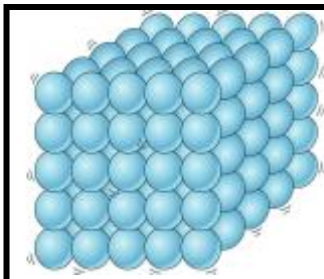
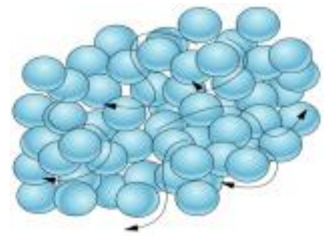
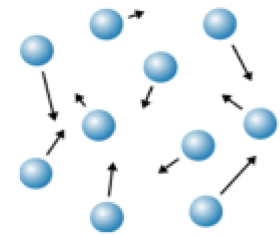
Review for Quiz 1

Particle Model

When we talk about matter, you need to understand how each of the three phases work at the particle level. This is why we work with the **particle model**. Use the illustrations of each phase to help you understand the criteria in the first column of this table.

	 Solid	 Liquid	 Gas
Distance between particles	Close	Close	Far apart
Attraction forces between particles	Strong	Not as strong	Weak
Movement of particles	Vibrations only	Able to slide over each other	Able to move freely
Shape of the matter	Hold their own shape	Shape of container	Shape of container
Volume of the matter	Volume of shape	Does not fill container	Fills container

Some important points about this:

- The higher the temperature, the more particles move… but you cannot make something so cold that all particle motion stops, there will always be some movement.
- If you freeze water, it will hold its shape. If you melt this ice, it will hold the shape of its container (or spill onto the floor if there is no container!) If you vaporize it, it will also hold the shape of its container (a balloon, the room it's in, etc).
- The volume of a liquid is **not** the volume of its container, unless it completely fills the container. If a gas is in a container, we say that its volume is the volume of the container because the gas particles move freely to occupy the entire container.

Atomic History

For this course, we talk *a lot* about atoms. This is why it's important to understand the history of the theory of atoms and look at the evolution of atomic models over time.

1. Democritus: *2500 years ago* — Democritus believed that atoms were the smallest form of matter (**discontinuous**). This means that they could not be divided into anything smaller.

2. <u>Aristotle:</u> *2400 years ago*

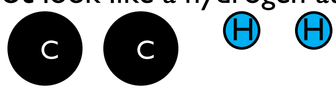
Aristotle, shortly after Democritus, proposed that atoms were **continuous** and **divisible**. This means that we could theoretically keep cutting atoms in half forever. He also believed that atoms were composed of "elements" such as earth, wind, water, and fire.

Who is correct? ***Democritus!***

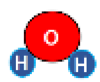
Atoms are in fact <u>discontinuous</u> and <u>chemically indivisible</u>.

3. <u>John Dalton:</u> *1800s*

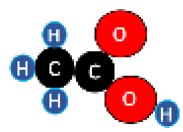
Dalton expanded Democritus' atomic theory and also stated that atoms are discontinuous. Furthermore, he stated atoms of the same element are **identical** and atoms of different elements are **different**. For example, all carbon atoms look alike, and all hydrogen atoms look alike, but a carbon atom **does not** look like a hydrogen atom.



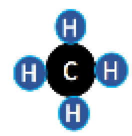
How to draw Dalton diagrams of molecules:



H_2O



CH_3COOH



CH_4

Other scientists contributed to atomic history that we will talk about later.

<u>ATOMS, ELEMENTS, COMPOUNDS, AND MOLECULES</u>

Make sure you understand the definitions for each of these words.

Atom: The smallest form of matter. It is chemically indivisible. The atom is often called the "building block of matter".

Element: This is any substance that is made up of <u>only one</u> type of atom. There are many different chemical elements listed on the *Periodic Table*.

Compound: This is any substance that involves 2 or more <u>different</u> atoms joined together.

Molecule: This is any substance that involves 2 or more atoms joined together (they may be the same atoms).

Be careful! A compound <u>is</u> a molecule, but a molecule is <u>not necessarily</u> a compound.

Examples: O_2 is a **molecule** (2 atoms joined together) and is an **element** (only one type of atom).
CO_2 is a **molecule** (more than 2 atoms joined together) and is a **compound** (2 different atoms).
Ne is an **atom** (it's by itself) and is an **element** (this is how it appears on the Periodic Table).

You also need to recognize the difference between a **pure substance** (only one substance) and a **mixture** (two or more substances. A mixture could have different types of elements, different types of compounds, or elements and compounds.

THE LAW OF CONSERVATION OF MASS

Mass can neither be created nor destroyed. It can, however, be transformed to different sources. This means that when you are performing a chemical reaction, the mass of what you started with (the reagents) **must** equal the mass of what you ended up with (the products).

Weird examples that still obey the law of conservation of mass:

- The mass of a cake may be slightly less than the mass of each individual ingredient. This is because the chemical change of baking a cake results in some form of gas (which accounts for a small fraction of mass).
- When a baby grows up, it may seem like they have created new mass, but this is not true. He or she has acquired mass from his or her surrounding environment (i.e. food!) and incorporated that mass into his or her body… "*you are what you eat!*"
- If you burn something, it may appear like you have destroyed mass, but this is also not true. Burning something creates ash, various gases, etc. The mass of these gases and ashes will equal the mass of the object prior to burning.

A chemical equation is written like this (the number of products and reagents will vary):

$$\text{Reagent} + \text{Reagent} \longrightarrow \text{Product} + \text{Product}$$

IMPORTANT: Never use an equal sign! Only use an arrow!

Because of the law of conservation of mass, you are able to calculate the mass of any missing reagent or product. For example:

1. 50 g of baking soda is added to 25 g of vinegar to produce 65 g of water and an unknown amount of carbon dioxide. We should begin by writing this information in the form of a chemical equation:

$$\text{Baking soda} + \text{Vinegar} \longrightarrow \text{Water} + \text{Carbon dioxide}$$

Baking soda	Vinegar	Water	Carbon dioxide
50 g	25 g	65 g	?
75 g		75 g	

75 g – 65 g of water = **10 g of Carbon dioxide**

2. Potassium chlorate breaks down into 32.9 g of potassium chloride and 2.8 g of oxygen. How much potassium chlorate did we begin with?

$$\text{Potassium chlorate} \longrightarrow \text{Potassium chloride} + \text{Oxygen}$$

Potassium chlorate	Potassium chloride	Oxygen
?	32.9	2.8 g
	35.7 g	

There are **35.7 g of Potassium chlorate**

3. During photosynthesis, a leaf takes in 1.32 g of carbon dioxide and an unknown amount of water. The leaf produces 0.90 g of sugar and 0.96 g of oxygen. What is the mass of water?

$$\text{Carbon dioxide} + \text{Water} \xrightarrow{\text{photosynthesis}} \text{Sugar} + \text{Oxygen}$$

Carbon dioxide	Water	Sugar	Oxygen
1.32 g	?	0.90 g	0.96 g
1.86 g		1.86 g	

1.86 g – 1.32 g = **0.54 g of water**