

Section 3

From Bedrock to Soil

Key Concept Weathering may lead to the formation of soil, which is an important natural resource.

What You Will Learn

- Soil is a mixture of weathered rock, organic material, water, and air.
- Soil composition, texture, fertility, and pH affect plant growth.
- Climate affects the types of soil that are found in different places.

Why It Matters

Soil is necessary for almost all plant life on land.

Most plants need soil to grow. But what exactly is soil? Many people think that soil is just dirt. To a scientist, **soil** is a loose mixture of small mineral fragments, organic material, water, and air that can support the growth of vegetation.

The Source of Soil

Because soils are made from weathered rock fragments, not all soils are the same. The kind of soil that forms depends on the source of the soil. The rock that breaks down into mineral fragments that form a soil is called **parent rock**. Different parent rocks have different chemical compositions. As a result, soils also differ in composition.

Bedrock is the layer of rock beneath soil. In some cases, the bedrock is the parent rock. In these cases, the soil remains above the bedrock that weathered to form the soil. Soil that remains above its parent rock is called *residual soil*. Few soils are residual soils.

Soil can be carried away from its parent rock by wind, water, ice, or gravity. This soil is called *transported soil*. **Figure 1** shows that water is one agent that moves soil from one place to another.



Figure 1 Rivers, such as the one shown here, may move transported soil long distances from its parent rock.

Soil Properties

Some soils are great for growing plants. Other soils can't support the growth of plants. To better understand soil, you must know about its properties. These properties include soil composition, soil texture, and soil fertility.

Soil Composition

You have learned that soil is made up of mineral fragments, organic material, water, and air. Soil composition describes the kinds and relative amounts of materials that the soil contains. Some soils contain more water or air than other soils do. Moist soil is generally darker than dry soil. Black soil is often rich in organic material. Black soil supports more plant life than a soil that has less organic matter does. The kinds and sizes of mineral particles in soil depend on the parent rock from which the soil formed.

Standards Check How does the amount of organic material in soil affect how well soil will support plant growth?



Soil Texture

Soil is made of particles of different sizes. These particles can be as large as 2 mm in diameter, as in the case of sand. Other particles can be too small to see without a microscope. *Soil texture* describes the relative amounts of soil particles of different sizes. **Figure 2** shows the soil texture for one kind of soil.

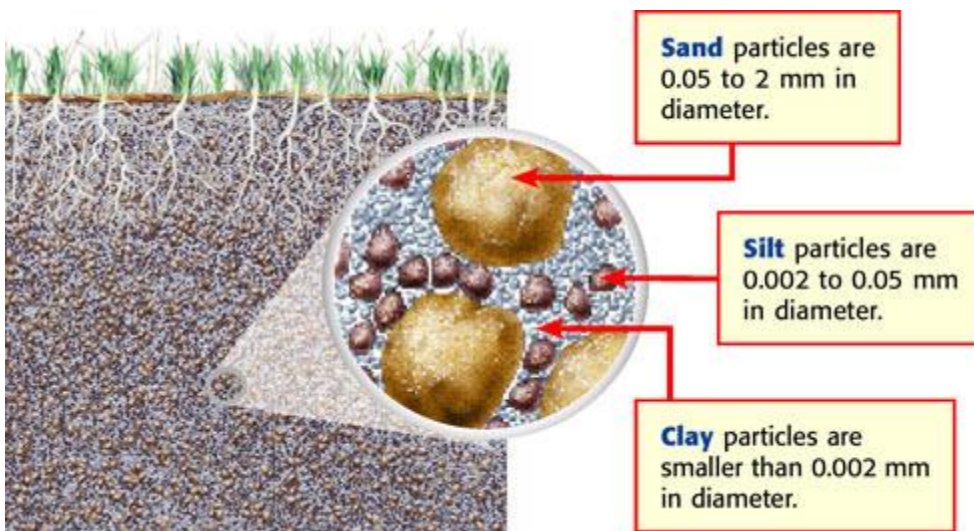


Figure 2 The proportion of different-sized particles in soil determines the texture of the soil. Sand makes up about 40% of the soil illustrated here. Silt and clay each make up about 30% of the soil. All soil particles are less than 2 mm in diameter.

Soil texture affects the consistency of soil. Consistency describes a soil's ability to be broken up for farming. For example, soil that contains a lot of clay can be hard, which makes breaking up the soil difficult. Soil texture also influences *infiltration*, or the ability of water to move into the soil.



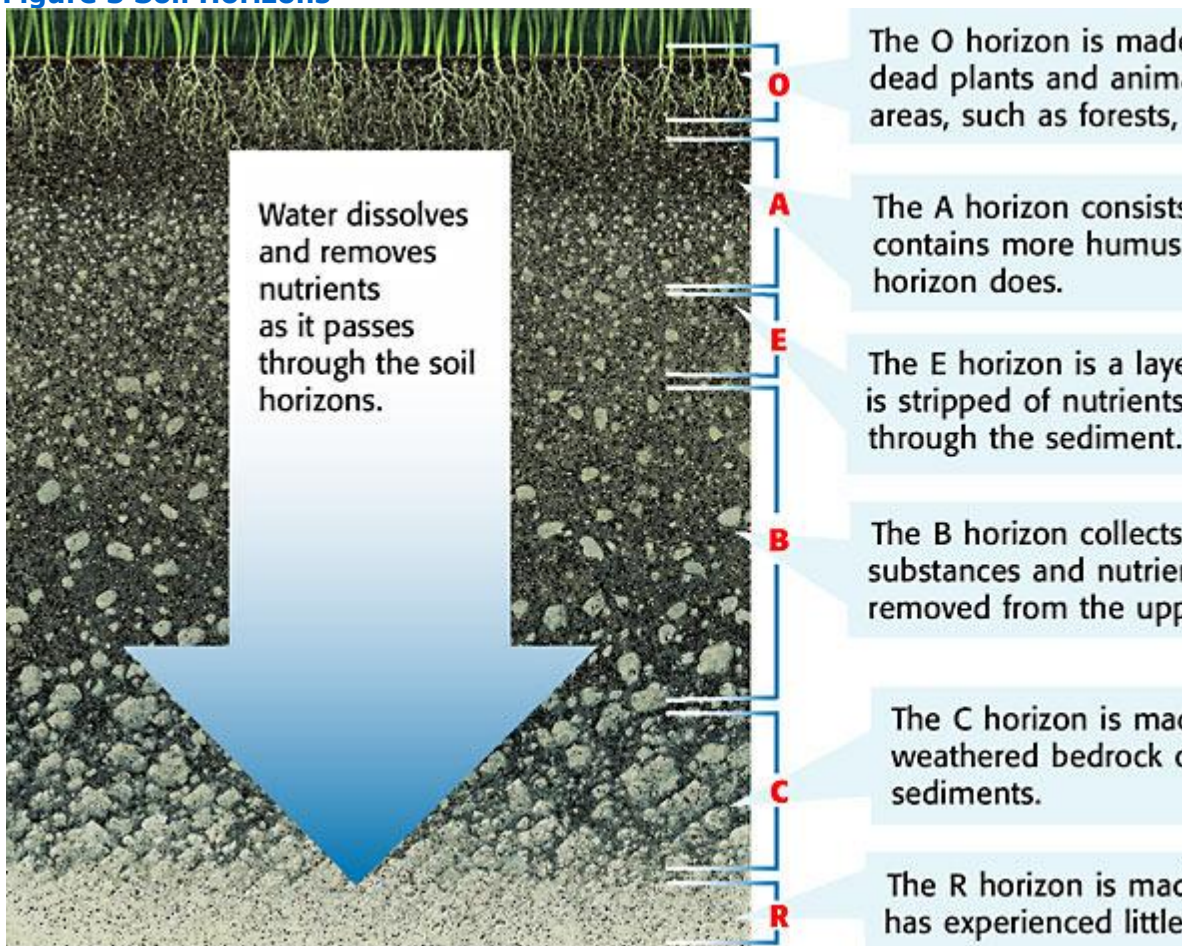
Soil Fertility

Nutrients in soil, such as nitrogen, phosphorus, and potassium, are needed for plants to grow. Some soils are rich in nutrients. Other soils may have few nutrients or may be unable to supply the nutrients to plants. The ability of soil to hold nutrients and to supply nutrients to plants is called *soil fertility*. Many nutrients in soil come from the parent rock. Other nutrients come from **humus**, the organic material that forms in soil from the decayed remains of plants and animals. These remains are broken down into nutrients by decomposers, such as bacteria and fungi.

Soil Horizons

Because of the way in which it forms, soil commonly ends up in a series of layers. Humus-rich soil is generally on top. More sediment rests below the humus-rich layer. Bedrock sits below the bottom soil layer. Because the layers are horizontal, soil scientists call these layers *horizons*. **Figure 3** shows what these horizons may look like.

Figure 3 Soil Horizons



The top layer of soil is commonly called *topsoil*. Topsoil has more humus than lower layers of soil do. The humus is rich in the nutrients that plants need to be healthy.



Soil pH

Soils can be acidic, neutral, or basic. The pH scale, which is shown in **Figure 4**, is used to measure how acidic or basic something is. The scale ranges from 0 to 14. The mid-point, which is 7, is neutral. Soil that has a pH below 7 is acidic. Soil that has a pH above 7 is basic.

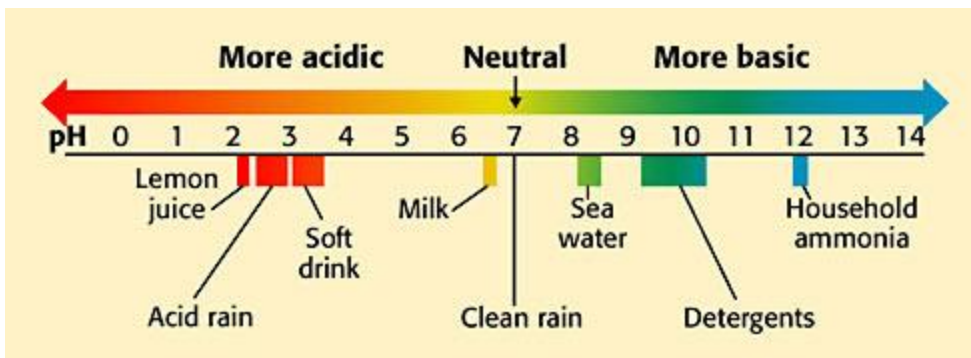


Figure 4 This pH scale shows the pH ranges of some common substances. **Can you find the pH of a beverage that you drink often?**

The pH of a soil influences how nutrients dissolve in the soil. Soil pH strongly influences soil fertility. For example, plants are unable to take up certain nutrients from soils that are basic, or that have a high pH. Soils that have a low pH can restrict uptake of other important nutrients by hungry plants. Most plants grow best in soils in the pH range of 5.5 to 7.0. A few plants grow best in soils of higher or lower pH.

Soil pH is determined partly by the soil's parent rock. Soil pH is also affected by the acidity of rainwater, the use of fertilizers, and the extent of chemical weathering.

Standards Check How does soil pH affect plant growth?

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Soil and Climate

Soil types vary from place to place, as **Figure 5** shows. The kinds of soils that develop depend on climate. The different characteristics of these soils affect the number and kinds of organisms that can survive in different areas.

Figure 5 Soils in Different Climates



Lush tropical rain forests have surprisingly thin topsoil.



The salty conditions of some desert soils make survival difficult for many plants.



Some arctic soils along Denali cannot support many plants.

Tropical Climates

Tropical rain forests receive a lot of direct sunlight and a large amount of rain. Because of these factors, plants grow year-round. The heat and moisture also cause dead organisms to decay easily. This decay provides rich humus to the soil.

However, soils in tropical rain forests are subjected to heavy rains. The heavy rains in this climate zone *leach*, or remove, nutrients from the topsoil. As a result, many tropical soils are nutrient poor. Another reason that this soil is nutrient poor is that lush vegetation uses up most of the nutrients in the soil.

Desert and Arctic Climates

Desert and arctic climates receive little rainfall. Thus, little leaching of nutrients happens in the soil in these climates. But the lack of rain leads to low rates of chemical weathering and little plant and animal life. As a result, soil forms slowly. Because of the lack of plant and animal life, the soil has little humus. Arctic soil has more humus than desert soil does because the climate slows the breakdown of organic materials.

Sometimes, desert soils can become harsh, even to desert plants! Groundwater in which mineral salts are dissolved seeps into desert soil. When the water evaporates, the salts are left in the soil. These salts can become so concentrated that plants cannot absorb water from the soil.

Temperate Forest and Grassland Climates

Much of the continental United States has a temperate climate. High rates of mechanical weathering cause thick soil layers to form. Temperate areas get a moderate amount of rain. Therefore, rates of chemical weathering are high, but rates of leaching are low.

Temperate soils are some of the most productive soils in the world, as **Figure 6** shows. In fact, the midwestern part of the United States has earned the nickname "breadbasket" for the many crops that the soil in the region supports.



Figure 6 The rich soils in areas that have a temperate climate support a vast farming industry.

Standards Check Why does soil in temperate climates support a large number of organisms?



Section Summary

- Soil forms from the weathering of bedrock.
- Soil texture affects how soil can be worked for farming and how well water passes through soil.
- The ability of soil to provide nutrients so that plants can survive and grow is called *soil fertility*.
- The pH of a soil influences which nutrients plants can take up from the soil.
- Different climates have different types of soil, depending on the temperature and rainfall.
- The characteristics of soil affect the number and types of organisms that an area can support.

