

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

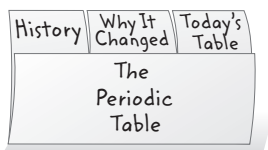
Create a Quiz As you study the information in this section, create questions about the information you read. Be sure to answer your questions. Refer to your questions and answers as you review the chapter.

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.



✓ Reading Check

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

✓ Key Concept Check

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

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. ✓

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.

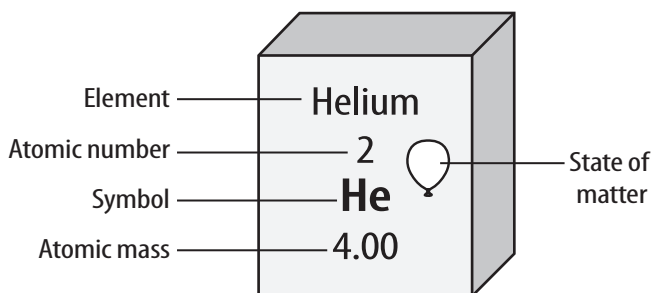
The atomic number of an element is the number of protons in the nucleus of each of that element’s atoms. When Moseley organized the table according to atomic number, he found that the columns contained elements with similar properties. ✓

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:

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

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

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

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

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?

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.

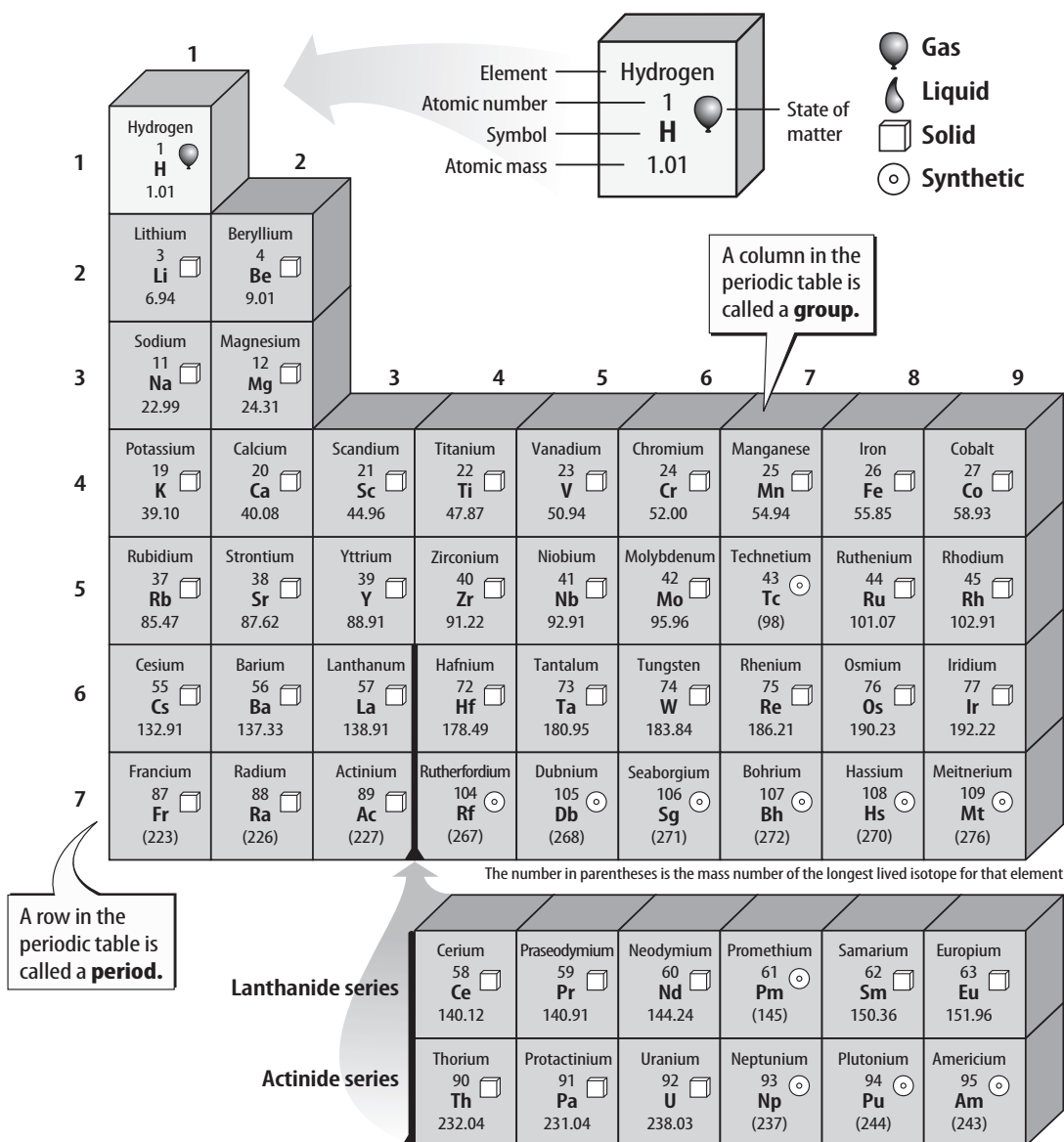
Nonmetals, except for hydrogen, are located on the right side of the periodic table. The properties of nonmetals are different from those of metals. Nonmetals do not conduct thermal energy or electricity. Many nonmetals are gases.

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?

PERIODIC TABLE OF THE ELEMENTS



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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?

Metal			Metalloid			Nonmetal			Recently discovered		
10	11	12	13	14	15	16	17	18			
Nickel 28 Ni 58.69	Copper 29 Cu 63.55	Zinc 30 Zn 65.38	Boron 5 B 10.81	Carbon 6 C 12.01	Nitrogen 7 N 14.01	Oxygen 8 O 16.00	Fluorine 9 F 19.00	Helium 2 He 4.00	Neon 10 Ne 20.18		
Palladium 46 Pd 106.42	Silver 47 Ag 107.87	Cadmium 48 Cd 112.41	Aluminum 13 Al 26.98	Silicon 14 Si 28.09	Phosphorus 15 P 30.97	Sulfur 16 S 32.07	Chlorine 17 Cl 35.45	Argon 18 Ar 39.95			
Platinum 78 Pt 195.08	Gold 79 Au 196.97	Mercury 80 Hg 200.59	Gallium 31 Ga 69.72	Germanium 32 Ge 72.64	Arsenic 33 As 74.92	Selenium 34 Se 78.96	Bromine 35 Br 79.90	Krypton 36 Kr 83.80			
Darmstadtium 110 Ds (281)	Roentgenium 111 Rg (280)	Ununbium * 112 Cn (285)	Indium 49 In 114.82	Tin 50 Sn 118.71	Antimony 51 Sb 121.76	Tellurium 52 Te 127.60	Iodine 53 I 126.90	Xenon 54 Xe 131.29			
			Thallium 81 Tl 204.38	Lead 82 Pb 207.20	Bismuth 83 Bi 208.98	Polonium 84 Po (209)	Astatine 85 At (210)	Radon 86 Rn (222)			
			Ununtrium * 113 Uut (284)	Ununquadium * 114 Uuq (289)	Ununpentium * 115 Uup (288)	Ununhexium * 116 Uuh (293)		Ununoctium * 118 Uuo (294)			

* The names and symbols for elements 112-116 and 118 are temporary. Final names will be selected when the elements' discoveries are verified.

Gadolinium 64 Gd 157.25	Terbium 65 Tb 158.93	Dysprosium 66 Dy 162.50	Holmium 67 Ho 164.93	Erbium 68 Er 167.26	Thulium 69 Tm 168.93	Ytterbium 70 Yb 173.05	Lutetium 71 Lu 174.97
Curium 96 Cm (247)	Berkelium 97 Bk (247)	Californium 98 Cf (251)	Einsteinium 99 Es (252)	Fermium 100 Fm (257)	Mendelevium 101 Md (258)	Nobelium 102 No (259)	Lawrencium 103 Lr (262)

After You Read

Mini Glossary

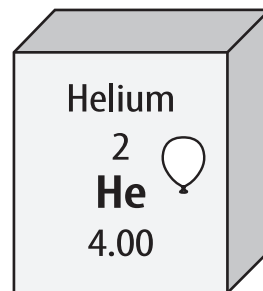
group: a column on the periodic table

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?



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