

Elements and the Periodic Table ▪ Section Summary

Organizing the Elements

Guide for Reading

- How did Mendeleev discover the pattern that led to the periodic table?
- What data about elements is found in the periodic table?
- How is the organization of the periodic table useful for predicting the properties of elements?

In 1869, the Russian scientist Dmitri Mendeleev discovered a set of patterns in the properties of the elements. **He noticed that a pattern of properties appeared when he arranged the elements in order of increasing atomic mass.** The **atomic mass** of an element is the average mass of all the isotopes of that element.

Mendeleev published the first periodic table. In the **periodic table**, the properties of the elements repeat in each period, or row, of the table. Mendeleev left three blank spaces in the table. He predicted that these spaces would be filled by elements that had not yet been discovered. He even predicted the properties of those elements. Those elements were soon discovered. Their properties are close to those predicted by Mendeleev.

The periodic table has been updated since Mendeleev's time as scientists discovered new elements. After protons were discovered, elements were rearranged according to atomic number. Some elements changed positions and the patterns of properties became more regular.

The modern periodic table contains over 100 squares, one for each element. **Each square includes the element's atomic number, chemical symbol, name, and atomic mass.** The **chemical symbol** for an element usually consists of one or two letters, such as Fe, the chemical symbol for iron.

The properties of an element can be predicted from its location in the periodic table. Each horizontal row of the table is called a **period**. As you move across a period from left to right, the properties of elements change in a predictable pattern. There are seven periods of elements.

The elements in a column are called a **group**, or family. The groups are numbered from Group 1 on the left to Group 18 on the right. The family name of a group is typically the name of the first element in the column. Elements in each group have similar characteristics.

Elements and the Periodic Table ▪ *Guided Reading and Study*

Organizing the Elements

This section explains how the elements are organized in a chart called the periodic table. It also explains what information the periodic table contains.

Use Target Reading Skills

Before you read, preview the red headings. In the graphic organizer below, ask a what or how question for each heading. As you read, write the answers to your questions.

Patterns in the Elements

Question	Answer
What pattern of elements did Mendeleev discover?	Patterns appeared when...

Patterns in the Elements

1. What did Dmitri Mendeleev discover in 1869?

2. What is the atomic mass of an element?

Elements and the Periodic Table ▪ *Guided Reading and Study*

3. Mendeleev noticed that patterns appeared when he arranged the elements in what way?

4. Is the following sentence true or false? Mendeleev also grouped elements that had similar properties. _____.

5. Mendeleev's periodic table had _____ blank spaces left in it, which represented elements that had not yet been discovered.

6. What does the word *periodic* mean?

7. A chart of the elements showing the repeating pattern of their properties is called the _____.

8. The modern periodic table is now arranged according to _____.

Finding Data on Elements

9. The atomic number for the element calcium (Ca) is 20. How many protons and electrons does each calcium atom have?

10. A one- or two-letter representation of an element is called a(n) _____.

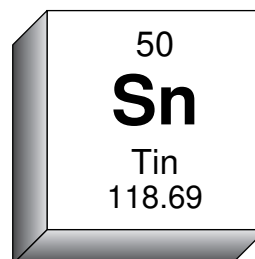
11. Use the square from the periodic table to fill in the blanks below.

a. Name of element: _____

b. Chemical symbol: _____

c. Atomic mass: _____

d. Atomic number: _____



Elements and the Periodic Table ▪ *Guided Reading and Study*

Organizing the Elements *(Continued)*

Organization of the Periodic Table

12. How can an element's properties be predicted?

13. Each horizontal row in the periodic table is called a(n)_____.

14. Is the following sentence true or false? Across a period from left to right, the properties of elements change according to a pattern._____.

15. Circle the letter of each term that refers to elements in a column of the periodic table.

- a. period
- b. family
- c. group
- d. symbol

16. Group 15 of the periodic table is the _____ family.

17. Circle the letter of the statement that is true about elements in each group.

- a. They all have the same atomic mass.
- b. They all have similar characteristics.
- c. They all have similar atomic numbers.
- d. They all have the same chemical symbol.

Elements and the Periodic Table ▪ Section Summary

Elements From Stardust

Guide for Reading

- How are elements created in stars?
- What are the results of fusion in large stars?

Like many other stars, the sun is made mostly of the element hydrogen. Because of the high pressures and hot temperatures, the hydrogen in the sun does not exist as either a solid, liquid, or gas. It exists in a state called plasma.

The **plasma** state of matter is made up of a gas-like mixture of free electrons and atoms stripped of their electrons. Normally, positively charged nuclei repel each other. But inside stars, the pressure is so high that nuclei are squeezed close enough together to collide with each other.

When colliding nuclei have enough energy, they can join together. **Nuclear fusion** is a process in which two atomic nuclei combine to form a larger nucleus. During nuclear fusion, huge amounts of energy are released. **Nuclear fusion, which occurs in stars on a huge scale, combines smaller nuclei into larger nuclei, creating heavier elements.**

In the sun and other stars, isotopes of hydrogen join together, producing a helium nucleus. At the same time a great deal of energy is released. This reaction is the major source of the sun's energy. The sun will eventually run out of hydrogen. However, scientists estimate that the sun has enough hydrogen to last another 5 billion years.

As helium builds up in the sun's core, the sun's temperature and volume change. These changes allow different nuclear fusion reactions to occur. First, two helium nuclei combine to form a beryllium nucleus. Then another helium nucleus can add to the beryllium nucleus, forming a carbon nucleus. And yet another helium nucleus can add to the carbon nucleus, forming oxygen. Stars the size of the sun do not contain enough energy to produce elements heavier than oxygen. Eventually a star like the sun shrinks and its elements blow away. Then, it forms a **nebula**, or cloudlike region of gases.

As they age, larger stars become even hotter than the sun. They have enough energy to produce heavier elements, such as magnesium and silicon. In more massive stars, fusion continues until the core is almost all iron.

A very massive star can explode in an event called a **supernova**. A supernova produces temperatures up to 1 billion degrees Celsius. **A supernova provides enough energy for the nuclear fusion reactions that create the heaviest elements.** Most astronomers agree that the matter in the sun and the planets around it originally came from a gigantic supernova that occurred billions of years ago.

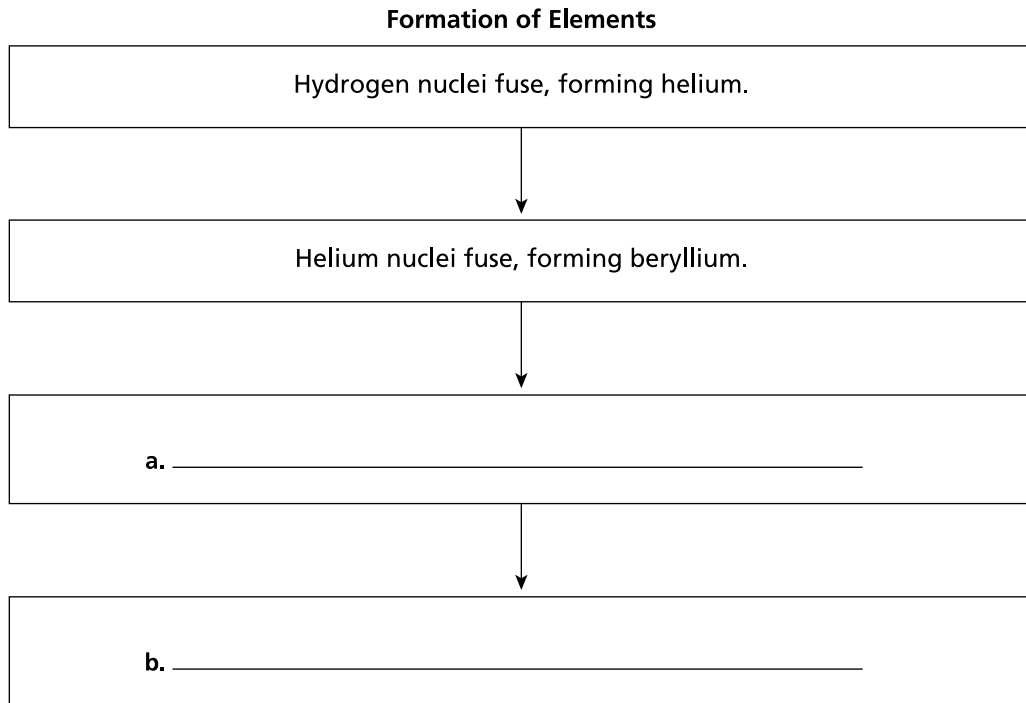
Elements and the Periodic Table ▪ *Guided Reading and Study*

Elements From Stardust

This section explains how elements form inside stars.

Use Target Reading Skills

As you read about how elements are formed in stars, fill in the flowchart to show the steps in the process



How Elements Form in Stars

1. Describe plasma.

2. The process in which two atomic nuclei combine to form a larger nucleus, releasing huge amounts of energy, is called _____.

3. What does nuclear fusion create inside stars?

Elements and the Periodic Table ▪ *Guided Reading and Study*

4. What is the fuel that powers the sun?

5. Circle the letter of the element that is produced when hydrogen nuclei fuse.

- a. helium
- b. beryllium
- c. carbon
- d. oxygen

6. Two helium nuclei fuse to form a nucleus of _____.

7. What nuclei fuse to form oxygen?

8. Is the following sentence true or false? Stars the size of the sun can produce elements heavier than oxygen. _____

9. What is a nebula and how does it form?

Elements From Large Stars

10. In stars more massive than the sun, fusion continues until the core is almost all _____.

11. What is a supernova?

12. A supernova provides enough energy for the nuclear fusion reactions that create the heaviest _____.



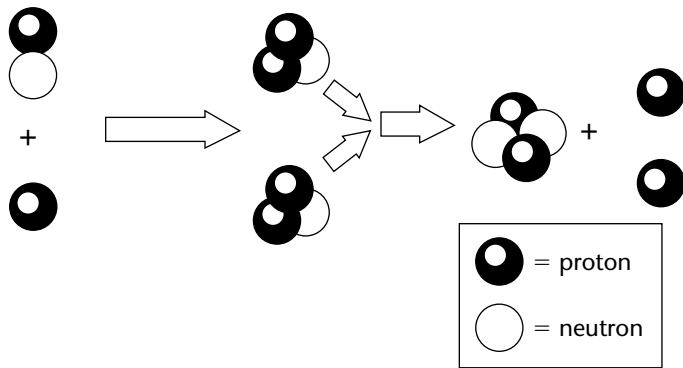
Elements and the Periodic Table ▪ *Review and Reinforce*

Elements From Stardust

Understanding Main Ideas

Write an answer for each of the following questions in the spaces provided.

1. What is the process shown below? What are the results of this process?



2. What is plasma?

3. What conditions in the sun's core allow the plasma state to exist?

4. What are the two most common elements in the sun? What three other elements are also produced in the sun?

5. In what event are the heaviest elements formed? Describe that event.
