To ensure that you understand the material in this chapter, you should review the meanings of the following bold terms and ask yourself how they relate to the topics in the chapter.

An element is a substance that cannot be broken down into simpler chemical substances. Only about 90 naturally occurring elements are known. They have varying abundances on Earth and in the body. Each element has a one- or two-letter chemical symbol.

The modern atomic theory states that the smallest piece of an element is an atom. Individual atoms are extremely small, on the order of $10^{-10}$ m across. Most elements exist in pure form as individual atoms, but some exist as diatomic molecules. Atoms themselves are composed of subatomic particles. The electron is a tiny subatomic particle with a negative charge. The proton has a positive charge and, while small, is much larger than the electron. The neutron is also much larger than an electron but has no electrical charge.

Protons, neutrons, and electrons have a specific arrangement in an atom. The protons and neutrons are found in the center of the atom, grouped together into a nucleus. The electrons are found in fuzzy clouds around the nucleus.

Each element has a characteristic number of protons in its nucleus. This number of protons is the atomic number of the element. An element may have different numbers of neutrons in the nuclei of its atoms; such atoms are referred to as isotopes. Two isotopes of hydrogen are deuterium, with a proton and a neutron in its nucleus, and tritium, with a proton and two neutrons in its nucleus. The sum of the numbers of protons and neutrons in a nucleus is called the mass number and is used to distinguish isotopes from each other.

Masses of individual atoms are measured in atomic mass units. An atomic mass unit is equal to 1/12th of the mass of a single carbon-12 atom. Because different isotopes of an element have different masses, the atomic mass of an element is a weighted average of the masses of all the element’s naturally occurring isotopes.

The modern theory of electron behavior is called quantum mechanics. According to this theory, electrons in atoms can only have specific, or quantized, energies. Electrons are grouped into general regions called shells, and within these into more specific regions called subshells. There are four types of subshells, and each type can hold up to a maximum number of electrons. The distribution of electrons into shells and subshells is the electron configuration of an atom. Chemistry typically occurs because of interactions between the electrons of the outermost shell of different atoms, called the valence shell electrons. Electrons in inner shells are called core electrons.

Elements are grouped together by similar chemical properties into a chart called the periodic table. Vertical columns of elements are called groups or families. Some of the groups of elements have names, like the alkali metals, the alkaline earth metals, the halogens, and the noble gases. A horizontal row of elements is called a period. Periods and groups have differing numbers of elements in them. The periodic table separates elements into metals, nonmetals, and semimetals. The periodic table is also separated into main group elements, transition metals, lanthanide elements, and actinide elements. The lanthanide and actinide elements are also referred to as inner transition metal elements. The shape of the periodic table reflects the sequential filling of shells and subshells in atoms.

The periodic table helps us understand trends in some of the properties of atoms. One such property is the atomic radius of atoms. From top to bottom of the periodic table, atoms get bigger because electrons are occupying larger and bigger shells. From left to right across the periodic table, electrons are filling the same shell but are being attracted by an
increasing positive charge from the nucleus, and thus the atoms get smaller.