Modern Periodic Table

Jean Brainard, Ph.D.

AUTHOR
Jean Brainard, Ph.D.

To access a customizable version of this book, as well as other interactive content, visit www.ck12.org

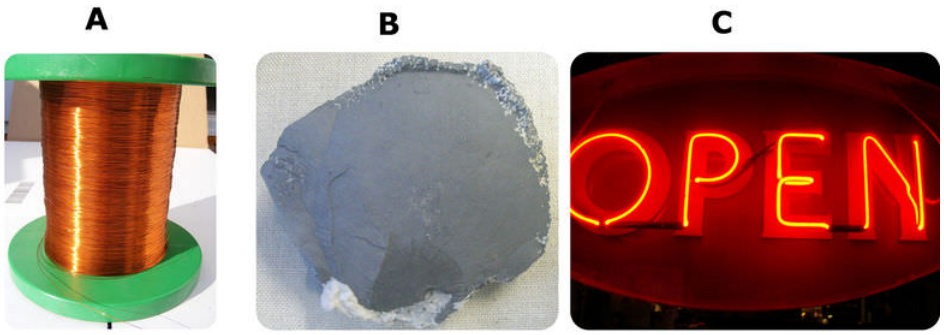
CK-12 Foundation is a non-profit organization with a mission to reduce the cost of textbook materials for the K-12 market both in the U.S. and worldwide. Using an open-source, collaborative, and web-based compilation model, CK-12 pioneers and promotes the creation and distribution of high-quality, adaptive online textbooks that can be mixed, modified and printed (i.e., the FlexBook® textbooks).

Printed: August 14, 2016

flexbook
next generation textbooks

CHAPTER 1 Modern Periodic Table

- Describe the modern periodic table of the elements.
- Demonstrate how to read the modern periodic table.
- Compare and contrast periods and groups of the modern periodic table.
- Identify classes of elements in the modern periodic table.



Look at substances A-C in the photos above. They look very different from one another, but they have something important in common. All three are elements, or pure substances. Can you identify which elements they are? For ideas, listen to the amazing elements song below. The singer rapidly names all of the known elements while pictures of the elements flash by. Even if the video doesn't help you name the elements pictured above, it will certainly impress you with the need to organize the large number of elements that have been discovered.

MEDIA

Click image to the left or use the URL below.

URL: https://www.ck12.org/flx/render/embeddedobject/194

The First Periodic Table

In the 1860s, a scientist named Dmitri Mendeleev also saw the need to organize the elements. He created a table in which he arranged all of the elements by increasing atomic mass from left to right across each row. When he placed eight elements in each row and then started again in the next row, each column of the table contained elements with similar properties. He called the columns of elements groups. Mendeleev's table is called a **periodic table** and the rows are called periods. That's because the table keeps repeating from row to row, and periodic means "repeating."

The Modern Periodic Table

A periodic table is still used today to organize the elements. You can see a simple version of the modern periodic table in the **Figure** 1.1. The modern table is based on Mendeleev's table, except the modern table arranges the elements by increasing atomic number instead of atomic mass. Atomic number is the number of protons in an atom, and this number is unique for each element. The modern table has more elements than Mendeleev's table because many elements have been discovered since Mendeleev's time.

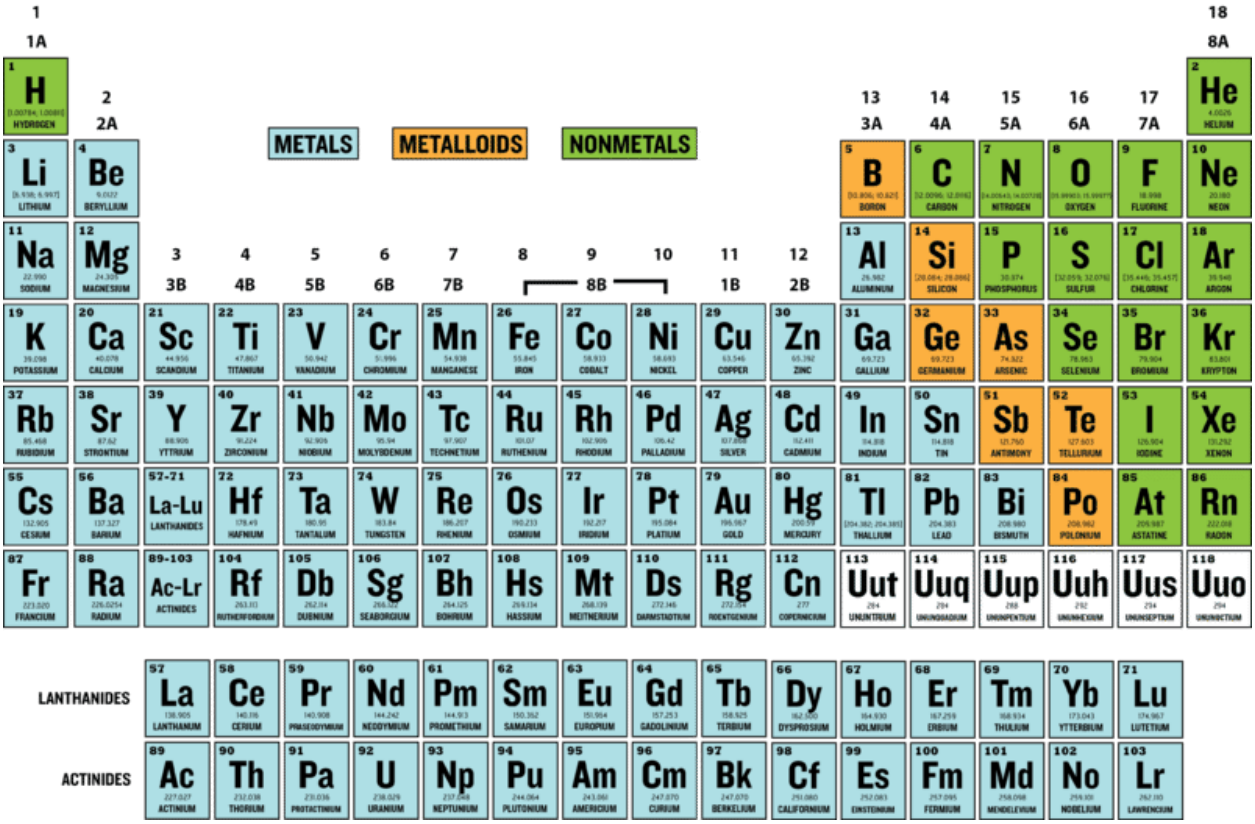


FIGURE 1.1

Reading the Table

In the **Figure** 1.1, each element is represented by its chemical symbol, which consists of one or two letters. The first letter of the symbol is always written in upper case, and the second letter—if there is one—is always written in lower case. For example, the symbol for copper is Cu. It stands for *cuprum*, which is the Latin word for copper. The number above each symbol in the table is its unique atomic number. Notice how the atomic numbers increase from left to right and from top to bottom in the table.

Q: Find the symbol for copper in the **Figure** 1.1. What is its atomic number? What does this number represent?

A: The atomic number of copper is 29. This number represents the number of protons in each atom of copper. (Copper is the element that makes up the coil of wire in photo A of the opening sequence of photos.)

Periods of the Modern Periodic Table

Rows of the modern periodic table are called **periods**, as they are in Mendeleev's table. From left to right across a period, each element has one more proton than the element before it. Some periods in the modern periodic table are longer than others. For example, period 1 contains only two elements: hydrogen (H) and helium (He). In contrast, periods 6 and 7 are so long that many of their elements are placed below the main part of the table. They are the elements starting with lanthanum (La) in period 6 and actinium (Ac) in period 7. Some elements in period 7 have not yet been named. They are represented by temporary three-letter symbols, such as Uub. The number of each period

represents the number of energy levels that have electrons in them for atoms of each element in that period.

Q: Find calcium (Ca) in the **Figure** 1.1. How many energy levels have electrons in them for atoms of calcium?

A: Calcium is in period 4, so its atoms have electrons in them for the first four energy levels.

Groups of the Modern Periodic Table

Columns of the modern table are called **groups**, as they are in Mendeleev's table. However, the modern table has many more groups—18 compared with just 8 in Mendeleev's table. Elements in the same group have similar properties. For example, all elements in group 18 are colorless, odorless gases, such as neon (Ne). (Neon is the element inside the light in opening photo C.) In contrast, all elements in group 1 are very reactive solids. They react explosively with water, as you can see in the video and **Figure** 1.2.

MEDIA

Click image to the left or use the URL below.

URL: https://www.ck12.org/flx/render/embeddedobject/79974

FIGURE 1.2

The alkali metal sodium (Na) reacting with water.

Classes of Elements

All elements can be classified in one of three classes: metals, metalloids, or nonmetals. Elements in each class share certain basic properties. For example, elements in the metals class can conduct electricity, whereas elements in the nonmetals class generally cannot. Elements in the metalloids class fall in between the metals and nonmetals in their properties. An example of a metalloid is arsenic (As). (Arsenic is the element in opening photo B.) In the periodic table above, elements are color coded to show their class. As you move from left to right across each period of the table, the elements change from metals to metalloids to nonmetals.

Q: To which class of elements does copper (Cu) belong: metal, metalloid, or nonmetal? Identify three other elements in this class.

A: In the **Figure** 1.1, the cell for copper is colored blue. This means that copper belongs to the metals class. Other elements in the metals class include iron (Fe), sodium (Na), and gold (Au). It is apparent from the table that the majority of elements are metals.

Summary

- The modern periodic table is used to organize all the known elements. Elements are arranged in the table by increasing atomic number.
- In the modern periodic table, each element is represented by its chemical symbol. The number above each symbol is its atomic number. Atomic numbers increase from left to right and from top to bottom in the table.
- Rows of the periodic table are called periods. From left to right across a period, each element has one more proton than the element before it.
- Columns of the periodic table are called groups. Elements in the same group have similar properties.
- All elements can be classified in one of three classes: metals, metalloids, or nonmetals. Elements in each class share certain basic properties. From left to right across each period of the periodic table, elements change from metals to metalloids to nonmetals.

Review

1. What is the modern periodic table?
2. Compare and contrast the periods and groups of the modern periodic table.
3. In the modern periodic table in **Figure** 1.1, find the element named lead (Pb). How many protons do atoms of lead have? To which class of elements does lead belong?
4. Which groups of the modern periodic table contain elements that are classified as metalloids?

References

1. Christopher Auyeung. Periodic Table . CC BY-NC 3.0
2. User:Ajhalls/Wikimedia Commons. Sodium reacting with water . Public Domain