Earth Science Reference Table

Your Best Friend

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

- Radioactive elements break down over time using half lives.
- A half life is the amount of time for half "the remaining" radioactive element to break down.
- Technically, it should never hit 0: 100…50…25…12.5…6.25 etc.
- Generally, we cannot read past 10 half lives as the # gets too small.
- Carbon 14 is great for things that "lived" recently.
- Uranium 238 is great for older rocks.

Specific Heats of Common Materials

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

- Specific heat is how much energy (joules (calories)) it takes to change each gram of a substance 1 degree.
- The more heat needed, the longer it takes to heat up.
- Water heats very slow, so it cools very slowly.
- Lead heats very fast, so it cools very fast.
- Remember to multiply either the amount of grams or joules you want to change.
- Ex: changing 10g of ice 1 deg = 10 x 2.11
- changing 1g of h20 5 deg = 4.18 x 5

Equations

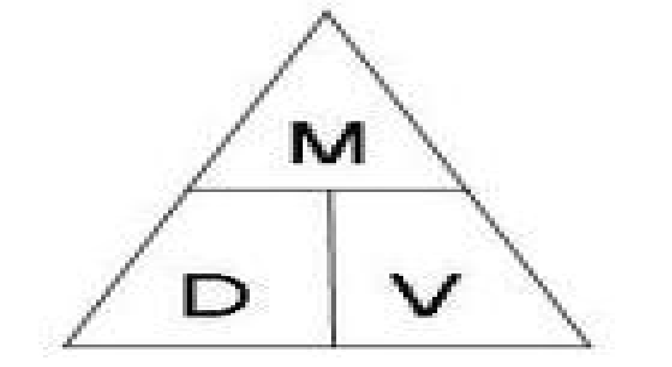
$$\text{Eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

$$\text{Gradient} = \frac{\text{change in field value}}{\text{distance}}$$

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

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

- Use these, don't ignore these.
- Remember to add the units into the equation.
- (except eccentricity, which has no units)
- Eccentricity = how stretched out an ellipse is.
- Gradient = slope.

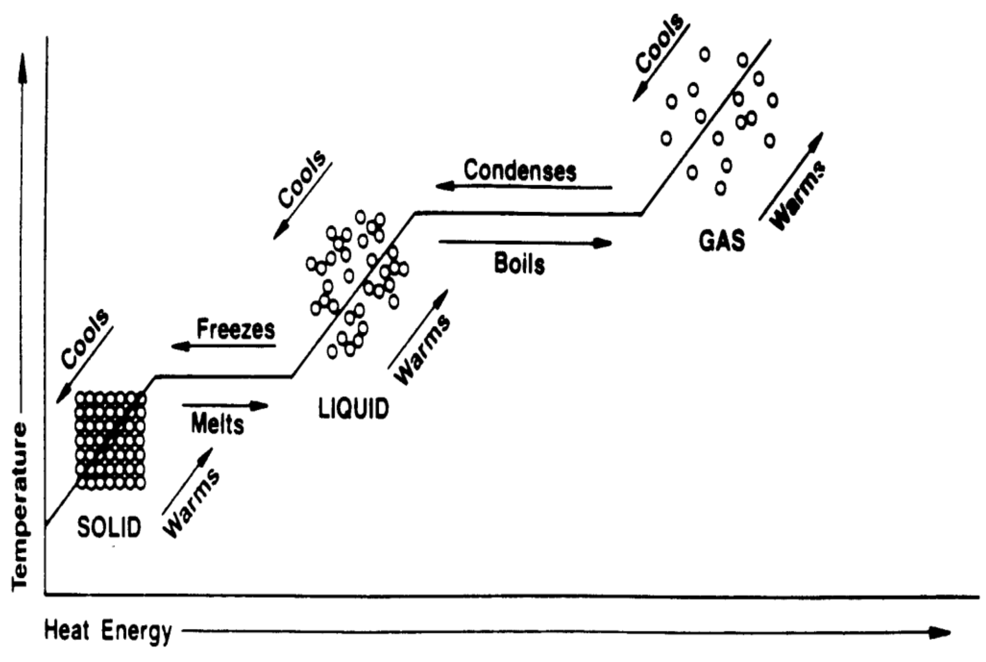


D = M/V
V = M/D
M = DV

$$\frac{30 \quad g}{15 \quad cm3}$$

Properties of Water

Heat energy gained during melting	334 J/g
Heat energy released during freezing	334 J/g
Heat energy gained during vaporization	2260 J/g
Heat energy released during condensation	2260 J/g
Density at 3.98°C	1.0 g/mL



- Phase changes occur on the flat part of the graph.
- To melt or boil water, you add heat.
- To condense or freeze, you remove heat.
- It takes more energy to condense and boil as they are higher up.
- Typically, water is at 1.0 g/ml, however it becomes less dense as it freezes. (ice floats)
- You must multiply the amount of grams you want to change by the joules needed.
- Example to freeze 10 grams of water: 10 x 334j must be removed.
- to condense 5 grams of vapor: 5 x 2260j must be added.

Lithosphere

Oceans, lakes, rivers, and Groundwater

Atmosphere

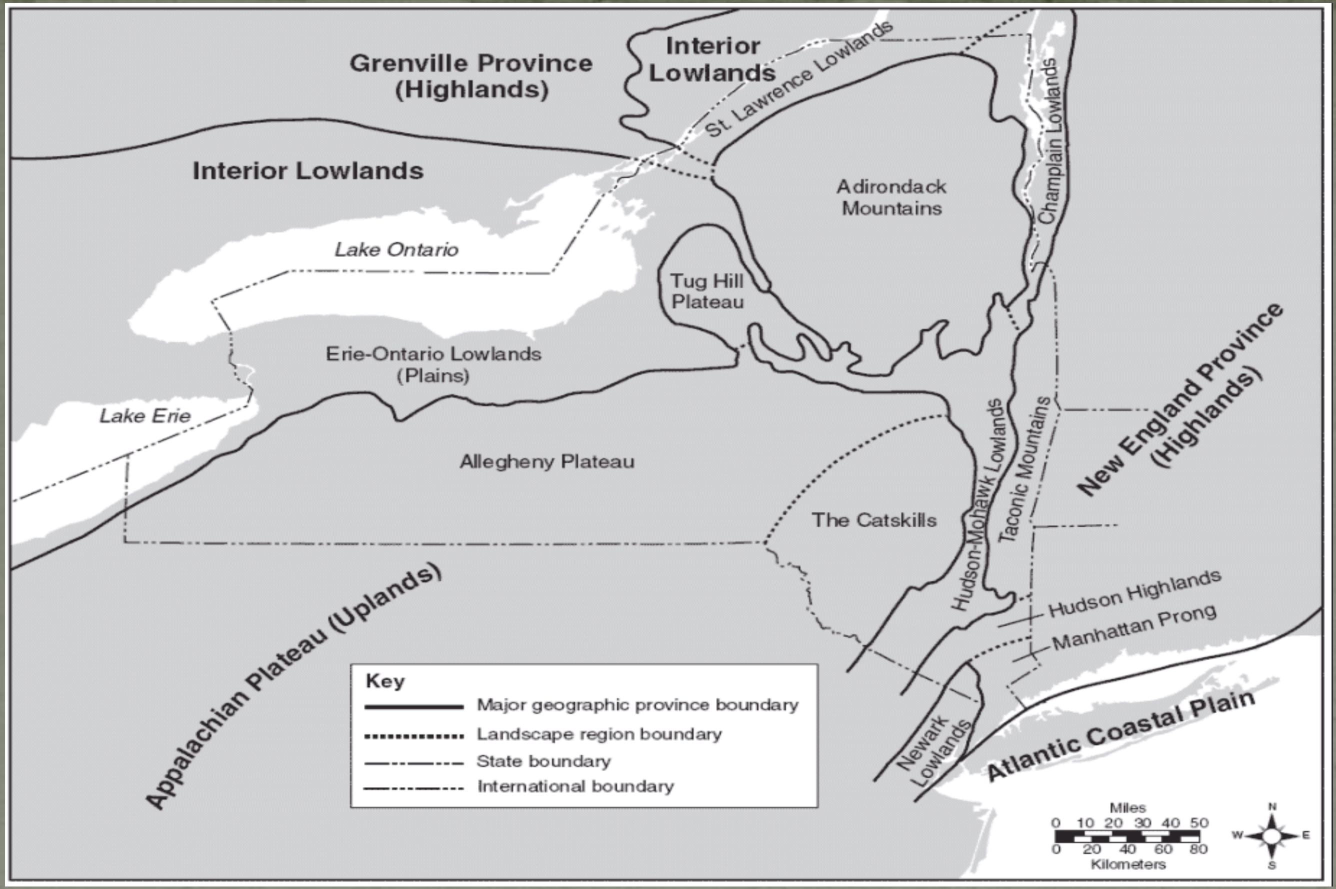
Average Chemical Composition of Earth's Crust, Hydrosphere, and Troposphere

ELEMENT (symbol)	CRUST		HYDROSPHERE	TROPOSPHERE
	Percent by mass	Percent by volume	Percent by volume	Percent by volume
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.48		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

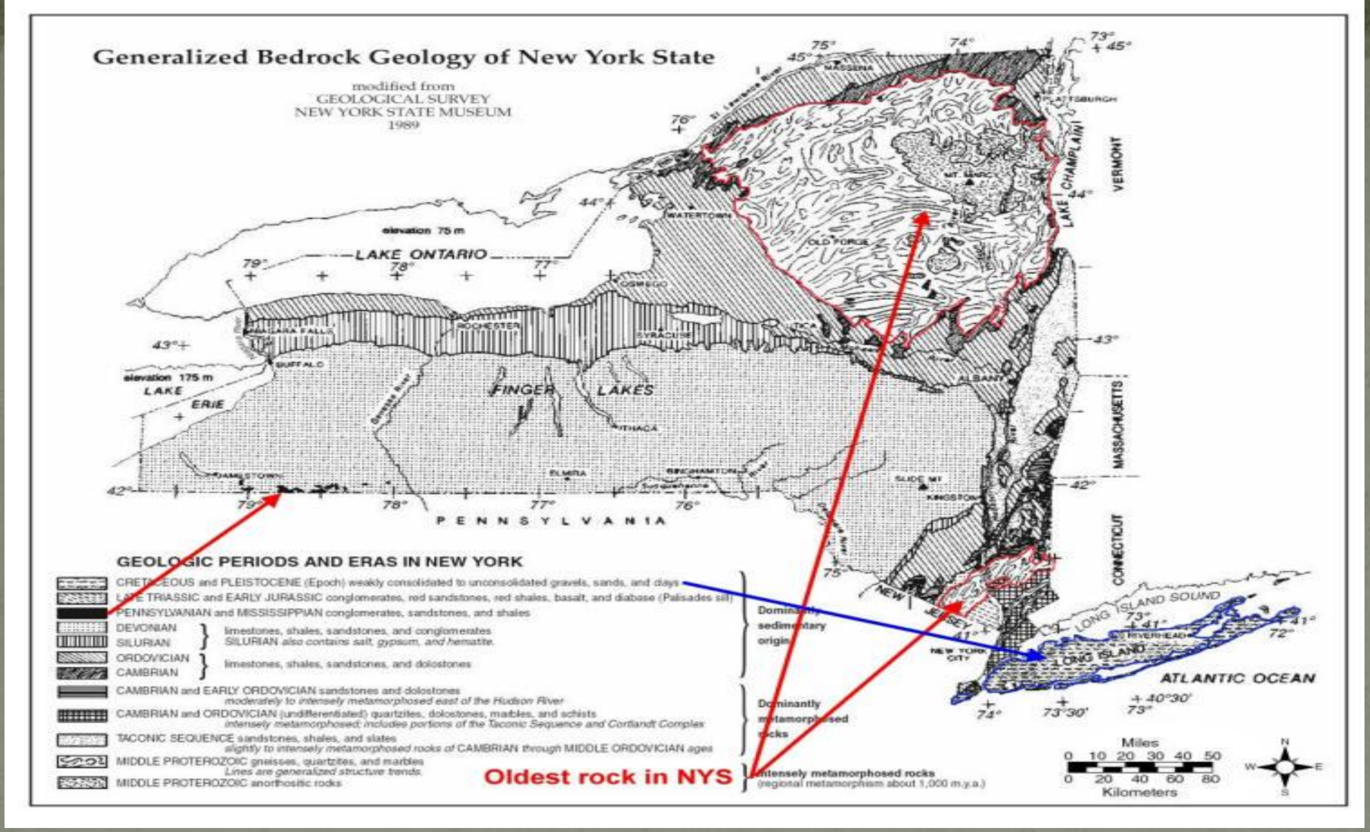
Mostly salt

CO2, H2O (vapor), and trace gases

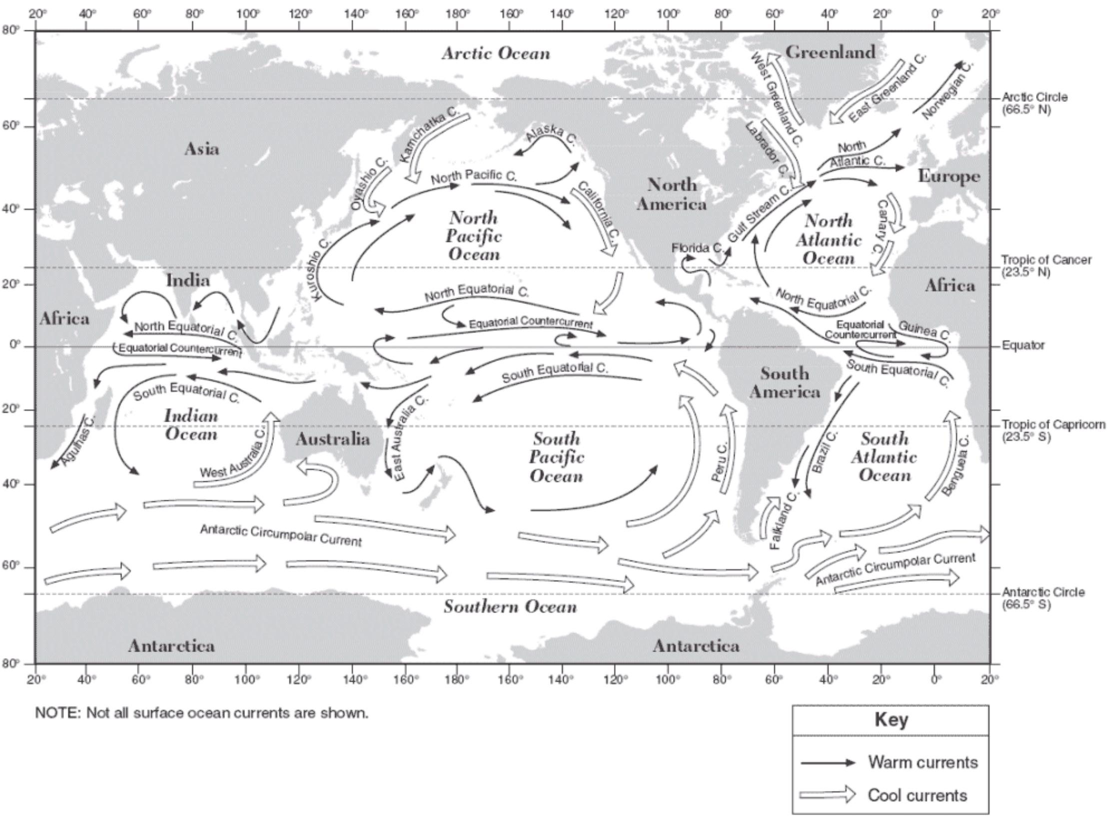
- Remember Crust % by mass is in order.
- Crust % by volume is not in order.
- Trace = small amount
- CO_2 and H_2O are major green house gasses.

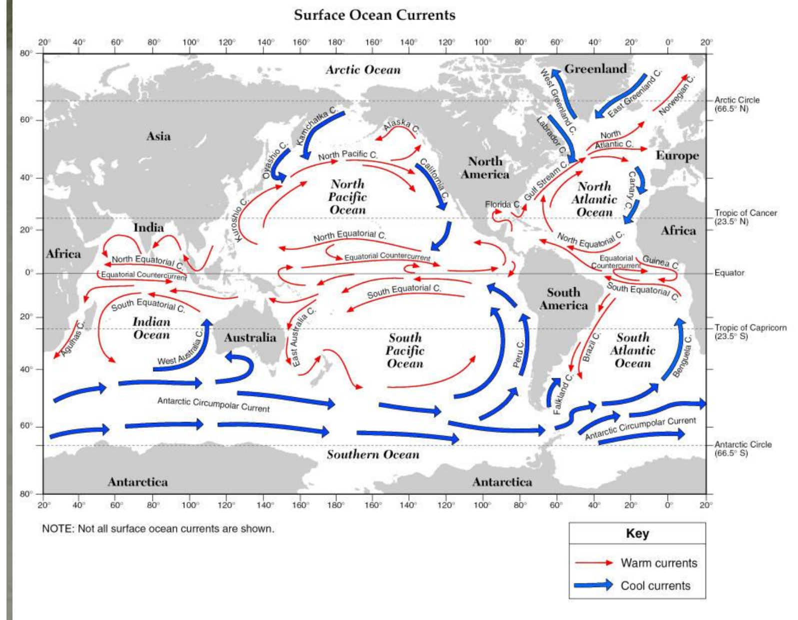


- Use with generalized bedrock page to indentify landscape region as well as geological history chart.
- Allegheny Plateau is part of the Appalachian Plateau.
- Mt. = uplift with distorted rock layers underneath.
- Plateau = uplifted area with horizontal layers underneath.
- Plains = flat low areas of sediment.

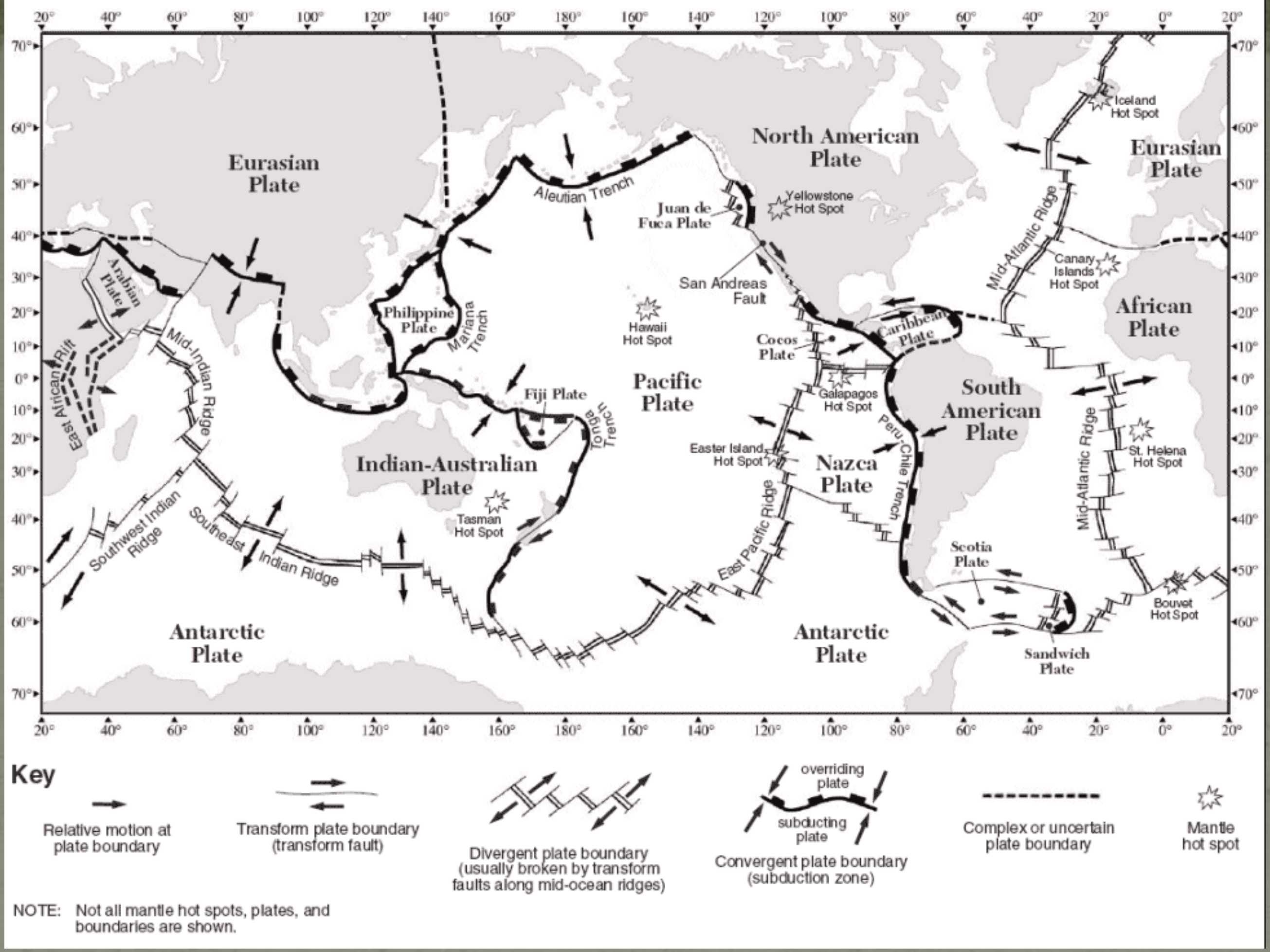


- Use with Geological History of NYS chart & landscape regions.
- Oldest rocks are on the bottom of the key (and in real life).
- Notice intensely metamorphic rocks are under mt. ranges (contact met).
- Long Island is mainly unconsolidated material (it is till from the last ice age).
- Some Time Periods must be identified by the Era they are in.
- Mesozoic = Cretaceous, Jurassic & Triassic.
- Latitude / Longitude shown on edges. 1 deg = 60 minutes.
- Half degrees are shown as a dash in between.

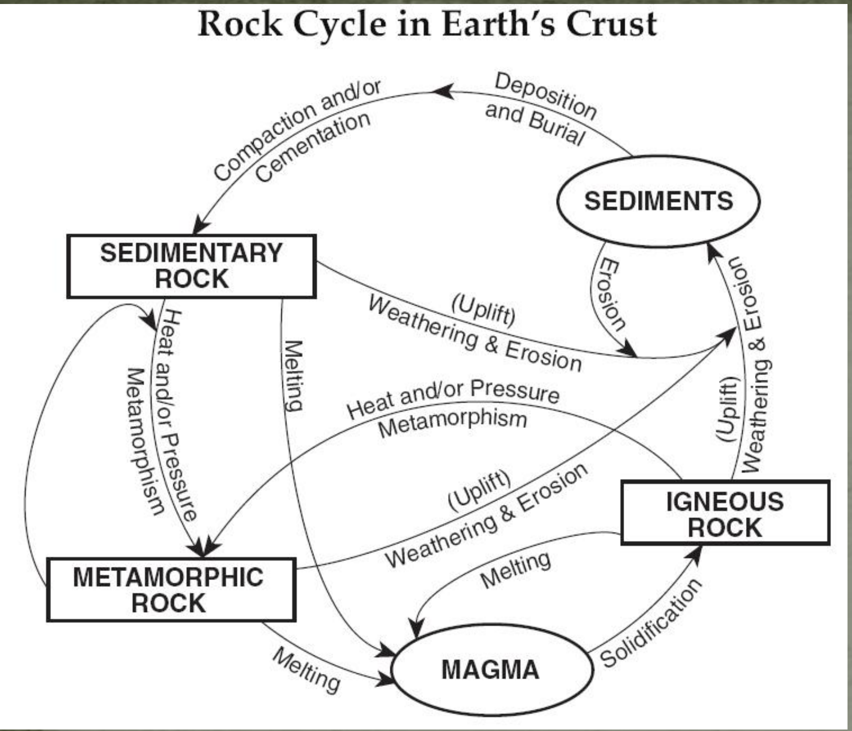


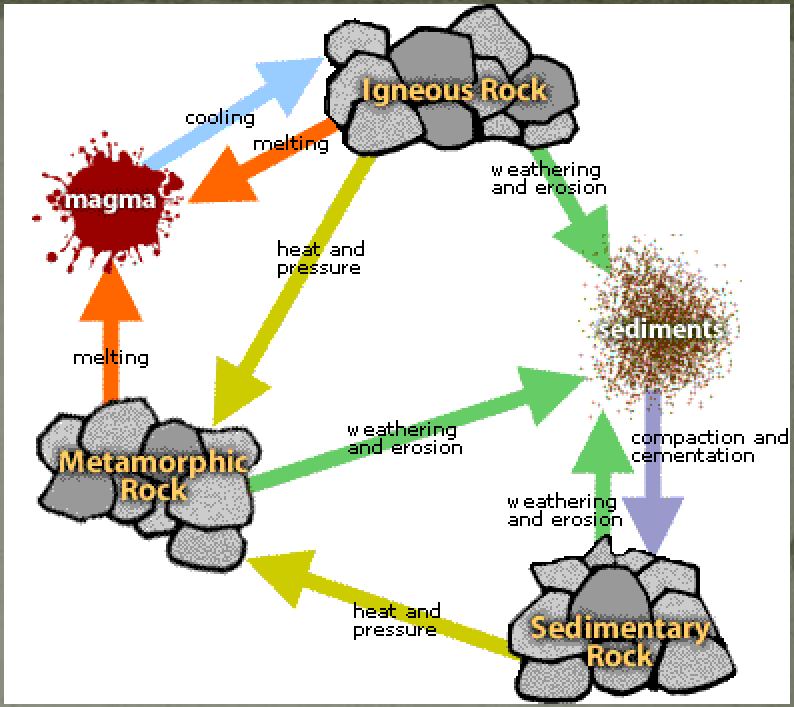


- Warm water starts at the equator, shown with solid line.
- Cold water is at the poles, shown with a white arrow.
- Movement is due to convection and the coriolis effect which is caused by Earths rotation.
- Clockwise (to the right) in the Northern Hemisphere
- Counterclockwise (to the left) in the Southern Hemisphere.
- Notice Tropics and their Latitude 23.5 (Suns location at the Solstices).
- Notices the Arctic/Antarctic 66.5 (No/Full sun at Solstices).
- All numbers related to Earths tilt of 23.5 deg.
- This can control continental temperatures (The coast of Alaska is kept warmer in winter).

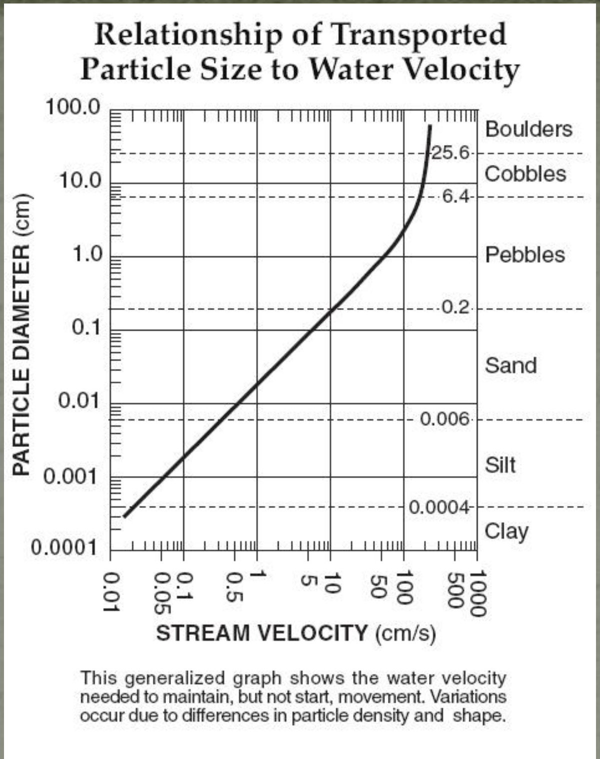


- Transform boundaries = side to side (shearing) (Faults, Earthquakes)
- Divergent (divide) = pull apart (tension) (ridges, rift valleys, new oceanic plates)
- Convergent = come together (compression) (mts., volcanoes, trenches, plate destroyed)
- Oceanic is more dense and gets pulled under (subducted).
- Hot Spots = where magma burns through the crust.
- Ring of fire (Pacific Ring) Most Earthquakes and Volcanoes.

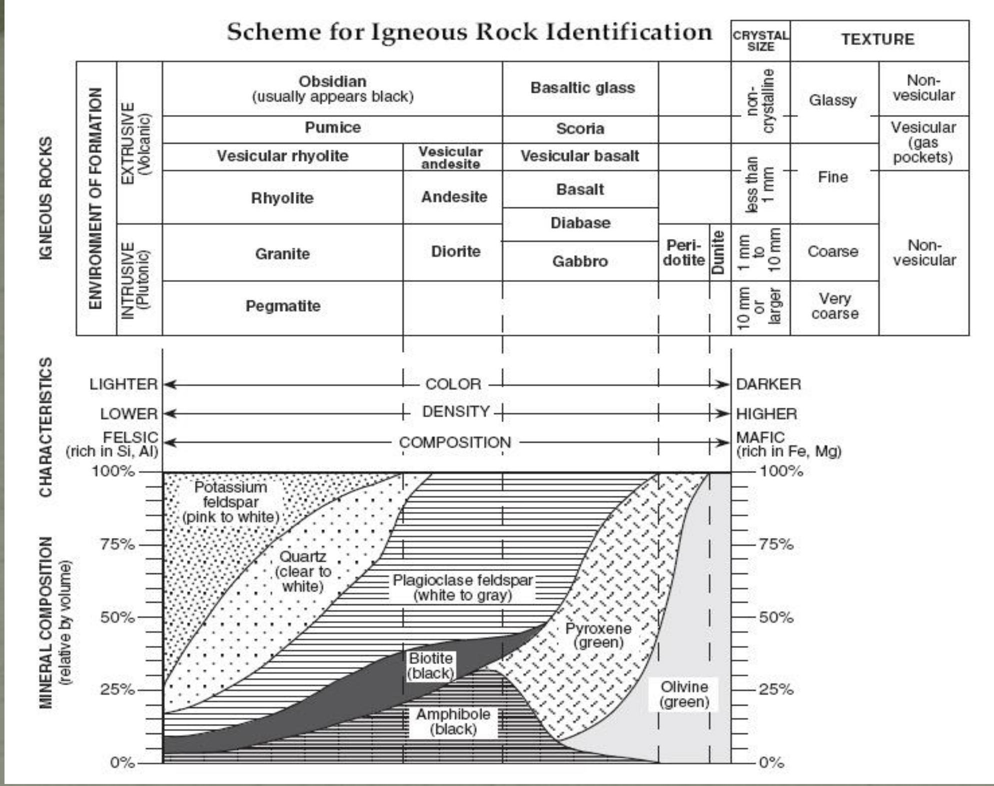




- Rock cycle shows how any category of rock can change into any other category, including a new form of itself.
- Burial, cementing or compaction creates sedimentary.
- Uplift leads to weather and erosion.
- Most surface rock is sedimentary.
- Most underground rock is igneous.
- Solidification = making solid (magma cooling).



- The faster the stream the larger the sediment it can erode / carry.
- It can carry everything below as well.
- If it can carry pebbles it can carry sand, silt, clay.
- The top notches match the bottom (use paper to line up).
- Sediment type changes at the dashed lines not solid lines.
- Be careful with the numbers (sand is 0.2 – 0.006) 0.5 is larger.
- Settling rate depends on density and shape as well.
- Include units cm(particle diameter)/speed(seconds).



- Igneous – Think FIRE. From Cooling and Solidification of Molten Rock.
- Extrusive – cools outside, fast, little to no crystals (Lava).
- Intrusive – cools inside, slow, larger crystals. (Magma).
- Vesicular – gas pockets, cooled fast but not too fast.
- Felsic – made of Si & Al, Mafic made of Fe, Mg. (use mineral chart for symbols).
- Go down the middle to find average mineral composition.
- Use a piece of paper to make a reference to compare to the scale.
- Amphibole = hornblende, Potassium Feldspar = Orthoclase (on mineral chart).
- Quartz & Potassium Feldspar on left, Olivine & Pyroxene on right.

INORGANIC LAND-DERIVED SEDIMENTARY ROCKS

TEXTURE	GRAIN SIZE	COMPOSITION	COMMENTS	ROCK NAME	MAP SYMBOL
Clastic (fragmental)	Pebbles, cobbles, and/or boulders embedded in sand, silt, and/or clay	Mostly quartz, feldspar, and clay minerals; may contain fragments of other rocks and minerals	Rounded fragments	**Conglomerate**	
			Angular fragments	**Breccia**	
	Sand (0.006 to 0.2 cm)		Fine to coarse	**Sandstone**	
	Silt (0.0004 to 0.006 cm)		Very fine grain	**Siltstone**	
	Clay (less than 0.0004 cm)		Compact; may split easily	**Shale**	

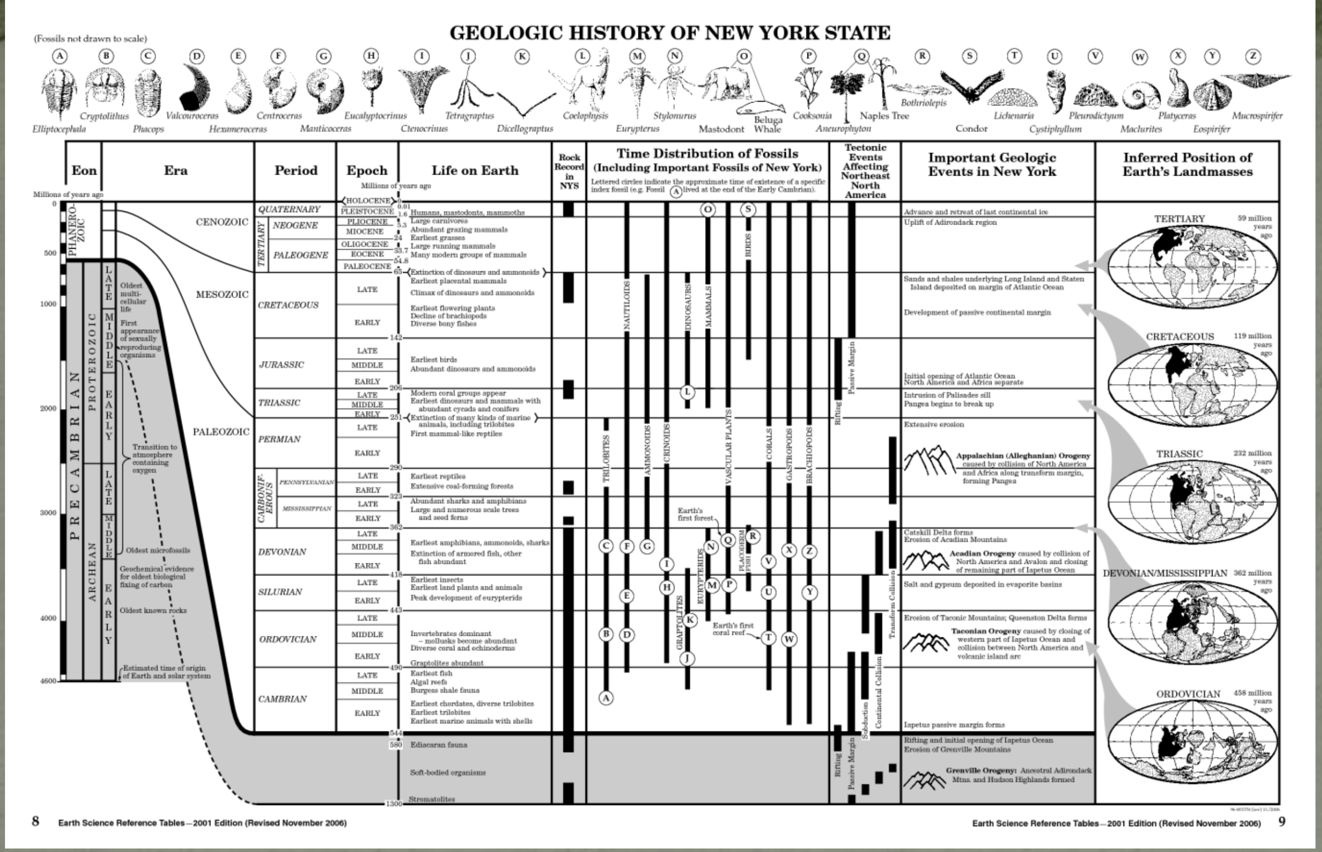
CHEMICALLY AND/OR ORGANICALLY FORMED SEDIMENTARY ROCKS

TEXTURE	GRAIN SIZE	COMPOSITION	COMMENTS	ROCK NAME	MAP SYMBOL
Crystalline	Fine to coarse crystals	Halite	Crystals from chemical precipitates and evaporites	**Rock salt**	
		Gypsum		**Rock gypsum**	
		Dolomite		**Dolostone**	
Crystalline or bioclastic	Microscopic to very coarse	Calcite	Precipitates of biologic origin or cemented shell fragments	**Limestone**	
Bioclastic		Carbon	Compacted plant remains	**Bituminous coal**	

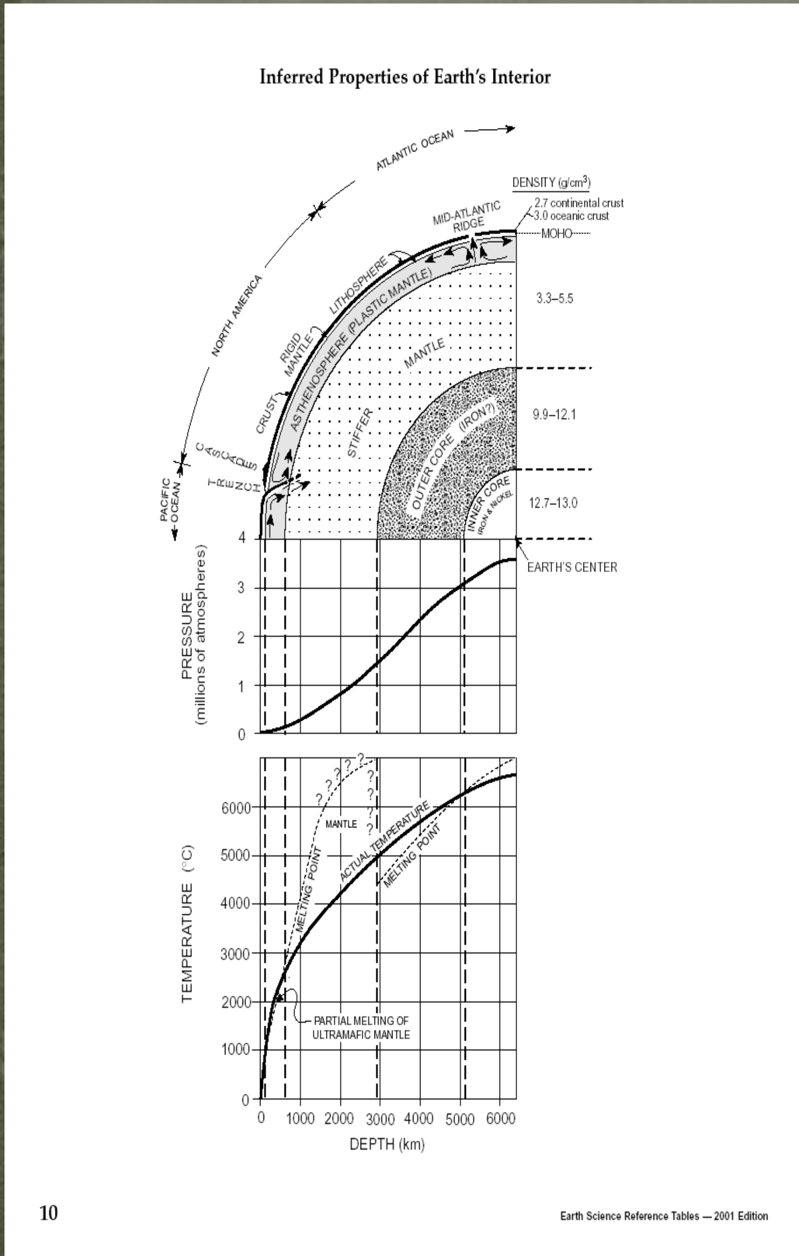
- Sedimentary rock form from recombining sediment.
- Deposition followed by compaction or cementing.
- Clastic means pieces/fragments. Arranged by grain size.
- Crystalline came out of water (not pieces).
- Precipitates – fell out of cooling water (sugar from coffee).
- Evaporites – water evaporated and left sediment behind (salt flats).
- Bioclastic – from living materials (trees, animals).
- Check comments and composition.

TEXTURE		GRAIN SIZE	COMPOSITION	TYPE OF METAMORPHISM	COMMENTS	ROCK NAME	MAP SYMBOL
FOLIATED	MINERAL ALIGNMENT	Fine	MICA	Regional (Heat and pressure increases)	Low-grade metamorphism of shale	**Slate**	
FOLIATED	MINERAL ALIGNMENT	Fine to medium	MICA, QUARTZ, FELDSPAR, AMPHIBOLE, GARNET	Regional (Heat and pressure increases)	Foliation surfaces shiny from microscopic mica crystals	**Phyllite**	
FOLIATED	MINERAL ALIGNMENT	Fine to medium	MICA, QUARTZ, FELDSPAR, AMPHIBOLE, GARNET	Regional (Heat and pressure increases)	Platy mica crystals visible from metamorphism of clay or feldspars	**Schist**	
FOLIATED	BAND-ING	Medium to coarse	MICA, QUARTZ, FELDSPAR, AMPHIBOLE, GARNET, PYROXENE	Regional (Heat and pressure increases)	High-grade metamorphism; mineral types segregated into bands	**Gneiss**	
NONFOLIATED		Fine	Carbon	Regional	Metamorphism of bituminous coal	**Anthracite coal**	
NONFOLIATED		Fine	Various minerals	Contact (heat)	Various rocks changed by heat from nearby magma/lava	**Hornfels**	
NONFOLIATED		Fine to coarse	Quartz	Regional or contact	Metamorphism of quartz sandstone	**Quartzite**	
NONFOLIATED		Fine to coarse	Calcite and/or dolomite	Regional or contact	Metamorphism of limestone or dolostone	**Marble**	
NONFOLIATED		Coarse	Various minerals	Regional or contact	Pebbles may be distorted or stretched	**Metaconglomerate**	

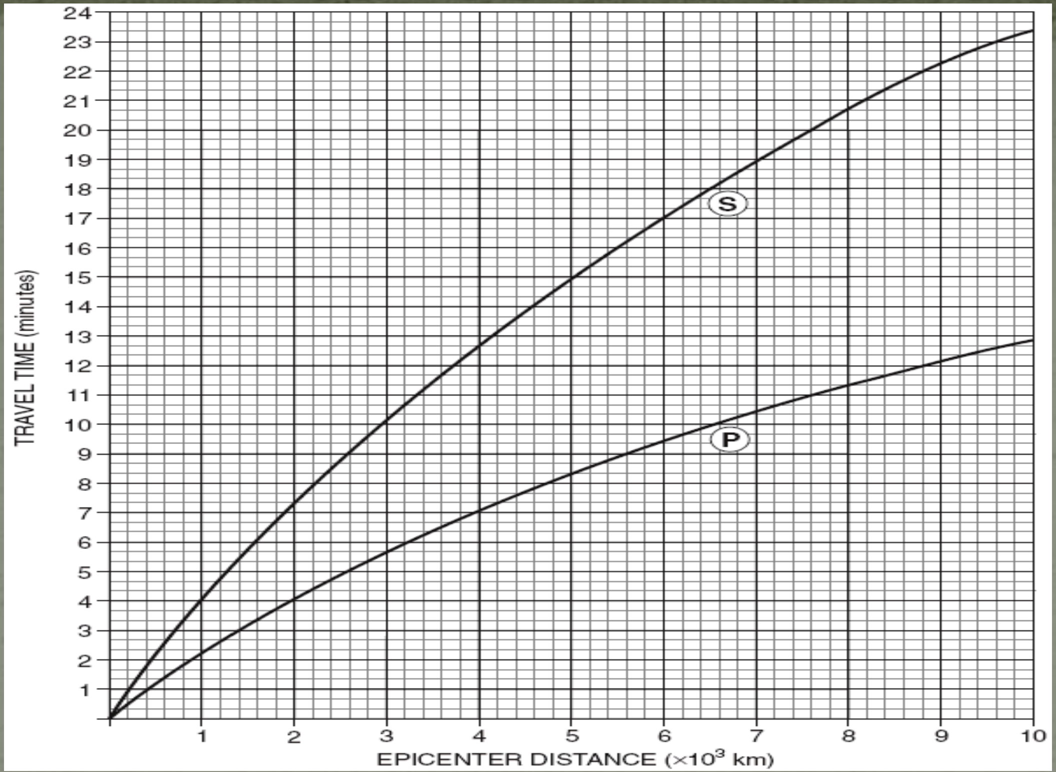
- Metamorphic rocks – changed rock due to heat and pressure.
- Contact met – heat directly applied (lava/magma).
- Regional met – an area changed by pressure (mts.).
- Foliated – Layers (like folded paper).
- Mineral alignment – visible physical layers like slate.
- Banding – a color band like gneiss, no physical layers.
- Granite changes to Gneiss.
- Nonfoliated – no physical layers.
- Check comments, composition and type.



- Most history is in Precambrian. (least knowledge due to lack of fossils w/shells).
- Phanerozoic is stretched out for easy viewing.
- Use time line next to Epoch, do not just go straight across.
- Eon, Era, Period, Epoch is like Year, Month, Week, Day.
- Periods change by dominant life, Era changes by mass extinctions.
- Index fossils identify time periods (short lived, wide spread are the best).
- Orogeny = time of mountain building.
- Position of continents shown on the right side.
- Rock record shows predominant rock being placed down at the time.
- Use this chart with landscape region and bedrock type charts.



- Shows what we believe, as we have never been through the crust.
- Earthquake waves show state of matter (P(solid & liquid) & S(solids)).
- Meteors show material type(iron/nickel)
- Density shown.(crust and oceanic)
- Moho – interface lithosphere / mantle.
- pressure – go down, then over left. It is in millions of atms. (atmospheres)
- 1 atm is 1 normal atmosphere weight.
- Temperature – go down then over.
- If temp is above melting it is liquid.
- If temp is below melting it is solid.
- Asthenosphere is plastic like mantle, which is why it's over and under the melting point.
- Depth – layers shown by dashed lines.
- Remember to double depth for full size of the Earth.



- P waves are fastest, S waves are slower.
- P – Primary, Phastest, Push/Pull, compression, pop, pretty much anything.
- S – Secondary, Slower, side/side, shearing, shaking, solids.
- Find what time they each arrived on the seismometer. Using paper make a reference sheet of the time difference to slide up between the P & S waves.
- This gives you the distance from the Epicenter (x103)
- If distance is given you can look straight up to find how long it would take to travel to the location.
- From that point you can figure how much later the S wave would arrive.

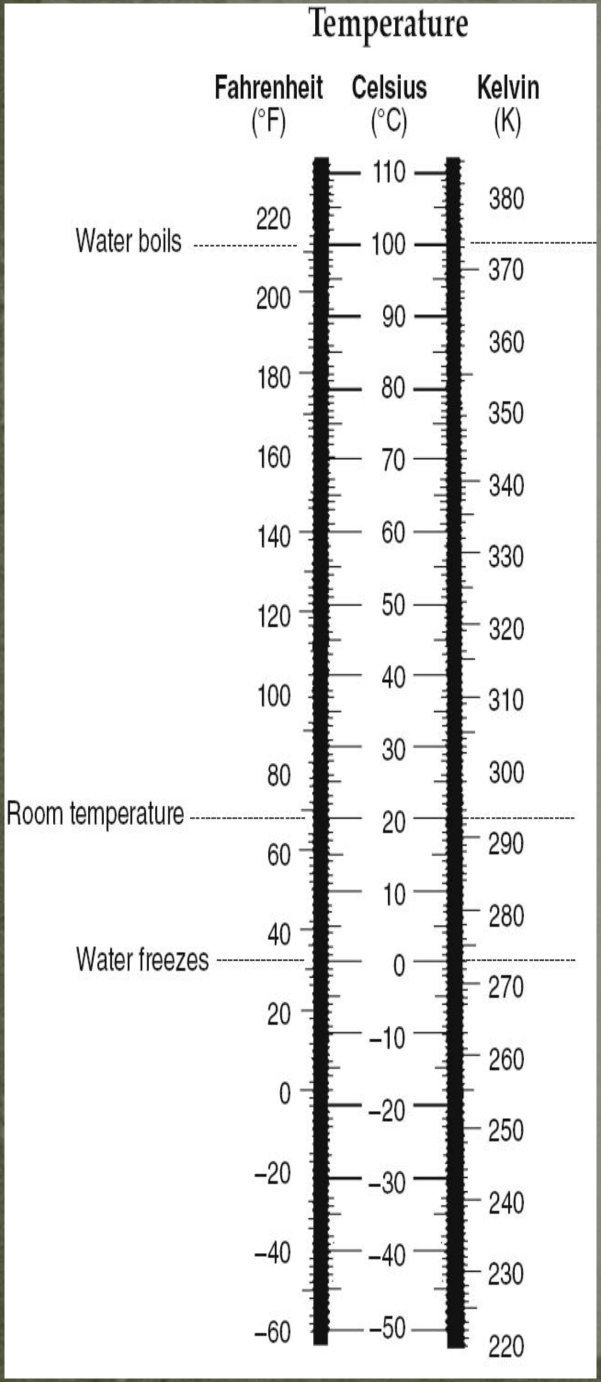
Dewpoint (°C)

Dry-Bulb Temperature (°C)	Difference Between Wet-Bulb and Dry-Bulb Temperatures (C°)														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
−20	−20	−33													
−18	−18	−28													
−16	−16	−24													
−14	−14	−21	−36												
−12	−12	−18	−28												
−10	−10	−14	−22												
−8	−8	−12	−18	−29											
−6	−6	−10	−14	−22											
−4	−4	−7	−12	−17	−29										
−2	−2	−5	−8	−13	−20										
0	0	−3	−6	−9	−15	−24									
2	2	−1	−3	−6	−11	−17									
4	4	1	−1	−4	−7	−11	−19								
6	6	4	1	−1	−4	−7	−13	−21							
8	8	6	3	1	−2	−5	−9	−14							
10	10	8	6	4	1	−2	−5	−9	−14	−28					
12	12	10	8	6	4	1	−2	−5	−9	−16					
14	14	12	11	9	6	4	1	−2	−5	−10	−17				
16	16	14	13	11	9	7	4	1	−1	−6	−10	−17			
18	18	16	15	13	11	9	7	4	2	−2	−5	−10	−19		
20	20	19	17	15	14	12	10	7	4	2	−2	−5	−10	−19	
22	22	21	19	17	16	14	12	10	8	5	3	−1	−5	−10	−19
24	24	23	21	20	18	16	14	12	10	8	6	2	−1	−5	−10
26	26	25	23	22	20	18	17	15	13	11	9	6	3	0	−4
28	28	27	25	24	22	21	19	17	16	14	11	9	7	4	1
30	30	29	27	26	24	23	21	19	18	16	14	12	10	8	5

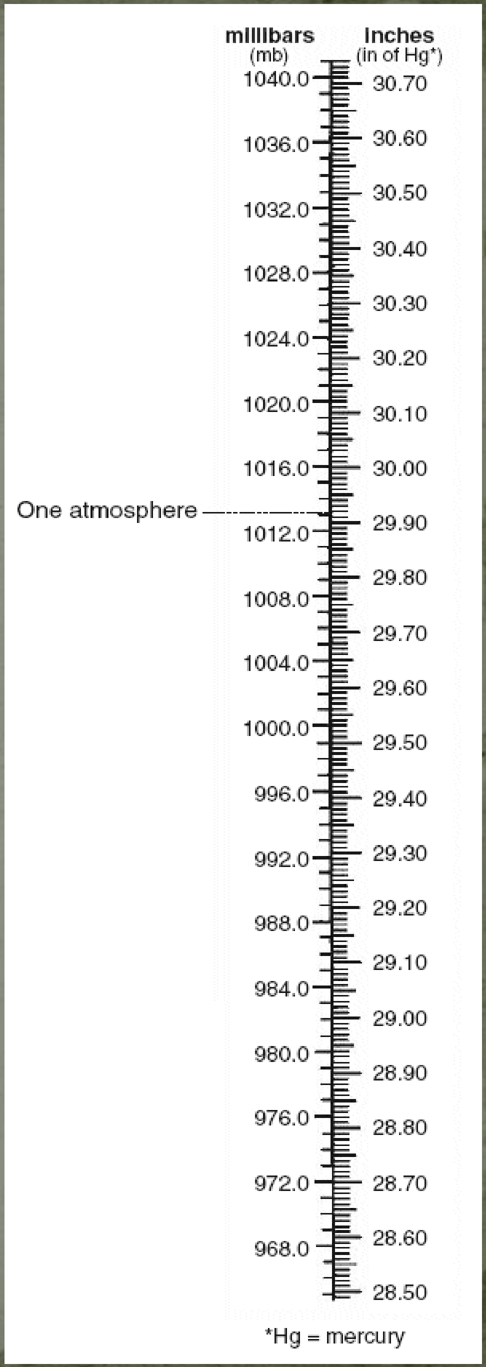
Relative Humidity (%)

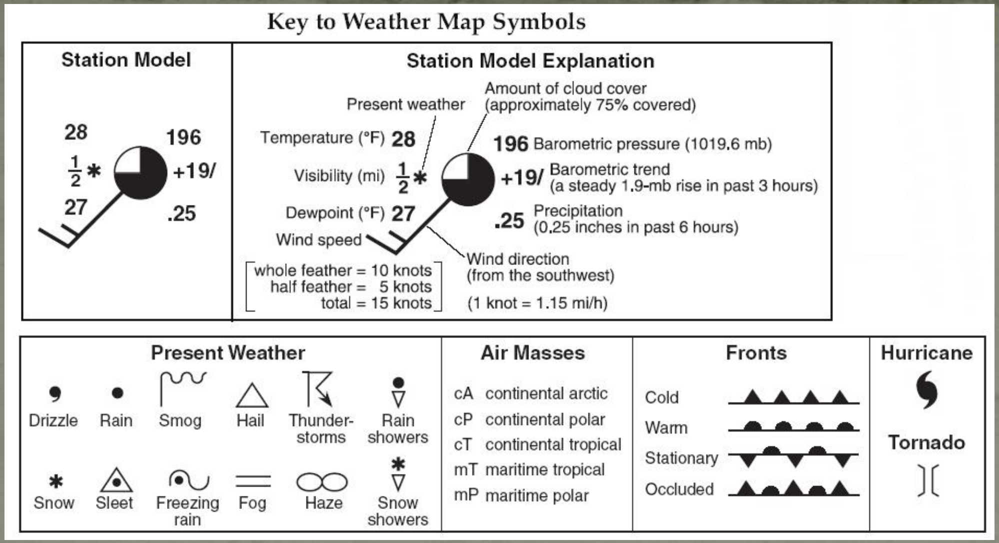
Dry-Bulb Temperature (°C)	Difference Between Wet-Bulb and Dry-Bulb Temperatures (C°)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
−20	100	28														
−18	100	40														
−16	100	48														
−14	100	55	11													
−12	100	61	23													
−10	100	66	33													
−8	100	71	41	13												
−6	100	73	48	20												
−4	100	77	54	32	11											
−2	100	79	58	37	20	1										
0	100	81	63	45	28	11										
2	100	83	67	51	36	20	6									
4	100	85	70	56	42	27	14									
6	100	86	72	59	46	35	22	10								
8	100	87	74	62	51	39	28	17	6							
10	100	88	76	65	54	43	33	24	13	4						
12	100	88	78	67	57	48	38	28	19	10	2					
14	100	89	79	69	60	50	41	33	25	16	8	1				
16	100	90	80	71	62	54	45	37	29	21	14	7	1			
18	100	91	81	72	64	56	48	40	33	26	19	12	6			
20	100	91	82	74	66	58	51	44	36	30	23	17	11	5		
22	100	92	83	75	68	60	53	46	40	33	27	21	15	10	4	
24	100	92	84	76	69	62	55	49	42	36	30	25	20	14	9	4
26	100	92	85	77	70	64	57	51	45	39	34	28	23	18	13	9
28	100	93	86	78	71	65	59	53	47	42	36	31	26	21	17	12
30	100	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16

- Dew point and Relative Humidity.
- Find the dry bulb (regular temperature).
- Go down the Side column (marked dry bulb).
- Find the wet bulb temperature.
- Figure out the difference between the wet and dry bulb.
- Move over that many spaces. (explained on the top line). (remember 0)
- If Dry bulb and DP is given, you can use that information to find relative humidity.
- If dry bulb and RH is given, you can use that information to find DP.

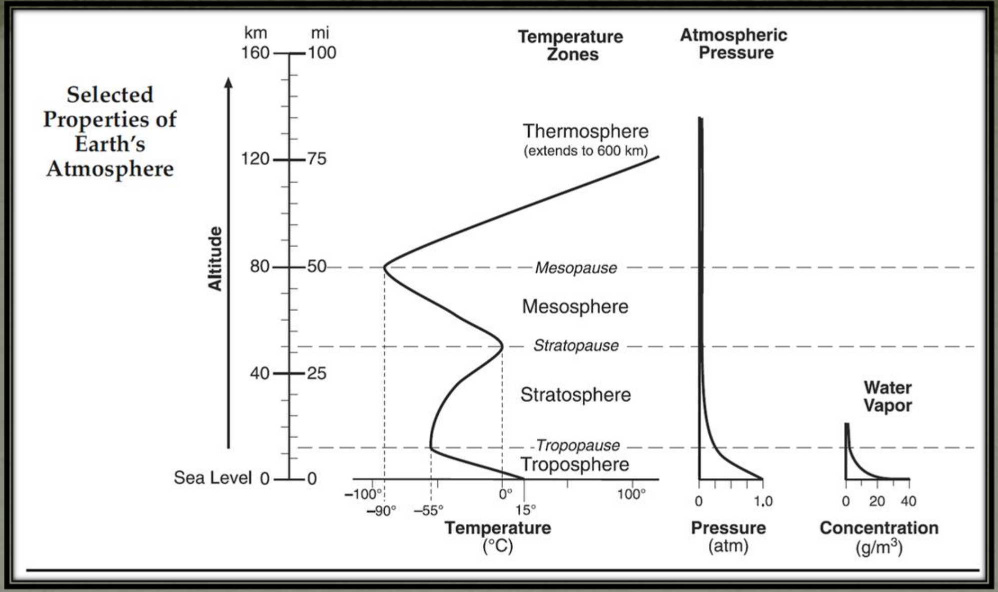


- Temperature and pressure. Just move directly over to the other side. You must be exact, so using paper is a good idea.
- Temperature, notice boil, freeze, room temperature degrees.
- Pressure notice 1 atm. for low and high pressure references.
- Hg= mercury.

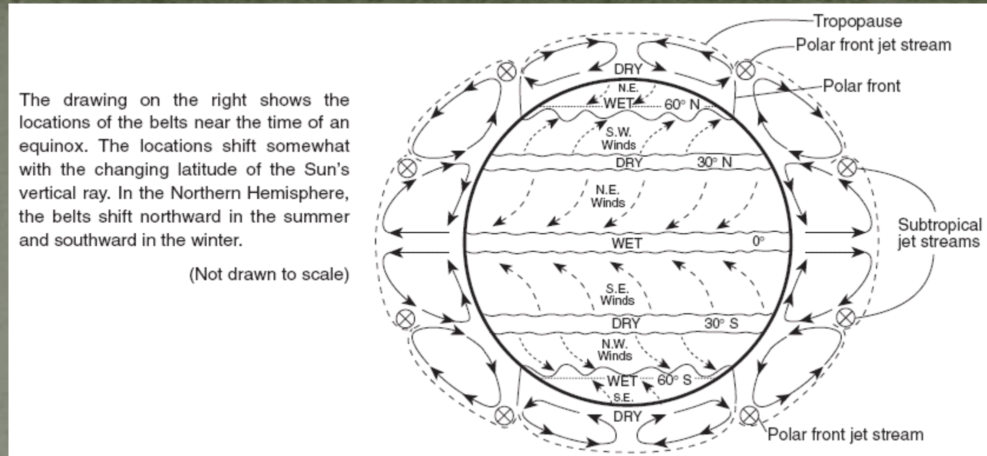




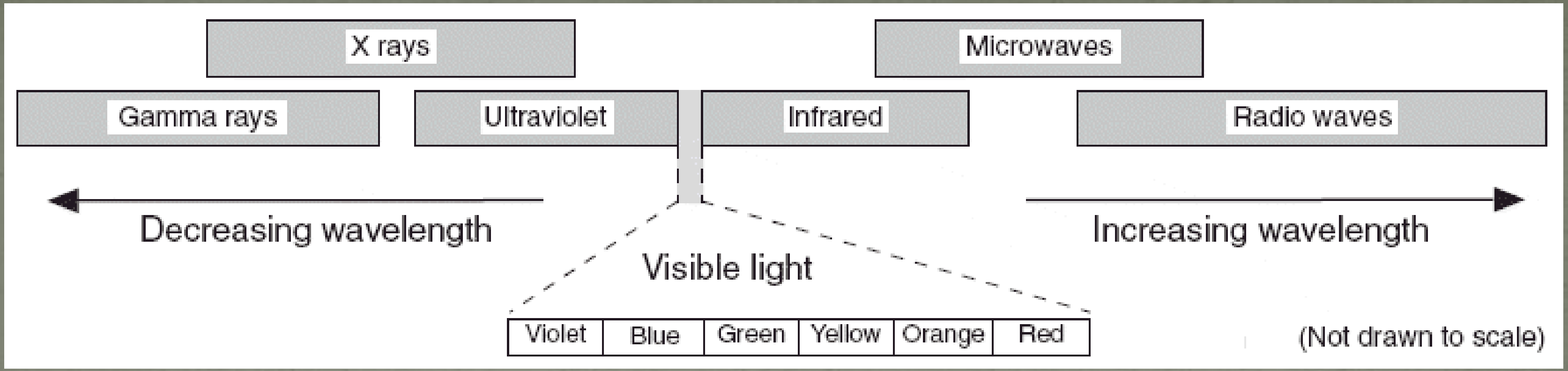
- Station model gives all information in the key.
- Remember, to go from model to real pressure:
- Above 500 add 9 and decimal; doesn't need help (720 = 972.0).
- Below 500 add 10 and decimal; needs help (124 = 1012.4).
- To check, see if your number appears on pressure chart.
- To move to the model from real pressure remove 9/10 and decimal.
- Wind is always shown from the direction it came. (N brings cold air).
- If the wind is only 5 knots the feather will be indented.
- All other information is given on the key.



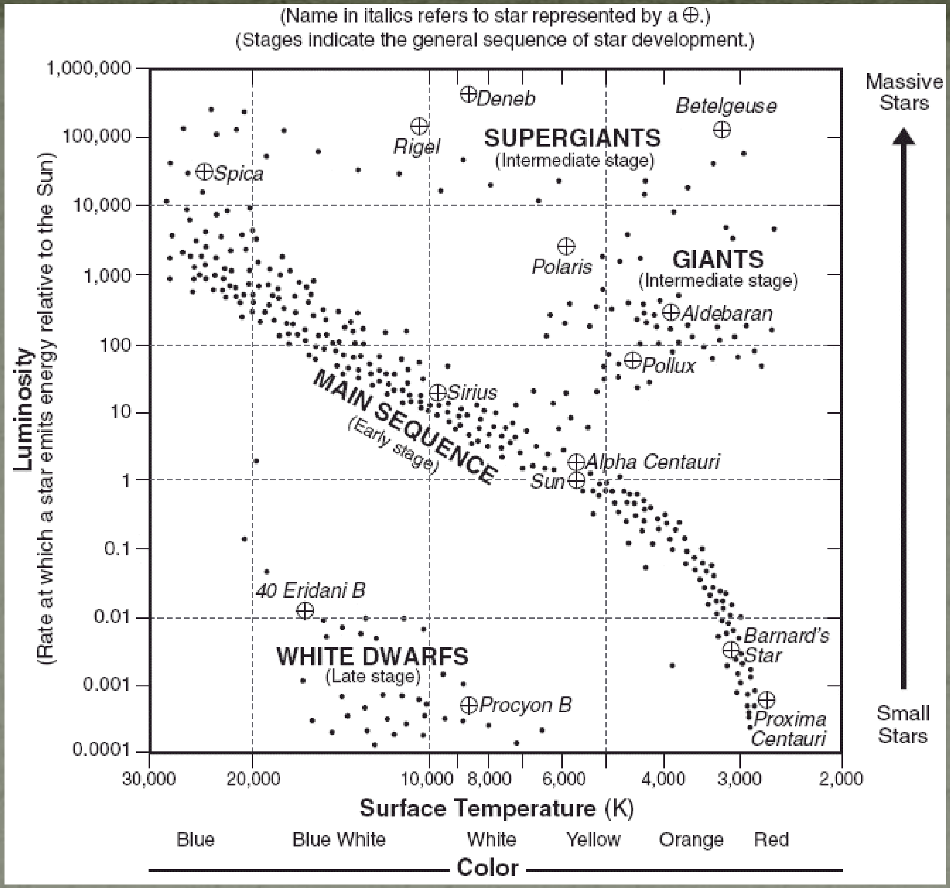
- Troposphere- Most important because it contains all life and almost all water vapor. When you go up in altitude the temp drops because air spreads out (less pressure) and it cannot absorb as much heat.
- Stratosphere – Temp rises with altitude because it contains more molecules that absorb heat (the ozone layer).
- Mesosphere - temp drops again due to less pressure.
- Thermosphere – temp technically rises because other layers are not blocking the rays (however molecules are so spread out it would feel cold).
- Notice : altitude – Km on left, Mi on right.
- Water vapor and pressure: lower altitude = more. Read the line down.



- Air rises and falls due to convection cells.
- Hot air is less dense so it rises (low pressure).
- Cold is more dense so it falls (high pressure).
- Wet air is also less dense because the lighter Hydrogen replaces the heavier Nitrogen, this also makes it rise (think puddles evaporate and going up into the air).
- 0 degrees – Doldrums (almost no air movement) Dull air.
- 30 deg. – Horse latitudes, calm air due to direction change.
- N. Hemisphere air returns H to L in a clockwise pattern. Shifts to the right due to coriolis effect.
- S. Hemisphere air returns counterclockwise – to the Left.
- Turn the chart over to notice the air moving right or left.
- X = Jet Streams. Areas between convection cells where the air moves extremely fast (up to several hundred mph) Think baseball pitching machine.



- Electromagnetic spectrum.
- Radiation travels in waves.
- We only see a small portion of the spectrum.
- Red is longest, blue/violet shortest (think rainbow).
- Longer waves are stretched and have less energy.
- Radio waves are long and not harmful.
- Small waves are compressed and high energy.
- Gamma rays are powerful and harmful.
- Think wave pools. Long low energy relaxing waves, short high energy fun waves.
- This can be used with the Doppler effect.
- If a galaxy is moving away, waves are stretched and shift to the red.
- If a galaxy is moving towards us, the waves are compressed and shift to the blue.



- Most stars are located on the Main Sequences (early stage).
- When stars get older their gravity loses and the stars size increases (giants).
- Old stars typically shrink down to a dwarf. Larger ones Nova (explode).
- Luminosity is brightness (relative to the sun).
- NOTICE – Temperature increases to the Left.
- In Fire: Blue = Hot (propane), Red/Orange = cooler (camp fire).

Celestial Object	Mean Distance from Sun (million km)	Period of Revolution (d=days) (y=years)	Period of Rotation at Equator	Eccentricity of Orbit	Equatorial Diameter (km)	Mass (Earth = 1)	Density (g/cm^3)
SUN	—	—	27 d	—	1,392,000	333,000.00	1.4
MERCURY	57.9	88 d	59 d	0.206	4,879	0.06	5.4
VENUS	108.2	224.7 d	243 d	0.007	12,104	0.82	5.2
EARTH	149.6	365.26 d	23 h 56 min 4 s	0.017	12,756	1.00	5.5
MARS	227.9	687 d	24 h 37 min 23 s	0.093	6,794	0.11	3.9
JUPITER	778.4	11.9 y	9 h 50 min 30 s	0.048	142,984	317.83	1.3
SATURN	1,426.7	29.5 y	10 h 14 min	0.054	120,536	95.16	0.7
URANUS	2,871.0	84.0 y	17 h 14 min	0.047	51,118	14.54	1.3
NEPTUNE	4,498.3	164.8 y	16 h	0.009	49,528	17.15	1.8
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 d	27.3 d	0.055	3,476	0.01	3.3

- Rotation = spinning (Earth takes ~24hrs (Day/ Night)).
- Revolution = orbiting (Earth takes ~365 days (Year)).
- All revolutions are counterclockwise.
- Almost all rotations are counterclockwise (except Venus).
- Everything goes counterclockwise (except clocks and Venus rotation).
- Eccentricity has no unit and is typically to the thousandth.
- 0 is more circular. 1 is more of an oval/line.
- Mass is compared to the Earth being 1.
- *side note not on the graph. An AU is the distance from Earth to the Sun. 1 AU is 93 Million miles.

LUSTER	HARDNESS	CLEAVAGE	FRACTURE	COMMON COLORS	DISTINGUISHING CHARACTERISTICS	USE(S)	COMPOSITION*	MINERAL NAME
Metallic luster	1–2	✔		silver to gray	black streak, greasy feel	pencil lead, lubricants	C	**Graphite**
Metallic luster	2.5	✔		metallic silver	gray-black streak, cubic cleavage, density = 7.6 g/cm^3	ore of lead, batteries	PbS	**Galena**
Metallic luster	5.5–6.5		✔	black to silver	black streak, magnetic	ore of iron, steel	Fe_3O_4	**Magnetite**
Metallic luster	6.5		✔	brassy yellow	green-black streak, (fool's gold)	ore of sulfur	FeS_2	**Pyrite**
Either	5.5 – 6.5 or 1		✔	metallic silver or earthy red	red-brown streak	ore of iron, jewelry	Fe_2O_3	**Hematite**
Nonmetallic luster	1	✔		white to green	greasy feel	ceramics, paper	$Mg_3Si_4O_{10}(OH)_2$	**Talc**
Nonmetallic luster	2		✔	yellow to amber	white-yellow streak	sulfuric acid	S	**Sulfur**
Nonmetallic luster	2	✔		white to pink or gray	easily scratched by fingernail	plaster of paris, drywall	$CaSO_4{\cdot}2H_2O$	**Selenite gypsum**
Nonmetallic luster	2–2.5	✔		colorless to yellow	flexible in thin sheets	paint, roofing	$KAl_3Si_3O_{10}(OH)_2$	**Muscovite mica**
Nonmetallic luster	2.5	✔		colorless to white	cubic cleavage, salty taste	food additive, melts ice	NaCl	**Halite**
Nonmetallic luster	2.5–3	✔		black to dark brown	flexible in thin sheets	construction materials	$K(Mg,Fe)_3$ $AlSi_3O_{10}(OH)_2$	**Biotite mica**
Nonmetallic luster	3	✔		colorless or variable	bubbles with acid, rhombohedral cleavage	cement, lime	$CaCO_3$	**Calcite**
Nonmetallic luster	3.5	✔		colorless or variable	bubbles with acid when powdered	building stones	$CaMg(CO_3)_2$	**Dolomite**
Nonmetallic luster	4	✔		colorless or variable	cleaves in 4 directions	hydrofluoric acid	CaF_2	**Fluorite**
Nonmetallic luster	5–6	✔		black to dark green	cleaves in 2 directions at 90°	mineral collections, jewelry	(Ca,Na) (Mg,Fe,Al) $(Si,Al)_2O_6$	**Pyroxene** (commonly augite)
Nonmetallic luster	5.5	✔		black to dark green	cleaves at 56° and 124°	mineral collections, jewelry	$CaNa(Mg,Fe)_4(Al,Fe,Ti)_3Si_6O_{22}(O,OH)_2$	**Amphibole** (commonly hornblende)
Nonmetallic luster	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics, glass	$KAlSi_3O_8$	**Potassium feldspar** (commonly orthoclase)
Nonmetallic luster	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics, glass	$(Na,Ca)AlSi_3O_8$	**Plagioclase feldspar**
Nonmetallic luster	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks, jewelry	$(Fe,Mg)_2SiO_4$	**Olivine**
Nonmetallic luster	7		✔	colorless or variable	glassy luster, may form hexagonal crystals	glass, jewelry, electronics	SiO_2	**Quartz**
Nonmetallic luster	6.5–7.5		✔	dark red to green	often seen as red glassy grains in NYS metamorphic rocks	jewelry (NYS gem), abrasives	$Fe_3Al_2Si_3O_{12}$	**Garnet**

*Chemical symbols: Al = aluminum, C = carbon, Ca = calcium, Cl = chlorine, F = fluorine, Fe = iron, H = hydrogen, K = potassium, Mg = magnesium, Na = sodium, O = oxygen, Pb = lead, S = sulfur, Si = silicon, Ti = titanium

✔ = dominant form of breakage

- Luster – How a mineral reflects light. Looks like a metal or does not (not just shiny).
- Hardness – Ability to scratch. Mohs hardness scale 1-10.
- Breakage – How it breaks along its atomic plain.
- Cleavage = clean break.
- Fracture = jagged break.
- Color – Can change based on minerals (least scientific)
- Streak – Color left behind when dragged across a streak plate. Does not have to match the mineral color.
- Atomic arrangement or how the mineral is built is the most important characteristic of a mineral (house frame).
- * Look over distinguishing characteristics and uses.
- Composition will always be the same for the same mineral.
- Chemical symbols are listed on the bottom.