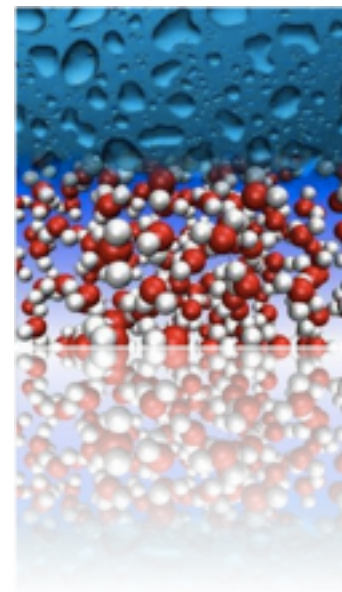
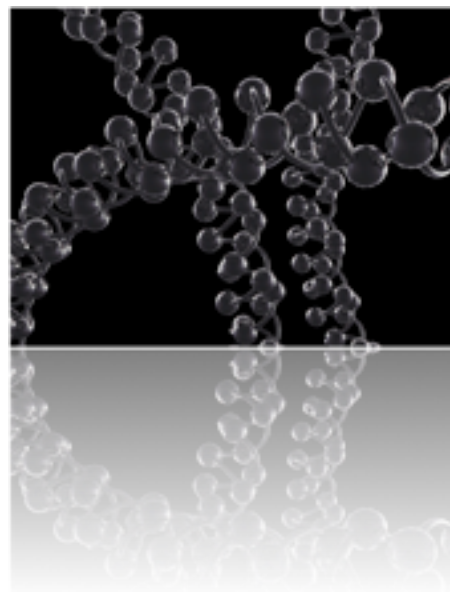
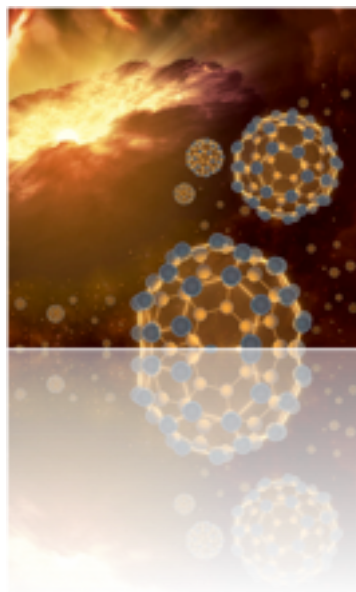
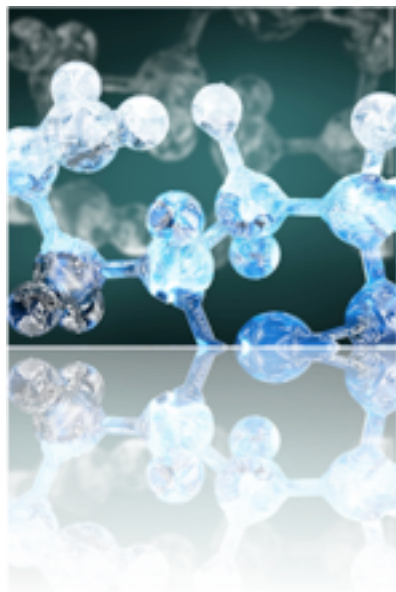


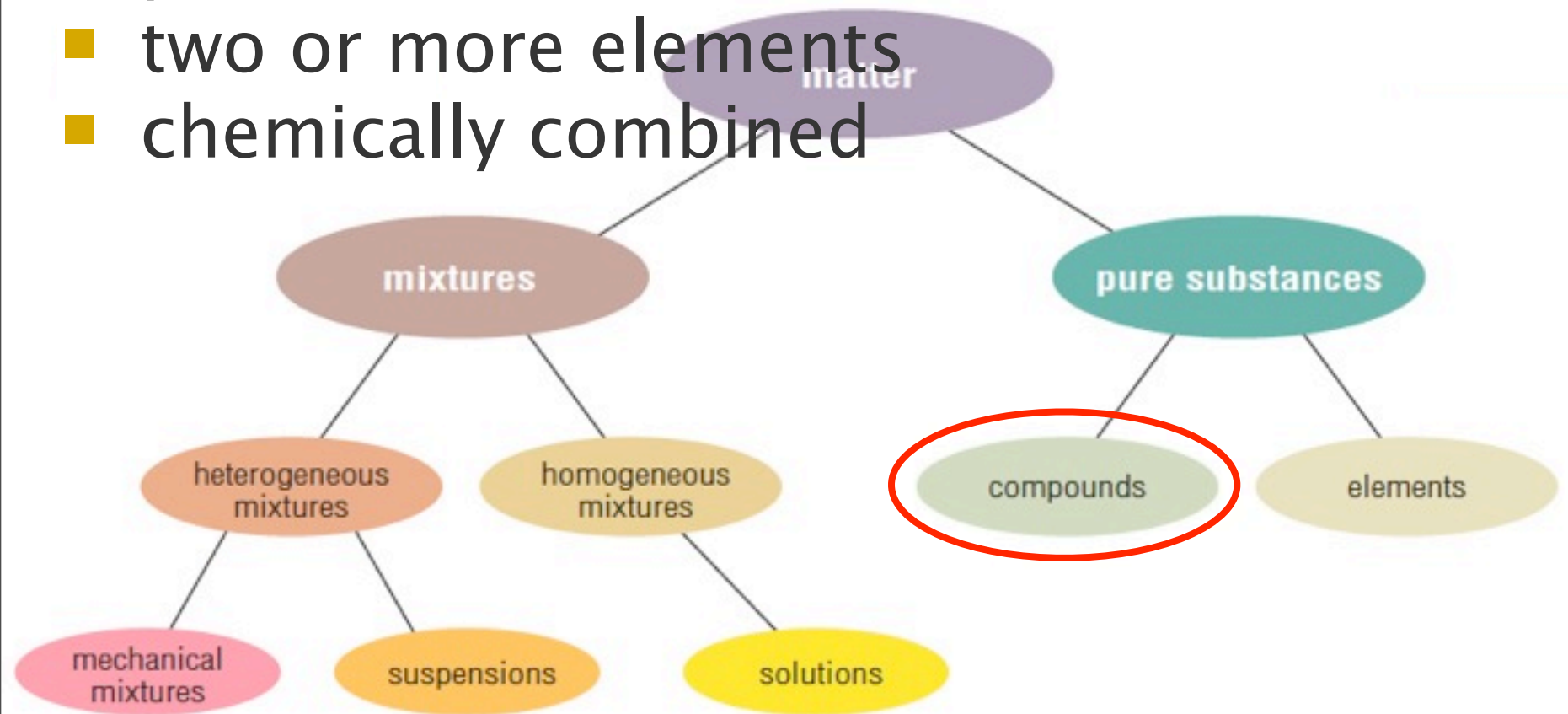
Molecular Compounds



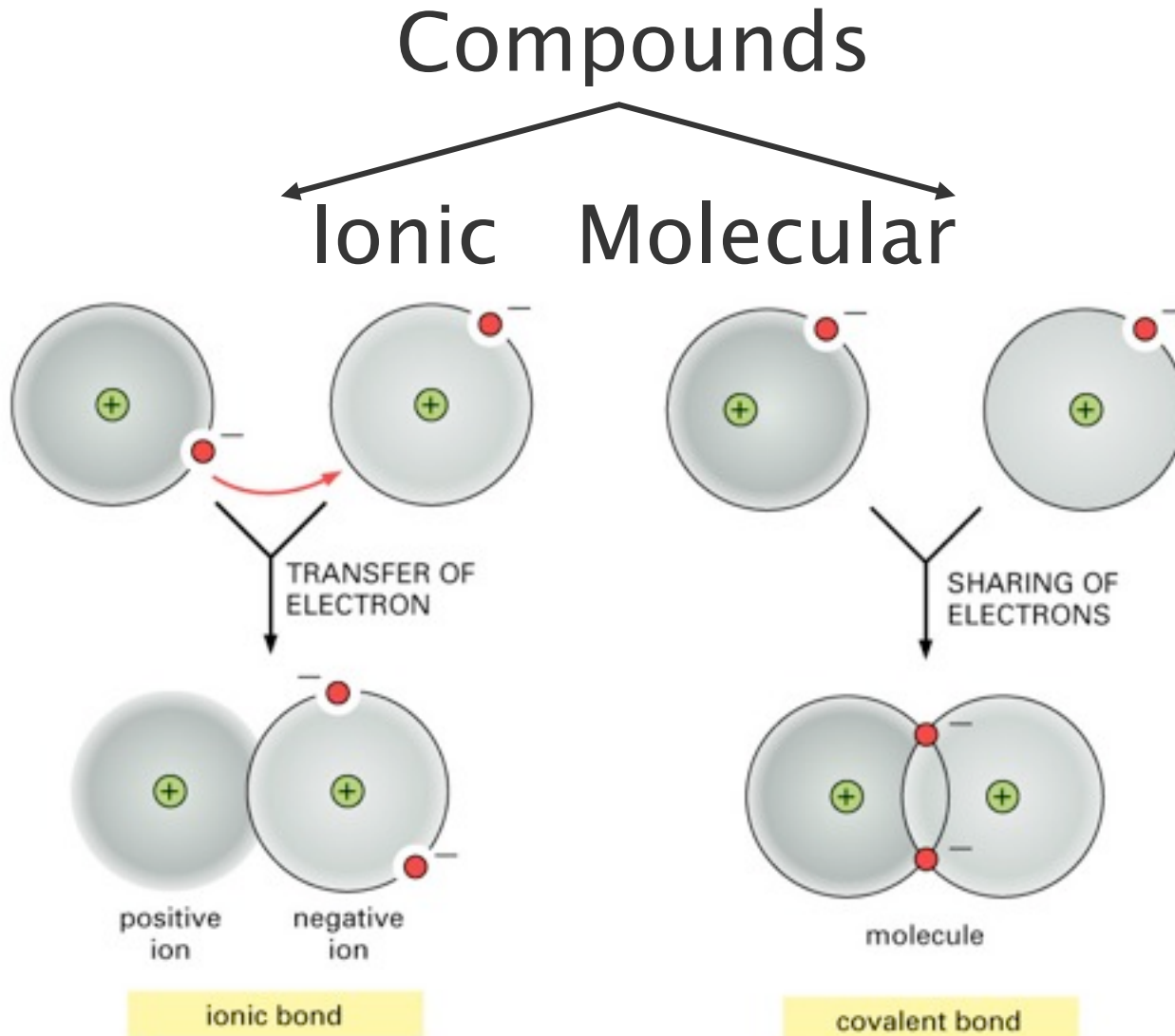
Review: Classification of Matter

Definition of compound:

- pure substance
- two or more elements
- chemically combined



Types of Compounds



Examples of Molecular Compounds

- Gases: H₂, O₂, CO₂, H₂O, N₂, ozone

Examples of Molecular Compounds



[Propane gas explosion aftermath in Florida \(July 30, 2013\)](http://blogs.ft.com/photo-diary/tag/propane-tanks/) <http://blogs.ft.com/photo-diary/tag/propane-tanks/>
Firefighters walk among thousands of exploded propane cylinders that litter the storage yard of a propane plant after massive explosions overnight in the plant's yard, in Tavares, Florida. Dozens of explosions rocked the propane tank servicing plant northwest of Orlando, late on Monday, injuring seven workers, at least three critically, and prompting the evacuation of nearby homes, authorities said.

- Hydrocarbons: methane (CH_4), propane (C_3H_8), butane (C_4H_{10}), octane (C_8H_{18})

Examples of Molecular Compounds

- Alcohols: ethanol (C_2H_6O), isopropanol (C_3H_8O)



Examples of Molecular Compounds

- Carbohydrates:
 $C_6H_{12}O_6$ (glucose, fructose), sucrose, starch



Examples of Molecular

- Most biological molecules: enzymes, proteins, fats, DNA



Examples of Molecular Compounds

- Most things that you eat: chocolate, caffeine, Tylenol

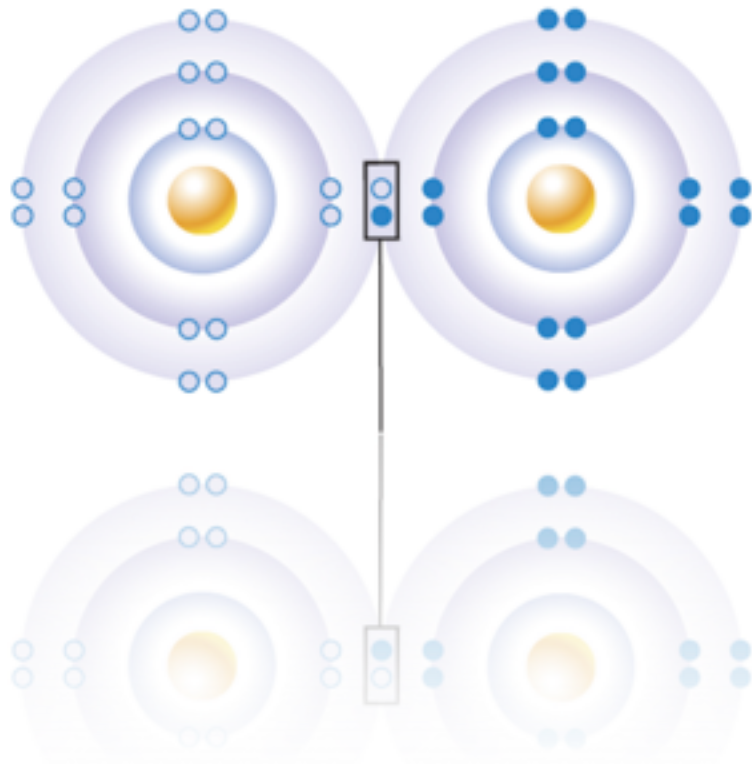


Properties of Molecular Compounds



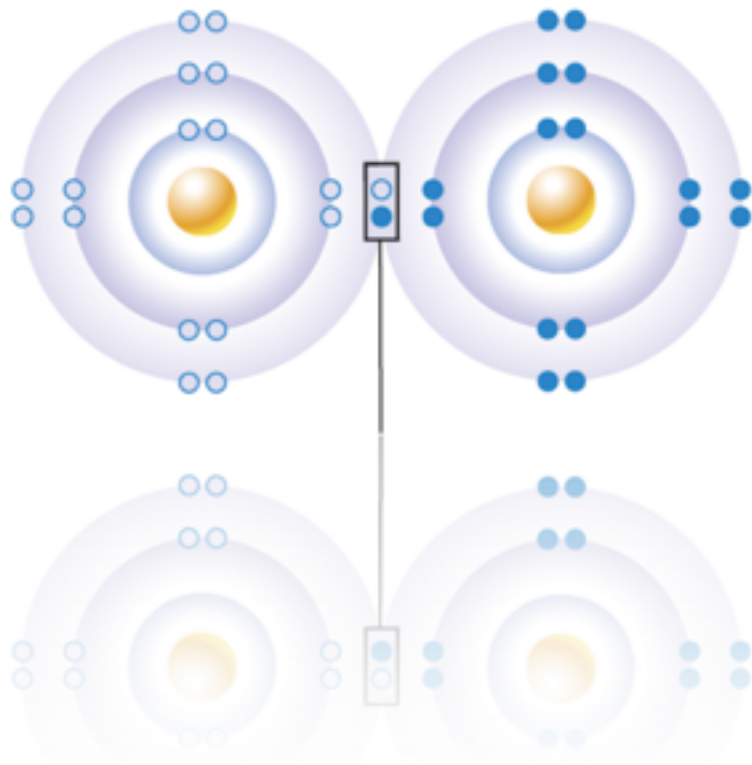
- soft
- low melting point
- solutions do not conduct electricity

Molecular Compound



- A molecular compound (or molecule) is a combination of two or more atoms held together by **covalent** bonds

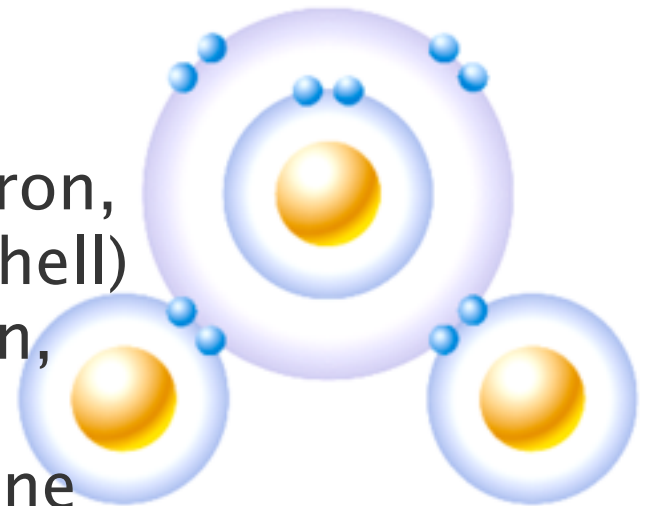
Covalent Bonds



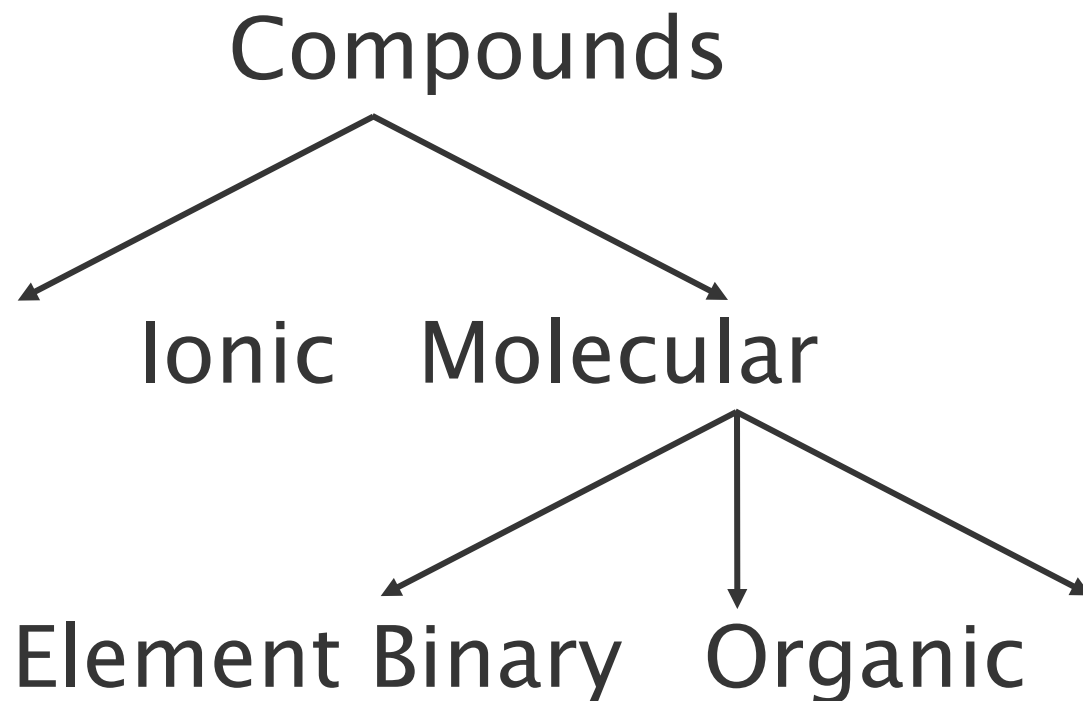
- occurs between the atoms of non-metals
- two atoms share a pair of electrons
- each bond represents a single pair of shared electrons

Covalent Bonds

- Electrons are shared so that the valence shell for each atom can be full.
- For example: water
 - Hydrogen has 1 valence electron, need 1 more to be full (first shell)
 - Oxygen has 6 valence electron, need 2 more to be full
 - Each hydrogen atom shares one pair of electrons with an oxygen atom
 - Each hydrogen atom now has 2 electrons
 - The oxygen now has 8 electrons in



Types of Compounds



Molecular Elements

Element	Formula
bromine	Br ₂
chlorine	Cl ₂
fluorine	F ₂
hydrogen	H ₂
iodine	I ₂
nitrogen	N ₂
oxygen	O ₂

- When two or more atoms of the **same** element combine
- A **diatomic** molecule is a molecule that naturally exists as two of the same atoms

Diatomic Mnemonic

- HOFBrINCl

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra																

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Molecular Compounds



- When atoms of two or more **different** non-metals combine
- Binary compounds consists of only 2 types of non-metals

Naming Binary Molecular Compounds

Number of Atoms	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-
6	hexa-
7	hepta-
8	octa-
9	nona-
10	deca-

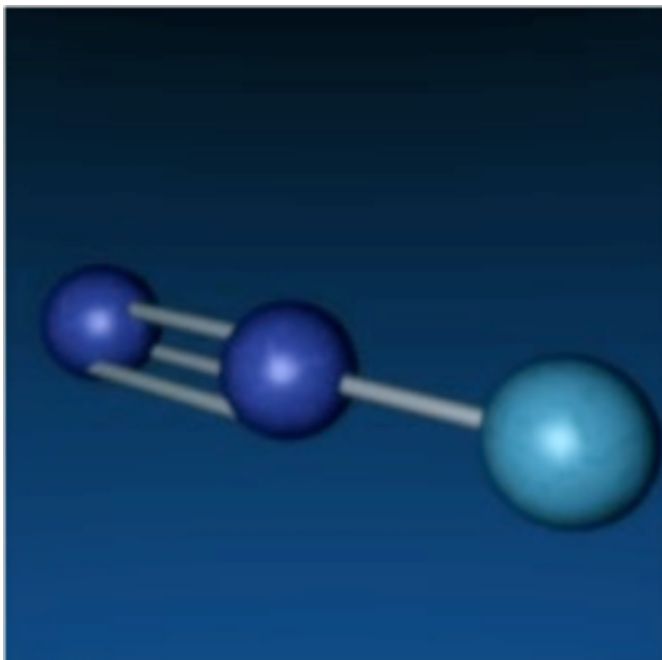
- For compounds that do not contain hydrogen:
 - Name the first element
 - Name the second element and change the ending to “-ide”
 - add prefixes to indicate the number of each

Naming Binary Molecular Compounds

Number of Atoms	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-
6	hexa-
7	hepta-
8	octa-
9	nona-
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- The prefix “mono” is not used when there is only one atom of the first element
- When “mono” is being added to oxygen, the last “o” is dropped
- Example:
“monoxide” not

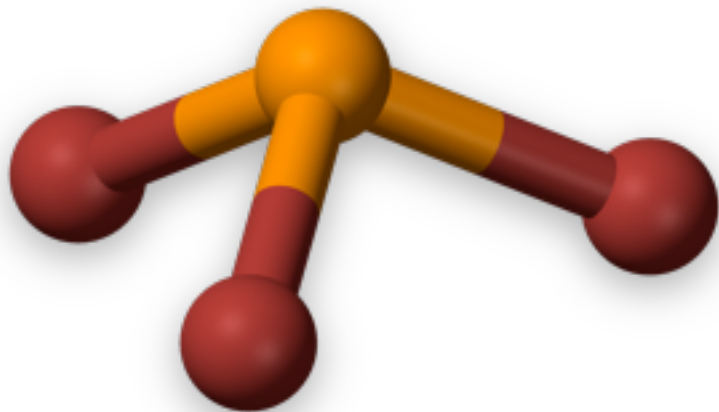
Naming Binary Molecular Compounds



Example 1: N₂O

- Name the first element: **nitrogen**
- Name the second element using “-ide”:
oxide
- Add prefixes:
dinitrogen monoxide

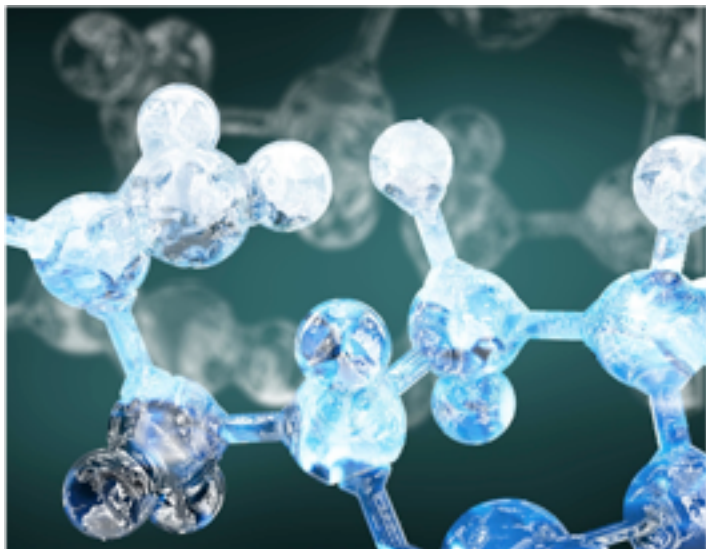
Naming Binary Molecular Compounds



Example 2: PBr₃

- Name the first element:
phosphorous
- Name the second element using “-ide”:
bromide
- Add prefixes:
**phosphorous
tribromide**

Naming Molecular Compounds



- Hydrogen is unique in many ways, and this is reflected in the naming systems
- Many compounds containing hydrogen have been given simpler names
- For example, dihydrogen monoxide (H₂O) is simply called “water”

Naming Molecular Compounds

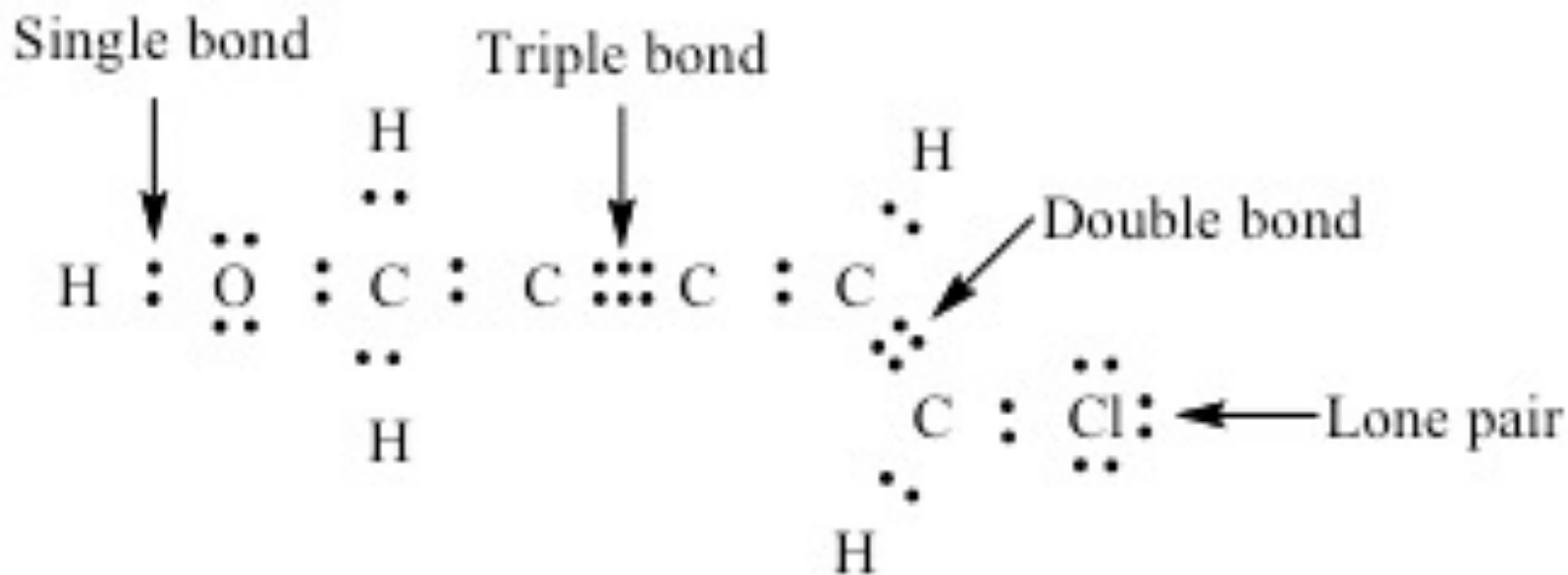
Name	Formula
water	H ₂ O
hydrogen peroxide	H ₂ O ₂
ammonia	NH ₃
methane	CH ₄

Molecular Compound Diagrams

- Lewis Dot Diagram
- Structural Diagram
- Line Diagram (Grade 10 MaCS)

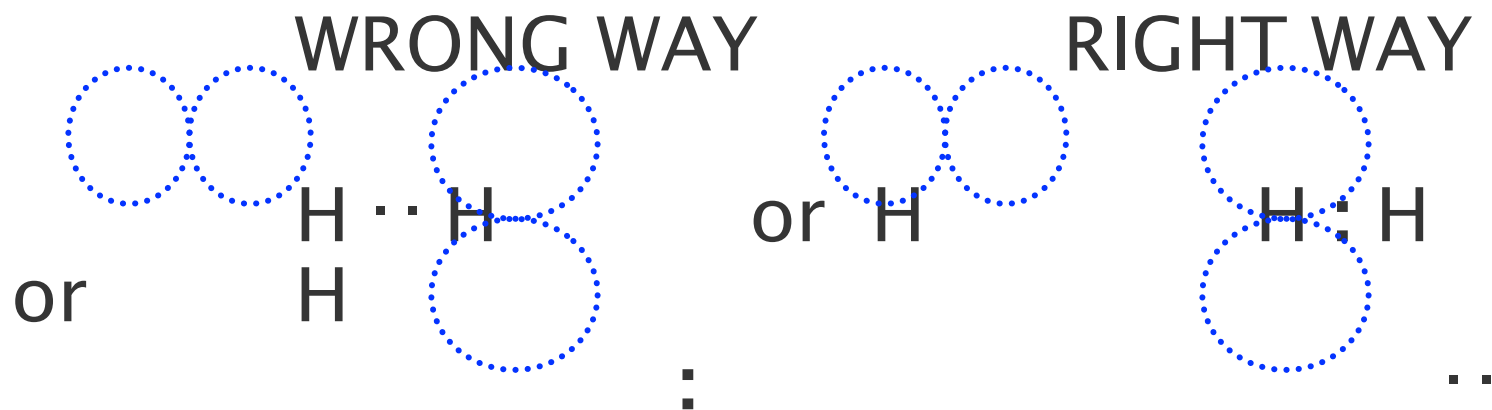
Lewis Dot Diagram

- An example:



Lewis Dot Diagram

- Recall: only valence electrons are shown
- only **UNPAIRED** electrons can be **shared**
- Arrangements of electrons around the element name must take on the same orientation as if there was an imaginary orbital ring around the atoms



Lewis Dot Diagram

- Recall: only valence electrons are shown
- only **UNPAIRED** electrons can be **shared**
- Arrangements of electrons around the element name must take on the same orientation as if there was an imaginary orbital ring around the atoms
- Practice: Draw the Lewis Dot Diagram for CH₄

Lone Pairs

- Pairs of electrons that are NOT shared
- Exists as part of ONE atom

- Practice:
 - Draw the Lewis Dot diagram for H₂O and NH₃
 - Which atom in each molecule has lone pairs?

Lewis Dot Diagram

- Sometimes atoms share more than one unpaired electron
- When this happens you get a double or triple bond
- Example: Draw the Lewis Dot diagram for CO₂

Practice

- Draw Lewis Dot Diagrams for these:
 - PBr₃
 - CS₂
 - CH₃OH
 - C₃H₈O
 - CHN

Drawing Molecular Compounds

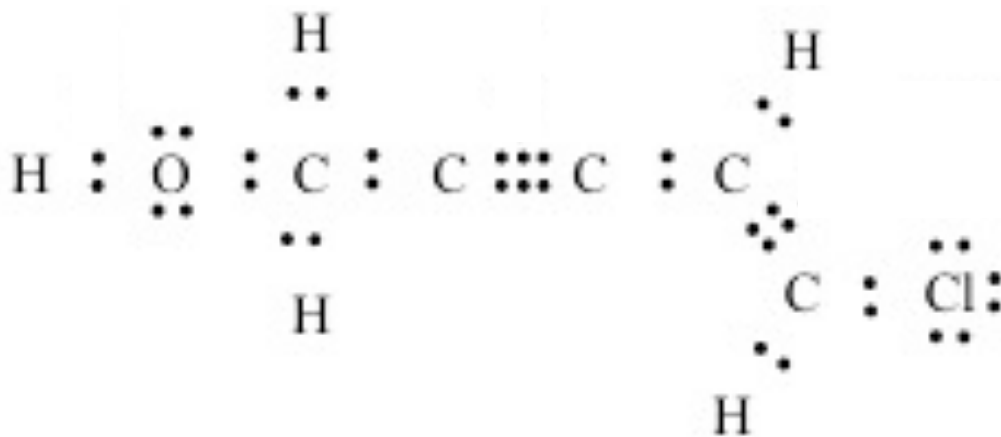
- Lewis diagrams can be quite time consuming and is difficult to read and thus most textbooks use alternate forms of representation:
 - Structural diagrams
 - Line diagrams

Structural Diagram

- Each **pair** of **shared** electrons (2 electrons) is replaced with a **single line** segment connecting the two atoms
- Each single line represents a **bond**
- If two atoms share 4 electrons (2 pairs), then you would use 2 line segments (like an equal sign) representing double bonds
- Lone pairs of electrons are NOT shown

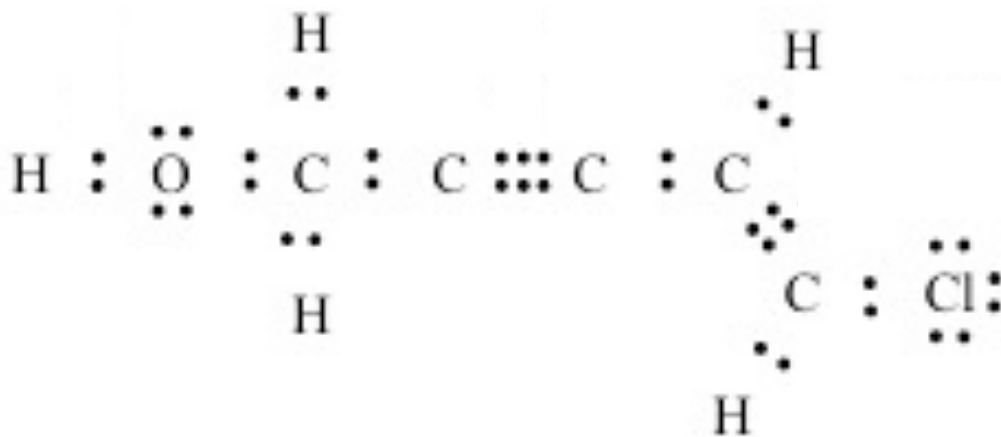
Structural Diagram

- Practice: translate this Lewis Dot diagram into a structural diagram



What pattern did you see?

- Notice the number of line segments that each atom (C, H, O) can make.



Summary

Atom	# of valence	# of unpaired electrons (can be	# of bond
H			
O			
N			
C			