Activity 3 - Atoms and Elements

Goals

- Write the correct symbols or names of some elements.
- Describe some physical properties of the elements you observe.
- Classify an element as a metal or nonmetal from its physical properties or location on the periodic table.
- Write the complete symbol of a nuclide including its mass number and atomic number.
- Use the complete symbol of a nuclide to determine mass number, atomic number, and the number of protons, neutrons and electrons.

Pre-lab Questions *(answer these on a separate sheet using complete sentences)*

1. What is the periodic table?
2. Where are the alkali metals located on the periodic table? Halogens? Noble gases?
3. Describe the three subatomic particles.
4. How are isotopes alike? Different?

Concepts to Review

Names and symbols of the elements
Properties of metals and nonmetals
Periodic table
Atoms
Subatomic particles
Isotopes

Introduction

Primary substances, called elements, build all the materials about you. There are 117 elements currently known (see http://www.webelements.com/). Some look very different from each other, while others look similar. In this experiment, you will describe the physical properties of some elements in a laboratory display. Then you will show the location of the elements on a blank periodic table.

Metals are elements that are usually shiny, or have a metallic luster. They are usually good conductors of heat and electricity, ductile (can be drawn into a wire), and malleable (can be beaten into sheets). Some of the metals such as sodium or calcium may have a white coating of oxide formed by reacting with oxygen in the air; if the metal were cut, you could see the fresh shiny surface underneath. In contrast, nonmetals are not good conductors of heat and electricity, are brittle (not ductile or malleable), and appear dull, not shiny.

Atoms

Atoms are made up of smaller bits of matter called **subatomic particles**. Of these, we will consider the protons, neutrons, and electrons. **Protons** are positively charged particles, **electrons** are negatively charged, and **neutrons** are neutral (have no charge). In an atom, the protons and neutrons are tightly packed in a tiny central body called the **nucleus**. Most of the atom is empty space, which contains fast-moving electrons. Electrons are so small that their mass is nearly negligible compared to the mass of the proton or neutron.

Every atom is identified by its atomic number and mass number. The **atomic number** is equal to the number of protons in the nucleus, which is the same as the nuclear charge. The **mass number** of an atom is the sum of the number of protons and neutrons, and is usually not equal to the exact measured mass of the atom.

atomic number = number of protons (p^+)
mass number = sum of the number of protons and neutrons ($p^+ + n^0$)

In a **neutral atom** (as opposed to an **ion**), the number of electrons is equal to the number of protons. Protons attract electrons because they have opposite charges.

number of protons (#p^+) = number of electrons (#e^-)

Isotopes

There are different versions of atoms for each of the elements. **Isotopes** are types of atoms of the same element that differ in the number of neutrons they contain. This means that isotopes of an element have the same number of protons, but different mass numbers. The following example represents the symbol of a sulfur nuclide that has 16 protons and 18 neutrons.

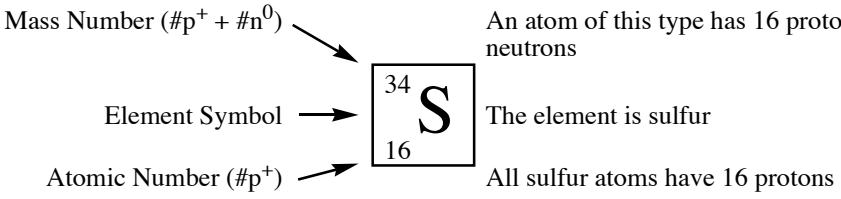

Figure 1. Complete symbol of a nuclide and the meaning of each component.

Periodic Table

The periodic table shown in Figure 1 on the next page contains information about each of the elements. The horizontal rows of the table are called **periods**, and the vertical columns are called **groups**. Each group contains elements that have similar physical and chemical properties. The groups are numbered across the top of the chart. Elements in Group 1A are the **alkali metals**, elements in Group 2A are the **alkaline earths,** and Group 7A contains the **halogens**. Group 8A contains the **noble gases**, which are elements that are generally unreactive with other elements. A double zigzag line that looks like a staircase separates the metals on the left side from the nonmetals on the right side.

1 1A																	18 8A
1 H	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe

Figure 2. The atomic numbers and symbols of some elements on the periodic table.

Materials

A display of samples of elements (metals and nonmetals), colored pencils.

Experimental Procedure

A. Physical Properties of Elements

Observe the elements in the laboratory display. In the worksheet provided, write the symbol and atomic number for each element listed. Describe a selection of physical properties such as color and luster. From your observations, identify each element as a metal, nonmetal, or metalloid.

B. Metals and Nonmetals on the Periodic Table

On the incomplete periodic table in Figure 3, write the symbols of the missing elements. Use your text or a periodic table in the laboratory as a reference. Write the group number at the top of each column of the representative (main group) elements. Using different colors, indicate the alkali metals, alkaline earth metals, halogens and noble gases. Write the period numbers for the horizontal rows shown. Outline and label the areas occupied by the metals, nonmetals, and metalloids.

Activity 3 - Atoms and Elements Worksheet

Name_____

Section_____ **Date**_____

Exercise A.

Complete the following table using the elements available in the lab:

Element Name (Atomic #)	Elemental Symbol	Physical Properties	Type of Element

After referring to a periodic table, review your answers regarding the "Type of Element" column. Are there any answers you would change based on their position in the periodic table?