APPLICATION *Biology*

Plants and Nitrogen

All organisms, including plants, require certain elements to survive and grow. These elements include carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, and several other elements needed in small amounts. An organism needs nitrogen to synthesize structural proteins, enzymes, and the nucleic acids DNA and RNA.

Carbon, hydrogen, and oxygen are available to plants from carbon dioxide in the air and from water in both the air and the soil. Nitrogen is necessary for plants' survival. Although nitrogen gas, N_2, makes up 78% of air, most plants cannot take nitrogen out of the air and incorporate it into their cells, because the strong triple covalent bond in N_2 is not easily broken. Plants need nitrogen in the form of a compound that they can take in and use. The process of using atmospheric N_2 to make NH_3 is called *nitrogen fixation*. Several kinds of nitrogen-fixing bacteria live in the soil and in the root nodules of plants called legumes. Legumes obtain the nitrogen they need through a symbiotic relationship with nitrogen-fixing bacteria. Legumes include peas, beans, clover, alfalfa, and locust trees. The bacteria convert nitrogen into ammonia, NH_3, which is then absorbed by the host plants.

Because wheat, rice, corn, and potatoes cannot perform the same feat as legumes, these plants depend on nitrogen-fixing bacteria in the soil. Soil bacteria convert NH_3 into nitrate ions, NO_3^-, the form of nitrogen that can be absorbed and used by plants. These plants also often need nitrogen fertilizers to supplement the work of the bacteria. Besides supplying nitrogen, fertilizers are manufactured to contain phosphorus, potassium, and trace minerals.

Nitrogen-fixing bacteria,* Rhizobium, *live in these small nodules that grow on the roots of soybeans.

Soybeans are legumes that live in a symbiotic relationship with nitrogen-fixing bacteria.