Elements

Name: _____

Date: _____ Per: _____

Key Words

atom
element
nucleus
proton
neutron
electron
neutral
atomic number
atomic mass
chemical symbol
reactivity

6.1-C1

Getting the Idea

Everything around you is matter, and so are you yourself. Matter is anything that has mass and volume. Almost all matter you are familiar with is made up of tiny particles called atoms. In this lesson and the next, you will learn about the different kinds of atoms.

Atoms and Elements

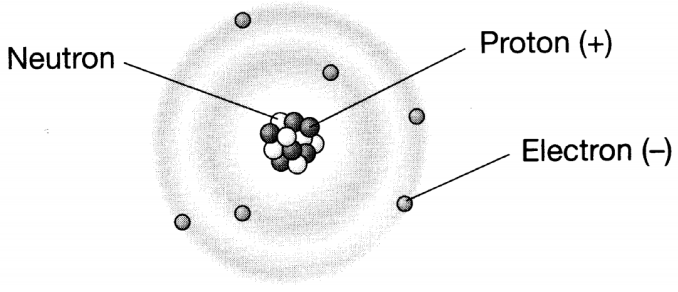
Atoms are the basic building blocks of most of the matter around you. But atoms are not all alike. There are different kinds of atoms, as you will see.

An **element** is a substance made up of only one kind of atom. Scientists have discovered about 117 elements. Ninety-two elements are found in nature. Carbon, oxygen, gold, silver, and iron are some naturally occurring elements. The remaining elements are synthetic, or made by humans in the laboratory.

Atoms and Their Parts

An atom is the smallest particle of an element that has all the properties of that element. Each element is made up of atoms that differ from those of every other element. To understand how atoms differ, you need to look at the particles that make up an atom. The diagram below shows the structure of a carbon atom. Notice that this atom is made up of three different kinds of particles. These are called *subatomic* particles.

Carbon Atom



The center of the atom is called the **nucleus**. The nucleus of most atoms is made up of two kinds of particles: protons and neutrons. **Protons** carry a positive (+) charge. **Neutrons** have no charge. The masses of protons and neutrons are measured in atomic mass units (amu). Each proton and neutron in an atom has a mass of about 1 amu.

Electrons are particles that move around in an area outside the nucleus. Electrons carry a negative (−) charge. Electrons have almost no mass compared to protons and neutrons. The table below summarizes the characteristics of protons, neutrons, and electrons.

Characteristics of Subatomic Particles

Subatomic Particle	Atomic Mass	Atomic Charge	Location
Proton	1 amu	+1	Nucleus
Neutron	1 amu	0	Nucleus
Electron	—	−1	Outside nucleus

Look at the carbon atom on page 54 again. Notice that the number of protons in the atom is equal to the number of electrons. As a result, each positive charge in the nucleus is balanced by a negative charge in the electrons outside the nucleus. The atom as a whole is electrically **neutral**—it has no overall charge.

The number of protons in the nucleus of an atom is called its **atomic number**. Each element has a different atomic number. For example, carbon has 6 protons in each atom and an atomic number of 6. Oxygen has 8 protons and an atomic number of 8.

Atomic mass is the mass of one atom of an element and is equal to the number of protons and neutrons in the nucleus. The table below shows the atomic masses of several common elements.

Atomic Masses of Some Elements

Element	Protons	Neutrons	Electrons	Atomic Mass
Carbon (C)	6	6	6	12 amu
Oxygen (O)	8	8	8	16 amu
Sodium (Na)	11	11	11	22 amu
Iron (Fe)	26	29	26	55 amu

Did You Know?

The number of protons in an atom of an element never changes, but the number of neutrons can vary. Most carbon atoms have 6 protons and 6 neutrons, but some have 7 or 8 neutrons. The average atomic mass of carbon is 12.01 amu.

In the table on page 2 notice the letters in parentheses next to the name of each element. These letters are the element's chemical symbol. A **chemical symbol** is a code, usually one or two letters, used to represent an element. Each element has its own chemical symbol. C always represents carbon, O always represents oxygen, Fe always represents iron, and so on.

Properties of Elements

Each element has different properties, or characteristics. The structure of an element's atoms determines its properties. For example, pure oxygen and pure hydrogen appear as colorless gases.

Carbon is a solid at room temperature. Carbon has several different forms. One form is graphite, a soft, gray substance. Graphite is the main material in pencil "lead." Another form of carbon is diamond, which is transparent and hard. In fact, diamond is the hardest material found in nature.

Iron and aluminum are shiny metals. Iron is silvery gray and heavy. Aluminum is silvery white and lightweight. You will learn more about the properties of metals in Lesson 10.

Elements are different in **reactivity**—the ability to form chemical bonds with other substances. Oxygen is highly reactive. It combines with other substances in the process called burning. Hydrogen is also very reactive. In fact, it causes explosions when it combines with some other elements. Iron reacts easily with water (hydrogen and oxygen) to form rust. Aluminum does not.

Did You Know?

Single atoms of oxygen are rare in nature. Most oxygen on Earth is in the form of O_2—two atoms of oxygen joined together.