6.1: Bacteria Reading

Where bacteria live and their role in ecosystems

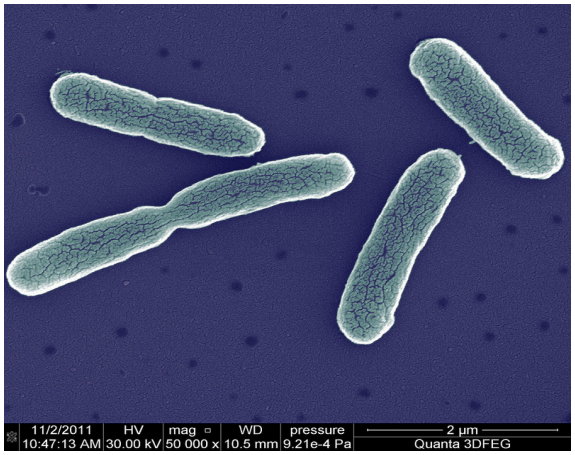


Figure 2 - This picture of rod-shaped bacteria cells was taken with an electron microscope. If this bacterium cell were an inch long, a cell of an onion would be about 40 inches long. Credit: FEI

Bacteria are tiny single-celled organisms. Most species are only about 1/10 the size of plant and animal cells, and many are even smaller. Bacterial cells may be many different shapes including spheres, rods, and spirals. Although bacteria are unicellular, some species clump together to form chains and others form films that stick to surfaces (such as plaque on your teeth). Bacteria live in many different environments, including in conditions that no plant or animal cells can survive. For example, some species live without oxygen or light at temperatures of -10°C. Although bacteria are too small to see without a microscope, they are much more abundant than any other type of cell on earth. In fact, if you could take the mass of all the bacteria on earth it would be greater than the mass of all of the plants and animals! More than 1,000 species of bacteria live in or on our bodies. You have about 100 trillion bacterial cells in and on your body right now. That means that bacterial cells outnumber your body cells 10 to 1.

Bacteria directly influence plant, animal and human health. Because some species of bacteria make plants and animals sick, like the MRSA bacteria in Figure 2, many people think of bacteria as generally harmful. In fact, most species of bacteria are not harmful to other organisms, and many are very helpful. For example, bacteria in our intestines play essential roles in supporting digestion of food and in producing vitamin B12 and vitamin K. Many helpful species of bacteria also live in or on plants. For example, some bacteria live inside plant roots and convert nitrogen from the air into a form that the plant can use to make proteins and other organic molecules.

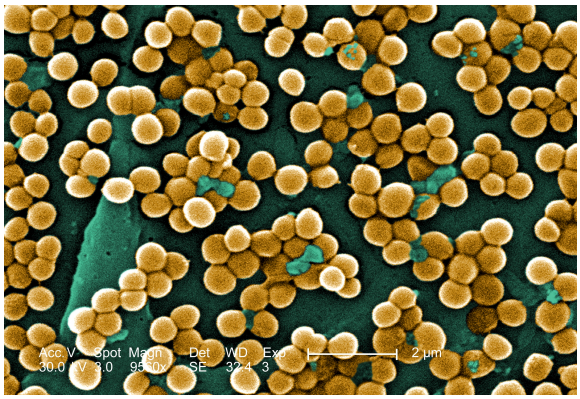


Figure 1 - Scanning electron microscope image of MRSA bacteria, or *Staphylococcus aureus*. Although these bacteria cause humans to be sick, most bacteria are helpful. Credit: CDC/Janice Haney Carr

Bacteria are very abundant in soil. A spoonful of soil contains 50 million bacterial cells representing up to 10,000 different species. Many of these species are decomposers that play an important role in nutrient cycling in ecosystems. Many types of organic material (such as cellulose that makes up wood) can only be broken down by certain species of bacteria that are able to digest them.

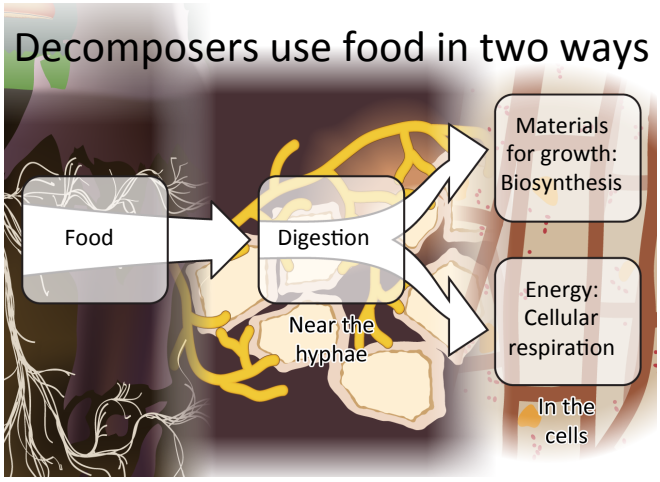
How bacteria get their food

Some bacteria are producers like plants; they make their own food from inorganic materials through the process of photosynthesis. Other species of bacteria are consumers like animals; they must eat organic matter produced by other organisms. It is important to remember that most decomposers are consumers – we distinguish them as decomposers because of their important role in returning matter from the bodies of dead organisms back into the environment through the processes of digestion and cellular respiration. Many complex organic molecules, such as those that make up hair, bone, and wood, can only be digested by bacteria, which makes bacteria essential for returning nutrients back to the environment.

Bacteria take in food by absorbing it through their cell membranes. Food particles have to be very tiny to move through the cell membrane, so digestion takes place outside their cells. Many bacteria feed on waste products from other organisms because they contain the organic molecules that were indigestible to the original consumer. In soil, these waste products are called detritus. Detritus is a major food source for bacteria. Like fungi, some bacteria secrete enzymes that can break down large organic molecules (polymers) into small organic molecules (monomers) that can then be absorbed.

How bacteria use matter and energy from their food to grow

Like all organisms, bacteria use food in two main ways: for gaining matter for growth (through the process of biosynthesis) and for gaining energy for movement and functioning (through the process of cellular respiration). Although bacterial cells are simpler than the cells that make up plants, animals or fungi, they are still made up of many different complex organic molecules including proteins, carbohydrates, and fats. Therefore, they must perform biosynthesis in order to rearrange atoms that they take in as food molecules into new organic molecules that make up their cellular structures.



Bacteria also release energy from their food through the process of cellular respiration. Many species of bacteria perform the exact same type of cellular respiration that plants, animals and fungi do. By rearranging food molecules containing high-energy C-C and C-H bonds into the inorganic products of carbon dioxide and water, energy is released that the cells can use to move and grow.

Although all bacteria get energy by rearranging organic molecules, many species perform different variations of the cellular respiration process. For example, some species can extract energy from organic molecules without oxygen. Fermentation is one such process that releases energy from organic molecules without the presence of oxygen. Fermentation is less efficient than cellular respiration though, which means that it releases less energy per gram of glucose. This is because fermentation creates high-energy byproducts such as ethanol (alcohol) or lactic acid. Bacteria that produce lactic acid through fermentation are called lactobacillus and are used to make foods such as yogurt, pickles, and sauerkraut.