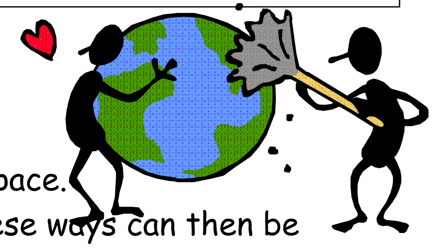
Name ___________ •Period ___

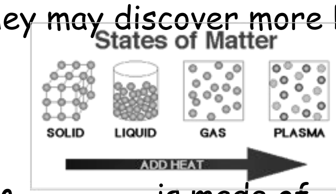
Matter is the Stuff Around You…made of Atoms: :



The Earth is a mixture of matter as gasses, liquids and solids.

Matter is everything around you that has mass and takes up space. **M**_ _ _ _ _ can be divided up in any way you want, but all of these ways can then be divided into **atoms**. Even though **m**_ _ _ _ _ can be found all over the universe, you usually find it in just three forms or states, **S**_ _ _ _ _ , **L**_ _ _ _ _ _ and **G**_ _

As of 1995, scientists have identified five **states of matter**. They may discover more by the time you get old. The five are **solids, liquids, gases, plasmas**, and a new one called **Bose-Einstein condensates**.



Matter can be separated into substances called **elements**. Each **e**_ _ _ _ _ _ is made of **atoms** that are alike. All **a**_ _ _ _ resemble each other and are made of similar parts, protons+, neutrons and electrons-. More parts make an **atom** a different **e**_ _ _ _ _.

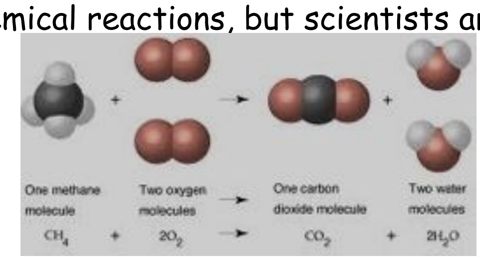
Atoms are the stuff that Matter is made of, which is the stuff around you.

The concept of **atoms** began over 2000 years ago in ancient Greece. Greek philosophers did not make actual measurements, but the Greek Democritus proclaimed that all matter might be made up of countless little particles called "**atoms**". It was only about 200 years ago (in the 1800's) that scientific study developed to explain the behavior of **atoms**. The noted scientists were John Dalton, Robert Brown and Albert Einstein. Then and still, it is difficult for people to believe what they can not see.

John Dalton, reasoned that if **atoms** really exist, they must all have certain properties in common. It was his clever work with the pressures and weights of gases that led him to believe that gases were indeed made of tiny particles **or atoms,** AND each type of gas had an **atom** with a different weight (mass). Dalton went on to propose that different types of **atoms** could combine to form all of the various known **elements. Dalton's Atomic Theory** led to what we know today. Dalton did not know about "subatomic" particles such as **protons, neutrons, electrons, and quarks**. Even so, many of Dalton's ideas stand. Scientists are now looking at even smaller parts, or "**strings**".

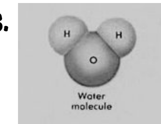
Dalton's Atomic Theory:

1. ***Matter consists of definite particles called atoms.*** We NOW know that **atoms** are particles that are made of smaller particles, such as **protons, neutrons, electrons, and quarks**.
2. ***Atoms are indestructible. In chemical reactions, the atoms rearrange but they do not themselves break apart.*** Dalton was right for normal chemical reactions, but scientists are able to take **atoms** apart (split the **atom**).



3. *The atoms of one particular element are all identical in mass and other properties.* Yes, but we now know that **atoms** of a specific **element** can have different numbers of **neutrons**, so have different masses. These are called **isotopes**.

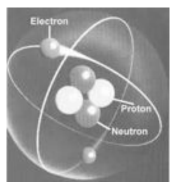
4. *When atoms of different elements combine to form compounds, new and more complex particles form. However, in a given compound the constituent atoms are always present in the same fixed numerical ratio.* This idea stands today and goes with **The Law of Conservation of Mass.**

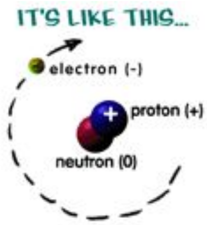


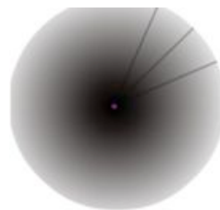
The Law of Conservation of Mass states that no detectable gain or loss of mass occurs in chemical reactions, so we say mass (weight) is conserved (or not lost). **The Law of Conservation of Mass** continues to work with new **Atomic Theories**. An example:

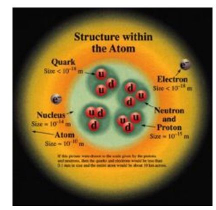
Water is always H_2O (18 amu) and always uses 2 H (2 amu) for each O (16 amu).
When water (18 amu) is broken up, it always gives 2 H (2amu) for each O (16 amu)

Atom Models over time:









Dalton (1800's) Rutherford (1900's) Bohr (1900's) Present Day

The Size of Atoms: Much of the difficulty scientists had in discovering, and then proving the existence of, **atoms**, is their size. Something so small had never been defined. There are still no methods to see actual **atoms**. Work with **atoms** has to be done by observing and studying how they act, not by how they actually look. Even special microscopes show only bumps. We have no way to see the parts of an **atom**. **It** would take more than a thousand of the largest possible **atoms** laying side by side to be seen by the most powerful optical microscope in existence.

After a while, scientists began to realize that **atoms** are made up of mostly empty space. The parts of **atoms** (**protons+, neutrons and electrons-**) compose only a tiny fraction of the total **atom**. The nucleus (**protons+ and neutrons**) has almost all (99.9%) of the mass. The **electrons-**, outside the nucleus, make the **atom** larger like a cloud, but don't add much mass (weight). **Thinks of a fly on your shoulder. The fly's mass compares to the electrons' mass.**

If an atom were the size of an apple, then an apple would be the size of the earth. A carbon **atom** has been estimated at 340 picometers (pm). A picometer is 1 trillionth of a meter (10^{-12}) or 0.000000000001 meter. (A centimeter is 10^{-2} or 0.01 meter.)

Today, many physicists believe **matter** (including **atoms** themselves) to be made up of even tinier things, little vibrating **strings**. Maybe, in your lifetime, the study of "**strings**" will be as common to study as **atoms**.