



Do Now ...

Date: Monday, February 1, 2016

Obj: Write electron dot structures.

Complete:

How many **valence** electrons in the following?

H ___

Be ___

B ___

C ___

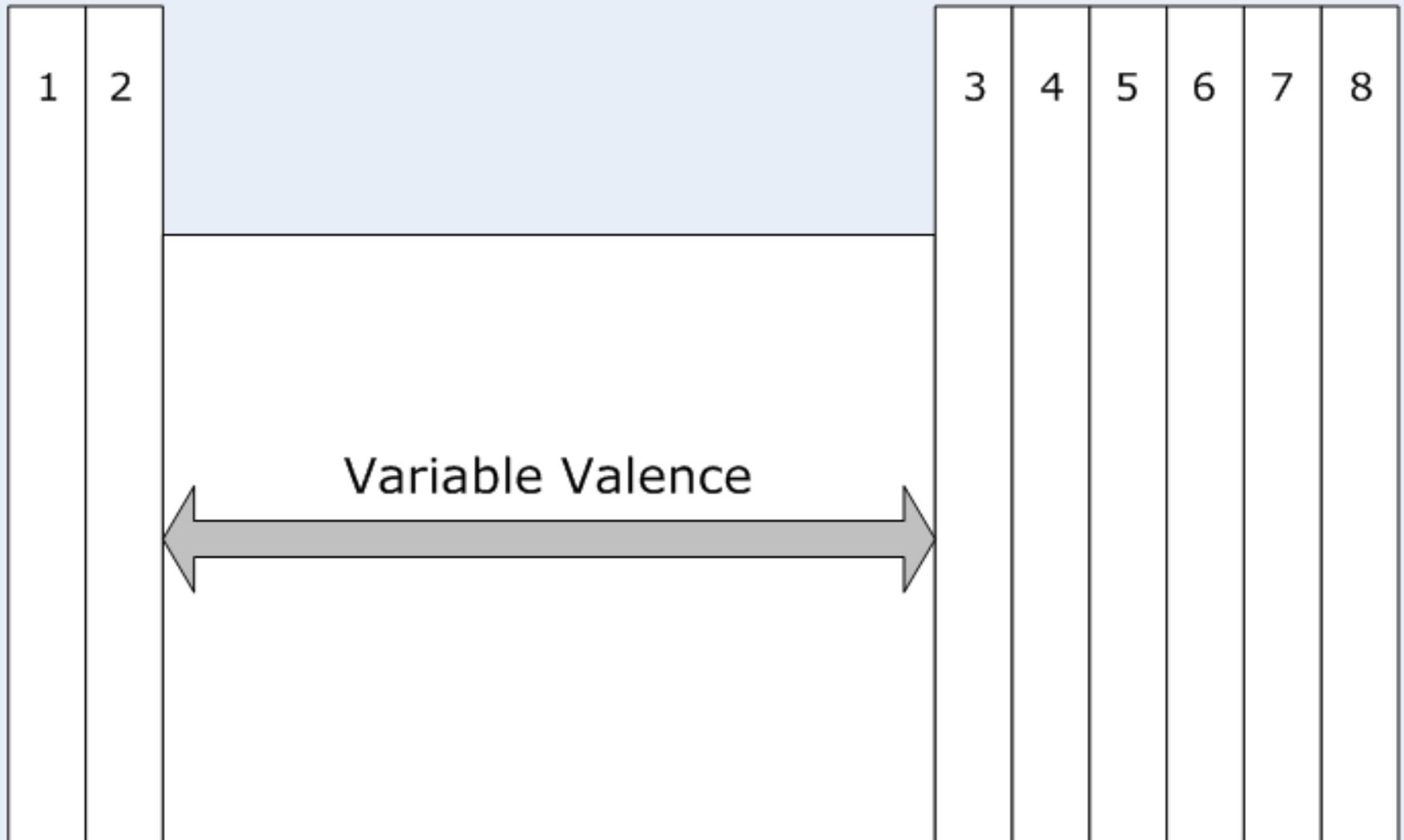
N ___

O ___

F ___

Ne ___

Valence



Monday, February 1, 2016

Today:

W-Up

Notes & Practice: Electron Dot Structures

Homework:

p247 #43, 44, 46a, 46b (write & answer questions)

Practice

Which are covalent?



Hint:

$\text{M} + \text{NM} = \text{Ionic}$

$\text{NM} + \text{NM} = \text{Covalent/Molecular}$

4. A brittle substance with a high melting point.

5. A substance that does not conduct electricity when dissolved in water.

Big Ideas – Covalent Bonds

- Atoms in covalent bonds interact with each other by **sharing** electrons.
- The **geometry (shape)** of a molecule affects its properties including compounds.
- **Carbon** has a unique ability to form a *variety* of compounds (chains and rings).

Covalent Bonds

Covalent bonds are formed when electron **pairs** are *shared* between atoms.

The sharing of electrons occurs so atoms acquire the electron configuration of noble gasses.

In general, covalent bonds are formed between *two non-metals*.

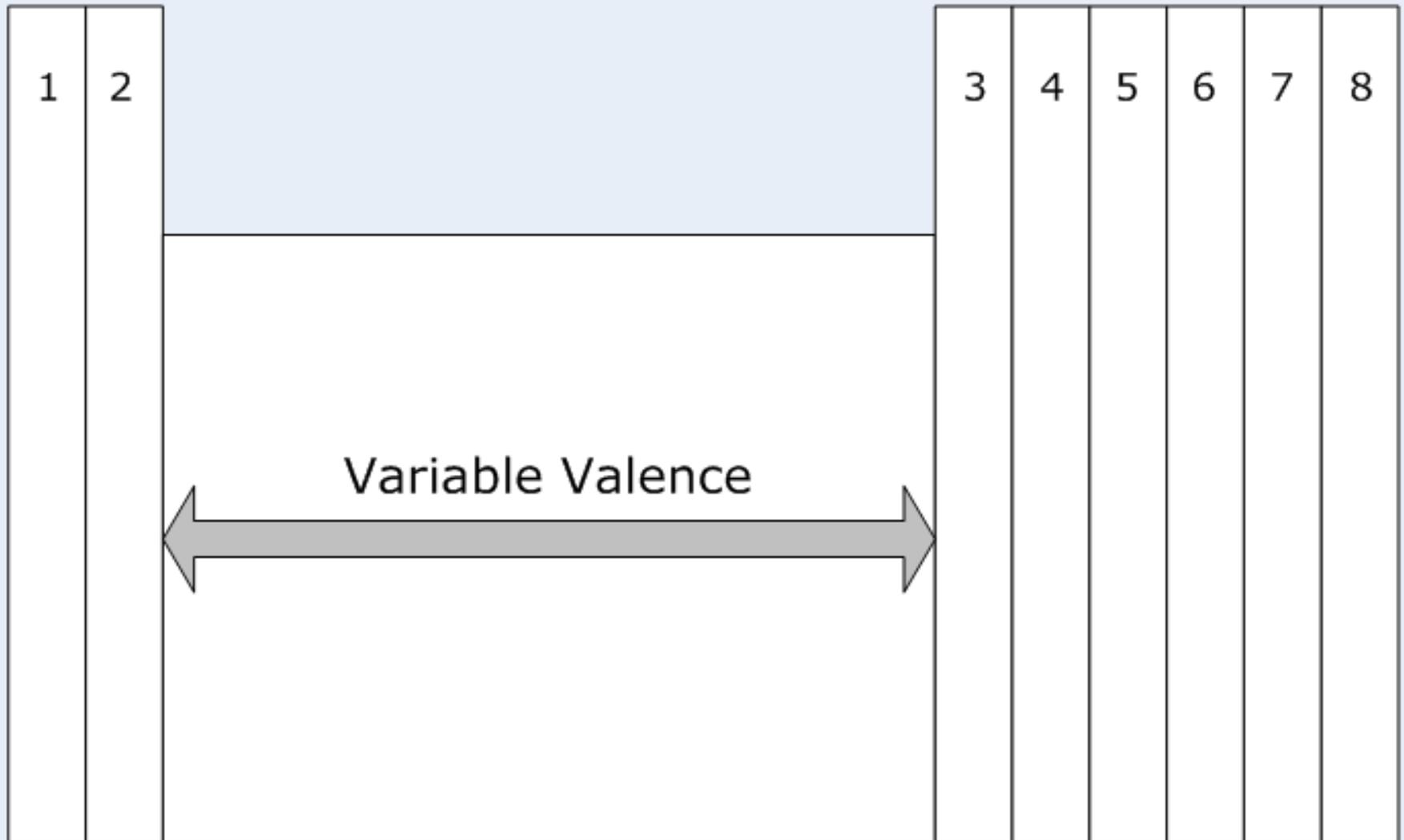
Finding Valence Electrons

1. Write out the electron configuration and count the electrons in the highest level.



2. OR, use the periodic table (Group 1A has 1, group 2A has 2, etc.).

Valence



The Octet Rule

Helps explain and understand covalent bonding.

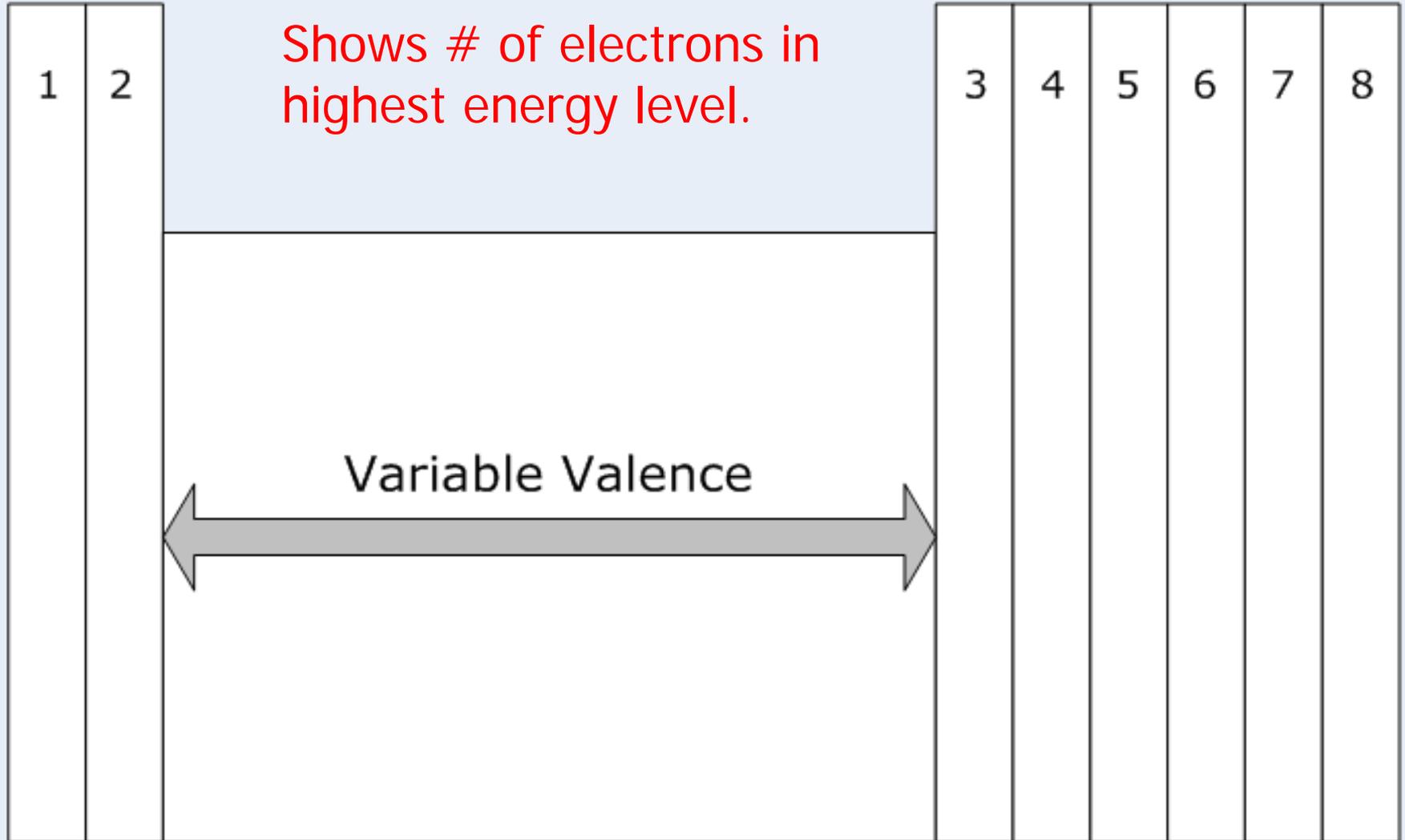
Atoms bond to get 8 valence electrons.

This is the most **stable** arrangement of electrons.

Hydrogen is an exception, it bonds to get 2 valance electrons and be like Helium.

Valence

Shows # of electrons in highest energy level.



Ionic Charges

+1	+2

Shows # of electrons lost or gained to fill the highest energy level.

+3	+/.4	-3	-2	-1	0

Valence

1	2

Shows # of electrons in highest energy level.

3	4	5	6	7	8

Ionic Charge, Valence

Br

Be

P

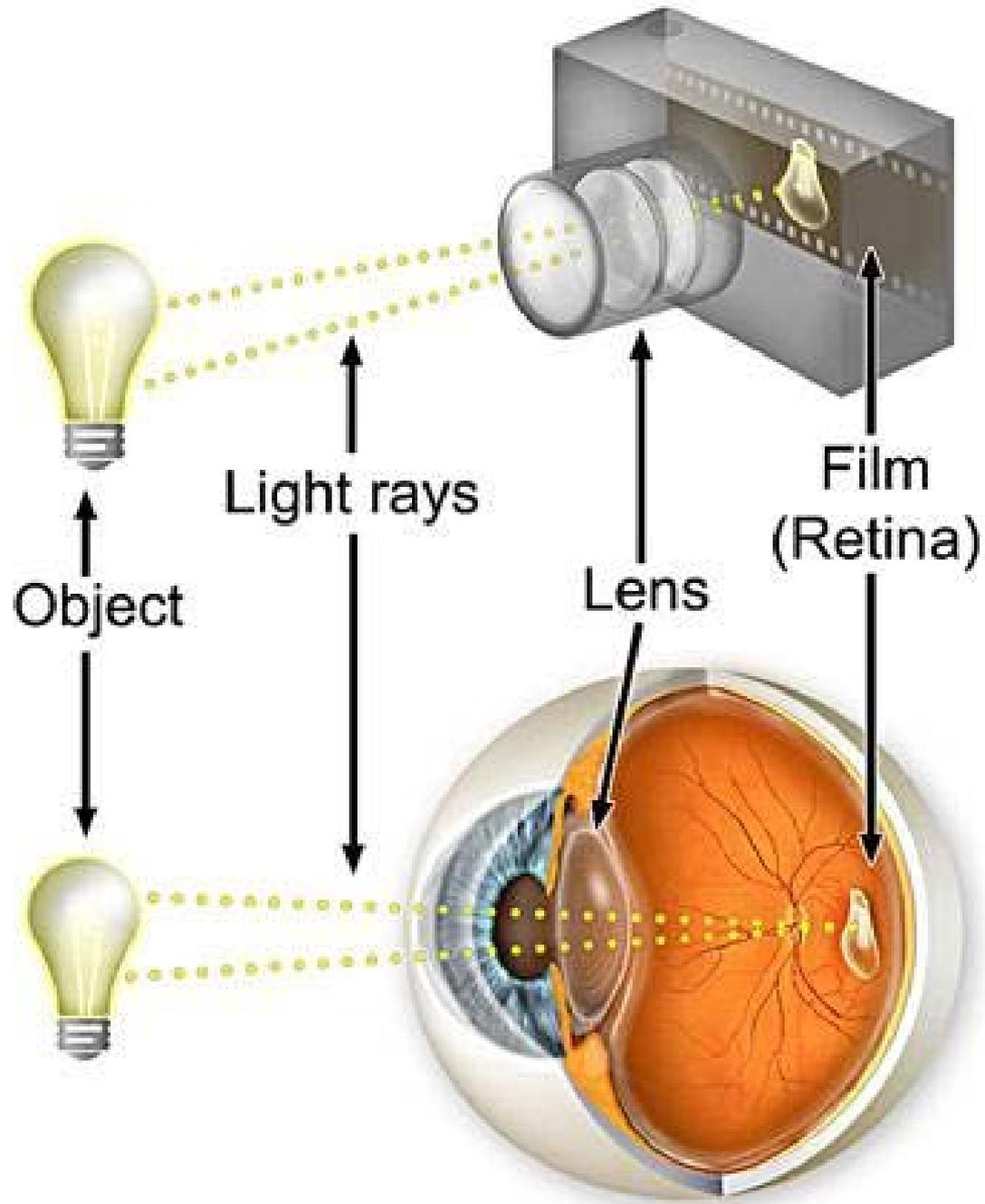
O

K

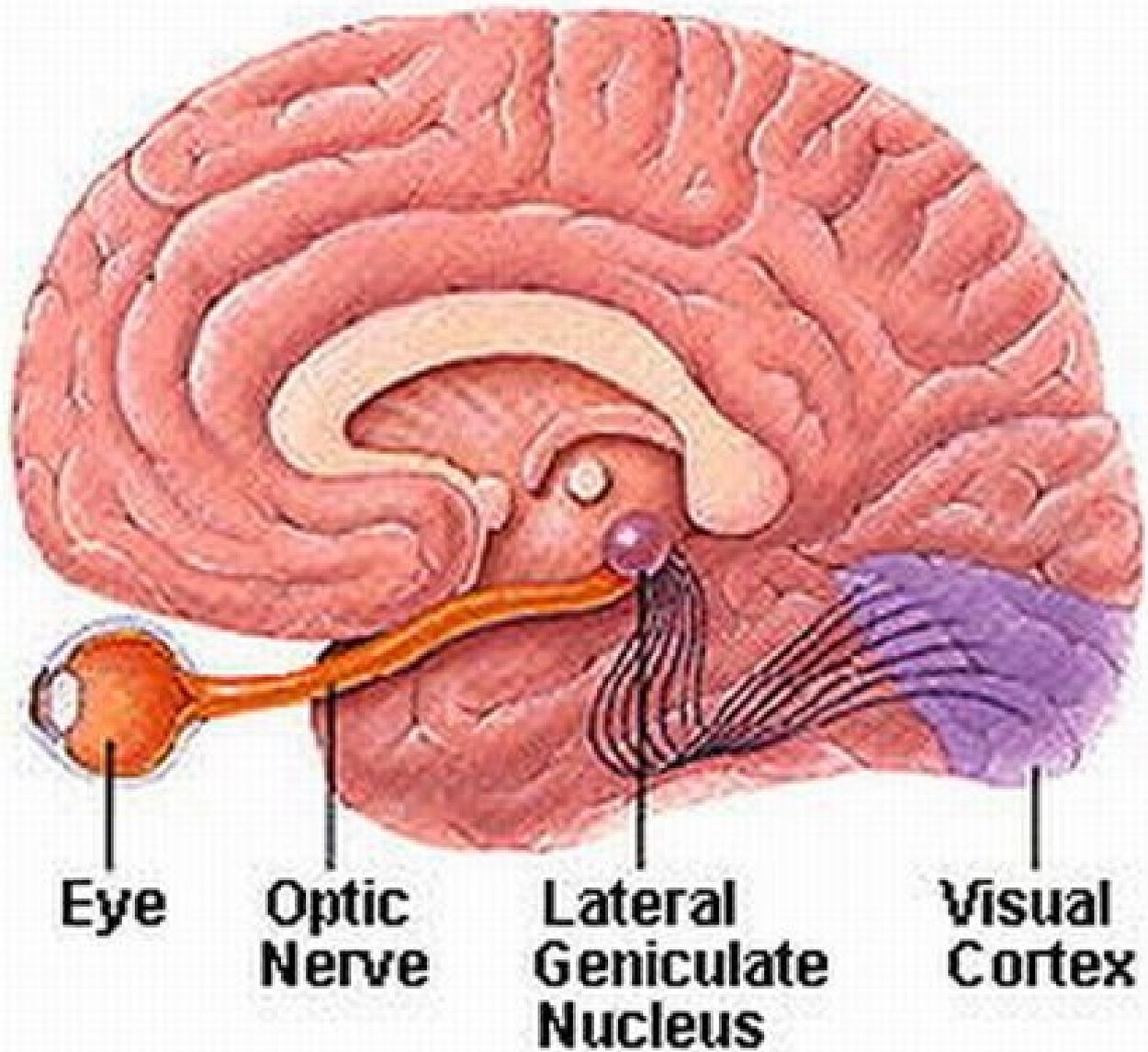
Optical Illusion

http://www.michaelbach.de/ot/mot_adaptSpiral/index.html

The Eye



The Eye and Brain



From http://www.msstrength.com/wp-content/themes/zen/images/optic_nerve.jpg

Electron/Lewis Dot Structures

Ex. Ca \rightarrow :Ca

because Calcium has 2 valence electrons

Draw the dot structures for:

H

N

P

Br

Xe

Single Covalent Bonds

A **single covalent bond** is formed when a pair of electrons is shared between atoms.

For example:



The formula for the resulting molecule is H₂

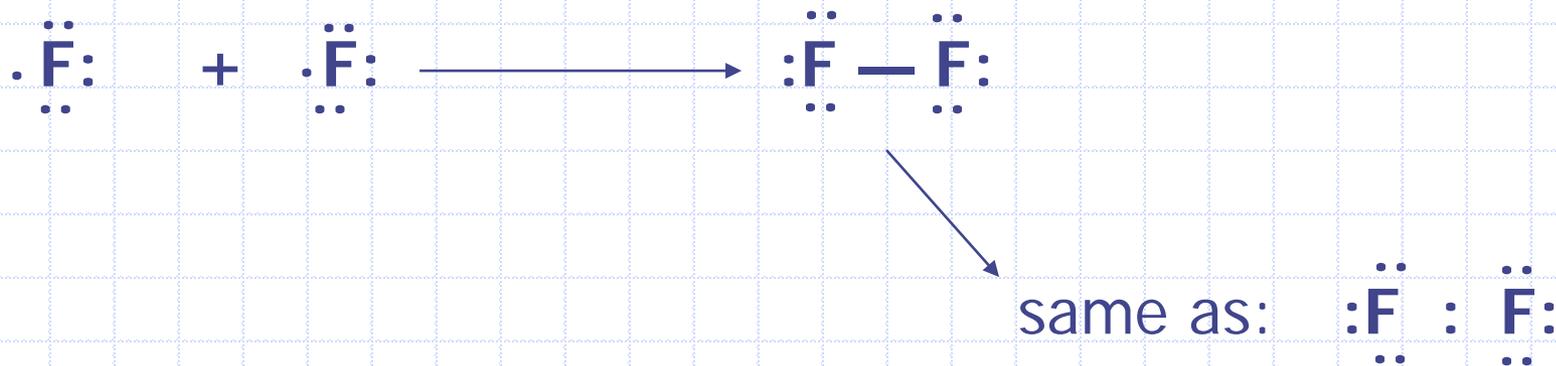
This can also be written as a **structural formula**.



Unshared Electrons

The pairs of valence electrons that are not shared are called **unshared electron pairs**.

For example:



What happened below?

How many electrons does each F have around it?

For example:



Double Covalent Bonds

A **double covalent bond** is formed when two pairs of electrons is shared between atoms.

For example:



This double bond can also be written as:

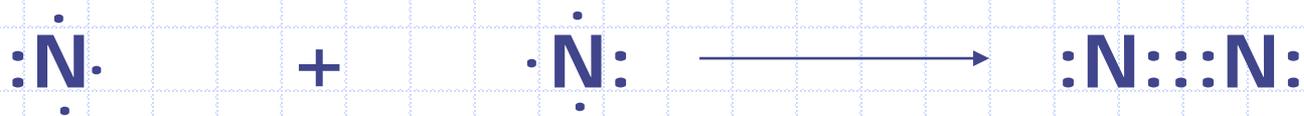


How many electrons does each O have around it?

Double and Triple Covalent Bonds

A **double covalent bond** is formed when two pairs of electrons is shared between atoms. A **triple covalent bond** shares three electron pairs.

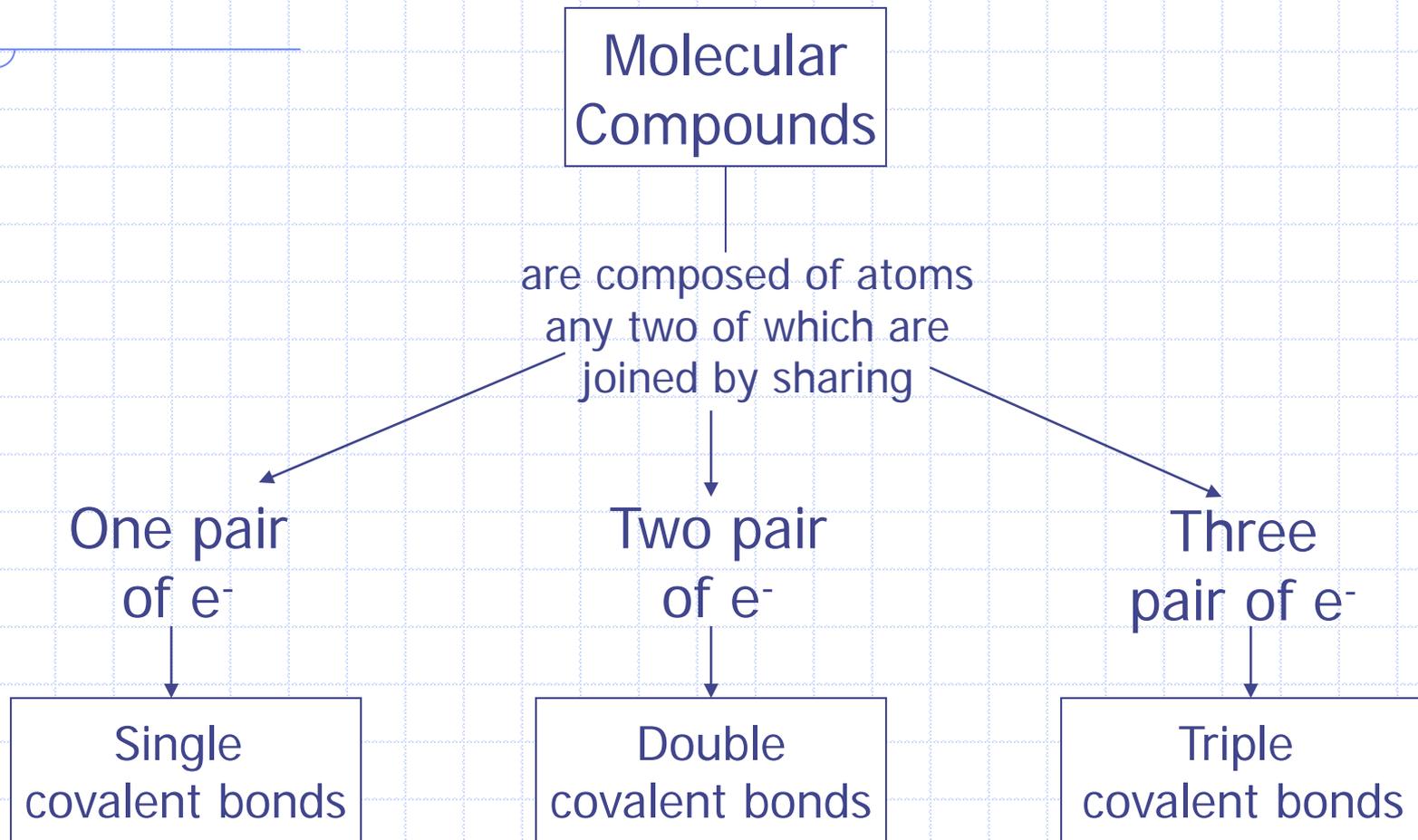
For example:



This triple bond can also be written as:



Concept Map - Molecular/Covalent Bonds



Practice – Covalent Bonds

Write the electron dot formulas and structural formulas for the formation of methane (CH₄).



Write the electron dot structure and structural formulas for the formation of ammonia (NH₃).



Electron/Lewis Dot Structures

1. Count the valence e⁻ for all atoms.
2. Add or subtract e⁻ if molecule is charged (+1, -1, ...).
3. Identify least electronegative atom and put at center.
Note: Hydrogen is never at the center.
4. Draw bonds between atoms. Subtract 2 valence e⁻ for each bond.
5. Complete octets on outside atoms. Subtract valence e⁻ for each e⁻ added.
6. Put remaining e⁻ in pairs on central atom.
7. If central atom does not have an octet, move e⁻ from outer atoms to form double or triple bonds.

Video: Drawing Lewis Structures

<http://youtu.be/1ZlnzyHahvo>

Practice

Write the electron dot and structural formulas for the following:

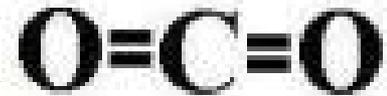


Practice – Covalent Bonds

Write the electron dot structure and structural formulas for the formation of carbon dioxide.



or



Write the electron dot formulas and structural formulas for HCl.

For F_2 .

Practice

Write the electron dot and structural formulas for:



oxygen gas
(molecular O_2)



oxygen free
radical gas

A few more

Write the electron dot and structural formulas for the following:



Covalent Bonds

- Atoms in covalent bonds interact with each other by **sharing** electrons.
- The **geometry** of a molecule affects its properties including compounds.
- **Carbon** has a unique ability to form a variety of compounds.



Do Now ...

Date: Tuesday, February 2, 2016

Obj: Use electron dot structures to describe covalent bonds between atoms.

Write the electron dot structures for:

P

PCl_3

CF_4

Tuesday, February 2, 2016

Today:

W-Up

Notes & Practice: Electron Dot Structures

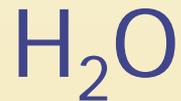
Homework: Review p 217-222 in your book.

Electron/Lewis Dot Structures

1. Count the valence e⁻ for all atoms.
2. Add or subtract e⁻ if molecule is charged (+1, -1, ...).
3. Identify least electronegative atom and put at center.
Note: Hydrogen is never at the center.
4. Draw bonds between atoms. Subtract 2 valence e⁻ for each bond.
5. Complete octets on outside atoms. Subtract valence e⁻ for each e⁻ added.
6. Put remaining e⁻ in pairs on central atom.
7. If central atom does not have an octet, move e⁻ from outer atoms to form double or triple bonds.

Practice

Write the electron dot and structural formulas for the following:



A few more

Write the electron dot and structural formulas for the following:



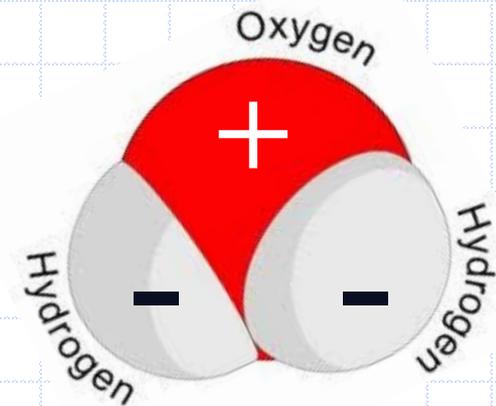
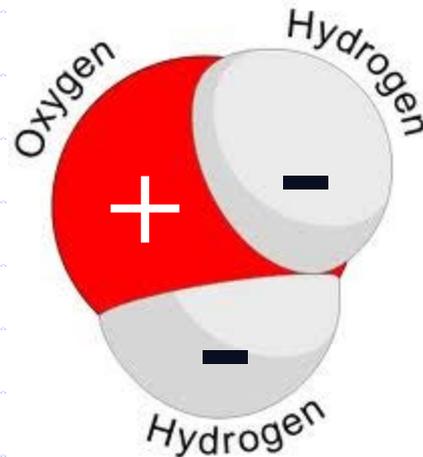


Do Now ...

Date: Wednesday, February 3, 2016

Obj: Describe polar covalent chemical bonds.

Complete: Since opposite charges attract, how would the two water molecules below line up?



Wednesday, February 3, 2016

Today:

W-Up

Notes & Practice: Polar Molecules

Mini-lab: Hydrogen Bonding

Wrap-Up

HW: Read p 232, 233, 237-244.

Draw shape of CH_4 and NH_3

Warm-Up

Ionic or Molecular (Covalent)?

H_2O covalent

KBr ionic

HCl covalent

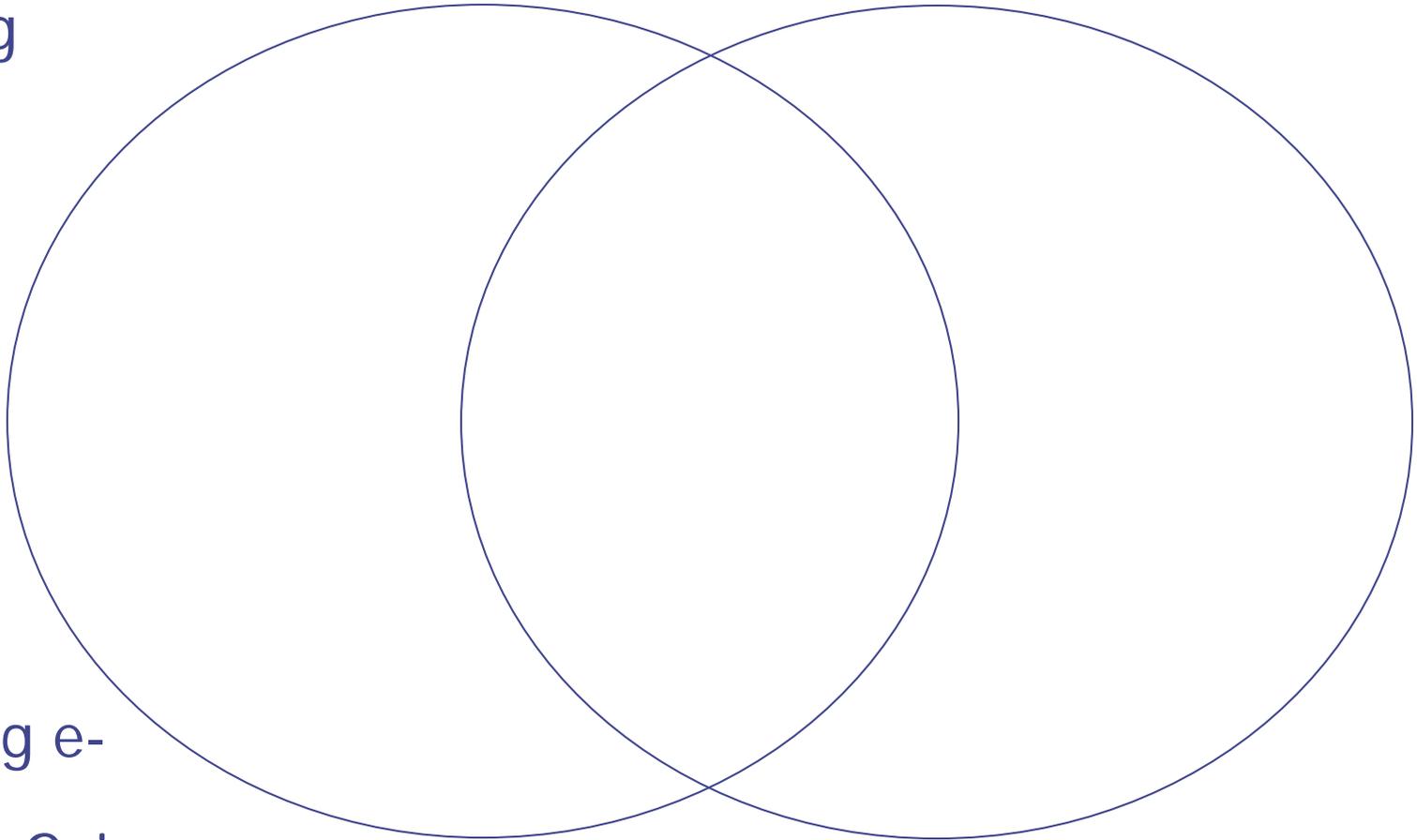
CCl_4 covalent

H_2 covalent

Ionic and
Covalent/
Molecular
Bonding

IONIC Bonding

COVALENT Bonding



Sharing e-

Loss or Gain e-

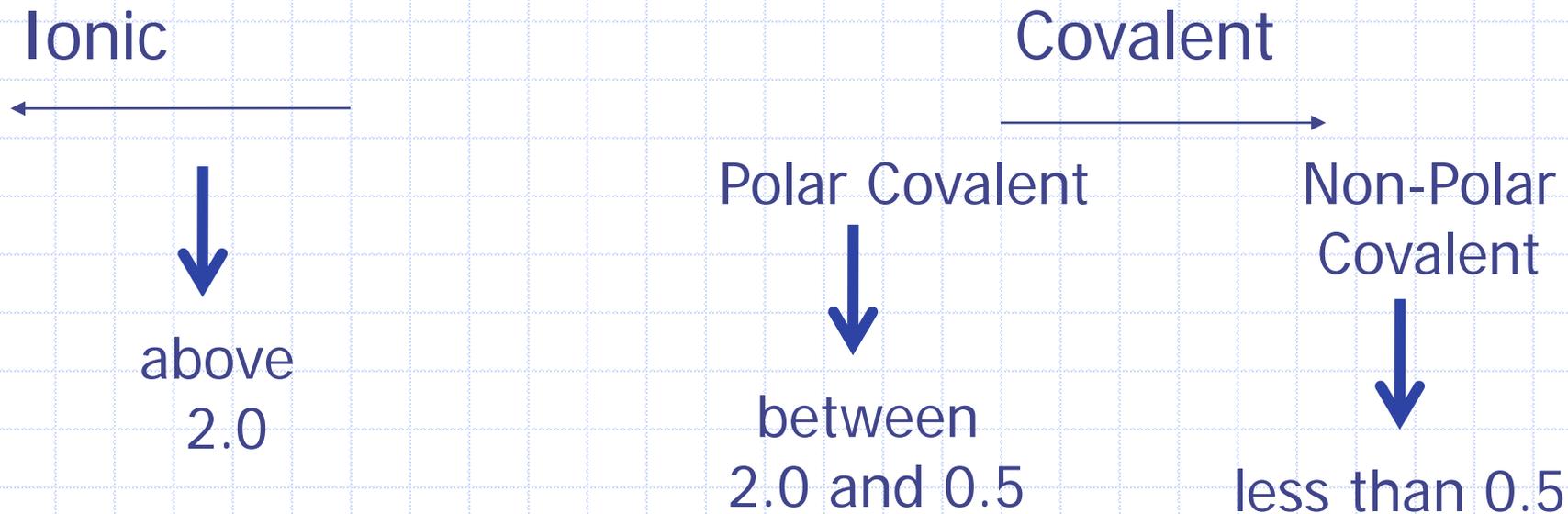
Involves anions and
cations

Electronegative
difference less than 2

Polar Covalent
Involves Valence e-

Ionic vs. Covalent Compounds

The difference between ionic bonding and covalent bonding is **continuum**.

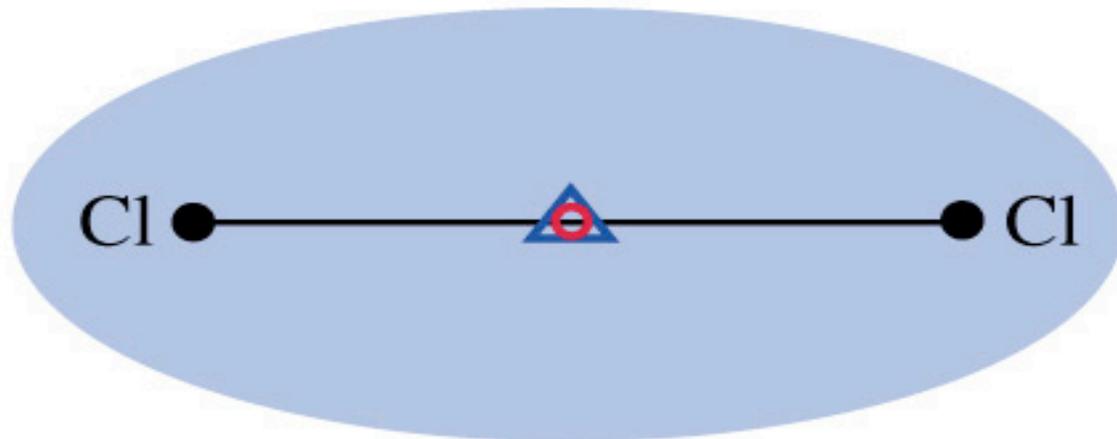
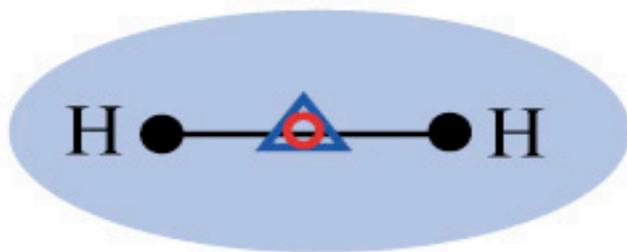


Polar Covalent Compounds

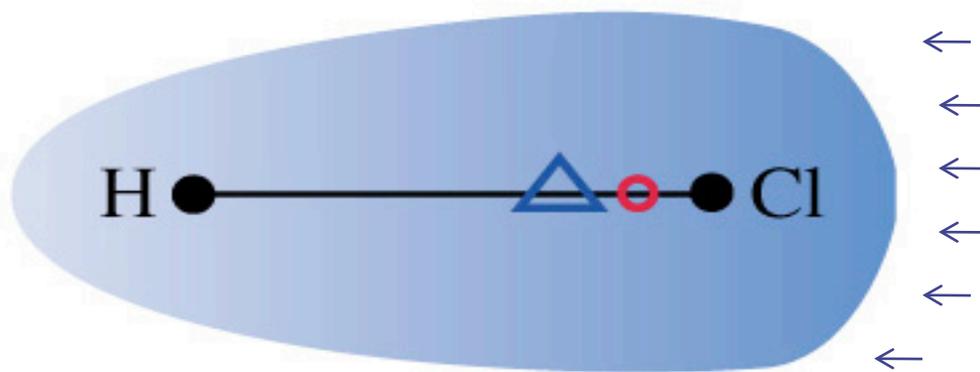
One end of the molecule is positive and one end negative.

A molecule that has two poles, or electrically charged regions, is called a **dipole**.

For example HCl or H₂O.



(a) Nonpolar covalent bonds



Valence
electrons
spend more
on this side.

(b) Polar covalent bond

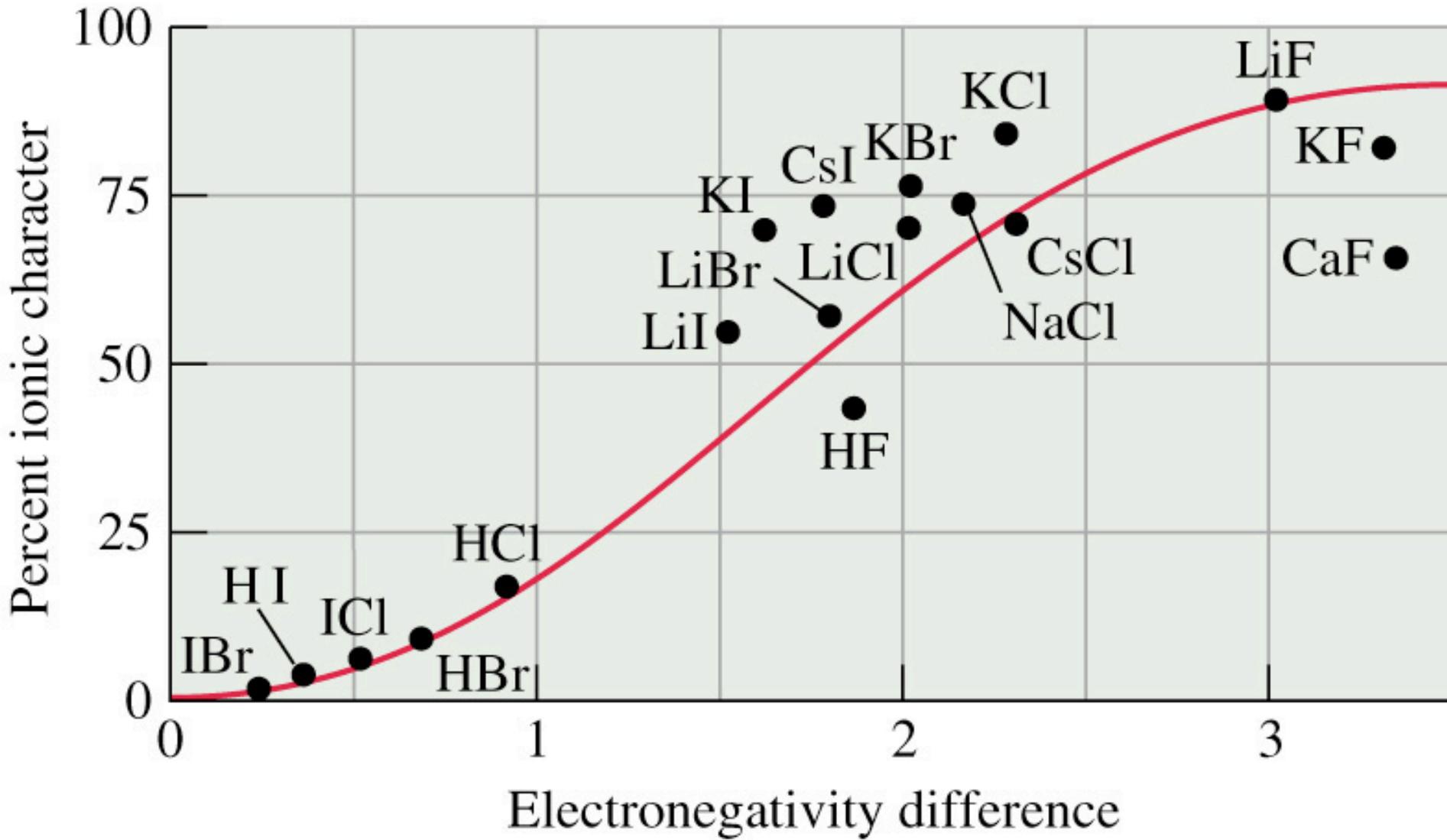
- = Atomic nucleus
- △ = Center of positive charge
- = Center of negative charge

What is Electronegativity?

Electronegativity is how strongly an atom attracts electrons to form chemical bonds.

What is Electronegativity?

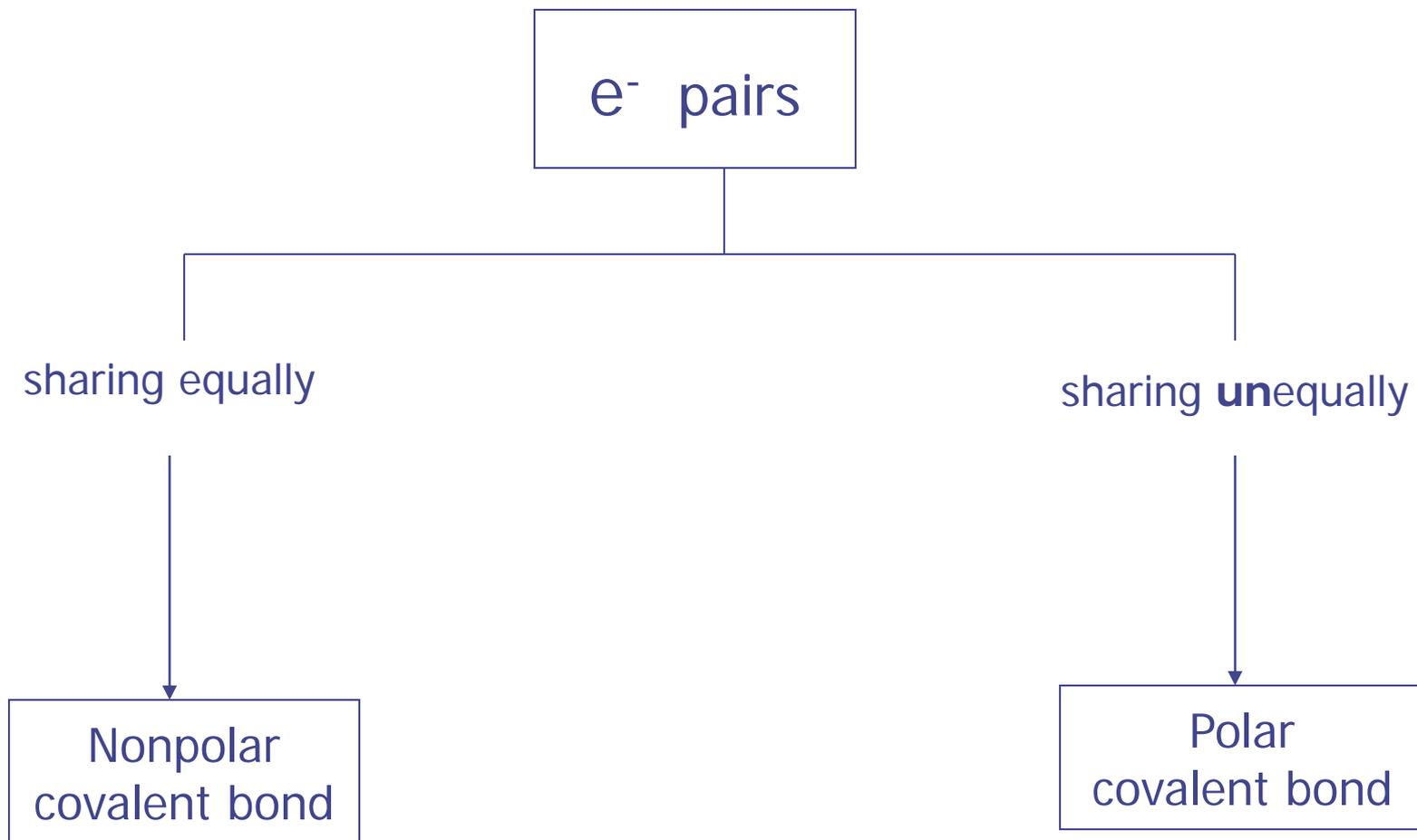
Ionic Compounds have a large difference in electronegativity between the metal and the nonmetal.



What is the relationship between how ionic a compound is and the difference in electronegativity?

From
http://cw.x.prenhall.com/petrucci/medialib/media_portfolio/text_images/FG11_04.JPG

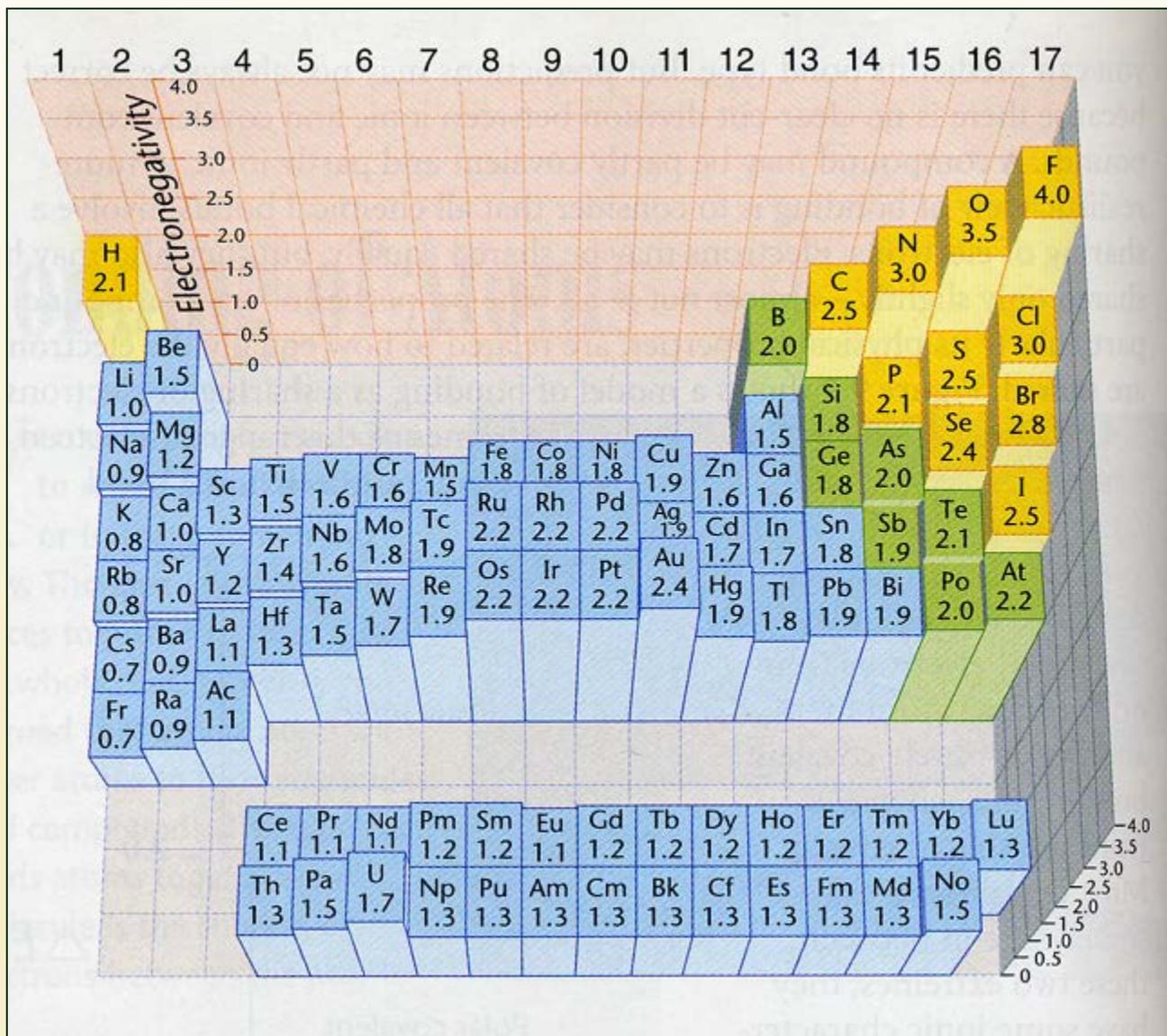
Concept Map - Covalent Bonds



Practice

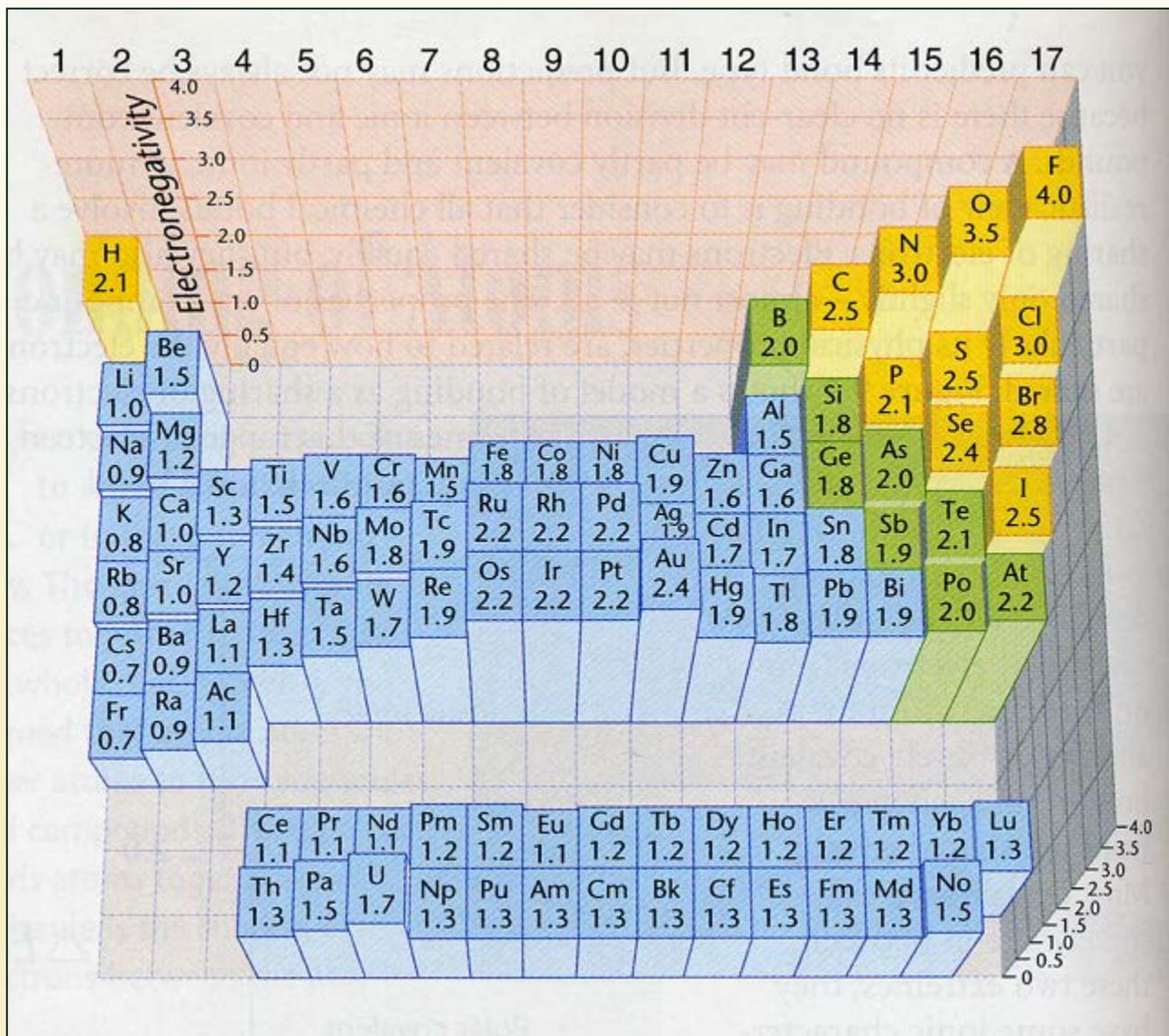
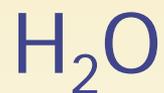
Based on the electronegativity of the bonding atoms, use the chart provided to determine the electronegativity difference and bond type of:

- a. N and H
- b. F and F
- c. Ca and O
- d. Al and Cl



Practice

Based on the electronegativity which of the following are ionic, covalent, or polar covalent?



Electronegativity

Periodic Trend:

- Increases across periods.
- Decreases down groups.

Which is the most electronegative element?
The least?

Polar Bonds

... are found in **covalent** compounds where electrons are **shared unequally**.

Polar Bonds

Electronegativity can be used to predict the polarity of polar covalent bonds.

If the atoms in a bond are the same, the bonding electrons are shared equally and the bond is a **nonpolar covalent bond**. For example, N_2 , O_2 , I_2 .

If the atoms in a bond are different and the bonding electrons are shared unequally, the bond is a **polar covalent bond**. For example HCl , H_2O .

Practice

Based on your notes and the periodic trend (electronegativity increases across periods, decreases down groups) describe the polarity and bond type of:

HF polar covalent

NaCl ionic

HCl polar covalent

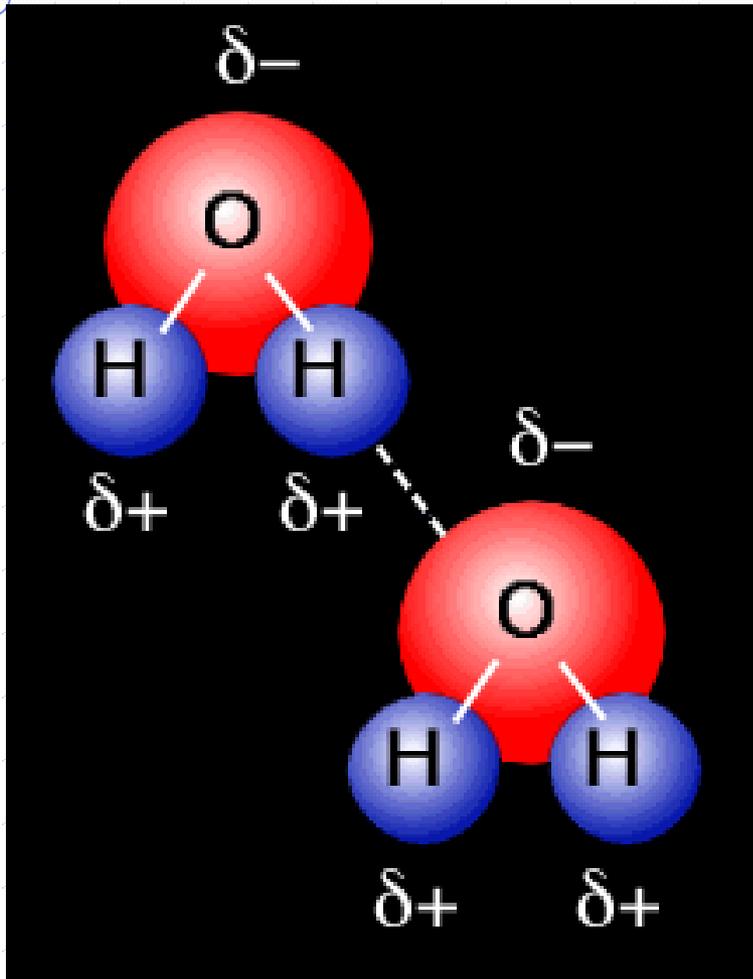
CH₄ nonpolar covalent

CCl₄ nonpolar covalent

Next Up: Hydrogen Bonding



Hydrogen Bonding



<http://www.northland.cc.mn.us/biology/Biology1111/animations/hydrogenbonds.html>

[or from file.](#)

Image from <http://www.lbl.gov/images/MicroWorlds/H2OH-bond.gif>

Mini-Lab

You are going to determine the strength of hydrogen bonds in three different liquids. Use the penny and appropriate dropper to collect data.

Create a data table to record information. Use the data to place the liquids in order of increasing hydrogen bonding. Be able to support your conclusion!

Practice

Draw the electron dot structures and describe the polarity and bond type of:

HF

NaCl

HCl

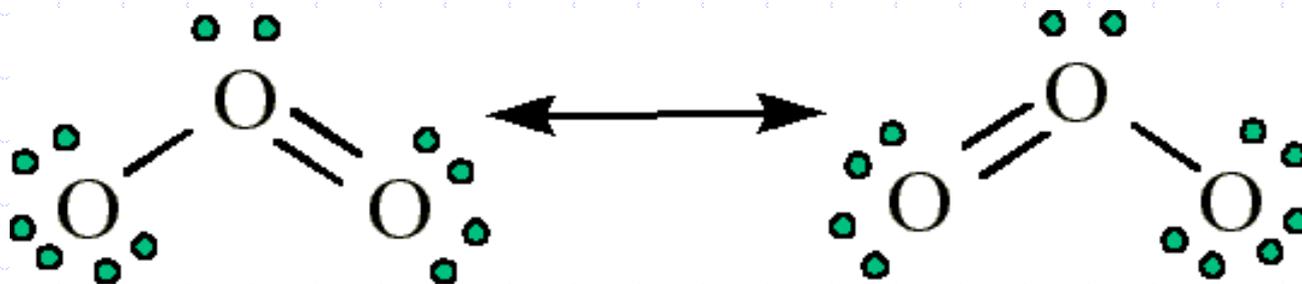
CH₄

CCl₄

Resonance

Resonance occurs when two or more electron dot structures can be written for a molecule.

For example, ozone:



There is really only one form of the ozone molecule.
We draw resonance structures to describe the molecule.

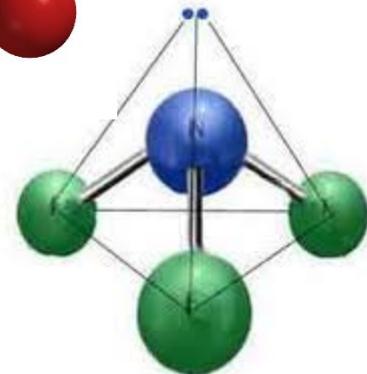
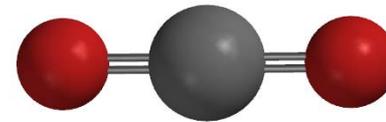
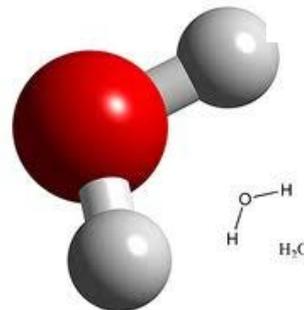
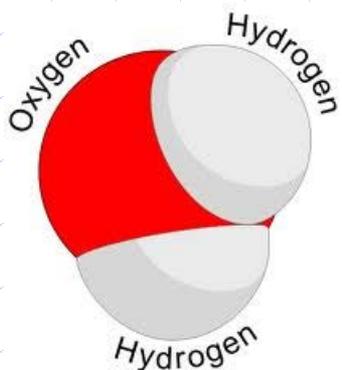


Do Now ...

Date: February 4, 2016

Obj: Prepare for semester two with overview of lab safety and topics.

Complete: Match the terms with the images.
Pyramidal, Tetrahedral, Bent, Linear



Thursday, February 4, 2016

Today:

Lab: Shapes of Molecules (VSPRE Theory)

Homework: Finish Lab, Study for Quiz

Warm Up

Draw an electron dot structure for each of the following covalent molecules. What can you say about their shapes?





Do Now ...

Date: February 5, 2016

Obj: Use VSPRE Theory to predict the shapes of molecules.

Copy & Answer: Use VSPRE to explain why different molecules have shapes (e.g. CH_4)

Include the words *electron clouds*, *valence electrons*, *repel*, and *bonds between atoms*.

Friday, February 5, 2016

Today:

Warm-Up

Notes, Demos, and Practice
Quiz

Homework: Review for Unit Test next
week.

Warm Up

How can the shape of a molecule influence its chemical and physical properties?

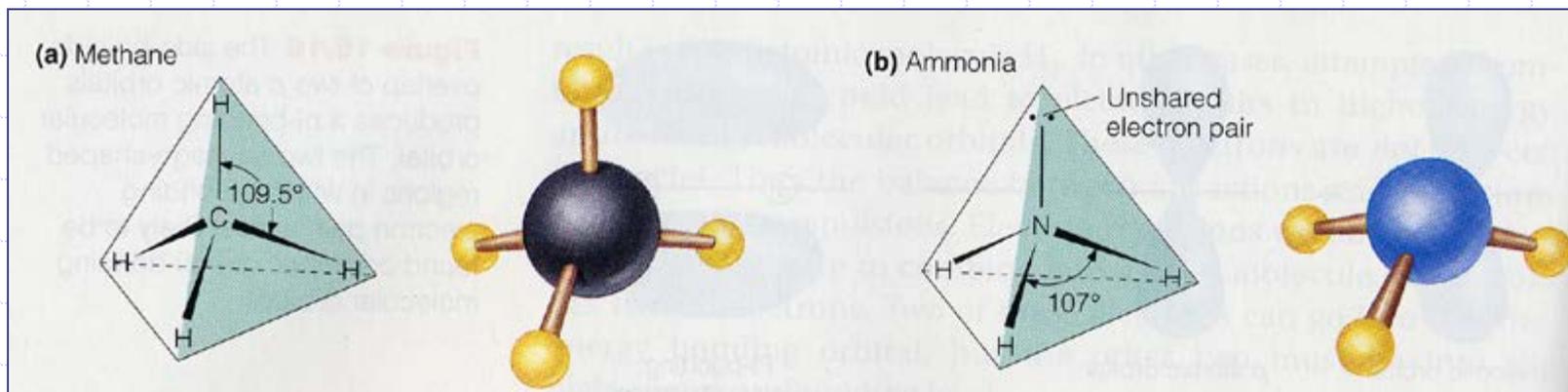
VSPRE Review



Valence-Shell, Electron-Pair Repulsion Theory (VSEPR)

VSEPR theory is a way to describe the three dimensional structure of molecules.

It states that electron pairs will repel each other in a molecule. The shape of the molecule adjusts so that the valence electrons of the atoms are as far apart as possible.



Valence-Shell, Electron-Pair Repulsion Theory (VSEPR)

Key Idea:

- Electron pairs repel each other in a molecule.
- The shape of the molecule adjusts so that the valence electrons are as far apart as possible.

Valence-Shell, Electron-Pair Repulsion Theory (VSEPR)

Common
molecular
shapes.

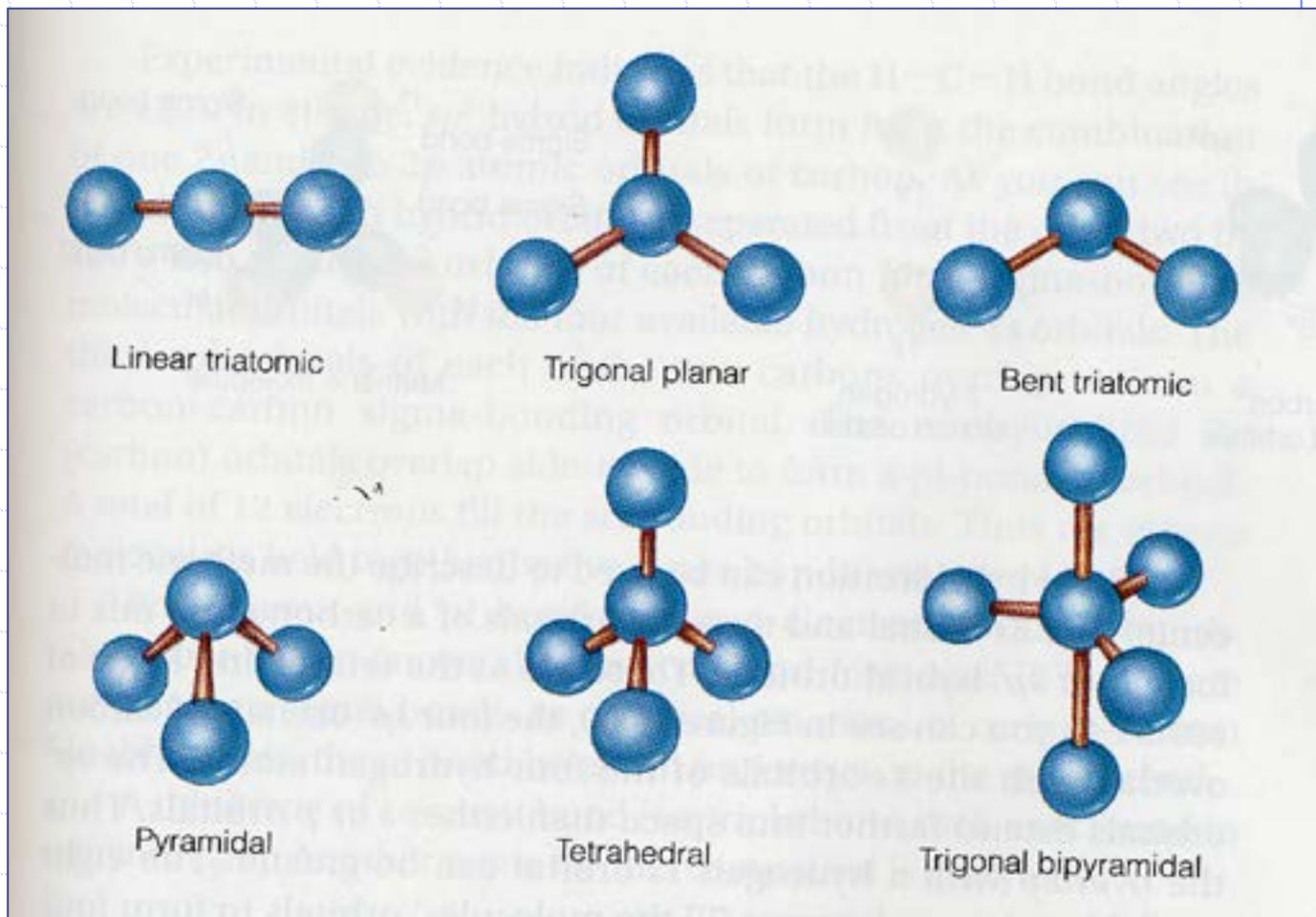


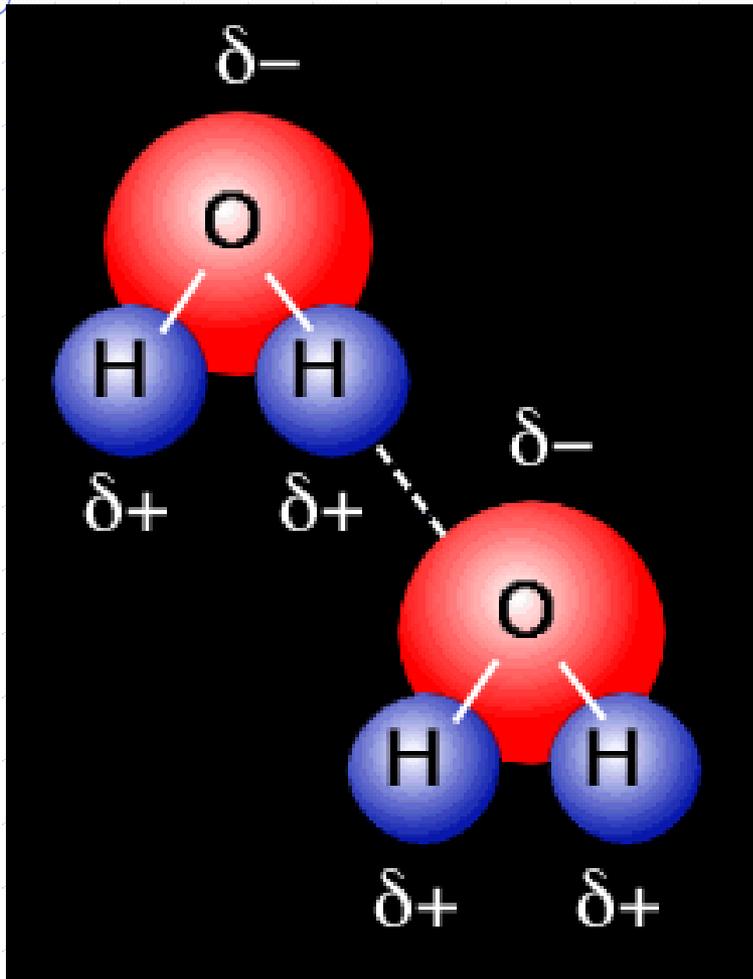


Image from http://lh5.google.ca/abramsv/R4CgLEKUIJI/AAAAAAACKU/xrAbVloPpx4/s1600-h/2051885882_736aa36288_o.

Properties of Substances

Characteristic	Ionic Compound	Covalent Compound
Representative unit	Formula Unit	Molecule
Bond Formation	Transfer of one or more e^- between atoms	Sharing of e^- pairs between atoms
Type of elements	Metallic and nonmetallic	Nonmetallic
Physical state	Solid	Solid, liquid, or gas
Melting point	High	Low
Solubility in water	Usually high	High to low
Electrical conductivity of aqueous solution	Good conductor	Poor to non-conducting

Hydrogen Bonding



<http://www.northland.cc.mn.us/biology/Biology1111/animations/hydrogenbonds.html>

[or from file.](#)

Image from <http://www.lbl.gov/images/MicroWorlds/H2OH-bond.gif>

H-bonding

How does this video relate to hydrogen bonding? What is happening at the molecular level? Why doesn't the lizard sink?

[Movie](#)

A Word of Caution

Bonding is more of a *continuum* between ionic and covalent. Think of bonds as being a percentage ionic or covalent.

The only exception is when two of the same atoms bond together (like H₂). This is 100% covalent.

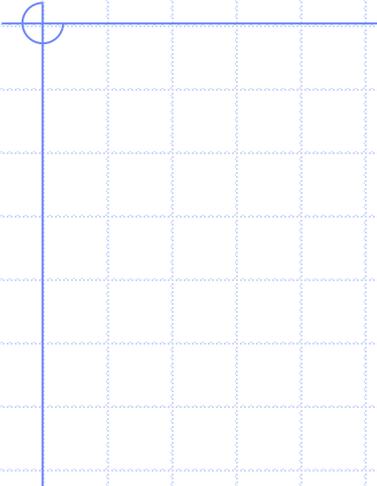
Electronegativity Differences and Bond

Electronegativity difference	Type of bond	Example
0.0-0.4	Covalent (nonpolar)	H-H
0.4 -1.0	Covalent (moderately polar)	H-Cl
1.0-2.0	Covalent (very polar)	H-F
>2.0	Ionic	NaCl

Practice

1. You are given a liquid that is not attracted to a charged comb. You cannot float a pin on its surface. Is it polar or non-polar?
2. Describe the type of bond between:
 - a. H and F
 - b. F and F
 - c. C and O
 - d. Na and Cl
3. Draw the electron dot and structural formula for CH_4 ? Is it polar or non-polar? What is its shape?









Old Content



Demo: H Bonding with AtomSmith



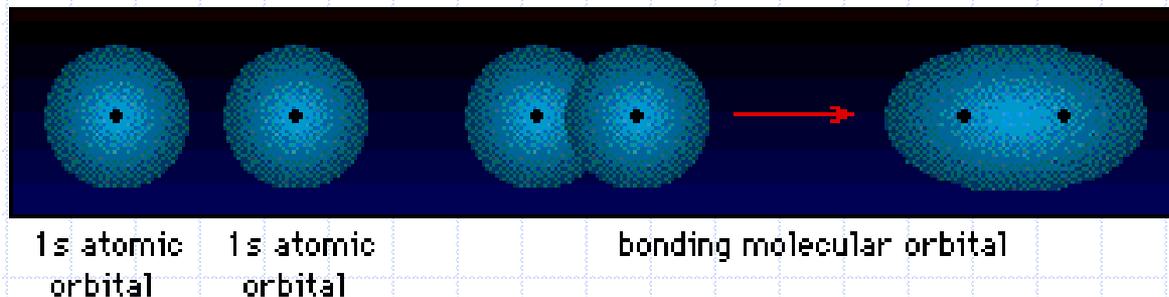


Molecular Orbitals

When two atoms combine their atomic orbitals overlap to form **molecular orbitals**.

The result is that the electrons in the bonded orbitals have a **lower energy** and is **more stable**.

For example:



Molecular Orbitals

For two hydrogen atoms bonding:

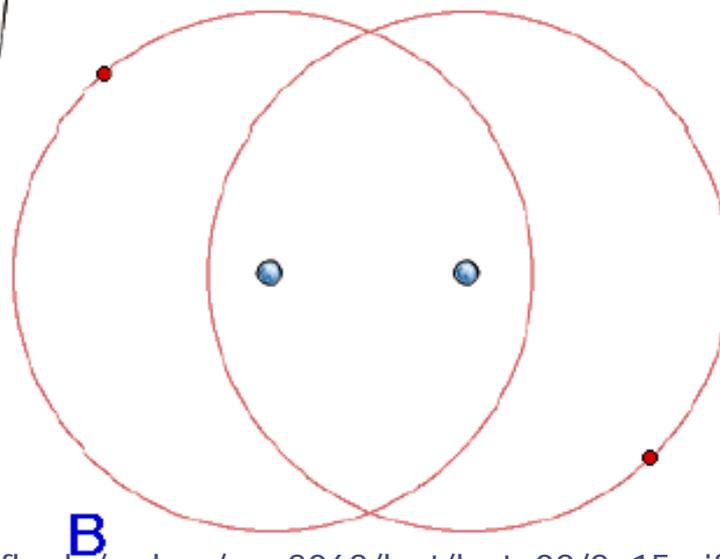
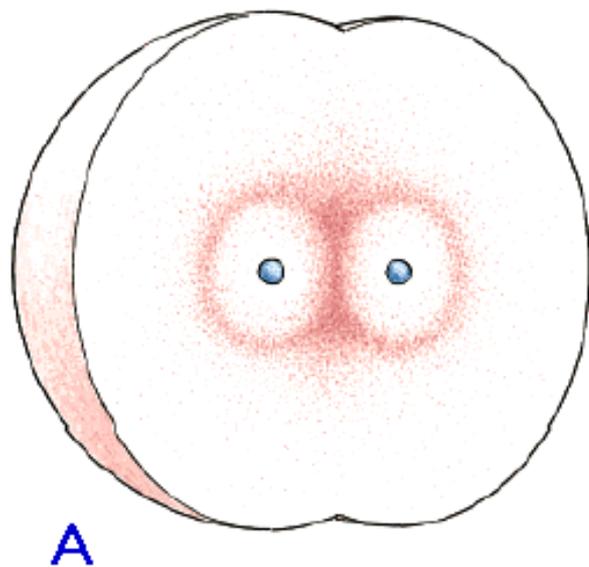


Image from http://www.agen.ufl.edu/~chyn/age2062/lect/lect_02/2_15.gif

Molecular Orbitals

Two hydrogen atoms approach each other.

Image shows the electron density of each atom.

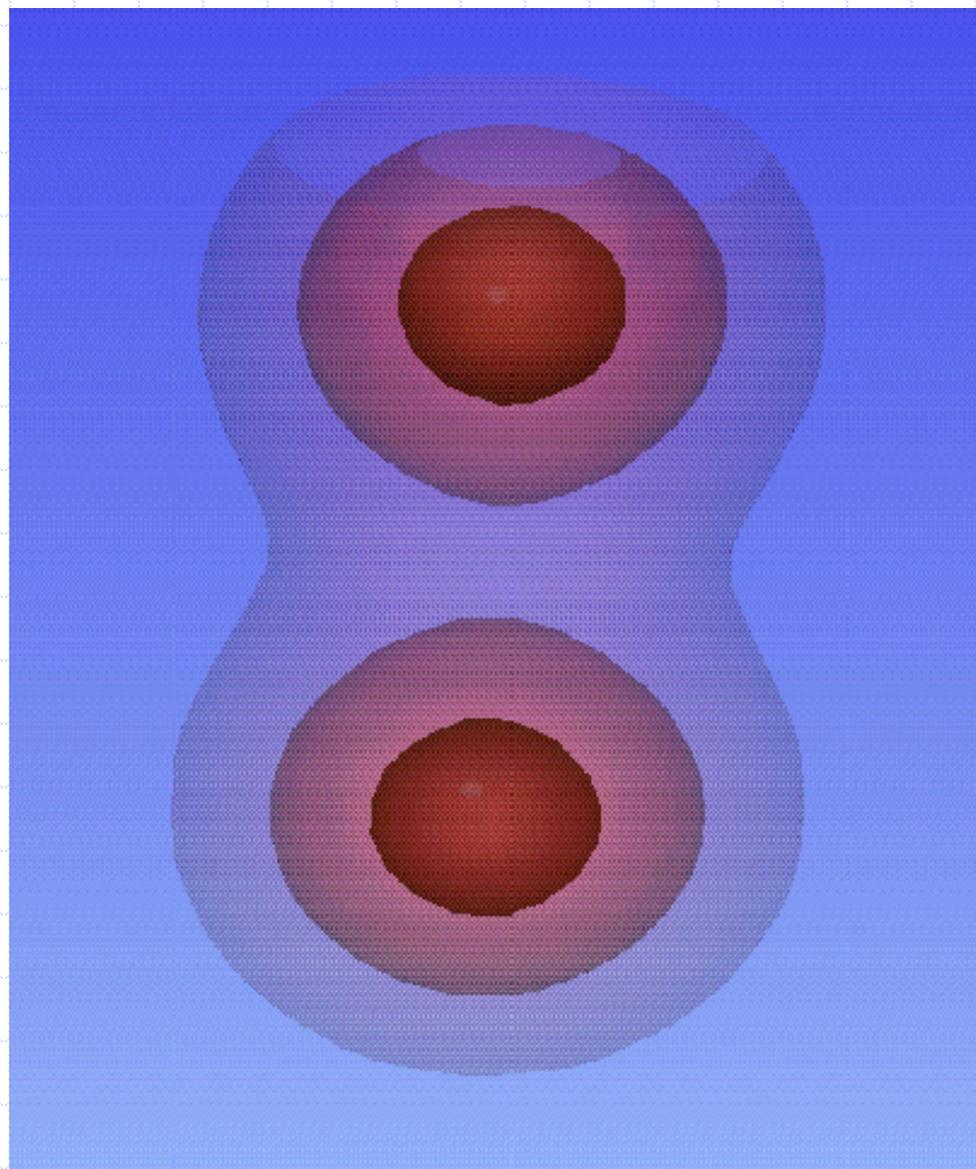


Image from

http://www.nyu.edu/classes/tuckerman/honors.chem/lectures/lecture_6/node1.htm

Molecular Orbitals

Hydrogen
atoms
approach
start to
bond.

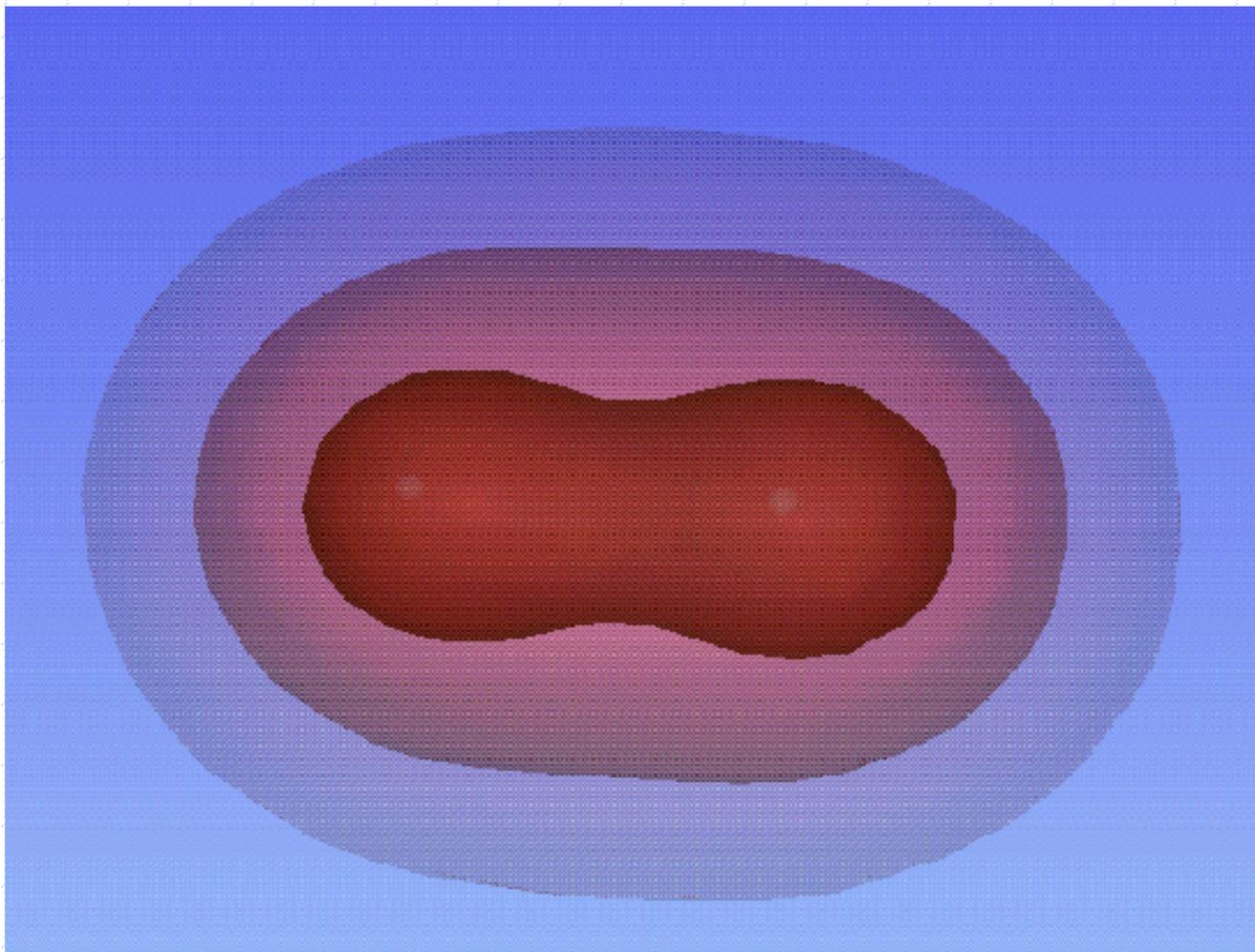
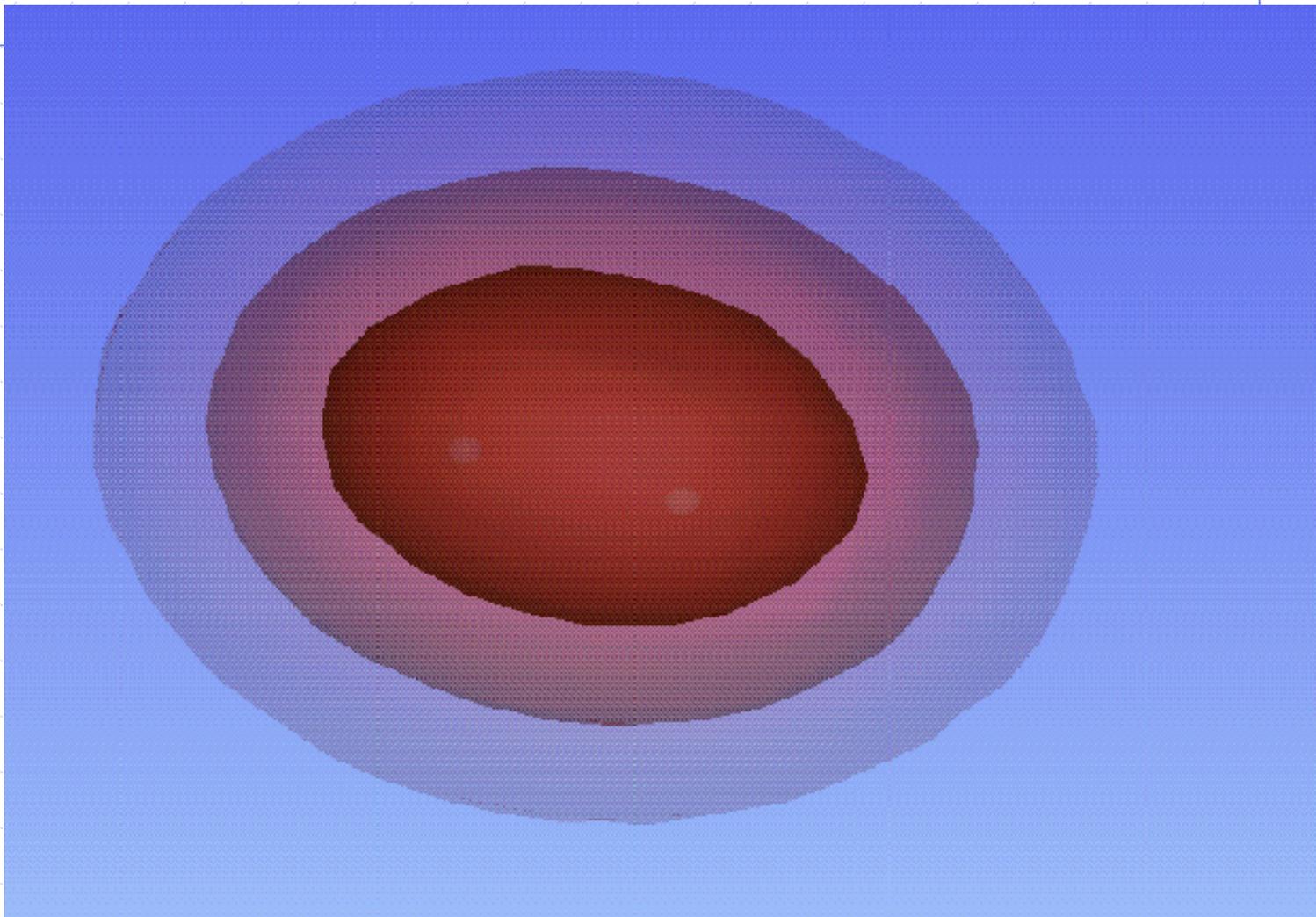


Image from

http://www.nyu.edu/classes/tuckerman/honors.chem/lectures/lecture_6/node1.htm

Molecular Orbitals

Atoms are bonded in a molecular orbital.



Warm-Up

Valence Electrons

In a paragraph state the importance of **valence electrons** and how they relate to the electron configuration of an atom.

Provide examples to support your writing.

Atomic Orbital Review

We've already spent some time looking at atomic orbitals.

<http://web.mit.edu/3.091/www/orbs/>

Group Work Expectations

1. Move into your groups and get right to work.
2. Stay in your groups!
3. Listen carefully to each other.
4. Monitor your group's progress and be aware of the time constraints.
5. Remember: each person in the group must be able to explain the main ideas.

Homework

Based on the results of the mini-lab and notes in class:

- describe hydrogen bonding in terms of electronegativity
- draw a diagram showing H-bonding in H₂O
- discuss why the different solutions in lab had varying degrees of hydrogen bonding.

MCR: Types of Chemical Bonds

Describe the three types of chemical bonds. Give examples of each bond, general properties, behavior of valence electrons, and other important information. Use your concept map to guide your writing.

To be collected.