

# Useful Decomposers Worksheet

We have seen that some decomposers such as molds undergo cellular respiration. This process converts a lot of the chemical potential energy in the mold's food source into energy the mold cells can use. Cellular respiration requires oxygen and leaves little solid material. Most of the atoms in the mold's food source end up as gases such as carbon dioxide.

We have also seen that cellular respiration is only one of a variety of metabolic processes that decomposers use. A number of decomposers undergo fermentation. Fermentation processes do not require oxygen, and they convert only a little of the chemical potential energy in the food sources into forms their cells can use. Fermentation processes typically leave behind smaller molecules that still have some chemical potential energy and therefore can be used as food for other organisms. We make use of many fermentation processes.

## Fermenters we use in our homes

A number of bacteria do lactose fermentation. Lactose is a sugar found in milk. Lactose fermentation of milk is used to produce yogurt, sour cream, cottage cheese, and cultured buttermilk. This fermentation produces lactic acid that gives these foods their sour taste. At the same time, the lactic acid prevents some other microbes from growing.

Pickling in salt water (brine) also involves lactic acid or acetic acid (vinegar) production by decomposers. The acids prevent other microbes from growing, helping to preserve the food. German sauerkraut, Korean kimchi, some types of pickles, and soy sauce are all foods made with this process.

## Other useful products from decomposers

Yeast is a widely used decomposer. It ferments sugars producing  $\text{CO}_2$  and the alcohol, ethanol. We use yeast in bread making. The bubbles of  $\text{CO}_2$  gas produced make the bread rise. The ethanol evaporates during baking. We also use yeast to make beer and wine. In beer making, both the  $\text{CO}_2$  and the alcohol are part of the product. In wine making, the  $\text{CO}_2$  gas is allowed to escape and only the ethanol is part of the product. Ethanol can be further fermented by particular bacteria. The product is acetic acid, the main ingredient in vinegar.

Decomposers compete for food. Producing products, such as lactic acid, that inhibit other decomposers is not the only way they try to stifle the competition. Some decomposers make special chemicals that kill off competitors. Many of our early antibiotics came from decomposers. The first antibiotic discovered, penicillin, is produced by a particular mold.

There are several other decomposers and decomposer products that we use in our homes. A number of cheeses, such as blue cheese, get their distinctive tastes from specific molds that are allowed to grow on them. Enzymatic drain cleaners use bacteria and enzymes from decomposers to break down/ decompose clogs. Enzymatic wallpaper removers use bacteria and enzymes from decomposers to break down wallpaper glue.

## 1. Which decomposers and their products are in your home?

Check each item that you have in your home

### **Anaerobic fermenters**

Yogurt (regular or frozen)		Bread		Sauer Kraut		Vinegar	
Sour cream		Other bread-like foods such as Danish pastry		Kimchi		Other:	
Cottage Cheese		Beer		Pickles			
Buttermilk		Wine		Soy sauce			

### **Aerobic decomposers**

Cheese flavored with mold (i.e. Blue Cheese)		Enzymatic drain cleaner		Enzymatic wall paper remover		Other:	
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### **Using anaerobic fermenters to make yogurt**

Follow the protocol below to make yogurt from milk. You will use the bacteria in some store-bought yogurt. It is important that you use sterile technique to make sure that only the desired lactose fermenters are introduced into the milk. Otherwise the milk will simply spoil/decompose.

1. Boil the canning jars and lids for at least 5 minutes.
2. Without touching the insides of the jars, use tongs to remove the jars (but not the lids) from the water and place them upside down on clean paper towels or bench paper.
3. Heat the milk in a sauce pan to 45°C.
4. Fill the canning jar half full with milk.
5. Add 1 tablespoon of yogurt.
6. Using tongs, remove the lids to the canning jars from the water and place them on the canning jar.
7. Close the jars tightly. Label them and place them in the incubator.
8. Tomorrow you will have yogurt thanks to decomposers.

## 2. Decomposers we use indirectly

In addition to using the foods and products that we looked at in question 1, there are a number of ways that we benefit indirectly from decomposers. When we want to break down substances in order to get rid of them, we use aerobic decomposers. Such is the case for solids in our waste water. Whether the water goes to a treatment plant or a septic tank, it is partially or wholly broken down by decomposers doing cellular respiration. Because the bacterial decomposers need oxygen, water in a treatment plant is sprayed through air so that it will pick up oxygen. Compost is another useful product of aerobic cellular respiration. Compost is decomposed organic matter such as leaves, grass clippings, food and animal waste. It is rich in nitrogen and the remaining organic carbon helps retain moisture and nutrients in the soil. Organic farming uses compost rather than fertilizer. Gardens of all sizes benefit from the addition of compost to the soil.

A number of mammals, including humans, have decomposers in their digestive systems. The larger organisms have a mutually beneficial relationship with these gut bacteria. The bacteria have a constant supply of food coming through the digestive system. In turn, the bacteria take the food and perform various anaerobic processes in order to get the energy they need. The products of those reactions are organic molecules that the host animal can absorb into their blood. Cattle used for beef or milk production would starve without the bacteria in their guts that ferment their fibrous food producing acids that the cattle can absorb. Sheep also have these types of bacteria in their guts. We would not have wool without them.

One of the industrial uses of anaerobic decomposers is in the production of ethanol from corn. Yeast is used to ferment the corn producing ethanol. Almost all of the gasoline we use is 10 – 15% ethanol. In 2011 in the U.S., almost 14 billion gallons of ethanol were produced. The amount of ethanol produced yearly has grown since then and we are working on making ethanol from plant materials such as grasses rather than from corn.

**Which of these do you do?** Check all that apply

***Anaerobic fermenters***

Eat Beef		Drink milk Eat cheese, yogurt or other milk products		Wear clothes containing wool		Use gasoline	
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***Aerobic decomposers***

Waste water treated at a plant		Waste water treated in a septic tank		Garden with compost		Eat organic vegetables or fruits	
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