5.3: How do Decomposers Digest Food? Reading

Purpose for Reading: *As you read this text, work to make sense of how decomposers break down matter so that they are able to grow, move, function.*

Zooming into Eating and Digestion

Scientists work to explain things we can observe—like decomposers growing, moving, and functioning—by "zooming in" to the smaller systems that decomposers are made of—cells—as well as the molecules that make up cells. Let's zoom into a decomposer to figure out how decomposers break down the food they eat.

Macroscopic scale: We observe decomposers breaking down organic matter at the macroscopic scale. Bread mold breaks down bread. What is happening inside, and outside of the mold at the microscopic and atomic-molecular scales to the food the mold breaks down?

Cellular scale: Every cell in bread mold needs food. All decomposers need a way to breakdown food (digestion) into small organic molecules, move the small organic molecules to each cell so that the cells can function (cellular respiration and biosynthesis). How is the food the bread mold breaks down changed into matter and energy it can use to grow, move, and function?

Atomic-molecular scale: Large organic molecules in the bread are broken down into smaller organic molecules during digestion. These small organic molecules are carried to cells all over the bread mold by the hyphae. Small molecules enter cells all over the mold. The small organic molecules are changed through cellular respiration and biosynthesis into the forms of matter and energy needed for growth and movement.

Using Four Steps to Explain Digestion

We can explain digestion—the breaking down of food into small organic molecules—by answering the four numbered questions on the Three Questions handout:

1. How do molecules move to the location of the chemical change?

Food starts breaking down into smaller pieces as decomposers secrete digestive enzymes into organic materials that are their food sources. Food is then absorbed into the decomposer's body through the mycelium (the network of hyphae outside of the fungus).

2. How are atoms in molecules rearranged into different molecules?

Cells of the fungus that are contact with the substance it is digesting will produce molecules (enzymes) that can break large organic molecules (proteins, carbohydrates, and fats) up into small organic molecules (amino acids, glucose, fatty acids, and glycerol).

3. What is happening to energy?

The chemical energy stored in the high energy bonds (C-C and C-H) in the large organic molecules remains in the small organic molecules because those bonds are not changed.

4. How do molecules move away from the location of the chemical change?

The small organic molecules move into the decomposer through the mycelium. The hyphae that make up the mycelium connect into the visible structure of the fungus and distribute small organic molecules to the interior fungal cells.

Fungal Fuel

Fungi are unique in their process of digestion occurs outside of their “bodies”. As such, the fungus needs to excrete enzyme molecules onto the substance it intends to digest rather than ingest and chew that substance (like an animal would). Fungi are sometimes capable of producing enzymes that can break down incredibly tough substances like the cellulose and lignin molecules that give wood its strength.

Scientists are interested in the enzyme production capabilities of fungi because it may significantly increase the kinds of substances we can use for renewable biofuels. Currently, most of the biofuel produced in the US is made from corn grain because it is relatively easy to break down and ferment into ethanol. However, the amount of corn grain available for fuel production is limited and most of the energy absorbed by a corn plant is used to produce the stalk and leaves. By studying fungi, we may be able to determine how to more effectively break down tougher, harder-to-digest plant components. If successful, this might mean that we could use the stalk and leaves of the corn for fuel and use the grain for food. This would effectively allow us to produce *two* products from the same field.