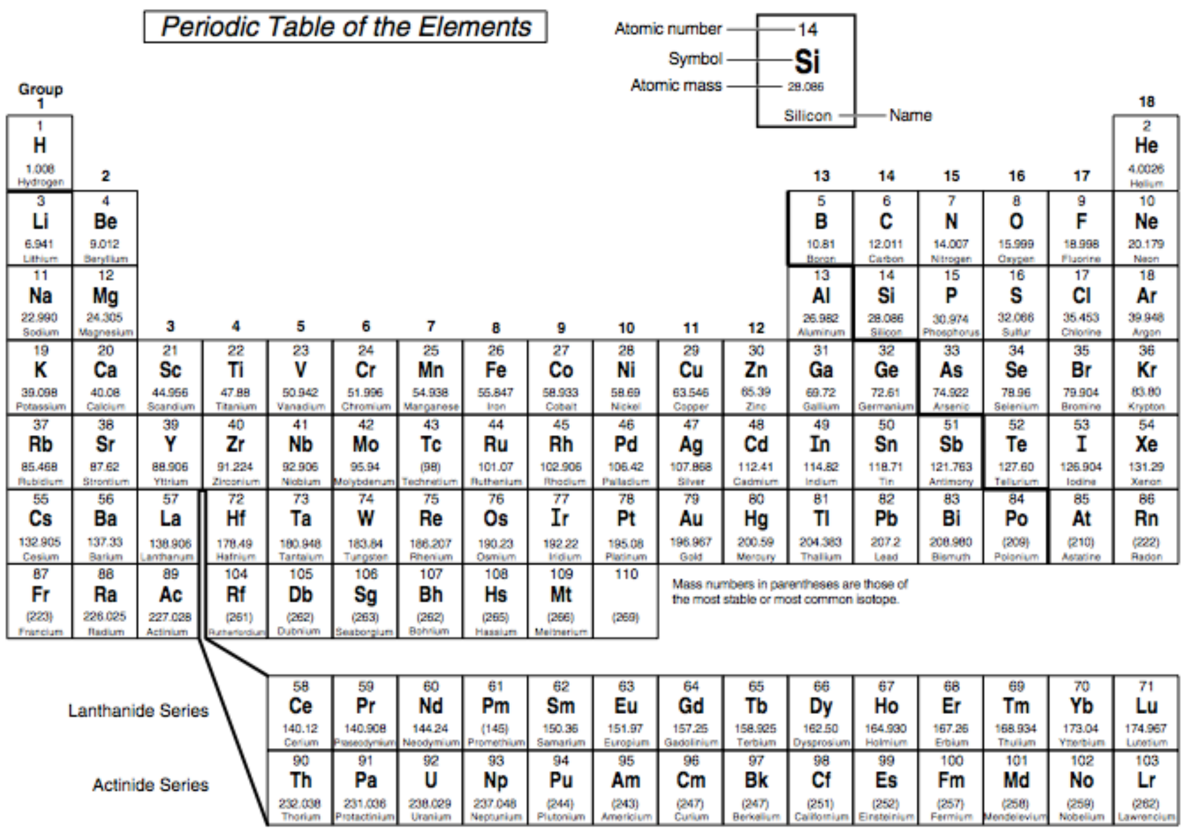
The Periodic Table

The **periodic law**, which is the basis for the modern periodic table, states that when elements are arranged in order of increasing atomic number, their physical and chemical properties show a periodic pattern. In this lesson, we will learn about these periodic patterns, or trends.

Basic Organization

The shape of the periodic table comes in part from the periodic law. Elements that have similar properties are aligned in vertical columns, called **groups** or **families**. The horizontal rows in the table are called **periods**. The periodic table has 7 periods and 18 groups.

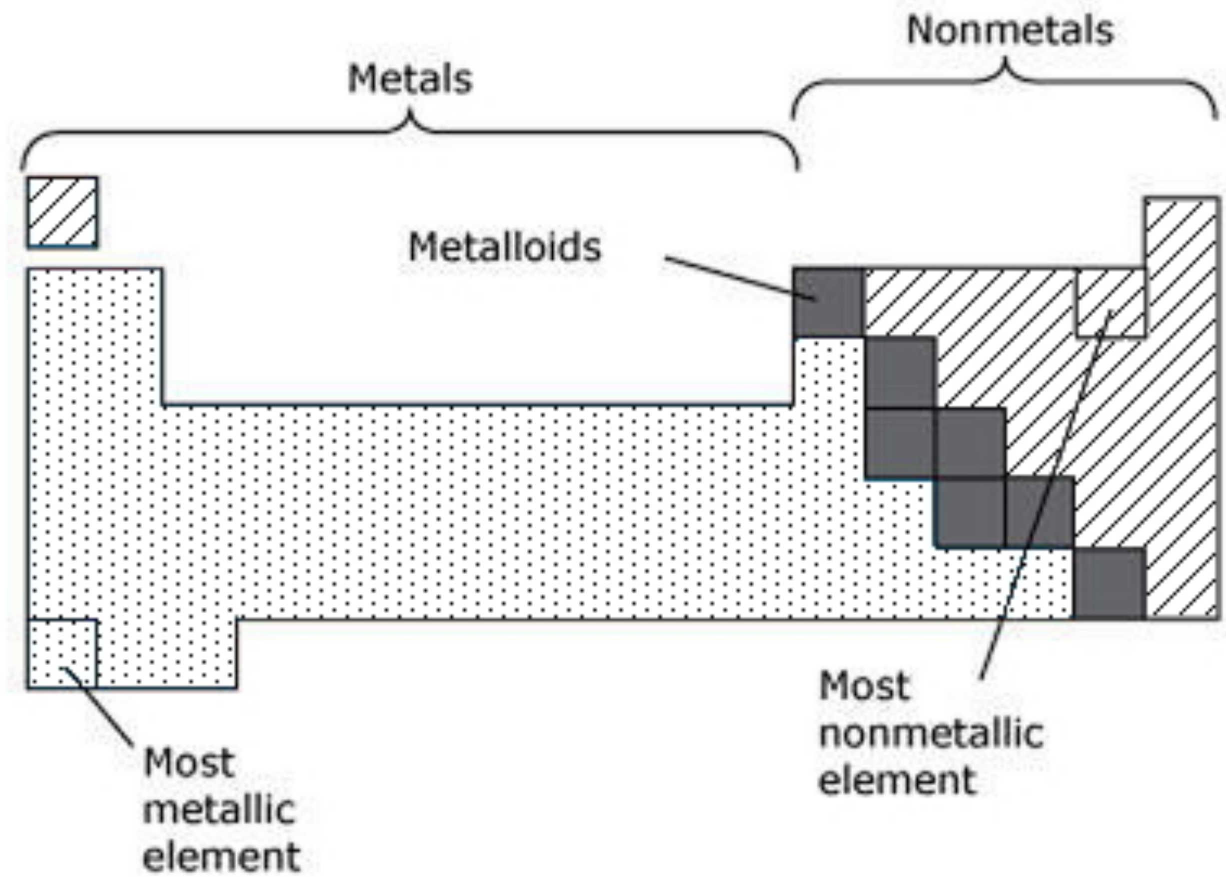


You have learned the names of several of the groups in previous science courses:

Group	Name
1	Alkali Metals
2	Alkaline Earth Metals
3 – 12	Transition Metals
16	Chalcogens
17	Halogens
18	Noble Gases

Metals, Nonmetals, and Semimetals

The squares on the periodic table below are shaded with 3 different patterns to indicate whether the element in each square is a metal, a nonmetal, or a semimetal.



Metals

- mostly solids at room temperature (mercury is a liquid)
- shiny, malleable, ductile
- good conductors of heat and electricity

Nonmetals

- many are gases at room temperature, some are solids, bromine is a liquid
- not shiny, may be hard solids or soft solids
- most are poor conductors of heat and electricity

Metalloids (semi-metals)

- have some properties of metals and some of nonmetals
- may have properties that are somewhere between a metal and a nonmetal

Electron Configuration

The electrons that occupy the highest principal energy level are the atom's outermost electrons. These electrons, which are largely responsible for an atom's chemical behavior are called **valence electrons**.

On the periodic table, elements that are in the same group have similar properties because they have valence electrons in similar configurations. For example, all of the elements in group 1 (alkali metals) have a single valence electron, and it resides in an *s* orbital.

To save space in writing electron configurations, chemists often use something called **noble gas notation**. In noble gas notation, an atom's inner electrons are represented by the symbol for the nearest noble gas with a lower atomic number. For example, the noble gas notation for lithium is

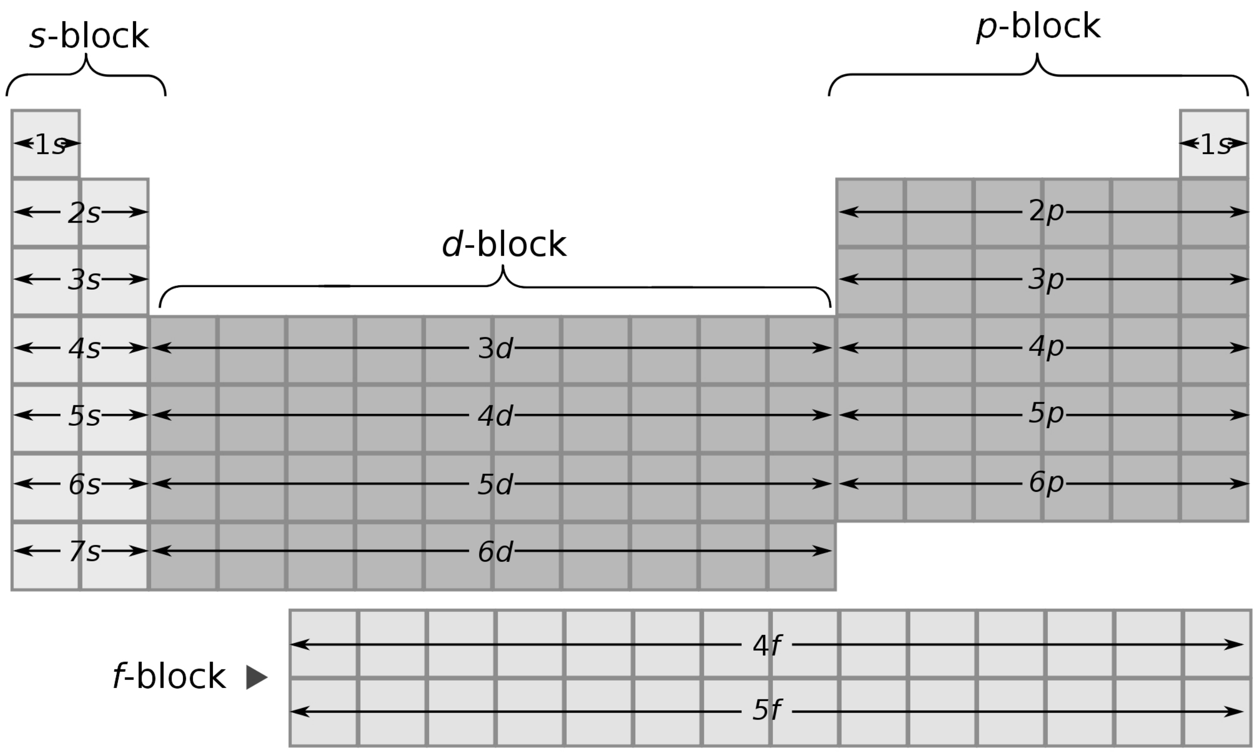
$$[He]2s^1$$

The symbol $[He]$ represents helium's electron configuration ($1s^2$).

Example
Write the electron configurations of the first four alkali metals in both sublevel and noble gas notation.

Orbital Blocks

The key to understanding the shape of the periodic table is to examine the elements' electron configurations. The simplest way to look at these electron configurations is to divide the periodic table into four sections, or blocks, as shown below.



The ***s*-block** is composed of all the elements in groups 1 and 2 (alkali metals and alkaline earth metals), plus hydrogen and helium. Elements in this block have valence electrons that are only in *s* orbitals. The *s*-block contains only two groups because an *s* orbital can hold a maximum of 2 electrons.

The ***p*-block** is composed of all the elements in groups 13 to 18, except helium. Remember that the first principal energy level has no p sublevel, which is why the first period of the table has no *p*-block elements. The first *p* orbital is the 2*p* orbital. The *p*-block is 6 elements wide because *p* orbitals can hold up to 6 electrons.

The ***d*-block** is composed of all the elements in groups 3 to 12, except the lanthanides and actinides. The first *d* orbital is the 3*d* orbital. A *d* orbital can hold up to 10 electrons, which is why the *d*-block is 10 elements wide.

The ***f*-block** elements are the 28 elements that are placed below the main body of the periodic table (atomic numbers 58 to 71 and 90 to 103). The *f*-block is 14 elements wide because an *f* sublevel can hold up to 14 electrons. It is important to note, however, that electrons do not fill *f* orbitals in a regular sequence. For this reason, we will not be writing any configurations for elements in this block.

Worksheet

1. Why do elements in a group have similar properties?

2. Sketch the general shape of the periodic table and label the *s*-, *p*-, *d*-, and *f*-blocks.

3. Describe the general differences between the elements on the right side of the periodic table and those on the left.

4. Write the electron configuration of each of the following elements in noble gas notation.

    a) magnesium
    b) iron
    c) phosphorous
    d) fluorine
    e) argon

5. Complete the attached worksheet (5-2 Review and Reinforcement).