Safety In The Science Lab

Know the **WHMIS** safety symbols and what they mean


Poisonous


Toxic


Corrosive


Compressed Gas


Flammable


Oxidizing


Highly Reactive


Biohazardous

CHEMICAL CHANGE

CONTENT CARD SET

Early Ideas About Matter

8000 B.C. Stone Age	Matter made up of solid material, fashioned into tools.	Stone tools
6000-100 B.C. Precious Metals	Chemists investigated properties of materials that were valuable to humans.	'gold and copper'
4500 B.C Bronze Age	The effect of heat on metals	alloys
1200 B.C. Iron Age	Iron combined with carbon to make steel, for stronger tools.	Steel
350 B.C. Alchemy	Everything was made out of Air – Water - Earth – Fire	'atomos particles'
1500 Democritus	Theory of Matter was based more on experimentation.	Alchemy

Scientific Inquiry

1660 Boyle	Particles can be compressed. Scienific Inquiry	Particle Model
1597 Libau	Chemical preparations and a textbook were written	Textbook
1770 Lavoisier	System for the naming of chemicals was developed.	Molecular Theory
1780	Air is necessary for combustion to occur.	Combustion

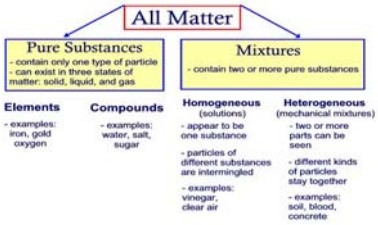
ATOMIC Theory

1808 Dalton	Observation principles during experimentation.	Billiard Ball Model
1897 Thomson	Raisin bun model with charged particles.	Raison Bun Model
1904 Nagaoka	Negatively charged particles orbiting around nucleus.	Solar System Model
1913 Bohr	Electrons travel in shells around a central nucleus	Atomic Theory
Chadwick	Subatomic particles	Protons, neutrons, electrons
1922 Rutherford	Electrons rotate randomly around the nucleus.	Shell Model

'Quantum Theory' Electrons moving randomly in a cloud around the central nucleus

Classification of Matter

Matter exists in three states: solid, liquid, or gas. Matter undergoes a change in state when energy is gained or lost.

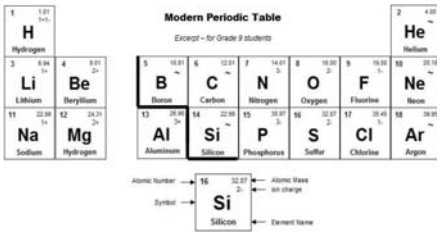


Properties are characteristics that can be used to describe a substance. These properties can be physical or chemical. Matter can change from one form to another, or create new materials. A physical change occurs when a material changes state. It is reversible.
A chemical change occurs when substances react and create a new substance. Evidence that a chemical change occurs includes, but is not limited to the following: Change in color, Change in odor, Formation of a gas, Release or absorption of energy (heat), Difficulty reversing the change (non-reversible).

Elements: Patterns and Order

Finding a pattern and an order in an unknown helps scientists to organize ideas and information. It also helps them to interpret what the information means and explain these ideas, based on what they have learned – developing Theories.
Early chemists used symbols of the sun and the planets to identify the elements. This became a problem, when more elements were discovered than planets. John Dalton developed a new set of symbols in the early 1800's to improve communication between chemists. Berzelius revised Dalton's symbols by replacing them with letters, instead of pictures and representing each element by their first letter (capitalized), or their first two letters (first one capitalized and the second letter lower case).
Elements were then listed in order of their atomic mass. Atomic mass is the mass of one atom of an element.
It is represented in *atomic mass units* (amu).
John Newland's "*law of octaves*" identified the pattern by which properties of the elements seemed to repeat at regular intervals, similar to the octave scale in music.

The Modern Periodic Table



Demitri Mendeleev later revised the pattern in 1869 by collecting the 63 elements known at the time and arranging them according to their properties.

By sorting and arranging the elements in this way, he was able to identify gaps - for undiscovered elements. They were later discovered and fit where he said they would.

Periodic Table Groupings

All the elements in a group (or column) are called families.

Group 1 - Alkali Metals - softer than most metals, good heat conductors and can explode if exposed to water.

Group 2 - Alkaline Earth Metals - extremely reactive, not found freely in nature. Radium is an alkaline earth metal.

Group 3-6-7 - Rare Earth Elements - 30 rare earth elements. Many of them are synthetic or man-made.

Groups 3-12 - Transition Metals - Iron, cobalt and nickel -the only elements known that produce a magnetic field.

Groups 13-15 - Other Metals - solid with a high density. Examples of them are tin, aluminum and lead. Metalliods - have metal and non-metal properties. Some are semi-conductors (can carry an electrical charge under special conditions), great for computers and calculators.

Group 14-16 - Non-Metals - can't conduct heat or electricity very well and are brittle. At room temperature, they turn into gasses and solids.

Group 17 - Halogens - "Halogen" means "salt former" so compounds that contain halogen are called "salts." At room temperature, they are in three states of matter: solid, liquid and gas.

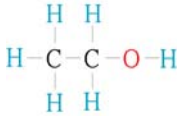
Group 18 - Noble Gases - don't react with other elements. All of these elements have the maximum number of electrons possible in their outer shell, making them stable. Helium, neon and krypton are noble gases.

Compounds

Each element in the periodic table has a chemical name. The combination of elements to form **compounds** have a **chemical name** and a **chemical formula**. The formula identifies which elements and how many of each are in the compound.

For example:

ethanol (C_2H_6O)
2 carbon atoms,
6 hydrogen atoms
1 oxygen atom



Guyton de Morveau developed a chemical naming system in 1787.

IUPAC (*International Union of Pure and Applied Chemistry*) is responsible for determining the appropriate name for each compound today.

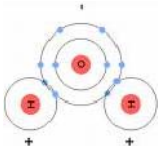
Rules for naming compounds:

1. The chemical name of the metal or positive ion goes first, followed by the name of the non-metal or negative ion.
2. The name of the non-metal negative ion changes its ending to **ide**.

Some ions are called **polyatomic ions** (meaning "*many*").

***Polyatomic ions** are a group of atoms acting as one.*
Eg. calcium carbonate, or limestone

Generally, elements in a group all have the same ion charge



Ionic Compounds pure substances formed as a result of the attraction between particles of opposite charges, called ions.	**Molecular Compounds** combined *non-metals* producing a pure substance called a molecule
compound contains a metal	compound doesn't contain a metal
high melting/boiling points	low melting/boiling points
distinct crystal shapes solids	solids, liquids, or gases
good electrical conductivity	good electrical insulators
table salt (NaCl) metal name is always first	sugar ($C_{12}H_{22}O_{11(s)}$) acetylene, water

Chemical Reactions

Occurs when two or more substances combine to form new substances.
Types: *combination*, *decomposition*, *displacement* and *exchange*

Substances at the beginning of the reaction are called **reactants**.
New materials produced by the reaction are called **products**.

Chemical reactions can be written as **word equations** which gives the names of all the reactants (separated by a "plus' sign +) followed by an arrow which points to the names of all the products (separated by a 'plus' sign +)
eg. (***iron + oxygen + water ---» rust***)
(*Iron plus oxygen plus water produces rust*)

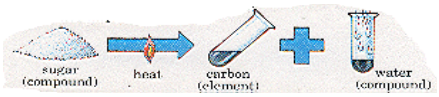
Evidence of Chemical Change

A **chemical change** results from a chemical reaction. Evidence that a chemical change has occurred include:

- A change on colour
- The formation of an odour
- The formation of a solid or a gas (bubbles)
- The release or absorption of energy

A chemical change, which **releases** energy, is called **EXOTHERMIC.**

A chemical change, which **absorbs** energy, is called **ENDOTHERMIC**



Types of Chemical Reactions

Combustion is a chemical reaction that occurs when oxygen reacts with a substance to form a new substance and gives off energy.

Corrosion is a slow chemical change that occurs when oxygen in the air reacts with a metal. Corrosion is a chemical reaction in which the metal is decomposed (eaten away), when it reacts with other substances in the environment.

Cellular Respiration is a chemical reaction that takes place in the cells in your body.

Law of Conservation of Mass

In a chemical reaction, the total mass of the reactants, are always equal to the total mass of the products.

This law goes well with the atomic theory
Atoms (matter) are never created or destroyed
In a chemical reaction the atoms and molecules are simply rearranged.

This law of conservation of mass does not apply to nuclear reactions, because there Is some loss of mass: *the mass is changed into energy*. This was first suggested by Albert Einstein in his famous equation:

$$E = MC^2$$

(E Is Energy, M is Mass, C^2 is a large number)
A very tiny amount of mass is equal to a very large amount of energy
In an open system some of the mass seems to disappear, when it is in the form of a gas.

Reaction Rate

The speed of a chemical reaction is called the reaction rate. Factors affecting the reaction rate include:

Temperature -The higher the temperature the faster the reaction rate

Surface Area -The more surface in contact, the faster the reaction rate

Concentration - The higher the concentration, the faster the reaction

Catalysts - The presence of a catalyst (substances that help a reaction proceed faster) also affects the reaction rate. Catalysts are not consumed in the reaction. Types of reactions involving catalysts can be found in living and non-living things.

Enzymes in the body speed up reactions, which break down food. They also help to rid the body of poison.