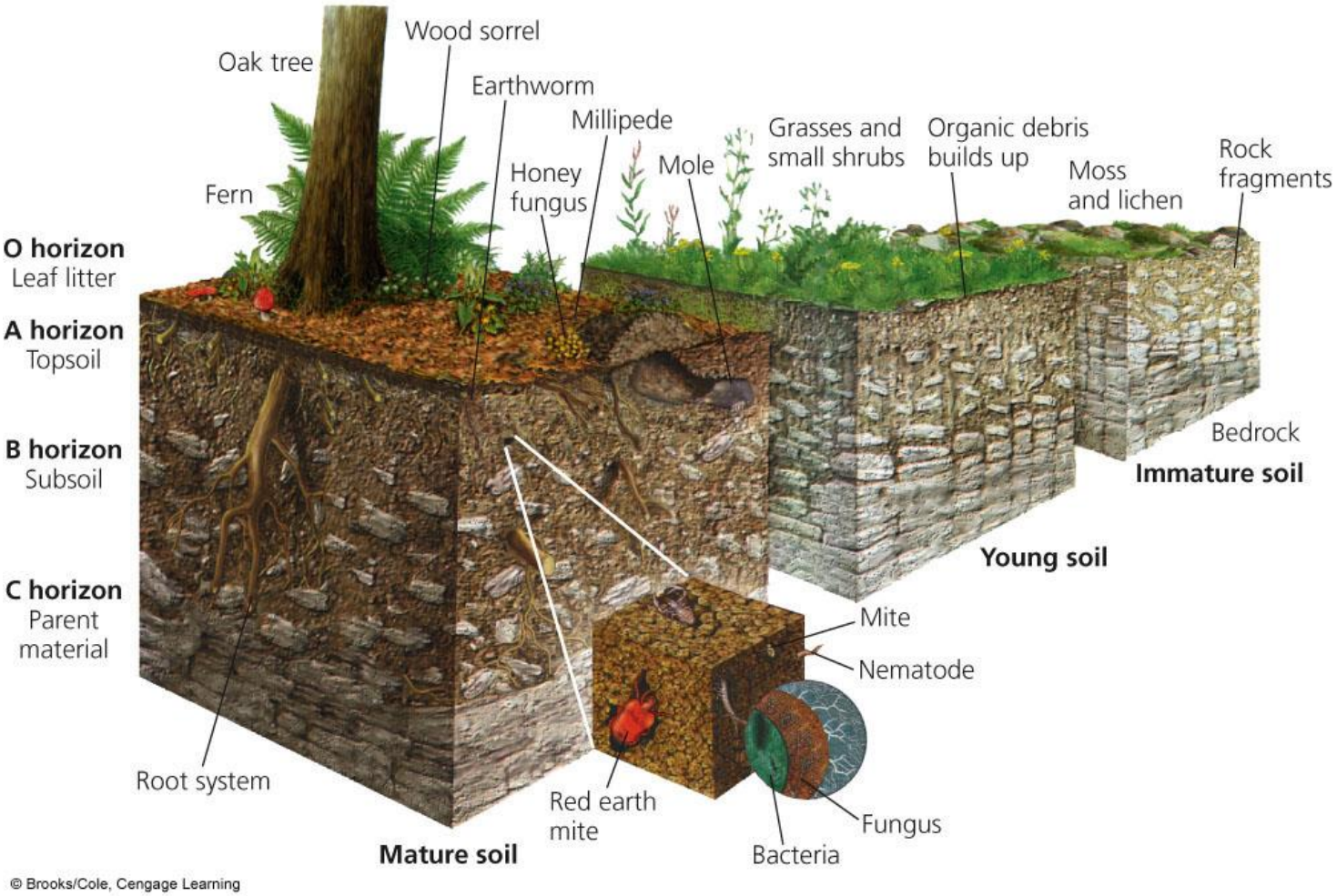


Figure 12-A p.281

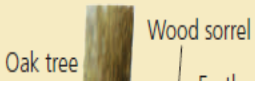
CENGAGENOW™ **Active Figure 12-A** Soil formation and generalized soil profile. Horizons, or layers, vary in number, composition, and thickness, depending on the type of soil. *See an animation based on this figure at* CengageNOW™. **Questions:** What role do you think the tree in this figure plays in soil formation? How might the picture change if the tree were removed? (Used by permission of Macmillan Publishing Company from Derek Elsom, *Earth,* New York: Macmillan, 1992. Copyright © 1992 by Marshall Editions Developments Limited)

Soil Is the Base of Life on Land

Soil is a complex mixture of eroded rock, mineral nutrients, decaying organic matter, water, air, and billions of living organisms, most of them microscopic decomposers. Soil formation begins when bedrock is slowly broken down into fragments and particles by physical, chemical, and biological processes called *weathering.* Figure 12-A shows a profile of different-aged soils.

Soil, the base of life on land, is a key component of the earth's natural capital. It supplies most of the nutrients needed for plant growth (Figure 1-4, p. 9), purifies and stores water, and helps to control the earth's climate by removing carbon dioxide from the atmosphere and storing it as carbon compounds.

Most mature soils—soils that have developed over a long period of time—contain at least three horizontal layers, or *horizons,* (Figure 12-A), each with a distinct texture and composition that varies with different types of soils. Think of them as floors in the geological building of life underneath your feet.



The roots of most plants and the majority of a soil's organic matter are concentrated in a soil's two upper layers, the O horizon of leaf litter and the A horizon of topsoil. In most mature soils, these two layers teem with bacteria, fungi, earthworms, and small insects all interacting in complex ways. Bacteria and other decomposer microorganisms found by the billions in every handful of topsoil break down some of its complex organic compounds into a porous mixture of the partially decomposed bodies of dead plants and animals, called *humus.* Top soil also usually includes inorganic materials such as clay, silt, and sand. Soil moisture carrying these dissolved nutrients is drawn up by the roots of plants and transported through stems and into leaves as part of the earth's chemical cycling processes.

The *B horizon* (*subsoil*) and the *C horizon* (*parent material*) contain most of a soil's inorganic matter, mostly broken-down rock consisting of varying mixtures of sand, silt, clay, and gravel. Much of it is transported by water from the A horizon (Figure 12-A). The C horizon lies on a base of parent material, which is often *bedrock.*

The spaces, or *pores,* between the solid organic and inorganic particles in the upper and lower soil layers contain varying amounts of air (mostly nitrogen and oxygen gas) and water. Plant roots use the oxygen for cellular respiration. As long as the O and A horizons are anchored by vegetation, the soil layers as a whole act as a sponge, storing water and releasing it in a nourishing trickle.

Although topsoil is a renewable resource, it is renewed very slowly, which means it can be depleted. Just 1 centimeter (0.4 inch) of topsoil can take hundreds of years to form, but it can be washed or blown away in a matter of weeks or months when we plow grassland or clear a forest and leave its topsoil unprotected.

Since the beginning of agriculture, human activities have accelerated natural soil erosion. We discuss erosion and ways to prevent or control it later in this chapter.

Critical Thinking

How does soil contribute to each of the four components of biodiversity described in Figure 4-2, p. 79?