The Periodic Table

Using the Periodic Table

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	1. The elements on the periodic table are arranged in rows in the order they were discovered.	
	2. The properties of an element are related to the element's location on the periodic table.	

Read to Learn

What is the periodic table?

There are more than 100 elements. Each element has a unique set of properties. Scientists use a table, called the periodic (pihr ee AH dihk) table, to organize elements. The **periodic table** *is a chart of the elements arranged into rows and columns according to their physical and chemical properties*. The periodic table can be used to determine the relationships among the elements.

This chapter describes the development of the periodic table. It will show you how to use the periodic table to learn about the elements.

Developing a Periodic Table

In 1869, a Russian chemist and teacher Dimitri Mendeleev (duh MEE tree · men duh LAY uf) put together an early periodic table. He studied the physical properties such as density, color, melting point, and atomic mass of each element. He also studied the chemical properties, such as how each element reacted with other elements. Mendeleev arranged the elements in rows of increasing atomic mass. He grouped elements with similar properties in the same column.

Key Concepts

- How are elements arranged on the periodic table?
- What can you learn about elements from the periodic table?

Study Coach

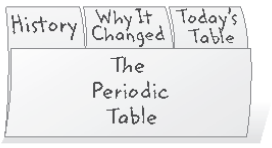
Create a Quiz As you study the information in this section, create questions about the information you read. Be sure to answer your questions. Refer to your questions and answers as you review the chapter.

Reading Check

1. Explain What physical property did Mendeleev use to place the elements in rows on the periodic table?

FOLDABLES®

Make a top-tab book to organize your notes about the development of the periodic table.



Patterns in Properties

The word *periodic* means "repeating pattern." Seasons and months are periodic because they follow a repeating pattern every year. The days of the week are periodic because they repeat every seven days.

What were some of the repeating patterns Mendeleev noticed in his table? Melting point is one property that shows a repeating pattern. Melting point is the temperature at which a solid changes to a liquid. In the periodic table, melting points increase and then decrease across a row. Boiling points and reactivity also follow a periodic pattern.

Predicting Properties of Undiscovered Elements

When all of the elements known in Mendeleev's time were arranged in a periodic table, there were large gaps between some elements. Mendeleev predicted that scientists would discover elements that would fit into these spaces. He also predicted that the properties of those elements would be similar to the known elements in the same columns. Both of Mendeleev's predictions turned out to be true.

Reading Check

2. Describe What did Mendeleev predict about the properties of the elements missing from his periodic table?

Changes to Mendeleev's Table

Mendeleev's periodic table made it possible for scientists to relate the properties of elements to their position on the table. However, the table had one big problem: some elements seemed to be out of place.

When elements were arranged in order of atomic mass, a few of the elements did not seem to belong in their columns. Their properties were similar to the properties of the elements in the next column on Mendeleev's table. What could be done to fix this problem on Mendeleev's table? The result is the periodic table we use today.

The Importance of Atomic Number

In the early 1900s, scientist Henry Moseley solved the problem with Mendeleev's table. Mendeleev had listed elements according to increasing atomic mass. Instead of listing elements according to increasing atomic mass, Moseley listed elements according to increasing atomic number.

The atomic number of an element is the number of protons in the nucleus of each of that element's atoms. When Mosely organized the table according to atomic number, he found that the columns contained elements with similar properties.

Key Concept Check

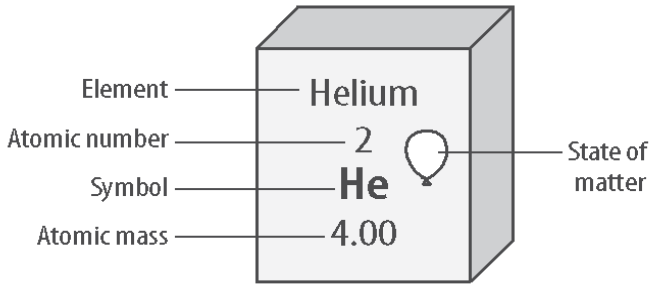
3. Identify What determines where an element is located on the periodic table you use today?

Today's Periodic Table

The periodic table is shown on the next two pages. You can identify many of the properties of an element from its placement on the periodic table. The table is organized into columns, rows, and blocks, which are based on certain patterns of properties. In the next two lessons, you will learn how an element's position on the periodic table can help you understand the element's physical and chemical properties.

What is on an element key?

Each element in the periodic table is represented by an element key. An element key shows important information about each element. The key shows the element's chemical symbol, atomic number, and atomic mass. The key also contains a symbol that shows the element's state of matter at room temperature. Look at the information given for helium in the figure on the right. It shows that helium is a gas at room temperature, it has the atomic number 2, its chemical symbol is He, and its atomic mass is 4.00.



Groups

A **group** *is a column on the periodic table.* Elements in the same group have similar chemical properties. This means that the elements in a group react with other elements in similar ways. There are patterns in the physical properties of a group, such as density, melting point, and boiling point. The groups are numbered 1–18 at the top of each column on the periodic table.

Periods

The rows on the periodic table are called **periods**. The atomic number of each element increases by 1 as you read from left to right across each period. The physical and chemical properties of the elements also change as you move from left to right across a period.

Math Skills

The distance around a circle is the circumference (C). The distance across the circle, through its center, is the diameter (d). The radius (r) is half of the diameter. The circumference divided by the diameter for any circle is equal to π (pi), or 3.14. The formula for finding the circumference is:

$$C = \pi d \text{ or } C = 2\pi r$$

Example: The circumference of an iron (Fe) atom is:

$$C = 2 \times 3.14 \times \mathbf{126\ pm}$$

(picometers; 1 picometer = one-trillionth of a meter)

$$C = \mathbf{791\ pm}$$

4. Use Geometry The radius of a uranium (U) atom is 156 pm. What is its circumference?

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Visual Check

5. Determine What does the key in the figure tell you about helium?

_____

Key Concept Check

6. Describe What can you infer about the properties of two elements in the same group?

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Metals, Nonmetals, and Metalloids

Almost three-fourths of the elements on the periodic table are metals. Metals are on the left side and in the middle of the table. Metals can have different properties, but all metals are shiny and conduct thermal energy and electricity.

Nonmetals, except for hydrogen, are located on the right side of the periodic table. The properties of nonmetals are different from those of metals. Nonmetals do not conduct thermal energy or electricity. Many nonmetals are gases.

Between the metals and the nonmetals on the periodic table are the metalloids. Metalloids have properties of both metals and nonmetals.

Visual Check

7. Identify How is the periodic table organized?

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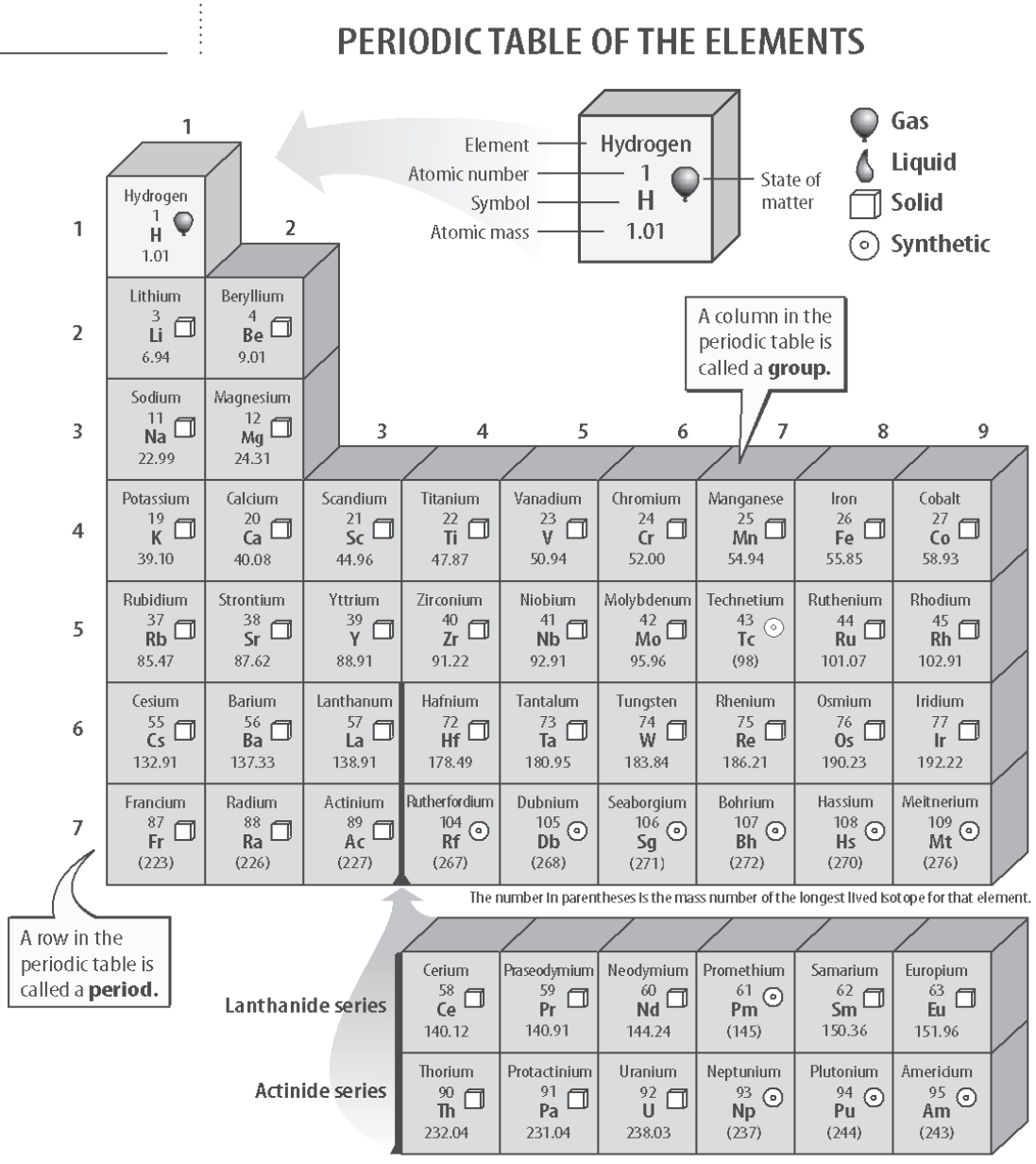


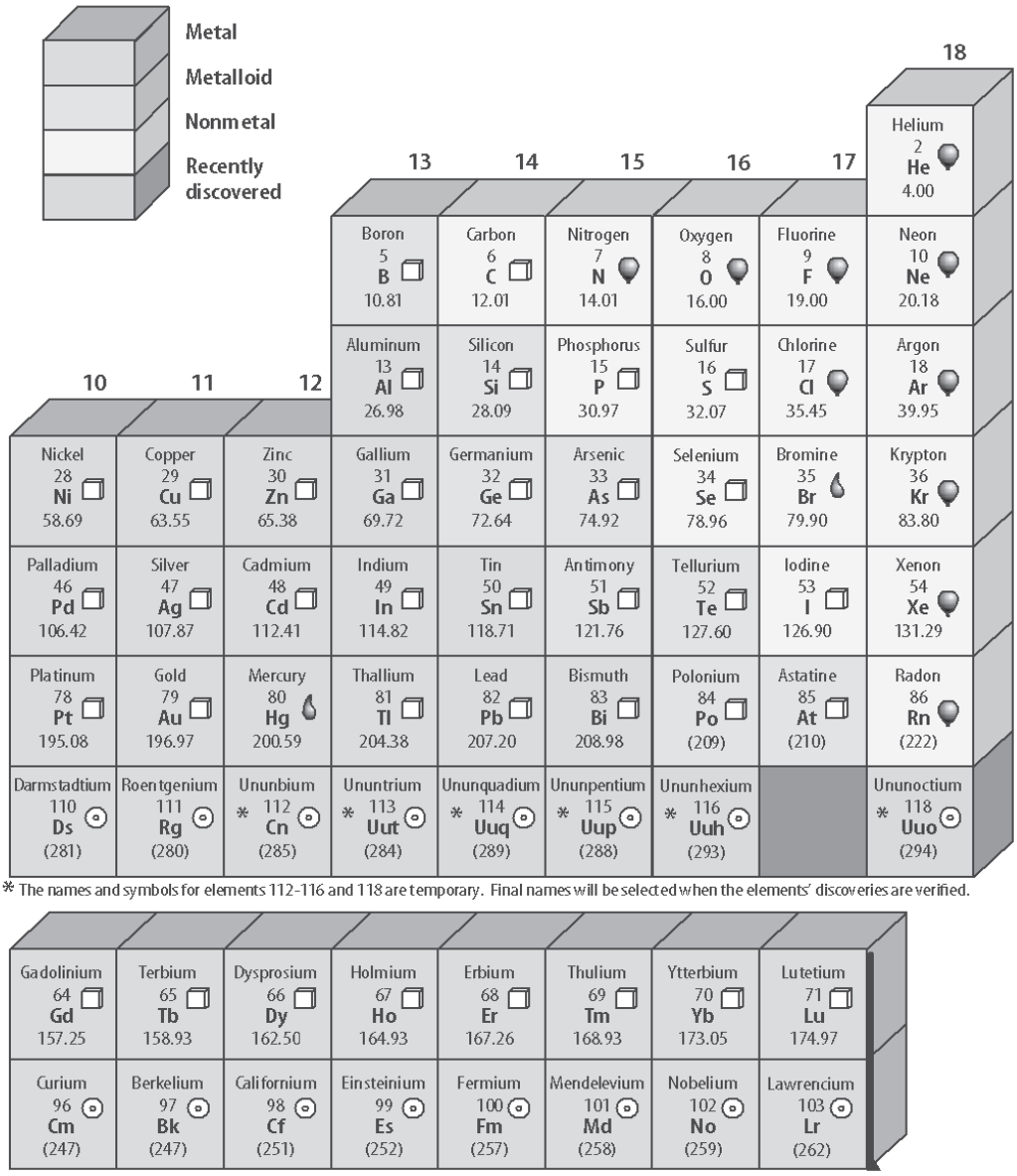
How Scientists Use the Periodic Table

More than 100 elements are known today. They are all listed on the periodic table. Each element has its own set of properties. It also has properties similar to the elements near it on the table. The periodic table shows how elements relate to each other and fit together into one organized chart. Scientists use the periodic table to understand and predict elements' properties.

The elements with the largest atomic masses are not found in nature. These are elements that can be made only by scientists in special laboratories. Elements that were created in laboratories are named to honor the scientists who created them or the laboratories in which they were created.

Reading Check

8. Explain How is the periodic table used to predict the properties of an element?



After You Read

Mini Glossary

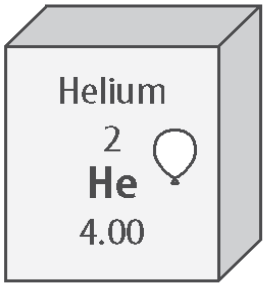
group: a column on the periodic table

period: a row on the periodic table

periodic (pihr ee AH dihk) table: a chart of the elements arranged into rows and columns according to their physical and chemical properties

1. Review the terms and their definitions in the Mini Glossary. Use all three words in the Mini Glossary to describe the periodic table and how it is arranged.

2. Examine the element key at right from the periodic table. From the element key, give all the information you can tell about the element shown.



3. How did preparing questions about the periodic table and the elements help you learn the information in the lesson?

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON