Chapter 8

Covalent Bonding

NOTE: The numbered sections on this outline do NOT correspond to Chapter Sections in the book.

8.1 - Covalent Bonding & Molecules

- Covalent Bond vs. Ionic Bond
- Molecule vs. Formula Unit
- Unshared Pair (Nonbonding Pair)
- Diatomic Molecules
- Double & Triple Bonds

8.2 - Molecular Shape & Geometry

- VSEPR Theory
- Molecular Shapes

8.3 - Bond Polarity & Intermolecular Attractions

- Electronegativity – Define & Periodic Trend (Review
- Nonpolar & Polar Covalent
- δ and +⟶ Notation
- van der Waals Forces
  - Dipole Interactions, Hydrogen Bonding
  - Dispersion Forces

8.1 - Covalent Bonding & Molecules

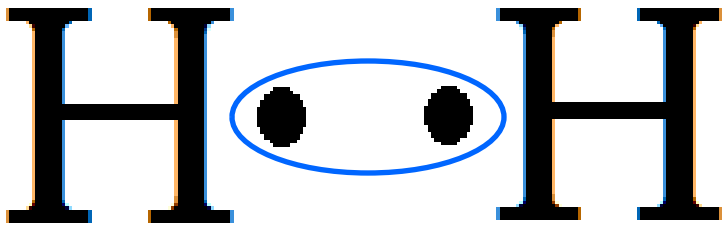
Ionic bonds are formed by electron transfer.

(b/w metal & nonmetal)

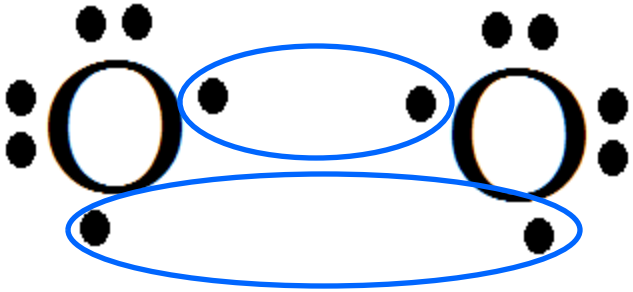
Covalent bonds are formed by electron sharing.

(b/w 2 nonmetals)

Covalent bonds form molecules.



single covalent bond



double covalent bond

H_2

O_2

Each atom shares e^- with another to have an octet.

How are ionic bonds different from covalent?

IONICCOVALENT

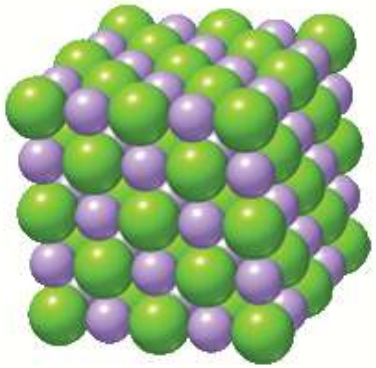
transfer of e-(forms ions!)sharing of e- (**CO**valent)

formula unitsmolecules

formed b/w metal & nonmetalformed b/w 2 nonmetals

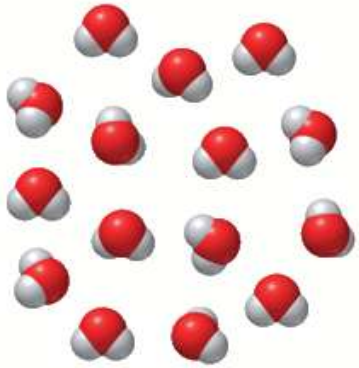
High melting pointslow melting points *(most are gases or liquids at room temp)*

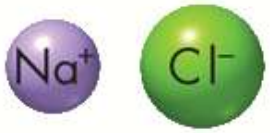
IONIC COVALENT



Array of sodium ions and chloride ions

Collection of water molecules





Formula unit of sodium chloride

Molecule of water

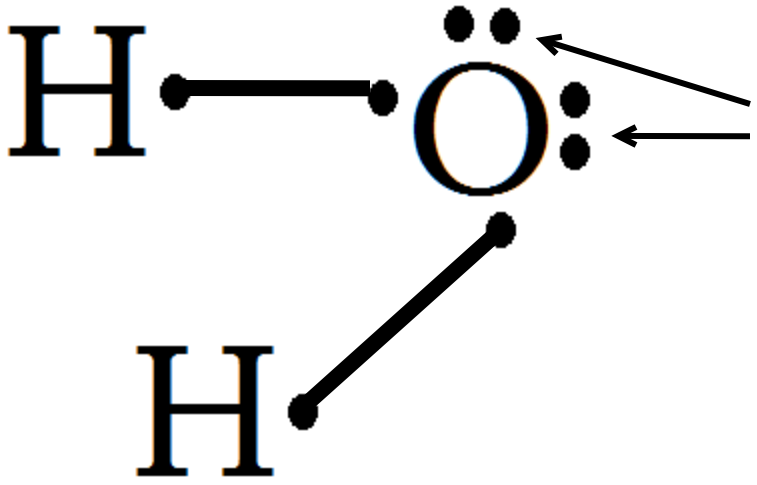
NaCl

Chemical formula

Chemical formula

H_2O

In covalent bonds, electron sharing usually occurs so that atoms attain the electron configurations of noble gases.



unshared pairs of e^-
(nonbonding pair)

H_2O

Diatomic Molecules - 2 identical atoms covalently bonded together.

7 diatomic molecules

H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2

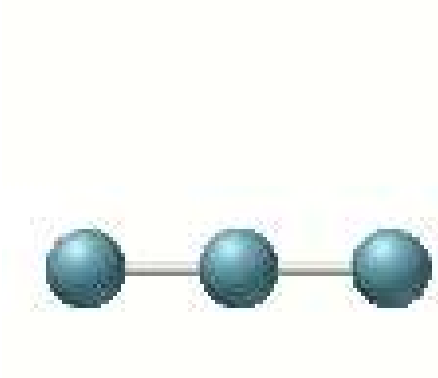
ASSIGN: Chapter 8 Worksheet #1

8.2 - Molecular Shape & Geometry

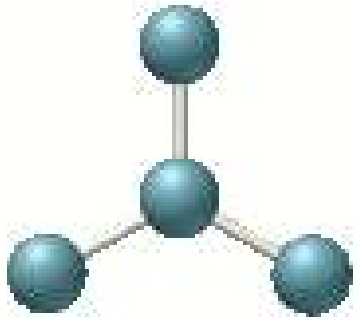
Valence Shell Electron Pair Repulsion Theory (VSEPR)
electron pairs repel each other and stay far apart from each other.

VSEPR explains the 3D shapes of molecules.

Common Molecular Shapes (p. 243)

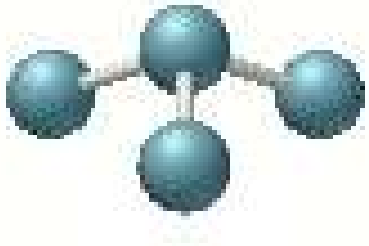


Linear

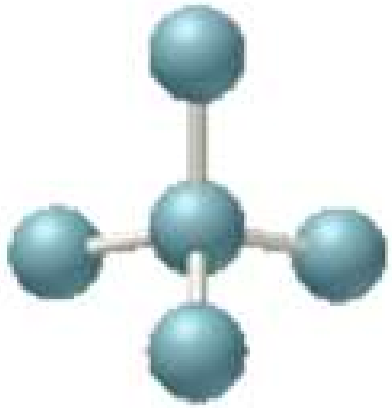


Trigonal planar

Bent

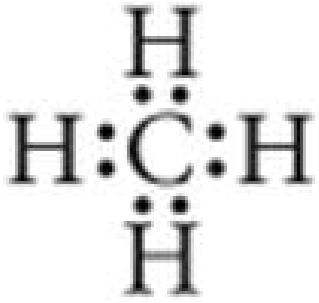


Trigonal Pyramidal

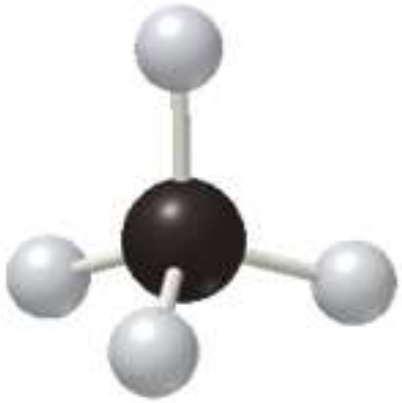


Tetrahedral

Methane (CH_4)



electron dot structure



molecular shape

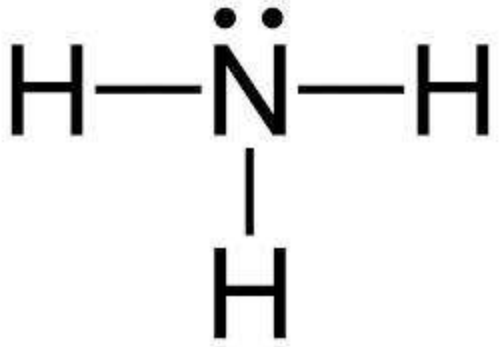
Molecular Geometry – 3d arrangement of bonded atoms INCLUDING nonbonding electron pairs

Molecular Shape – 3d arrangement of bonded atoms ONLY

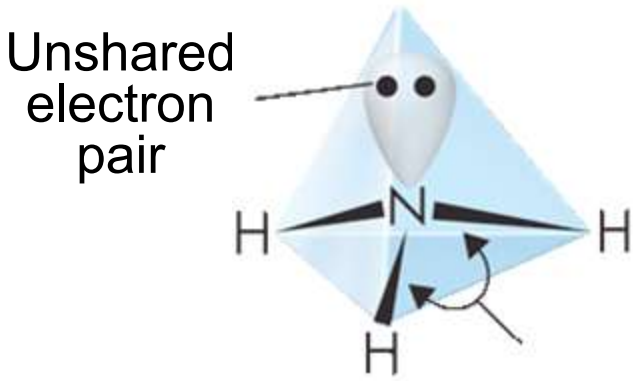
The molecular shape may not be the same as the geometry

Unshared pairs of electrons require space as well.

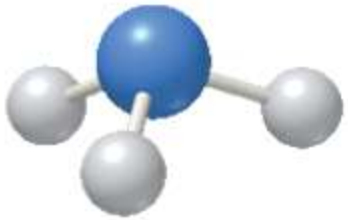
Ammonia (NH_3)



electron dot structure

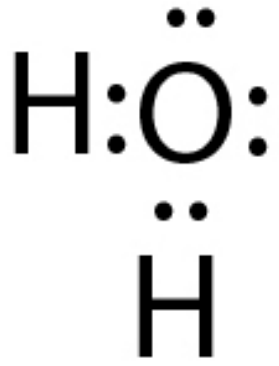


molecular geometry

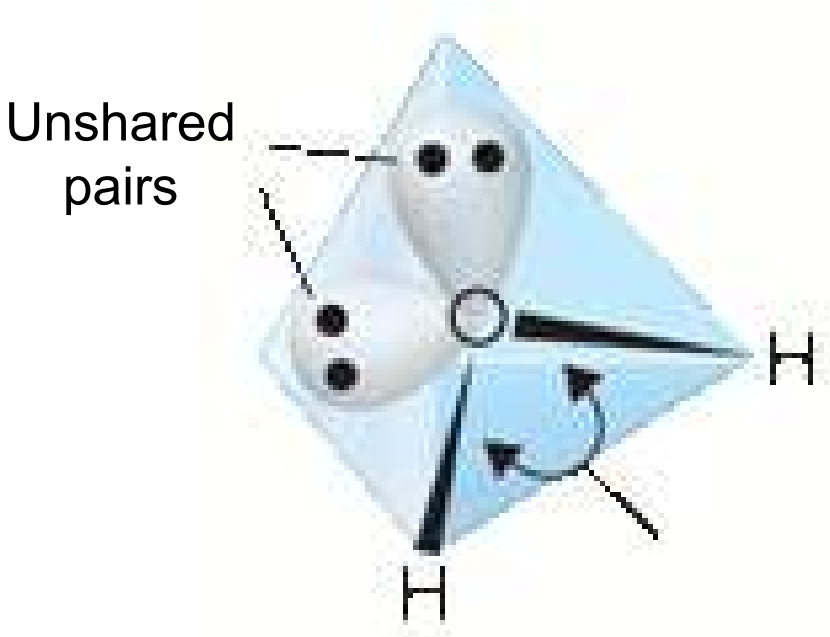


molecular shape

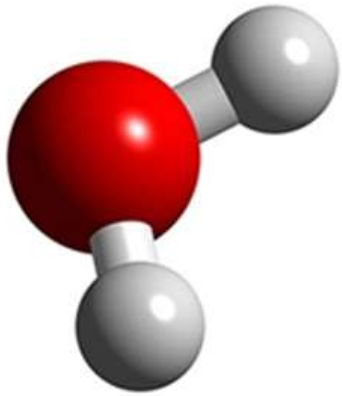
Water (H_2O)



electron dot structure



molecular geometry



molecular shape

The water molecule has a bent shape because of the unshared pairs

8.1 - Covalent Bonding & Molecules

Lewis Symbols for Elements

3 properties of Ionic & Covalent Bonds

7 Diatomic Molecules

Electron Dot Structure for Molecules

Non-bonding (Unshared) Electron Pairs)

8.2 - Molecular Shape & Geometry

Explain VSEPR Theory

Molecular Shape vs. Molecular Geometry

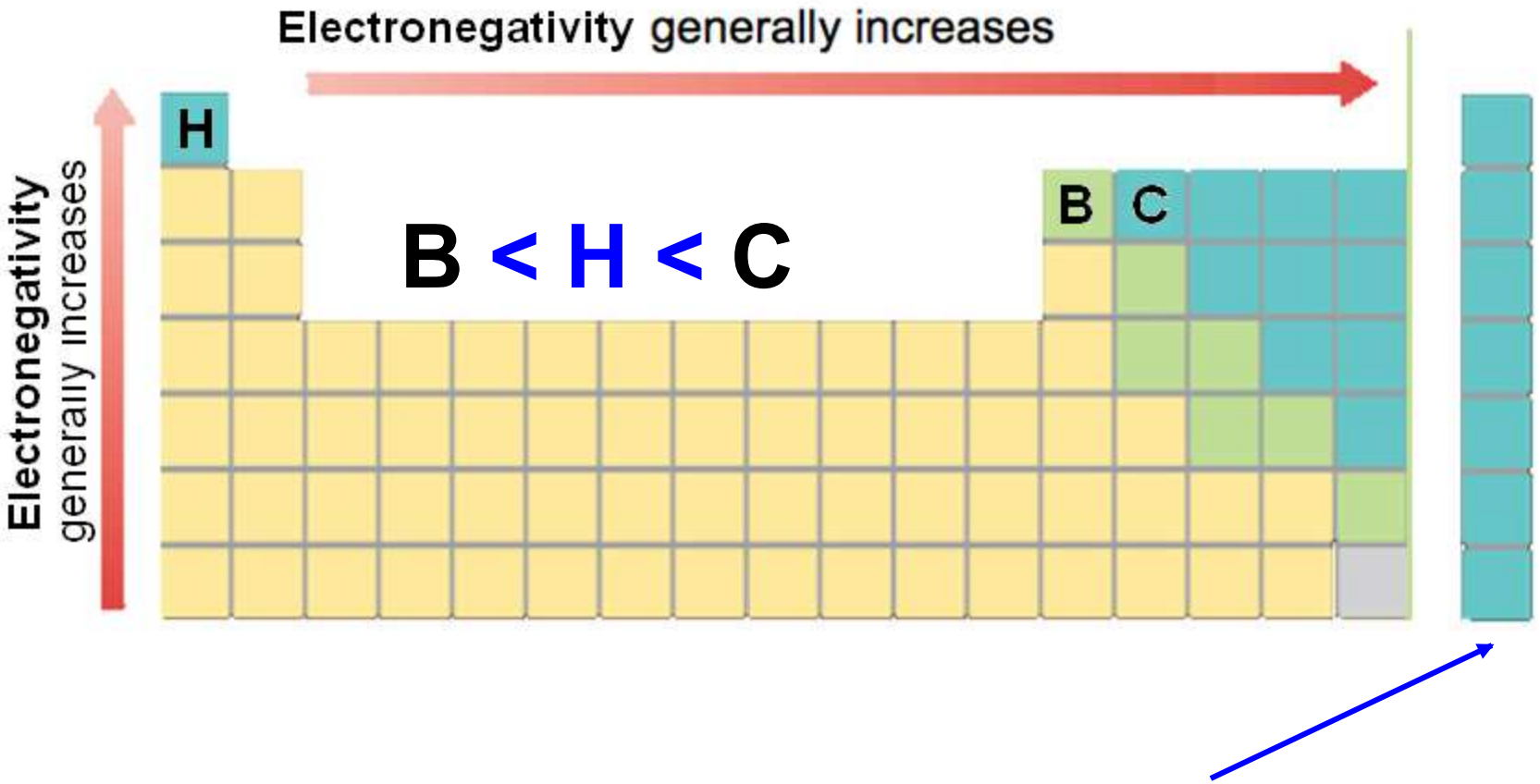
8.3 - Bond Polarity & Intermolecular Attractions

Electronegativity – Define & Periodic Trend (Review
Nonpolar & Polar Covalent Bonds
δ and $+\rightarrow$ Notation
Polar & Nonpolar Molecules
van der Waals Forces
  Dipole Interactions, Hydrogen Bonding
  Dispersion Forces

Review from Chapter 6

Electronegativity – an atom's attraction for electrons.

Electronegativity Review…

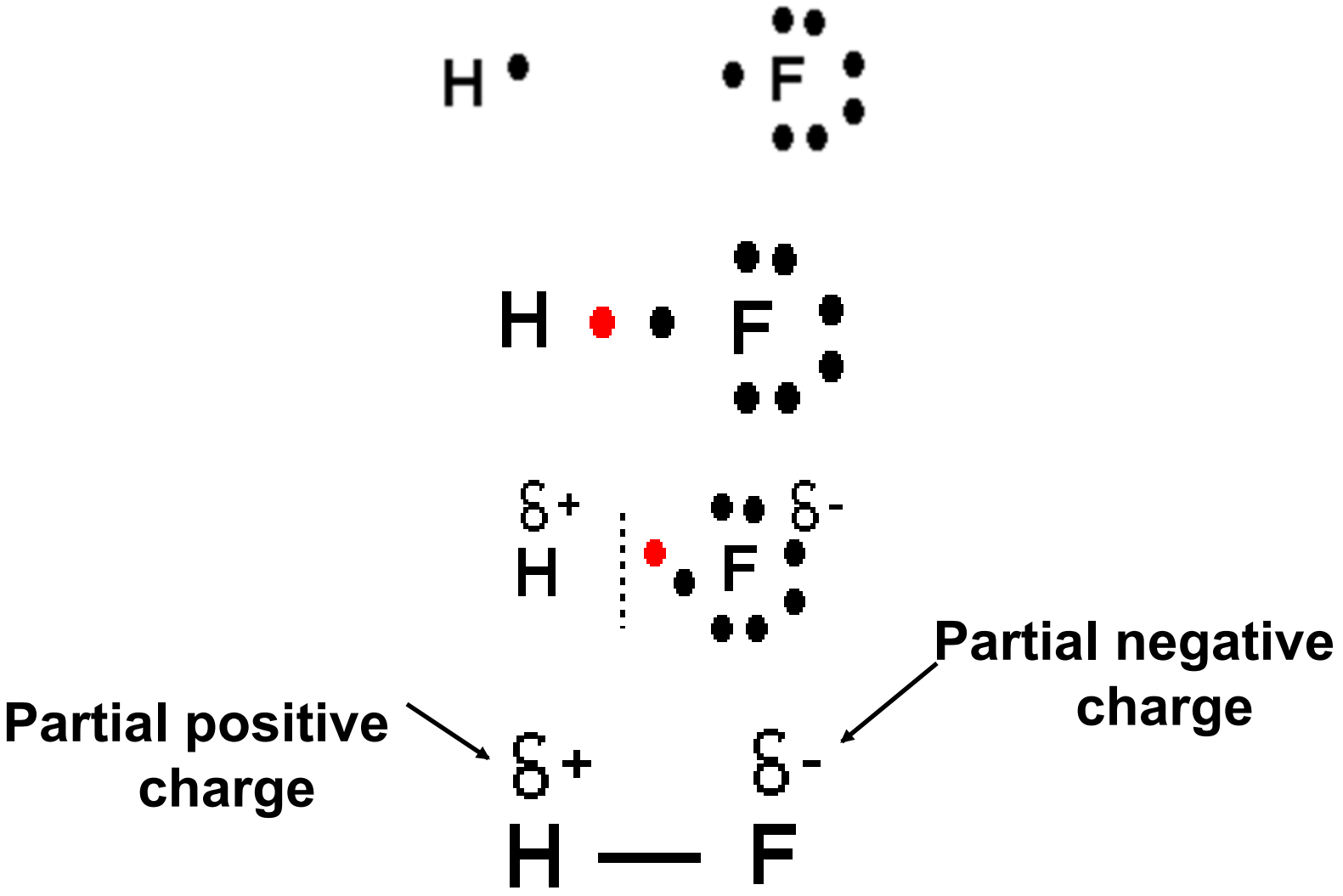


Noble gases do not have e-neg values

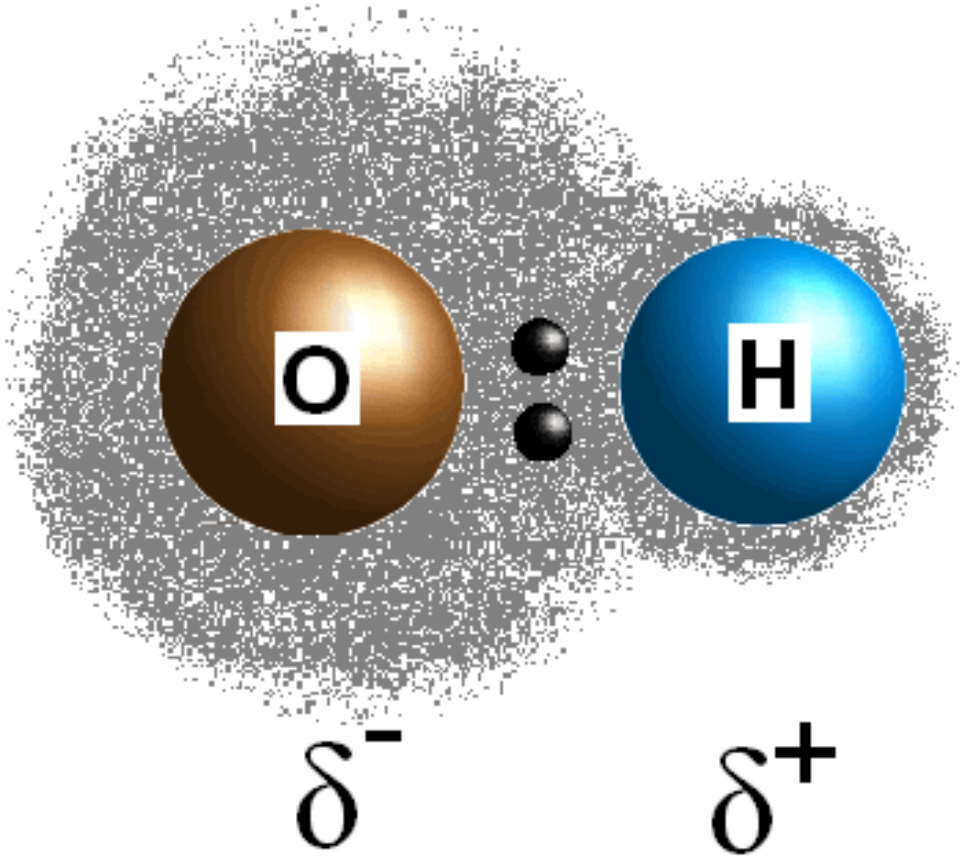
Covalent bonding involves a sharing of valence electrons.

But, the sharing may not be equal.

The more electronegative atom attracts electrons more, causing a slightly negative charge (δ^-) on it.

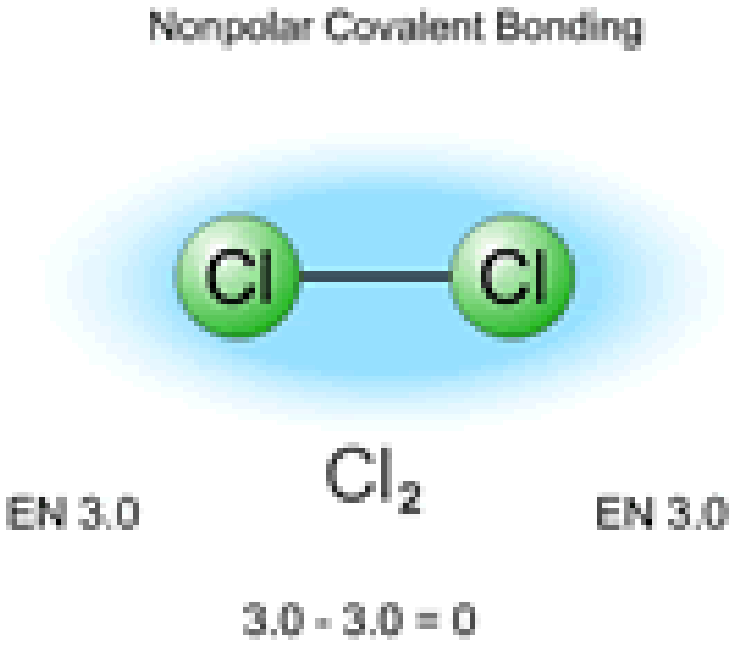


Polar Covalent Bond (polar bond) – covalent bond in which the electrons are shared unequally.



A **nonpolar** covalent bond occurs between 2 identical atoms.

Since each atom in a nonpolar bond has the same electronegativity, the electrons are shared equally.



7 diatomic molecules (H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2)

The polar nature of a bond can also be shown by an arrow pointing to the more electronegative atom.

H—Cl

In our class, the bond between 2 atoms can only be

1)Ionic – b/w metal & nonmetal

2)Polar Covalent – b/w 2 different nonmetals

3)Nonpolar Covalent – b/w 2 identical nonmetals

4)Metallic – b/w 2 metals

Identify the bonds between these elements as ionic, polar covalent or nonpolar covalent.

a)H – Br b) K – Cl

c)C – O d) Li – O

e)Cl – F f) Br – Br

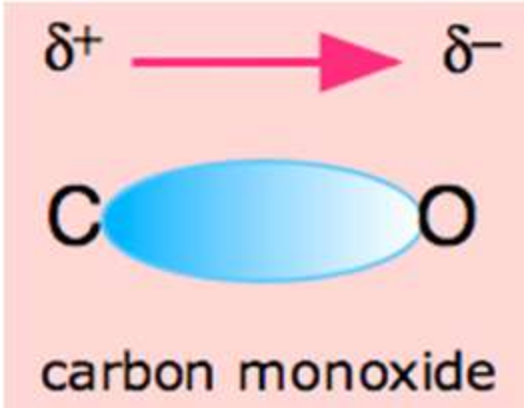
g)H – Oh) H – Mg

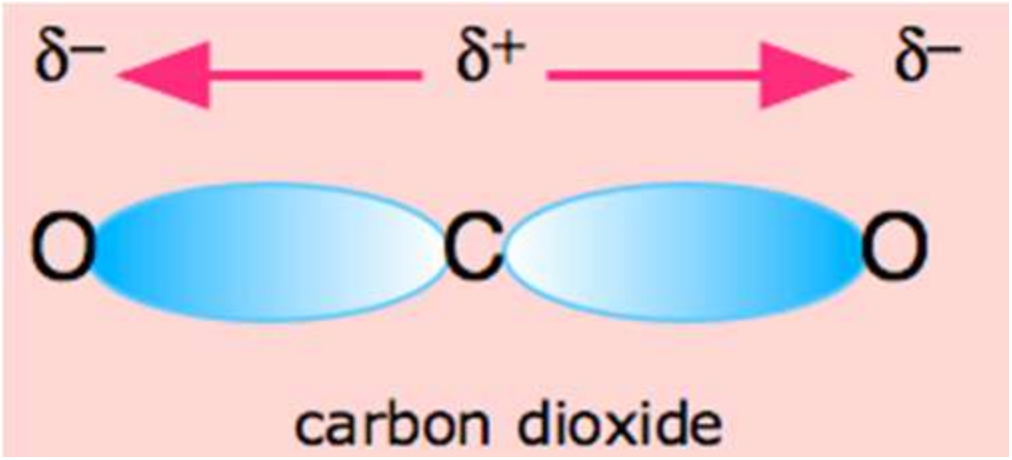
Place a δ^- symbol above the more electronegative atom in the bond.

The polar bonds cause a molecule to be polar or nonpolar

A polar molecule is also called a **dipole**

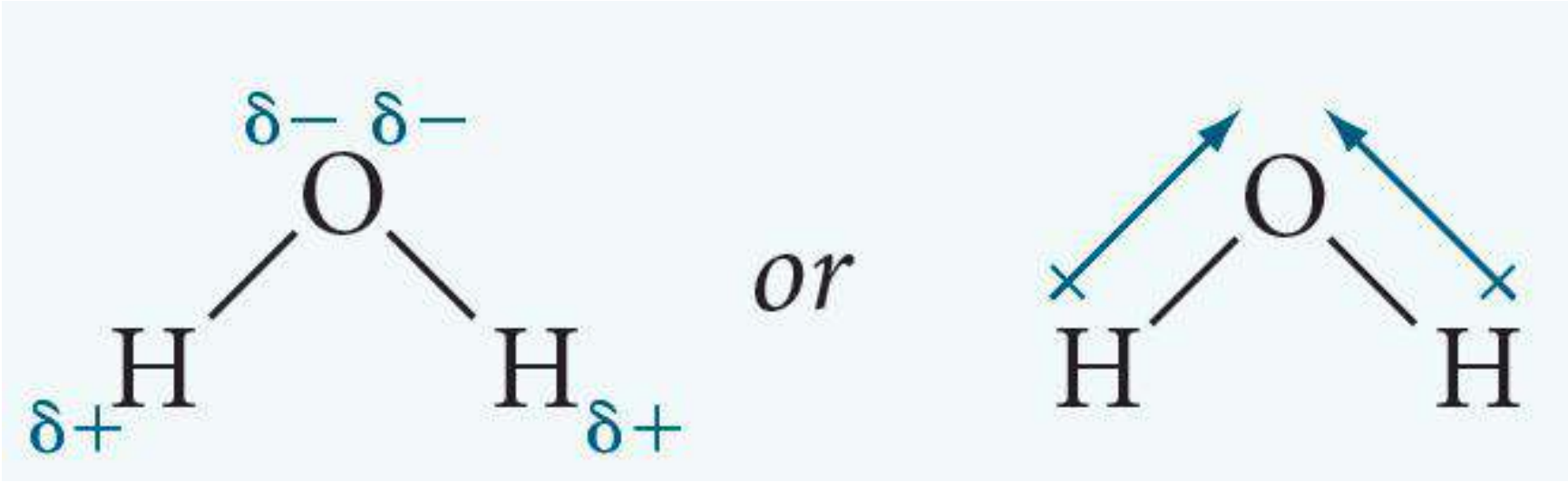
Carbon dioxide is a nonpolar molecule although it contains polar bonds.





The polar bonds cancel out in this case.

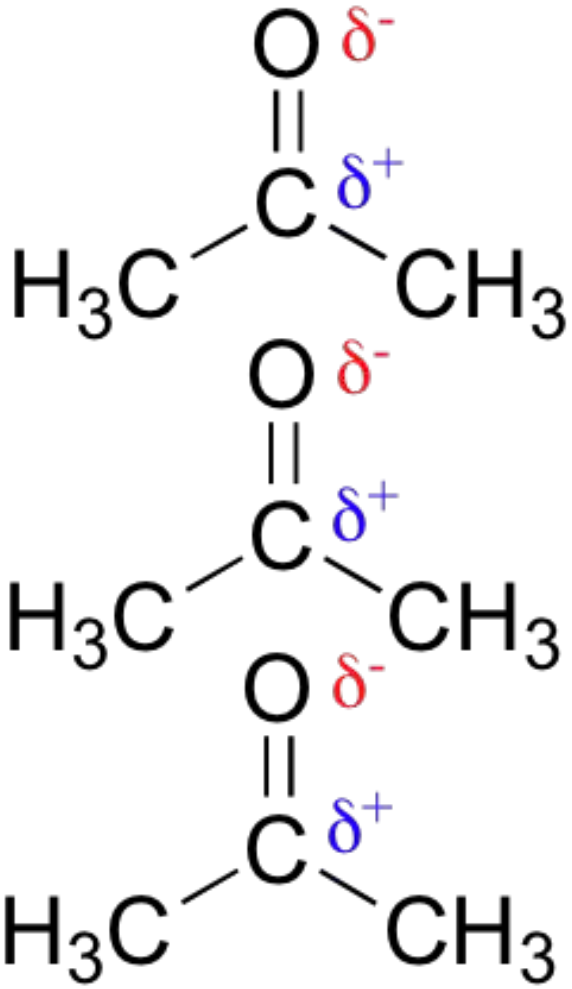
Water is a polar molecule since its partial charges do not cancel out.



Intermolecular Attractions – attractive forces between separate molecules; also called van der Waals Forces

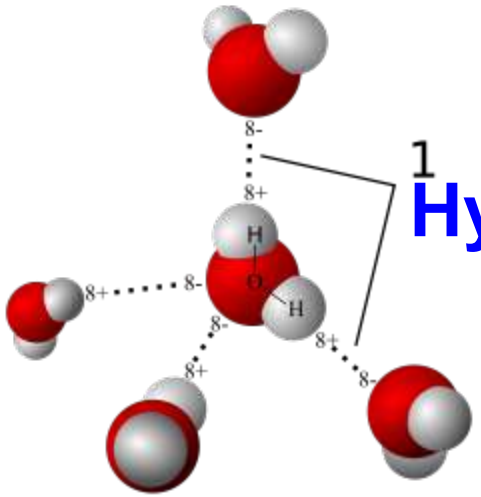
These attractive forces are much weaker than ionic or covalent bonds, but without these attractions, solid and liquid matter would not exist.

1. Dipole Interactions – occurs when polar molecules are attracted to one another.

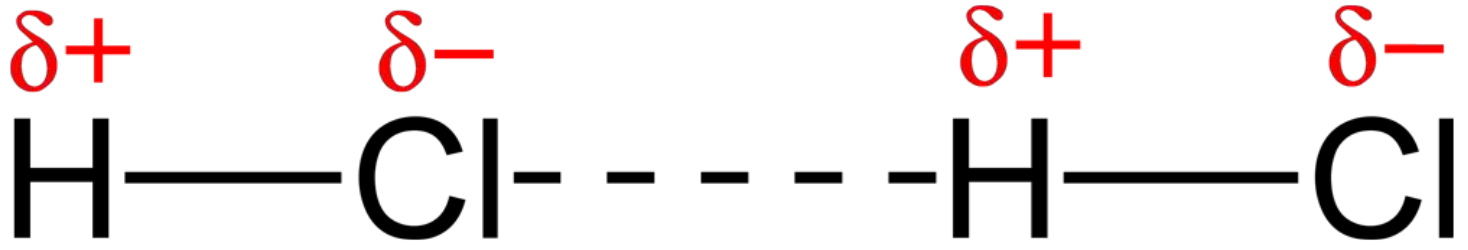


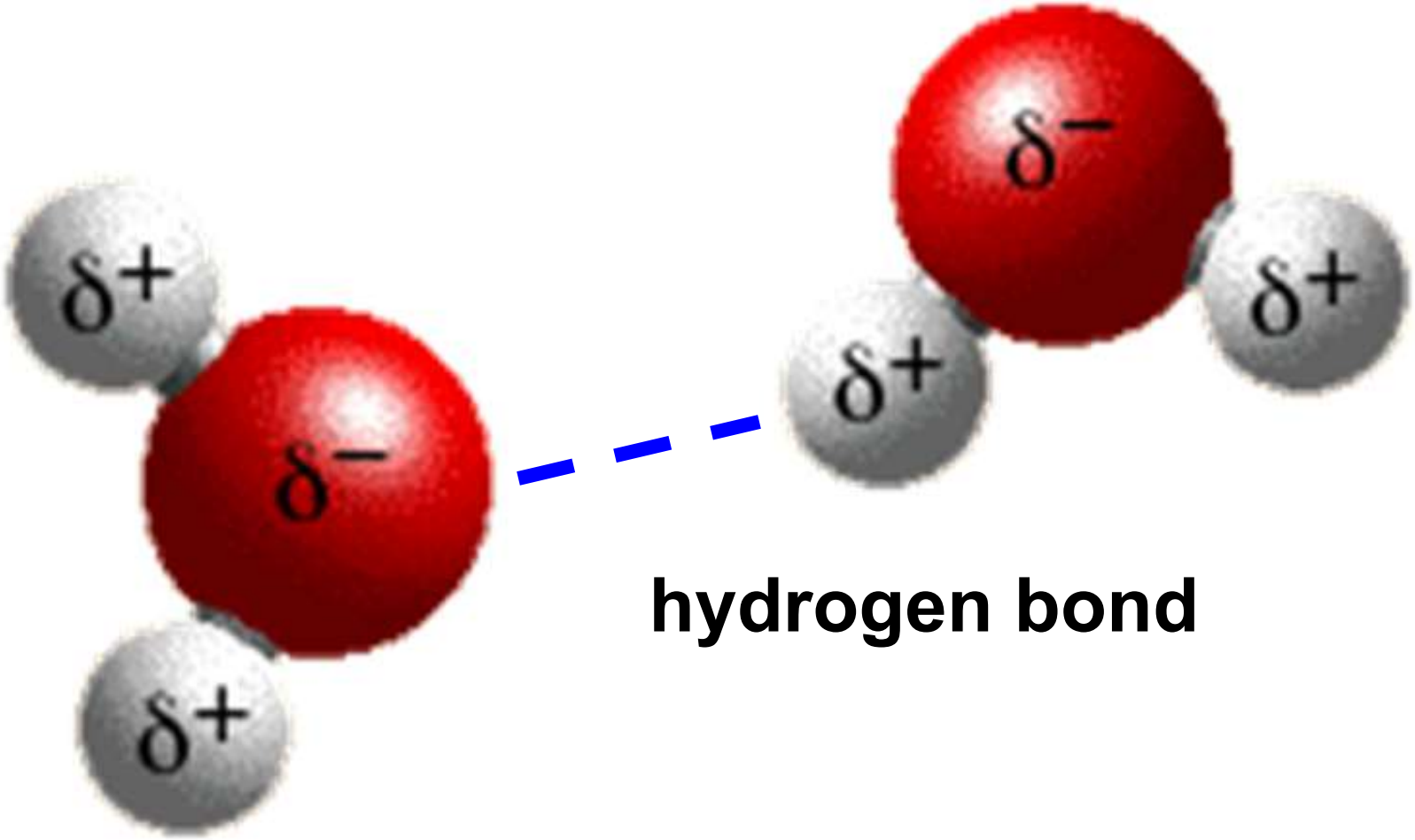
3 acetone molecules attracting each other.

Hydrogen Bond – strong intermolecular attractive force between H in one molecule and an electronegative atom in another nearby molecule.



Hydrogen Bonds in H_2O



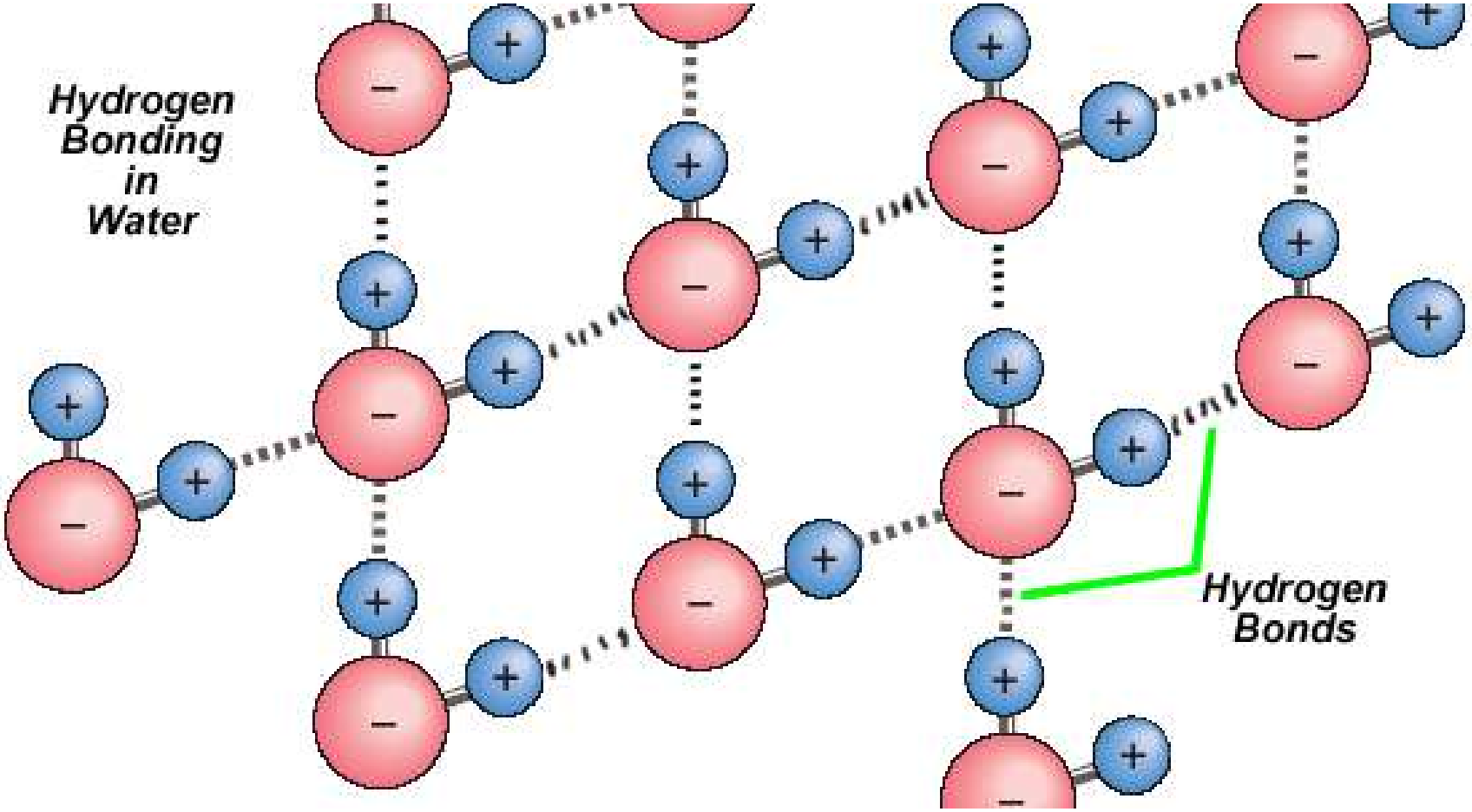


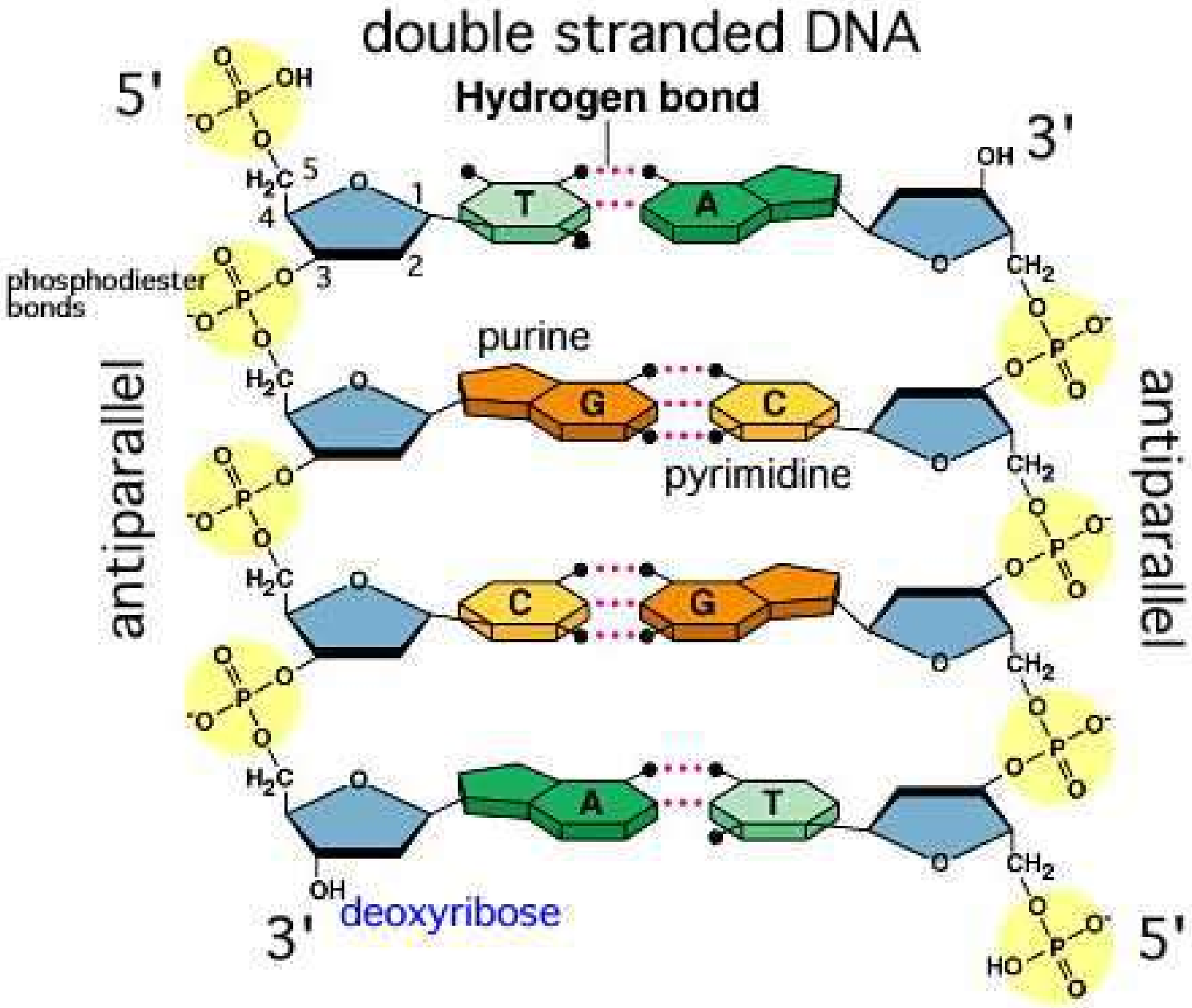
hydrogen bond

The slightly charged atoms on separate water molecules create an attractive force between them.

Cohesion – attraction to same substance.

Adhesion – attraction to different substance


Hydrogen Bonding in Water
Hydrogen Bonds


double stranded DNA
Hydrogen bond
5'
3'
phosphodiester bonds
purine
pyrimidine
antiparallel
antiparallel
T
A
G
C
C
G
A
T
3'
deoxyribose
5'

ASSIGN: Read Dispersion Forces (p. 251)

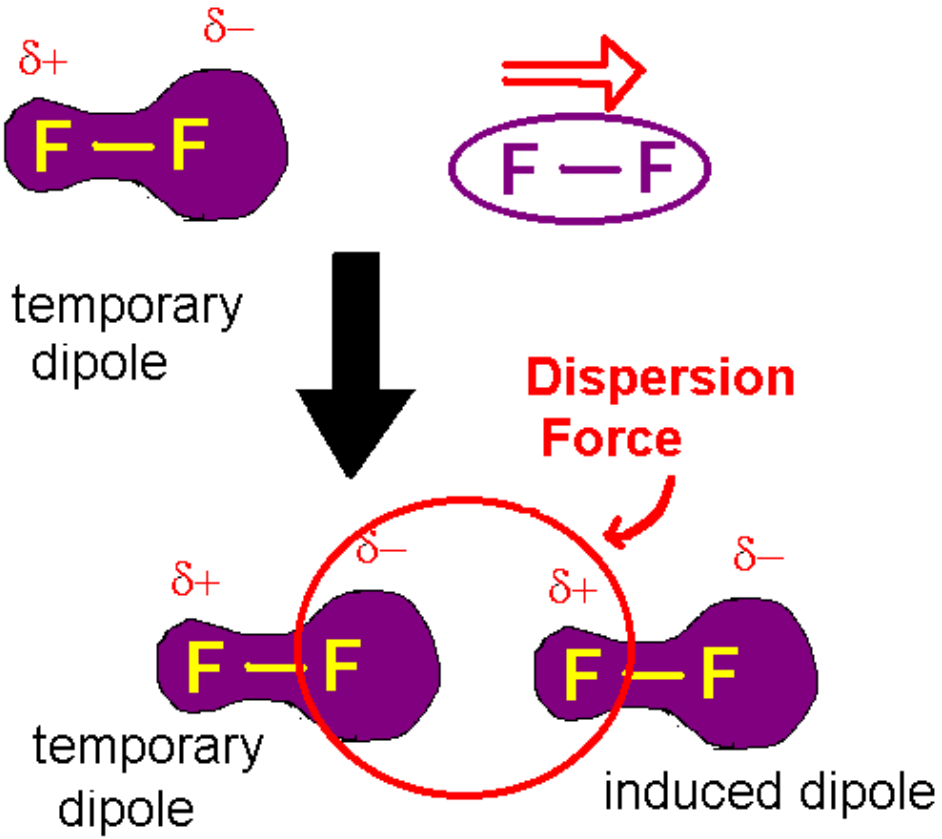
1. What is a dispersion force?

2. What causes dispersion forces between molecules?

3. Which molecules do dispersion forces occur in?

4. Which types of molecules are dispersion forces most important?

2. Dispersion Forces – temporary attractive forces between molecules due to random electron motion (London forces)



F_2 melts at 53 K, Boils at 85 K

Without dispersion forces, nonpolar molecules could never be liquids or solids.

Molecule	Melt Pt	Boil Pt
F_2	53 K	85 K
Cl_2	171.6 K	239.1 K
Br_2	265.8 K	332.0 K
I_2	386.8 K	457.4 K

Cohesion – attraction to same substance.

Adhesion – attraction to different substance

Chapter 8 ASSIGNMENT

#29-38 & 64-68 page 256, 257