Name: _____

unit B

Science 9

MATTER & CHEMICAL CHANGE

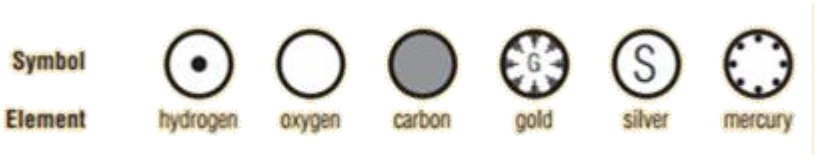
The Periodic Table

2.2 Organizing the Elements & 2.3 The Periodic Table Today

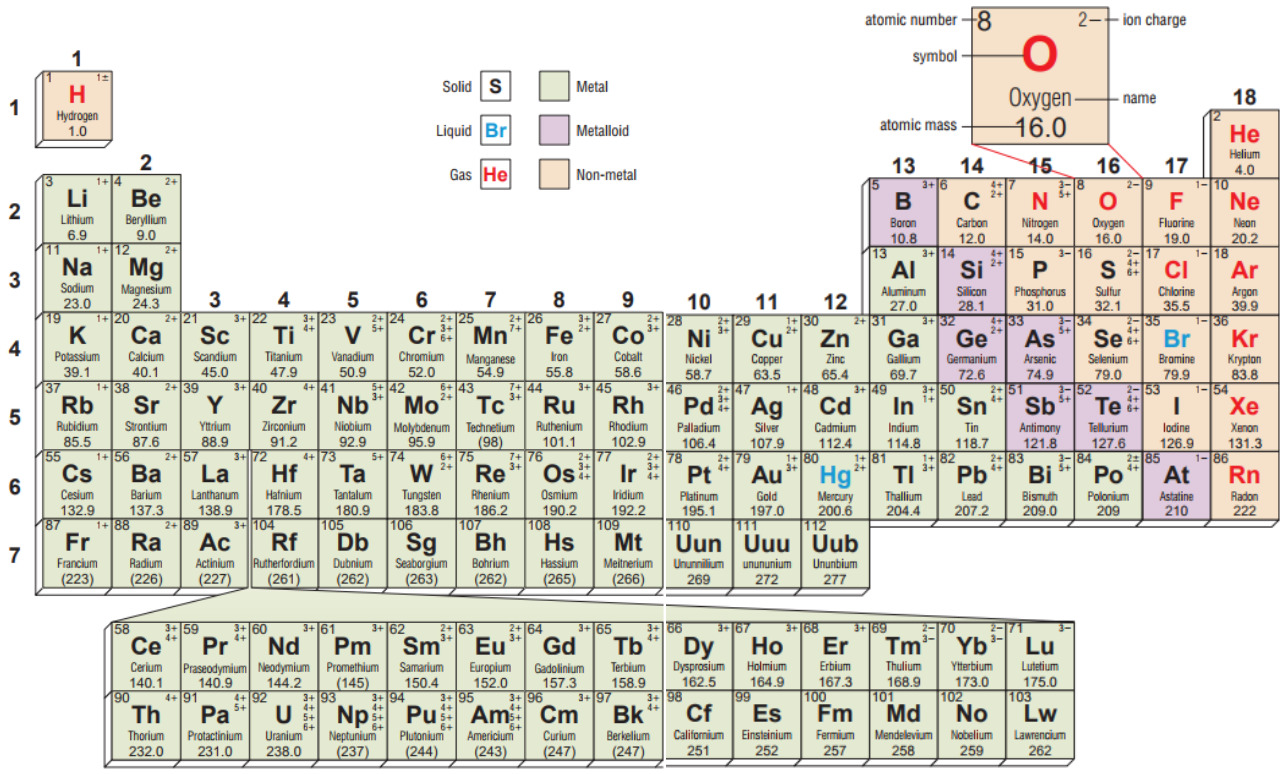
Learning Targets:

1. *Demonstrate understanding of the origins of the periodic table, and relate patterns in the physical and chemical properties of elements to their positions in the periodic table*
2. *Use the periodic table to*
    a. *Identify the number of protons and electrons in each atom, as well as other information about each atom*
    b. *Describe the relationship between the structure of atoms in each group and the properties of elements in that group*

- As elements were being discovered, organizing the elements in a _____ way was a goal of many early chemists.
- One of the first attempts by a scientist to create a system for organizing the elements was made by _____. He developed a set of symbols for the elements:



- Swedish chemist Berzelius later suggested using _____ rather than pictures to represent each element.
- The first letter (_____) of an element would become the symbol
- For elements with the same first letter, a _____ second letter would be added
    - Example: "H" stands for _____ and "He" stands for _____
- It was soon realized that the elements could be listed in order of increasing _____.
    - Atomic mass is the mass of one _____ of an element.
- Russian chemist Dmitri _____ was able to organize the elements in a way that reflected the patterns in the _____ of the elements.
- The 18 _____ in the table contain _____ or families of elements with similar chemical _____.
- The _____ in the periodic table, called _____, are numbered _____ to _____.



Label each of the following on the periodic table above

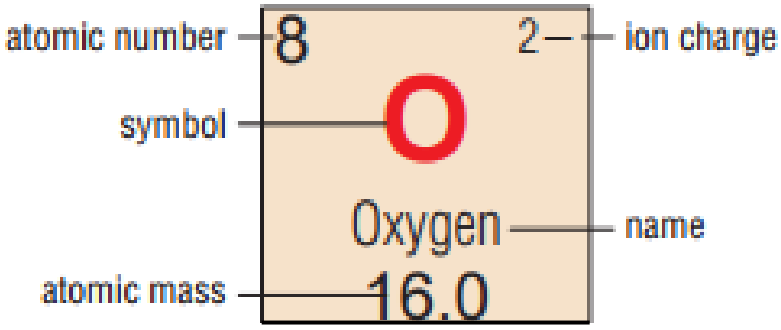
- Metals, non-metals, metalloids
- Alkali metals
- Alkaline earth metals
- Halogens
- Noble gases

Chemical Families of the Periodic Table

Directions: List some properties of the elements in each of the following chemical families

Chemical Family (group)	Characteristics of Elements
Alkali metals	
Alkaline-earth metals	
Halogens	
Noble gases	

Atomic Number



- The number above the element's symbol on the _____ is the atomic number.
- It shows how many _____ are in the _____ of one atom of the element.
    - Example: Oxygen (O) has _____ protons.
- The atomic number also tells you how many _____ are in atom of the element

Atomic Mass

- The number _____ the element's name is the _____.
- Tells you the total mass of all the _____ and _____ in an atom.
- The **mass number** represents the _____ of the number of protons and neutrons in an atom.
    - Example: carbon has _____ protons and _____ neutrons, so its mass number is _____.

mass number – atomic number = number of neutrons

Note: Where applicable, round the atomic mass to the nearest whole number to get the mass number. Example: The atomic mass of titanium (Ti) is 47.9, so the mass number is 48.

Check Your Understanding

Directions: Fill in the missing information in the table

Atomic symbol	Atomic number	Protons	Neutrons	Electrons	Mass Number	Atomic Mass
B			6			
	11				24	
		31	37			
				39	89	

1.2 Organizing Matter

Learning target:

1. *Describe and apply different ways of classifying materials based on their composition and properties*

Scientists like to organize and classify things. There are different methods of classifying substances

Method 1: Classification by States of Matter

Matter exists in three basic states: gas, solid, and liquid.

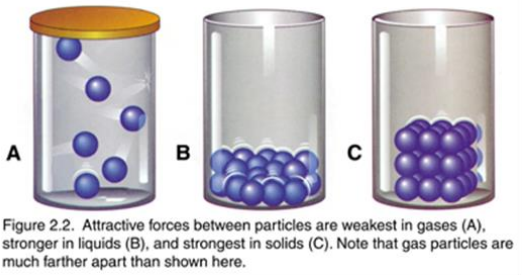
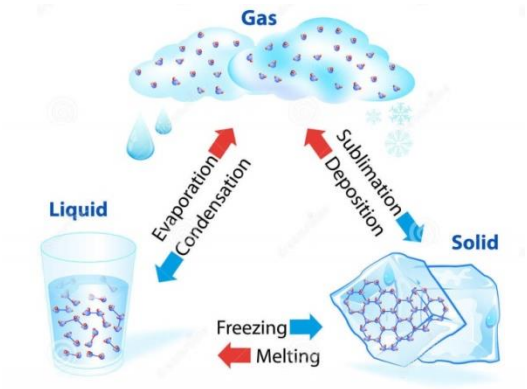


Figure 2.2. Attractive forces between particles are weakest in gases (A), stronger in liquids (B), and strongest in solids (C). Note that gas particles are much farther apart than shown here.



_____ _____ _____

The state of a substance depends on its _____

Method 2: Classification by Properties of Matter

- Properties are characteristics that can be used to _____ a substance.
- All matter has two types of properties: _____ and _____

Physical Properties of Matter

Match the physical property of matter with the appropriate description

_____: ability to resist scratching; measured on Mohs' hardness scale from 1-10

_____: ability to be pounded or rolled into sheets (e.g. aluminum foil)

_____: ability to be stretched into a long wire (e.g. copper)

_____: ability to dissolve in a liquid (e.g. sugar is soluble in water, but oil is not)

_____: ability to conduct electricity or heat? (e.g. most metals)

List 3 other examples of physical properties of matter: _____

_____

Chemical Properties of Matter

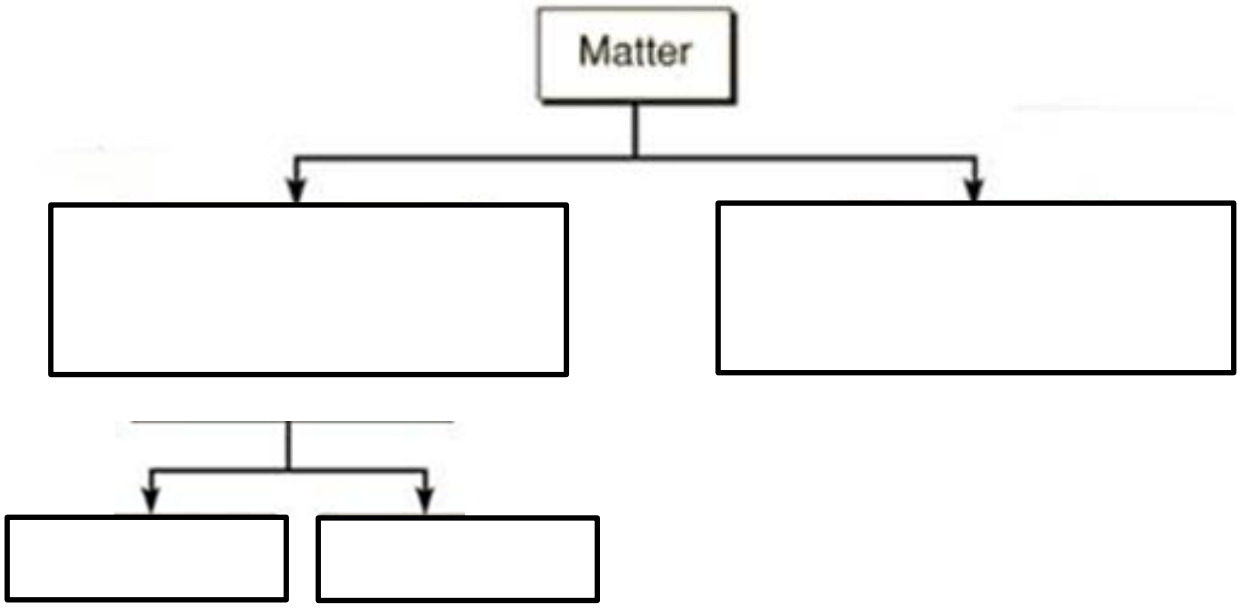
- A _____ property describes how a substance interacts with other substances such as _____.
- Chemical properties are _____ when a chemical _____ occurs.
- A chemical change results in the _____ of a new substance with different properties
    - Example: a pancake has different _____ from those of its _____.

Method 3: Classification by composition (by what the substance is made up of)

- All matter is either a pure substance or a mixture. Physical and chemical properties show us whether a substance is "pure" or a mixture.

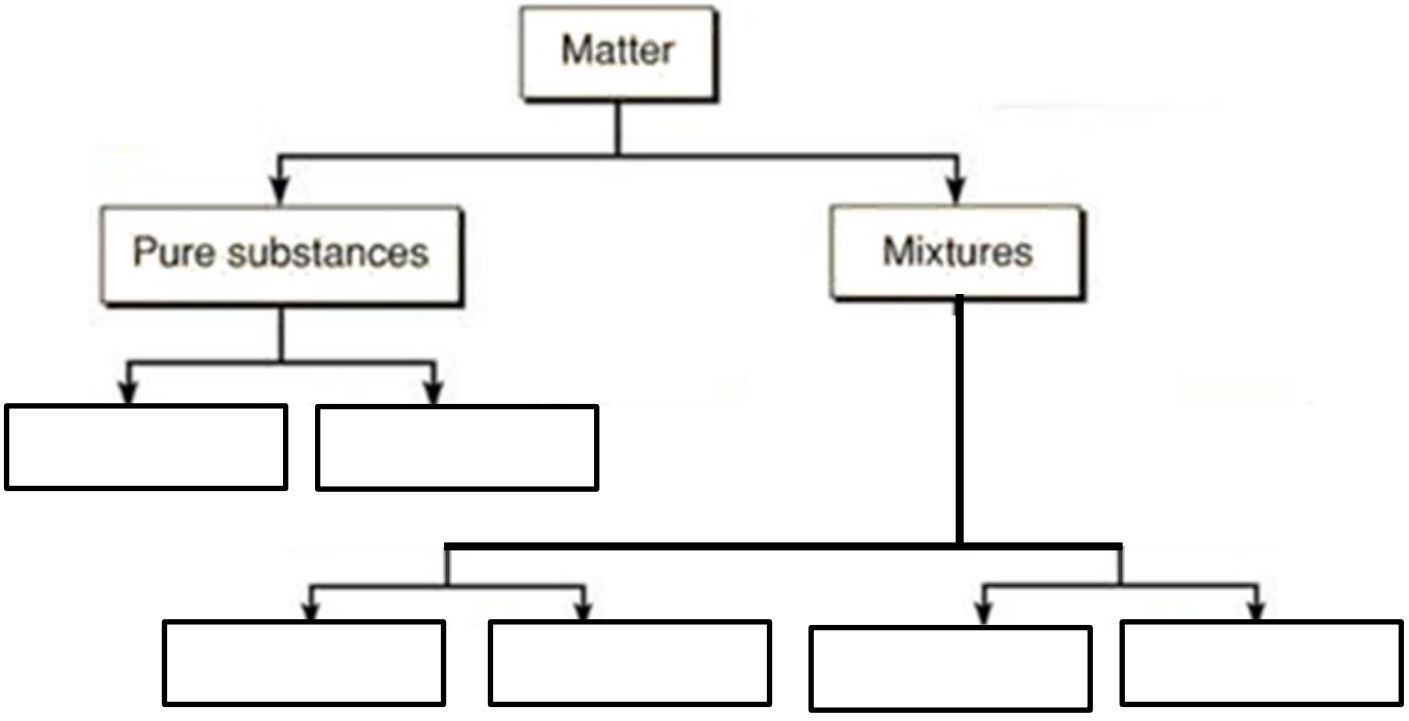
Pure Substances

- Made of only _____ kind of matter. A pure substance may be either a(n):
    1. _____: a material that cannot be broken down into any simpler substance. Elements are all organized into a _____ according to their properties. (e.g. hydrogen, carbon, and _____)
    2. _____: the combination of two or more elements.



Mixtures

- A _____ is a combination of _____, but the pure substances do not "chemically" combine.
- There are _____ main types of mixtures.
    1. _____ mixture (aka _____ mixture) – the different substances that make up the mixture are _____.
        - Examples: _____
    2. _____ (aka _____ mixture) – the different substances that make it up are not separately _____.
        - Examples: _____
    3. _____: a cloudy mixture in which tiny particles of one substance are held within another. Particles can be separated using _____
        - Example: _____
    4. _____: similar to a suspension, but particles are so _____ that they cannot be easily separated.
        - Examples: _____



Lab Safety

1.1 Safety in the Science Class

Learning Targets

1. *Identify and evaluate dangers of caustic materials and potentially explosive reactions*
2. *Identify and demonstrate safe lab practices.*

Label these Symbol Shapes

Label these Common Hazard Warnings

Label these WHMIS Symbols

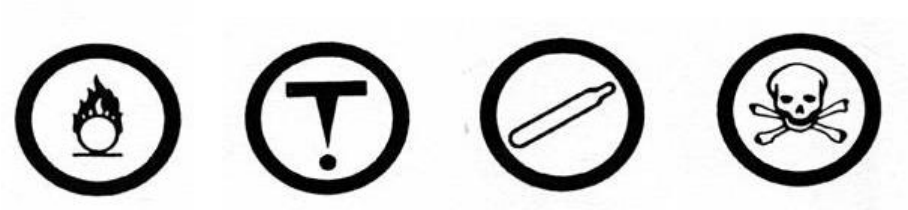
W _____

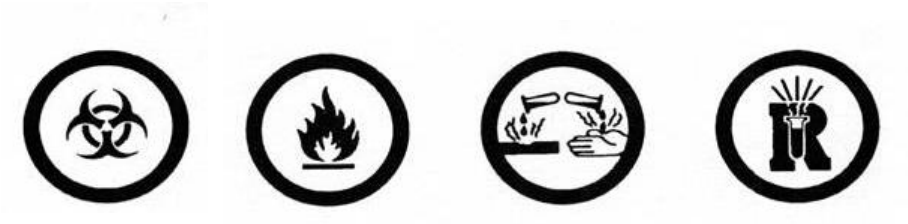
H _____

M _____

I _____

S _____





General Lab Safety Rules

1. **Hair**_____
2. **Clothing**_____
3. **Footwear**_____
4. **Eyewear**_____
5. **Chemical Disposal**_____
   _____
6. **Spills, equipment damage, and injuries**
   _____

Chemical Reactions I

1.3 Observing Changes in Matter

Learning Target:

1. *Investigate and describe properties of materials*

Physical Change

- The material changes from one _____ to another.
- The material can also physically change back into its _____.
- Example: _____

Chemical Change

- _____ or more materials _____ and create _____ materials.
- The new materials have completely different _____ from the original substances.
- Example: _____

How can you tell when a chemical change has taken place?

If you make two or more of the following observations, then a CHEMICAL change has *probably* taken place.

Evidence of a chemical change
1. Change in _____
2. Change in _____
3. Formation of a _____ or _____
4. Release or absorption of _____

Note: You cannot be sure that chemical change has occurred unless you are certain that a new substance has been formed.

Combining Elements

3.1 Naming Compounds

Learning Target

1. *Identify and describe chemicals commonly found in the home, and write the chemical symbols.*
2. *Read and interpret chemical formulas for compounds of two elements*
3. *Draw simple models of compounds*

- List a cleaning product you have in your house: _____
- List a substance you might find in your kitchen for cooking or baking: _____

- Each of the compounds you listed above has a _____ _____ and a _____ _____.

Chemical Formulas

- Look at the chemical formula for water, shown below.
- What two elements make up water? _____ and _____
- Notice that next to the H is a small 2 as a _____ ("sub" means below)
- The 2 indicates that there are 2 _____ of _____ to go with every atom of oxygen in water.
- Figure 3.4 shows how the atoms in water are _____

H_2O

Chemical formula for water

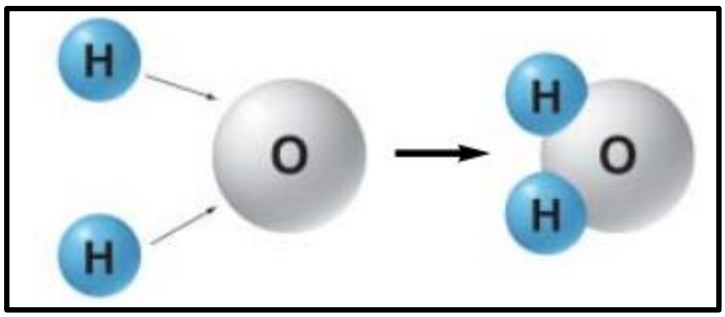


Figure 3.4 In water, two hydrogen atoms join with each oxygen atom.

Note: *If no subscript is written next to an element, then there is only 1 atom of that element*

Indicating the physical state of a compound

- After the chemical formula, a subscript for solid (s), liquid (l), gas (g) or aqueous (aq) is used to indicate the state of the compound
- Aqueous just means the compound is dissolved in _____.

$NaCl_{(aq)}$

Check Your Understanding

Directions: Fill in the missing information in the table below

Compound	Elements in Compound	Number of Atoms of Each Element	Drawing of Compound
$Al_2O_{3(s)}$			
$Na_2O_{(s)}$			
$NaOH_{(s)}$			

3.2 Ionic Compounds

Learning targets:

1. Give the IUPAC name and common name of compounds with two elements
2. Identify examples of combining ratios/number of atoms per molecule found in some common materials, and use information on charges to predict combining ratios in ionic compounds of two elements

Ionic Compounds

- Ionic compounds are _____ formed as a result of the attraction between particles of opposite charges, called _____.
    - Table salt (NaCl) is formed from _____ charged _____ ions and _____ charged _____ ions

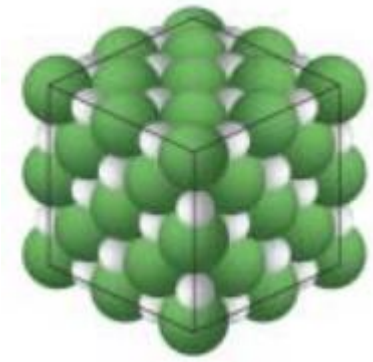


Figure 3.7 The crystals in this table salt are held together by ionic bonds.

Some Physical Properties of Ionic Compounds

Physical Property	Characteristics of Ionic Compounds
Classification of matter	
State at room temperature	
Melting point	
conductivity	
Structure when combined	
solubility	

- When melted or dissolved in water, they will conduct _____ → led to the invention of _____ → led to the invention of _____.
- When an ionic compound is dissolved in water, the metal and non-metal form and _____ solution of _____.
- An ion is an _____ or group of atoms that has become electrically _____ through the _____ or _____ of _____.
    - Look at the examples of ion charges on the next page

Some examples of ion charges for various elements. Fill in the missing information.

Element	Ion Charge	Ion Notation
Hydrogen		H^+
Lithium		
Nitrogen		N^{3-}
Oxygen		
Iron		Fe^{2+} or Fe^{3+}
Copper		

To indicate ions in written notation, a plus sign (+) or a minus sign (-) is placed to the upper right of the element symbol

- Example: sodium ion = Na^+
- Example: chlorine ion = Cl^{1-}

Polyatomic Ions

- "poly" means _____
- Polyatomic ions are a _____ of atoms acting as _____.
    - Example: 1 carbon and 3 oxygen form the polyatomic ion called _____ or (_____)
- When carbonate reacts with calcium, the product is calcium carbonate, or _____ ($CaCO_{3(s)}$)

Naming Ionic Compounds (IUPAC Naming)

All binary ionic compounds (those containing two elements only) can be named using the following rules:

1.) The chemical name of the _____, or positive ion goes _____, followed by the name of the _____, or negative ion.

2.) The name of the non-metal negative ion changes its ending to _____.

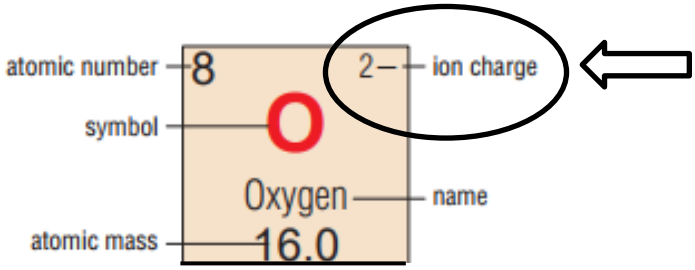
Examples:

- NaCl is named: _____
- $CaCl_2$ is named: _____

Exception:

- Where negative ions are _____ ions, the name remains unchanged.
    - Example: $CaCO_{3(s)}$ is named calcium carbonate

Using Ion Charges and Chemical Names to Write Formulas



You can find an element's charge by looking at the periodic table

Step 1	You Try!
Write the metal element's symbol with its ion charge (you can find the ion charge on the periodic table). Then write the non-metal element's symbol with its charge. **Ca^{2+} Cl^{1-}**	Write the element symbols and charges for each ion: Aluminum, Fluorine

Step 2	You Try!
Balance the ion charges. The positive ion charge must balance the negative ion charges. In this example, each calcium ion is 2+, so we need two Cl^{1-} to balance **Ca^{2+} Cl^{1-} Cl^{1-}** **2+ 1- 1-** **2+ 2- The charges are balanced**	Balance the ion charges:

Step 3	You Try!
Write the formula by indicating how many atoms of each element are in it, as shown. Do not include the ion charge. Place the number of atoms of each element in a subscript after the element's symbol. If there is only one atom, no number is used. **$CaCl_2$**	Write the formula for the ionic compound formed from aluminum and fluorine:

3.3 Molecular Compounds

Learning Target

1.) Distinguish between ionic and molecular compounds, and describe the properties of some common examples of each.
2.) Read and interpret chemical formulas for compounds of two elements, and give the IUPAC name and common name of these compounds

When _____ combine, a pure substance called a molecule, or a molecular compound, is formed. The physical properties of molecular compounds differ from ionic compound, as shown in the table below.

Physical Property	Characteristics of Ionic Compounds	Characteristics of Molecular Compounds
Classification of matter	Pure substance	
State at room temperature	Almost always solid	
Melting point	high	
conductivity	Good conductors of electricity	
Structure when combined	crystal	No particular structure; varies from molecule to molecule
solubility	Dissolves in water	Generally does not dissolve in water (sugar, $C_6H_{12}O_6$, is an exception)

Writing Formulas for Molecular Compounds

- No _____ are present, and the ion charge is not used in the formulas. This makes it hard to _____ how non-metals combine.
- The formulas still show what elements are present, and how many of each type of atom make up the molecule.
    - **Example**: Ammonia ($NH_{3(g)}$) is a molecular compound formed when three _____ atoms combine with one _____ atom.

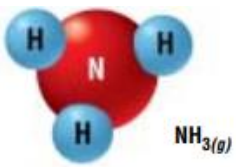


Figure 3.15 In a molecule of ammonia, each hydrogen atom is attached to the nitrogen atom. The formula is $NH_{3(g)}$.

Naming Molecular Compounds (IUPAC Naming)

All molecular compounds, except those containing _____, can be named using the following rules:

1.) Name the _____ element in the compound (just like for ionic compounds)

2.) Name the _____ element in the compound and change its ending to "_____" (just like for ionic compounds)

3.) When there is more than one atom of an element, a _____ is used. Fill in the missing prefixes in the table.

   - Exception: When the first element has only _____ atom, the prefix "mono" not used.

Number of Atoms	Prefix
1	
2	
3	
4	
5	

Summary: Molecular compounds are named using this format:

_____ + _____ _____ + _____

Examples:

1.) CO_2 _____

2.) N_2O _____

3.) N_2O_3 _____

4.) CCl_4 _____

5.) PF_5 _____

Chemical Reactions II

4.1 Chemical Reactions

Learning Targets

1.) Identify conditions under which properties of a material are changed, and critically evaluate if a new substance has been produced.
2.) Observe and describe evidence of chemical change in reactions between familiar materials
3.) Describe familiar chemical reactions, and represent these reactions by using word equations and chemical formulas and by constructing models of reactants and products

A **chemical reaction** takes place when _____ or more substances _____ to form a _____ substance.

The materials at the start of a reaction are called the _____.

- In the example of a campfire, the reactants are _____ and _____.

The new materials produced by the chemical reaction are called _____.

- In the example of a campfire, the products are _____ and _____.

A chemical reaction can be written as a chemical _____ equation, as shown below, using the campfire example.

_____ + _____ → _____ + _____ + _____

The reactants always appear to the _____ of the arrow and the products to the _____.

_____ _____ separate the reactants from each other and the products from each other.

Recall from Chemical Reactions I (section 1.3) that when a chemical reaction occurs, a new substance forms and evidence of that reaction may include one or more of the following:

- _____
- _____
- _____
- _____

Remember*: The only way to know for sure if a chemical reaction has taken place is if one or more new substances are formed.*

Endothermic and Exothermic Reactions

A chemical reaction that _____ heat energy is called an exothermic reaction

- (Think **EX**othermic → heat is **EX**iting)

A chemical reaction that _____ heat energy is called an endothermic reaction

Chemical Changes Involving Oxygen

1. _____ is a chemical reaction that occurs when oxygen reacts with a substance to form a new substance and give off heat _____.
    - _____ is a common example of a combustion reaction.

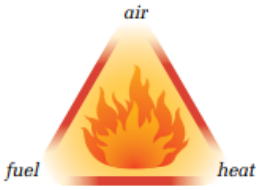
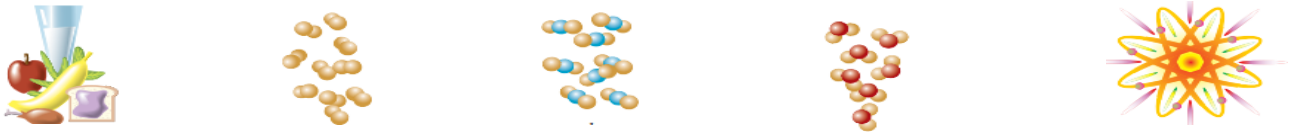


Figure 4.3 This fire triangle shows the three factors that keep a fire going. If any one of them is missing, the fire will not continue burning.

2. _____ is the slow chemical change that occurs when oxygen in the _____ reacts with a _____.
    - A common example of corrosion is _____
    - Write the word and chemical equation for the rusting of iron below (use Google!):

_____	+	_____	→	_____	
_____	+	_____	→	_____	

3. _____ is a chemical reaction that takes place in the cells in your body. Label the diagram below with the **word and chemical equations**.



_____	+	_____	→	_____	+	_____	+	_____
_____	+	_____	→	_____	+	_____	+	_____

4.2 Conservation of Mass

Learning Target:

1. Observe and describe patterns of chemical change

In a chemical reaction, the total mass of the products is always the _____ as the total mass of the _____. This law is called the

_____

The **Law of Conservation of Mass** states that matter cannot be _____ or _____ in a chemical reaction.

Write the **chemical and word equations** for the reaction pictured above:

Mass of iron: _____

Mass of sulfur: _____

Total mass of reactants: _____ **Total mass of products**: _____

Check Your Understanding:

Explain why the total mass of the reactants is the same as the total mass of the products

_____

_____

_____

_____

4.3 Reaction Rates

The reaction rate refers to how fast the reaction occurs.

- Cooking an egg is example of a chemical reaction. List one way you could speed up the cooking process: _____

The four factors that can affect the rate of a chemical reaction are:

1. _____
2. _____
3. _____
4. _____

Directions: Fill in the missing information in the table below.

Factor Affecting Reaction Rate	**Explanation – How can it be used to speed up or slow down a reaction?**	**Example**
Catalysts		
Concentration of Reactants		
Temperature of Reactants		
Surface Area of Reactants		