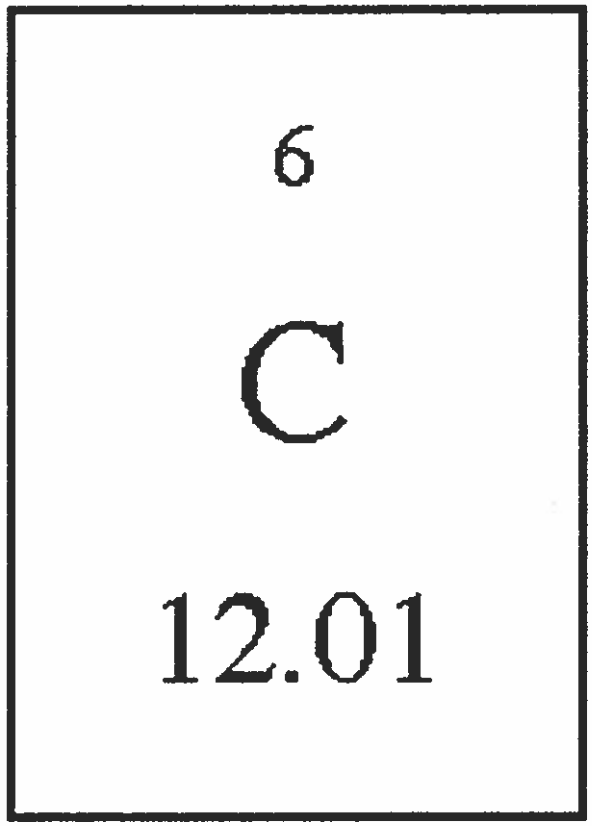
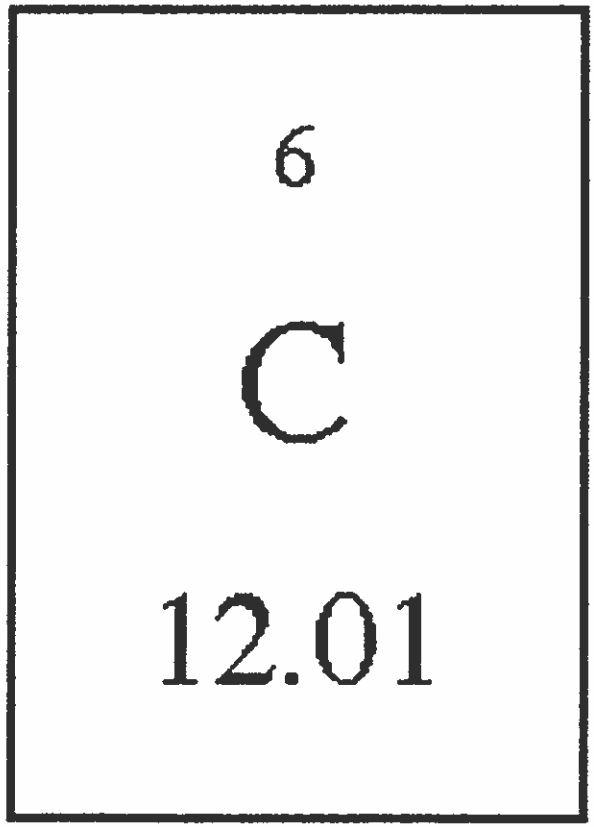
Determining Atomic Number and Mass

- Atomic Number is the number you see above the symbol on the periodic table.
  - Ex. 6
- Atomic Mass is the Number below the symbol
  - Ex. 12.011



Determining Number of Protons, Neutrons, and Electrons

- The number of protons and electrons always equals the atomic number of the element
  - Ex. 6 protons, 6 electrons
- The number of neutrons equals the mass – the atomic number
  - Ex. 12-6= 6 neutrons



Name _____ Class _____ Date _____

Skills Practice Lab

Drawing Atomic Models

Introduction

Look at the many different things in your classroom or lab: desks, chairs, windows, laboratory equipment, students, shoes, and notebooks. If all of these things are made from atoms and all atoms are made of only a few kinds of particles, what accounts for the variety of things that you see?

Atoms of different elements have different numbers of protons in their nuclei. In atoms that have a neutral charge, the number of electrons around the nucleus equals the number of protons in the nucleus. As it turns out, the number of electrons in an atom is one of the most important things in determining the chemical properties of the atom.

Elements are arranged in the periodic table according to the number of protons in each atom, which also corresponds to the number of electrons in the atom. The periodic table is called "periodic" because as the number of protons increases, certain chemical properties appear over and over again—periodically. In this activity, you will draw models of atoms and will place the atoms in the proper place on a periodic table.

OBJECTIVES

Draw models of atoms that show the numbers of protons and neutrons and electrons in proper energy levels.

Locate the proper position of atoms on a periodic table.

Infer the relationship of the number of energy levels and number of valence electrons in an atom to the group and period of the atom on a periodic table.

MATERIALS

paper
pencil
periodic table of the elements

Procedure

DRAWING MODELS OF ATOMS

1. **Figure 1** shows a model of an atom. This type of model is sometimes called a *Bohr model* because it was first used by the physicist Niels Bohr. The model shows a nucleus in the center that has three protons (p^+) and four neutrons (n). Surrounding the nucleus are three electrons (e^-). Notice that the number of electrons equals the number of protons in the nucleus.

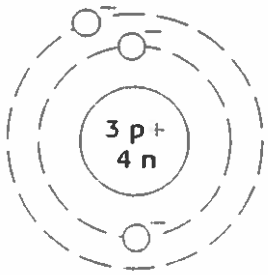


FIGURE 1

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Drawing Atomic Models (cont.)

2. The atomic number of an atom equals the number of protons in the atom's nucleus. The sum of the number of protons and the number of neutrons in the nucleus is the mass number of an atom. In a data table like **Data Table 1** shown below, fill in the number of protons, the number of neutrons, the atomic number, and the mass number for the atom in **Figure 1** (Atom A).
3. Notice that **Figure 1** shows the first two electrons in Atom A in the first energy level, on the circle closest to the nucleus. The third electron is in the second energy level, on a circle farther from the nucleus. The first energy level of any atom can hold only up to two electrons. The second and third energy levels can each hold up to eight electrons. In a data table like **Data Table 2** shown below, fill in the total number of electrons, the number of energy levels, and the number of electrons in the highest energy level (the circle farthest from the nucleus) for Atom A.
4. On a separate piece of paper, draw a model of an atom that has 11 protons and 12 neutrons. Remember that the first energy level for electrons can hold only 2 atoms, while the second and third energy levels can hold up to 8. Label your atom "Atom B." The style of your model should be similar to the style of Atom A, shown in **Figure 1.**
5. Fill in your data table with the appropriate values for Atom B.
6. On your paper, draw a model of an atom that has an atomic number of 19 and a mass number of 39. Label this atom "Atom C." Fill in the appropriate values for this atom in your data table.
7. On your paper, draw a model of an atom that has an atomic number of 17 and a mass number of 35. Label this atom "Atom D." Fill in the appropriate values for this atom in your data table.

DATA TABLE 1

Atom	# of protons	# of neutrons	Atomic number	Mass number
Atom A				
Atom B				
Atom C				
Atom D				

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Drawing Atomic Models (cont.)

DATA TABLE 2

Atom	Total # of electrons	# of energy levels	# of electrons in highest energy level
Atom A			
Atom B			
Atom C			
Atom D			

PLACING ELEMENTS IN THE PERIODIC TABLE

8. **Figure 2** shows part of a simple periodic table that is partially filled in. Copy this table onto a separate sheet of paper. Locate the proper places for Atoms A, B, C, and D on the table. On your copy of the table, write the name of the atom (A, B, C, or D) and the atomic number in the appropriate box for each atom.

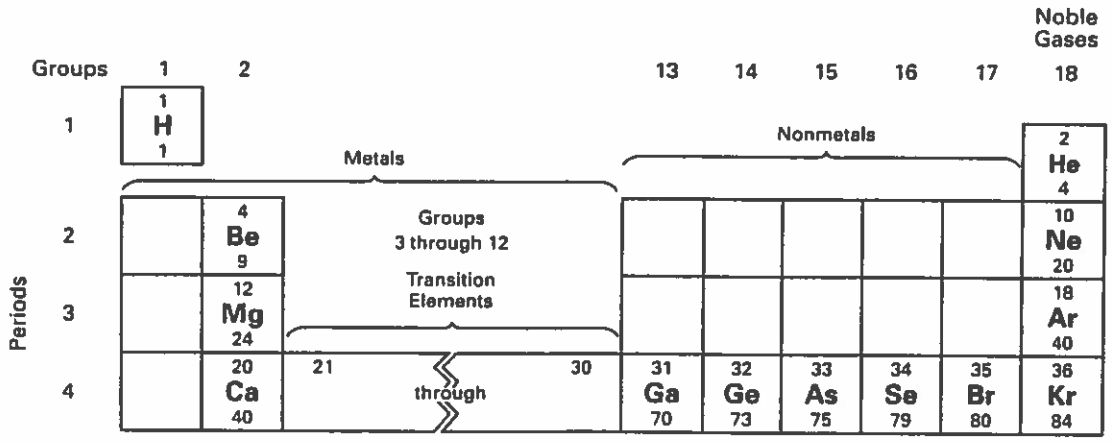

FIGURE 2

ANALYSIS

1. **Recognizing patterns** What value in the data tables do Atoms A, B, and C have in common? How is this similarity reflected in their positions in the periodic table?

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2. **Recognizing patterns** How does the period number of each atom compare with the number of energy levels in the atom?

CONCLUSIONS

1. **Drawing conclusions** Examine a periodic table in your classroom or in your textbook. What are the proper names of Atoms A, B, C, and D?

2. **Drawing conclusions** Which is more important in determining an element's chemical properties: its group or its period on the periodic table?

3. **Applying conclusions** Find the element fluorine on a periodic table. How many protons does a fluorine atom have? How many electrons does a neutral fluorine atom have? Which one of the atoms that you studied in this experiment is most chemically similar to fluorine?

DO NOT WRITE ON ME!

Name Date Class

Section 6.1 **Atoms and Their Interactions,** *continued*

Compounds and Bonding

A **compound** is a substance made of atoms of two or more elements. These atoms are chemically combined. Table salt is a compound of the elements sodium and chlorine. If an electrical current is passed through melted salt, the salt breaks down into these two elements. The element chlorine is a poison. When it is combined with sodium to form salt, the chlorine is harmless. The properties of a compound are different from the properties of the individual elements that make it up.

3. What is a compound?

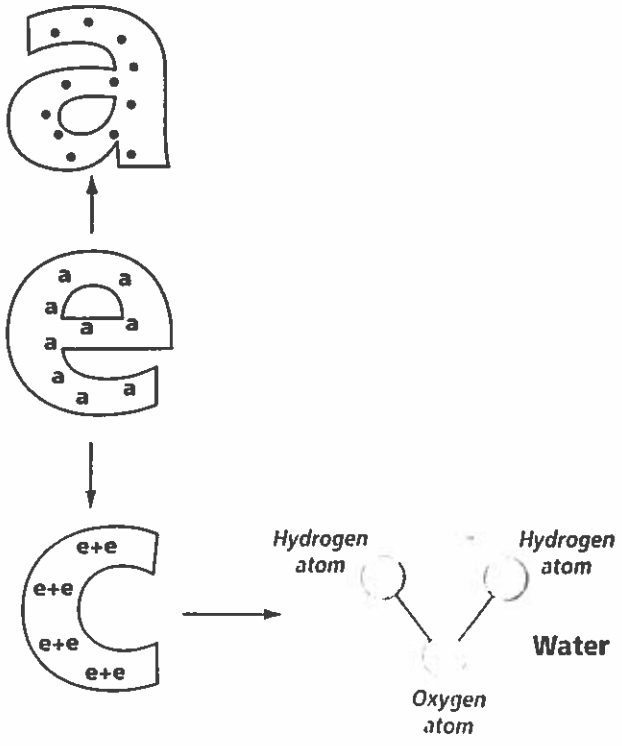
Why do atoms combine?

Atoms chemically combine with other atoms to form compounds only when the result is more stable than the individual atoms. An atom becomes more stable when the energy level farthest from the nucleus is filled with the maximum number of electrons it can hold. For most atoms, this means when the second level has eight electrons. One way to fill energy levels is to share electrons with other atoms. This is what hydrogen atoms do. When two atoms share electrons, the force that holds the atoms together is called a **covalent** (koh VAY lunt) **bond.**

Atom
- smallest particle of an element
- contains protons, neutrons, and electrons

Element
- made up of atoms
- cannot be broken down into simpler substances
- Hydrogen and oxygen are elements.

Compound
- made up of chemically combined elements
- can be broken down into its elements
- a water molecule is a compound, made up of two hydrogen atoms and one oxygen atom.



Section 6.1 Atoms and Their Interactions, *continued*

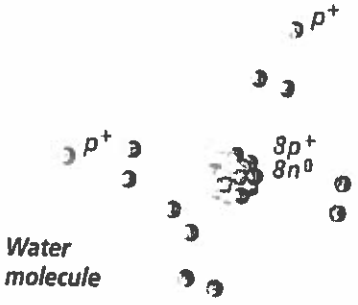
Reading Check

4. What is a group of atoms held together by covalent bonds called?

_____

_____

_____



Water molecule

Think it Over

5. **Compare** What does a covalent bond do that an ionic bond does not? (Circle your choice.)
   a. shares electrons
   b. shares neutrons
   c. shares atoms

Hydrogen atoms have only one energy level with one electron. To be full, this level would need two electrons. For this reason, a hydrogen atom will share its one electron with another hydrogen atom. This makes both atoms more stable. The two shared electrons move in the space around the nuclei of both atoms. The positively charged nuclei attract the negatively charged electrons that are shared. This attraction holds the two atoms together. When a group of atoms is held together by covalent bonds, the group is called a **molecule.** A molecule has no charge, positive or negative.

How do covalent bonds form?

Most compounds in organisms have covalent bonds. Water is a great example. In a molecule of water, there are two hydrogen atoms and one oxygen atom. Each hydrogen atom shares its one electron. The oxygen atom shares the six electrons it has in its outer energy level. By sharing eight electrons, all three atoms become stable.

How do ionic bonds form?

Not all atoms bond together by sharing electrons. A sodium atom and a chlorine atom bond in another way to make table salt. A sodium atom has 11 electrons. This means the outer energy level has only one electron (2 in first level, 8 in second level, 1 in third level). A chlorine atom has 17 electrons. This means that there are seven electrons in a chlorine atom's outer level (2 in first level, 8 in second level, 7 in third level). When sodium and chlorine bond together, the sodium atom loses one electron to the chlorine atom. The chlorine atom gains this electron. When an atom gains or loses electrons, it becomes electrically charged. It is then called an **ion.** An ion is a positively or negatively charged atom.

As a result of bonding, the sodium ion now has eight electrons in its outer energy level. This makes the sodium ion stable, but gives it a positive charge, because it now has more protons than electrons. The chloride ion now also has eight electrons in its outer level. It is stable but has a negative charge since it now has more electrons than protons. These opposite charges attract the sodium ion to the chloride ion. This attractive force between two ions of opposite charge is known as an **ionic bond.** An ionic bond, then, is what bonds sodium and chlorine together to make table salt.