The Size of the Atom

Atoms are extremely small, about 0.0000000001 meters in diameter. This means that you could fit millions of atoms in the period at the end of this sentence. It would take you about 500 years to count the number of atoms in a grain of salt.

Electrons are much less massive than protons or neutrons—about 2000 times less massive. This means almost all of an atom’s mass is in the nucleus. The electron cloud, however, is much larger than the nucleus. It is about 10,000 times the diameter of the nucleus. The diagram on page 201, picturing the basic structure of the atom, is not drawn to scale. If the nucleus were as large as shown, the electron cloud would extend far beyond your classroom.

The negative electrons stick around the nucleus because they are attracted to the positively charged protons. Electrical charges that are alike (such as two negative charges) repel each other. Negative electrons, therefore, remain spread out in the electron cloud. Neutral atoms have an equal number of protons and electrons.

Atomic Numbers

If all atoms are composed of the same particles, how can there be more than 100 different elements? The identity of an atom is determined by the number of protons in its nucleus, called the atomic number. Every hydrogen atom—atomic number 1—has exactly one proton in its nucleus. Every gold atom has 79 protons; the atomic number of gold is 79.

Atomic Mass Numbers

The total number of protons and neutrons in an atom’s nucleus is called its atomic mass number. The atoms of a certain element always have the same number of protons. They may not, however, always have the same number of neutrons. Not all atoms of an element, therefore, have the same atomic mass number.

All chlorine atoms, for instance, have 17 protons. However, some chlorine atoms have 18 neutrons, while other chlorine atoms have 20 neutrons. Atoms of chlorine with 18 and 20 neutrons are called chlorine isotopes. Isotopes are atoms of the same element that have a different number of neutrons. Some elements have many naturally occurring isotopes, while other elements have just a few.