15: Element Names

A Matter of History (or The History of Matter)

I suppose as long as people have lived they have wondered what things are made of. Imagine what it would have been like to live before there were microscopes to allow us to see things that are very small, and no special instruments to investigate tiny things. People could only have imagined what things must be like on a small scale.

Historical writings show that great thinkers of long ago tried to think up answers to this question just by their own reasoning. Some imagined that everything is made of tiny hard balls that stick together. Others thought of tiny bits of earth. Yet others thought that everything was just solid through and through. There were even mystical theories about mysterious vapors and fluids that could become either a solid or a fluid under different conditions.

Empedocles

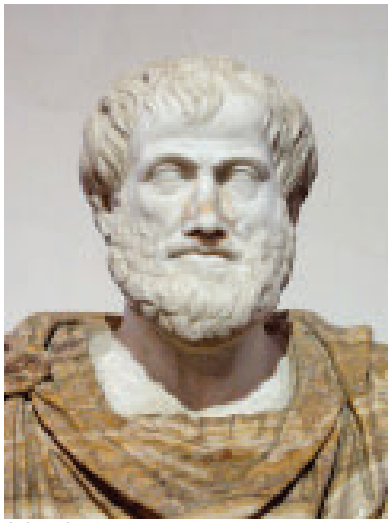
A string of great thinkers and experimenters have brought us to where we are today in our understanding of matter. We have records as early as 440 B.C. wherein the Greek philosopher Empedocles said that matter was created from four "elements" which he named earth, air, water and fire. At about the same time, Democritus made the more accurate guess that all matter was made up of particles that could not be divided. These he named "atoms" [Gk: *a* + *tomos*, no + cut]. He believed that atoms were indestructible so they could not be broken down into smaller parts.

Democritus

Knowing that the ancient Greek philosophers usually did not have experiments to rest their theories upon, the theory of Democritus was a pretty good one. His idea was not absolutely true because atoms can be further broken down in nuclear reactions, and they can give up electrons in normal chemistry. But the basic idea that all matter is made up of tiny indestructible units is a pretty accurate

way of thinking about atoms in everyday chemistry. He also believed that atoms are constantly in motion and that they can combine with each other in different ways. These ideas are also quite accurate.

It turns out that Democritus, as accurate as he was, was not the most popular philosopher in history. Another philosopher named Aristotle (perhaps you've heard of him) came along in the fourth century B.C. with a competing theory based on the ideas of Empedocles. His theory of the four elements of nature dominated thought for almost two thousand years!


Aristotle

By the 1800's people had come to realize that Aristotle was wrong. But now they had more than just imagination upon which to base their theories. Philosophers were replaced by experimenters. In papers published between 1803 and 1810, John Dalton clearly stated an atomic theory. Much of what Dalton said was repeated from what others had thought earlier: the early Greeks, Democritus and Lucretius, the French Levoisier, and others throughout the 1700's had contributed to Dalton's understanding of atoms. But the things that Dalton summarized are still believed to be basically true.


Dalton

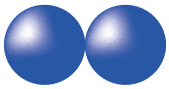
Dalton wrote that atoms were tiny particles that could not be further divided. He said that atoms of the same element are alike in mass and size, and that atoms of different kinds are of different masses and sizes. He believed (accurately) that specific compounds are formed from specific combinations of different atoms, and that atoms of elements could combine in different numbers to make different compounds.

Groups of Atoms

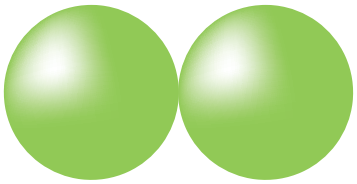
In Lesson 6 we mentioned that atoms hang together to make molecules and compounds. Let's review that information together because it is so important in the understanding of chemistry. I'll also add a few new facts as we go.

There are some 90 different elements (kinds of atoms) found in nature and a few of those can be found as free elements, without being bound to any other. An example of this is gold which can be mined as gold metal. Others, although not found that way naturally, can be purified and made into pure elements. An example of this is iron which is found in minerals, such as taconite, and purifed to make iron metal. Most elements prefer to be bound up

into molecules with other atoms. Even if they are separated to make pure elements, they will quickly react with others to form compounds again.



H_2

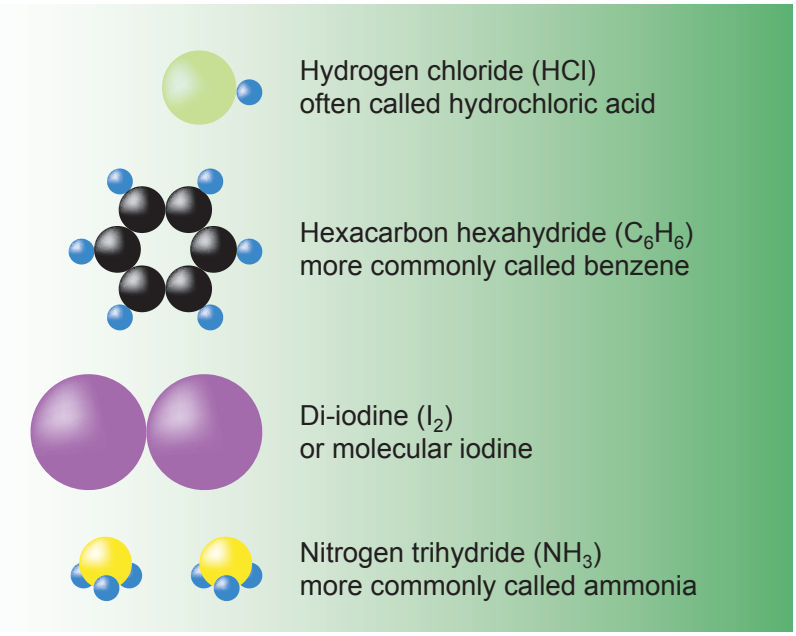


Cl_2

A single atom of the element, hydrogen, will scarecely be found by itslef. It is way too reactive to continue that way. It will react with another atom of hydrogen to form a hydrogen molecule (H_2) or with some other element, such as chlorine to make a compound (HCl). The same is true with pure chlorine. You'll scarcely see a lone chlorine atom. You will, however, see a chlorine molecule (Cl_2) made from two such atoms.

If you'll remember, a compound is a combination of two or more atoms of different elements bound togethr in a molecule. For example, if you remember from Lesson 6, two atoms of hydrogen (atomic symbol, H) and one atom of oxygen (O) combine to give H_2O. The chemical name of water is dihydrogen oxide.

The element's symbols, along with the little numbers called **subscripts** that appear below the line of text, like the 2 in H_2O, together make up what we call the **molecular formula** of water. Molecular formulas are among the first things you learn in a chemistry class. The formula tells you exactly which elements are in that molecule and the number of each kind of atom in the molecule. We can look at the formula, H_2O, and immediately know that there are two atoms of hydrogen and an atom of oxygen in the molecule. If a formula has been written for a chemical we can be sure that the exact makeup of that chemical from elements is known.



Above, there are four different kinds of molecules. Which of them shows two molecules of the same compound?

If we want to communicate that there are two molecules of H_2O we place a big two in front of the whole formula, like this: 2 H_2O.

The Famous Elements

Although there are, as I have said, 90-ish different kinds of atoms, most everything we see is made up of only a few of those 90. You hear about the common ones all the time. Some of the most common are:

Aluminum	Iron	Phosphorus
Calcium	Magnesium	Potassium
Carbon	Manganese	Silicon
Chlorine	Nickel	Sodium
Copper	Nitrogen	Sulfur
Hydrogen	Oxygen	Zinc

Then there are a few others that we have heard of, not because they are so common, but because they are important for some other reason. Some are precious:

Silver	Gold	Platinum

Many are radioactive and a few of those are used for making bombs or operating nuclear reactors:

Uranium	Plutonium	Thorium

These are the most famous of the elements. Others are so rare and have so little use that they are nearly unknown. Here are just a few of those:

Tantalum	Gadolinium	Astatine

Today you will learn the names of the first 35 elements by their symbols in the periodic table. The figure below highlights the ones you will begin learning today as you get to your activities.