

Atoms, Elements, Compounds, and Mixtures

section 2 The Simplest Matter

What You'll Learn

- how elements and the periodic table are related
- what atomic number and mass number are
- what makes an isotope
- how metals, metalloids, and nonmetals differ

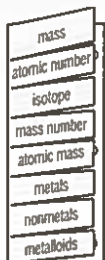
Mark the Text

Highlight Highlight words and sentences you think are important. After you finish reading, make sure you understand all the words and sentences you highlighted.

FOLDABLES™

B Build Vocabulary

Make the following Foldable. Write each vocabulary term on an outside tab. Then write the definition of each term inside the Foldable.



Before You Read

Think of two different electronic devices, such as a television and a computer. How are these items similar? How are they different?

Read to Learn

The Elements

Have you watched television today? A common object such as a TV set may seem simple. But, it is made up of many different materials like plastic, glass, and metals. All of these materials have one thing in common. They are made up of even simpler materials. If you had the right tools, you could separate the plastics, glass, and metals into these simpler materials.

How many elements are there?

If you separate materials into their simplest forms, you will have groups of atoms called elements. Remember that an element is matter made of only one kind of atom. We know of at least 115 elements. About 90 of those are found naturally on Earth. Some examples of natural elements are the oxygen and nitrogen in the air you breathe. You might be wearing the elements gold or silver as jewelry.

Synthetic Elements The rest of the elements are called synthetic elements. These elements are made in nuclear reactions. Scientists use machines called particle accelerators to produce these reactions. Some synthetic elements are used in medical testing. They are also found in smoke detectors and heart pacemaker batteries.

The Periodic Table

In libraries, books are organized so you can find the information quickly. The elements are organized this way too. When scientists need to find information about an element, they look at the periodic table. It is a chart chemists made to organize the elements. The look of the periodic table has changed many times over the years. It changed as scientists learned more about elements and atoms.

Look on the inside back cover of this book. You'll see the modern periodic table. Each element has a chemical symbol. The symbols are one to three letters. Writing elements with their symbols saves time and space. These symbols are part of an international system that is understood by scientists all over the world. ✓

How is the periodic table organized?

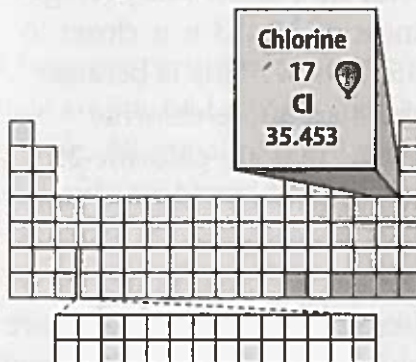
The elements on the periodic table are organized by their properties. The elements in each row and column are related to each other. The rows on the table are called periods. The elements in a row have the same number of energy levels. The columns are called groups. The elements in a group have similar properties. They also may form similar bonds.

Identifying Characteristics

Each element is different and has different properties. One way to tell differences is by how the atomic particles in each element are related. The periodic table has numbers that show these relationships.

What do atomic numbers tell you?

Find chlorine on the periodic table. It is also shown in the figure. Cl is the symbol for chlorine. There are numbers above and below the symbol. The top number is the atomic number. The **atomic number** tells you the number of protons in the nucleus of each atom of that element. The atomic number of chlorine is 17. Every atom of chlorine has 17 protons in its nucleus.



✓ Reading Check

1. **Identify** How many letters are in the chemical symbols for elements?
 - a. 1 or 3
 - b. 2 or 3
 - c. 1, 2, or 3
 - d. 2, 3, or 4

Picture This

2. **Determine** In the figure, circle chlorine's symbol and underline its atomic number.

What are isotopes?

Every atom of the same element has the same number of protons. But the number of neutrons in an atom can be different, even in the same element. For example, some chlorine atoms have 18 neutrons in their nucleus. Others have 20 neutrons. These two types of chlorine atoms are called chlorine-35 and chlorine-37. They are called isotopes (I suh tohps). **Isotopes** are atoms of the same element that have different numbers of neutrons in their nuclei. ✓

✓ Reading Check

3. **Describe** What makes two isotopes of the same element different?

Mass Number You can show which isotope you are talking about by using the mass number. The **mass number** is the number of protons plus the number of neutrons in an atom. The mass number of chlorine-35 is 35. The mass number of chlorine-37 is 37. Hydrogen has three isotopes. Their mass numbers are 1, 2, and 3. Each hydrogen atom always has one proton. But the number of neutrons is different in each isotope of hydrogen.

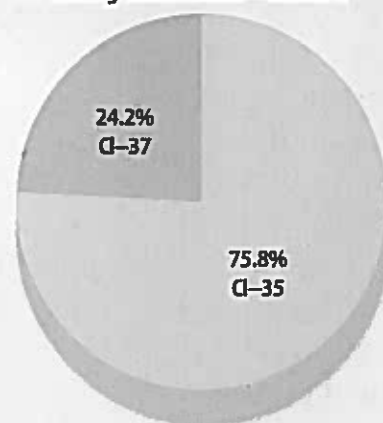
What is atomic mass?

The **atomic mass** is the weighted average mass of all the isotopes of an element. It is the number found below the element symbol on the periodic table. Look at the figure on the previous page. You will see that the mass number for chlorine is 35.453. The unit that scientists use for atomic mass is the atomic mass unit, or u. One atomic mass unit is equal to 1/12 the mass of a carbon-12 atom.

Chlorine's atomic mass could be confusing because there are no chlorine atoms with that mass. The average mass of 35.453 u is closer to 35 than 37. This is because there are more chlorine atoms that are chlorine-35 than there are chlorine atoms that are chlorine-37. Look at the circle graph. About 76 percent of chlorine atoms are chlorine-35. About 24 percent are chlorine-37. That means if you have 1,000 chlorine atoms, about 758 will be chlorine-35 and about 242 will be chlorine-37.

Circle Graph Showing Abundance of Chlorine Isotopes

Average atomic mass = 35.453 u



Picture This

4. **Interpret Data** Which isotope of chlorine is found less often?

Classification of Elements

Elements are classified into three categories. The elements in each category have similar properties. The three categories are metals, metalloids (ME tuh loydz), and nonmetals. The properties of these categories are described below. ✓

What are metals?

Metals are elements that usually are shiny or have a metallic appearance and are good conductors of heat and electricity. All metals except mercury are solids at room temperature. Metals are malleable (MAL yuh bul). This means they can be pounded into different shapes. Coins are an example of how malleable metals can be made into different shapes. Metals are also ductile. This means they can be stretched into wires without breaking. Look at the periodic table. You will see that most of the elements are metals.

What are nonmetals?

Nonmetals are elements that are usually dull in appearance. Most are poor conductors of heat and electricity. Many are gases at room temperature. Bromine is a nonmetal that is a liquid at room temperature. Most of the solid nonmetals are brittle. This means they cannot change shape easily without breaking. Nonmetals are important to your body and health. More than 97 percent of your body is made up of nonmetals. The most common nonmetals in your body are oxygen and carbon. Except for hydrogen, the nonmetals are on the right side of the periodic table.

What are metalloids?

Metalloids are elements that have properties of both metals and nonmetals. Nonmetals are found between metals and nonmetals on the periodic table. All metalloids are solids at room temperature. Some metalloids are shiny. Many are good conductors of electricity. But they are not as good at conducting heat and electricity as metals. Silicon is an important metalloid. It is used to make the electronic circuits found in computers, televisions, and other electronics.

✓ Reading Check

5. **Classify** which of the following is *not* a type of element?
- metalloids
 - precious metals
 - nonmetals
 - metals



Think it Over

6. **Explain** Metalloids are located between the metals and nonmetals on the periodic table. What does this tell you about their properties?

● After You Read

Mini Glossary

atomic mass: the weighted average mass of all the isotopes of an element

atomic number: the number of protons in the nucleus of each atom of that element

isotopes: two or more atoms of the same element that have different numbers of neutrons in their nuclei

mass number: the number of protons plus the number of neutrons in the nucleus of an atom

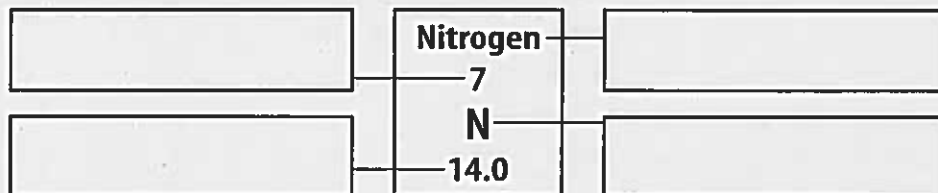
metal: an element that usually is shiny or has a metallic appearance, is ductile and malleable, and is a good conductor of heat and electricity

metalloids: elements that have properties of both metals and nonmetals

nonmetal: an element that usually is dull in appearance, is a gas or a brittle solid at room temperature, and is a poor conductor of heat and electricity

1. Review the terms and their definitions in the Mini Glossary. What is the difference between the atomic number and the mass number of an element?

2. The figure below shows an element from the periodic table. Label each part.



3. How could you use a set of multicolored marbles to show a group of elementary students how the periodic table is arranged?



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