

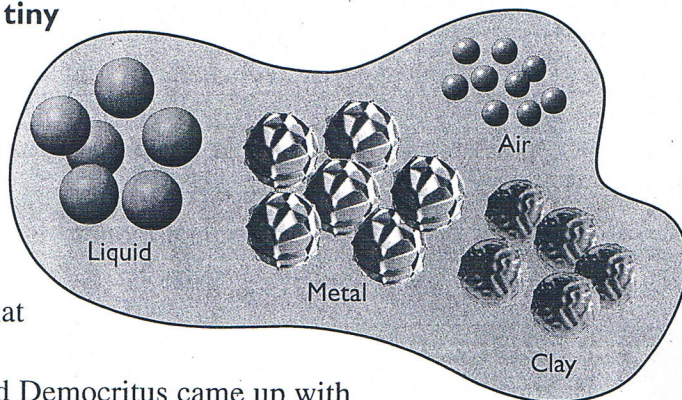
Building Blocks

Democritus's Tiny Particles

The idea that matter is made up of tiny particles is far from new.

When you hear someone talk about “atomic science,” you may think of cutting-edge research. But the study of atoms goes back a long way. In fact, the word *atom* was first used almost 2,500 years ago. It comes from a Greek word that means “not divisible.”

Around 440 B.C., a Greek scholar named Democritus came up with the idea that all matter is made up of tiny particles he called atoms. He imagined atoms as tiny, hard spheres that could not be broken apart. His was the first model of the atom. Our understanding of these small bits of matter has changed since then, but Democritus was right about some things.



▲ Democritus's atoms

Before You Read

TOO SMALL TO STUDY One way that scientists study things that are too small to be seen or too large to fit into a laboratory is to use models. For example, a map can show the whole world on a tabletop. An architect might make a model of a building she wants to construct. In Lesson 37 you made your own model of atoms and elements.

► *What other models can you think of that might be used to help people study something that cannot be seen easily?*

Read

Democritus believed that the physical properties of atoms could explain the behavior of different materials.

An Early Model

As we do today, Democritus imagined that there were many different kinds of atoms. Some, he said, are very light and free to **dart** about this way and that, and they can move far apart from each other. The air and other gases are made of such atoms, Democritus said.

But water had different kinds of atoms, thought Democritus, and they were arranged differently. He pictured the atoms of water and other liquids as larger and heavier than atoms of gases, because the atoms of liquids tend to stick together. And since anyone could see that liquids flow, their atoms must be **slick** and smooth. If they were not, they would not slip and slide over and around each other.

Atoms that make up copper, iron, rocks, and other heavy solid objects must be even larger and heavier than atoms of liquids, Democritus thought. And since it is hard to break apart such solid objects, their atoms must have very rough and jagged surfaces that cause the atoms to lock together tightly.

dart: move quickly

slick: slippery

From: Gallant, Roy. *Explorers of the Atom*. Doubleday.

NOTEZONE

Underline words or phrases that tell how Democritus imagined the physical properties of atoms.

FIND OUT MORE

SCIENCE SAURUS

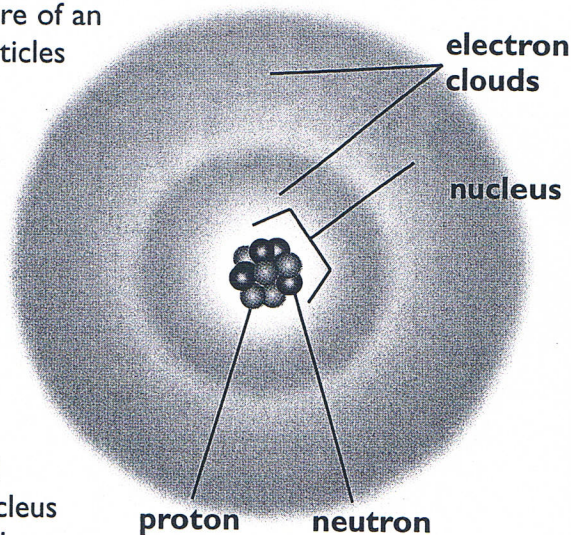
The Evolution of Atomic Theory 258
Elements, Molecules, and Compounds 259

SCILINKS

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Code: CSPD17

A MODERN MODEL Democritus's idea that matter is made up of atoms is still accepted. But today, we know atoms are made of even smaller particles. These particles are protons, neutrons, and electrons. What makes one atom different from another isn't the texture of an atom's surface, it's the number of particles in the atom.

If you look at the drawing of an atom shown here, you will see that the particles we call protons and neutrons are in the center of the atom. This is the nucleus of the atom. Almost all of an atom's mass is contained in the nucleus. The number of protons and neutrons is about equal in most atoms. The particles we call electrons zip around through empty space, orbiting the nucleus in electron clouds. Most of the time the number of electrons is also equal to the number of protons.



In the modern model, it is the electrons in an atom's outermost electron cloud that interact with other atoms.

► *In what ways does the modern model agree with Democritus's ideas about the surface of the atom? In what ways is it different?*

It wasn't until many centuries after Democritus lived that scientists first started conducting experiments with atoms in the laboratory. In one such experiment, protons were fired at a very, very thin sheet of gold foil. Most of the protons went straight through the foil and out the other side. But a few bounced back.

► *Use the model of the atom above to try to explain the results of this experiment.*

▶ Propose Explanations

COMPARING METHODS Back in Democritus's time, scientists did not perform experiments and collect data. Instead, they simply thought about questions—debating and arguing their opinions with one another. Today, scientists rely on scientific evidence for answers to their questions.

- ▶ *Look back at the reading. What did Democritus base his ideas about atoms on?*

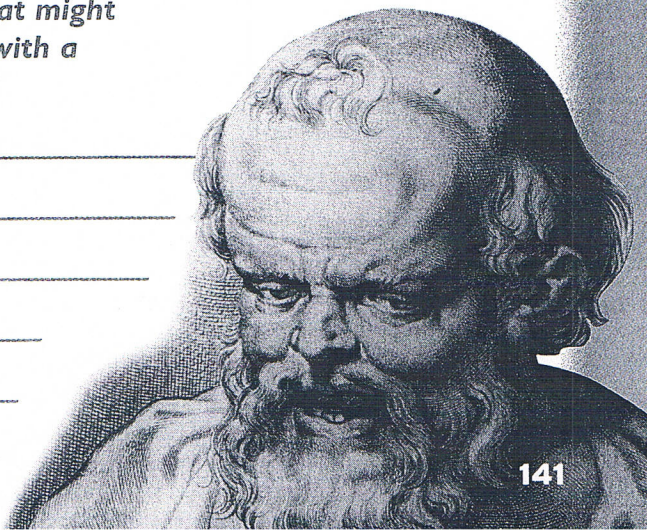
Democritus made an assumption about materials and the atoms that make them up that turned out to be incorrect.

- ▶ *What was the assumption?*

Think about the gold foil experiment described on page 140.

- ▶ *How are the methods used by scientists today better than those used by philosophers in Democritus's time?*

- ▶ *What do modern scientists have that might have helped Democritus come up with a more accurate model of the atom?*



Democritus ▶