# Properties of Carbon

## Key Concepts

- Why does carbon play a central role in the chemistry of living organisms?
- What are four forms of pure carbon?

Carbon has four valence electrons—the electrons available for forming chemical bonds. A chemical bond is the force that holds two atoms together. A covalent chemical bond between two atoms is made up of the atoms' valence electrons. **Because of its unique ability to combine in many ways with itself and other elements, carbon has a central role in the chemistry of living organisms**. It is possible to form substances that consist of molecules made of many carbon atoms. Carbon atoms in such molecules can be arranged in different ways. Carbon atoms can form straight chains, branched chains, and rings.

Because of the ways in which carbon atoms form bonds, carbon can exist in different forms as a pure element. **Diamond, graphite, fullerenes, and nanotubes are four forms of the element carbon.**

The hardest mineral—**diamond**—forms deep within Earth under very high pressure and temperature. Solid diamond crystals are extremely hard and unreactive because each carbon atom in diamond is strongly bonded to four other carbon atoms. Diamonds are used in industry as cutting tools and also in jewelry as gems.

The "lead" in a lead pencil is mostly **graphite,** another form of the element carbon. In graphite, carbon atoms are bonded tightly together in flat layers. However, the bonds between atoms in different layers are very weak, so the layers slide easily past one another. Because it is so slippery, graphite makes an excellent lubricant in machines.

In 1985, a new form of the element carbon was made. The new form consists of carbon atoms arranged in the shape of a hollow sphere. This form is called a **fullerene.** In 1991, another form of carbon was made—the nanotube. In a **nanotube,** carbon atoms are arranged in the shape of a long, hollow tube. Nanotubes are tiny, light, flexible, and very strong. They are also good conductors of heat and electricity.

Chemists are looking for ways to use fullerenes and nanotubes. Because fullerenes enclose a ball-shaped open area, they may be able to carry substances, such as medicines, inside them. Nanotubes may also be used as conductors in electrical devices.