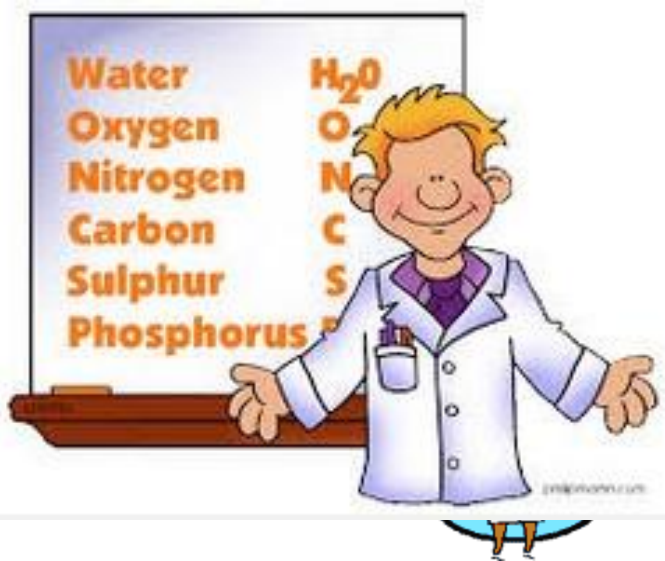
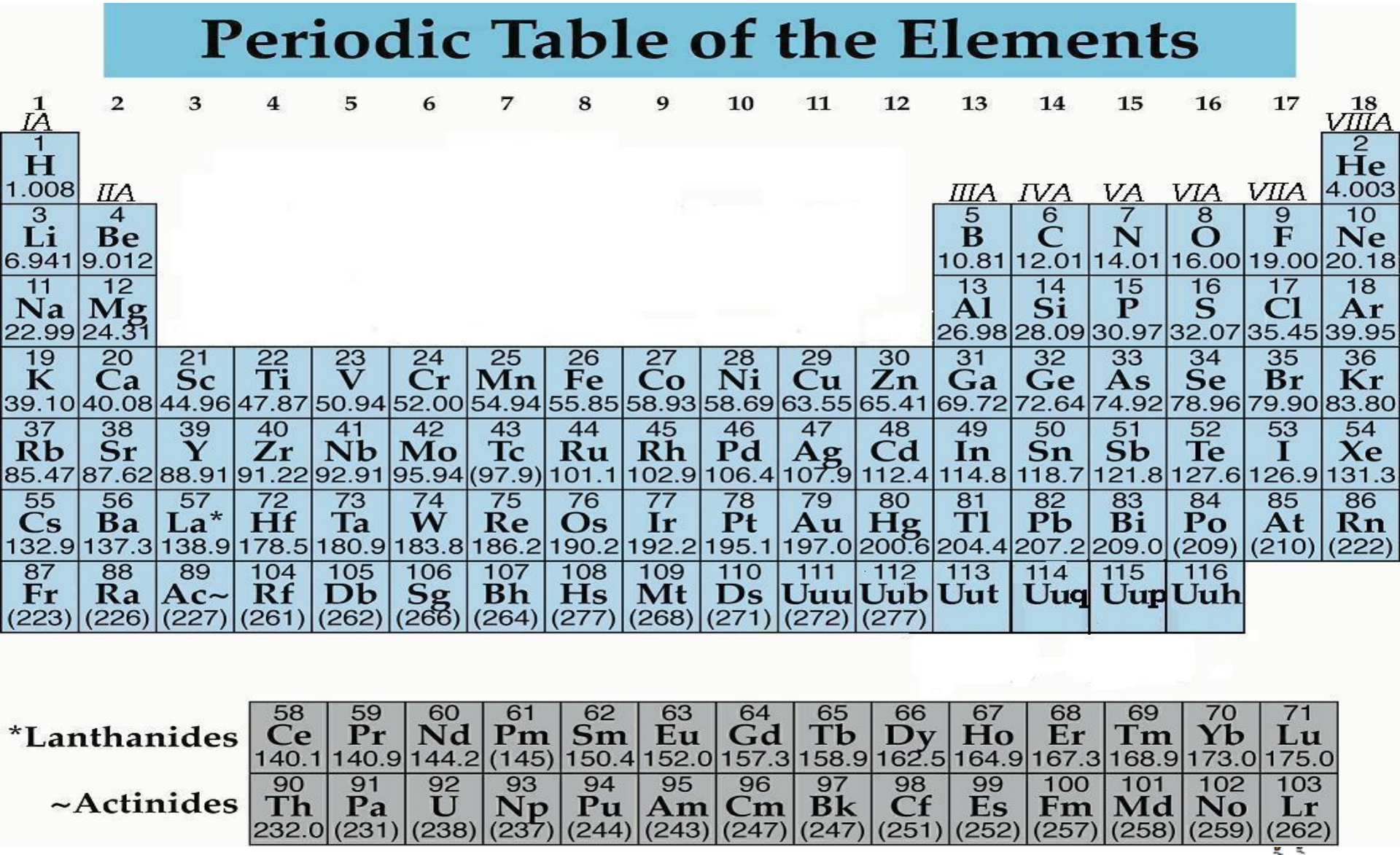
Science 9

Unit 2:Chemistry

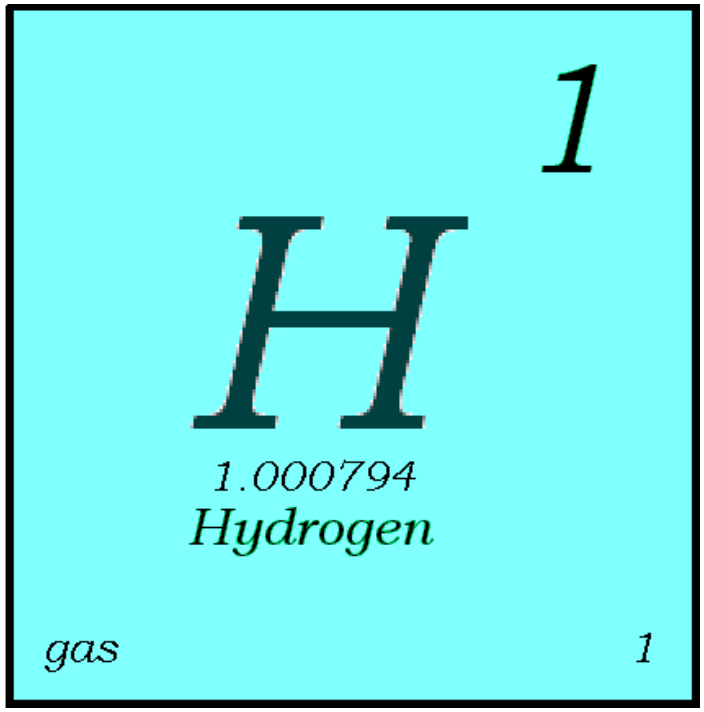
Topic 7: Periodic Table and Atomic Structure



How do you read the PERIODIC TABLE?

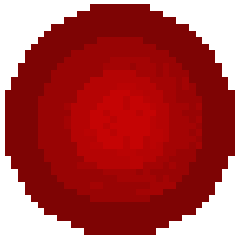


Key to the Periodic Table



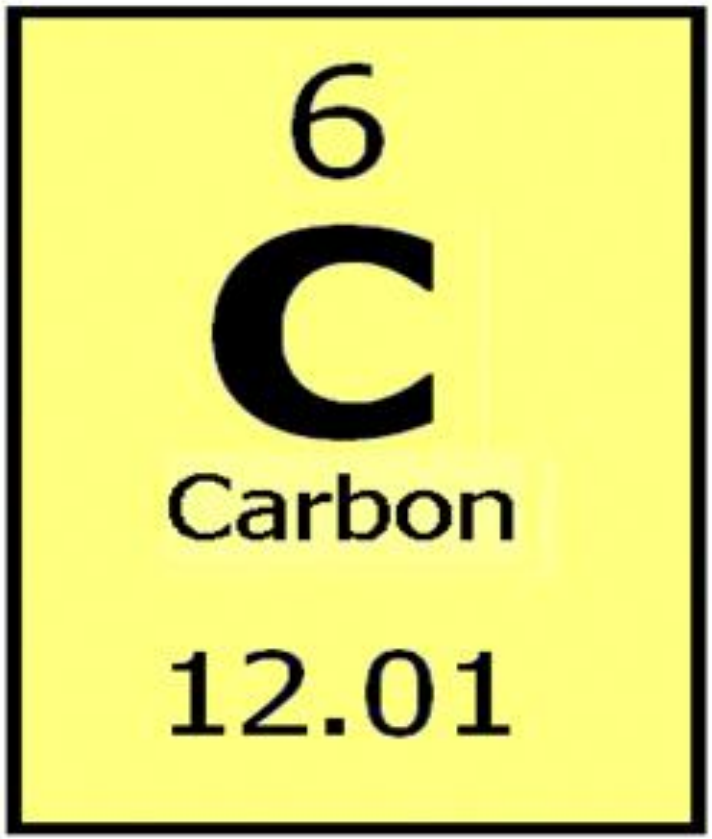
- Elements are organized on the table according to their atomic number, usually found near the top of the square.
  - **The atomic number** refers to how many protons an atom of that element has.
  - For instance, hydrogen has 1 proton, so it's atomic number is 1.
  - The atomic number is unique to that element. No two elements have the same atomic number.

Atomic Number



- This refers to how many protons an atom of that element has.
- No two elements, have the same number of protons.

What's in a square?



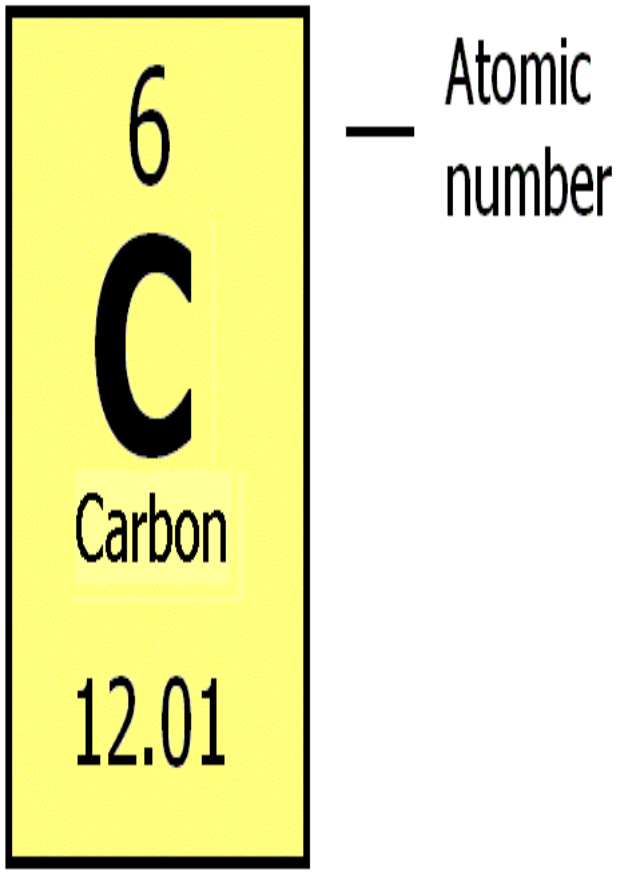
Atomic number

Symbol

Name

Atomic mass

What is the ATOMIC NUMBER?



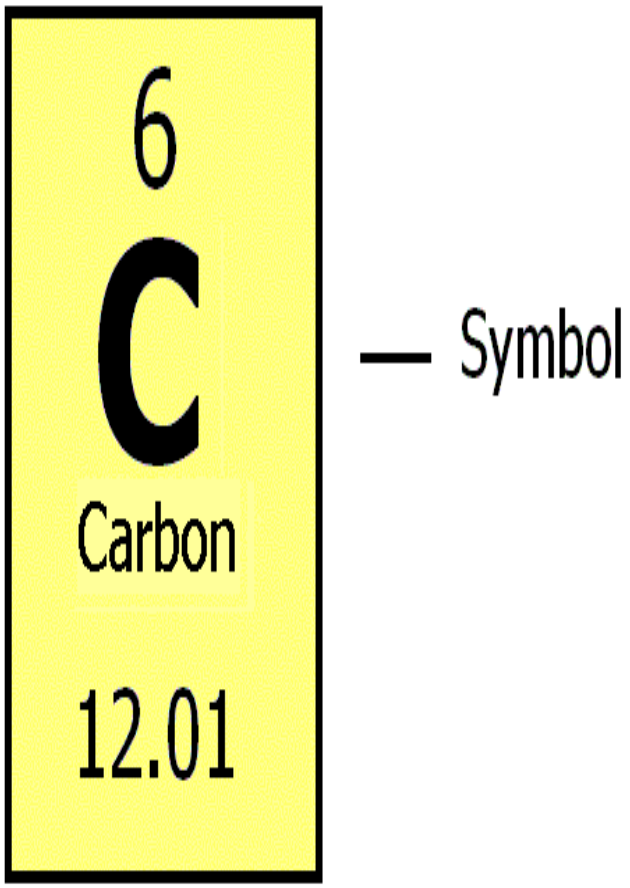
- The number of protons found in the nucleus of an atom

Or

- The number of electrons surrounding the nucleus of an atom.

What is the SYMBOL?

- An abbreviation of the element name.



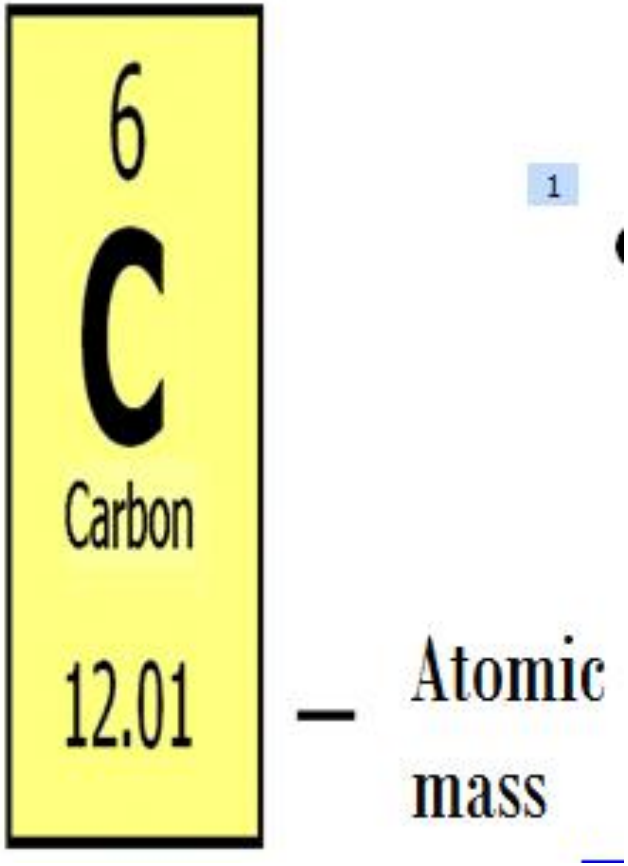
Symbols

C **Carbon**

Cu **Copper**

- All elements have their own unique symbol.
- It can consist of a single capital letter, or a capital letter and one or two lower case letters.

What is the ATOMIC Mass?

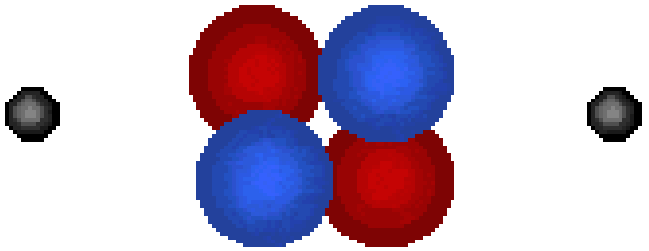


- The number of protons and neutrons in the nucleus of an atom.

Also referred to as Atomic Weight

Atomic Mass

- Atomic Mass refers to the “weight” of the atom.
- It is derived at by adding the number of protons with the number of neutrons.



He

This is a helium atom. Its atomic mass is 4 (protons plus neutrons).

What is its atomic number?

How do I find the number of protons, electrons, and neutrons in an element using the periodic table?

# of PROTONS = ATOMIC NUMBER

# of ELECTRONS = ATOMIC NUMBER

# of NEUTRONS = ATOMIC WEIGHT − ATOMIC NUMBER

ATOMIC FORMULA

4 **Atomic mass** the number of protons and neutrons in an atom

He

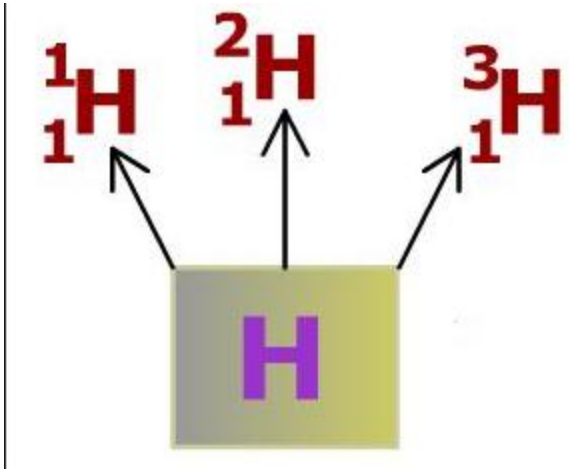
2 **Atomic number** the number of protons in an atom

number of electrons = number of protons

Science 9

Unit 2:Chemistry

Topic 8: Isotopes



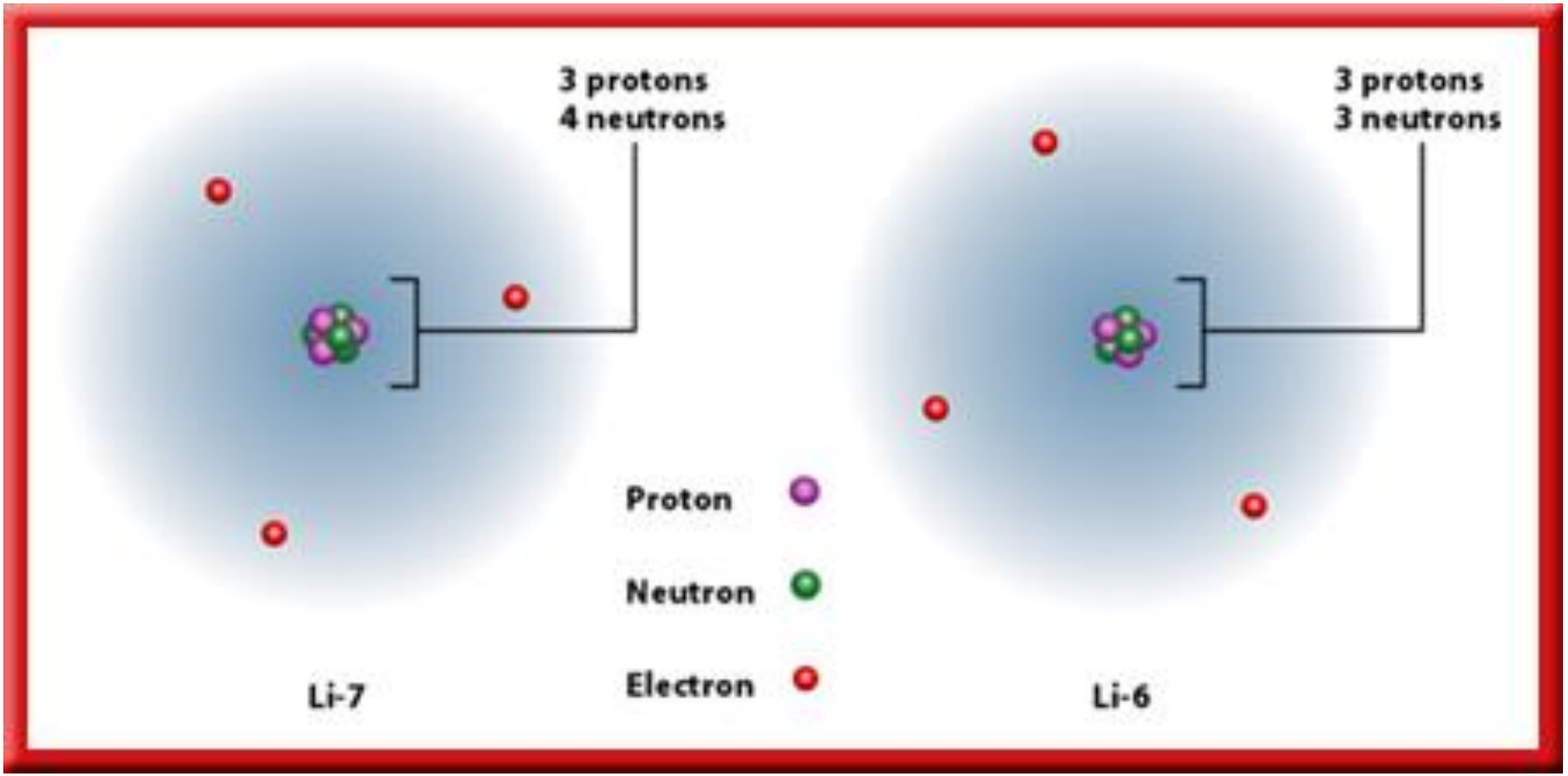
Isotopes

- Isotopes are atoms of the same elements that contain different numbers of neutrons.

Isotopes of chlorine

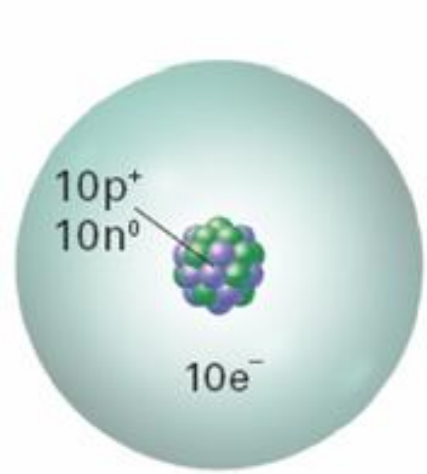
$^{35}_{17}Cl$ $^{37}_{17}Cl$

chlorine - 35 **chlorine - 37**

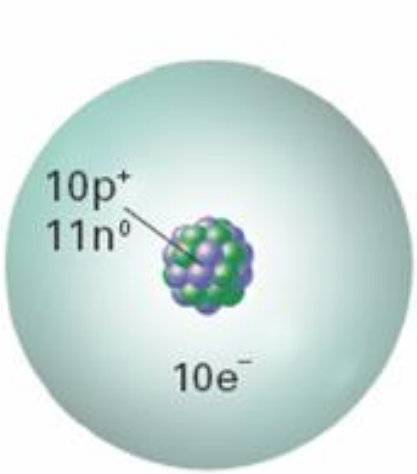

3 protons
4 neutrons
3 protons
3 neutrons
Proton
Neutron
Electron
Li-7
Li-6

Isotopes

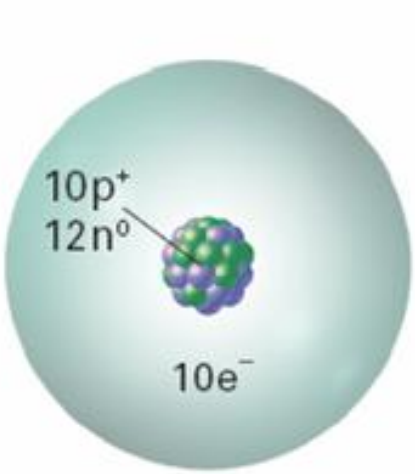
Despite these differences, **isotopes are chemically alike** because they have identical numbers of protons and electrons.



Neon-20
10 protons
10 neutrons
10 electrons

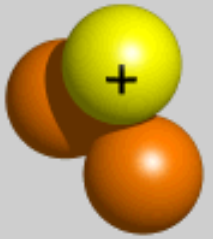


Neon-21
10 protons
11 neutrons
10 electrons



Neon-22
10 protons
12 neutrons
10 electrons

Isotopes

Isotope	Protons	Electrons	Neutrons	Nucleus
Hydrogen-1	1	1	0	
Hydrogen-2	1	1	1	
Hydrogen-3	1	1	2	

Learning Check

Naturally occurring carbon consists of three isotopes, ^{12}C, ^{13}C, and ^{14}C. State the number of protons, neutrons, and electrons in each of these carbon atoms.

	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
#P	_____	_____	_____
#N	_____	_____	_____
#E	_____	_____	

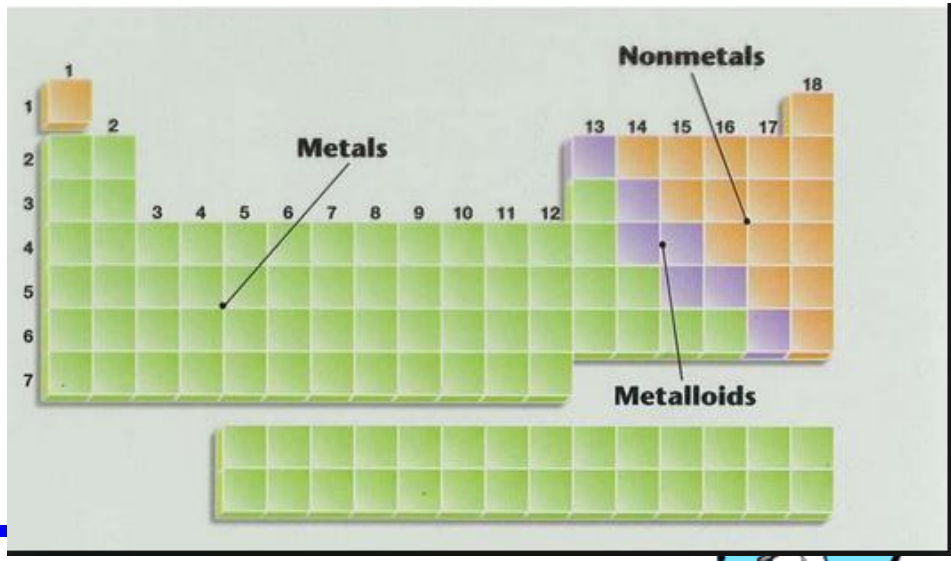
Solution

	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
#P	6	6	6
#N	6	7	8
#E	6	6	6

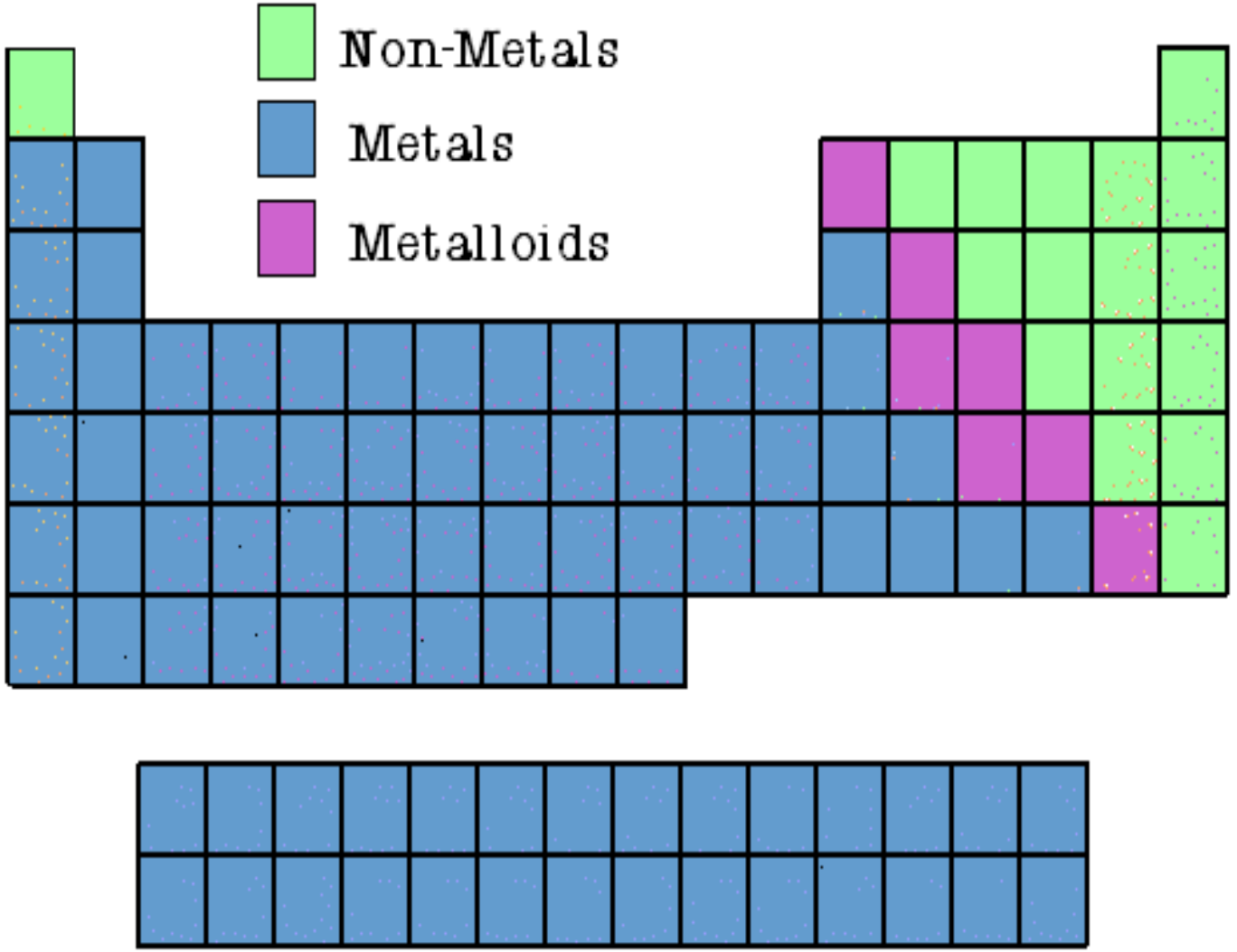
Science 9

Unit 2:Chemistry

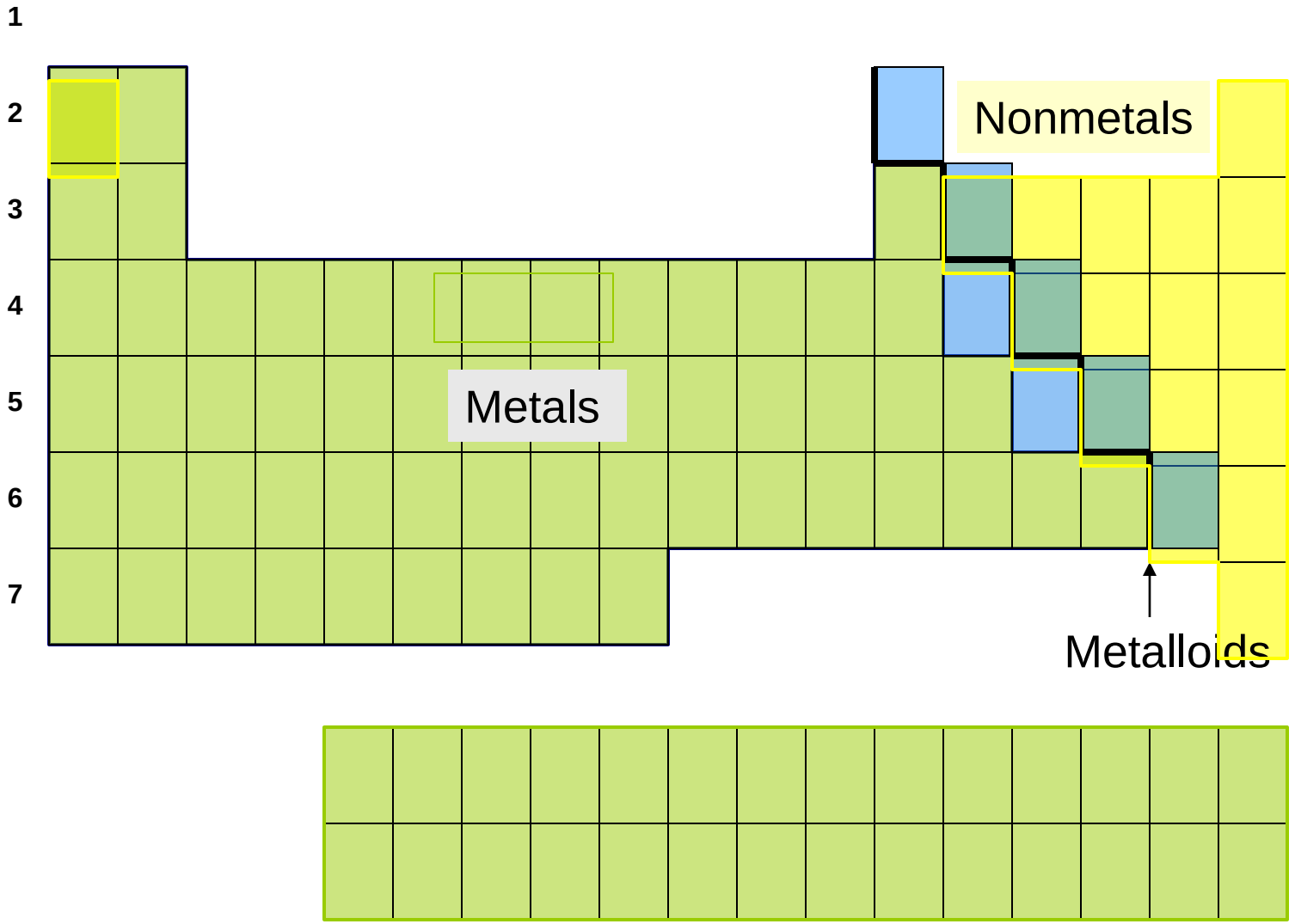
Topic 9: Metals, Nonmetals and Metalloids



The elements of the periodic table can be divided into three main categories: Metals, Non-Metals, and Metalloids.



There are more metals than monmetals or metalloids



The dark staircase line separates the metals from the nonmetals. However , the metalloids are arranged around this line.

Metals, Non-metals, and Metalloids

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca											31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr											49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba											81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn

All the metals appear on the left side of the periodic table.

All the non-metals (except hydrogen) appear on the right.

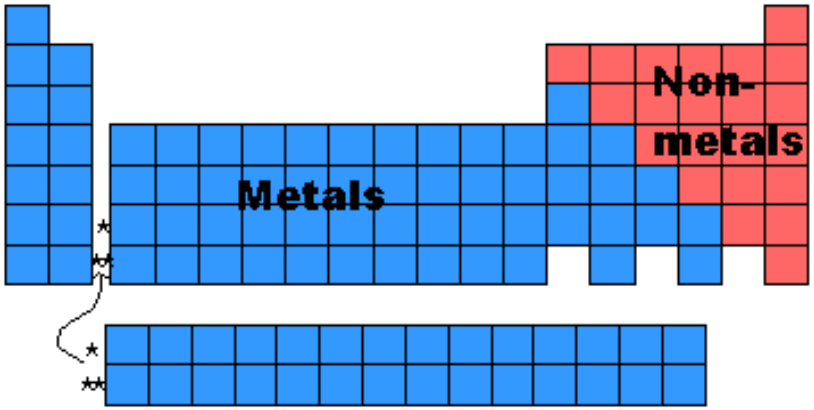
The metalloids form a diagonal line toward the right side.

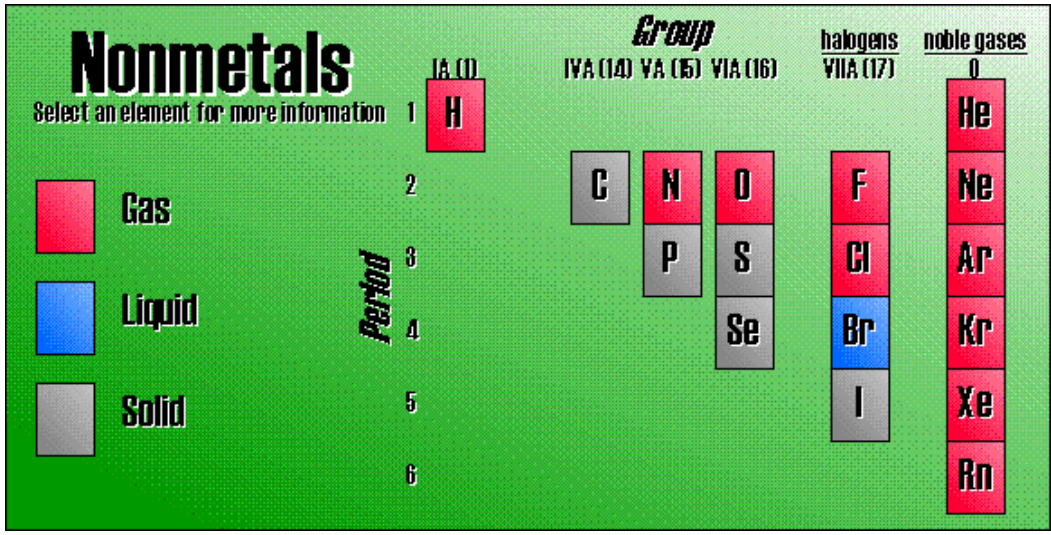
These non-metals are all gases at room temperature.

Properties of Metals

- Metals are good conductors of heat and electricity.
- Metals are shiny.
- Metals are ductile (can be stretched into thin wires).
- Metals are malleable (can be pounded into thin sheets).
- A chemical property of m
  which results in corrosion

Examples of NONMETALS





Non metals may be solids, liquids or gases.

Examples:

Solids – Carbon, Sulfur, Phosphorus

Liquid – Bromine

Gases – Oxygen, Hydrogen, Nitrogen

Properties of Non-Metals

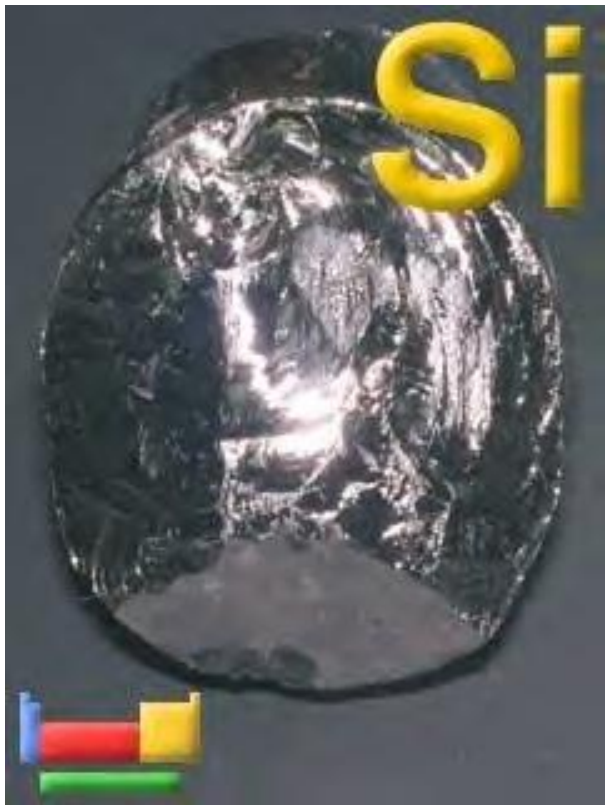
Sulfur

- Non-metals are poor conductors of heat and electricity.
- Non-metals are not ductile or malleable.
- Solid non-metals are brittle and break easily.
- They are dull.
- Many non-metals are gases.

METALLOIDS

The elements contained in the classification of Metalloids:

Properties of Metalloids



Silicon

- Metalloids (metal-like) have properties of both metals and non-metals.
- They are solids that can be shiny or dull.
- They conduct heat and electricity better than non-metals but not as well as metals.
- They are ductile and malleable.

SUMMARY FOR METALS, NON-METALS AND METALLOIDS

	State at Room Temperature	Appearance	Conductivity	Malleability and Ductility
Metals	• solid except for mercury (a liquid)	• shiny lustre	• good conductors of heat and electricity	• malleable • ductile
Non-metals	• some gases • some solids • only bromine is a liquid	• not very shiny	• poor conductors of heat and electricity	• brittle • not ductile
Metalloids	• solids	• can be shiny or dull	• may conduct electricity • poor conductors of heat	• brittle • not ductile

Science 9

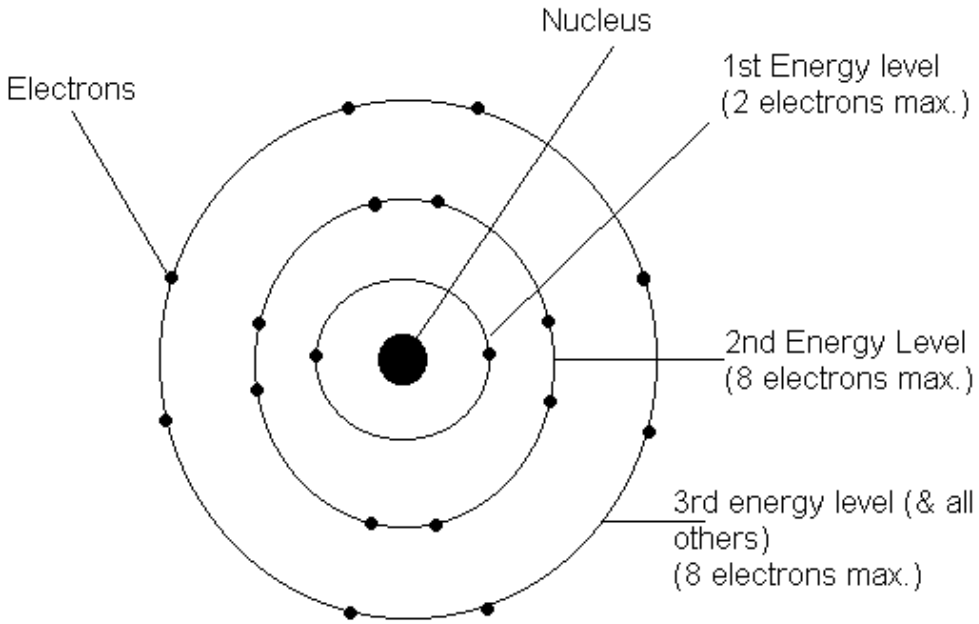
Unit 2:Chemistry

Topic 10 : BOHR'S MODEL

ATOMIC STRUCTURE

Electrons are arranged in Energy Levels or Shells around the nucleus of an atom.

- first shell — a maximum of 2 electrons
- second shell — a maximum of 8 electrons
- third shell — a maximum of 8 electrons

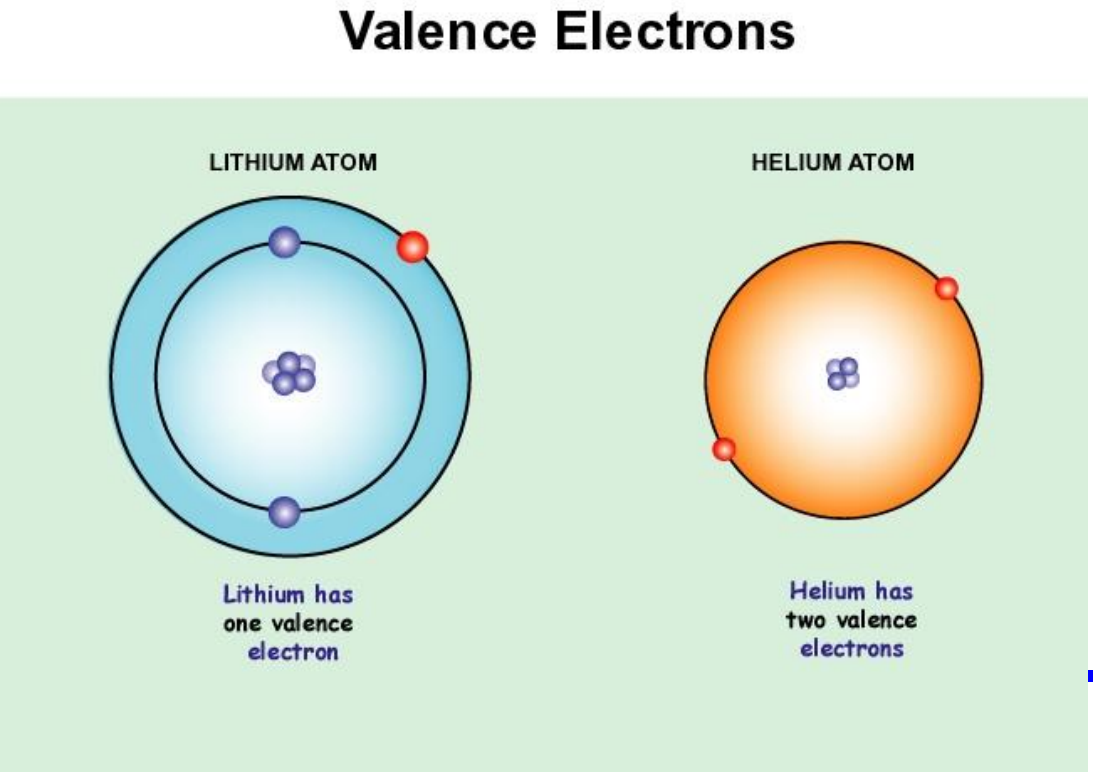


Electron Energy Levels

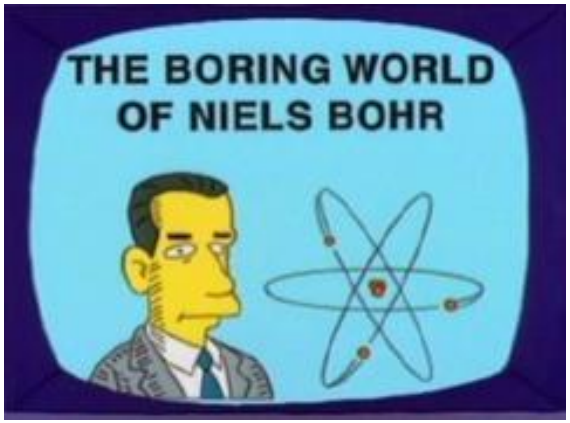
Valence Electrons

- The electrons in the outer most electron shell are called **valence electrons**

- The shell containing electrons that is **furthest** from the nucleus is called the **valence shell.**



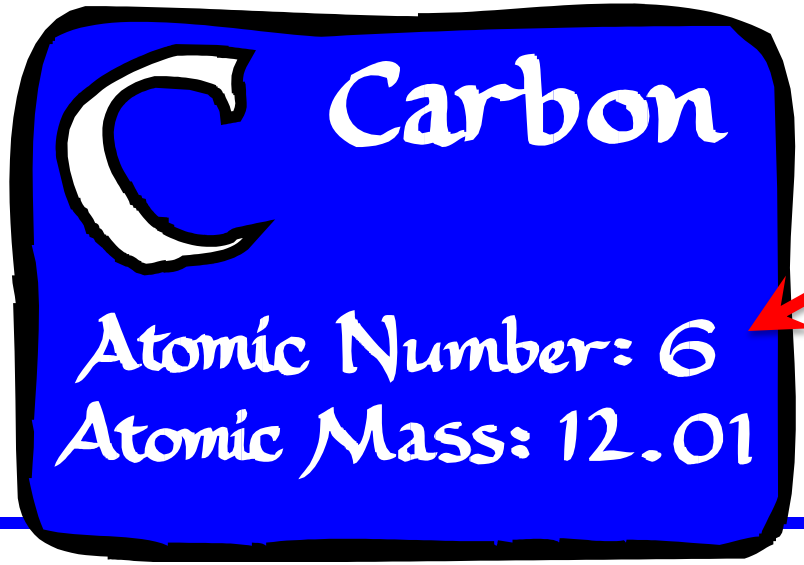
How to Draw a Bohr Model



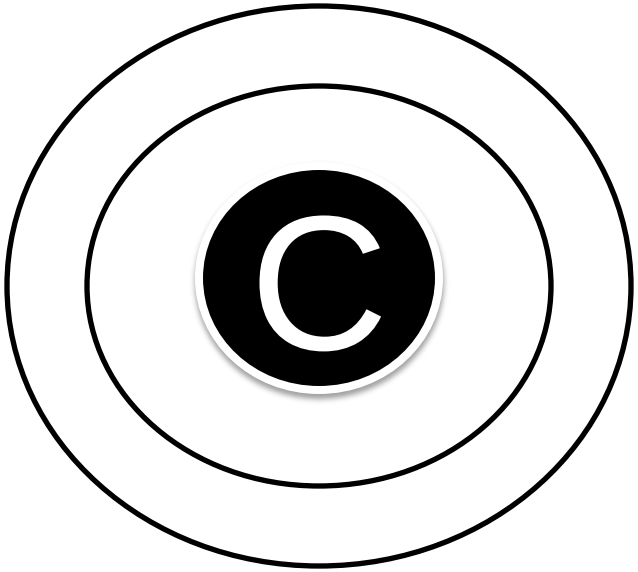
- Niels Bohr created a visual model of the atom to make them easy to understand
- A Bohr Model contains a central nucleus surrounded by electron shells
- For each model you state the number of protons and neutrons in the nucleus and draw a dot on the electron shells for each electron

Bohr Model

1) Find your element on the periodic table.
2) Determine the number of electrons – it is the same as the atomic number.
3) This is how many electrons you will draw.

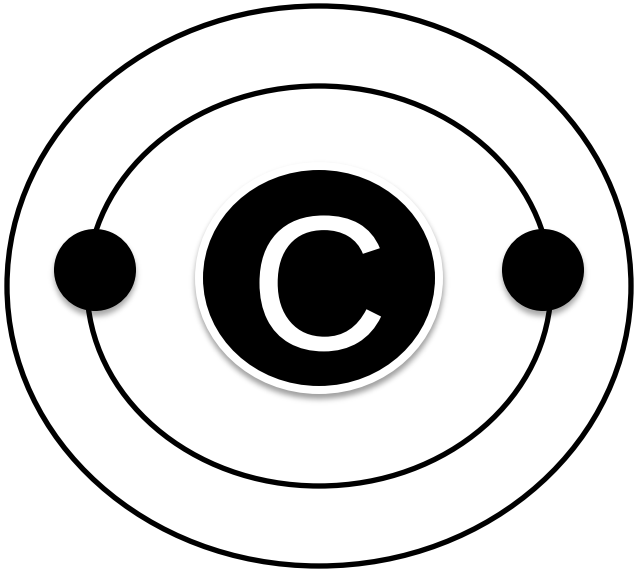


Bohr Model



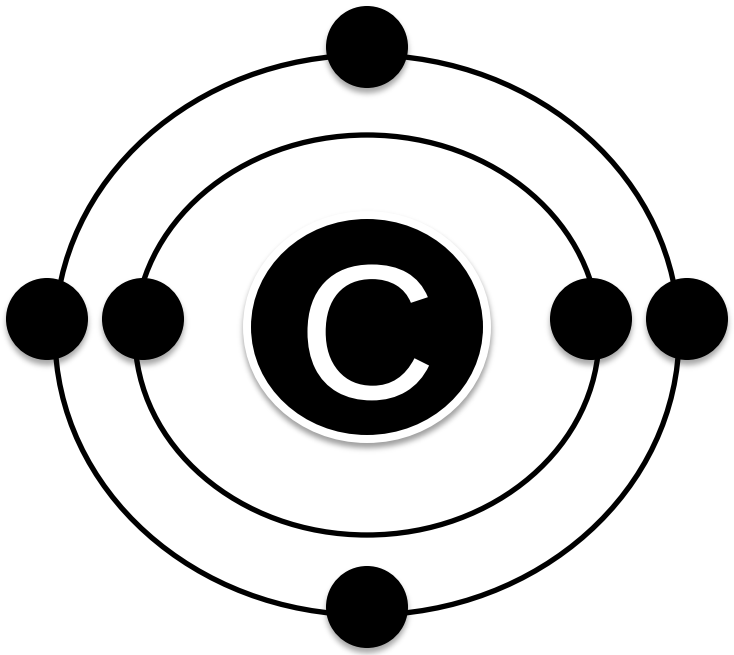
1) Draw a nucleus with the element symbol inside.
2) Carbon is in the 2nd period, so it has two energy levels, or shells.
3) Draw the shells around the nucleus.

Bohr Diagrams



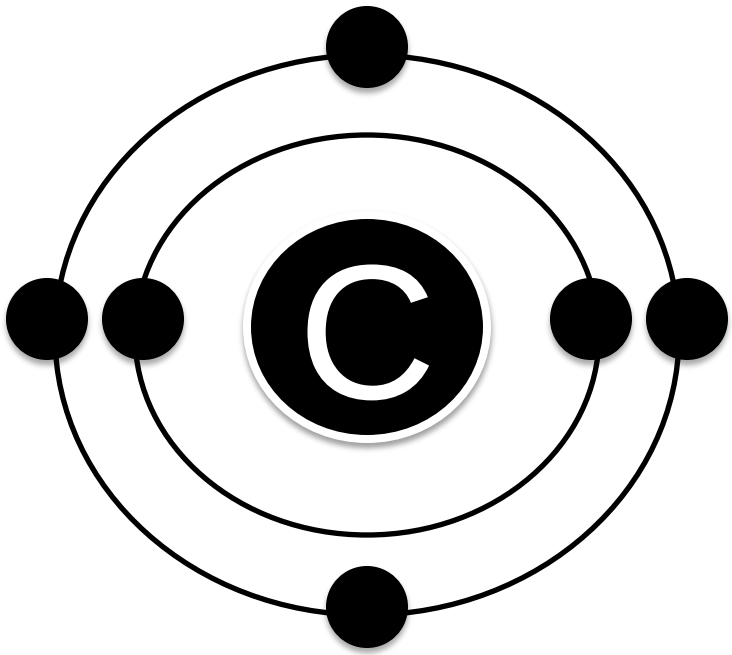
1) Add the electrons.
2) Carbon has 6 electrons.
3) The first shell can only hold 2 electrons.

Bohr Model



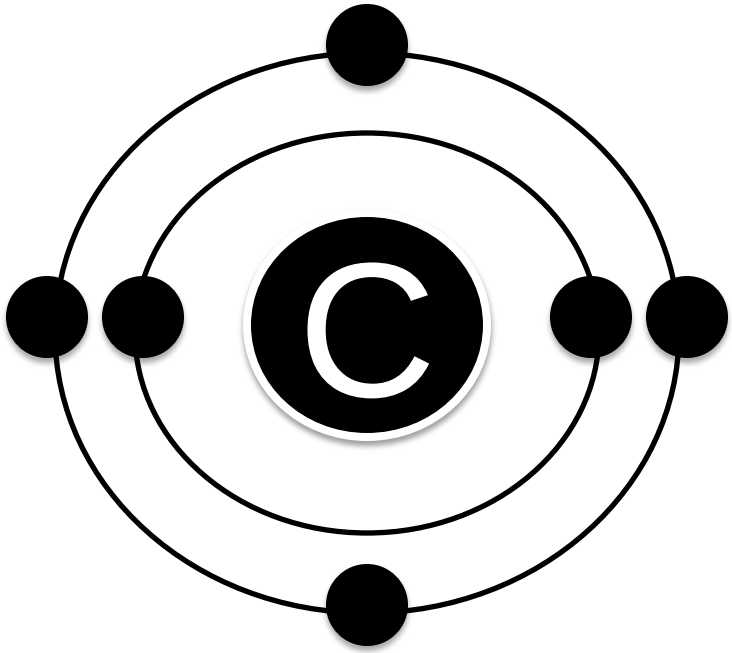
1) Since you have 2 electrons already drawn, you need to add 4 more.
2) These go in the 2nd shell.
3) Add one at a time - starting on the right side and going counter clock-wise.

Bohr Model



1) Check your work.
2) You should have 6 total electrons for Carbon.
3) Only two electrons can fit in the 1st shell.
4) The 2nd shell can hold up to 8 electrons.
5) The 3rd shell can hold 18, but the elements in the first few periods only use 8 electrons.

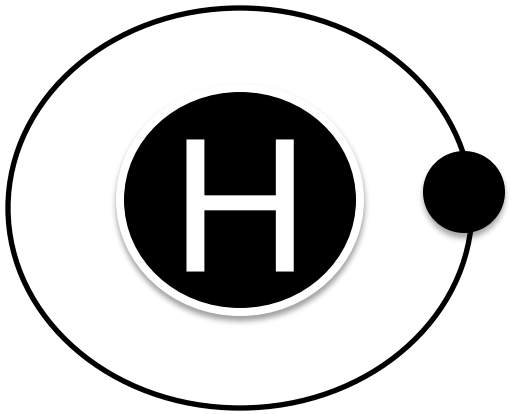
Bohr Model



Try the following elements on your own:

a) H
b) He
c) O
d) Al
e) Ne
f) K

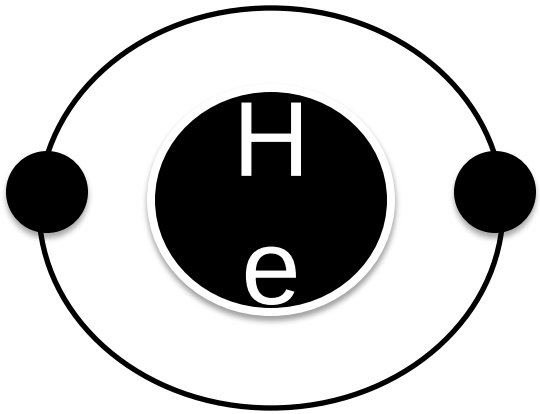
Bohr Model



Try the following elements on your own:

a) H – **1 electron**
b) He
c) O
d) Al
e) Ne
f) K

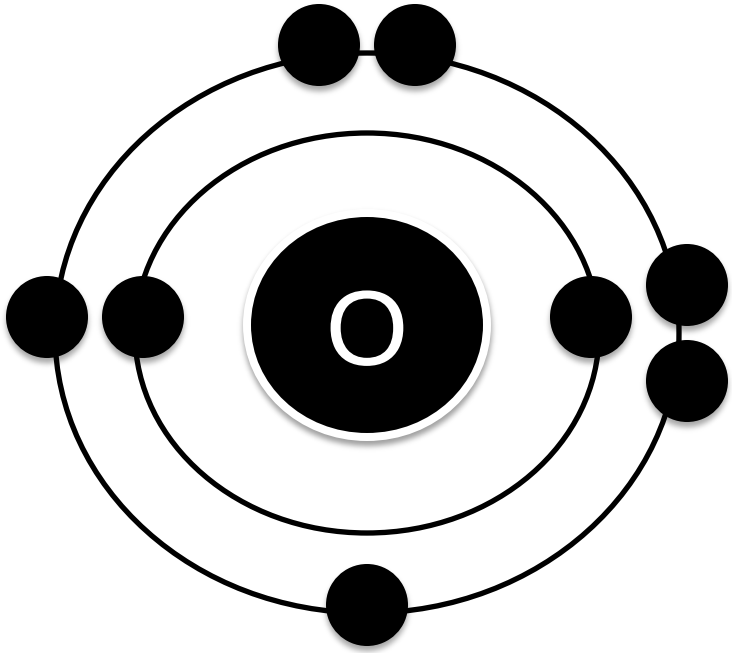
Bohr Model



Try the following elements on your own:

a) H
b) He **- 2 electrons**
c) O
d) Al
e) Ne
f) K

Bohr Model



Try the following elements on your own:

a) H

b) He

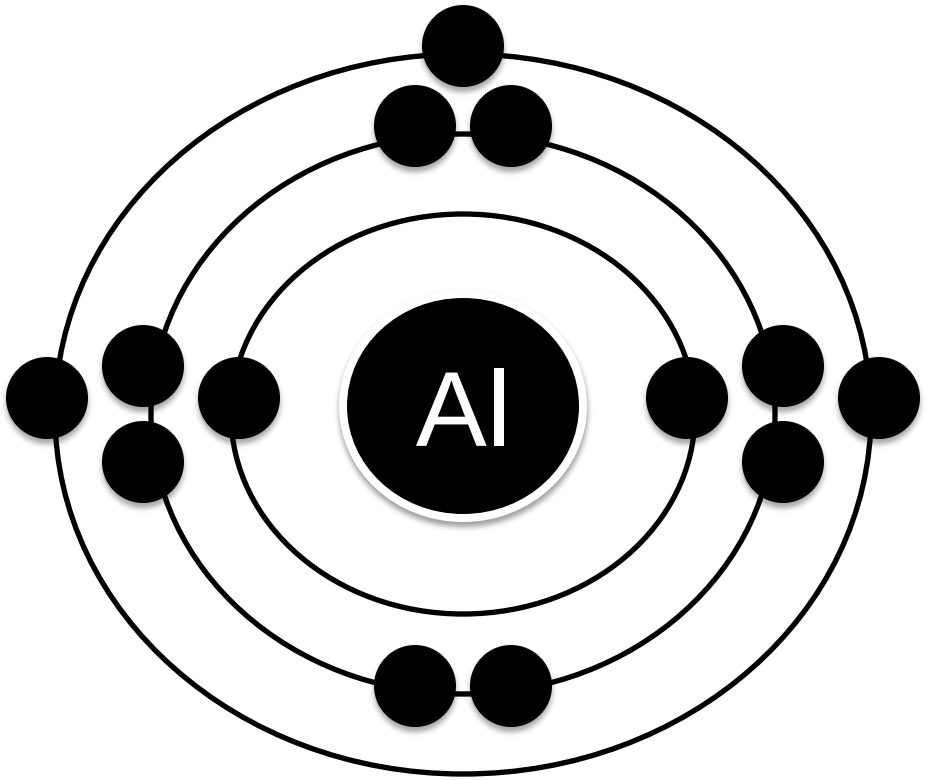
c) O **- 8 electrons**

d) Al

e) Ne

f) K

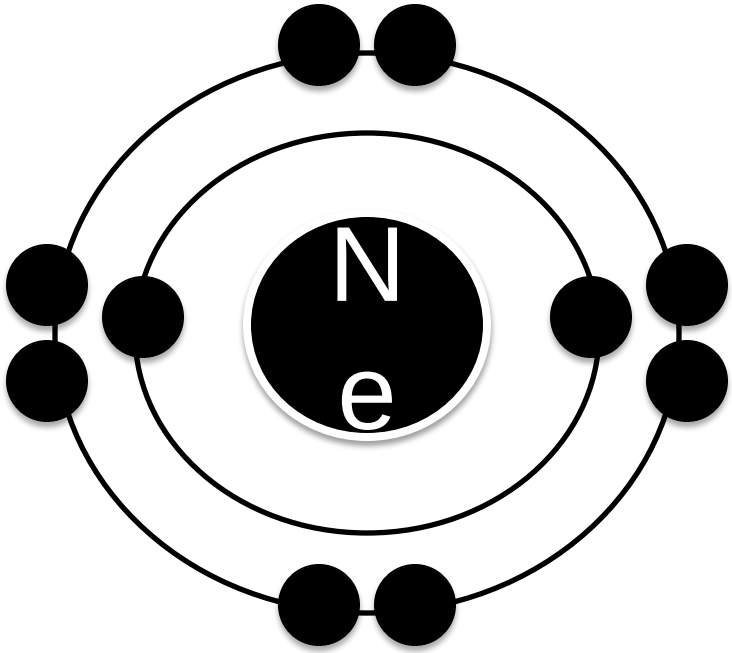
Bohr Model



Try the following elements on your own:

a) H
b) He
c) O
d) Al **- 13 electrons**
e) Ne
f) K

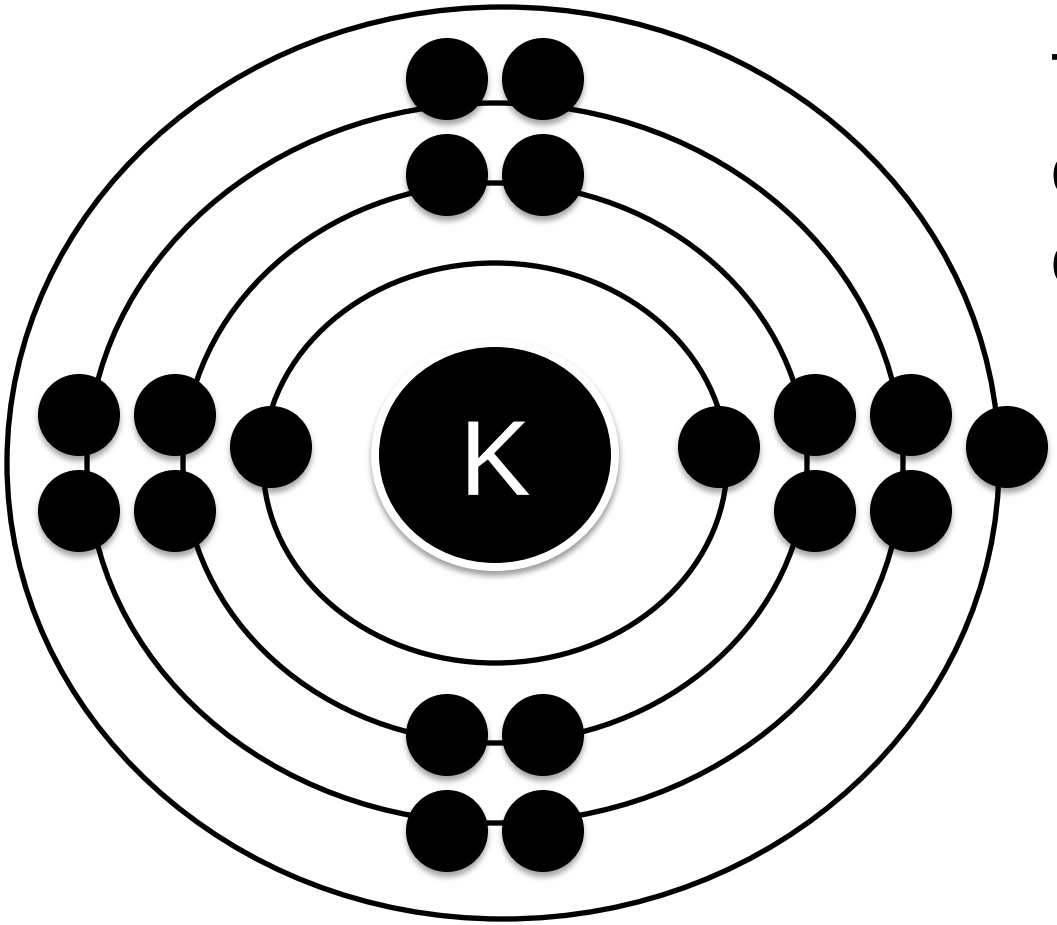
Bohr Model



Try the following elements on your own:

a) H
b) He
c) O
d) Al
e) Ne **- 10 electrons**
f) K

Bohr Model



Try the following elements on your own:

a) H
b) He
c) O
d) Al
e) Ne
f) K **- 19 electrons**

Student Activity => Bohr Model

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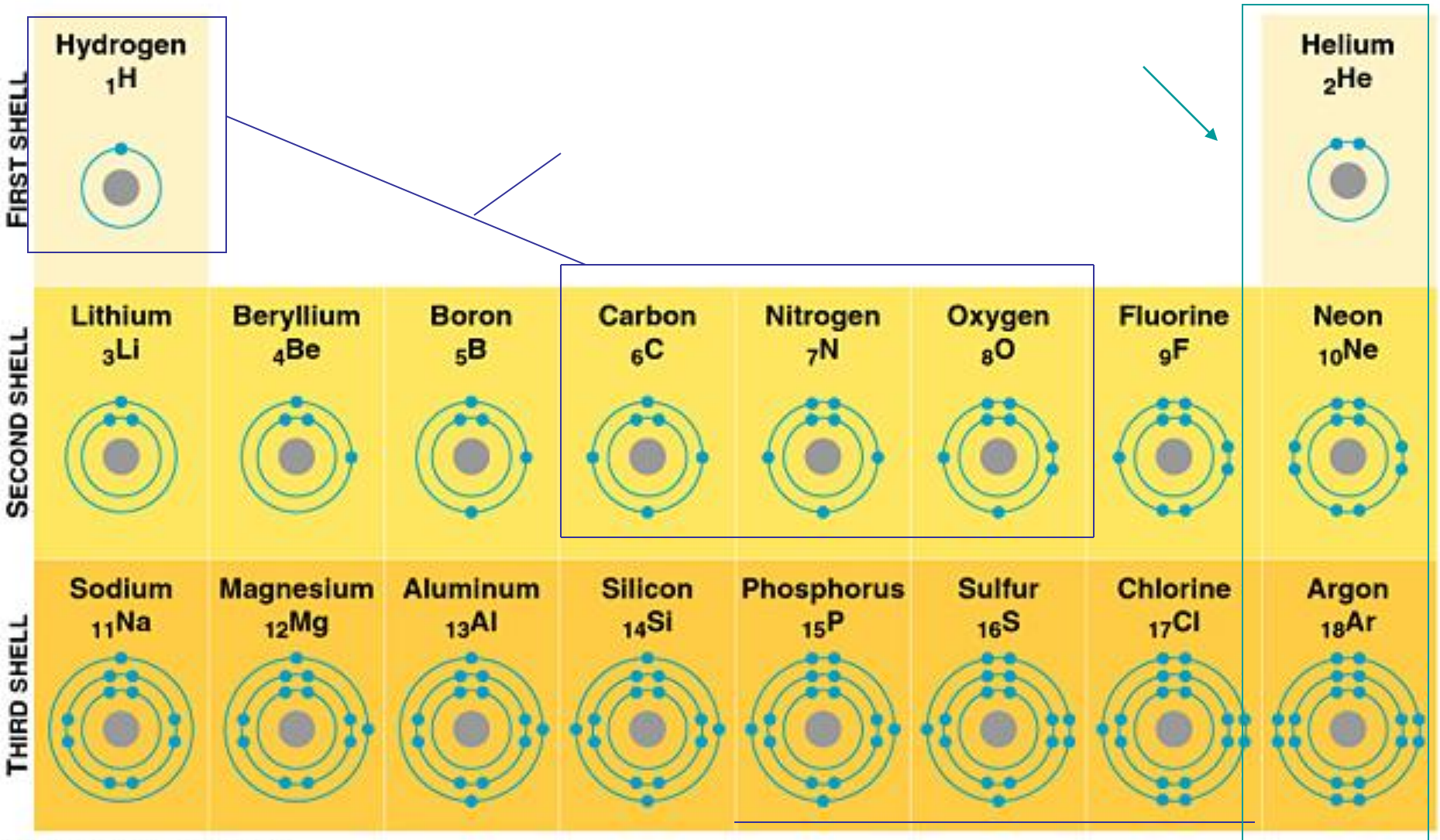
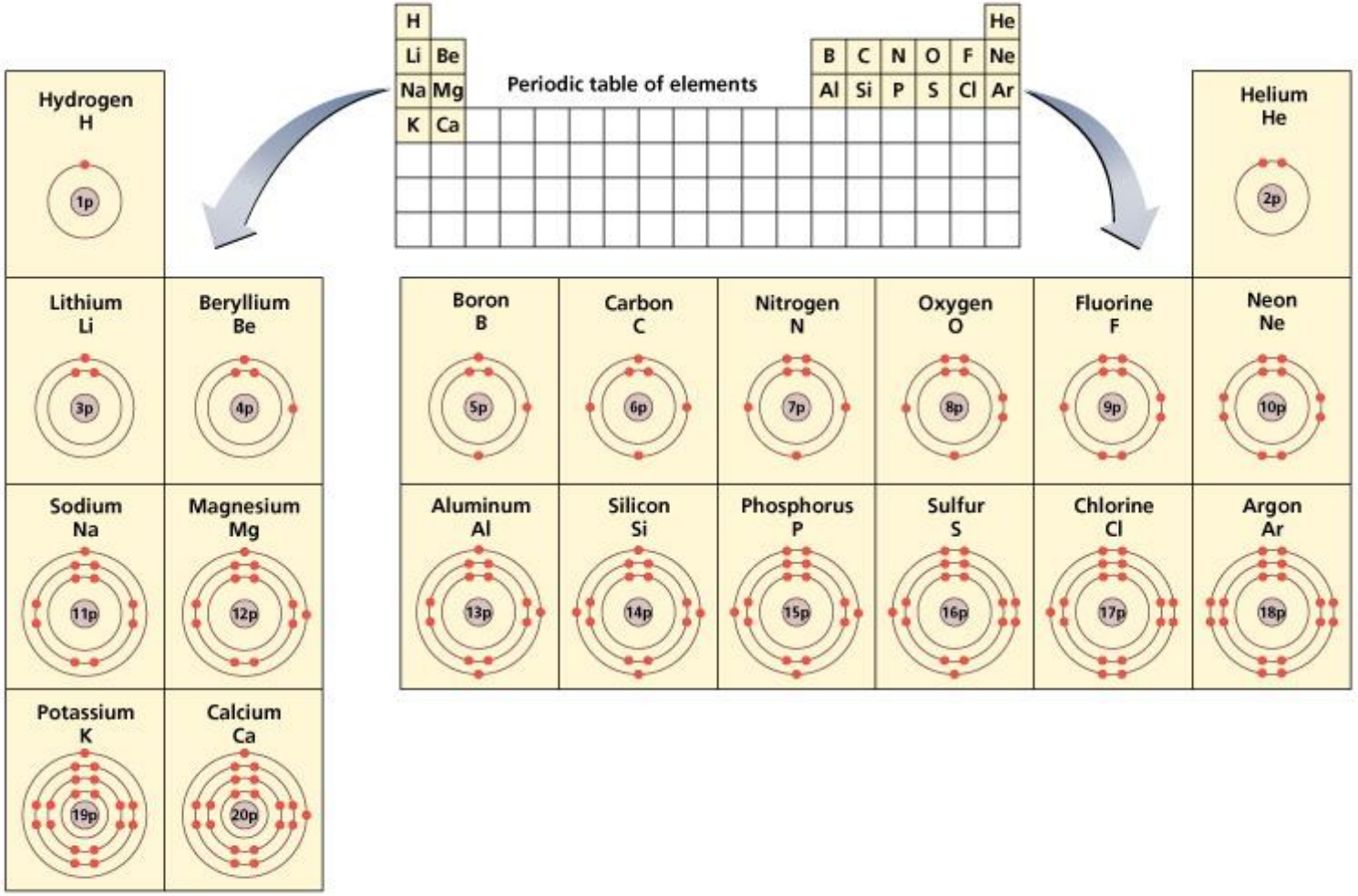
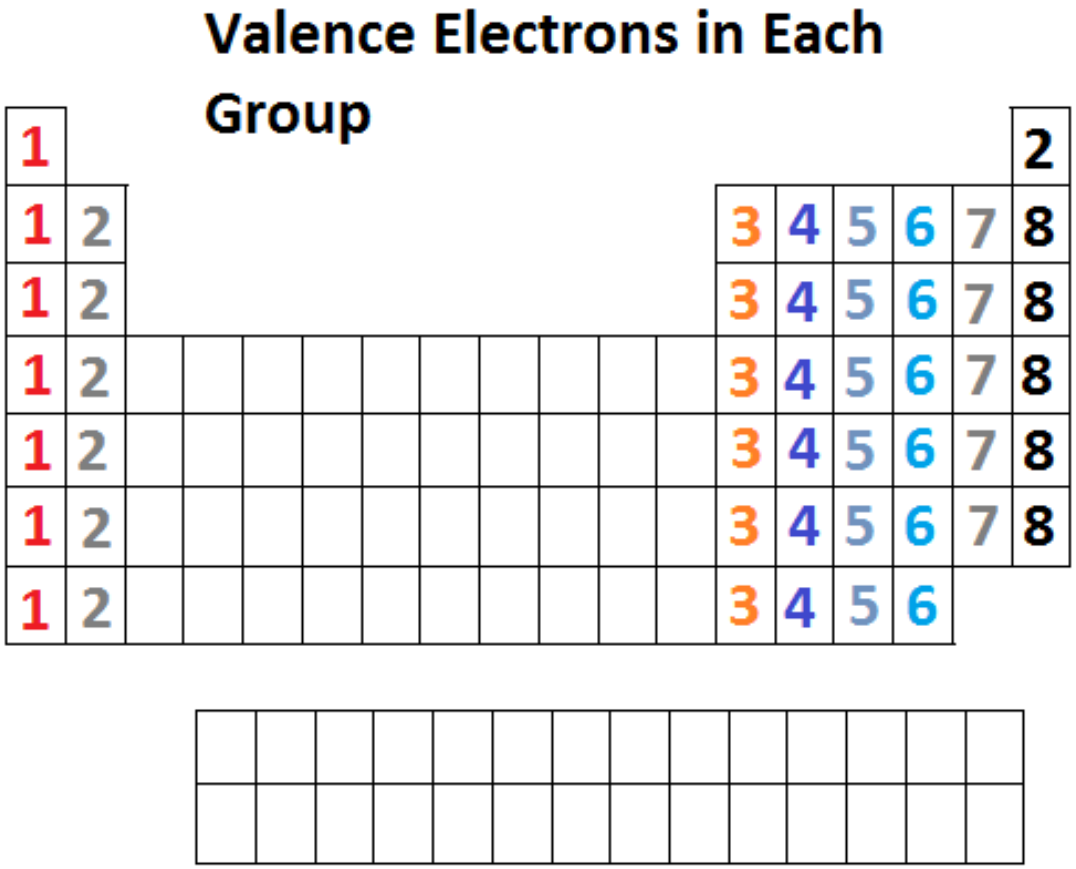
Draw a Bohr Model for the first 18 elements.



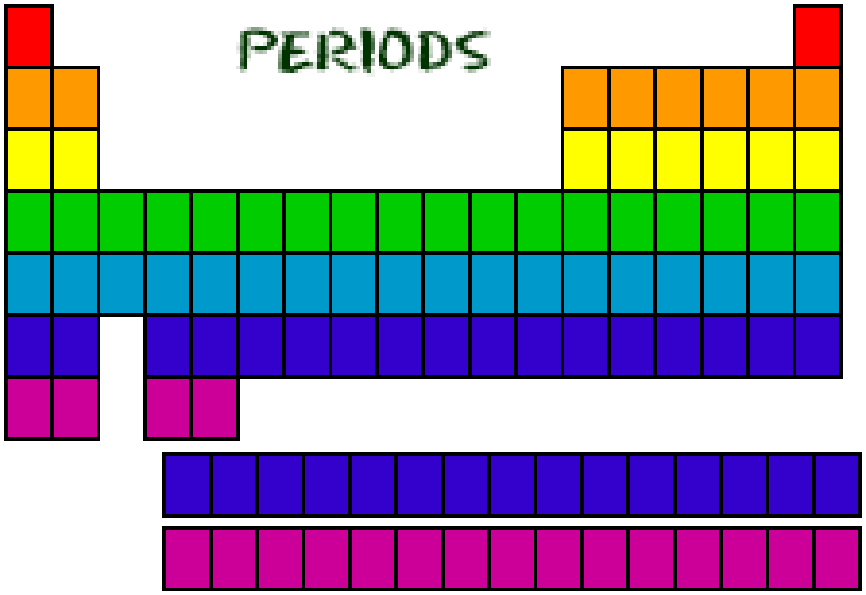
Period number indicates the number of shells



Number of valence electrons of a main (A) group atom = Group number



Quick way to Bohr Models



- Find out which period (row) your element is in.
- Elements in the **1st period** have one energy level.
- Elements in the **2nd period** have two energy levels, and so on.

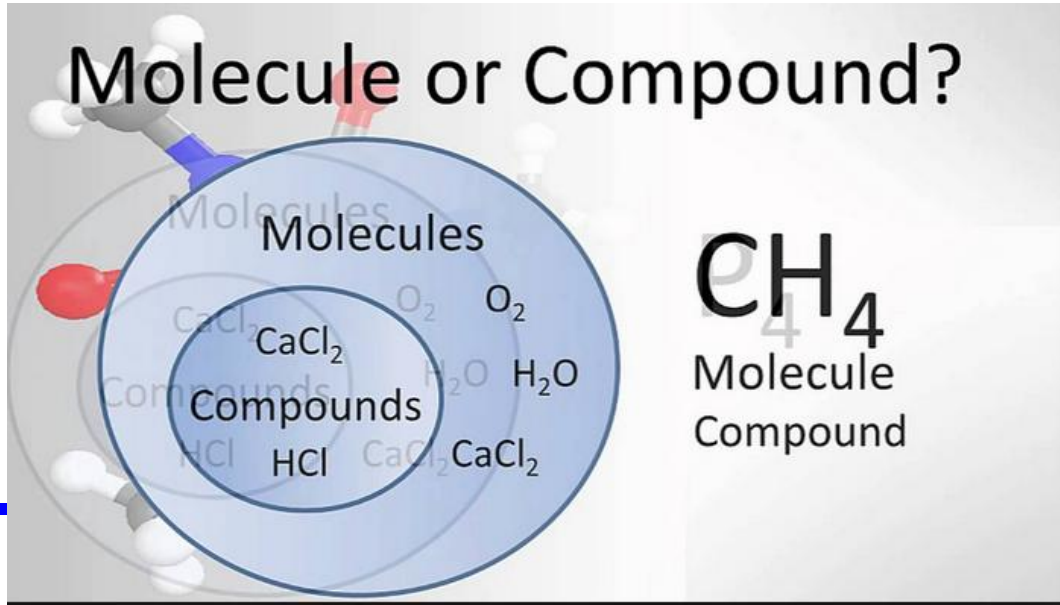
Student Worksheet

- Complete worksheet 10: Bohr's Model of the Atoms

Science 9

Unit 2:Chemistry

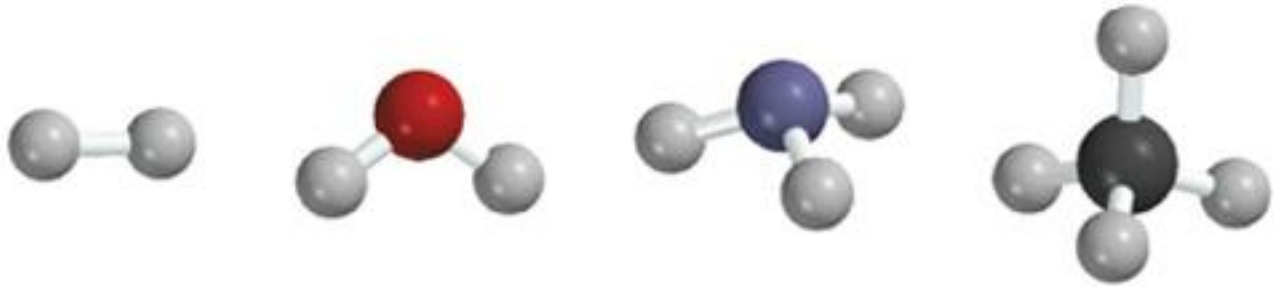
Topic 11 : Molecules and Compounds



An Introduction to Formula Writing

- most compounds are known by their International Union of Pure and Applied Chemistry (IUPAC) names. This organization has determined a set of rules to be used for naming chemicals.

A ***molecule*** is made of two or more atoms in a definite arrangement held together by chemical bonds



H_2 H_2O NH_3 CH_4

A ***diatomic molecule*** contains only two atoms

H_2, N_2, O_2, Br_2, HCl, CO

A ***polyatomic molecule*** contains more than two atoms

O_3, H_2O, NH_3, CH_4

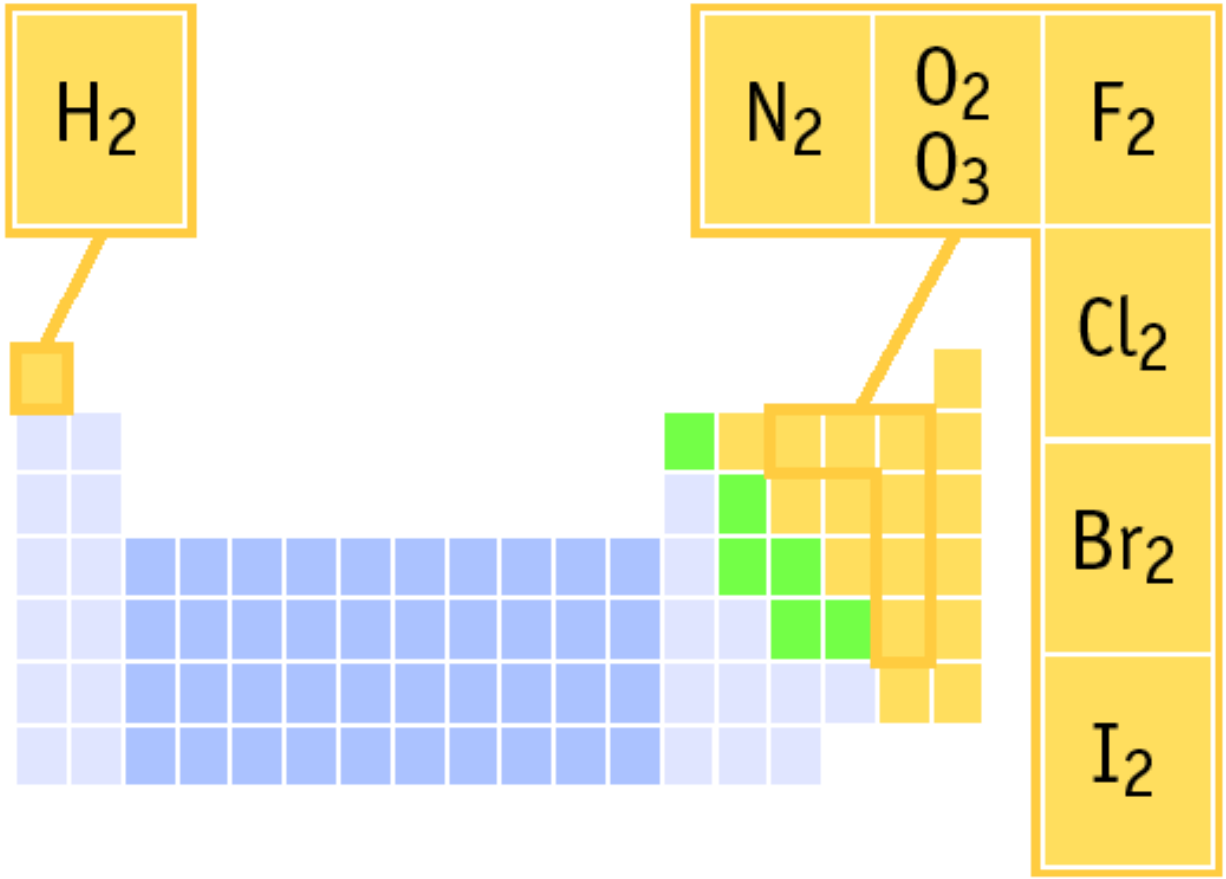
Molecules are combinations of two or more atoms

Molecular element - if the atoms are all the same

For example oxygen gas is a molecule composed of two atoms of oxygen. Since there are two atoms the molecule is called a **diatomic molecule**. *(just remember the **gen's**)*

oxygen		O_2
hydrogen		H_2
nitrogen		N_2
The Halogens (group 17)	fluorine	F_2
	chlorine	Cl_2
	bromine	Br_2
	iodine	I_2

ELEMENTS THAT EXIST AS DIATOMIC MOLECULES



Remember:

BrINClHOF

These elements only exist as PAIRS. Note that when they combine to make compounds, they are no longer elements so they are no longer in pairs!

Compound - a molecule that contains two or more different types of atoms or ions.

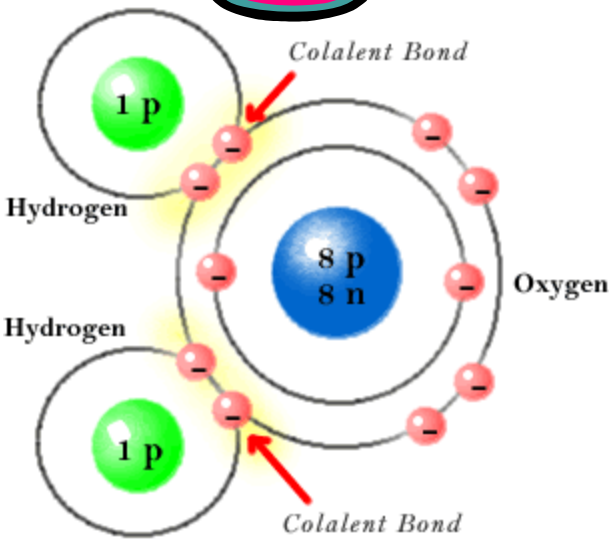
Two or more elements *bonded* together = COMPOUND

Have properties different from the original element.

Have a chemical formula

Not easily separated.

New properties!!!!



Bohr Model of H_2O

Water (H_2O) is a compound because it contains both Hydrogen and Oxygen, two different types of atoms.

Formula

The **formula** for water (H_2O) is a combination of symbols and subscripts.

- H and O are the **symbols** for the two types of elements (Hydrogen and Oxygen) found in water.
- The 2 is called a **subscript**, representing the number of atoms present.

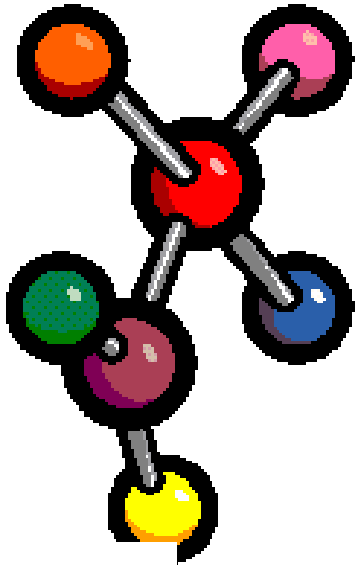
- Note, there is an invisible 1 by the oxygen

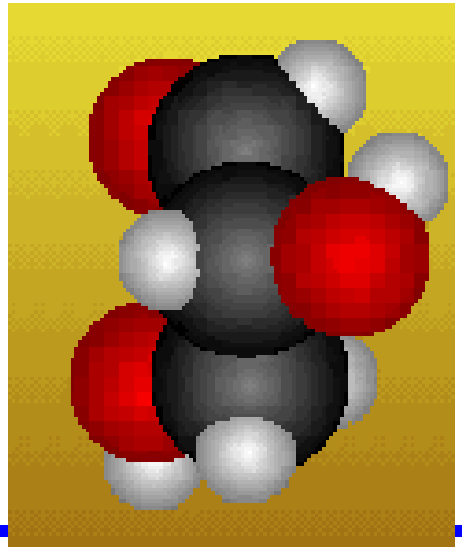
Student Work

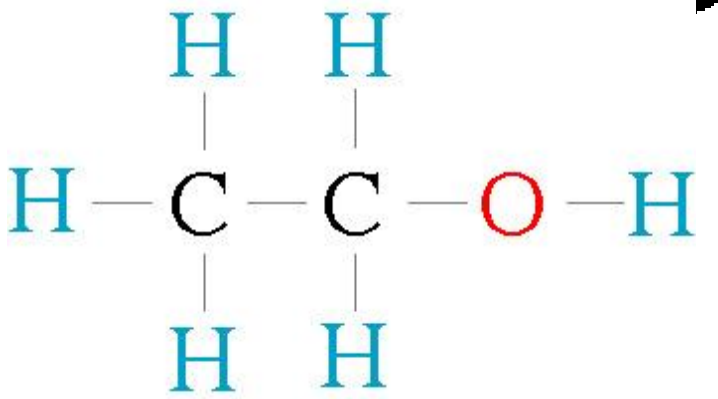
- Worksheet Number 1

MODELS OF COMPOUNDS

A. BALL AND STICK
B. SPACE FILLING
C. STRUCTURAL FORMULA



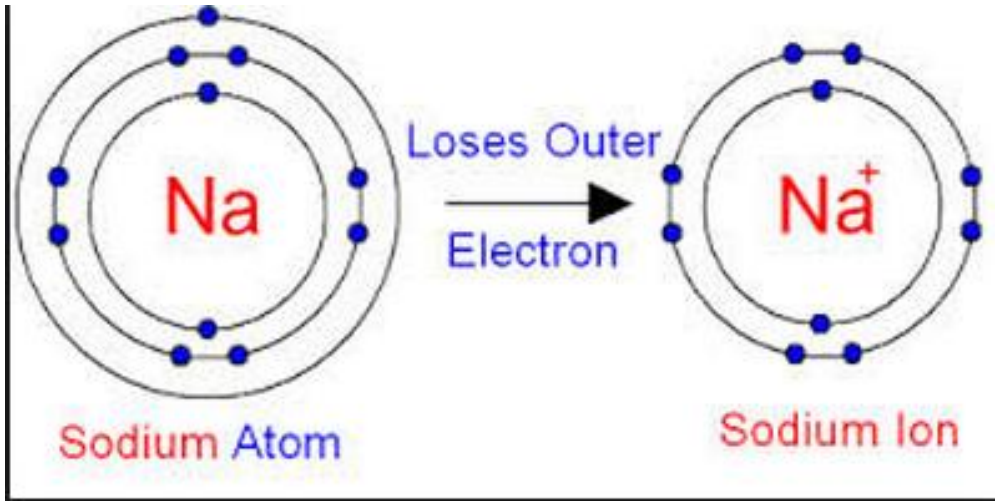




Science 9

Unit 2:Chemistry

Topic 12 : Ions



Why gain or lose electrons?

- **Electrons are lost or gained so that the valance shell is filled.**

- **The valance shell is filled to make the atom more stable like the noble gases.**

CATION

- Metal atoms lose electrons to become positive

- metals form cations.
-
- A cation is a positve (+) ion (clue: the t in cation resembles a + sign).

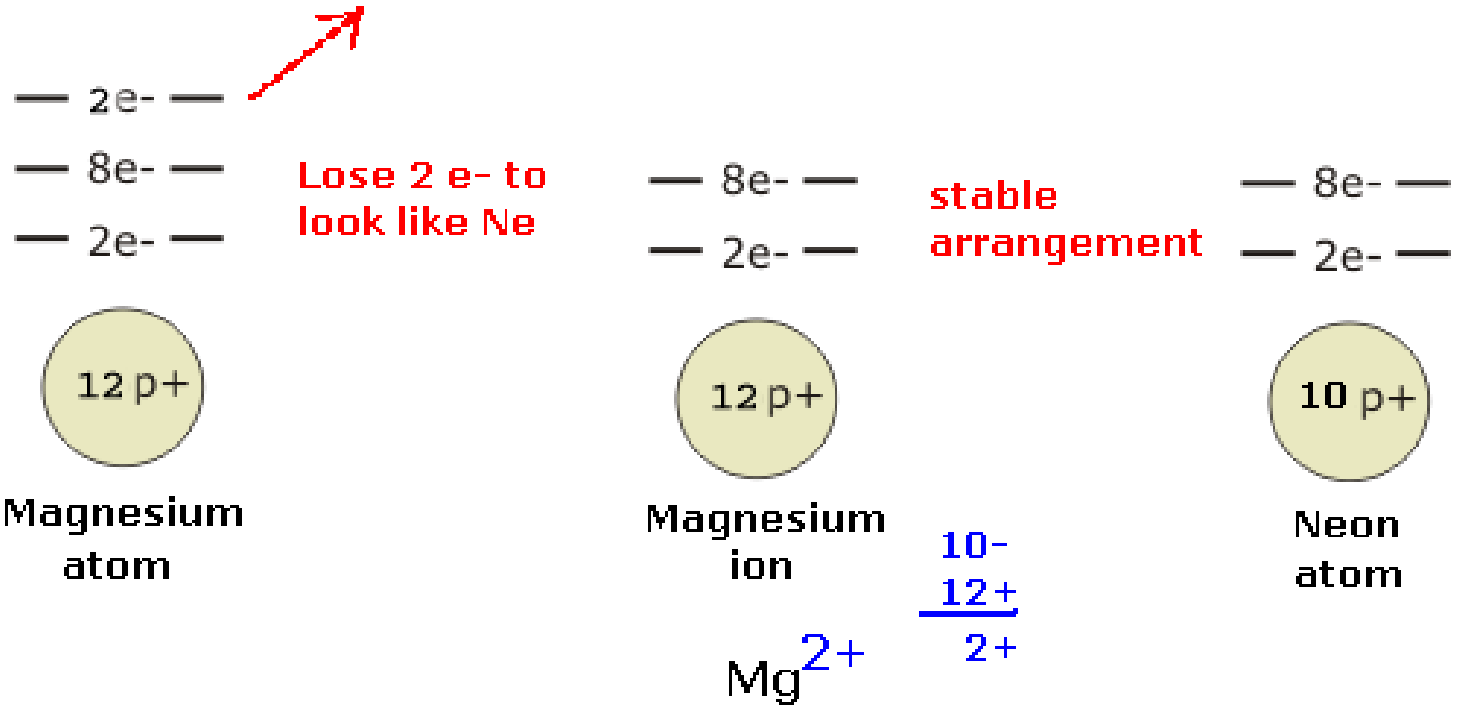
Na

11 protons
11 electrons

Na^+

11 protons
10 electrons

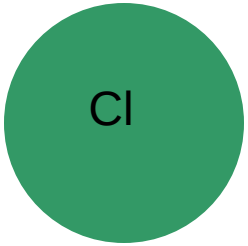
Let's consider magnesium:



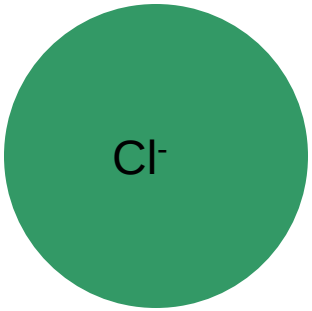
Anion

- An anion is **A N**egative **ION** (A N ion)
- Non-metal atoms gain electrons to become more negative thus, non-metals form anions:

- Example:

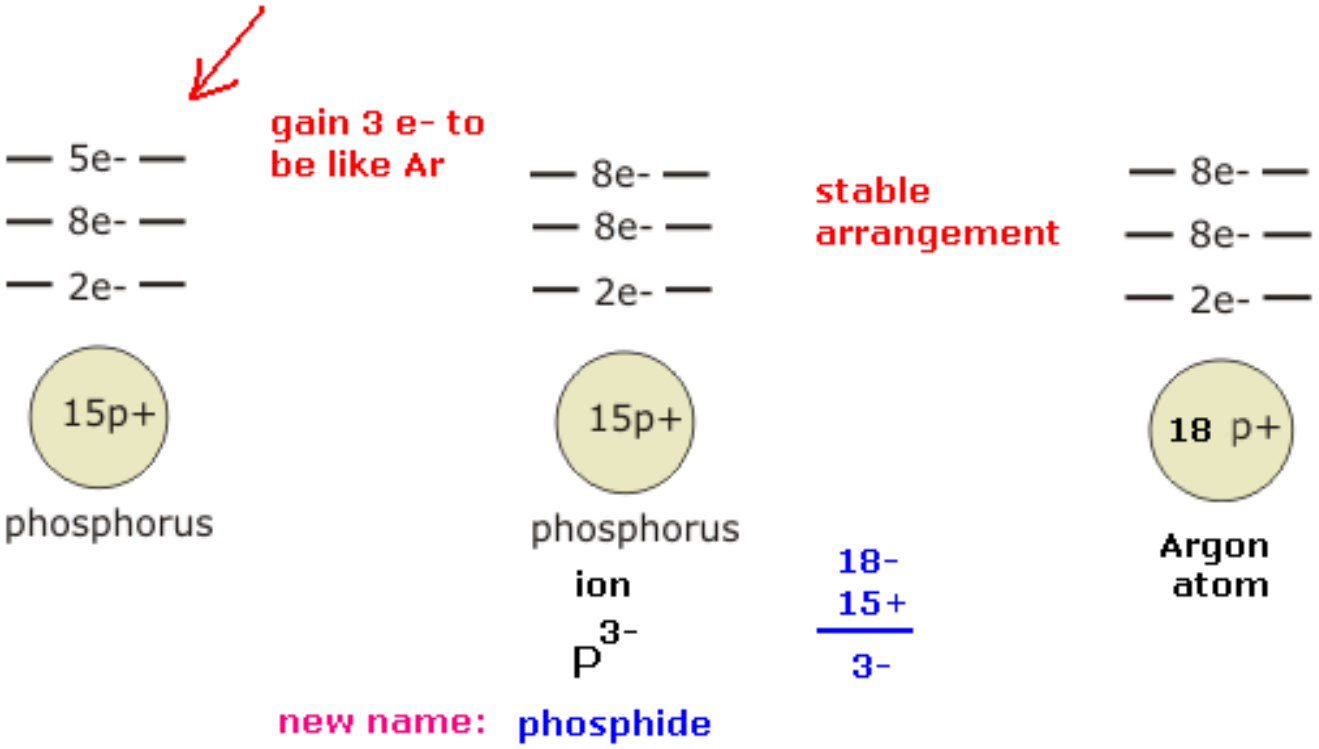


17 protons
17 electrons

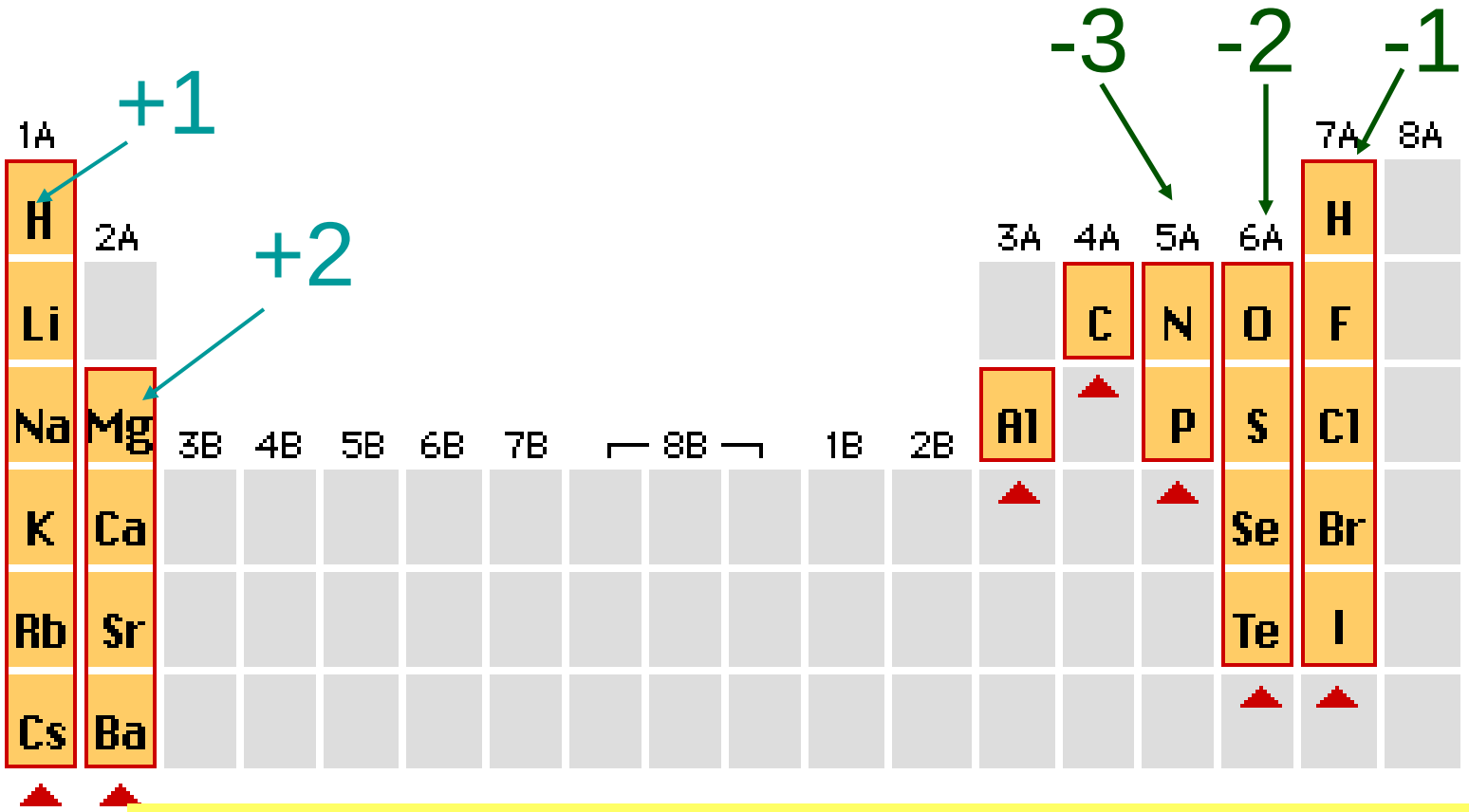


17 protons
18 electrons

Let's look at phosphorus:

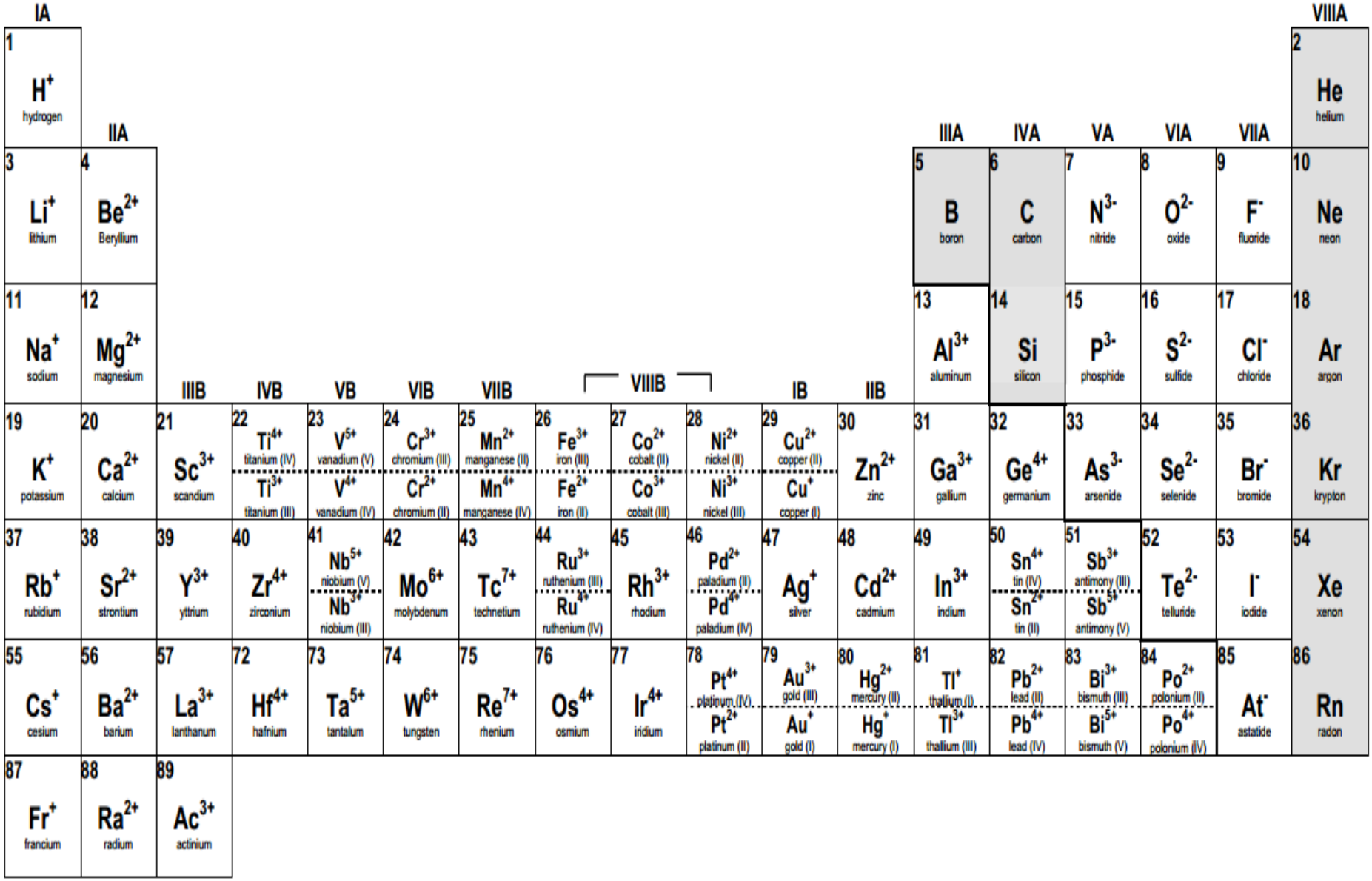


Charges on Common Ions



By losing or gaining e-, atom has same number of e-'s as nearest Group 8A atom.

Periodic Table of Ions

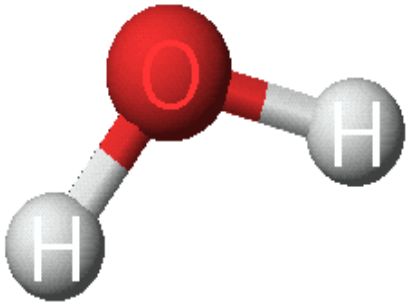


Student Worksheet

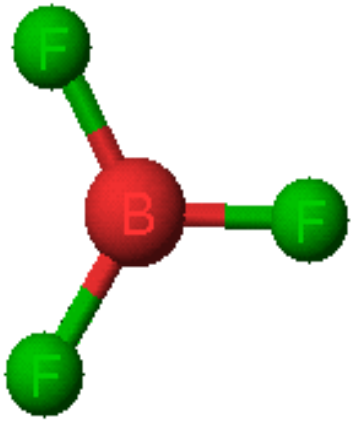
- Bohr's Model of Ions

Science 9

Unit 2:Chemistry



Topic 13 :
Covalent Bonding



Chemical Bonds

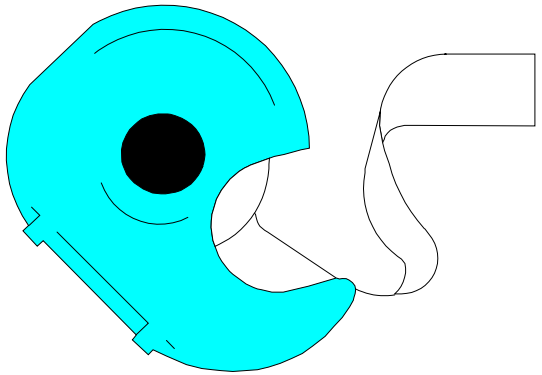
Forms of Chemical Bonds

- **Chemical bonding** is the force of attraction between atoms.

- We will deal with two types of bonding:

1) Covalent Bonding

2) Ionic Bonding.



Covalent Bonding (molecular compounds)

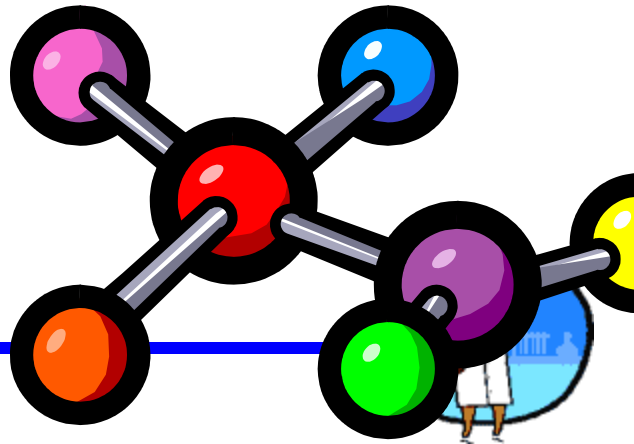
- **Covalent (sharing of valence electrons)**

- results from sharing electrons between the atoms. Usually found between nonmetals.

  – recall the position of non-metals to the right of the steps on the periodic table.

- Covalent bonds are used to form **Molecular compounds**

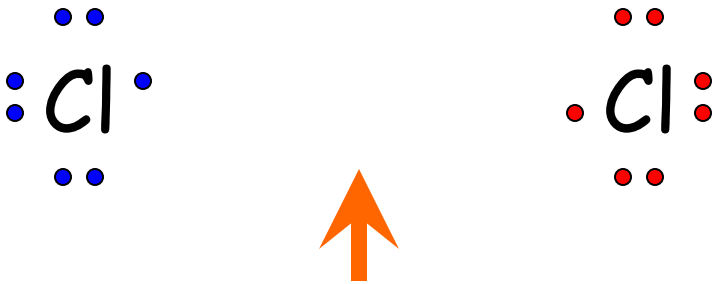
- Examples
  - H_2O , CO_2 , O_2



COVALENT BOND FORMATION

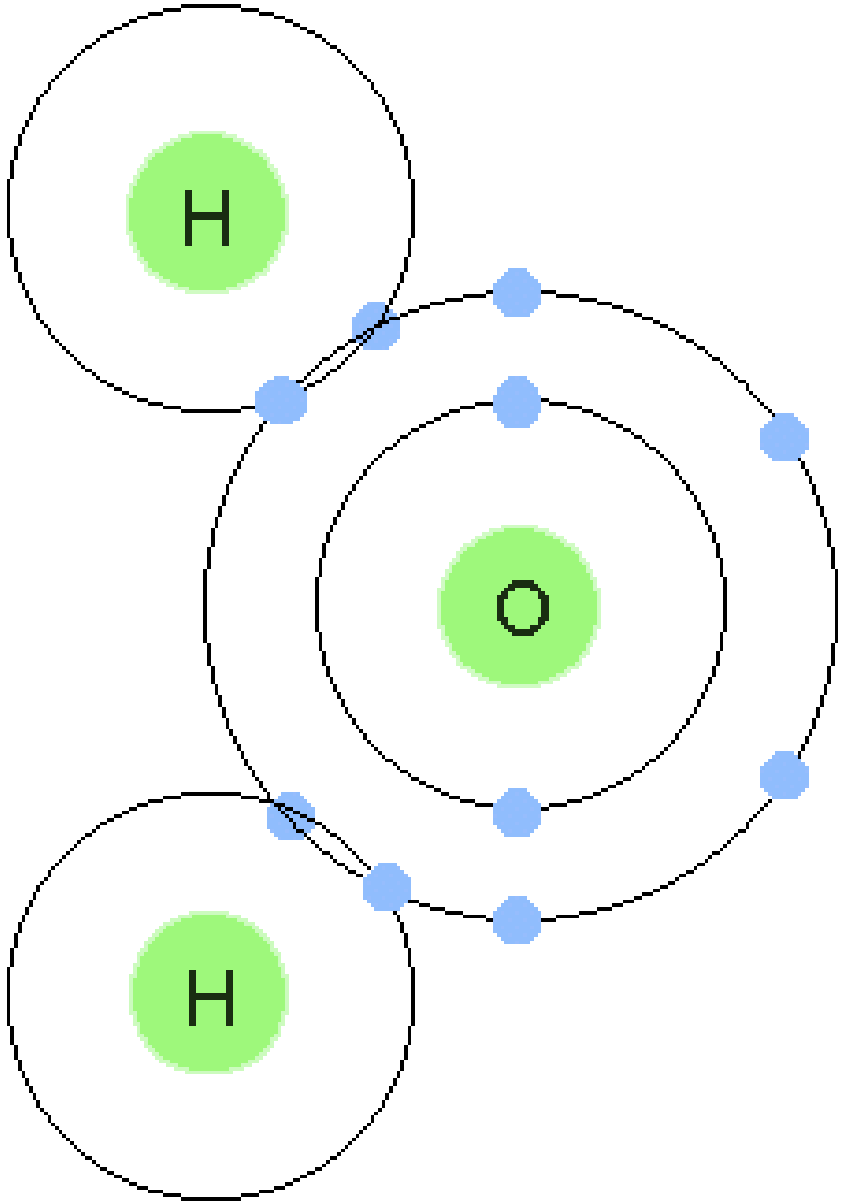
When one nonmetal shares one or more electrons with an atom of another nonmetal so both atoms end up with eight valence electrons

Cl_2 This is the formation of a covalent bond.

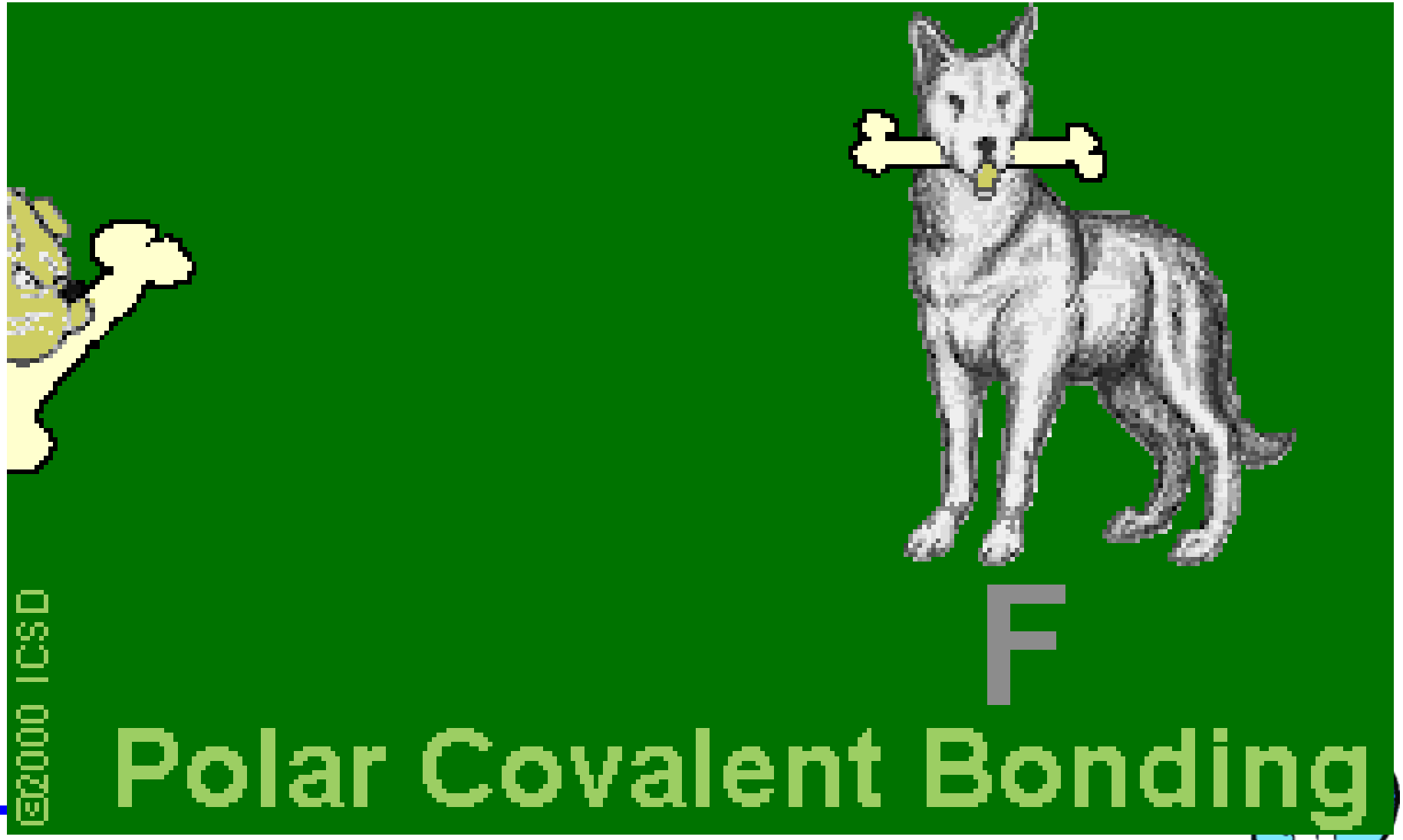


sharing of a pair of electrons

and the formation of molecules


H
O
H

Covalent Bonds: Unevenly matched, but willing to share.



Naming and writing formulas for molecular compounds

1. Common names Of molecular compounds

(i) sucrose or table sugar ($C_{12}H_{22}O_{11}$)

(ii) carbon dioxide (CO_2)

(iii) carbon monoxide (CO)

(iv) methane (CH_4)

(v) water (H_2O)

2. diatomic molecule. *(just remember the **gen's or 7 UP**)*

oxygen		O_2
hydrogen		H_2
nitrogen		N_2
The Halogens (group 17)	fluorine	F_2
	chlorine	Cl_2
	bromine	Br_2
	iodine	I_2

3. Naming Binary Molecular Compounds

You must know this list (first ten prefixes) in order to convert formula to names or to convert names to formulas.

IUPAC Prefixes from 1 - 10

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

What do you do when you are given the formula and you are asked to write the IUPAC name?

1) Name the first element that appears in the formula.

2) Name the second element that appears in the formula, changing its ending to *–ide.*

3) Use **prefixes** to indicate the number of atoms of each element in the molecular formula

Note:

The prefix *mono-* is generally omitted for the first element.

For ease of pronunciation, we usually eliminate the last letter of a prefix that ends in “o” or “a” when naming an oxide

Write a IUPAC name for **CCl_4**.

Answer

The first element is **C**. Its full name is **carbon**.

The second element is **chlorine (Cl)**. Its name is shortened to **chlor**, and the prefix **-ide** is added to give **chloride**.

The prefix **mono (1)** is added to carbon, and the prefix **tetra (4)** is added to chloride to give the name: **monocarbon tetrachloride**.

The prefix mono is omitted from the first element name to give **carbon tetrachloride**.

Your turn:

1. What is the IUPAC name for CF_4 ?

   The IUPAC name is **carbon tetrafluoride.**

2. What is the IUPAC name for SiO_2 ?

   The IUPAC name is **silicon dioxide**.

3. What is the IUPAC name for SO_3 ?

   The IUPAC name is **sulfur trioxide**.

4. What is the IUPAC name for P_4S_3 ?

   The IUPAC name is **tetraphosphorus trisulfide**.

FORMULA WRITING

To write a formula for a molecular compound, just follow the directions indicated by the prefixes in the name of the compound. The prefixes tell you the number of atoms of the element in the compound.

Example: Write the chemical formula for **nitrogen dioxide**
.

Nitrogen and oxygen are obviously the two elements in the compound. The absence of a prefix on nitrogen and the "di" in front of oxide indicates 2 atoms of oxygen. So
the formula is:

$$NO_2$$

Your turn: Write the molecular formula for each of the following compounds:

1. **nitrogen triiodide**

   NI_3.

2. **triphosphorus pentabromide**

   P_3Br_5

3. **carbon disulfide**

   CS_2

4. **sulfur trioxide**

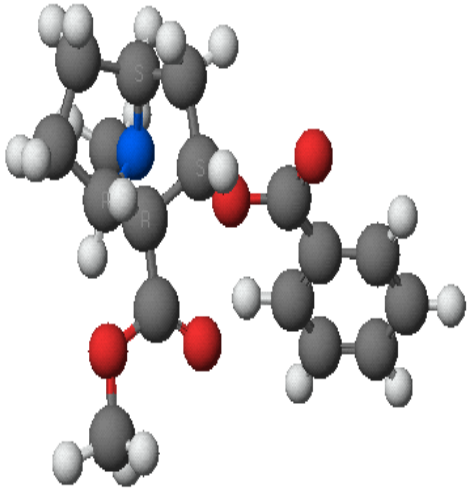
   SO_3

Student Work

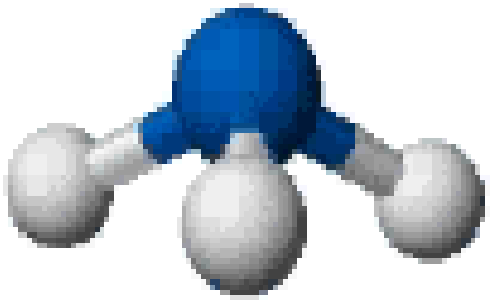
- Read 5.11 "Molecular Compounds" on pages 203 - 204. Answer questions 1 - 6 on page 204

Science 9

Unit 2:Chemistry



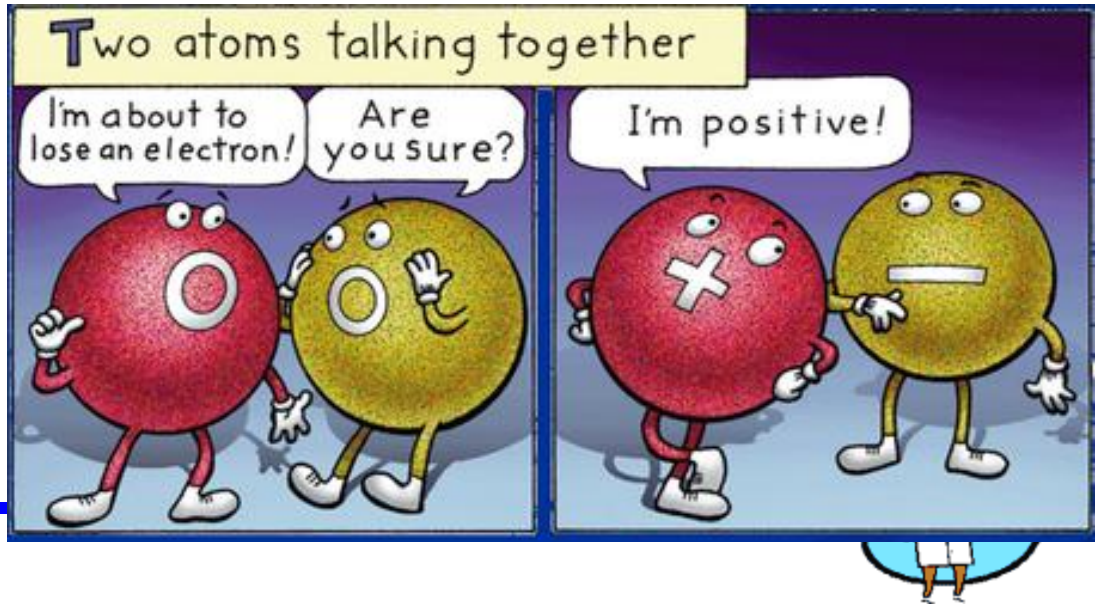
Topic 14 :
Ionic Bonding



Ionic Bonding

- **Ionic Bonding** results from the "**transfer"** of electrons from a metal to a nonmetal.

- Examples:
- NaCl (sodium chloride)



IONIC BOND FORMATION

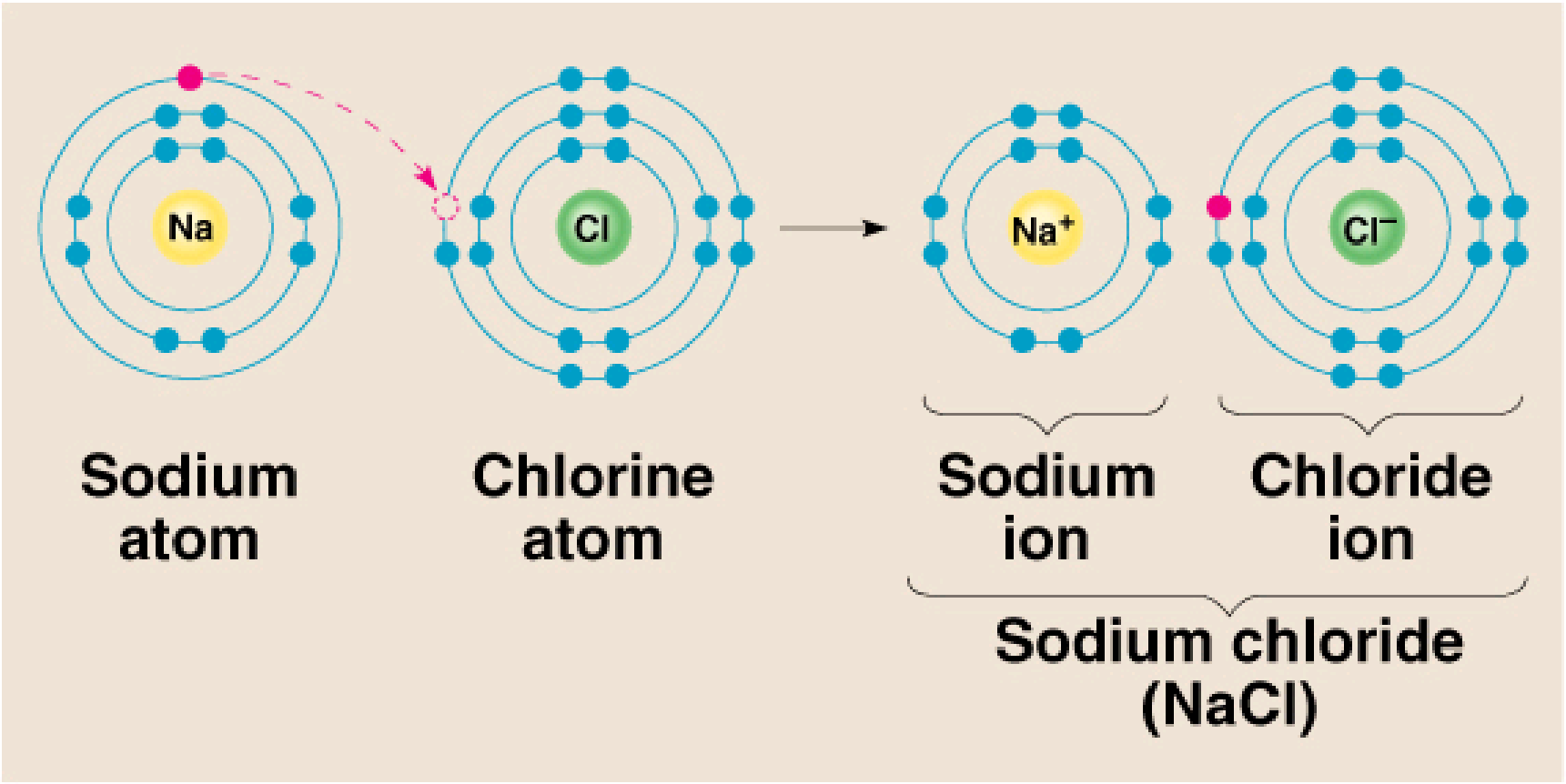
Non-Metal **Metal**

Neutral atoms come near each other. Electron(s) are transferred from the Metal atom to the Non-metal atom. They stick together like magnets.

NaCl This is the formation of an ionic bond.

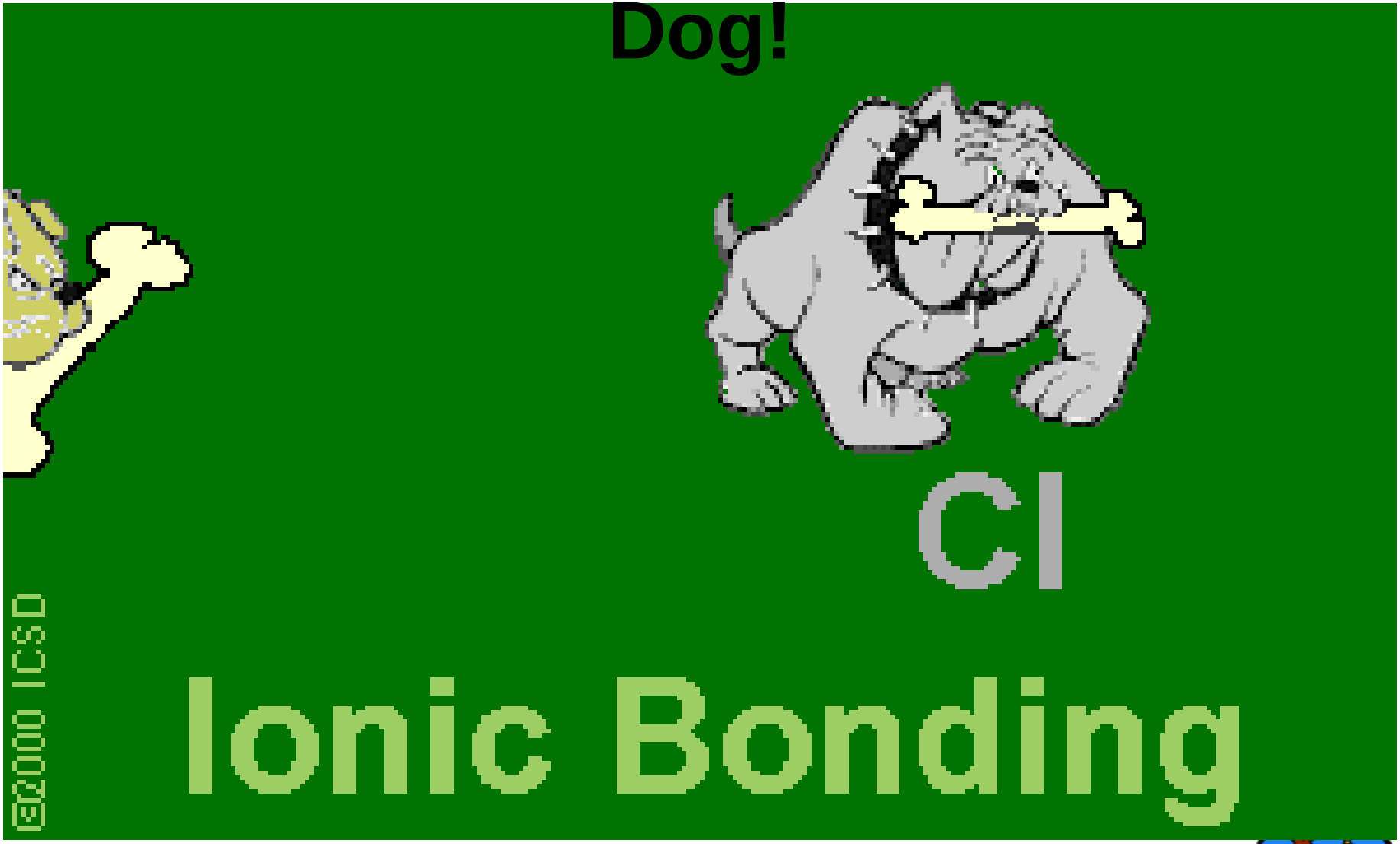
electron transfer

and the formation of ions



1). Ionic bond – electron from Na is transferred to Cl, this causes a charge imbalance in each atom. The Na becomes (Na+) and the Cl becomes (Cl-), charged particles or ions.

Ionic Bonds: One Big Greedy Thief Dog!



Rules For Naming- Ionic Compounds

1. Common names of Ionic compounds

(i) Sodium Chloride (NaCl)

(ii) Calcium Carbonate ($CaCO_3$)

(iii) Sodium Hydroxide (NaOH)

2. Rules For Naming Binary Ionic Compounds

i) Name the cation (+) by writing the full name of the metal

ii) Name the anion (-) by shortening the name of the atom and add the **ide** ending

Examples:

1. LiBr **Lithium Bromide**

2. $AlCl_3$ **Aluminum Chloride**

3. Rb_2S **Rubidium sulfide**

Note: Do Not use prefixes - they are for molecular compounds (two non-metals. Ionic compounds are writing as empirical formulas (lowest ratio)

Your Turn:
Write the chemical formula for each compound:

1. Na_2S **Sodium sulfide**

2. $AlBr_3$ **Aluminum Bromide**

3. BAI_2 **Barium Iodide**

4. Mg_3N_2 **Magnesium Nitride**

Ionic versus Covalent

	IONIC	COVALENT
Bonded Name	Salt	Molecule
Bonding Type	Transfer e^-	Share e^-
Types of Elements	Metal & Nonmetal	Nonmetals
Physical State	Solid	Solid, Liquid, or Gas
Melting Point	High (above 300ºC)	Low (below 300 ºC)
Solubility	Dissolves in Water	Varies
Conductivity	Good	Poor

Science 9

Unit 2:Chemistry

Topic 15 : Physical and Chemical Changes

Physical changes

Physical changes change in which no new substance in produced; only a physical property is altered.

It could include a change in: texture, shape, size, color, odor, volume, mass, and density.

Examples

Liquid H_20 freezes to form ice

Sawing wood into small pieces.

Salt dissolving

Breaking chalk

Evidence of Physical Change:

- changing shape (reforming a lump of clay)
- dissolving within another substance (salt in water)
- changing states of matter

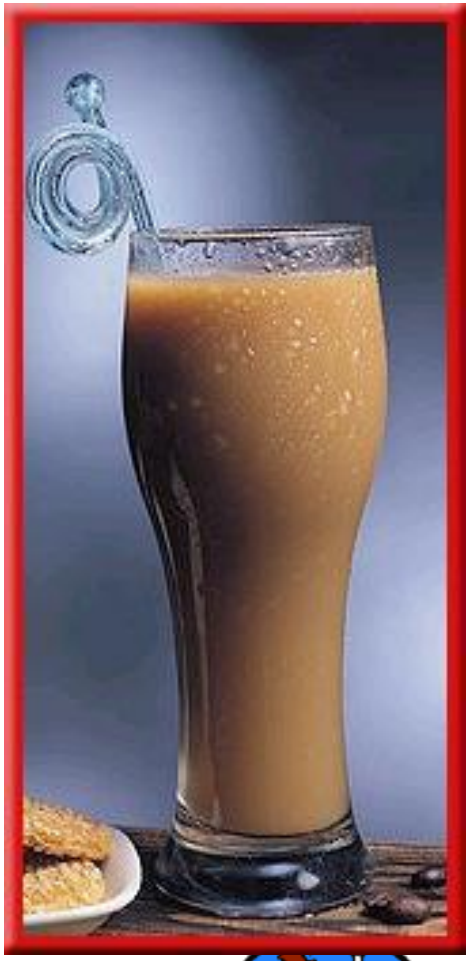
- Solidification (freezing) [liquid = > solid]

– Vaporization (boiling)[liquid =>gas]

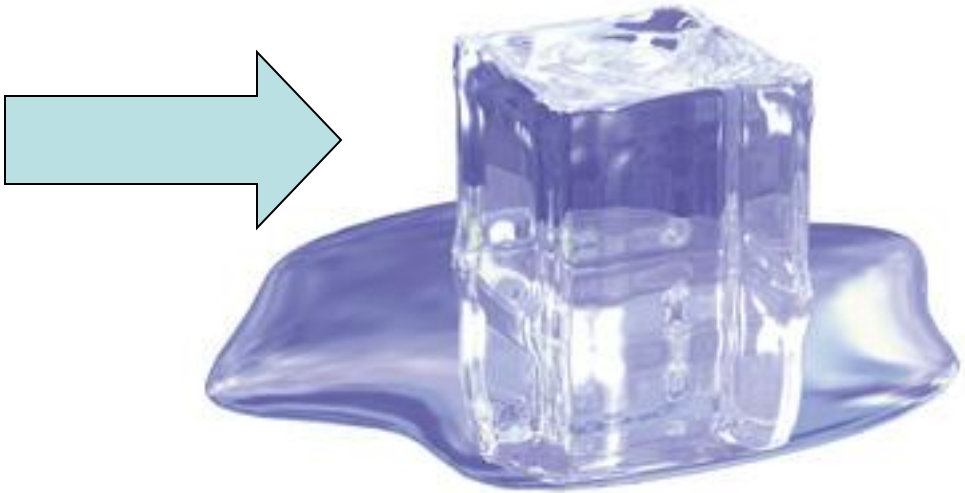
–Condensation [gas => liquid]

- Melting [solid => liquid]

–Sublimation [solid => gas]



Physical Change



Chemical Change:

- **Chemical Changes** a change which results in the formation of one or more new substances, with different compositions and properties from the original matter. These changes are usually irreversible.

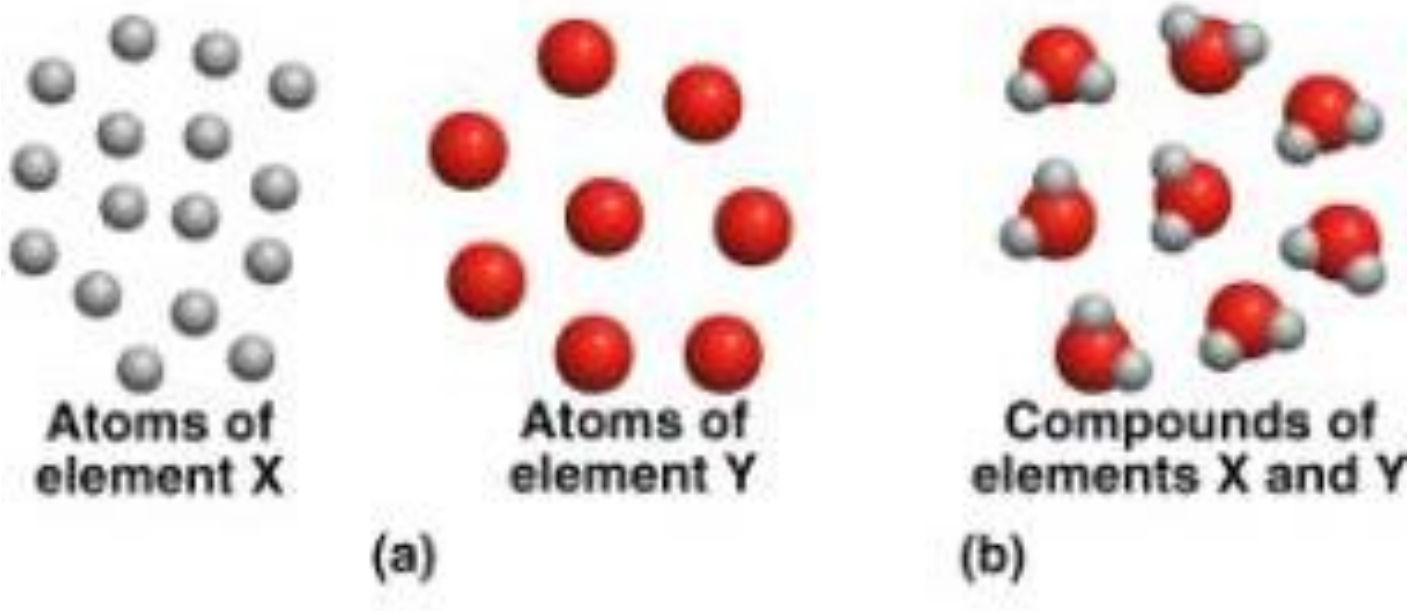
hydrogen + oxygen ⟶ water

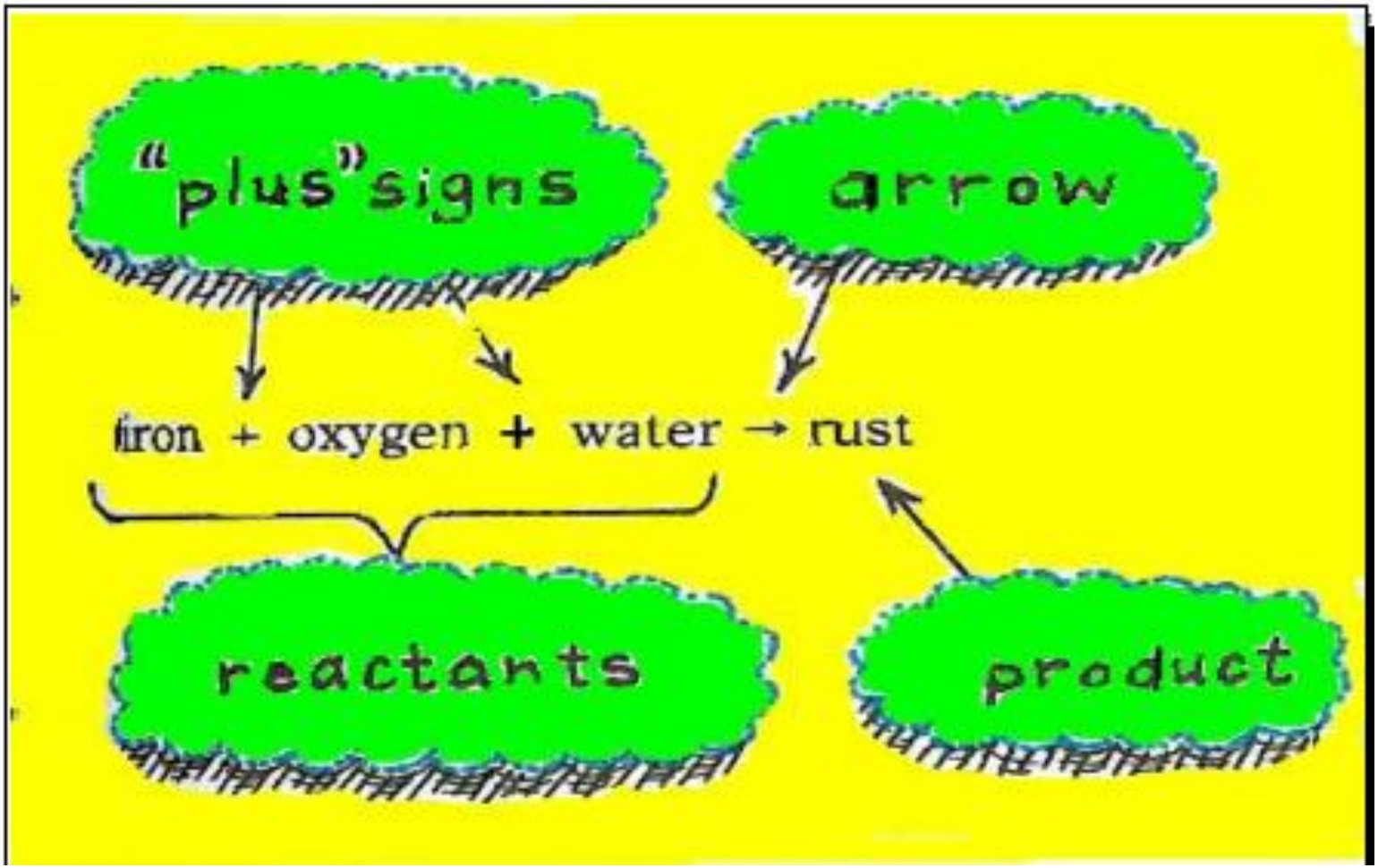
Reactant : Any substance that is used up in a chemical reaction. There may be more than one. Example: Hydrogen and oxygen

Product: the new substance that is formed in the chemical reaction Example: Water

Chemical Changes

- Atoms are re-arranged, **NOT** created or destroyed. New chemical bonds are formed.

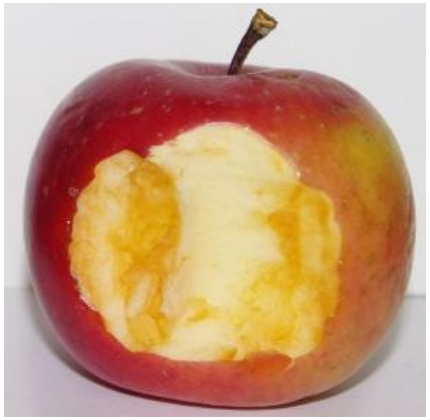



"plus" signs
arrow
iron + oxygen + water → rust
reactants
product

Examples of Chemical Changes

Iron rusting

Rotten apple



Egg cooking

Wood burning

Moldy Bread

Milk Souring

Evidence of a Chemical Change:

- There are four main observations to indicate a chemical change:

1. colour change:

the formation of a substance whose colour is quite different from the colour of the reactants

2. Precipitate Formation:

Precipitate refers to the formation of solid that settles out of a solution.

3. **Gas Formation** (Effervescent):

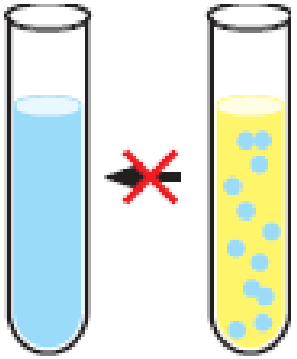
the formation of a gas, gas bubbles etc. Effervescent

.

4. energy change:

the absorption or the release of heat and/or light, sound, electrical energy.

5. The process is difficult to reverse.



the process is difficult to reverse

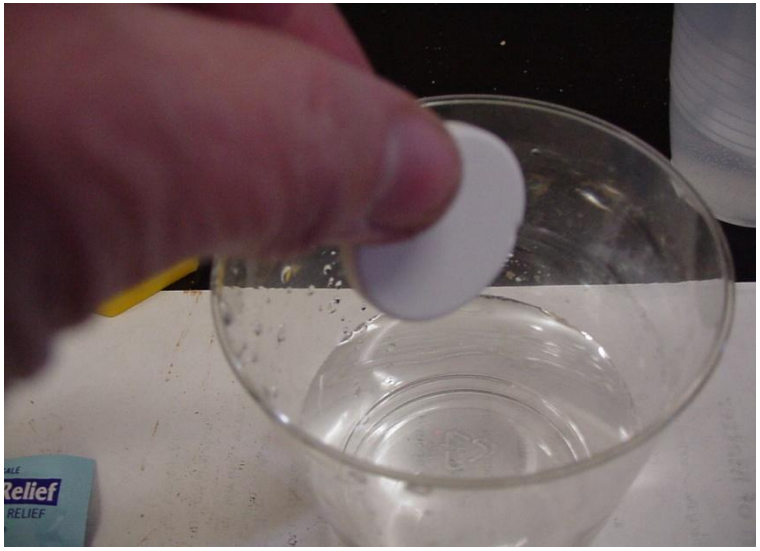
Sometimes the wording can help you identify if it is a chemical or physical change.

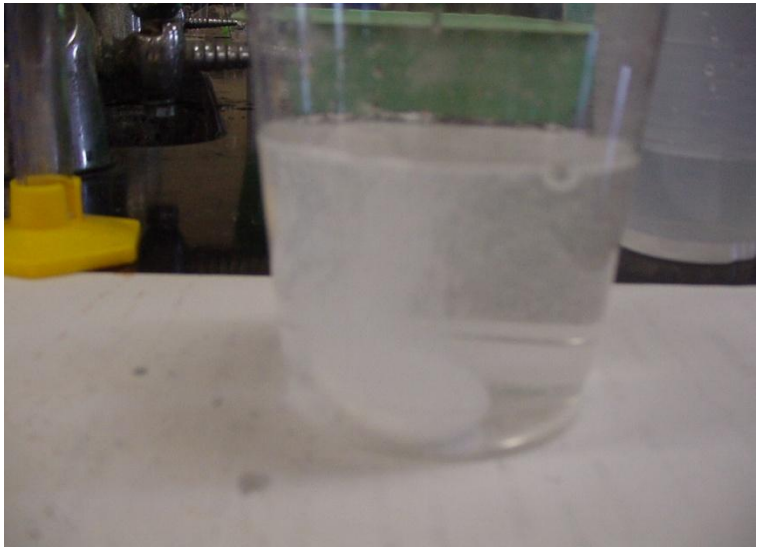
Physical Change Vocabulary	Chemical Change Vocabulary
grinding	burning
eroding	rotting
breaking	rusting
evaporating	
meting	
condensing	
drying	
freezing	

1. A. Physical Change
   B. Chemical Change

Rusting nails

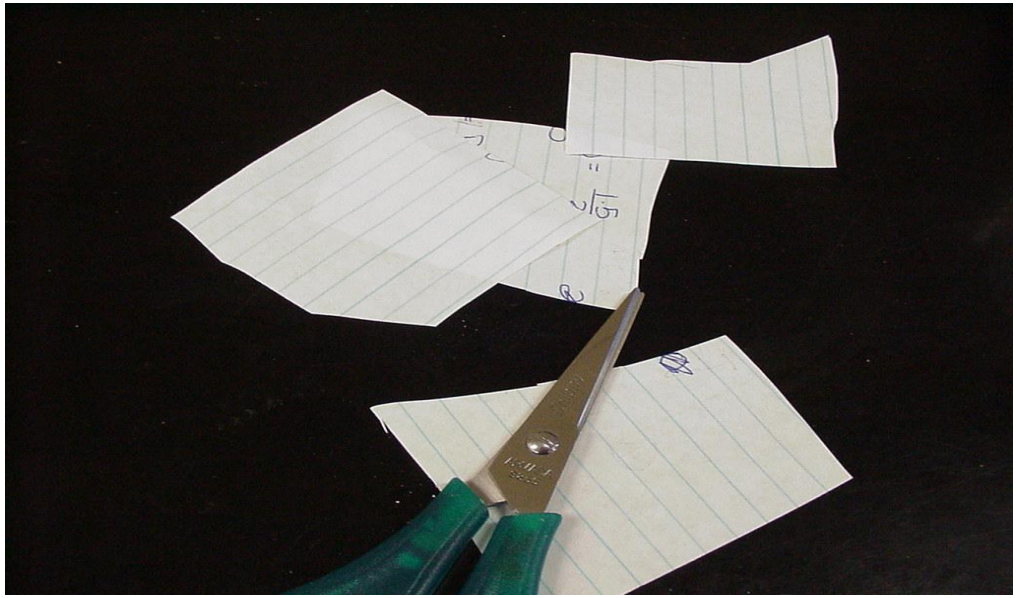
2. A. Physical Change
B. Chemical Change





Effervescent tablet

3. A. Physical Change
B. Chemical Change



Cut paper

4. A. Physical Change
B. Chemical Change

Vinegar and Baking soda

5. A. Physical Change
   B. Chemical Change

Salt and water

6. A. Physical Change
   B. Chemical Change

Broken glass

7. A. Physical Change
B. Chemical Change

Burning wood

8. A. Physical Change
B. Chemical Change

Ice melting

9. A. Physical Change
B. Chemical Change

Removing iron filings from a mixture

10. A. Physical Change
B. Chemical Change

Boiling water

Check your paper and place in notebook

1. B - Chemical
2. B - Chemical
3. A - Physical
4. B - Chemical
5. A - Physical
6. A - Physical
7. B - Chemical
8. A - Physical
9. A - Physical
10. A - Physical