

1.4: Early Ideas about the Building Blocks of Matter

The first people to propose that matter was composed of small, indestructible particles were Leucippus (fifth century B.C.E., exact dates unknown) and his student Democritus (460–370 B.C.E.). These Greek philosophers theorized that matter was ultimately composed of small, indivisible particles they named *atomos*. Democritus wrote, “The first principles of the universe are atoms and empty space: everything else is merely thought to exist.” Leucippus and Democritus proposed that many different kinds of atoms existed, each different in shape and size, and that they moved randomly through empty space. As we discussed in [Section 1.3](#), other influential Greek thinkers of the time, such as Plato and Aristotle, did not embrace the atomic ideas of Leucippus and Democritus. Instead, they held that matter had no smallest parts (that it was continuous) and that different substances were composed of various proportions of fire, air, earth, and water. Since there was no experimental way to test the relative merits of the competing ideas, Aristotle’s view prevailed, largely because he was so influential. The idea that matter was composed of atoms took a back seat for nearly 2000 years.

In the sixteenth century, modern science began to emerge. A greater emphasis on observation led Nicolaus Copernicus (1473–1543) to publish *On the Revolution of the Heavenly Orbs* in 1543. The publication of that book—which proposed that the sun, not Earth, was at the center of the universe—marks the beginning of what we now call the *scientific revolution*. The next 200 years—and the work of scientists such as Francis Bacon (1561–1626), Johannes Kepler (1571–1630), Galileo Galilei (1564–1642), Robert Boyle (1627–1691), and Isaac Newton (1642–1727)—brought rapid advancement as the scientific approach became the established way to learn about the physical world. By the early 1800s, certain observations led the English chemist John Dalton (introduced in [Section 1.3](#)) to offer convincing evidence that supported the early atomic ideas of Leucippus and Democritus and to propose his atomic theory.