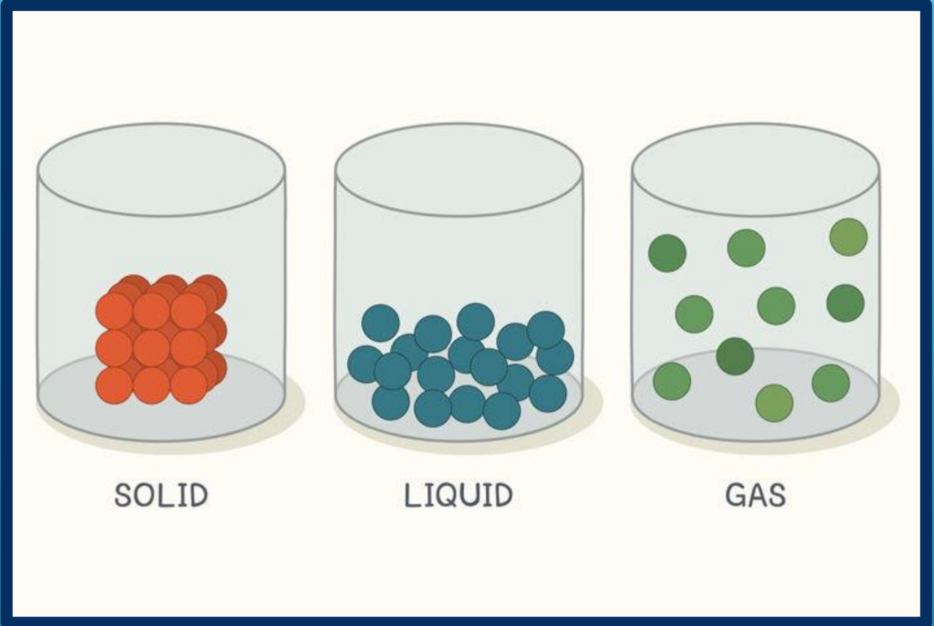
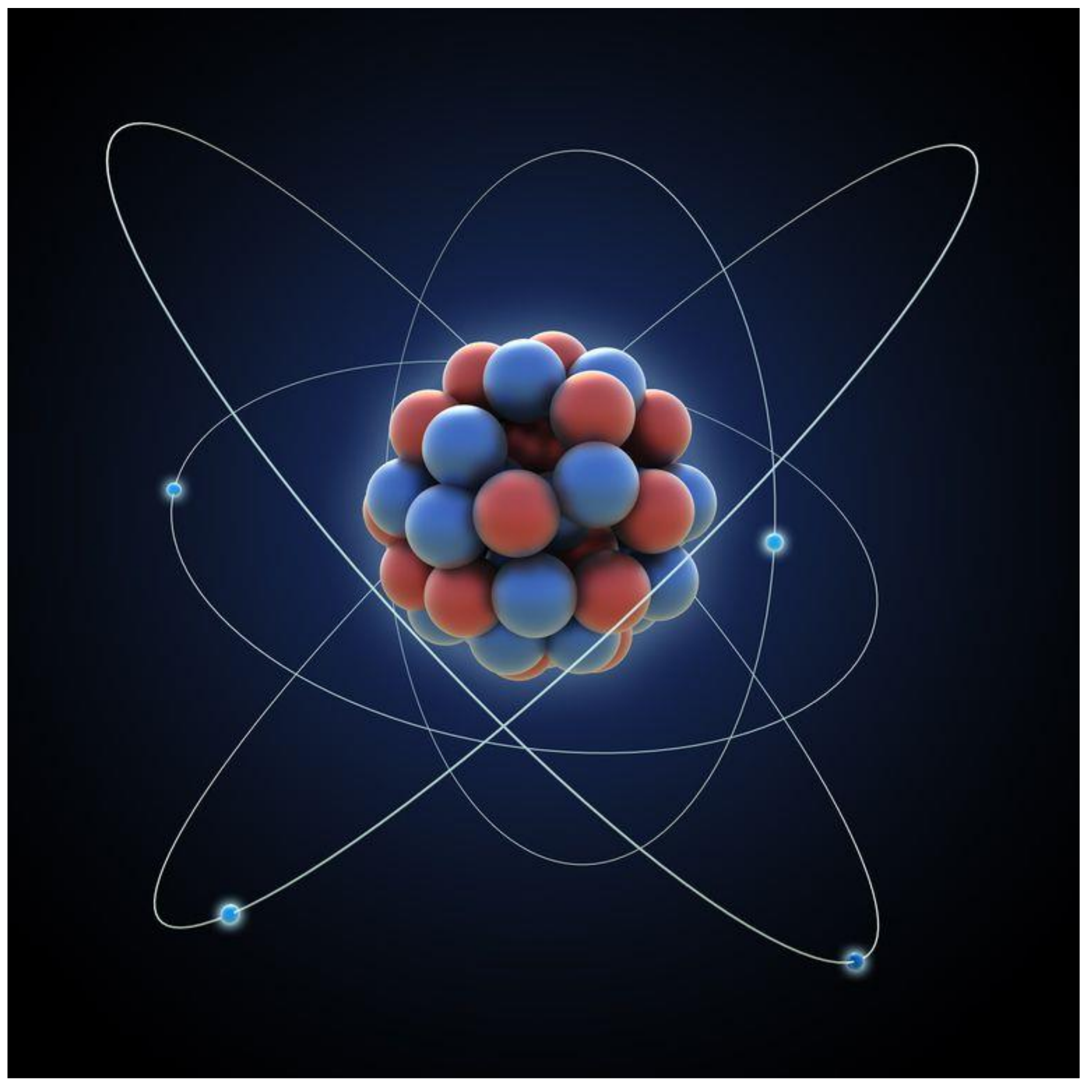
UNIT B - MATTER & CHEMICAL CHANGE

SECTION 1.0 – Matter can be described and organized by its physical and chemical properties





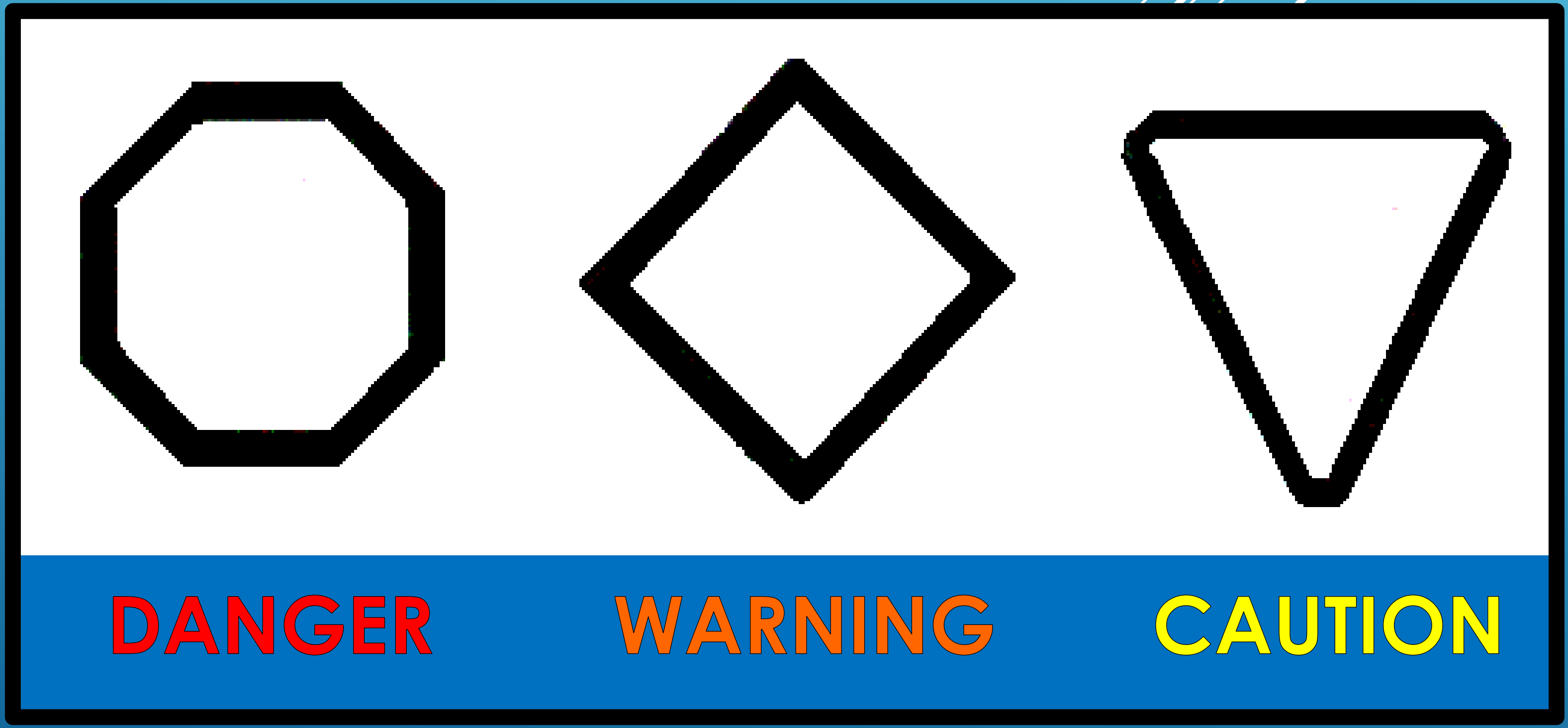
MATTER – Anything that has mass and occupies space.

DO YOU SEE ANYTHING THAT SHOULDN'T BE GOING ON IN A SCIENCE LAB?

SAFETY HAZARD SYMBOL SHAPES

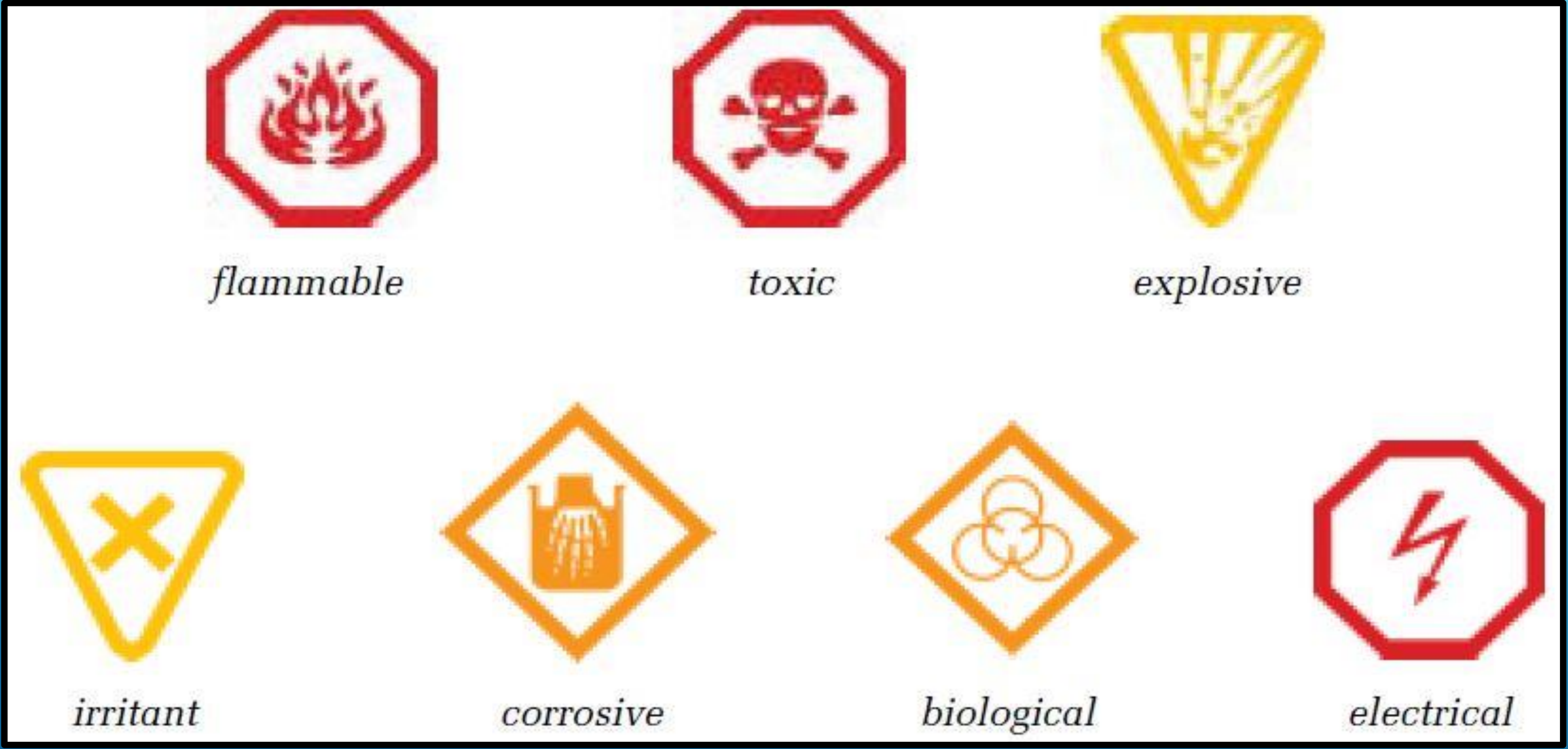
3 Possible Shapes

More Sides = More Dangerous



THE 7 SAFETY HAZARD SYMBOLS

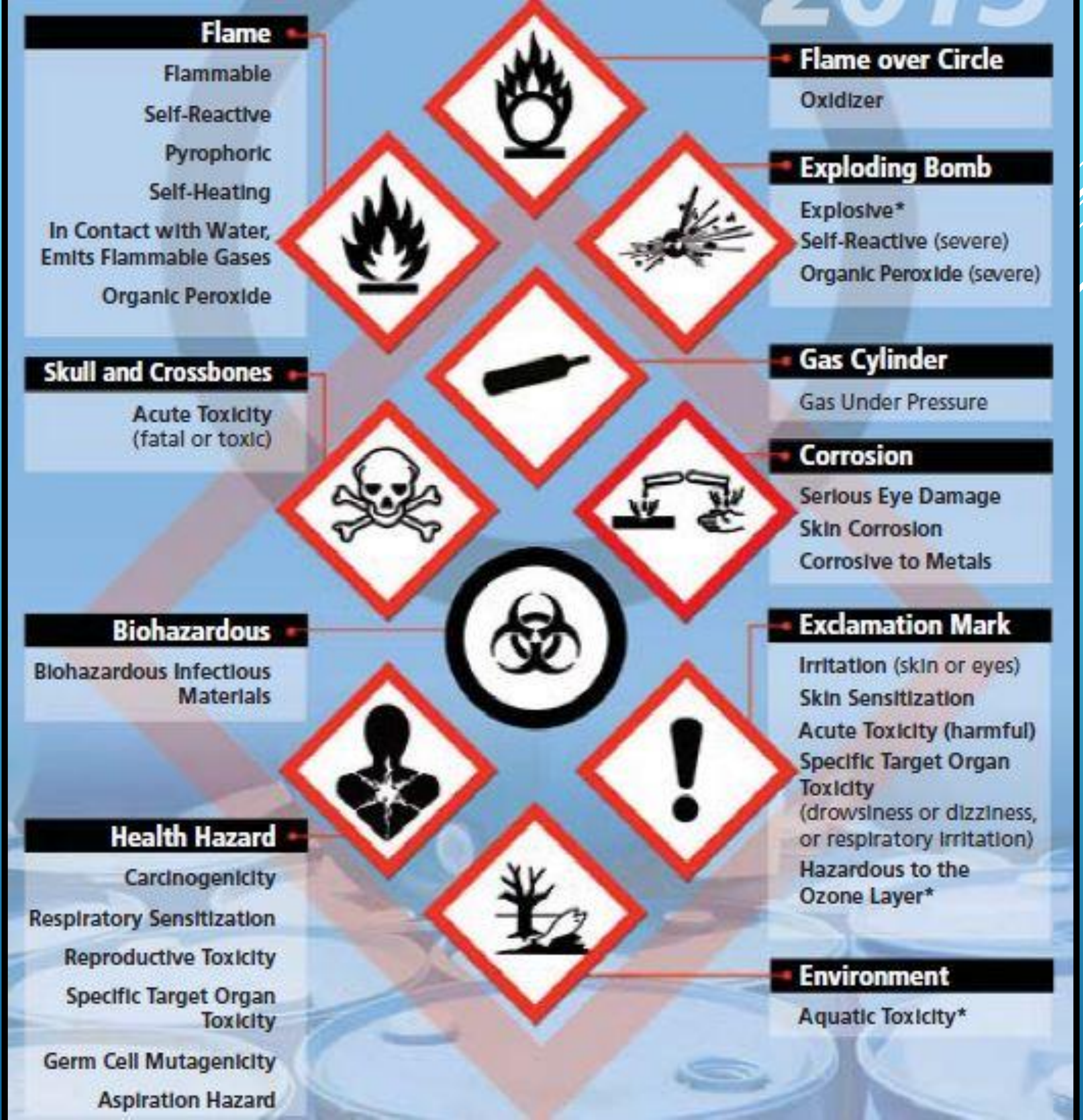
7 safety symbols can go in any of the 3 shapes



SECTION 1.1 – Safety In The Science Class

WHMIS SYMBOLS

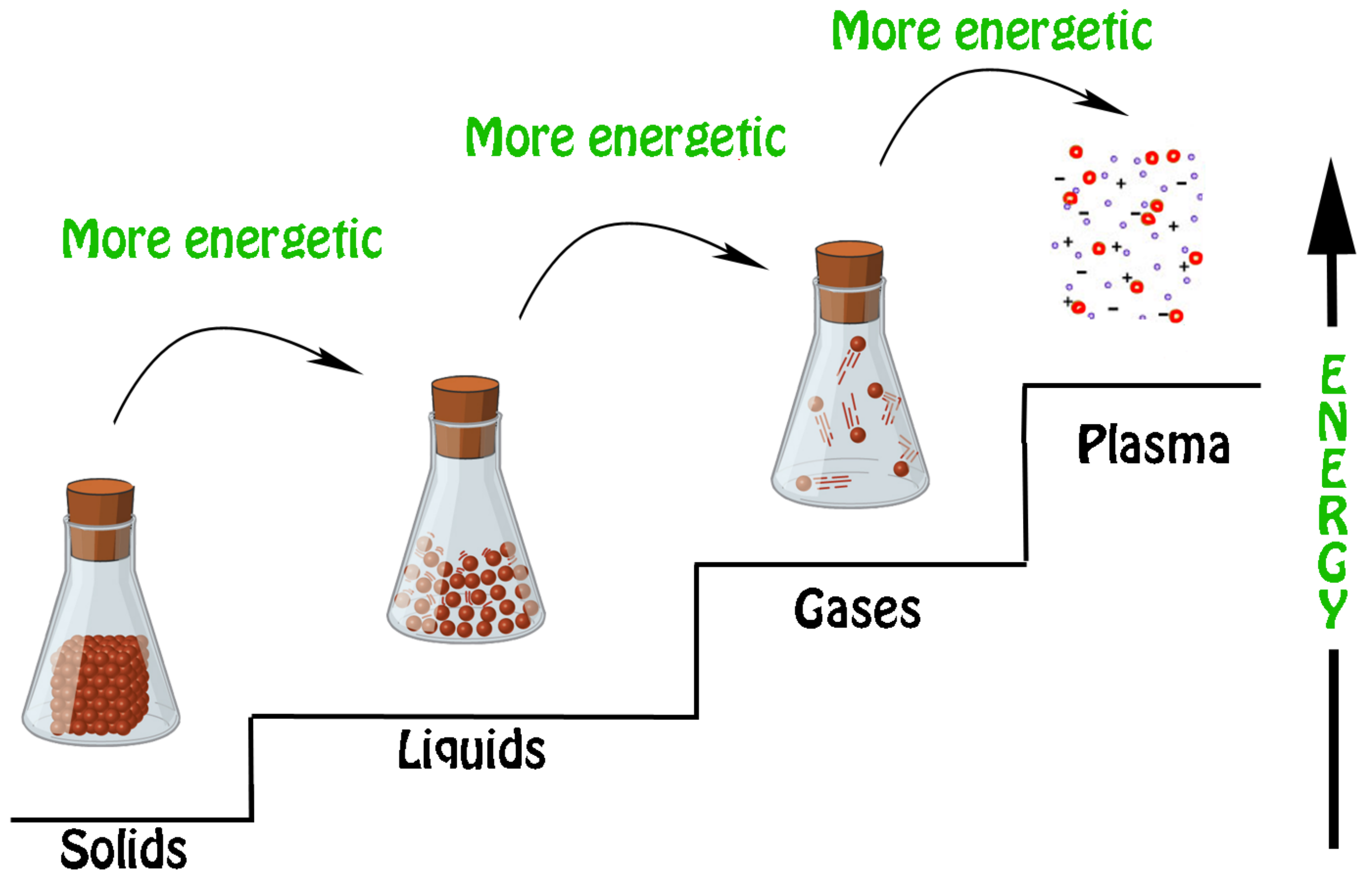
Workplace Hazardous Materials Information System



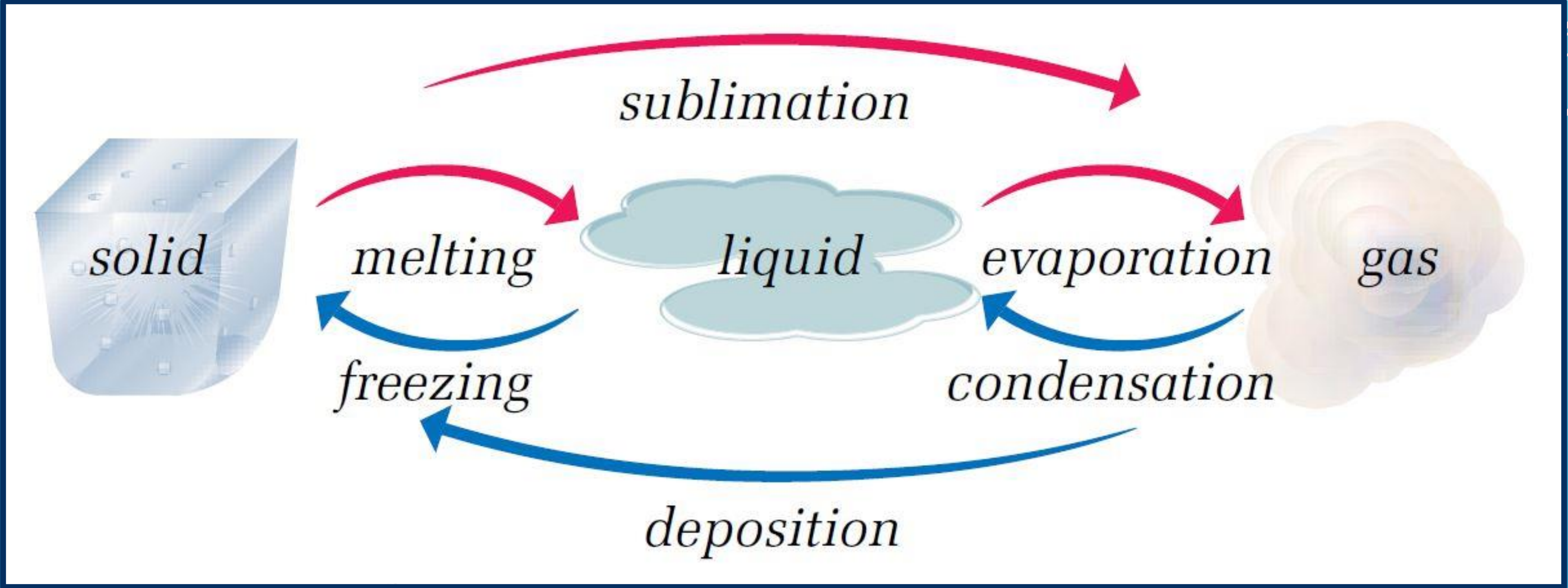
STATES OF MATTER

There are 4 states of matter:

- Solid
- Liquid
- Gas
- Plasma



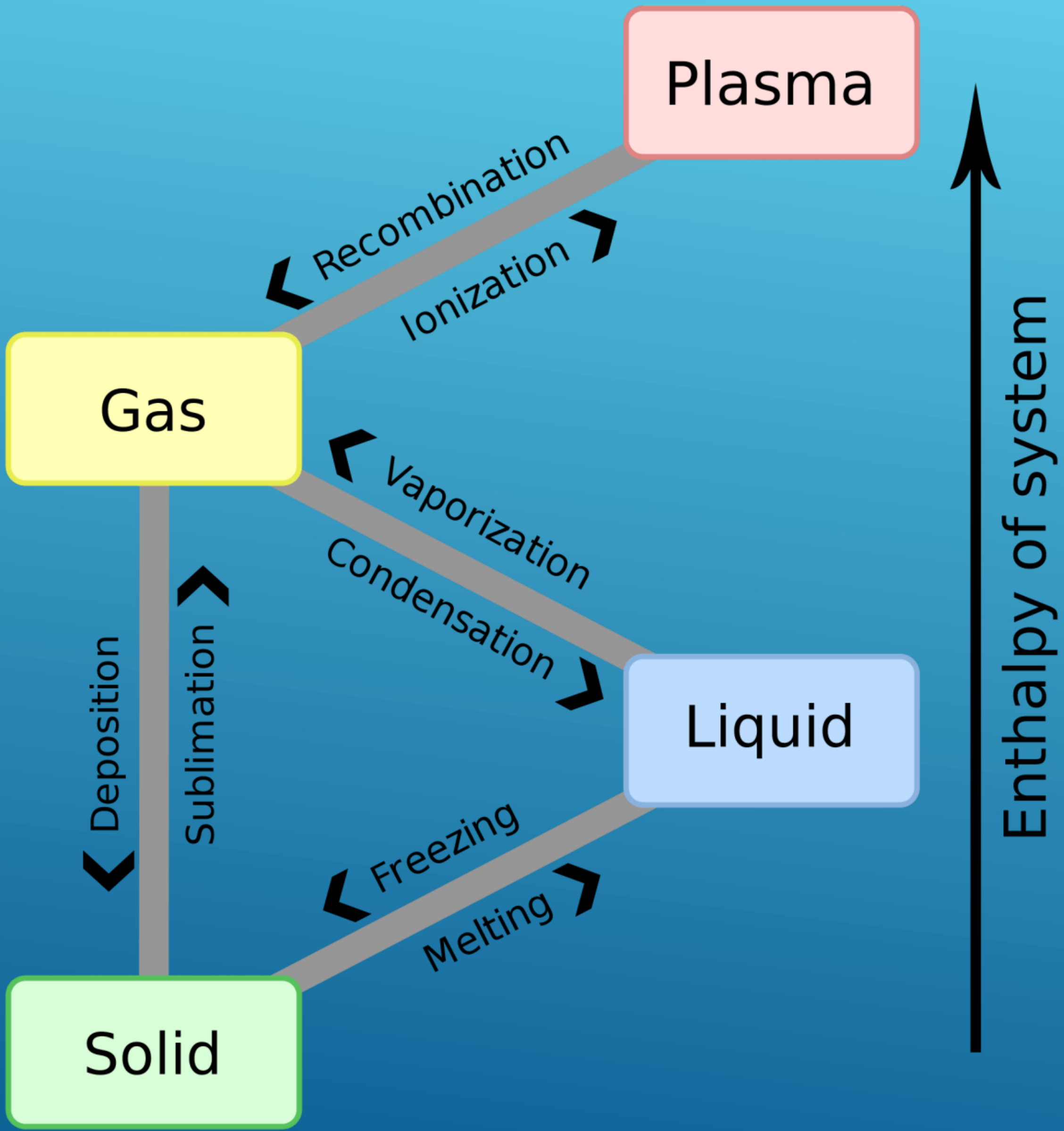
As you go from solids, to liquids, to gases, and finally to plasma, the energy levels of the particles are increasing



PHASE CHANGES:

- MELTING
- FREEZING
- EVAPORATION
- CONDENSATION
- SUBLIMATION
- DEPOSITION

SECTION 1.2 – Organizing Matter



Phase Changes:

- Melting
- Freezing
- Condensation
- Evaporation
- Sublimation
- Deposition

WHAT IS A PROPERTY?

property characteristic that describes a particular substance (e.g., colour, lustre, melting point, crystal shape, solubility, density)

Physical Properties:

A property that describes the physical appearance & composition of a substance

Some Physical Properties of Matter

- colour
- lustre
- melting point
- boiling point
- hardness
- malleability
- ductility
- crystal shape
- solubility
- density
- conductivity

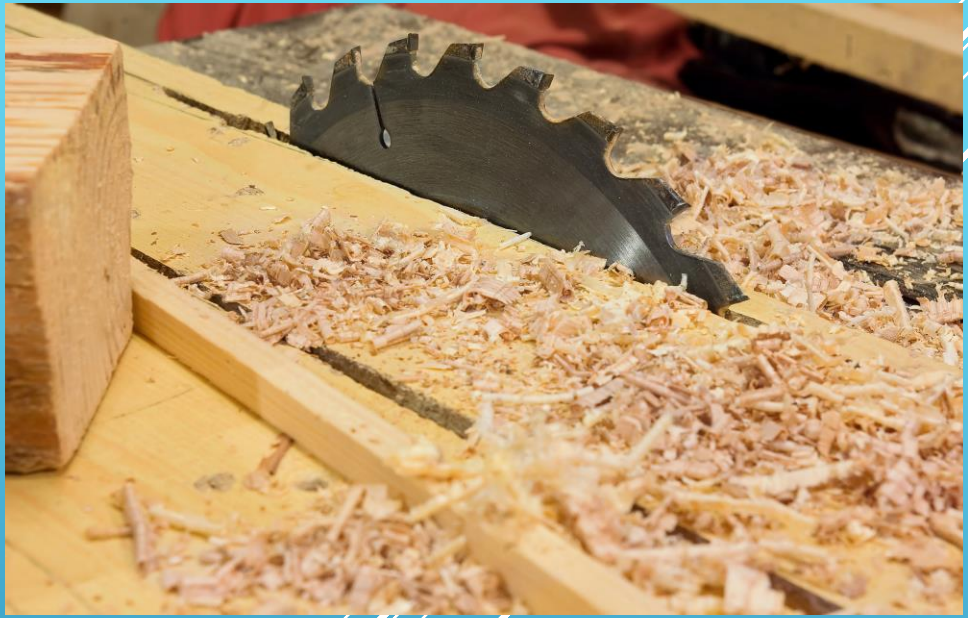
SECTION 1.2 – Organizing Matter

Physical Properties

Melting point	The melting point of a substance is the temperature at which it changes from a solid to a liquid. The melting point of ice is 0°C. At this temperature, it changes into water. Other substances have different melting points. For example, table salt melts at 801°C, and propane melts at –190°C.
Boiling point	The boiling point of a substance is the temperature at which its liquid phase changes to the gas phase. At sea level, water's boiling point is 100°C. Table salt boils at 1413°C, and propane boils at –42°C.
Hardness	Hardness is a substance's ability to resist being scratched. Hardness is usually measured on the Mohs' hardness scale from 1 to 10. The mineral talc is the softest substance on the scale (1). Diamond is the hardest (10). Figure 1.7 shows the scale.
Malleability	A substance that can be pounded or rolled into sheets is said to be **malleable**. Metals such as gold and tin are malleable. Aluminum foil is an example of a product made from a malleable substance.
Ductility	Any solid that can be stretched into a long wire is said to be **ductile**. The most common example of a ductile material is copper.
Crystal shape	The shape of a substance's crystals can help identify it. Silicon crystals, for example, are diamond shaped. Salt crystals form cubes.
Solubility	**Solubility** is the ability of a substance to be dissolved in another. For example, sugar is soluble in water, but cooking oil is not.
Density	**Density** is the amount of mass in a given volume of a substance. The density of water is 1 g/mL. The density of gold is 19 g/cm^3.
Conductivity	**Conductivity** is the ability of a substance to conduct electricity or heat. A substance that conducts electricity or heat is called a conductor. A substance with little or no conductivity is an insulator.

SECTION 1.2 – Organizing Matter

Physical Change: A change in the appearance or state of a substance that does not change the substance' composition.



Physical changes don't create any new substances! There is only a change of shape or state.

Chemical Properties:

A description of how a substance interacts with other substances such as acids. Chemical properties are only observable when a chemical change occurs.

Chemical Properties of Matter—Examples

- reaction with acids
- ability to burn
- reaction with water
- behaviour in air
- reaction to heat

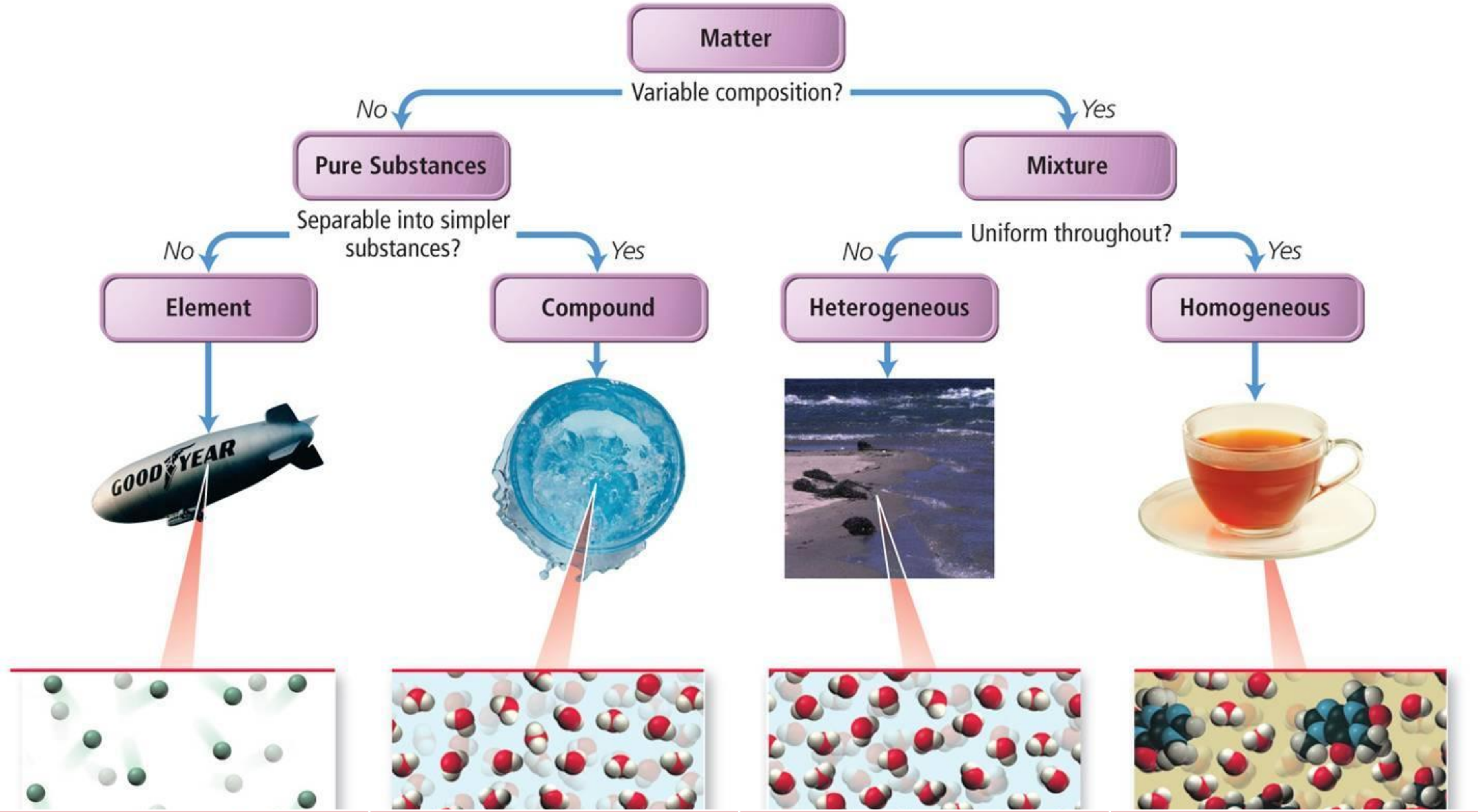
Clues for Chemical Changes

Evidence of Chemical Change	Example
Change in colour	When bleach is added to the dye on a denim jacket, a noticeable colour change occurs.
Change in odour	When a match is struck, the substances in the match head react and give off a distinctive odour.
Formation of a solid or gas	When vinegar (a liquid) is added to baking soda (a solid), carbon dioxide gas is formed.
Release or absorption of heat energy	When gasoline burns in a car engine, heat is released.

SECTION 1.2 – Organizing Matter

What is a Pure Substance?

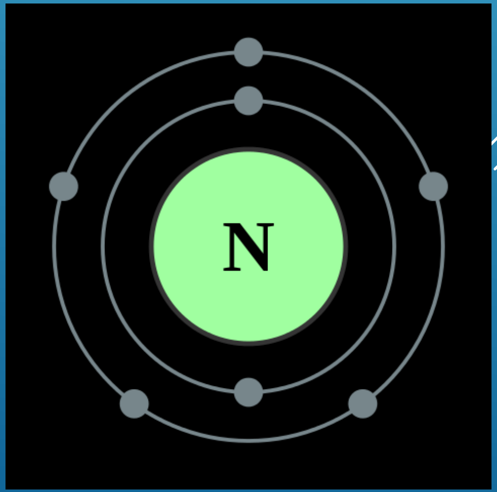
A substance made up of only one type of matter. Elements & Compounds are both good examples of pure substances. Mixtures are a combination of pure substances.



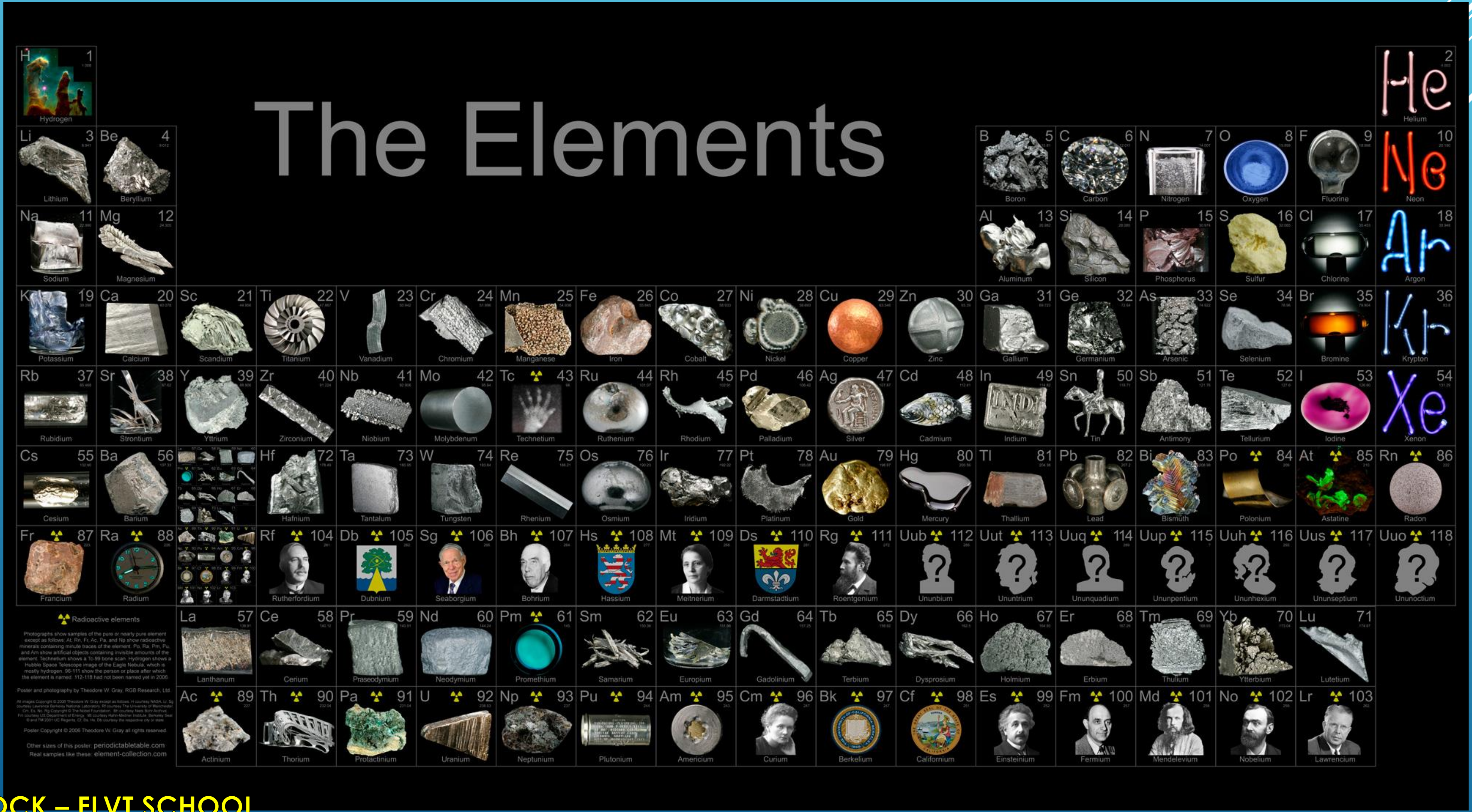
ELEMENTS	COMPOUNDS	HETEROGENEOUS	HOMOGENEOUS
Hydrogen, Gold, Oxygen, Nitrogen, Silver, Sodium, Argon, Helium, Copper, Mercury	Water Carbon Dioxide Sugar Acetic Acid Methane	Mixtures where you can clearly see the different components	Mixtures that appear to look like one substance

ELEMENTS - Pure Substances

An **element** is a material that cannot be broken down into any simpler substance. Elements are the basic building blocks for all compounds. Later in this unit, you will learn how elements are organized into a **periodic table** according to their properties. Each element has its own symbol. For example, hydrogen is H, carbon is C, and oxygen is O.



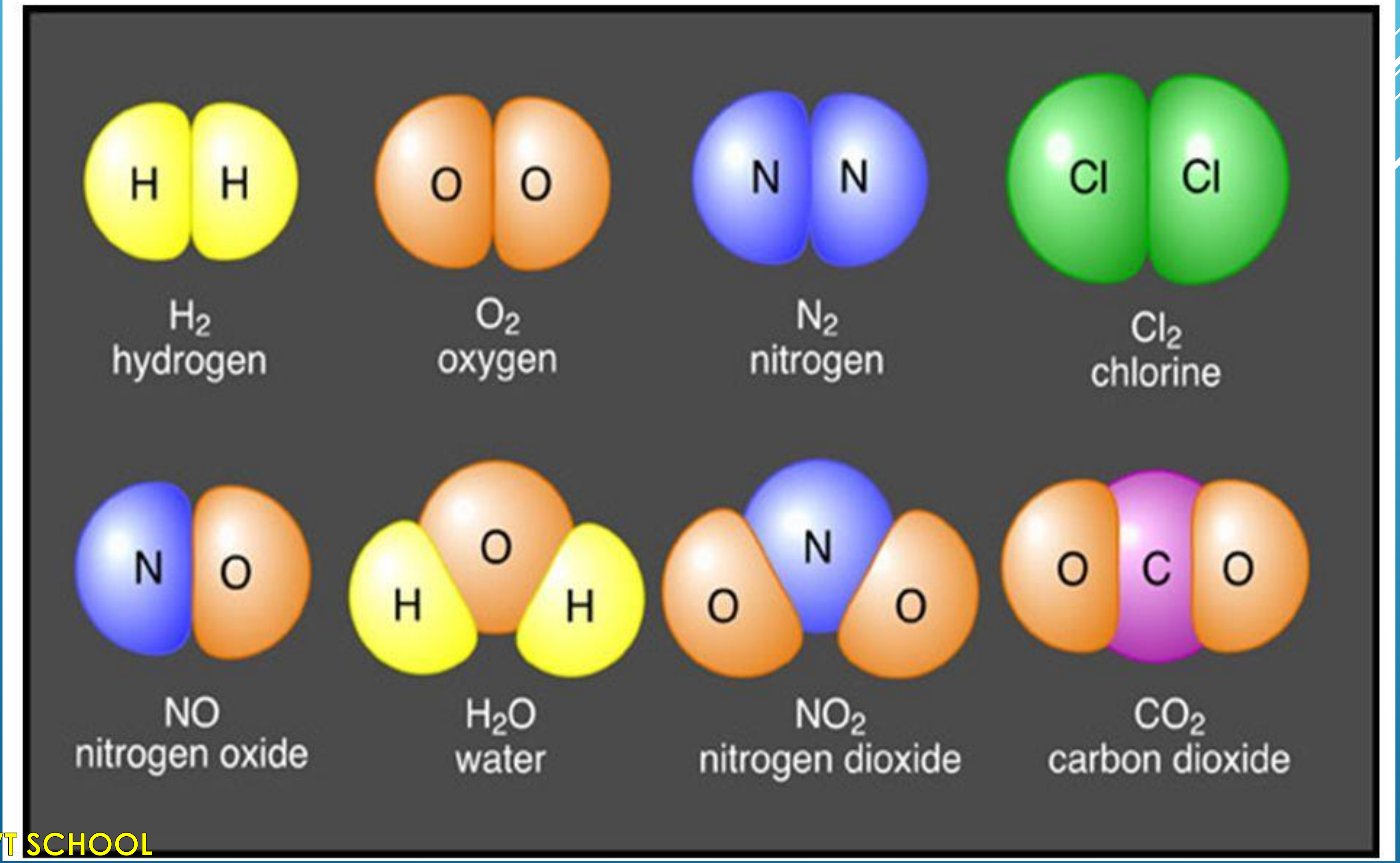
ELEMENTS - Pure Substances



COMPOUNDS - Pure Substances

When two or more elements combine chemically—that is, in specific, fixed proportions—they form a **compound**. When the elements hydrogen and oxygen are combined in specific proportions, they form the compound water. Carbon and oxygen chemically combined form the compound carbon dioxide, the gas that is used to create the "fizz" in carbonated drinks. Later in this unit, you will learn that compounds have chemical names and formulas. For example, water is H_2O and carbon dioxide is CO_2.

ELEMENTS vs COMPOUNDS



WHAT IS A MIXTURE?

mixture combination of pure substances; unlike a compound, the components of a mixture do not combine chemically and are not always in the same ratio

Heterogeneous Mixtures

mechanical mixture heterogeneous mixture; mixture in which the different substances that make up the mixture are visible

Homogenous Mixtures

solution homogeneous mixture; mixture of two or more pure substances that looks like one substance

Homogenous Mixtures

Examples of Solutions

Type of Solution	Example
Solid dissolved in liquid	sugar in hot coffee
Liquid dissolved in liquid	acetic acid in water (to create white vinegar)
Gas dissolved in liquid	carbon dioxide gas in water (to create carbonated pop)
Gas dissolved in gas	oxygen and smaller amounts of other gases in nitrogen (in the atmosphere)
Solid dissolved in solid	copper in silver (to create sterling silver)

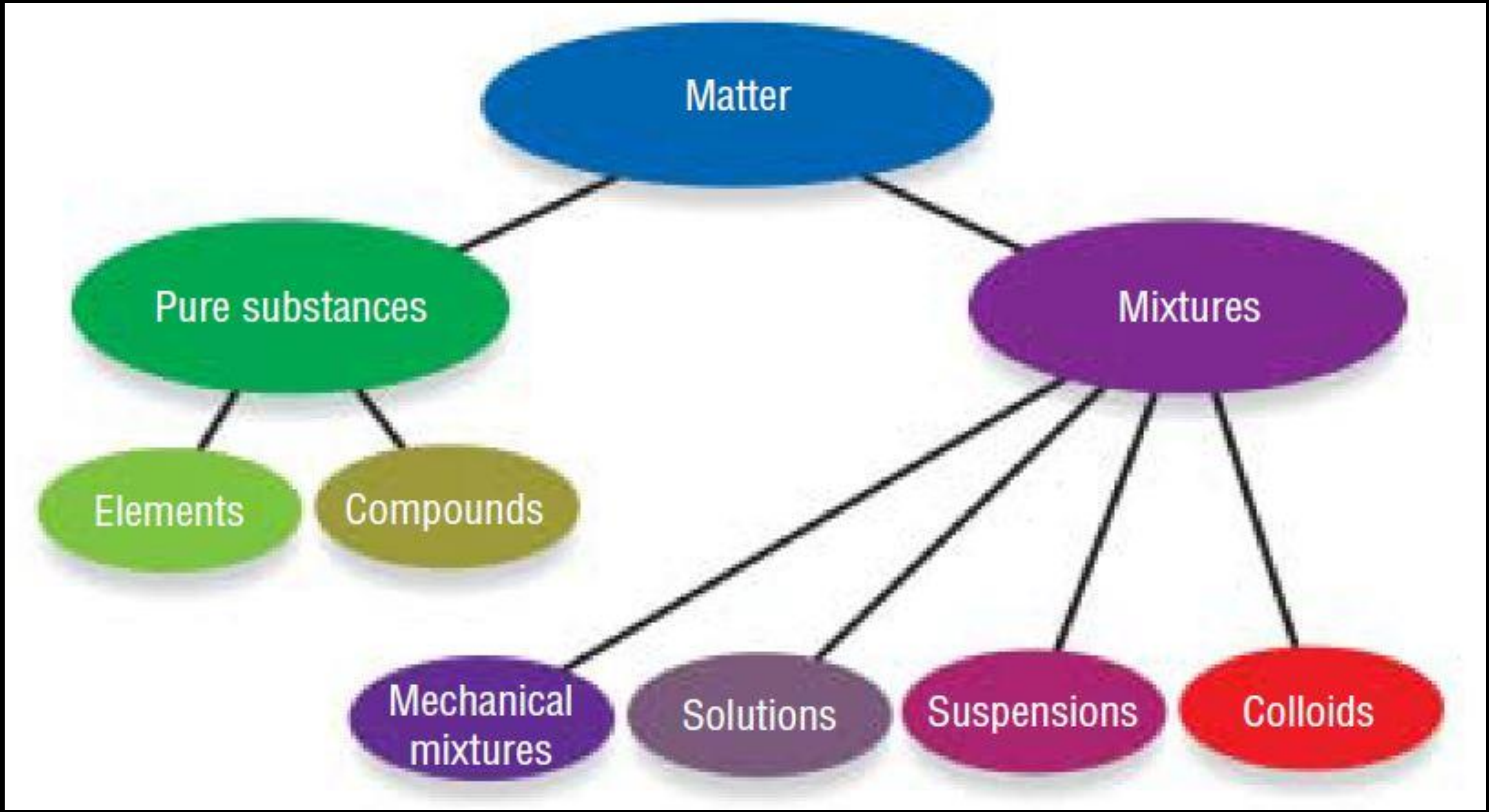
Homogenous Mixtures

suspension cloudy mixture in which tiny particles of one substance are held within another, and the particles can be separated out

Homogenous Mixtures

colloid cloudy mixture in which tiny particles of one substance are held within another and particles cannot be separated out from the other substance

SECTION 1.2 – Types of Mixtures p.103



Physical Change:
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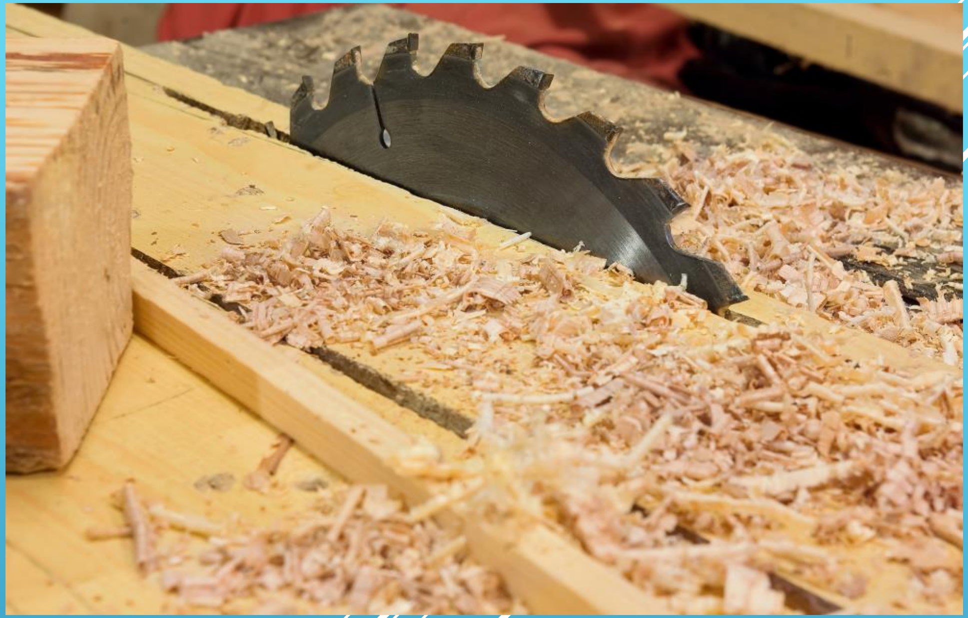

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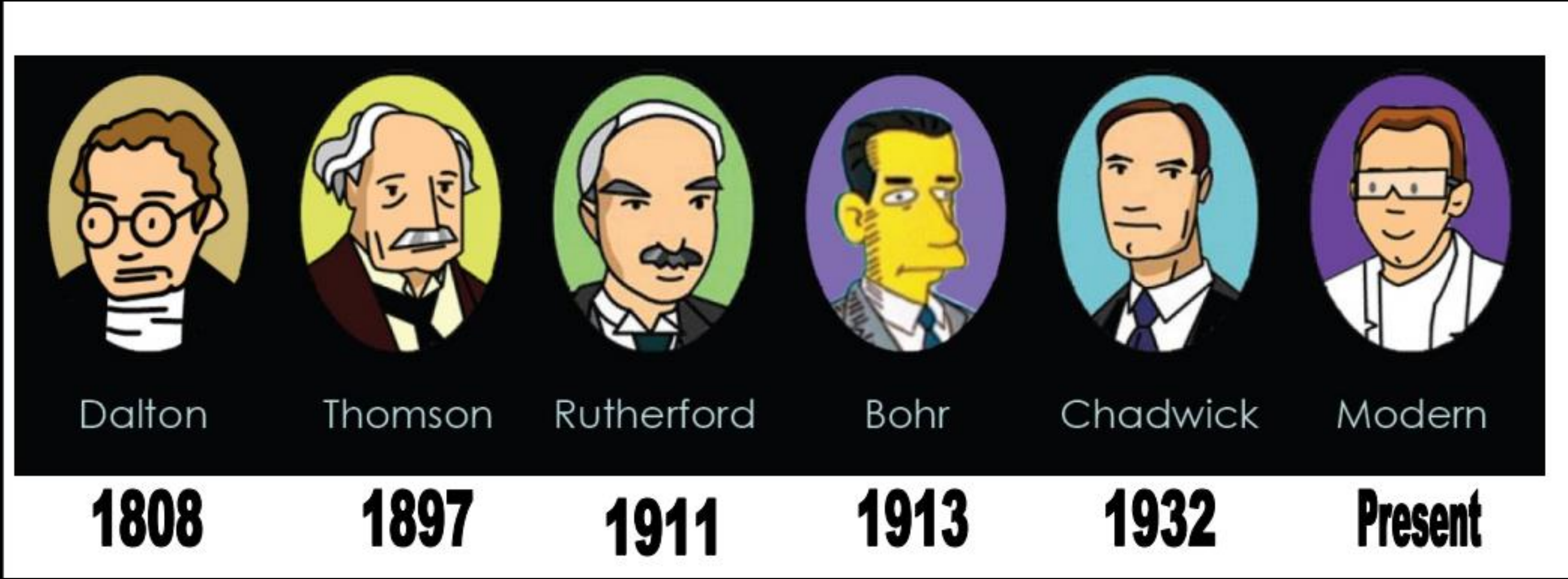
Release or absorption of heat energy	When gasoline burns in a car engine, heat is released.

WHAT IS A FREEZE DRYING?

In the freeze-drying process, the food is first frozen to convert the water content in the food to ice. The frozen food is then put in a pressure chamber and the pressure is reduced until the ice sublimes (changes from a solid to a gas). The result is that about 98% of the water in the original food item is removed. This leaves a food that is about 10% its original mass and that, once packaged, doesn't have to be refrigerated. When it's time to eat, all you do is stir in hot water!

SECTION 2.0 – An understanding of the nature of matter has developed through observations over time.



The Stone Age

The first chemists lived before 8000 B.C. in an area now called the Middle East. This period is known as the Stone Age because humans used only simple stone tools at the time. Metals had not been discovered.

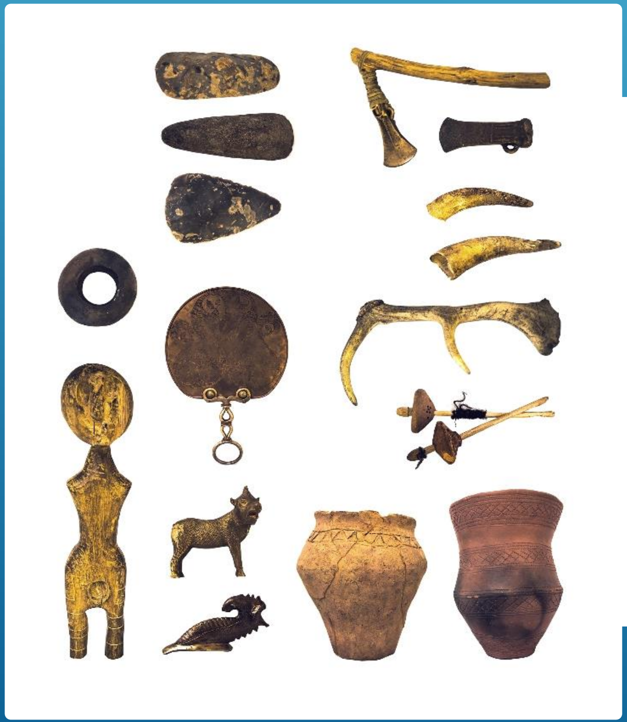


Figure 2.1 Humans in the Stone Age could make only simple stone and bone tools like these. Stone Age people improved their lives when they discovered how to start and control fires. They used fire mainly for cooking and warmth.

The Stone Age

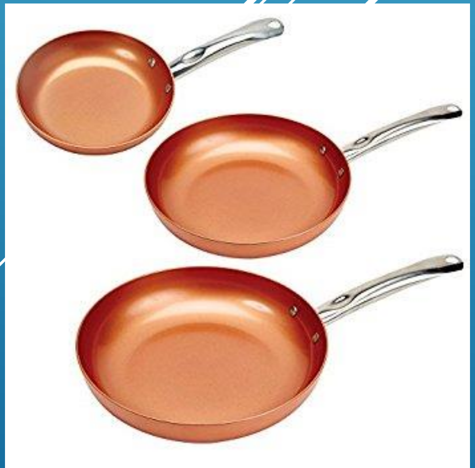
Once these first chemists learned how to start and control fire, they learned how to change a range of substances to their advantage. For example, they could cook their food, fire-harden mud bricks to strengthen them, and make tougher tools. Eventually this ability to control fire led to the production of glass and ceramic material.

GOLD

Between 6000 B.C. and 1000 B.C., early chemists investigated only materials that had a high value to humans. Many of these materials were metals, such as gold and copper. Gold became highly valued because of its properties. It had attractive colour and lustre, and it didn't tarnish. Its softness made it easy to shape into detailed designs, form into wire, and beat into sheets. Because it is so soft, however, gold could not be used for tools or weapons.

COPPER

Copper became valuable because it could be used to make pots, coins, tools, and jewellery. It was early chemists asking questions that led to an understanding of copper's properties and how the material could be controlled. A piece of natural, untreated copper is brittle—that is, it breaks easily. In that state, therefore, it isn't a useful material for making things. However, when copper is heated, it becomes very useful because it can be rolled into sheets or stretched into long wires.

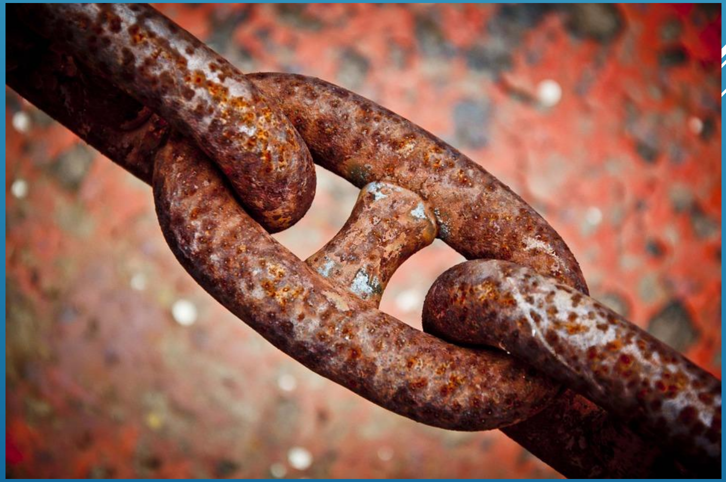


Copper & Tin make BRONZE

Later experimenting with copper (about 4500 B.C.) led to the creation of a hard, strong material known as bronze, which is produced when copper and tin are heated together.

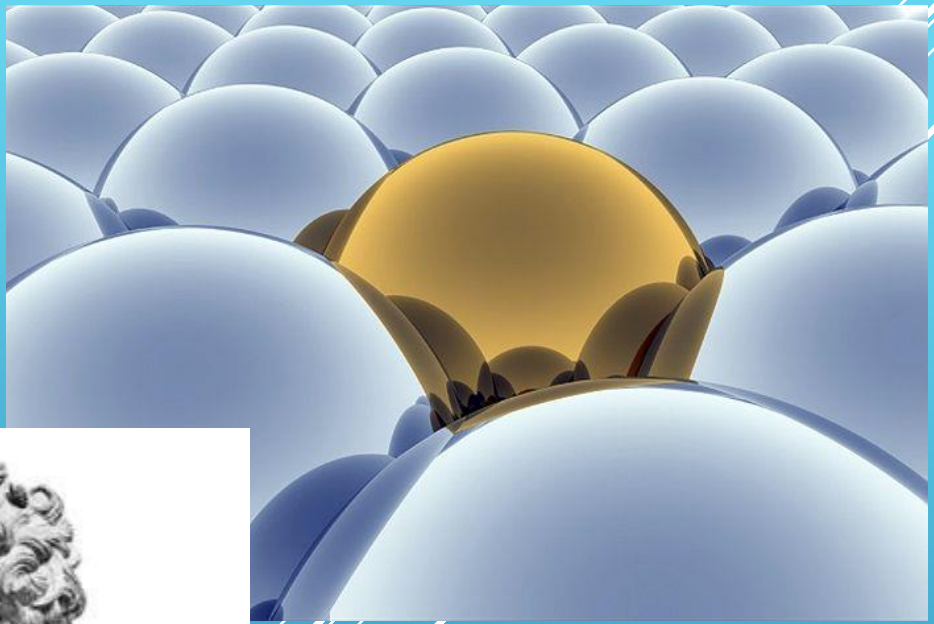
THE IRON AGE

Around 1200 B.C., a group of people in the Middle East called Hittites discovered how to extract iron from rocks and turn it into a useful material. The Iron Age began. Eventually, people learned to combine iron with carbon to produce an even harder material—steel. Steel meant sharper blades could be fashioned for hunting and stronger armour could be built to protect soldiers in battle.

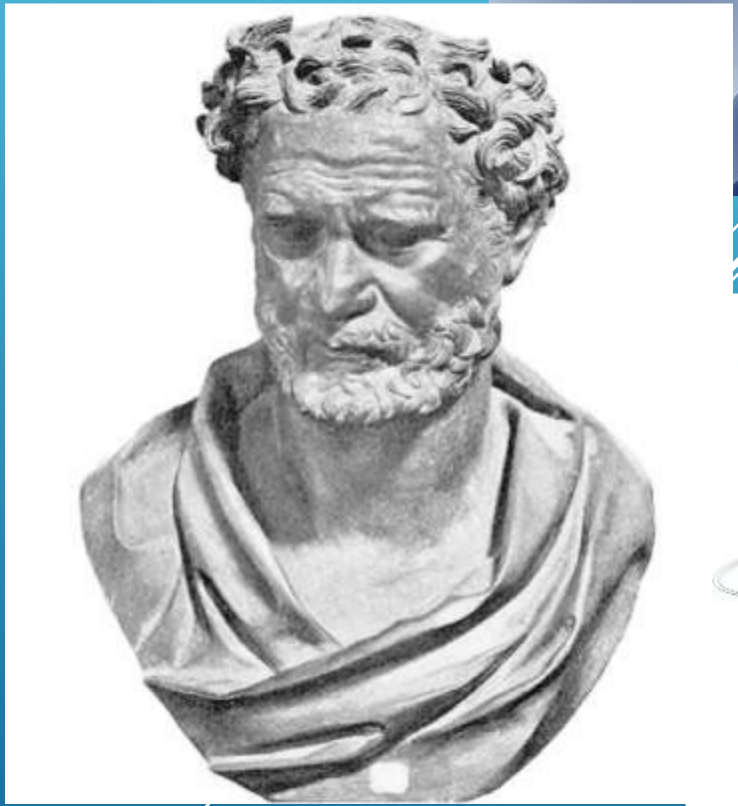


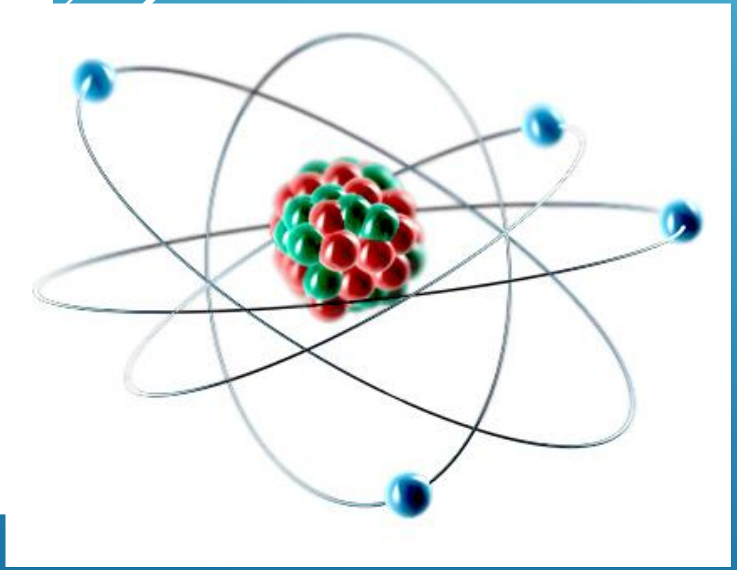
SECTION 2.1 – Emerging Ideas About The Composition of Matter pg.116

Democritus (400 B.C.)



Democritus taught that every material was made up of a different type of *atomos*. Atomos which means indivisible was the smallest form of matter. He claimed that mixing different types of atomos would create new materials.

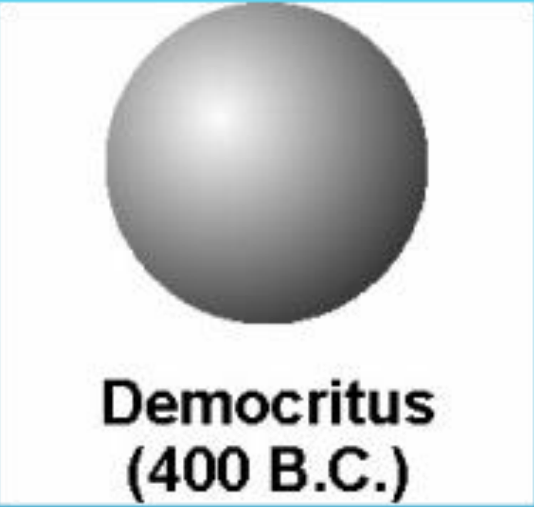


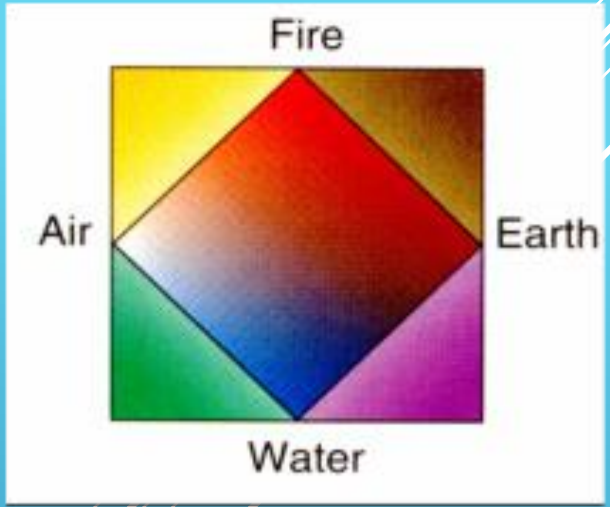


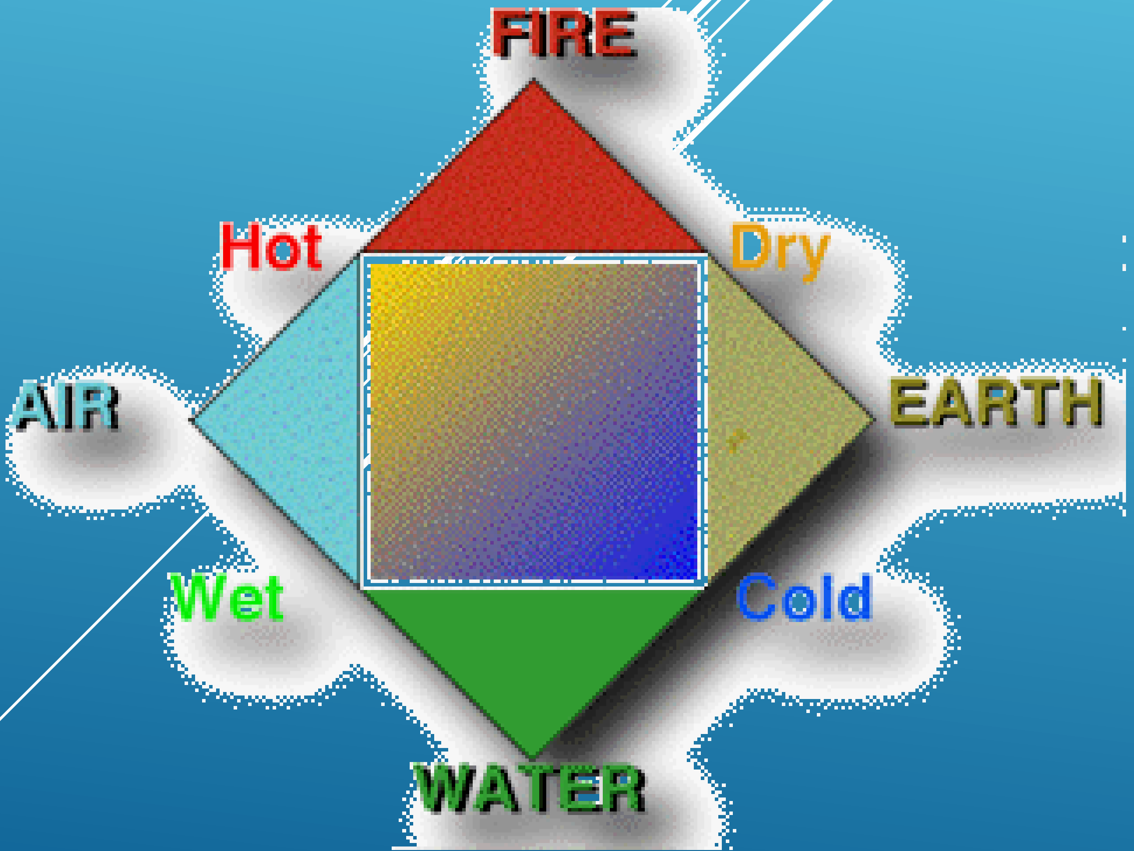
SECTION 2.1 – Emerging Ideas About The Composition of Matter pg.116

Aristotle (350 B.C.)

Aristotle stated that everything was made of 4 elements… Fire, Air, Earth, and Water. He was well known and respected so his theory about matter was preferred over Democritus’ for over 2000 years.

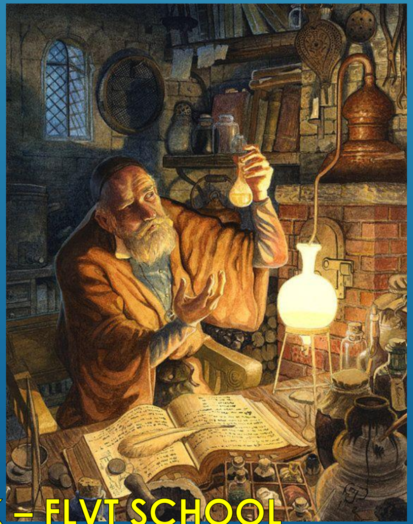


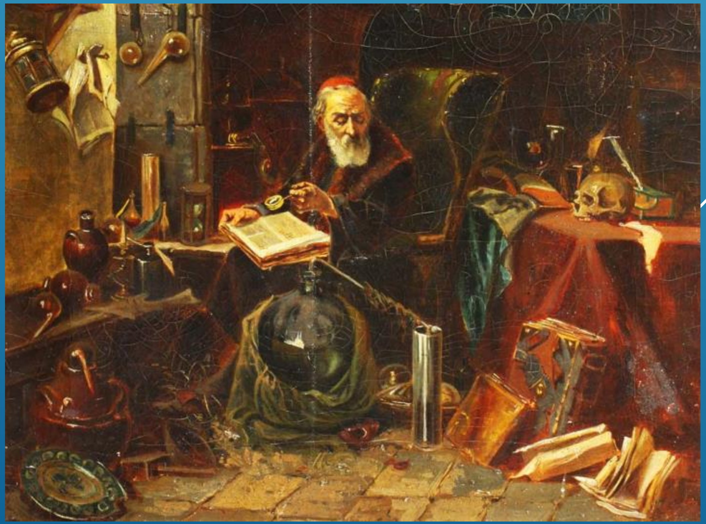


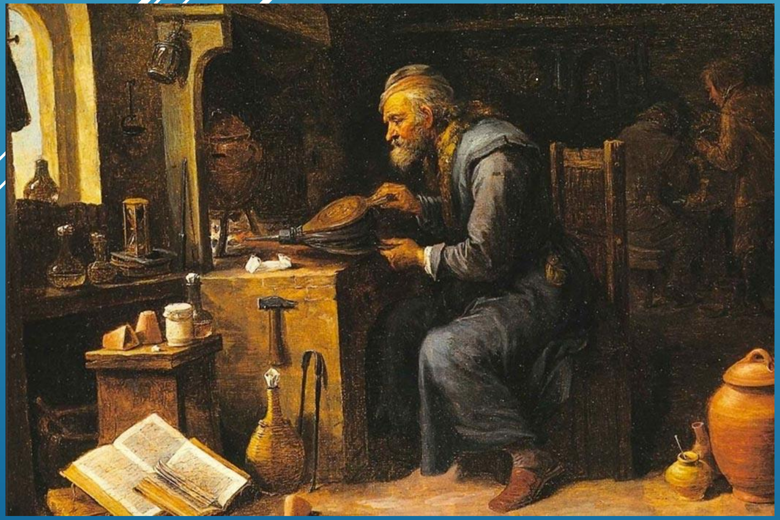


Alchemists

For the next 2000 years after Democritus's time, experiments with matter were mainly carried out by alchemists, people who were part magician, part scientist. (The word "alchemy" comes from the Arabic word *al-kimiya*, which translates as "the chemist.") Today, the study of alchemy would be called a pseudo-science (an activity that is not a real science because it includes the use of magic). Alchemists believed that it should be possible to change metals into gold. They were not interested in understanding the nature of matter.







Alchemists

Even though they weren't real scientists, alchemists performed some of the first chemistry experiments. In doing so, they invented many useful tools that we still use in labs today, such as beakers and filters. They also made practical discoveries. For example, the Arab alchemist al-Razi discovered what we now call plaster of Paris—a material that today's doctors still use to hold broken bones in place until they heal.