



The Periodic Table

Student Objectives

- Describe the atomic structure of an element.
- Organize the first 18 elements of the periodic table according to their atomic mass, number of electron shells, and valence electrons, then compare their order within the periodic table.
- Identify common physical properties and uses of elements within a family.

Materials

- *Elements of Chemistry: The Periodic Table* video
- Computer with Internet access
- Periodic table
- Index cards

Procedures

1. Create a card for each of the first 18 elements of the periodic table. Include the following information at the top of each card, leaving at least half of the card empty so that students can fill in more information:
 - Atomic number
 - Element symbol
 - Atomic name
 - Atomic mass

Make enough copies of these cards so that small groups of students will each have one set. Also, make sure that all classroom periodic tables are put away or covered up.

2. Review the definition of an element and an atom. Next, review the basic structure of an atom, including the nucleus, protons, neutrons, and electrons. Choose one of the first 18 elements on the periodic table. Show the class how to draw a model for that element using the element's atomic number and atomic mass. Point out how many electron shells are in the model, as well as the number of valence electrons, or electrons in the outermost shell.
3. Divide the class into small groups. Give each group one set of element cards (one for each of the first 18 elements on the periodic table.) Based on the facts on the card, ask groups to fill in the bottom of each card with the following information:
 - Number of protons, electrons, and neutrons
 - A model of an atom of that element
 - Number of electron shells in the atom
 - Number of valence electrons
4. Next, ask each group to arrange their cards in order using the following rules:
 - Cards must be placed in the order of their atomic number.
 - All cards in the same column must have the same number of valence electrons.
 - All cards in the same row must have the same number of electron shells.
5. When groups have completed this task, reveal a periodic table to the class. Ask them to compare the order of their cards with the order of the periodic table.
6. Point out that the periodic table is arranged according to the same rules they used. The rows of the periodic table are called "periods," and the columns are called "groups." Since elements in the same group have the same number of valence electrons, they react in similar ways. This is why elements in the same group have similar properties.

7. Point out the elements that fall in the center of the periodic table. They are called "transitional elements." The groups and periods of these elements follow the same basic rules, but their electrons are configured differently. All of the elements in this block have the same number of valence electrons because electrons are added to interior shells instead of the valence shell.
8. Identify the following families on the periodic table, and assign one to each classroom group:
 - o Halogens
 - o Noble gases
 - o Alkali metals
 - o Alkaline Earth metals
 - o Transition metals
9. Have students work with a partner to determine the physical properties of one element in their assigned family: density, boiling point, melting point, and conductivity. In addition, ask them to name at least two common uses for that element.
10. Have partners share what they learned with their groups. Discuss and identify common physical properties of elements within their family. Were elements in that family used in similar ways?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students produced accurate cards for the first 18 elements of the periodic table, including all of the requested information; showed a clear understanding of atomic number, valence electrons, and electron shells by placing their cards in the correct order; worked well within their group to identify several common properties of elements within their assigned family.
- **2 points:** Students produced adequate cards for the first 18 elements of the periodic table, including most of the requested information; showed a satisfactory understanding of atomic number, valence electrons, and electron shells by placing most of their cards in the correct order; worked well within their group to identify some common properties of elements within their assigned family.
- **1 point:** Students produced inaccurate cards for the first 18 elements of the periodic table, including little of the requested information; showed an unsatisfactory understanding of atomic number, valence electrons, and electron shells and could not place their cards in the correct order; had difficulty working within their group and could identify few or none of the common properties of elements within their assigned family.

Vocabulary

alloy

Definition: A solid substance made by mixing a metal with another substance, usually another metal, to have specific properties that metals alone lack

Context: The earliest metalworkers combined different elemental metals in search of the best alloys for weapons and tools.

element

Definition: A substance composed of one type of atom and cannot be chemically separated

Context: Antoine Lavoisier was the first to define an element as a pure substance that cannot be broken down.

group

Definition: A column or group of columns in the periodic table; elements in one group have the same number of electrons in the outermost shell

Context: Elements in each group share similar chemical properties.

period

Definition: A row of the periodic table; each row corresponds to the number of electron shells in an atom of the elements in that row

Context: The elements in the second period each have two electron shells, and the elements in the sixth period have six electron shells.

periodic table of the elements

Definition: An organization of Earth's elements arranged according to atomic number, the number of protons each element's nucleus contains

Context: The structure of the periodic table corresponds directly to atomic structure. This makes the table an invaluable tool for determining the property and behavior of elements and predicting how they will interact.

semiconductor

Definition: An element that conducts electricity at higher temperatures, but stops electricity from flowing at lower temperatures

Context: The temperature of silicon transistors determines whether they conduct or block electrical currents.

valence electrons

Definition: The electrons contained in the outermost shell in an atom of an element; the electrons available for chemical bonding

Context: All the transition metals have the same number of valence electrons because electrons are added to interior shells instead of the valence shell.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K–12. To view the standards, visit this Web site: <http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following national standards:

- Physical Science: Structure and properties of matter

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following national standards:

- Science – Physical Sciences: Understands the structure and properties of matter; Understands the nature of scientific knowledge
- Technology: Understands the nature of technological design