CH7 FACT SHEET

ATOMIC STRUCTURE

CLASSWORK AGENDA FOR THE WEEK

(1) Draw diagrams of atoms to show how models of atoms have evolved.
(2) Construct a model of a Bohr atom.
(3) Diagram how atoms can be transformed into ions.
(4) Diagram how atoms can form ionic or covalent bonds with other atoms.

What do the following have in common: a gorilla, an apple tree, your socks, the planet Mars, this piece of paper? Answer: They are all made of **atoms**. Even the ink in the dot atop the "i" in the word "ink" is made of atoms: about a trillion of them! That's 1,000,000,000,000 atoms (10^{12} atoms). It's hard to imagine that objects so large can be made of objects so small but it's a fact. The ancient Greeks guessed that atoms existed but no one knew for sure that they actually did until the beginning of the 20th century. The great American physicist **Albert Einstein** (b. 1879; d. 1955) convinced scientists that atoms must exist in 1905. He proved that the tiny movements of particles seen jumping around under a microscope—a phenomenon called **Brownian motion**—was the result of atoms hitting and jostling the particles to make them move.

The Greek philosopher **Democritus** (b. 460 B.C.; d. 370 B.C.) was the first to use the term "atoms" to describe these incredibly tiny units of matter. The English chemist **John Dalton** (b. 1766; d. 1844) developed the first **atomic theory of atoms** based on laboratory experiments. Today, scientists describe matter according to the **Atomic-Molecular Theory**. According to the Atomic-Molecular Theory of Matter, all matter is made of tiny particles that are in constant motion. The first clear estimate of the actual size of an atom was made by the American scientist **Irving Langmuir** (b. 1881; d. 1957) in 1917. He showed that an average atom was about one-billionth of a meter in diameter.

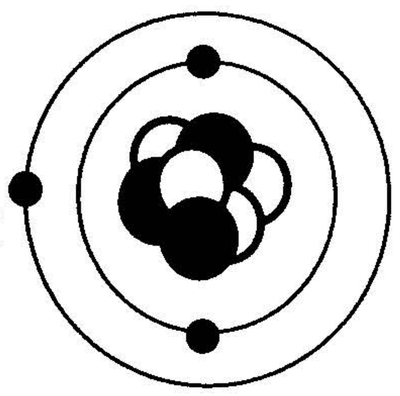
In the past century, scientists have discovered that an atom is made of three **subatomic particles**: **protons**, **neutrons**, and **electrons**. The English physicist **J. J. Thomson** (b. 1856; d. 1940) discovered the *negatively charged electron* in 1897. In 1911, the New Zealand-English physicist **Ernst Rutherford** (b. 1871; d. 1937) showed that atoms have a small but heavy center called a **nucleus**. The nucleus contains *protons* that have a *positive electrical charge* and a mass that is 1,840 times greater than that of an electron. Rutherford showed that the nucleus is extremely small compared to the size of the entire atom. If the nucleus of an atom were the size of a basketball, and you placed the ball on the 50-yard-line of a football field, then the tiny orbitting electrons would be as far away as the stands. Neutrons, which occupy the nucleus along with protons, have no electrical charge. Neutrons having about the same mass as protons were discovered in 1932 by the English physicist **James Chadwick** (b. 1891; d. 1974). Most recently, scientists have discovered that protons and neutrons are made of smaller particles of matter which they call **quarks**. Electrons belong to a group of subatomic particles called **leptons**. *The arrangement of electrons surrounding the nucleus gives an atom its chemical properties.*

In 1913, the Danish physicist **Niels Bohr** (b. 1885: d. 1962) showed that electrons orbit the nucleus in well-defined orbits like the planets of our solar system orbit the sun. In the **Bohr Model** of an atom, an **electron-shell diagram** shows the arrangement of *all of the electrons surrounding the nucleus* of an atom. Figure A shows a Bohr Model of a lithium atom. There are 3 protons and 4 neutrons in the nucleus and 3 electrons orbitting in two "electron-shells." Negatively charged electrons are attracted to

FIGURE A

A lithium atom has 3 protons, 4 neutrons, and 3 electrons in two "electrons shells."

(Li•)



the positively charged nucleus but are forced to orbit in different shells because their "like" electrical charges repel one another. The electrons in the "outermost electron-shell" are the only electrons involved in chemical reactions. Chemists use **electron-dot formulas** to show the number of electrons in the "outermost electron-shell." The "electron-dot formula" for lithium is shown in parentheses in Figure A. With some exceptions, *The Periodic Table of the Elements*, can tell you how many electrons occupy the outer shell of any atom. Each vertical column in *The Table* is called a **family** and the Roman numeral at the top of each family is called a **family number**. In families IA, IIA, IIIB, IVB, VB, VIB, and VIIB the family number tells how many electrons are in the atom's last shell. In family VIIIB, helium is the only atom with only two electrons in its outer shell. All of the other elements in family VIIIB have atoms with eight electrons in their outer shell. The Bohr model of atoms helps a scientist explain why chemical elements react the way they do during chemical reactions.

Homework Directions

1. Draw *electron-shell diagrams* for the atoms of the following elements: sodium, calcium, carbon, nitrogen, and oxygen.
2. Draw *electron-dot formulas* for the atoms of the following elements: sodium, carbon, oxygen, phosphorus, magnesium, calcium, nitrogen, chlorine, silicon, and krypton.

Assignment due: _____

_____ Student's Signature

_____ Parent's Signature

____/____/____ Date