FLORIDA
Chapter 7

The Periodic TABLE

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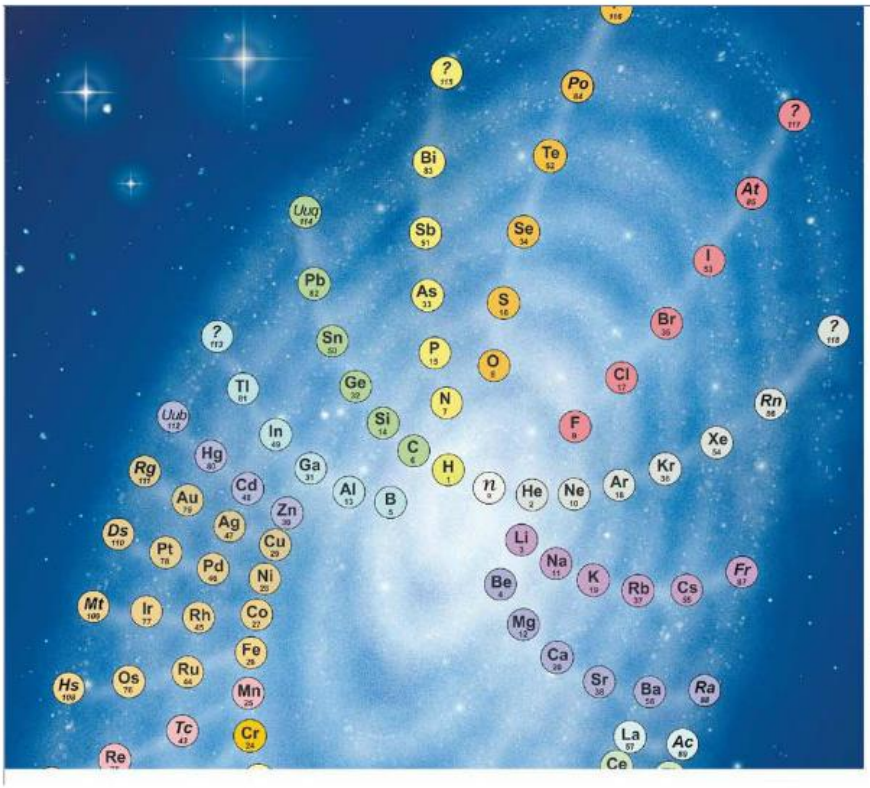

Inquiry **Same Information?**

1. You probably have seen a copy of a table that is used to organize the elements. Does it look like this chart? Describe the symbols in this image. How are they arranged?

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What is the periodic table?

The "junk drawer" in **Figure 1** is full of pens, notepads, rubber bands, and other supplies. It would be difficult to find a particular item in this messy drawer. How might you organize it? First, you might dump the contents onto the counter. Then you could sort everything into piles. Pens and pencils might go into one pile. Notepads and paper go into another. Organizing the contents of the drawer makes it easier to find the things you need, also shown in **Figure 1.**

Just as sorting helps to organize the objects in the junk drawer, sorting can help scientists organize information about the elements. Recall that there are more than 100 elements, each with a unique set of physical and chemical 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.* It can be used to determine the relationships among the elements.

In this chapter, you will read about how the periodic table was developed. You will also read about how you can use the periodic table to learn about the elements.

Figure 1 Sorting objects by their similarities makes it easier to find what you need.

Developing a Periodic Table

In 1869, a Russian chemist and teacher named Dimitri Mendeleev (duh MEE tree · men duh LAY uf) was working on a way to classify elements. At that time, more than 60 elements had been discovered. He studied the physical properties such as density, color, melting point, and atomic mass of each element. Mendeleev also noted chemical properties such as how each element reacted with other elements. Mendeleev arranged the elements in a list using their atomic masses. He noticed that the properties of the elements seemed to repeat in a pattern.

When Mendeleev placed his list of elements into a table, he arranged them in rows of increasing atomic mass. Elements with similar properties were grouped in the same column. The columns in his table are like the piles of sorted objects in your junk drawer. Both contain groups of things with similar properties.

Patterns in Properties

The term *periodic* means "repeating pattern." For example, seasons and months are periodic because they follow a repeating pattern every year. The days of the week are periodic since 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. Recall that melting point is the temperature at which a solid changes to a liquid. The blue line in **Figure 2** represents the melting points of the elements in row 2 of the periodic table. Notice that the melting point of carbon is higher than the melting point of lithium. However, the melting point of fluorine, at the far right of the row, is lower than that of carbon. How do these melting points show a pattern? Look at the red line in **Figure 2.** This line represents the melting points of the elements in row 3 of the periodic table. The melting points follow the same increasing and then decreasing pattern as the blue line, or row 2. Boiling point and reactivity also follow a periodic pattern.

Active Reading **2. List** What physical property did Mendeleev use to place the elements in rows on the periodic table?

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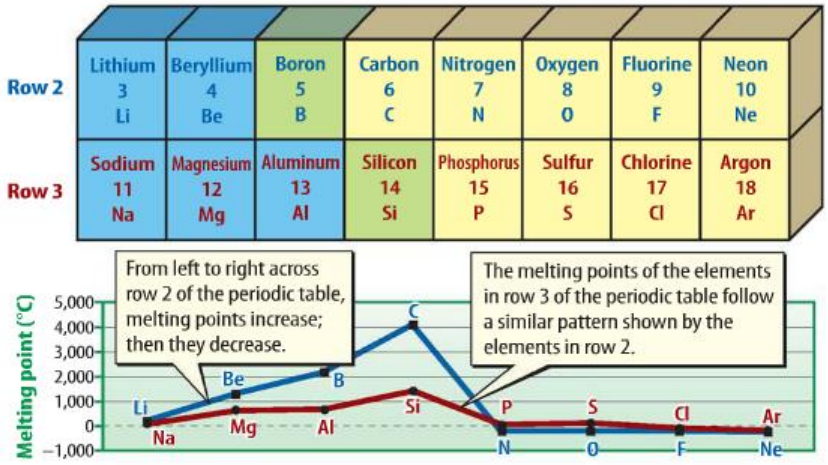
A Periodic Property

Figure 2 Melting points increase, then decrease, across a period on the periodic table.



Predicting Properties of Undiscovered Elements

When Mendeleev arranged all known elements by increasing atomic mass, there were large gaps between some elements. He predicted that scientists would discover elements that would fit into these spaces. Mendeleev also predicted that the properties of these elements would be similar to the known elements in the same columns. Both of his predictions turned out to be true.

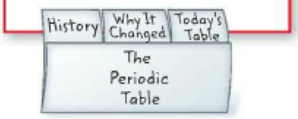
Changes to Mendeleev's Table

Mendeleev's periodic table enabled scientists to relate the properties of the known elements to their positions on the table. However, the table had a problem—some elements seemed out of place. Mendeleev believed that the atomic masses of certain elements must be invalid because the elements appeared in the wrong place on the periodic table. For example, Mendeleev placed tellurium before iodine despite the fact that tellurium has a greater atomic mass than iodine. He did so because iodine's properties more closely resemble those of fluorine and chlorine, just as copper's properties are closer to those of silver and gold, as shown in **Figure 3.**

Active Reading

FOLDABLES® LA.8.2.2.3

Use four sheets of paper to make a top-tab book. Use it to organize your notes about the development of the periodic table.



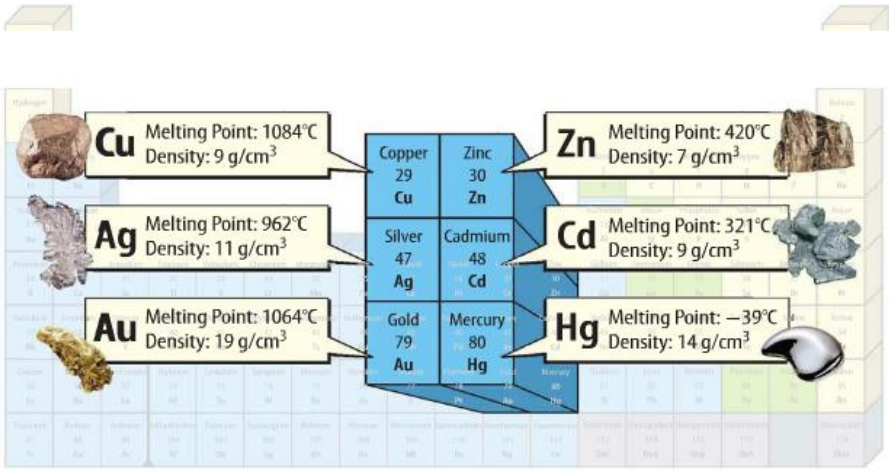


Figure 3 On today's periodic table, copper is in the same column as silver and gold. Zinc is in the same column as cadmium and mercury.

The Importance of Atomic Number

In the early 1900s, scientist Henry Moseley solved the problem with Mendeleev's table. Moseley found that if elements were listed according to increasing atomic number instead of listing atomic mass, columns would contain elements with similar properties. Recall that the atomic number of an element is the number of protons in the nucleus of each of that element's atoms.

Click below.

abc

Active Reading **3. Recall** Underline what determines where an element is located on the periodic table.

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SCIENCE USE V. COMMON USE

period

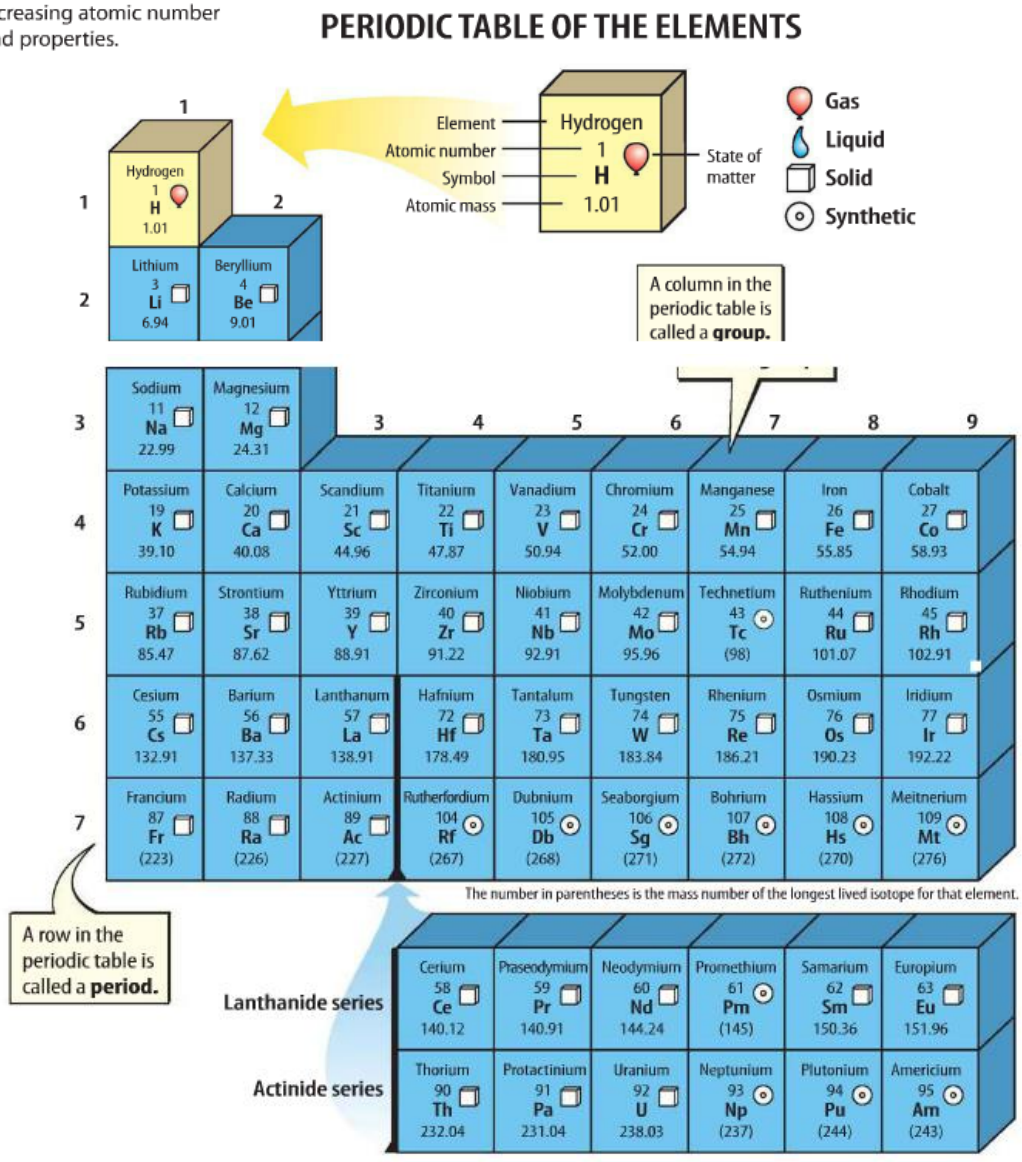
Science Use the completion of a cycle; a row on the periodic table

Common Use a point used to mark the end of a sentence; a time frame

Today's Periodic Table

You can identify many of the properties of an element from its placement on the **periodic** table. The table, as shown in **Figure 4,** 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 interpret the element's physical and chemical properties.

Figure 4 The periodic table is used to organize elements according to increasing atomic number and properties.



What is on an element key?

The element key shows an element's chemical symbol, atomic number, and atomic mass. The key also contains a symbol that shows the state of matter at room temperature. Look at the element key for helium in **Figure 5.** Helium is a gas at room temperature. Some versions of the periodic table give additional information, such as density, conductivity, or melting point.

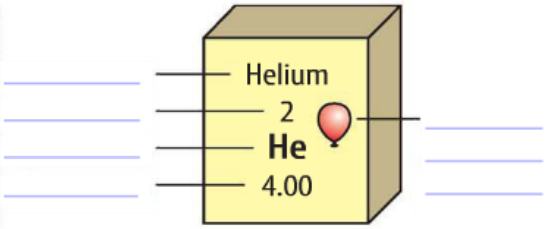


Figure 5 An element key shows important information about each element.

Active Reading **4. Label** What does this key tell you about helium?

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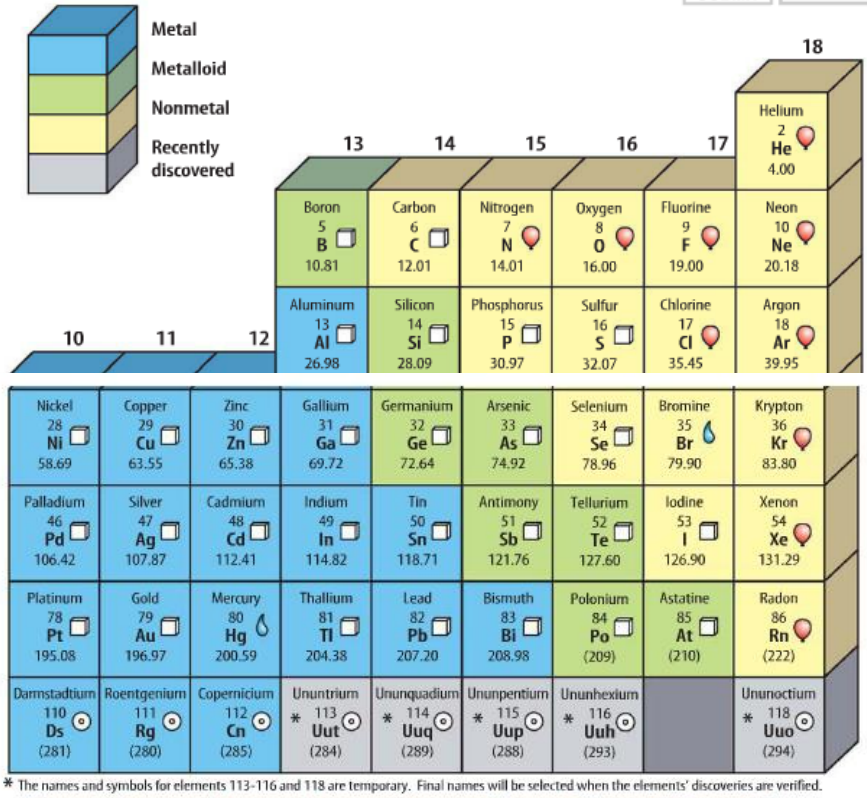

Math Skills MA.6.A.3.6

Use Geometry

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 determining the circumference is:

$C = \pi d$ or $C = 2\pi r$

For example, an iron (Fe) atom has a radius of 126 pm (picometers; 1 picometer = one-trillionth of a meter) The circumference of an iron atom is:

$C = 2 \times 3.14 \times 126\ pm$

$C = 791\ pm$

Groups

A **group** *is a column on the periodic table.* Elements in the same group have similar chemical properties and 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, as shown in **Figure 4.**

6. NGSSS Check **Classify** What can you infer about the properties of two elements in the same group? SC.8.P.8.6

Periods

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

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. Individual metals have some properties that differ, but all metals are shiny and conduct thermal energy and electricity.

5. Practice The radius of a uranium (U) atom is 156 pm. What is its circumference?

With the exception of hydrogen, nonmetals are located on the right side of the periodic table. The properties of nonmetals differ from the properties of metals. Many nonmetals are gases, and they do not conduct thermal energy or electricity.

Between the metals and the nonmetals on the periodic table are the metalloids. Metalloids have properties of both metals and nonmetals. **Figure 6** shows an example of a metal, a metalloid, and a nonmetal.

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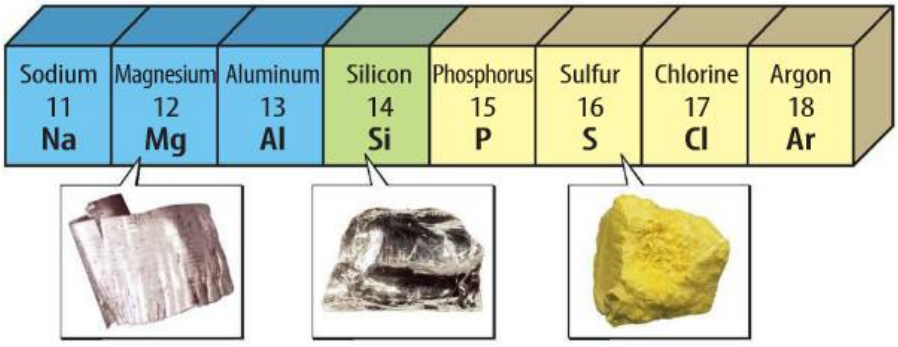
Figure 6 In period 3, magnesium is a metal, silicon is a metalloid, and sulfur is a nonmetal.



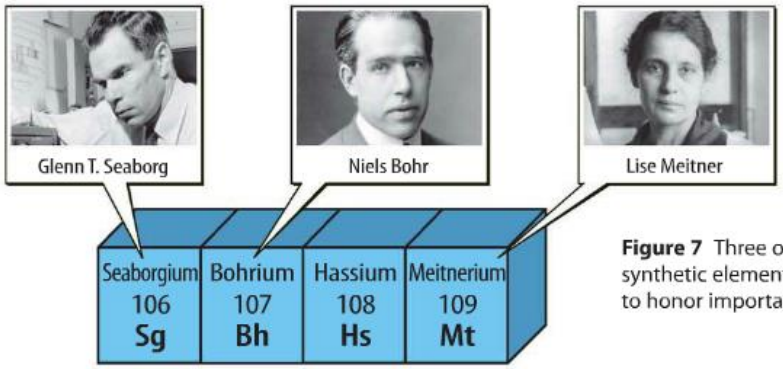


Figure 7 Three of these synthetic elements are named to honor important scientists.

How Scientists Use the Periodic Table

Even today, new elements are created in laboratories, named, and added to the present-day periodic table. Four of these elements are shown in **Figure 7.** These elements are all synthetic, or made by people, and do not occur naturally on Earth. Sometimes scientists can create only a few atoms of a new element. Yet scientists can use the periodic table to predict the properties of new elements they create. Look back at the periodic table in **Figure 4.** What group would you predict to contain element 117? You would probably expect element 117 to be in group 17 and to have similar properties to other elements in the group. Scientists hope to one day synthesize element 117.

The periodic table contains more than 100 elements. Each element has unique properties that differ from the properties of other elements. But each element also shares similar properties with nearby elements. 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. You can, too.

Active Reading

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

Inquiry

SC.8.N.1.1, SC.8.P.8.6

LAB STATION

Try It!

MiniLab ***How does atom size change across a period?*** at connectED.mcgraw-hill.com

Apply It!

After you complete the lab, answer these questions.

1. **Describe** the relationship between your observations of the atomic radii and the atomic number (the number of protons and neutrons) in period 2.

2. **Predict** the pattern of atomic radii of the elements in group 2.

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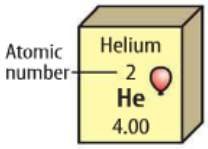
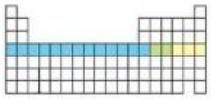
Lesson Review 1

Visual Summary



On the periodic table, elements are arranged according to increasing atomic number and similar properties.

A column of the periodic table is called a group. Elements in the same group have similar properties.



A row of the periodic table is called a period. Properties of elements repeat in the same pattern from left to right across each period.

Use Vocabulary

1 **Identify** the scientific term used for rows on the periodic table.

2 **Name** the scientific term used for columns on the periodic table.

Understand Key Concepts

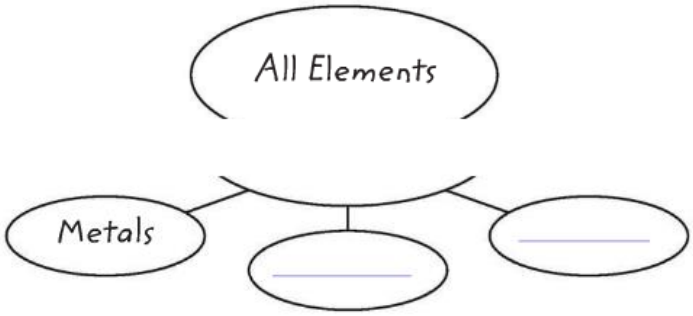
3 The _____ increases by one for each element as you move left to right across a period. SC.8.P.8.6

4 What does the decimal number in an element key represent?

(A) atomic mass (C) chemical symbol
(B) atomic number (D) state of matter

Interpret Graphics

5 **Identify** Fill in the graphic organizer below to identify the color-coded regions of the periodic table. LA.8.2.2.3



Critical Thinking

6 **Predict** Look at the perioidic table and predict three elements that have lower melting points than calcium (Ca). SC.8.P.8.6

Math Skills MA.6.A.3.6

7 Carbon (C) and silicon (Si) are in group 4 of the periodic table. The atomic radius of carbon is 77 pm and sulfur is 117 pm. What is the circumference of each atom?

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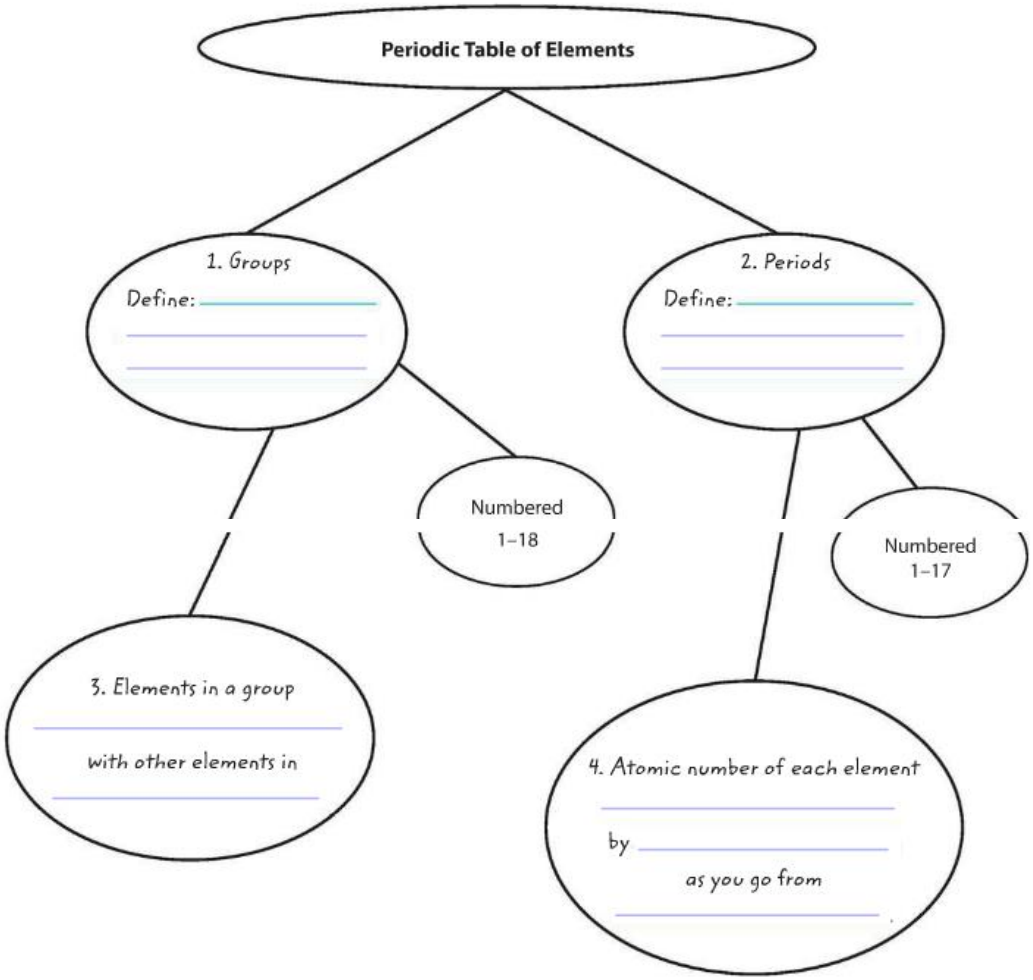
Organize Show how the periodic table is arranged by completing the concept map.



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