. In the beginning, our planet had no oxygen. Carbon dioxide was the major gas. **Cyanobacteria—descendants of blue-green algae-produced oxygen that lead to creation of ozone layer and an atmosphere that supported life**

Paleozoic Era—Age of Invertebrates and the creation of Pangaea

Mesozoic Era—Age of Reptiles—dinosaurs dominate and Pangaea breaks apart

Cenozoic Era—Age of Mammals—man comes into existence

We live in the Cenozoic Era, in the Quaternary Period, in the Recent Epoch