Warm-up 9/16 - UNIT 2

- Please turn to the next blank page in your composition notebook.
  - Put a huge header on this page that lists the unit and unit title
    - UNIT 2: The Chemistry of Life (Chapter 2)
- On the left side please put today's date and head the page Warm-up.
  - 1. What elements do you think are necessary for life?
  - 2. What do you already know about atoms and elements?

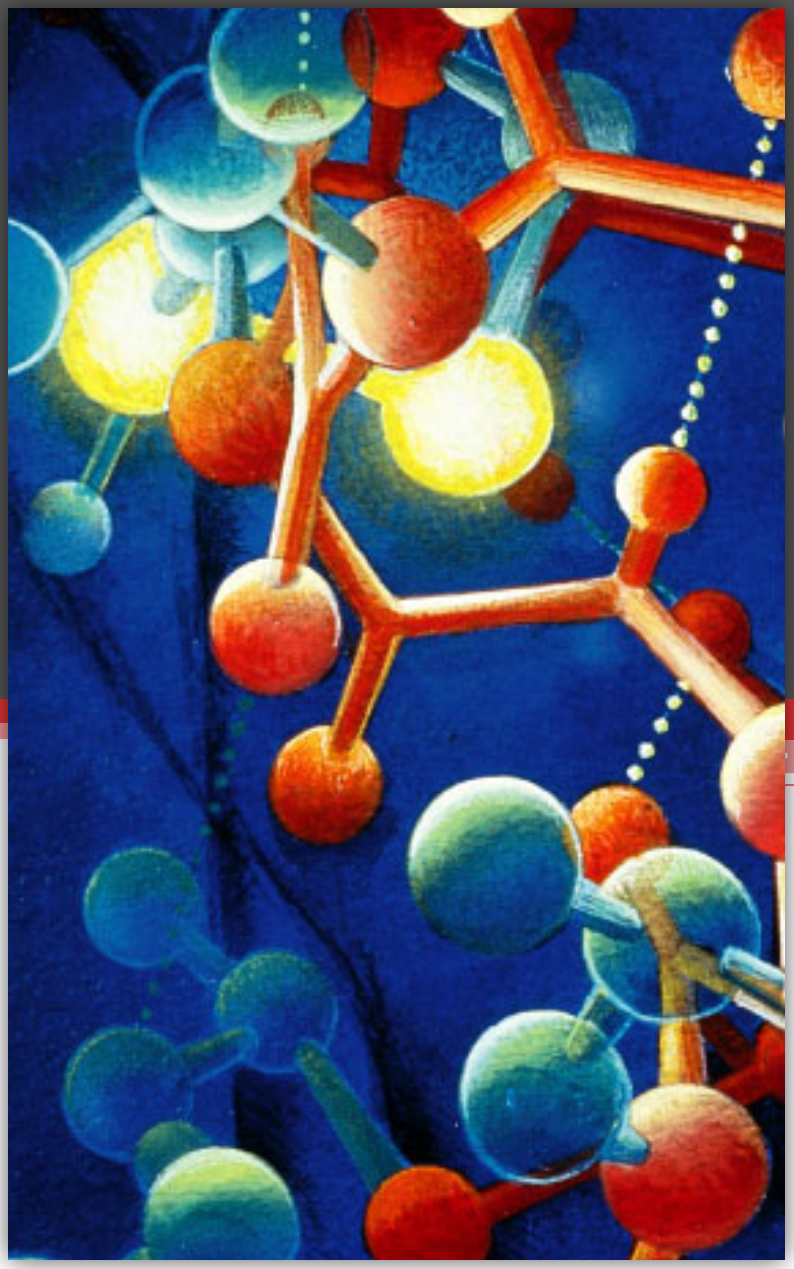
Homework

- Read section 2.1 and take the quiz egg for 2.1 before Tuesday night.

- Reminder to New 9th Grade students:
  - Please take the QuizEggs for 1.3 and 1.1 before next Friday. On Friday they will be inputted as a 0 if incomplete.

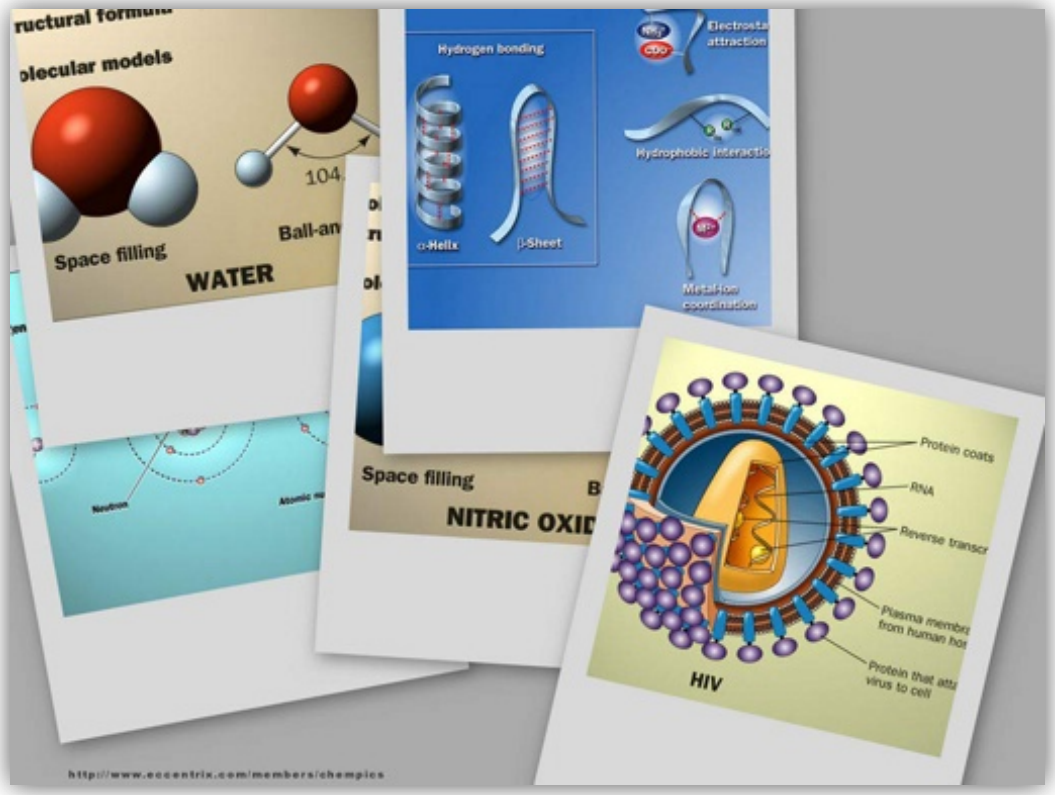
Chapter 2

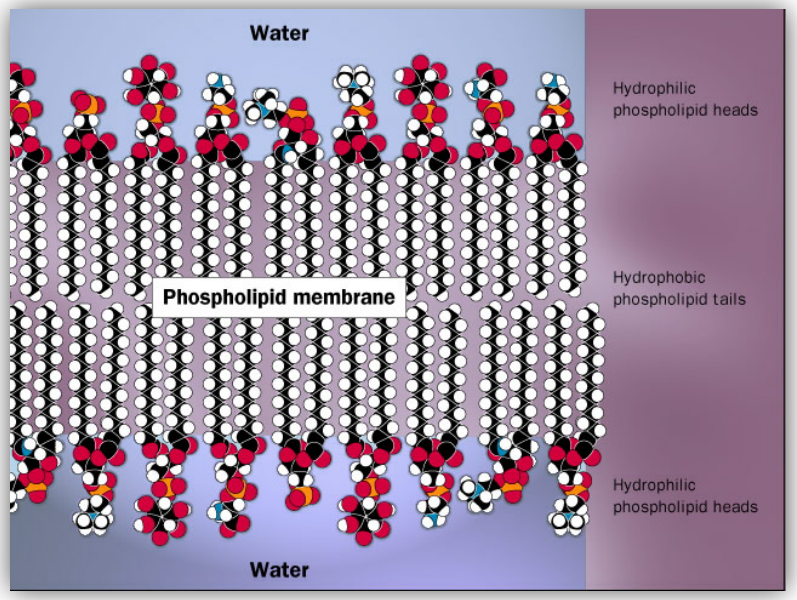
The Chemical Basis of Life



Why are we studying chemistry?

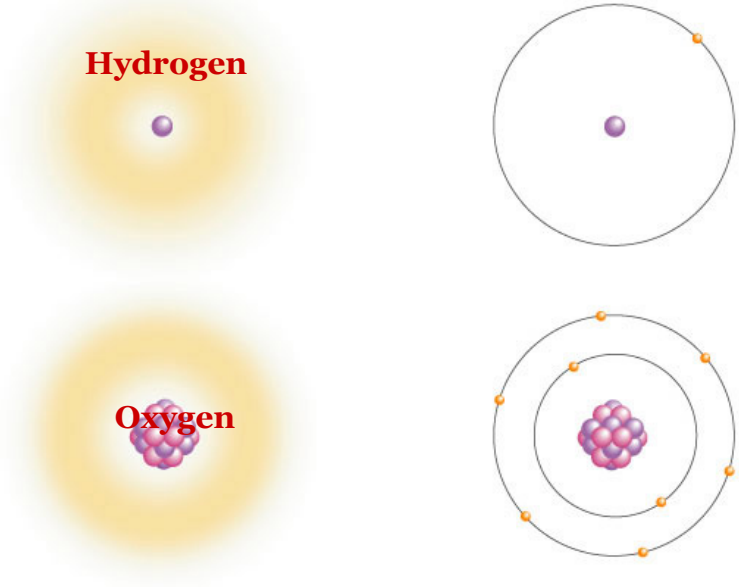
- Biology has chemistry at its foundation





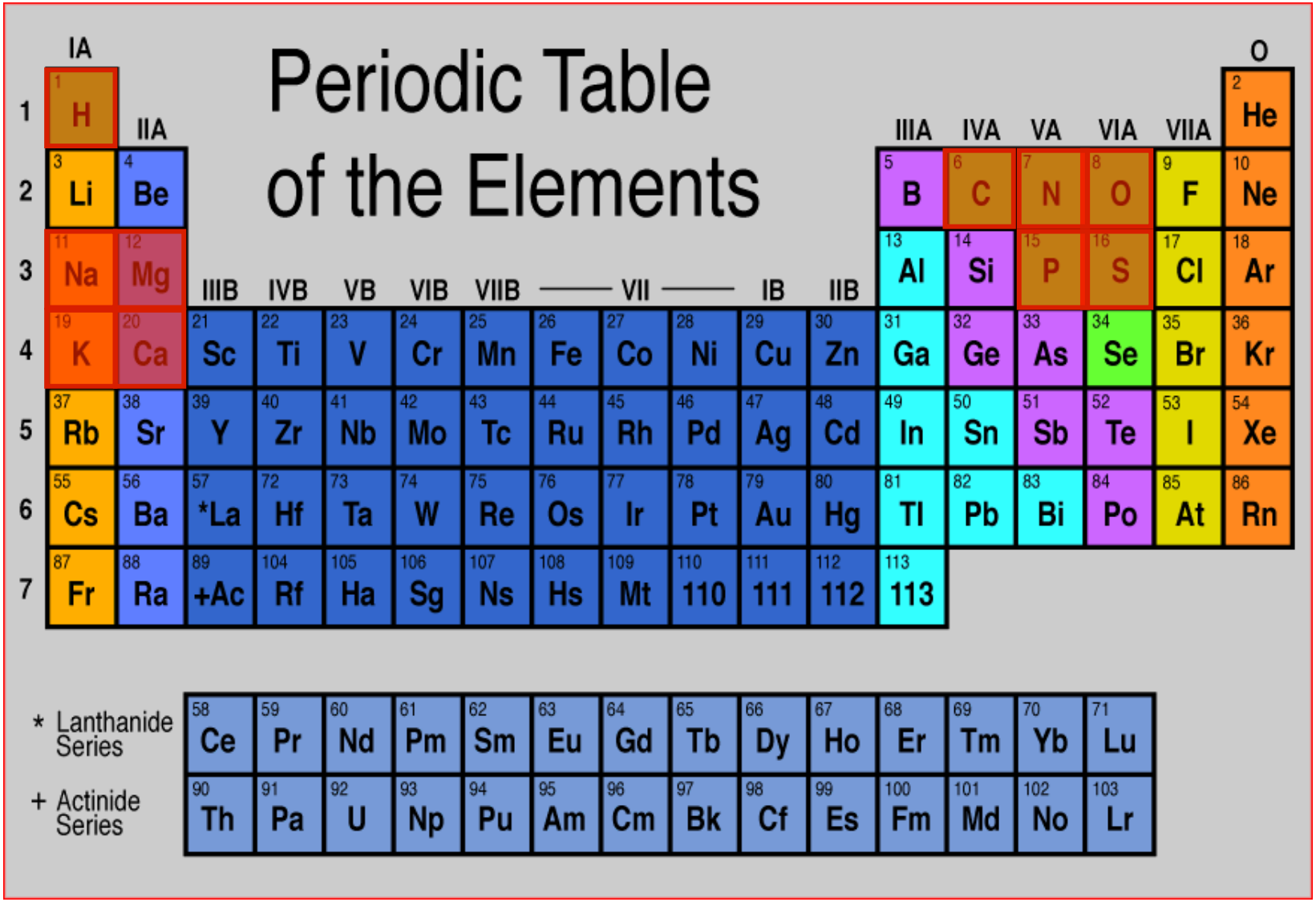
Life Requires About 25 Elements

- **Matter** is anything that takes up space and has mass
  - The different types of matter are made up of one or more chemical elements
- An **element** is a pure substance that cannot be broken down into other substances by ordinary chemical means.



The World of Elements

2005-2006



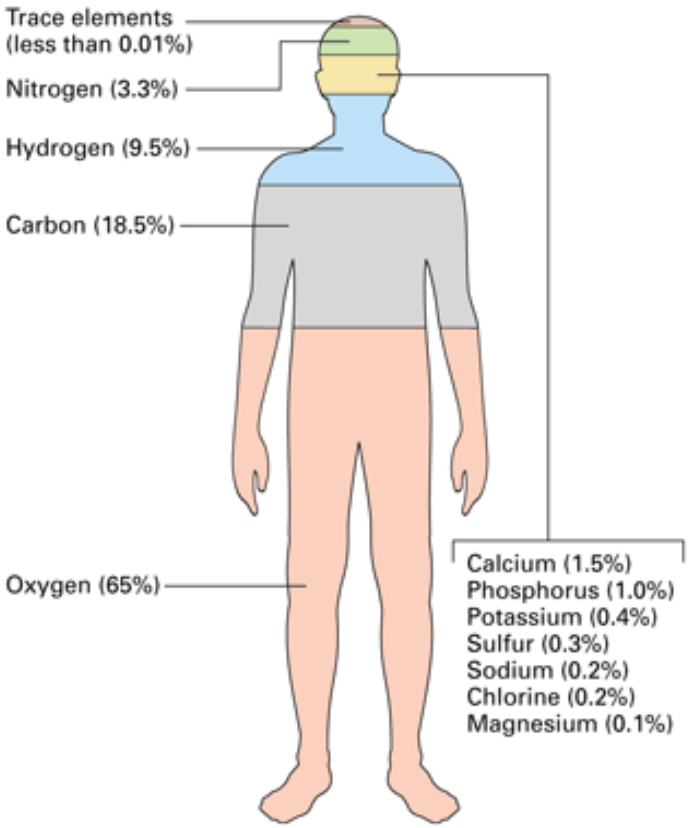
Crash Course – Periodic Table

Life requires ~25 chemical elements

- About **25** of 92 elements are essential for life
  - **Four** elements make up **96%** of living matter:
    - **carbon (C)**
    - **hydrogen (H)**
    - **oxygen (O)**
    - **nitrogen (N)**
  - **Four** elements make up most of the remaining **4%**:
    - **phosphorus (P)**
    - **calcium (Ca)**
    - **sulfur (S)**
    - **potassium (K)**

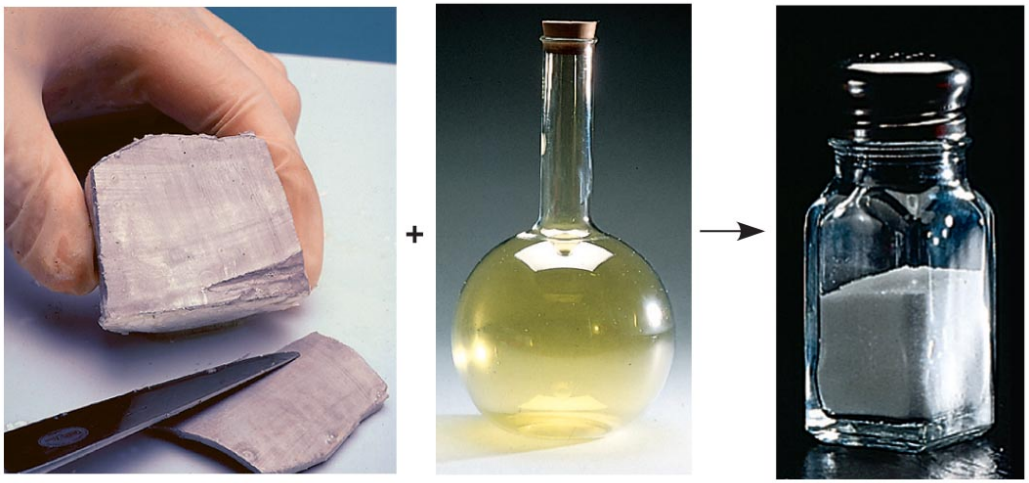
Trace Elements

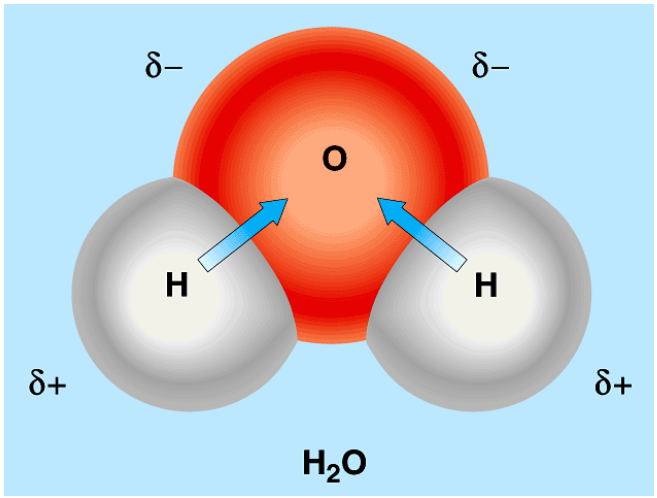
- **Trace elements** are those required by an organism in minute (tiny) quantities.
  - make up less than 0.01% of your body mass
    - Examples:
      - 0.15 mg iodine daily for healthy thyroid
      - Iron= 0.004% body mass, carry O_2



Compounds

- Most elements can combine chemically with other elements, forming **compounds**.
- A compound is a substance consisting of two or more elements in a fixed ratio
- A compound has characteristics different from those of its elements
  - Examples:
    - Water (H_2O) is a compound
      - Always contain the same ratio of hydrogen (H) to oxygen (O)
    - Table salt= NaCl





Warm-up 9/19

- Remember that all Warm-up questions need to be numbered and written in full. All Warm-up questions go on the left hand side!

- #3. What four elements make up 96% of living matter in our bodies?
- #4. What is an element that makes up less than .01% of your body mass? List an example.

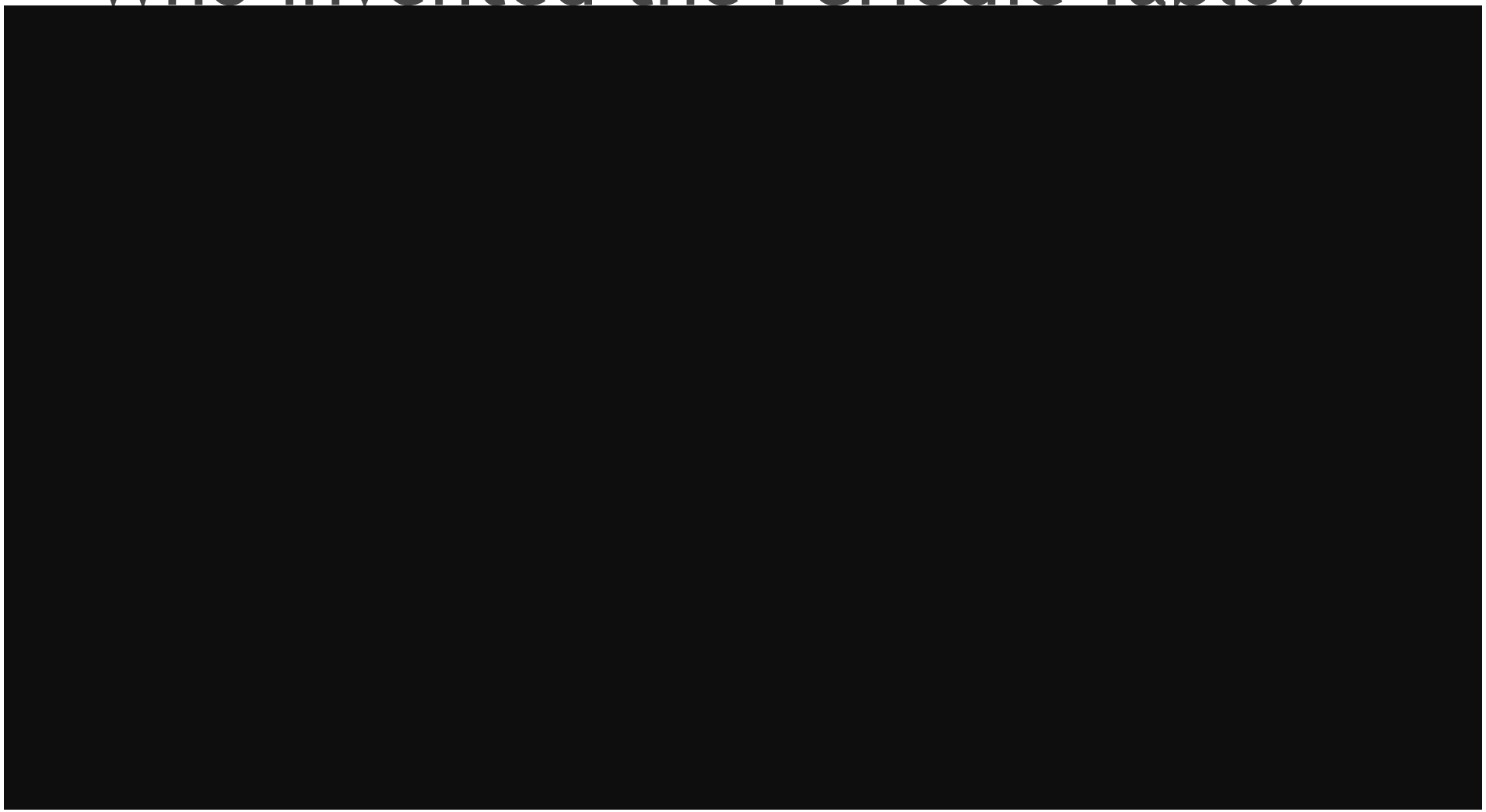
Warm-up 9/20

- Today's warm up questions will be answered during the two videos we are watching. Leave room to answer the questions.
- 5. Who invented the Periodic Table? What did he/she use to group the elements?
- 6. How does Bill Nye's cheese analogy explain an atom?
- 7.List an example or a specific isotope used in..
  - 1. Medicine
  - 2. Industry
  - 3. Agriculture
- 8. How is the "bomb pulse" used to date our cells? Where is the oldest cell in your body? Where is the youngest cell?

Homework

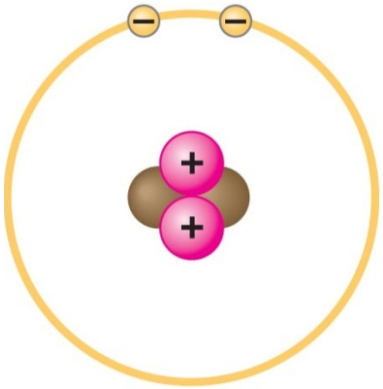
- Read Section 2.2 and Take the QuizEgg #8 by Wednesday Night. College Prep, earn an extra point if you take it tonight!

Who invented the Periodic Table?



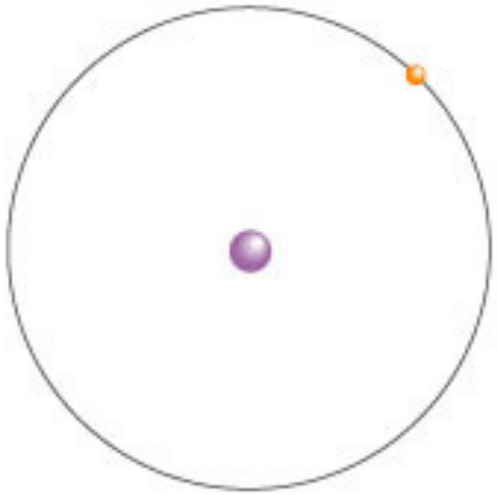
Chemical properties are based on the structure of atoms

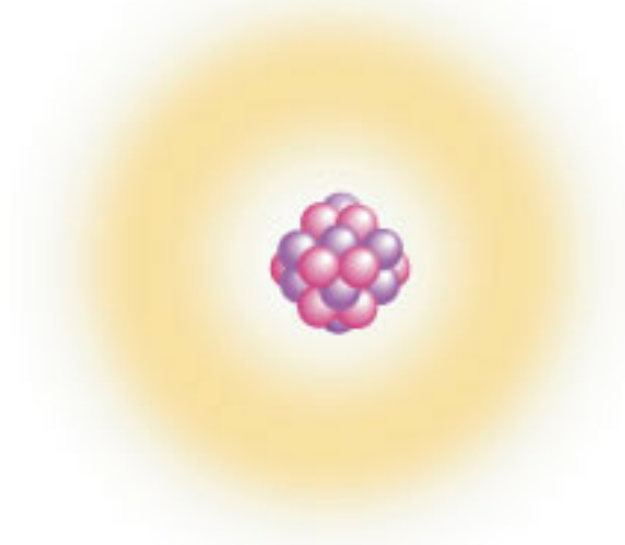
- An **atom** is the smallest possible particle of an element.
- Atoms are made up of 3 even smaller parts called **subatomic particles:**
  - **Protons**: have a single unit of positive electrical charge (+)
  - **Electrons**: have a single unit of negative electrical charge (-)
  - **Neutrons**: have no electrical charge, neutral



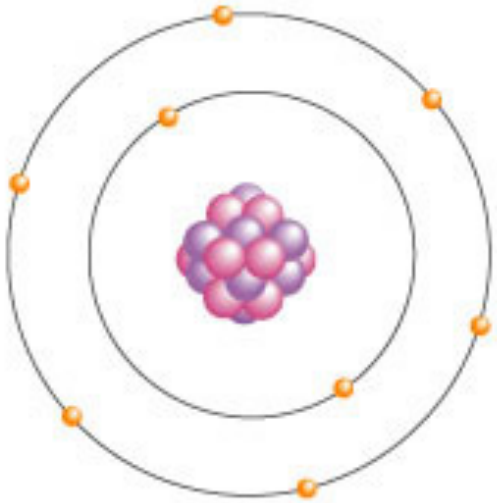
- **Everything is made of matter**
- **Matter is made of atoms**

Hydrogen
1 proton
1 electron





Oxygen
8 protons
8 neutrons
8 electrons



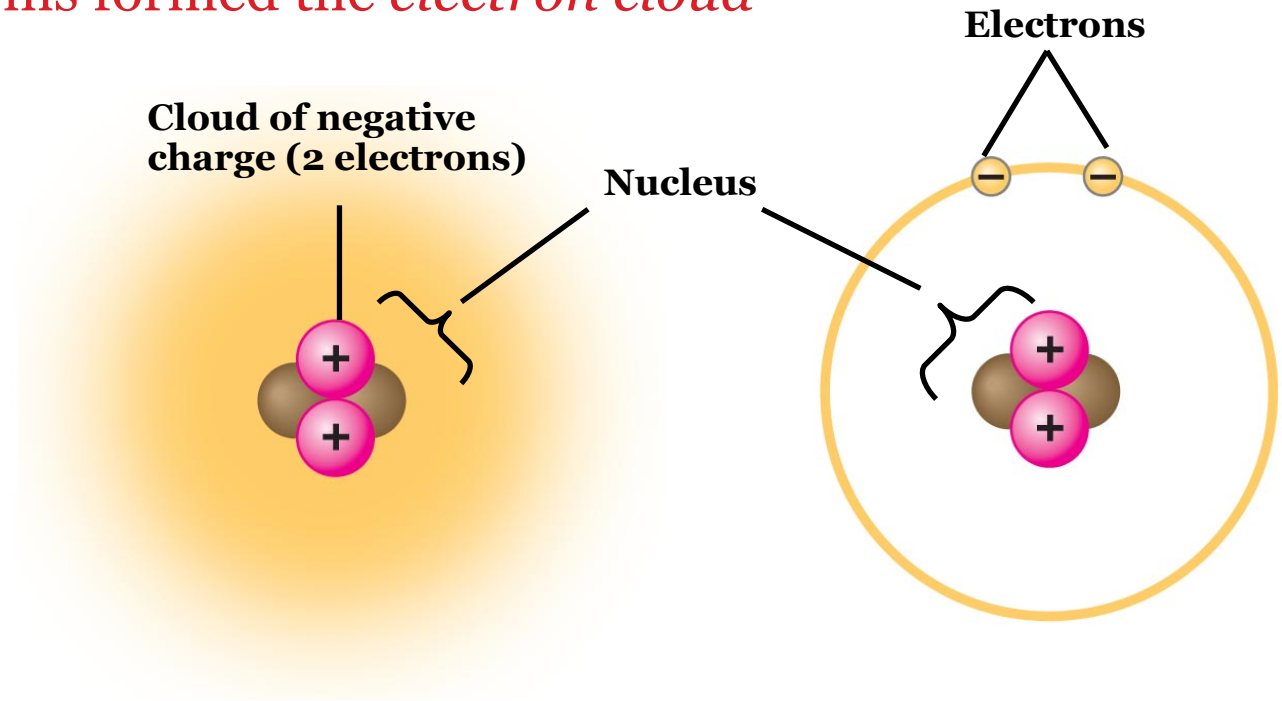
Proton +

Neutron o

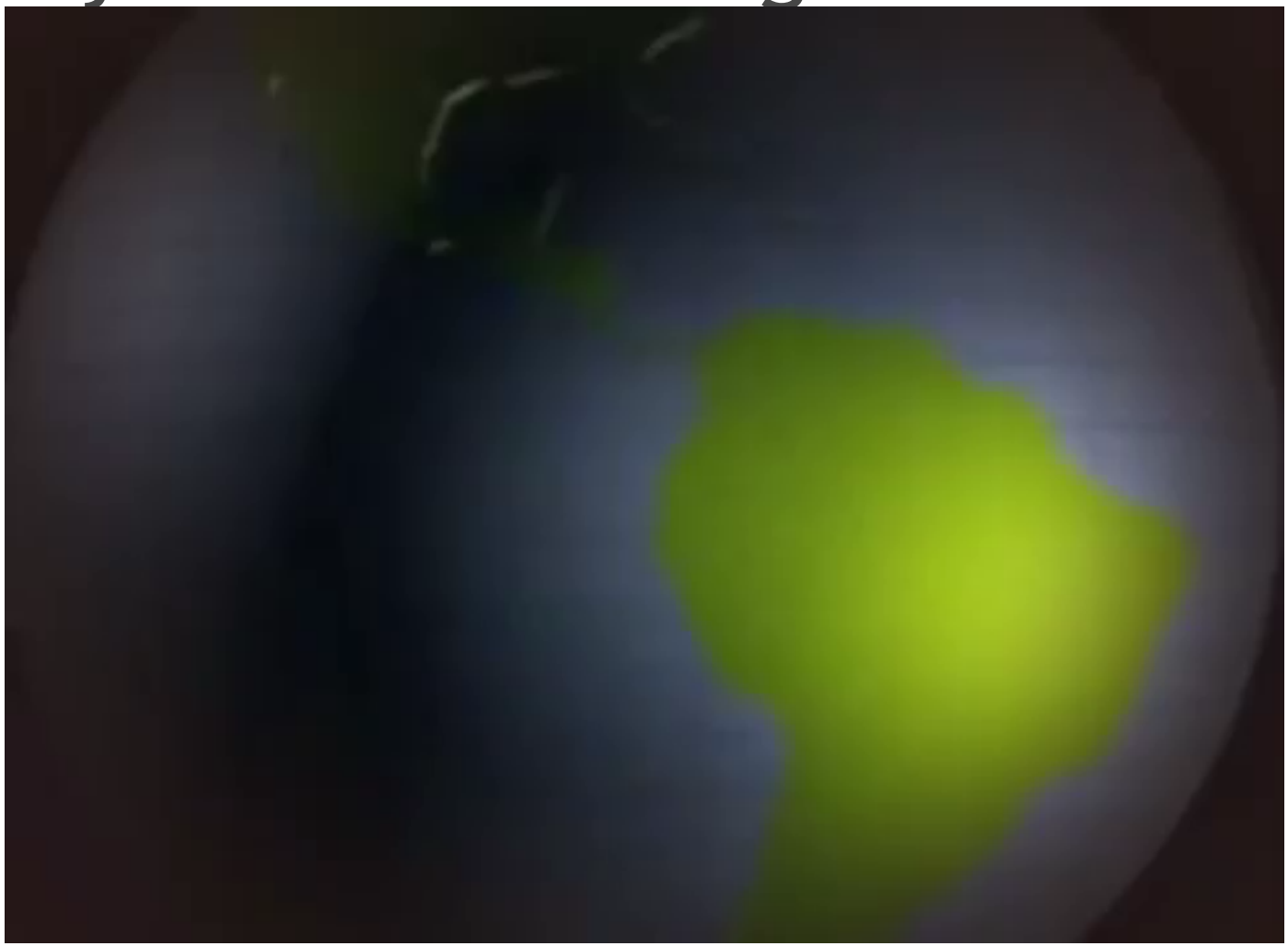
Electron –

Atom Arrangement

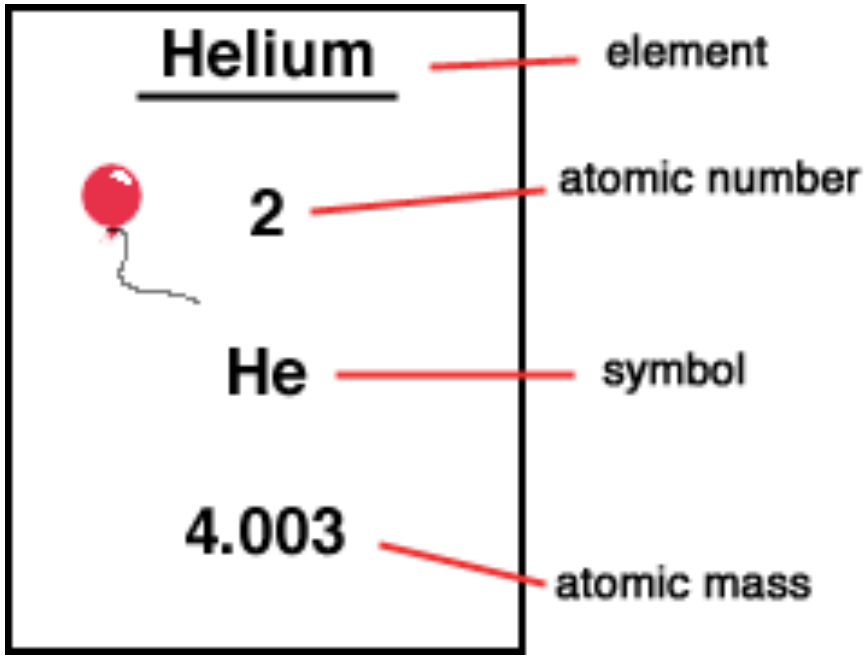
- Protons and neutrons are tightly packed together in the center of an atom, forming a **nucleus**.
- Electrons move around the outside of the nucleus at great speed.
  - This formed the *electron cloud*



Bill Nye – Atom arrangement



- The *physical* and *chemical properties* of an element depend on the number and arrangement of protons, electrons, and neutrons.
- <u>All atoms of a particular element have the same # of protons, known as the element's **atomic number**.</u>



Atomic mass

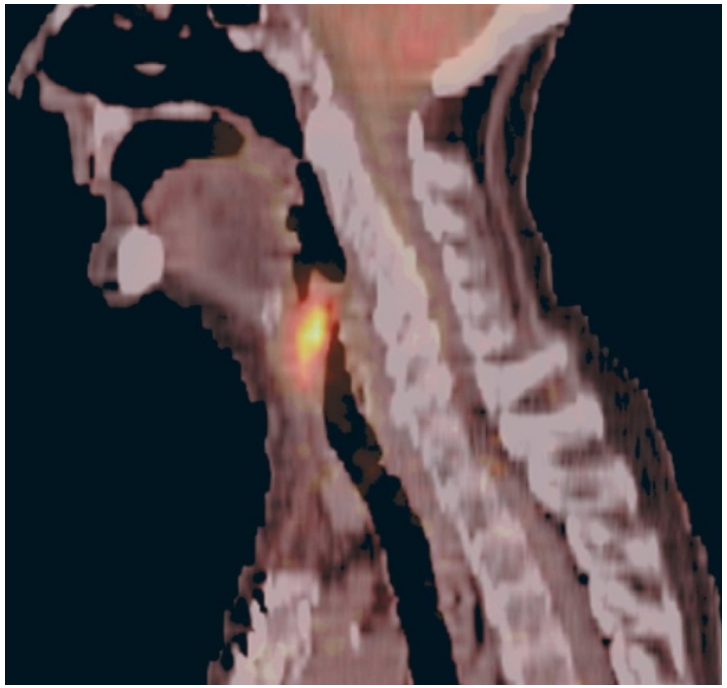
- **Atomic mass** - the mass of an atom of a chemical element expressed in atomic mass units. It is approximately equivalent to the number of protons and neutrons in the atom.

Atom Game

- Pull out a post it note – put your name on it!
  - Using your seat number draw out and label an atom.
    - Your seat number = the atomic number
    - You have a neutrally charged atom
    - What element do you have?

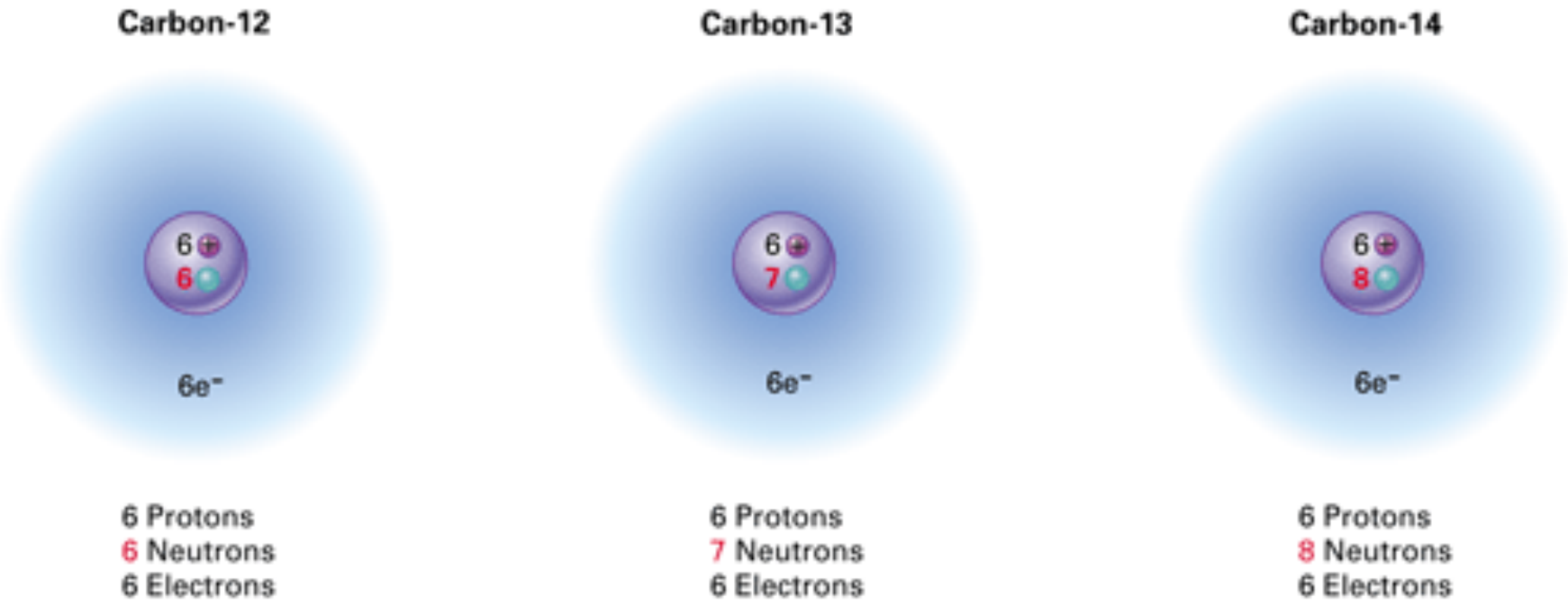
Isotopes

- Some elements have different forms called **isotopes**, which differ only in their # of neutrons.
- The nucleus of a *radioactive isotope* is unstable and breaks down over time, giving off matter and energy.
- Some applications of radioactive isotopes in biological research are:
  - Dating fossils
  - Tracing atoms through metabolic processes
  - Diagnosing medical disorders

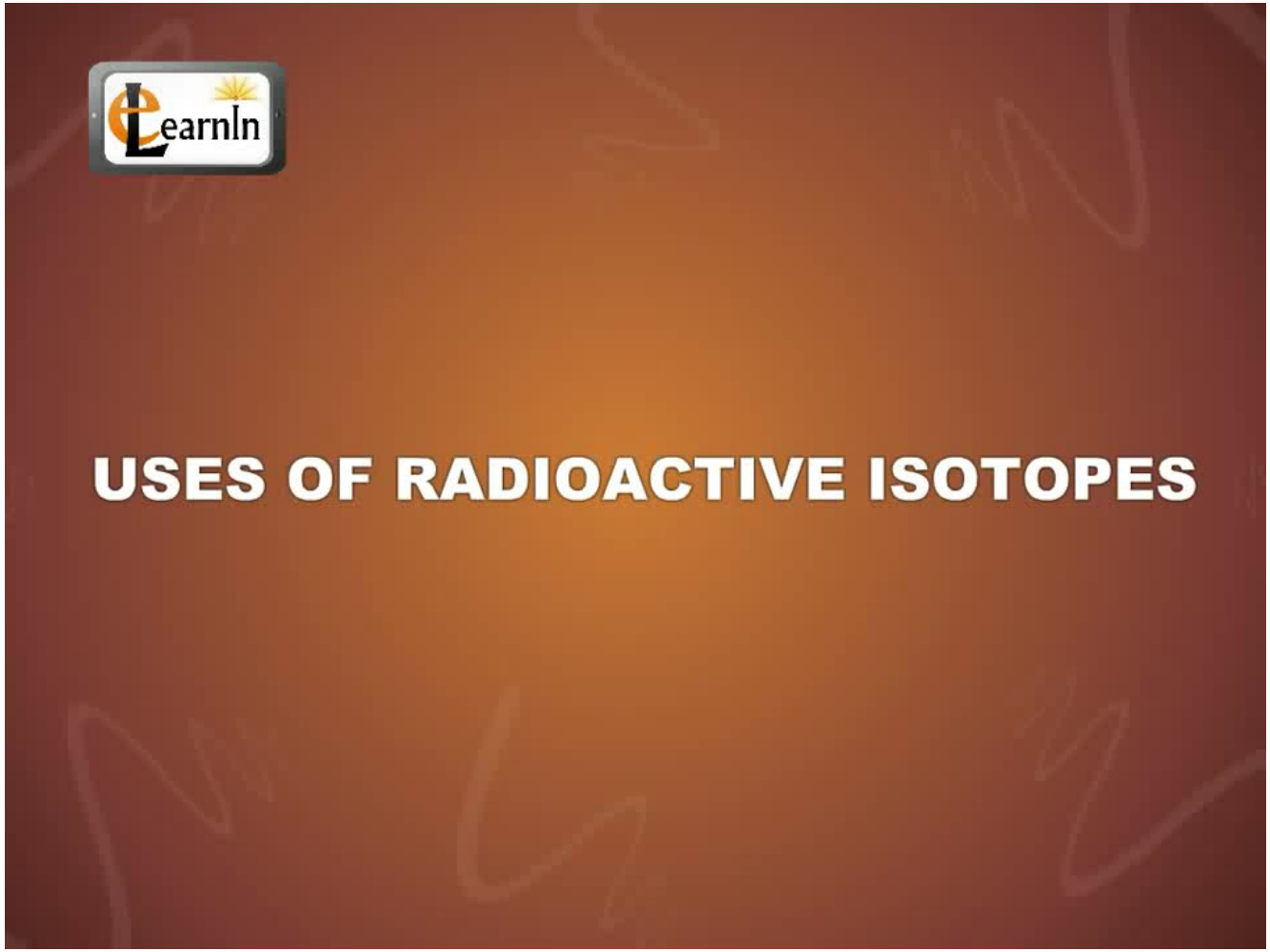


Isotope		Half-life of parent (years)	Useful range (years)
Parent	Daughter		
Carbon 14	Nitrogen 14	5,730	100 - 30,000
Potassium 40	Argon 40	1.3 billion	100,000 - 4.5 billion
Rubidium 87	Strontium 87	47 billion	10 million - 4.5 billion
Uranium 238 Uranium 235	Lead 206 Lead 207	4.5 billion 710 million	10 million - 4.6 billion

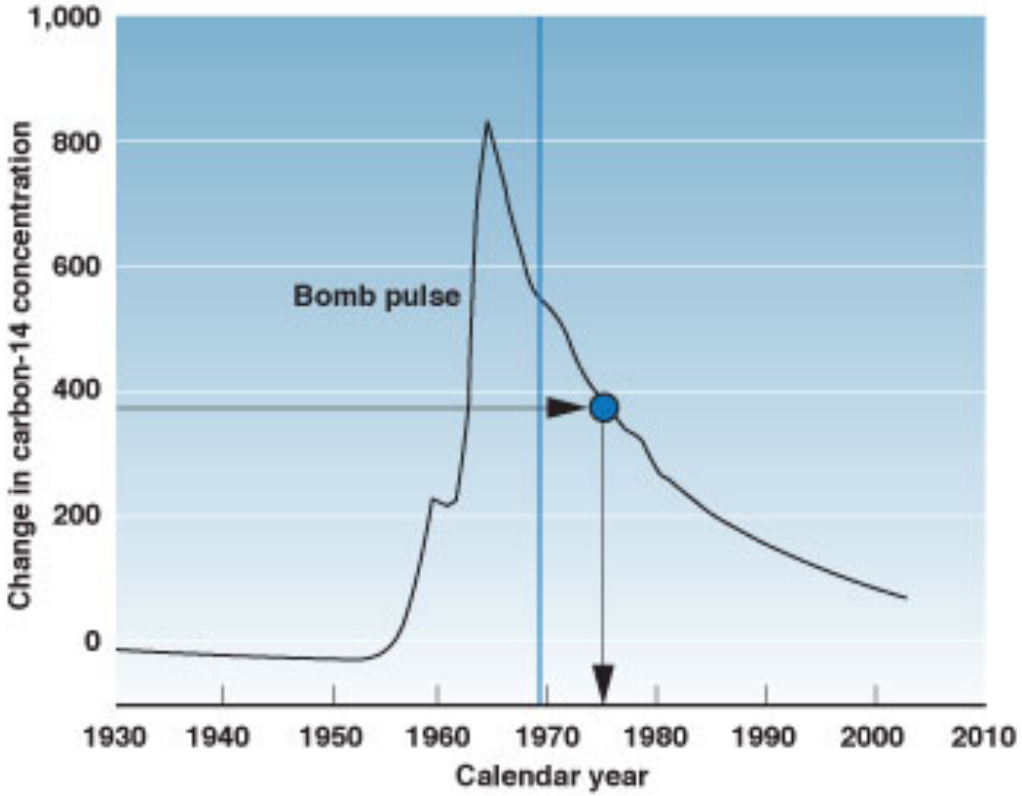
Isotopes


Carbon-12
6
6
6e⁻
6 Protons
6 Neutrons
6 Electrons
Carbon-13
6
7
6e⁻
6 Protons
7 Neutrons
6 Electrons
Carbon-14
6
8
6e⁻
6 Protons
8 Neutrons
6 Electrons

Uses of Radioactive Isotopes



Carbon Dating - RadioLab



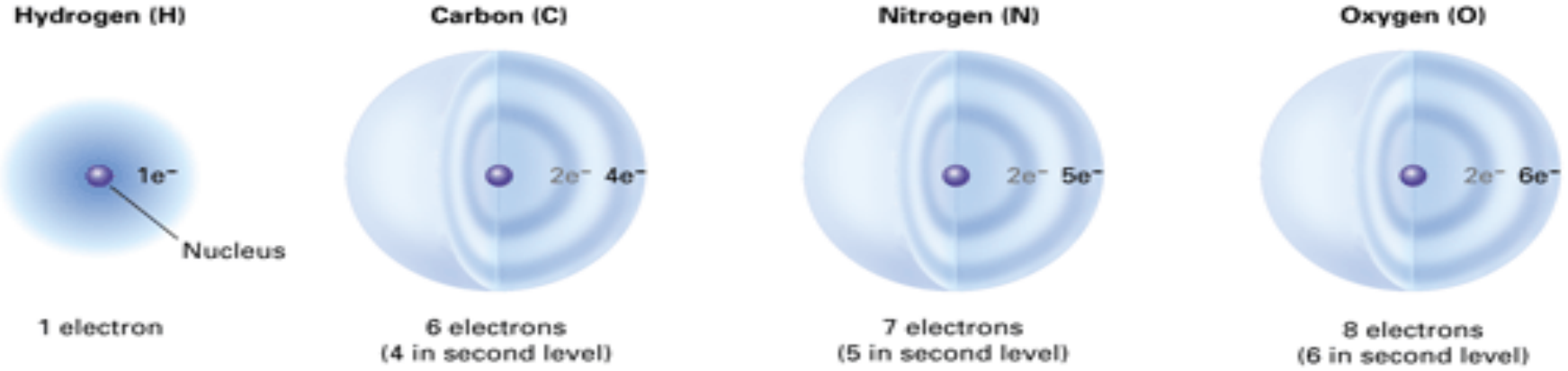
Name	Symbol	Atomic number	Mass Number	Number of neutrons	Number of Electrons	Cha
hydrogen-2	^{2}H	1	2	1	1	0
	^{3}H					
sodium-22	$^{22}Na^{+}$				10	
		12	24		12	
		12	25		13	
	$^{46}Ti^{-2}$					
	^{107}Ag					
	$^{19}F^{-1}$					
carbon-12					6	
carbon-13					6	
carbon-14					6	
carbon-12					7	
carbon-12					5	
	^{4}He					
		8		8	10	
argon-40		18			18	
	^{70}Ga					
	$^{70}Ga^{+3}$					
		4	9		2	
		7		8	8	

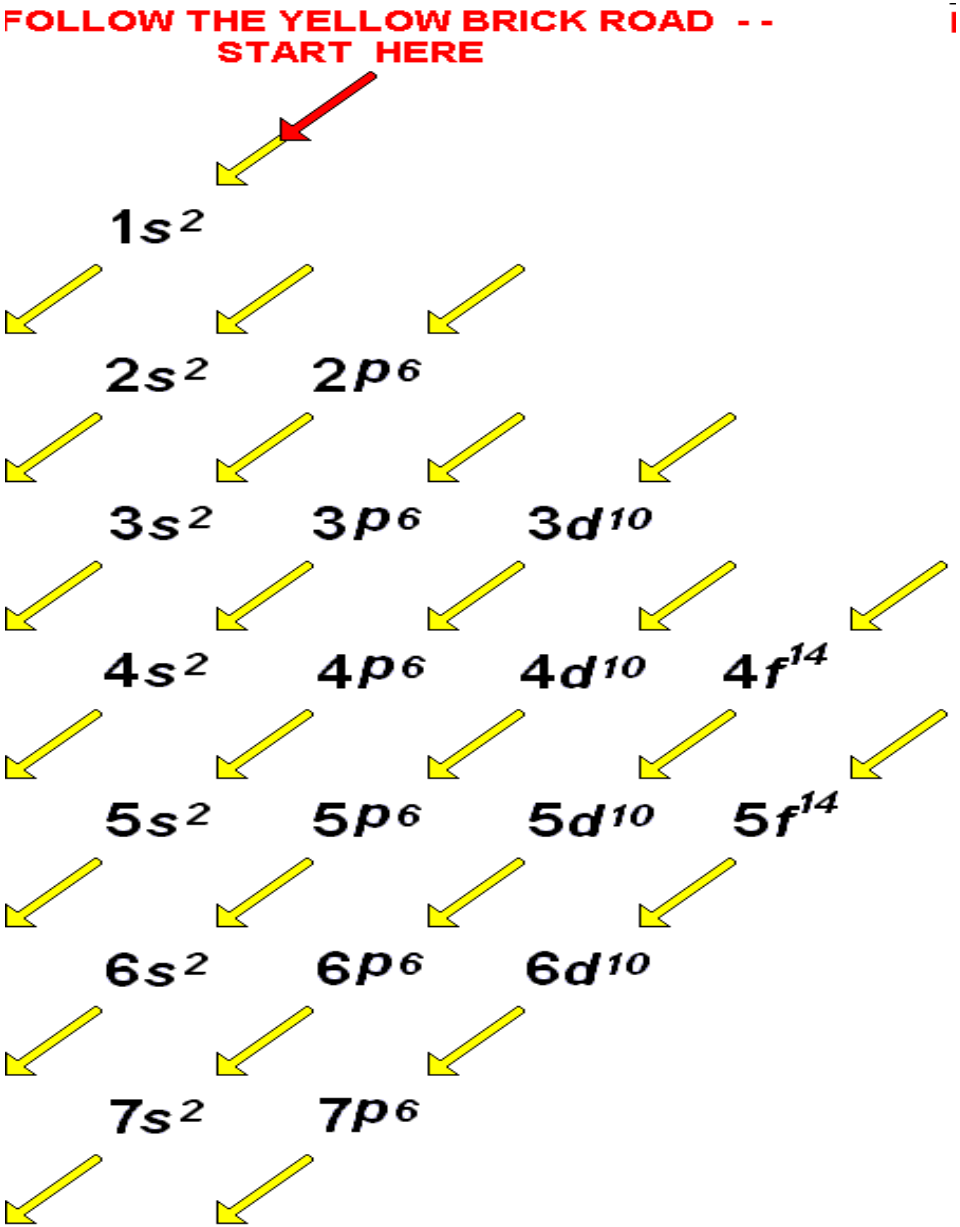
Warm-up 9/21

- Pull out the Atom Simulation Sheet – We will be going over the answers to several after I have checked that it was complete.
- 9. What are the three subatomic particles, and which are located in the nucleus?
- 10. Which subatomic particle would be different in an isotope?
- 11. What are some of the uses of radioactive isotopes?

Electrons & Energy Levels

- An atom's electrons belong to certain energy levels.
  - 1st energy level → lowest energy level, nearest to nucleus hold 2 electrons
  - 2nd energy level→ holds up to 8
  - 3rd energy level → holds up to 18
  - 4th energy level → holds up to 32

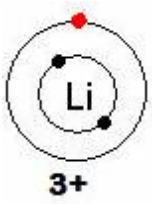


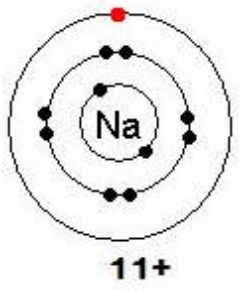


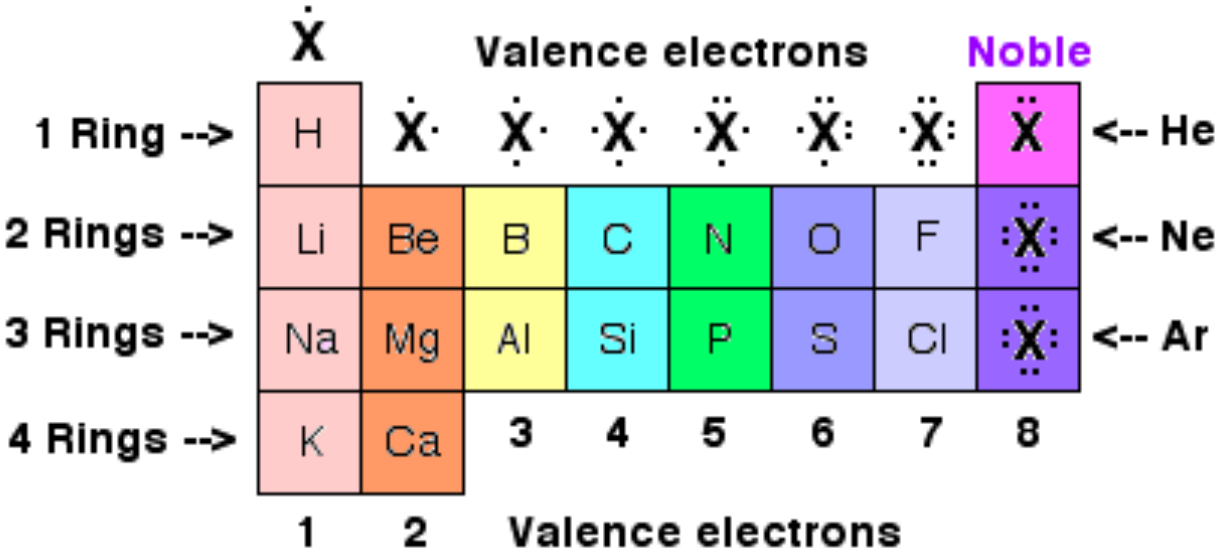
Can you find the 2, 8, 18, and 32 electrons in each level?

Energy Levels and Reactivity

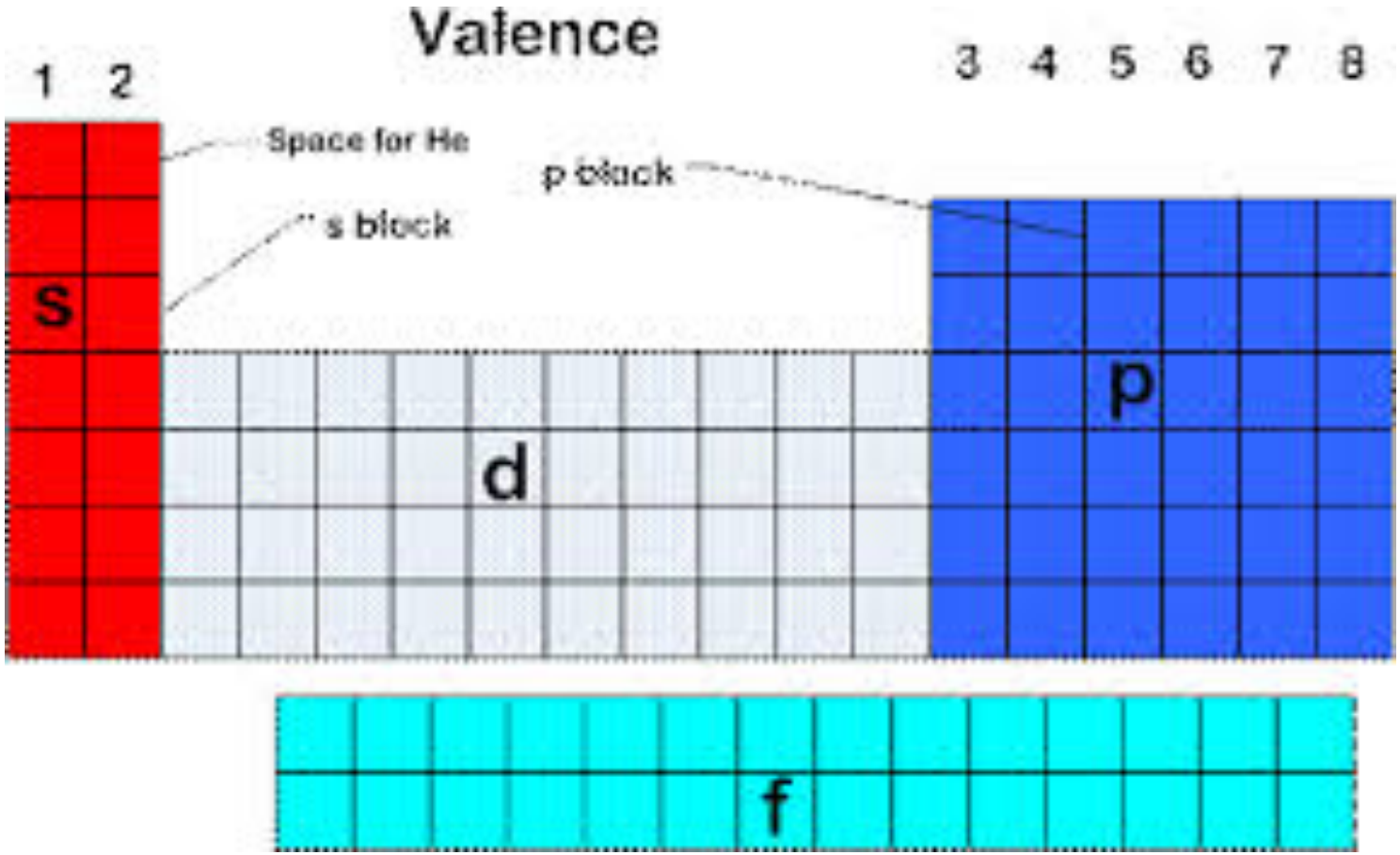
- Valence electrons - electrons in the highest occupied energy level of an atom. They determine how an atom reacts with other atoms- **reactivity.**
  - Atoms with PARTLY filled energy levels tend to react with other atoms, filling their highest energy levels



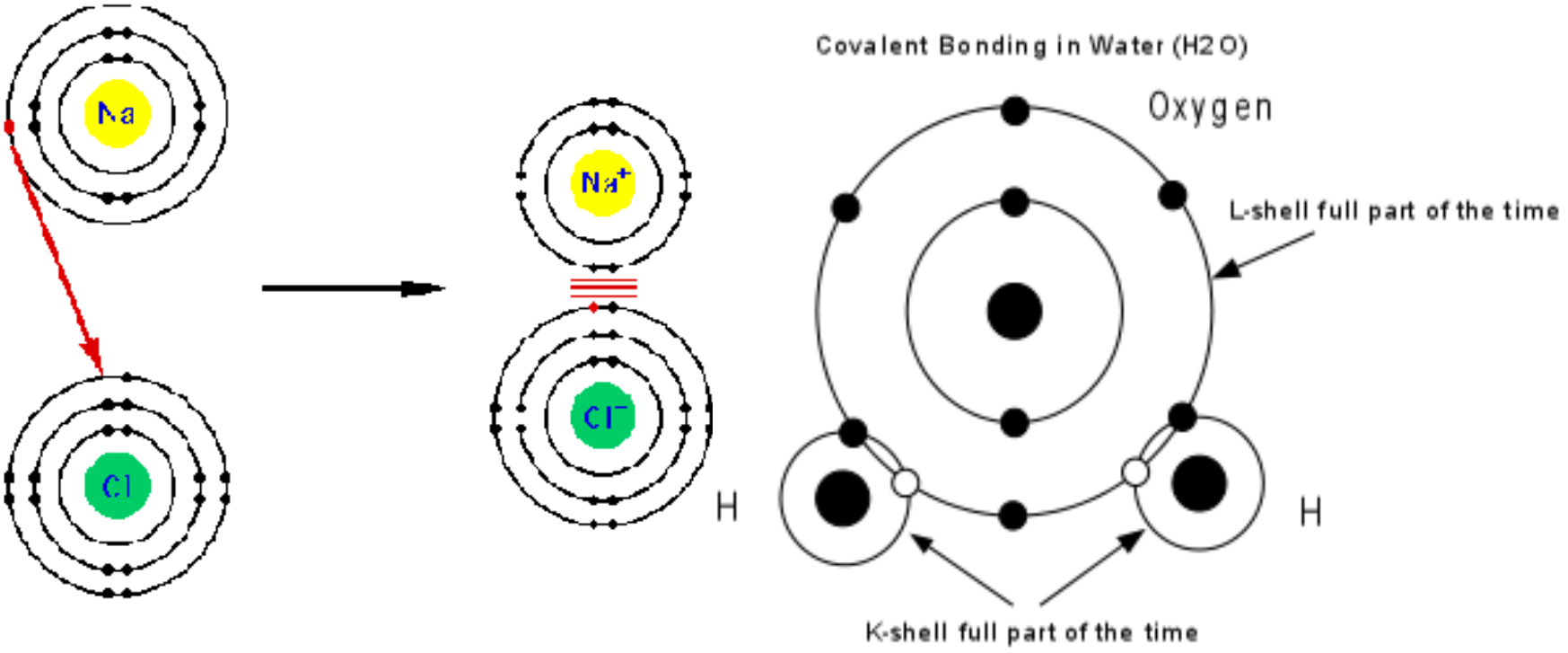




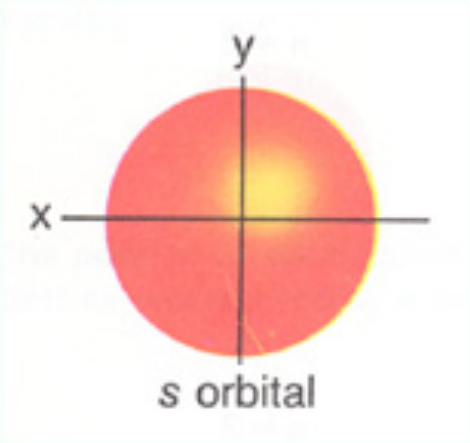
Valence Electrons – Periodic Table



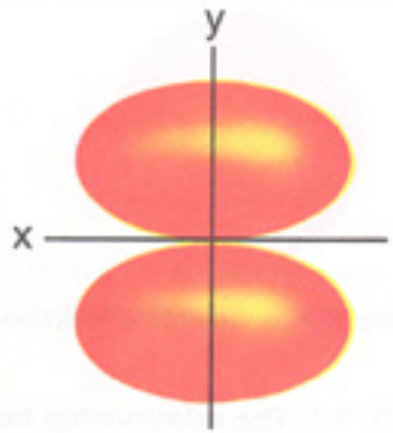
Energy Levels and Reactivity



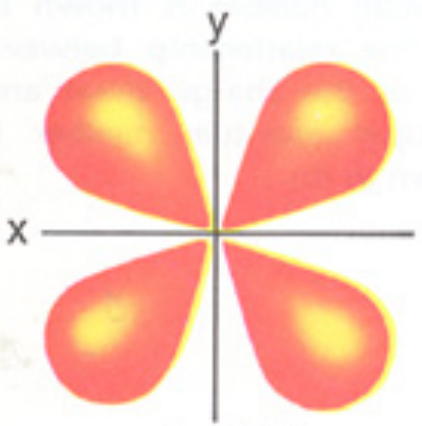
Orbitals



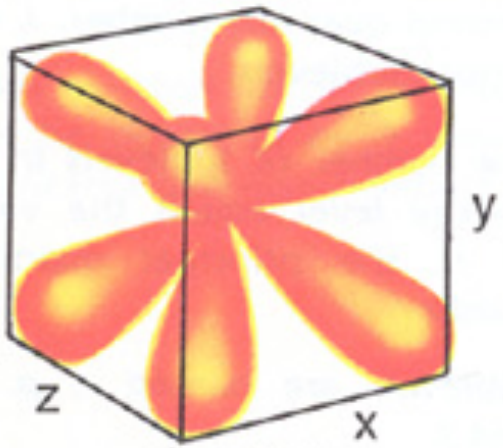
s orbital



p orbital

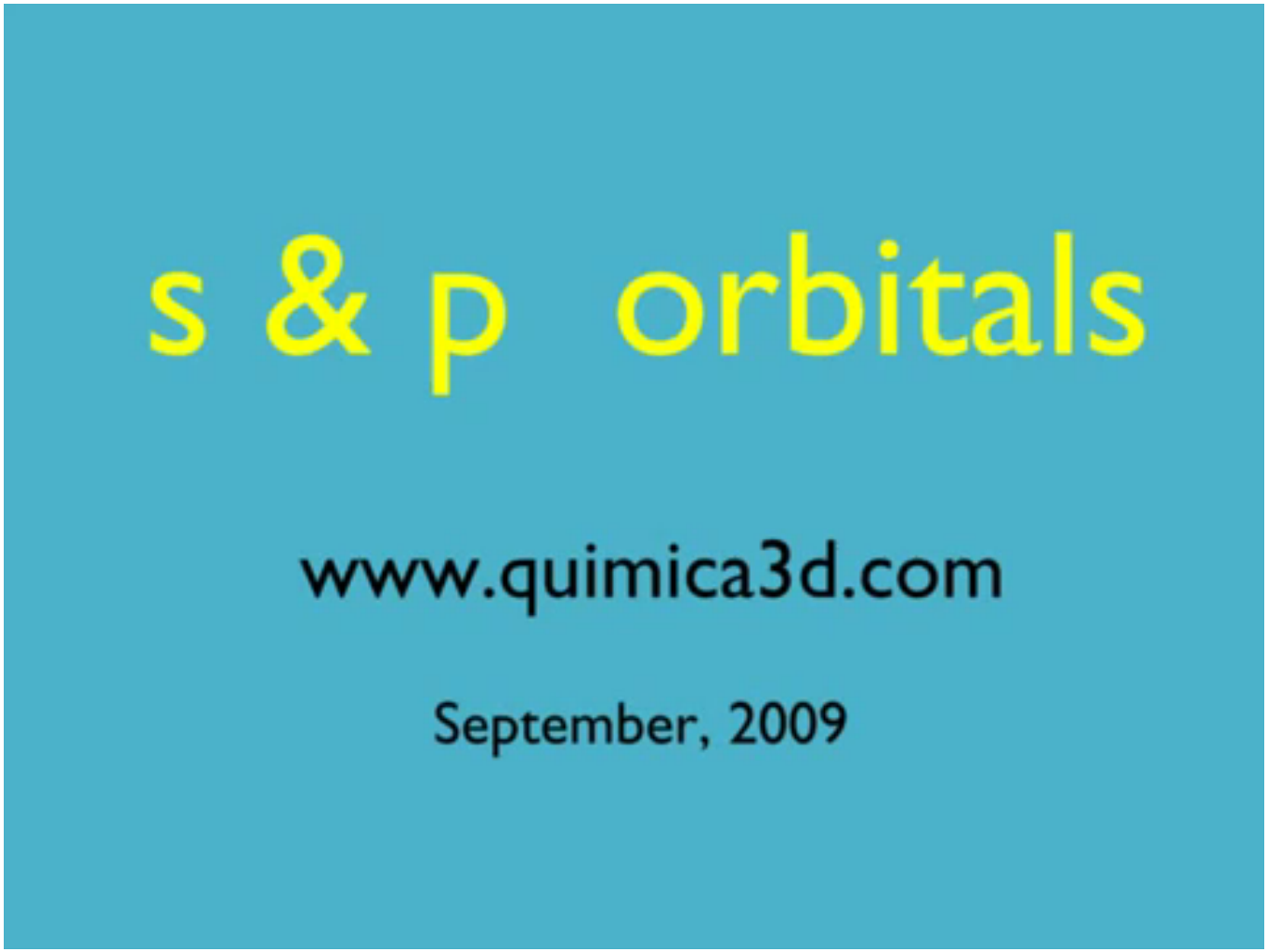


d orbital



f orbital

ORBITALS



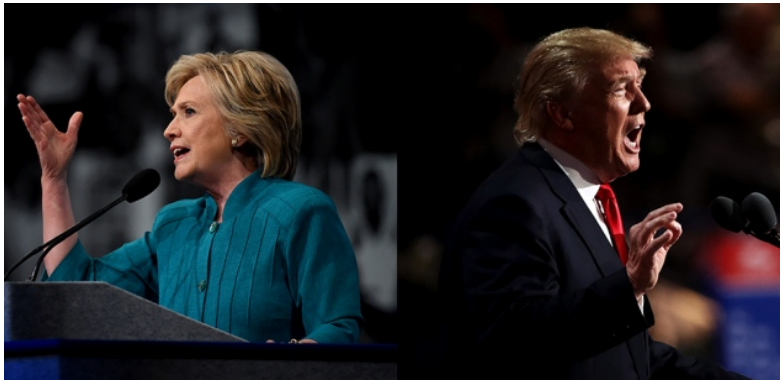
Dynamic Periodic Table

- http://www.ptable.com

Warm-up 9/26

- #12 What is a valence electron?
- #13 What do valence electrons reveal about an element?
- #14 How many valence electrons do each of the following elements have?
  - Be
  - Si
  - Cl
    - Hint: use your periodic table from Friday. Practice identifying how many protons and neutrons each has as well.

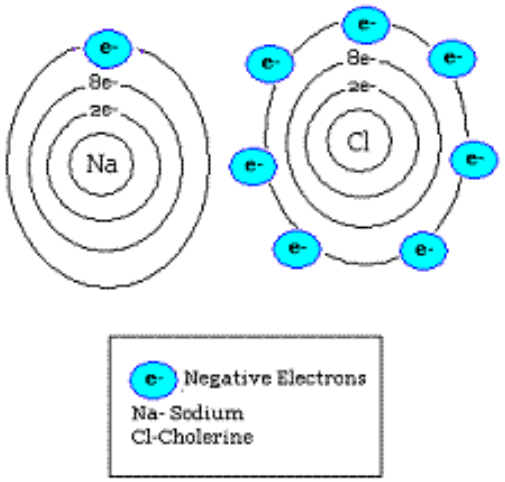
Debate Tonight!



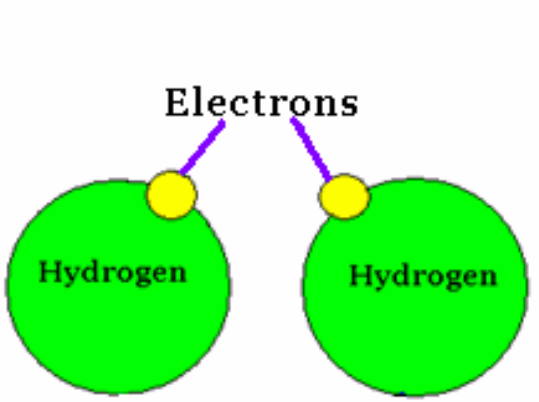
	Donald Trump	Hillary Clinton
Vaccines		✓
Climate Change		✓
Energy	✓	✓
GMOs		
NASA/Space	✓	✓
Evidence-Based Medicine		
Biomedical Research		✓

Chemical Bonds Join Atoms to One Another

- When atoms share or transfer electrons, an attraction, or **chemical bond**, forms that hold the atoms together.
  - 2 types of bonds:



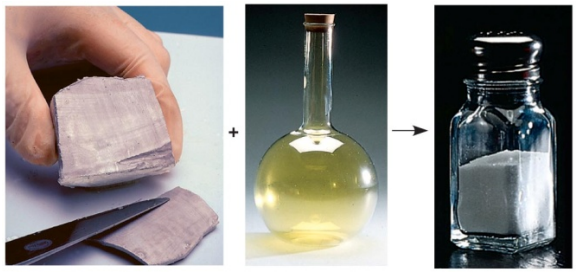
Covalent

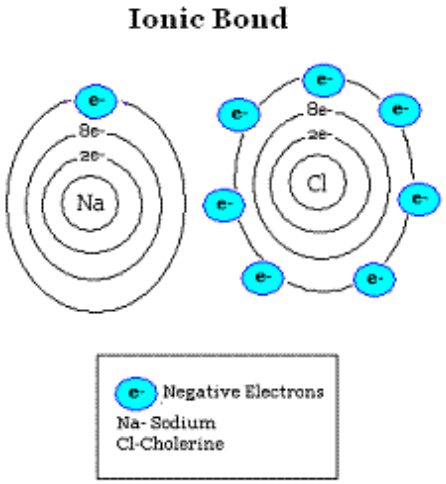


Ted Ed – How atoms bond.

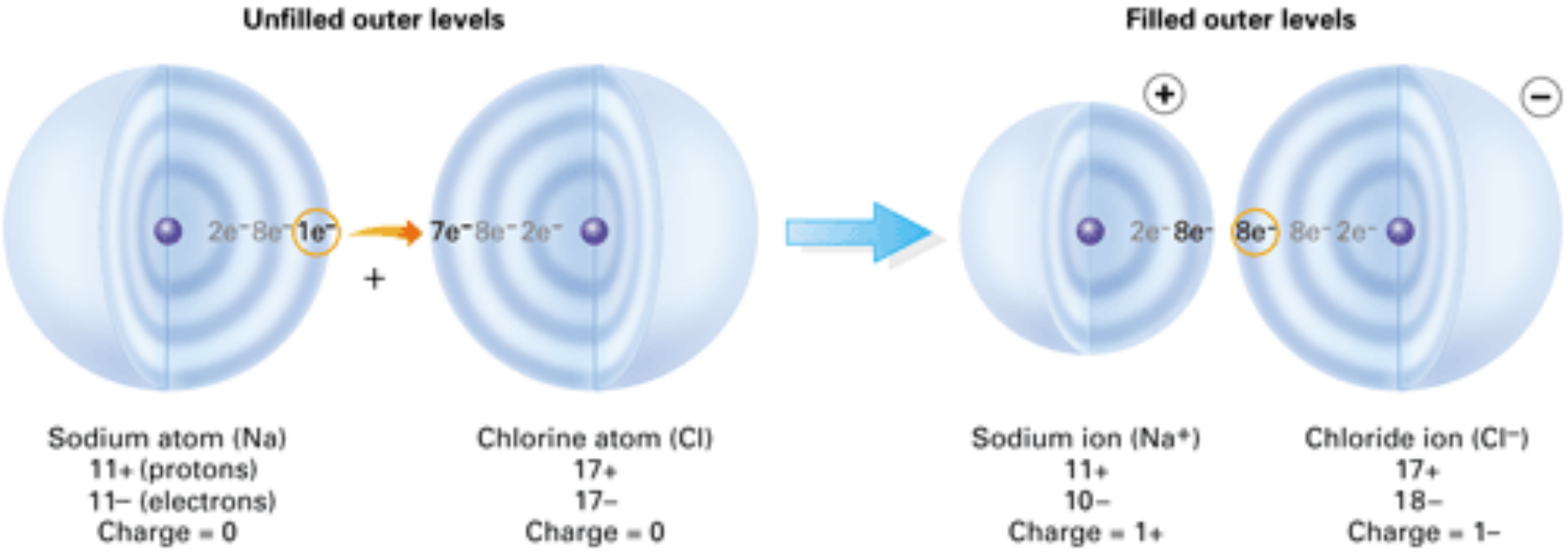
Ionic Bonds

- **1. Ionic bond**: chemical bond, occurs when an atom *transfers* an electron to another atom
  - The 2 atoms are now electrically charged and called **ions**.
  - The attraction between 2 oppositely charged ions hold the 2 ions together in an ionic bond (like magnets).



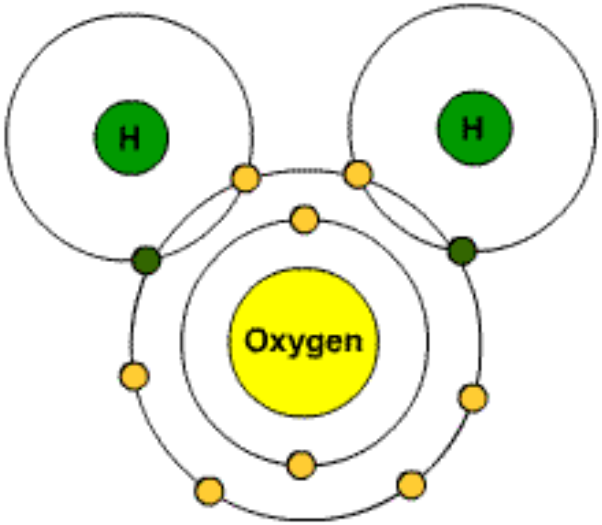


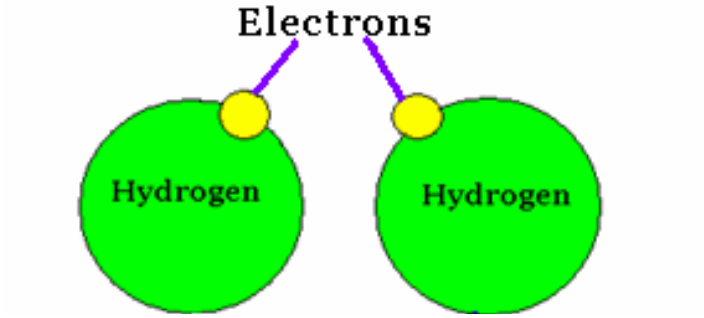
Ionic Bonds

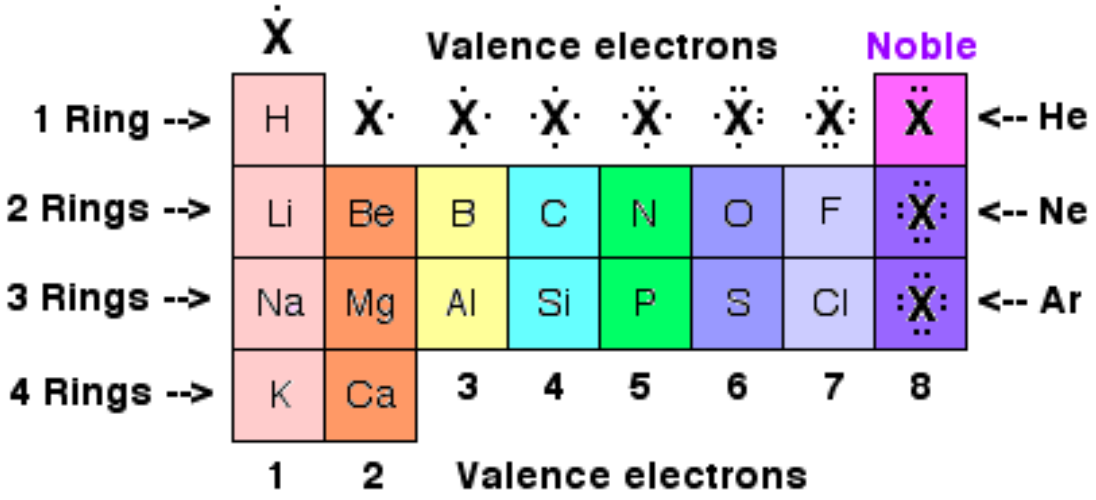

Unfilled outer levels
Filled outer levels
2e⁻ 8e⁻ 1e⁻
+
7e⁻ 8e⁻ 2e⁻
2e⁻ 8e⁻
8e⁻ 8e⁻ 2e⁻
Sodium atom (Na)
11+ (protons)
11– (electrons)
Charge = 0
Chlorine atom (Cl)
17+
17–
Charge = 0
Sodium ion (Na⁺)
11+
10–
Charge = 1+
Chloride ion (Cl⁻)
17+
18–
Charge = 1–

Covalent Bonds

- **2. Covalent bond**: forms when 2 atoms *share* electrons
  - The # of covalent bonds an atom can form usually equals the # of electrons needed to fill its highest occupied energy level



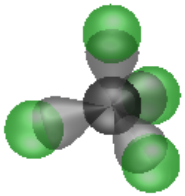




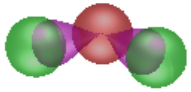
Molecule

- Molecule - 2 or more atoms held together by covalent bonds form a **molecule.**

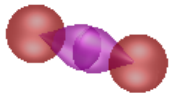
Methane, CH_4



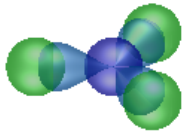
Water, H_2O



Oxygen, O_2



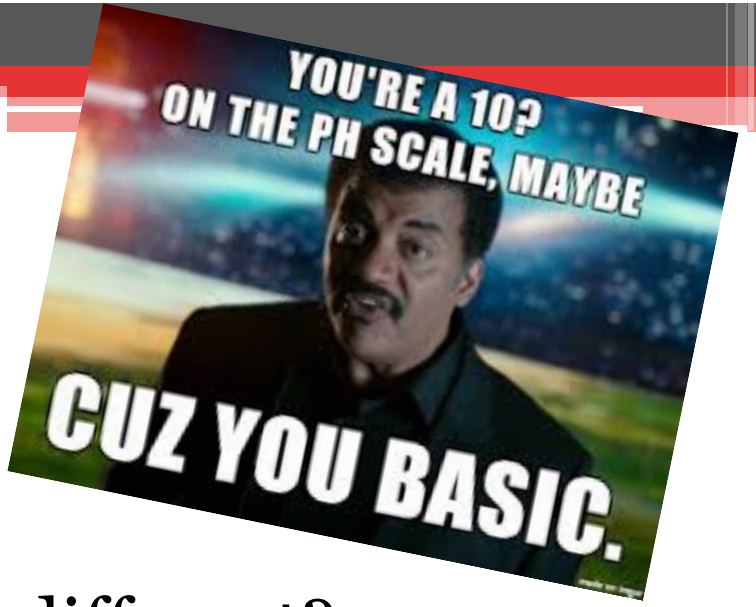
Ammonia, NH_3



Warm-up 9/27

- 15. How are ionic and covalent bonds different?

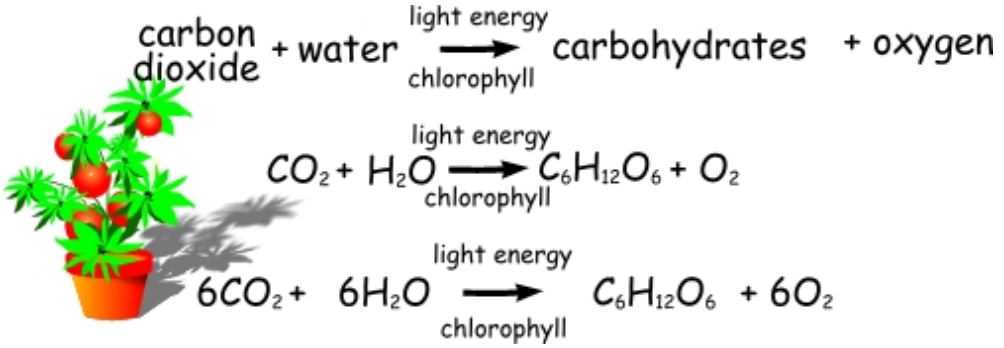
Warm-up 9/29



- 16. How are acids and bases different?
- 17. What does the pH scale measure?
- 18. Label the pH scale with the highest, lowest, and neutral pH. Indicate where acids and bases are on the scale.

Chemical Reaction

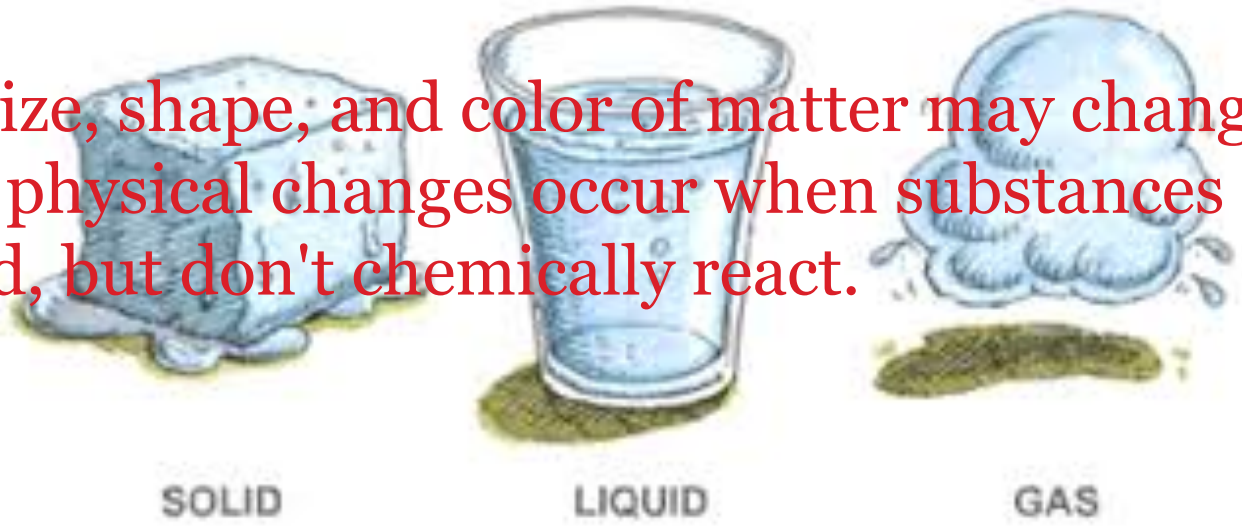
- A **chemical reaction** occurs when chemical bonds break and new bonds form.
  - Produces 1 or more new substances
  - Chemical equation shows the starting material for the reaction, or **reactants**, and the ending materials or **products**



Ted Ed – Chemical Reaction

Physical Changes

- Physical changes involve states of matter and energy.
- No new substance is created during a **physical change**, although the matter takes a different form.
  - The size, shape, and color of matter may change. Also, physical changes occur when substances are mixed, but don't chemically react.

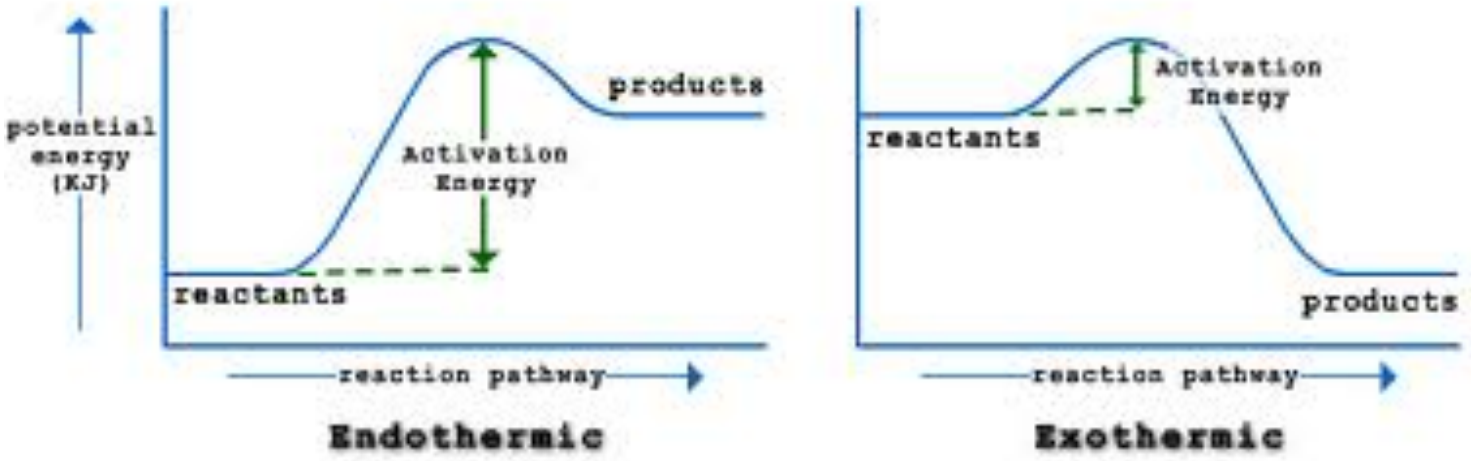


Chemical Changes

- **Chemical changes** involve chemical reactions and the creation of new products.
- Typically, a chemical change is irreversible.

Endothermic vs Exothermic

- **Exothermic** – chemical reaction releases more energy than it absorbs
- **Endothermic** – chemical reaction that absorbs more energy than it releases



Aqueous Solution

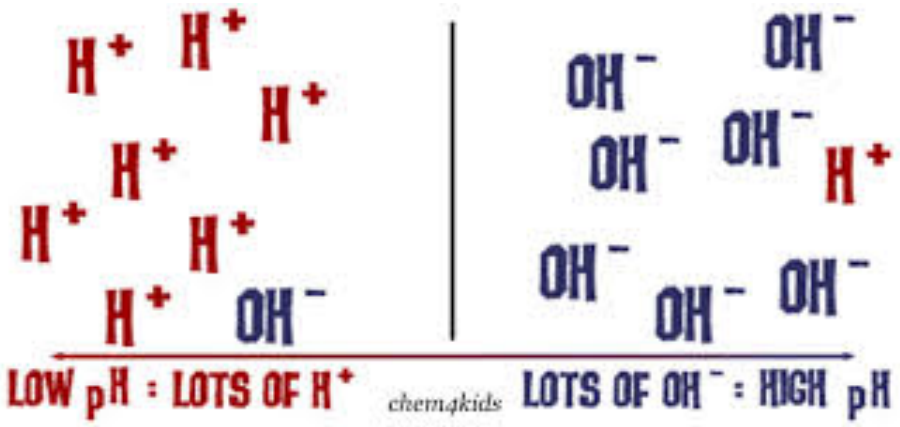
- A **solution** is a mixture of substances that is the same throughout (homogenous).
  - **Solvent** – substance present in greater amount, dissolves another substance
  - **Solute** – substance that dissolves in solvent
  - **Aqueous solution** – solvent is water

pH Scale

- A solutions acidity or H^+ ion concentration is measured by the **pH scale.**
  - 0-6.9 = acidic
  - 7 = neutral
  - 7.1-14 = basic/alkaline

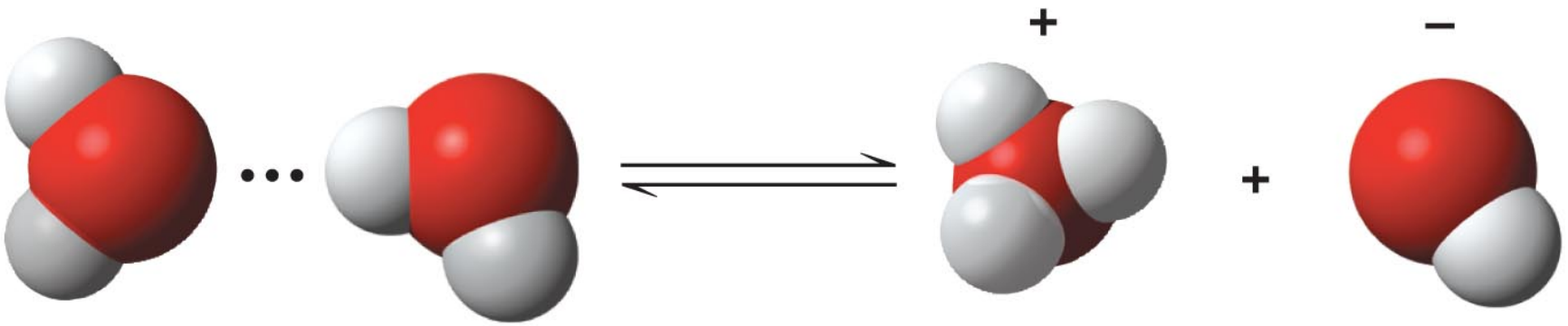
Acid vs. Base

- **Acid** – a compound that releases a proton – Hydrogen ion (H^+) when it dissolves in water
  - More H^+ or H_3O^+
- **Base** – compounds that remove H^+ from a solution.
  - More OH^-



Acids and Bases

- In some aqueous solutions the solute (substance that is dissolved) breaks into ions.
  - A compound that adds hydrogen ions (H+) to a solution is an **acid**
  - A compound that removes H+ ions from a solution is a **base**

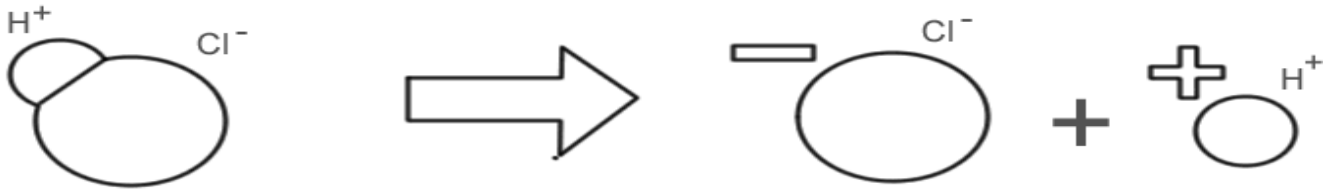


$$H_2O \rightarrow H^+ + OH^-$$

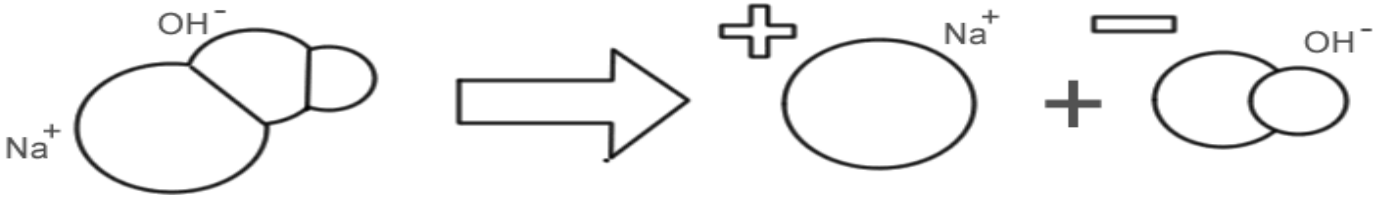
ACIDS & BASES

Chlorine (green)
Sodium (blue)

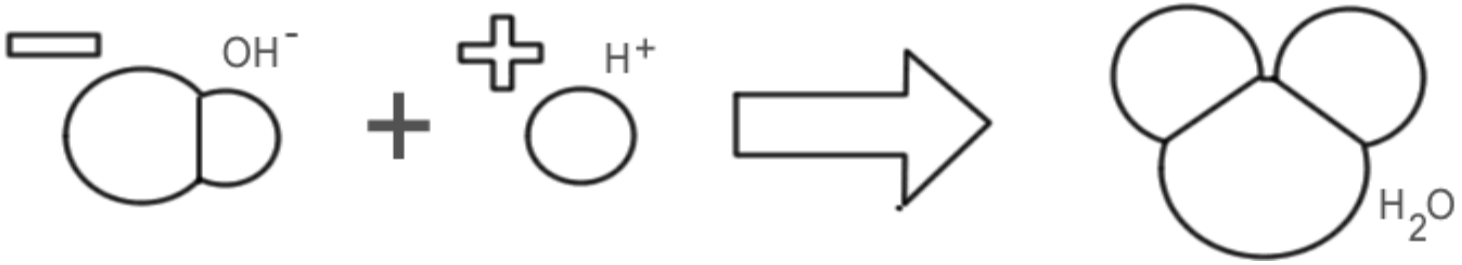
Hydrochloric Acid



Sodium Hydroxide



NEUTRALIZATION



pH Scale

- The **pH scale** describes how acidic or basic a solution is.
  - Many cells are sensitive to slight changes in pH
- Many biological fluids contain **buffers**, substances that resist changes in pH

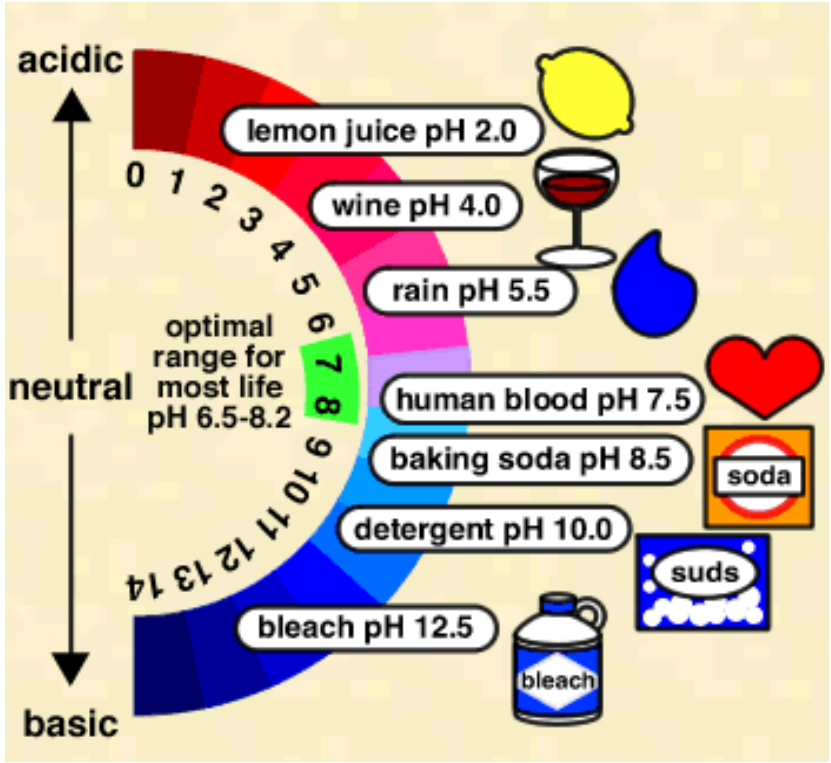
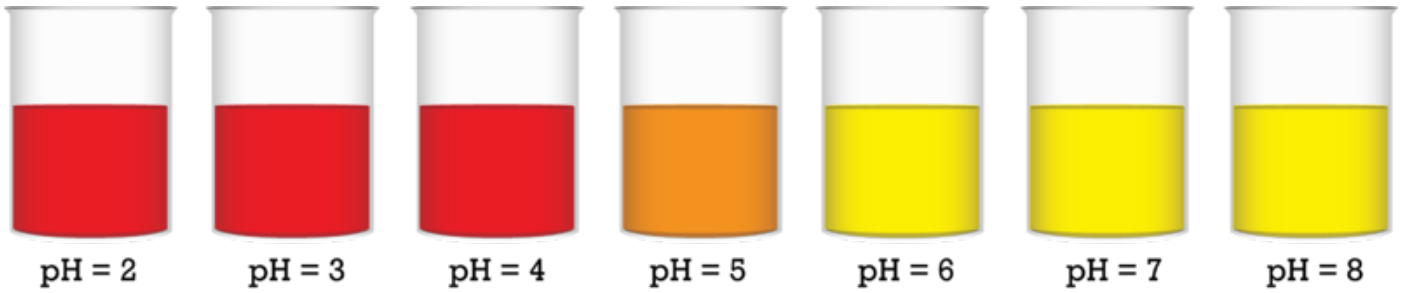


Fig. 3-10

pH Indicators

- Phenol red – indicates a change in pH
  - Hint: if it stays pink…the same color it was when added, it is a _____ change.



Sunset in a Bag Lab

- Materials:
  - Graduated cylinder
  - Plastic bag
  - Warm water
  - Phenol red solution
  - Calcium chloride - Damp rid
  - Sodium Bicarbonate - Baking soda

Key Terms

- Chemical Reaction – occurs when chemical bonds break and new ones form
  - Forms a new substance
  - $CaCl_2 + 2\ NaHCO_3 \rightarrow CaCO_3 + 2NaCl + H_2O + CO_2$
  - calcium chloride (Damprid) | sodium bicarbonate (baking soda) | calcium carbonate (chalk) | sodium chloride (salt) | water | carbon dioxide
- Exothermic Reaction – chemical reaction that releases heat
- Endothermic Reaction – chemical reaction that absorbs heat

- NOTE: We are performing this lab under aqueous conditions (in water).
  - Phenol red is a pH indicator.
  - It changes colors when changing from acidic to basic conditions.

Procedure

- 1. Add 20 ml of warm water to the plastic bag
- 2. Add a teaspoon of calcium chloride (Damp rid) to the water, and seal the bag.
- 3. Slosh the contents to mix the solution.
- 4 RECORD your observations
- 5. Add 5 ml of phenol red solution to the same bag, and seal the bag.
- 6. Slosh the contents to mix the solution.
- 7. RECORD your observations.
- 8. Open the bag and QUICKLY add a teaspoon of baking soda, and RESEAL the bag.
- 9. Slosh the contents to mix the solution.
- 10. RECORD your observations.

- NOTE: We are performing this lab under aqueous conditions (in water).
  - Phenol red is a pH indicator. It changes colors when changing from acidic to basic conditions.

Analysis and Conclusions – Copy and fill in the table below.

	Observations	Physical Change? (if yes, then how do you know?)	Chemical Change? (if yes, then how do you know?)
Calcium Chloride (Damp Rid) and Water			
Calcium Chloride (Damp Rid) and Water +phenol red			
Calcium Chloride (Damp Rid) and Water +phenol red +baking soda			

Bellwork: Analysis and Conclusions

- Pull out your data table from yesterday. Copy down the questions below if you have not already done so.
- Analysis and Conclusion Questions:
  - 1. Using what you learned in today's lab (including endothermic/exothermic reactions), try to explain how "snap" hot and cold packs work.
  - 2. Identify the reactants and the products of the chemical reaction that took place.

Warm-up 9/30

- #19. Explain the difference between an endothermic and exothermic reaction.
- #20. List two examples of observations made in the Sunset in a Bag lab, that would imply that a chemical change had taken place.

Homework

- Read Section 2.4
- QuizEgg 2.4 is due by Tuesday night, 10/4.

Homework Reminders

- QuizEgg 2.4 Due TONIGHT!
- Kahoot! Quiz Tomorrow:
  - pH simulation
  - Ionic and Covalent Bonding

Ionic vs. Covalent Bonding

Ionic and Covalent Bonding Practice

Warm-up 9/28

- Show how the following elements would form an ionic bond.
  -
  - Mg + Br
  - Pb + S

Warm-up 9/28

- #21 Show how the following elements would form a covalent bond.
  - Si + O
  - O + O

Homework – Bonding Practice Due Tomorrow

- Covalent Bonds:
  - 1. F + F

- Ionic Bonds:
  - 2. Al + Br

  - Please also read section 2.3 – QuizEgg will be assigned Tomorrow…QuizEgg will be due Wednesday night!

Super Blood Moon Last Night

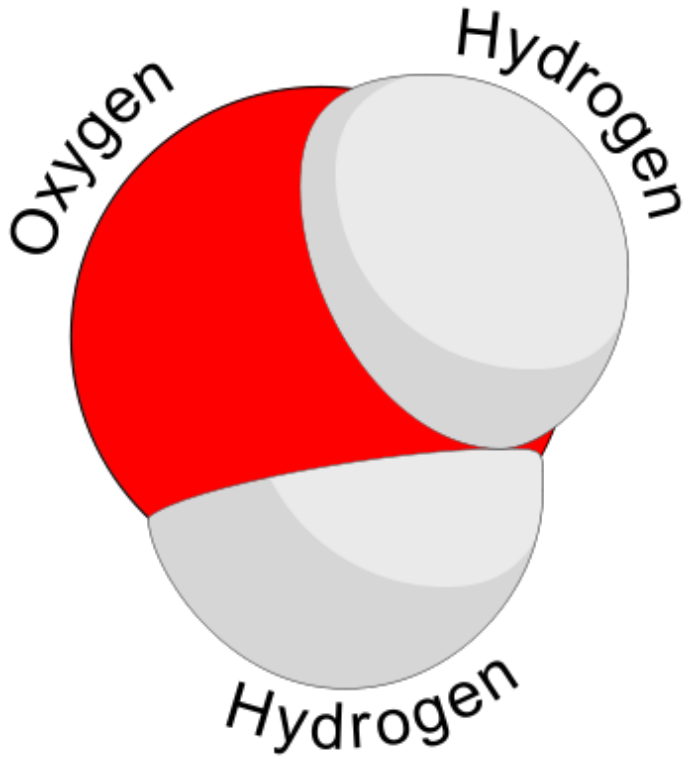
How do we measure water on the moon?

Water on Mars?

Life on Mars?

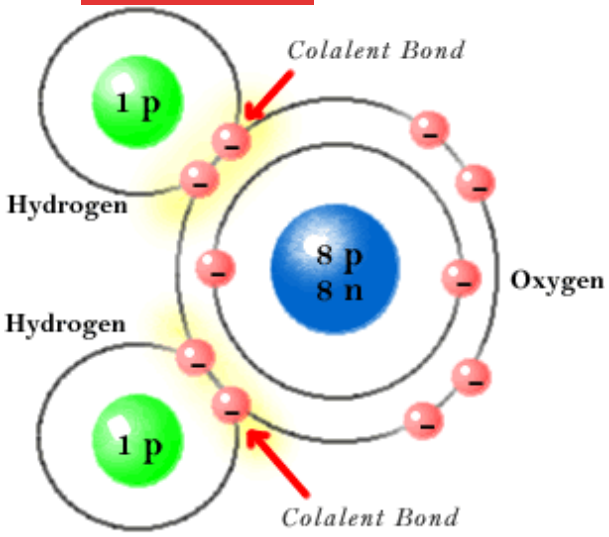
Properties of Water and Life

- The water molecule is made up of 2 H atoms joined to one O by a single covalent bond

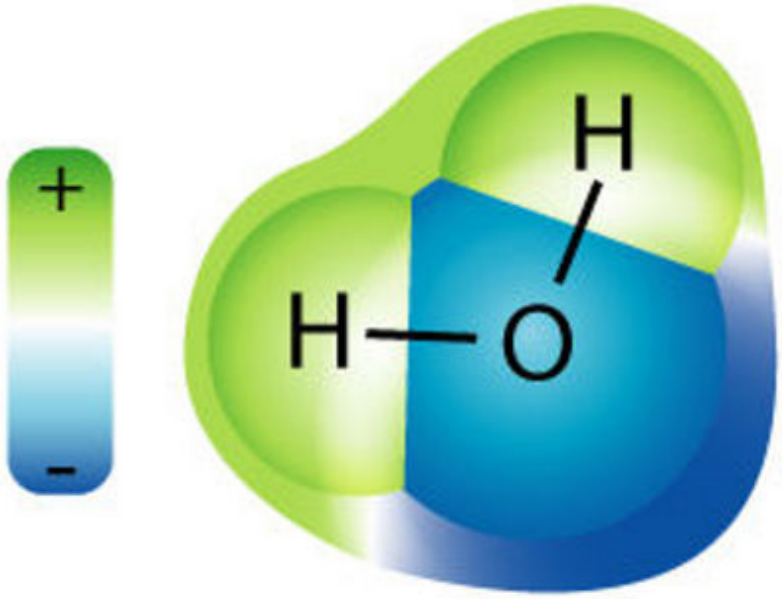


Water is a **polar molecule**

- O pulls electrons much more strongly than H
  - Makes O slightly (-), H slightly (+)
  - Opposite ends of the molecule have opposite charges

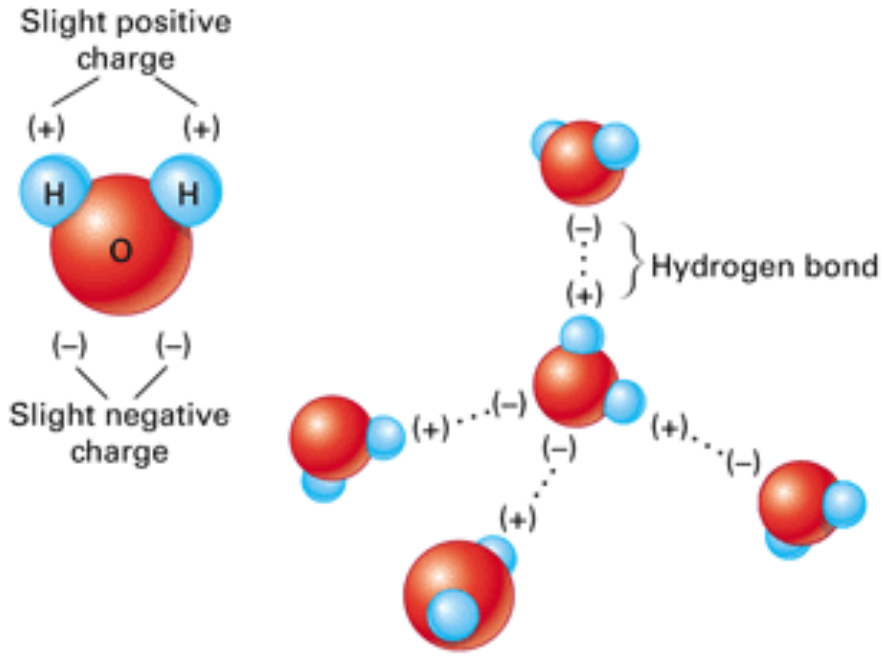


Bohr Model of H_2O



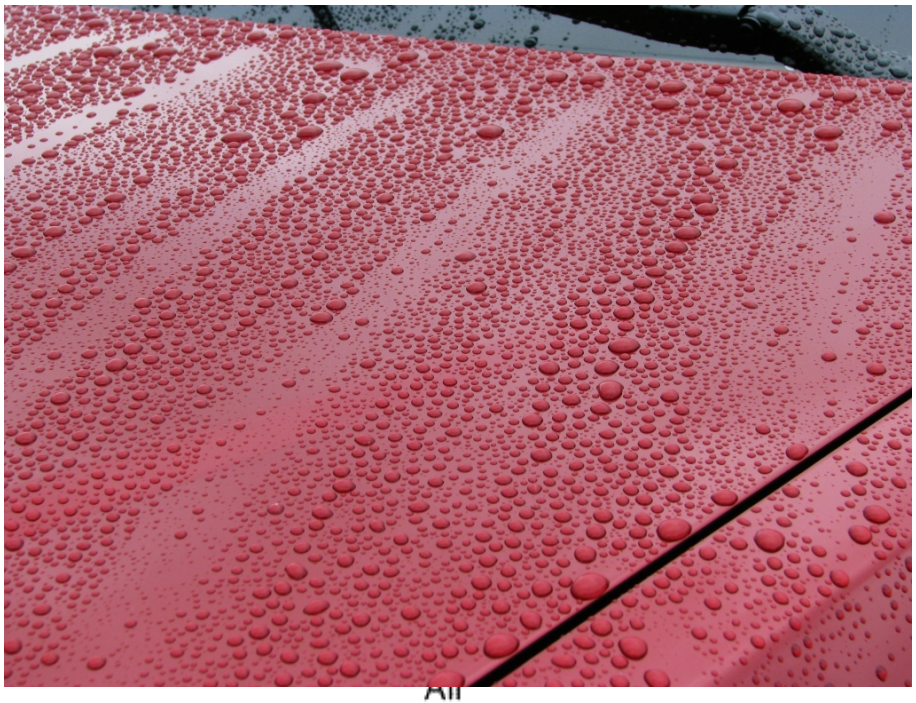
Hydrogen Bonds

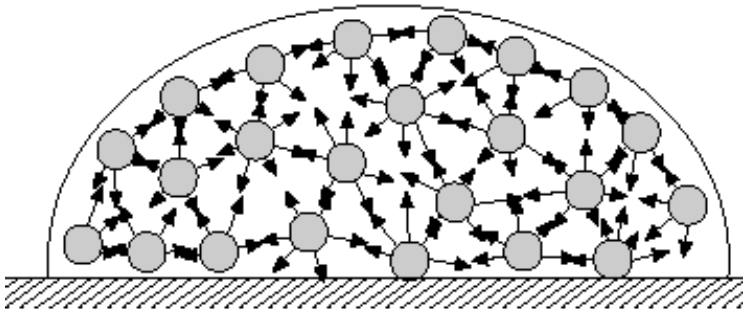
- Being polar, water molecules have a weak attraction to each other, forming *hydrogen bonds*.
  - **Hydrogen bond**: Chemical bond between 2 molecules formed by the attraction of a slightly (+) H atom to a slightly (-) atom



Cohesion

- Water has MANY UNUSUAL PROPERTIES because of its polar nature and ability to hydrogen bond
  - 1. Cohesion: the tendency of molecules of the same kind to stick together
    - Water has strong cohesion
    - Ex. water bead

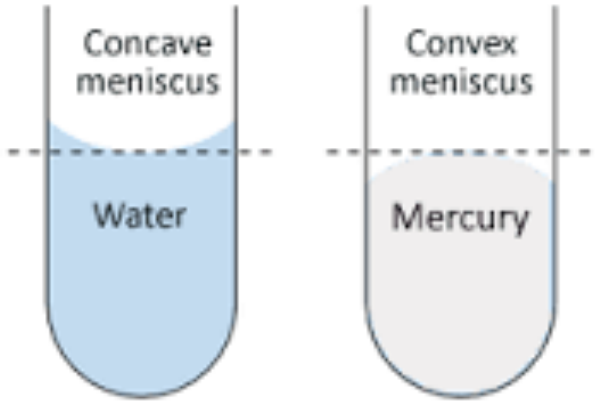


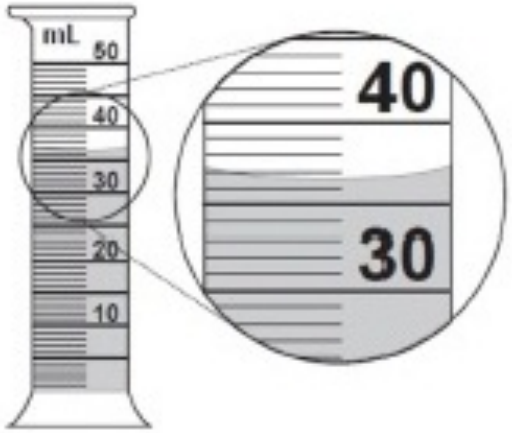


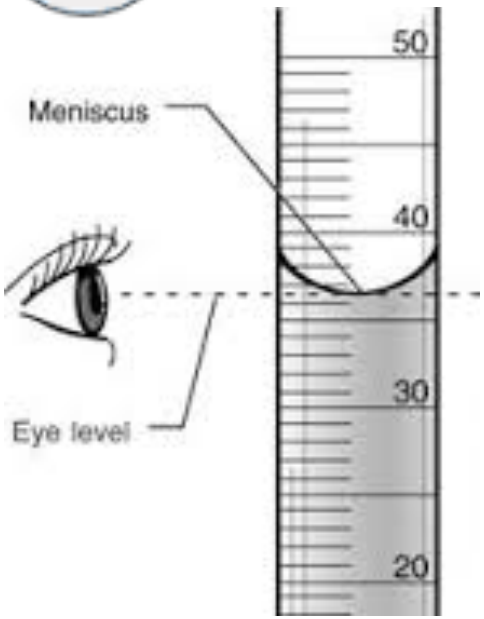
Molecules inside a water drop are attracted in all directions. Drops on the surface are attracted to the sides and inward.

Adhesion

- 2. Adhesion: molecules are attracted to OTHER molecules
  - Ex. Meniscus in a test tube

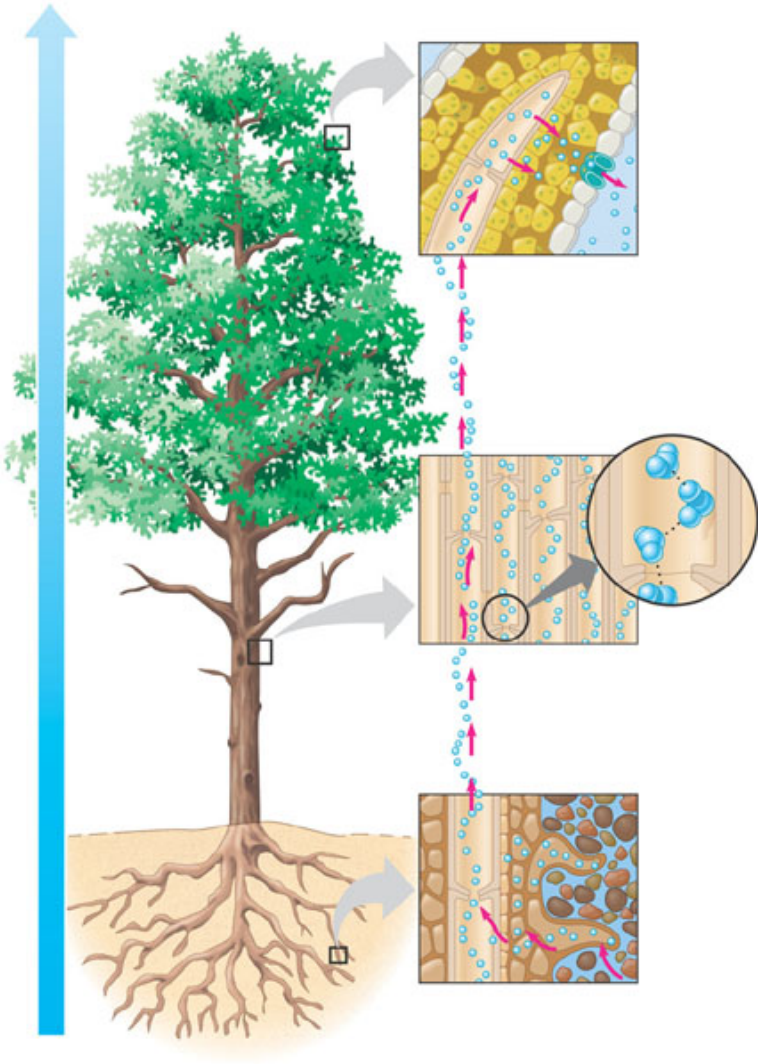






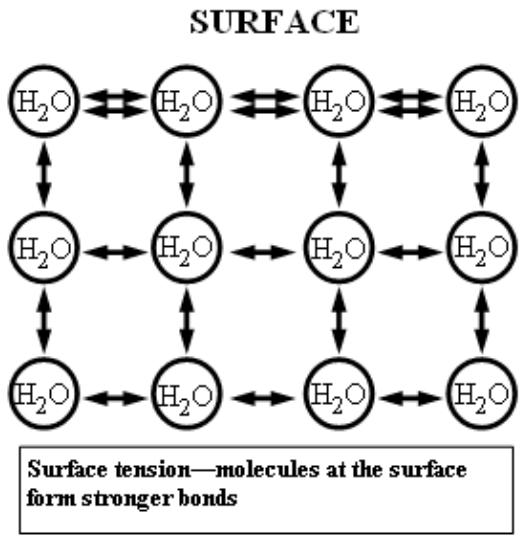
Cohesion and Adhesion Together

- Ex. Cohesion and adhesion help move water up from the roots of a plant.
  - Cohesion
    - H_2O molecules sticking to each other forming a rope that is pulled out as water vapor "exhaled" through the leaves.
  - Adhesion
    - Water molecules stick to the walls of the inside of the plant



3. Surface Tension

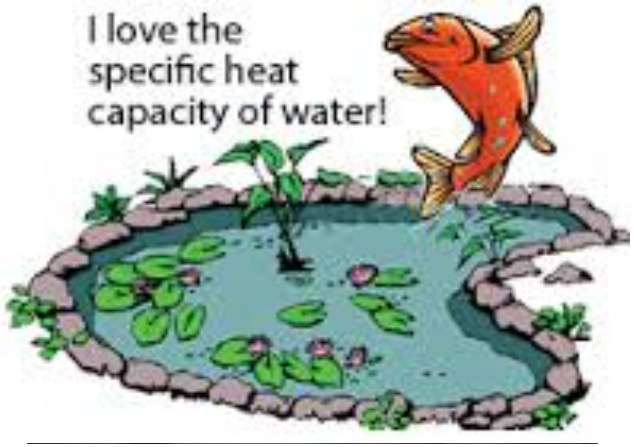
- Water has a HIGH surface tension.
- The bonds at the surface are stronger than those below the surface.
  - Example: Basilisk lizard



Surface tension—molecules at the surface form stronger bonds

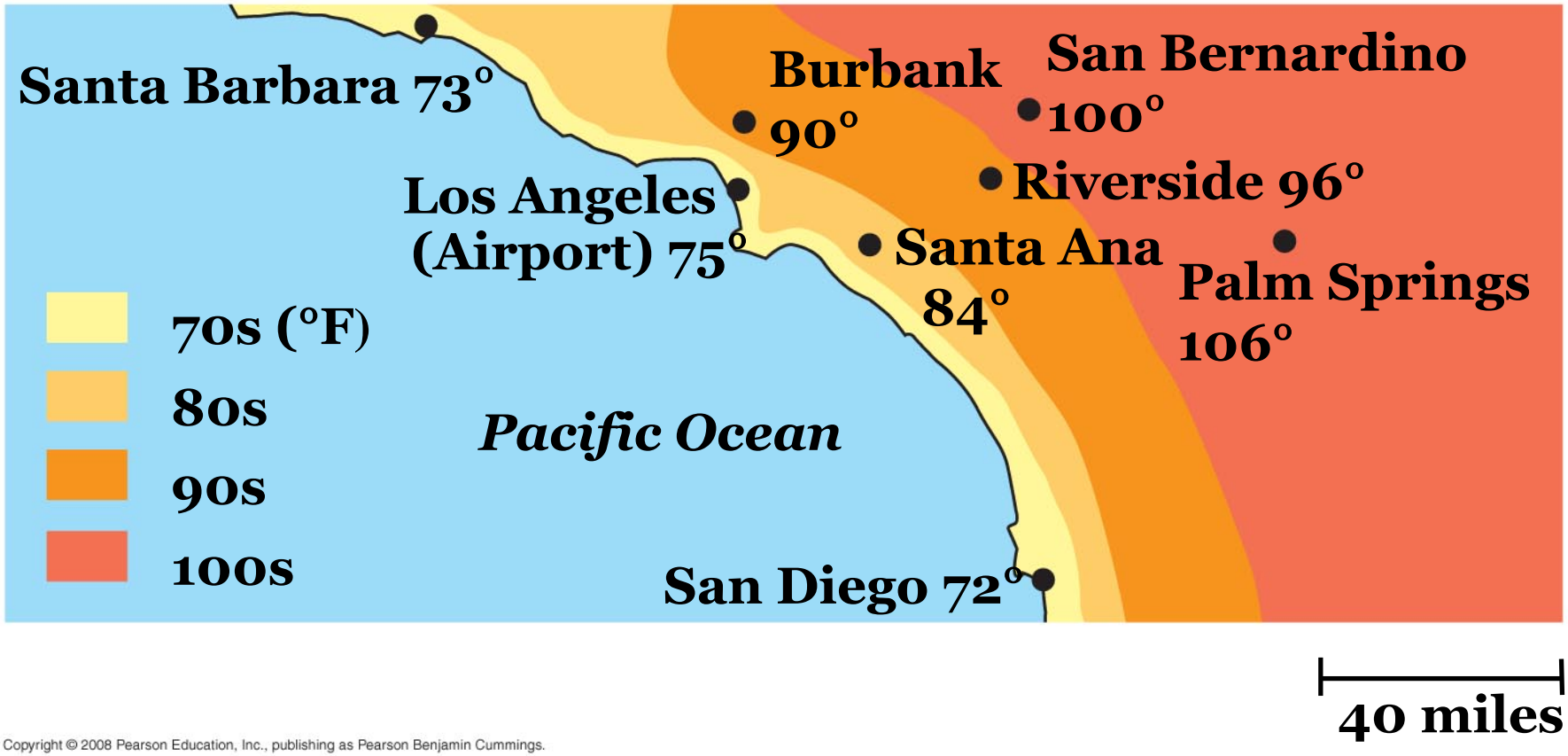
Specific Heat Capacity

- **4. Specific heat capacity -** the amount of heat required to raise the temperature of 1 gram of a substance by 1°C.
  - Water has HIGH specific heat capacity **(heat of vaporization)**
  - Helps the earth's temperature remain moderate since water traps heat during the day and releases it slowly at night.
    - As a result, the temperature on earth's surface does not vary very widely, ranging from extremes of 134°F to -129°F.
    - For comparison, the moon has no liquid water and its temperatures can range from 240°F to -290°F



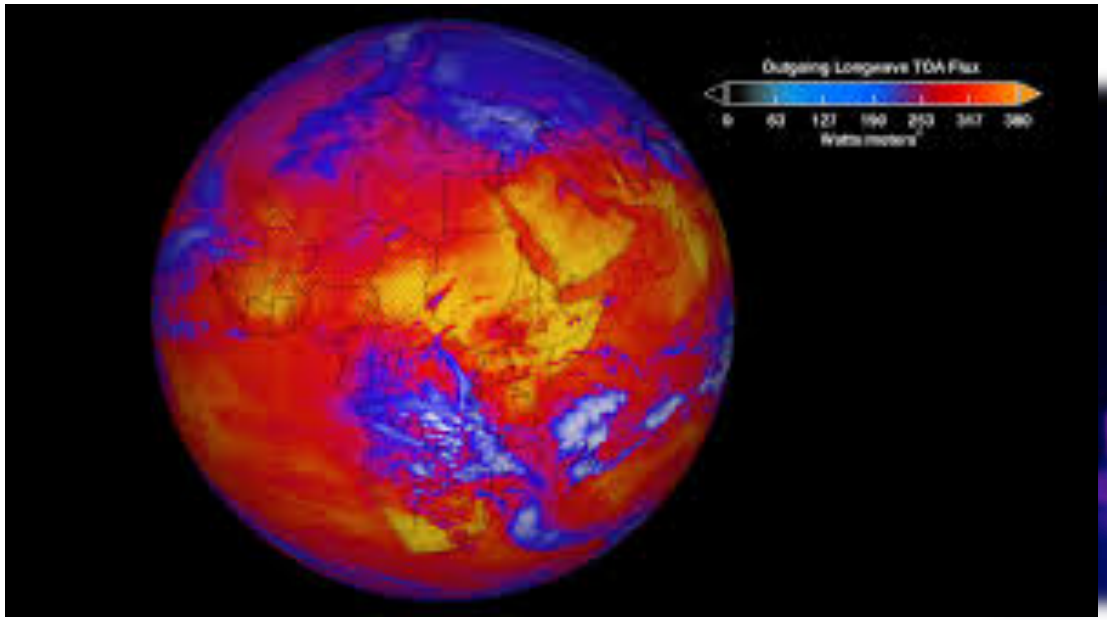
Specific Heats of Selected Materials	
Material	**C (J/kg·K)**
Aluminum	897
Concrete	850
Diamond	509
Glass	840
Helium	5193
Water	4181

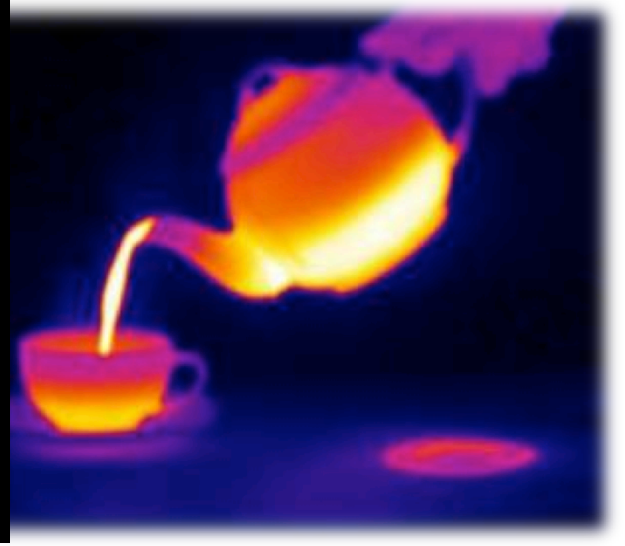
Fig. 3-5

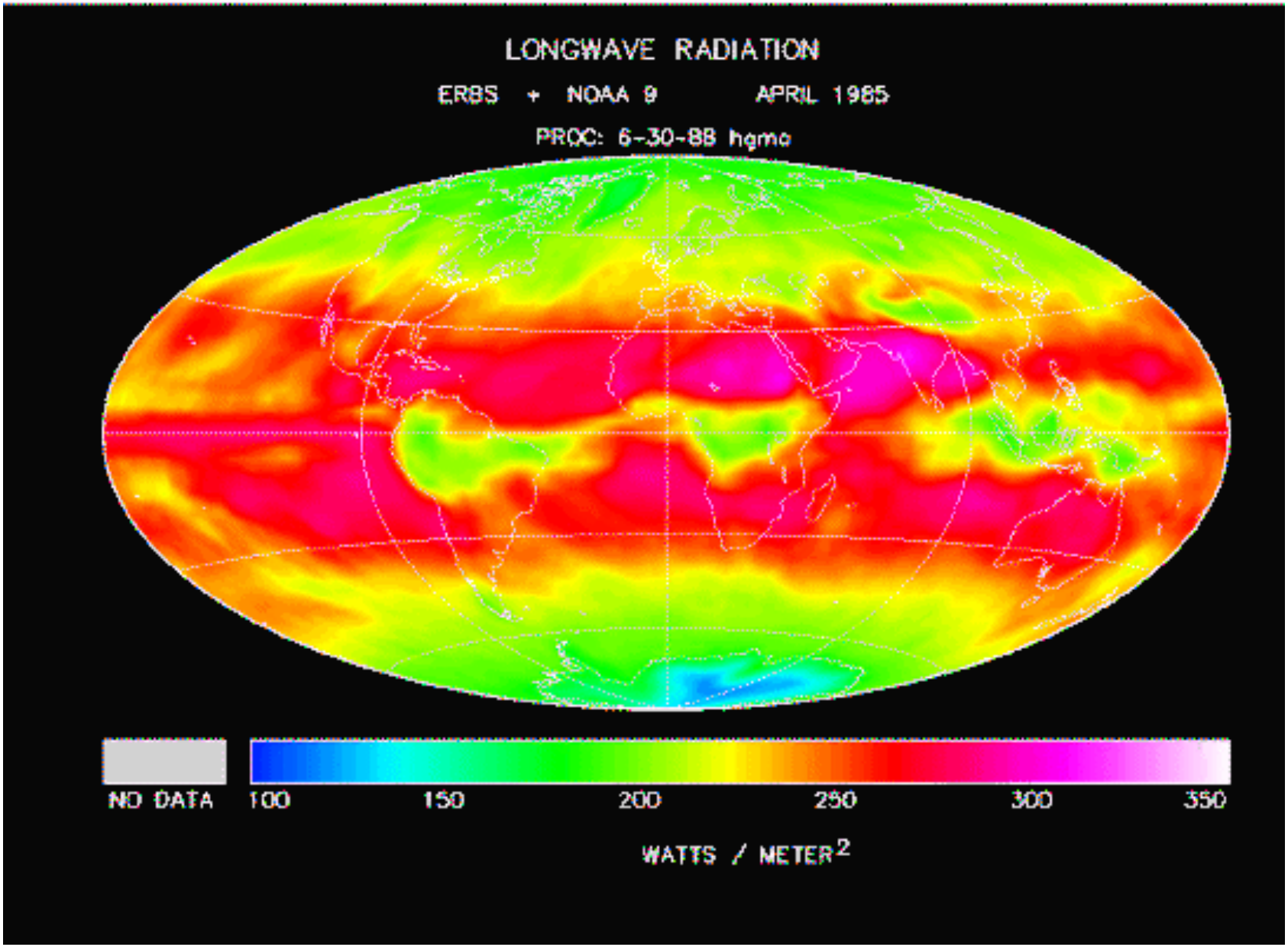


Thermal Energy

- Water can absorb more thermal energy without a large increase in temperature
  - **Thermal energy**: the energy of the motion of particles in a substance
  - **Temperature -** measure of the average thermal energy (particle motion) in a substance

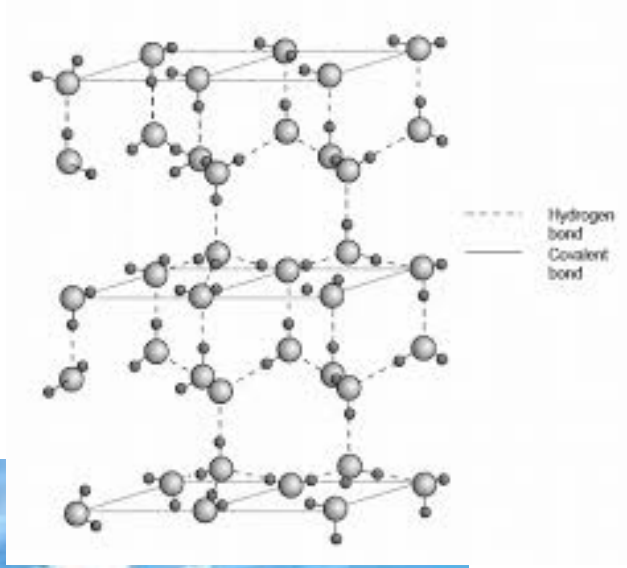


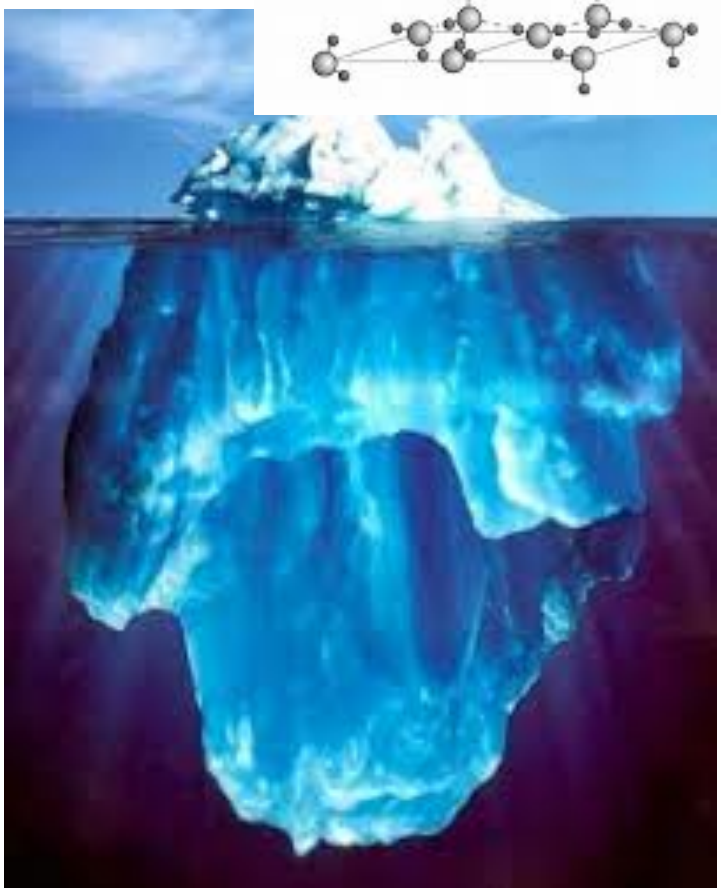



LONGWAVE RADIATION
ERBS + NOAA 9 APRIL 1985
PROC: 6-30-88 hgmo
NO DATA
100
150
200
250
300
350
WATTS / METER2

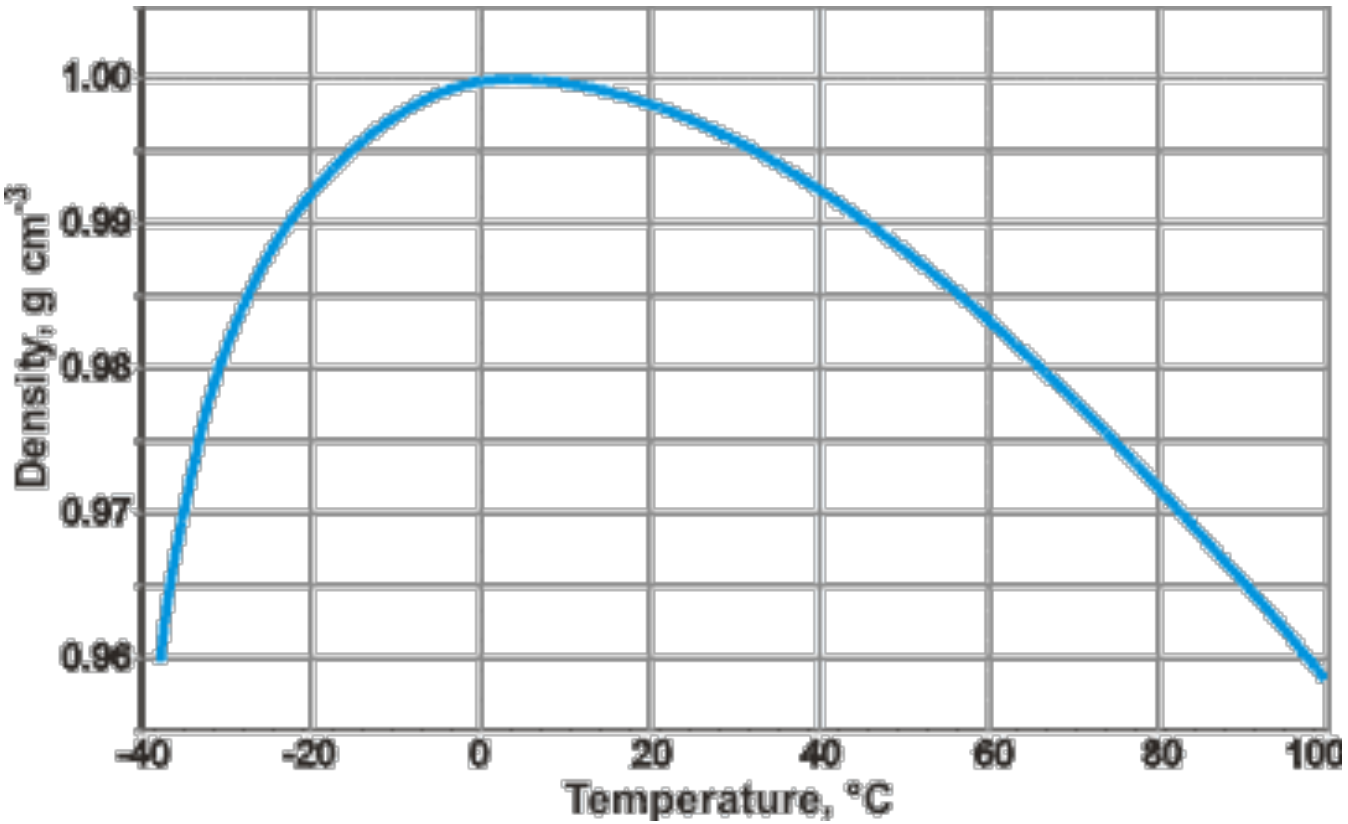
5. Density of Water

- Water's different states have different densities.
- Water molecules EXPAND when freezing,
  - Water crystallizes into an open hexagonal form. This hexagonal lattice contains more space than the liquid state.



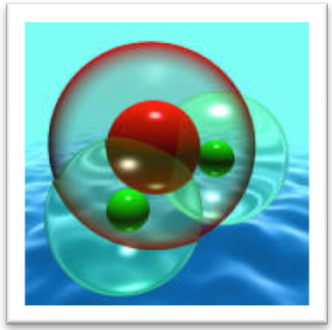


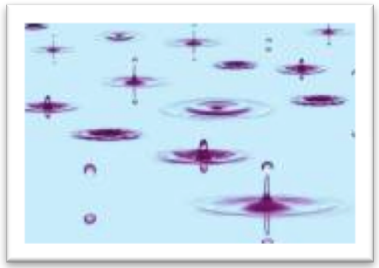
Density of Water



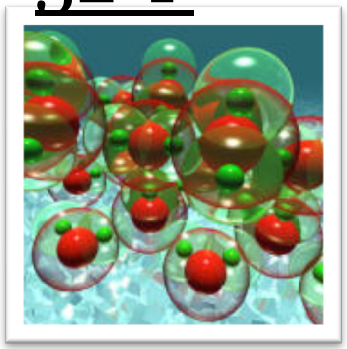
Phases of Water

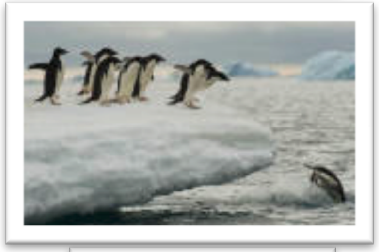
- Liquid: @room temperature



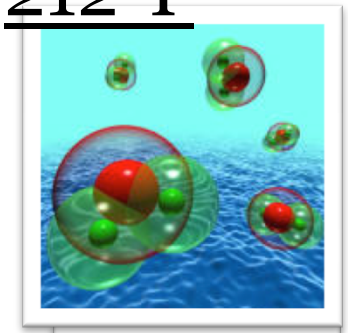


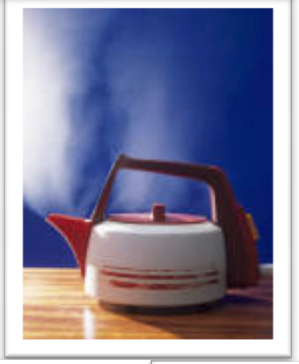
- Solid: 0°C, 32°F





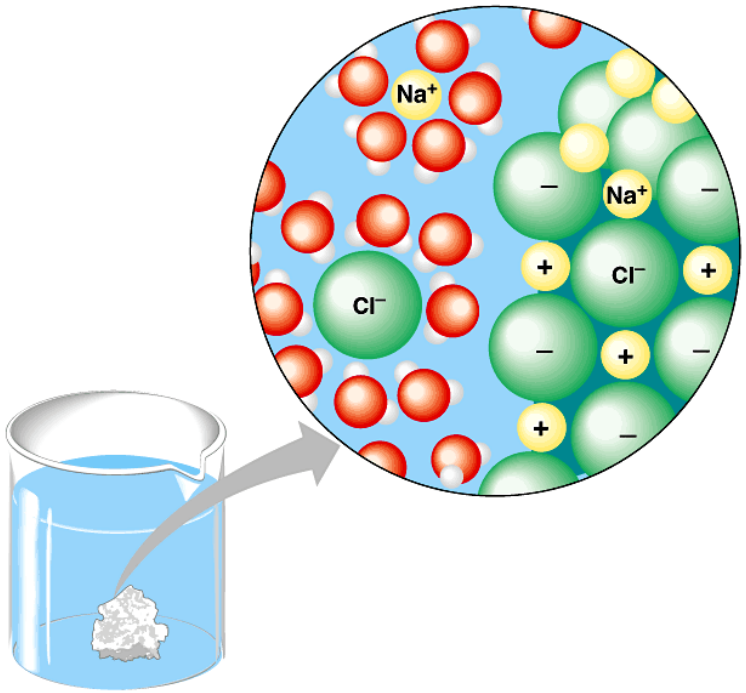
- Gas: 100° C, 212°F





6. Universal Solvent

- Water is an important **solvent (dissolves other substances)** forming many **solutions.**
  - Solvent: substance that dissolves other substances
- When water is the solvent, the solution is called an **aqueous solution**.



Review the Properties

The Properties of Water

Hydrophobic vs. Hydrophilic

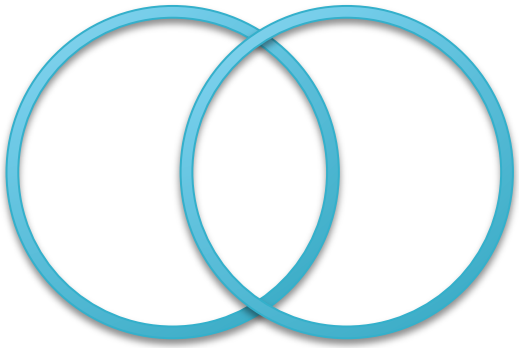
- Ions and molecules that interact with water are said to be **hydrophilic.**
- Non ionized and non-polar molecules that do not interact with water are said to be **hydrophobic**.

Warm-up 10/4

21. Explain why water is a polar molecule. Draw a picture of a water molecule showing its polarity.

Warm-up 10/5

- 22. Compare and contrast cohesion and adhesion using a Venn diagram?



- 23. List two additional properties of water and give examples for each.