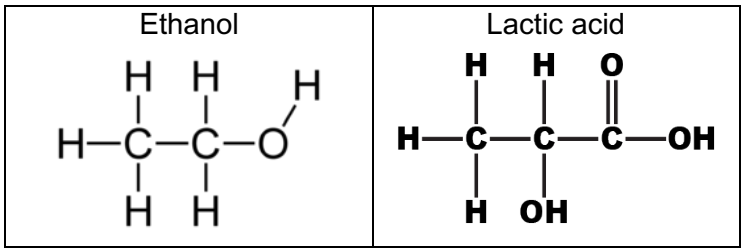
6.1: Decomposers Without Oxygen

Life without oxygen

Some decomposers survive without oxygen. How can they do that? How do people use these decomposers?

Many organisms can eek out some energy from organic molecules even when there is no oxygen around—what scientists call *anaerobic* conditions

Under anaerobic conditions, the organisms are not able to use all of the C-C and C-H high energy bonds. As with cellular respiration, these organisms start with molecules with lots of C-C and C-H bonds, often sugar. To get the energy they need to live, these organisms break a few of the C-C bonds replacing them with slightly lower energy C-H bonds. This process is called *fermentation.* Thus, the products of fermentation tend to be molecules with 2 or 3 carbon atoms.



Where do anaerobic organisms live?

It turns out that this process is good for us and for many other organisms. Microbes or bacteria in the guts of plant eaters ranging from termites to cows produce molecules these mostly 2 and 3-carbon organic acids that are then absorbed by the host organism. The host organism uses cellular respiration to transform the energy in the C-C and C-H bonds of the acids to usable forms. Without these microbes, the energy in most plant matter would not be accessible to other organisms.

People also use the products of some anaerobic processes for energy, not for our bodies, but for our cars. When yeast (a single celled fungus) ferments sugar, it produces ethanol and carbon dioxide. We use yeast to ferment sugar from corn grain or processed plant material such as switchgrass. When purified, we can use the ethanol produced to run our cars. In our cars, the potential chemical energy in the remaining C-C and C-H bonds in the ethanol is converted to kinetic and thermal energy. To learn how biofuels like ethanol can help with the problem of global climate change watch: *The Life Cycles of Fuels* at https://vimeo.com/166055834.

We also use the products of anaerobic processes in our food. When we use yeast to make bread, the bubbles of CO_2 make the bread rise. The alcohol produced along with the CO_2 evaporates during baking. When we use yeast to ferment grain or grapes to make wine or beer, the ethanol (alcohol) produced prevents many other microbes from growing. Because of this, fermentation is a way of preserving grains and grapes. Yogurt is made by adding a mix of bacteria to milk. The bacteria ferment the sugar in the milk which produces lactic acid. The acid gives yogurt its sour taste and alters some the milk proteins so that they have a creamy texture. The acid also prevents some disease-causing microbes from growing in the milk. Pickling is another process where the acids that anaerobic bacteria produce are used to preserve food.

Modeling a fermentation reaction

1. In your group, use your molecular modeling kit to make a glucose molecules ($C_6H_{12}O_6$).
2. Break the glucose molecule into two 3-carbon pieces.
3. Take each of these pieces and break it into a 1-carbon and a 2-carbon piece.
4. Rearrange the hydrogen and oxygen atoms so that the 1-carbon piece becomes carbon dioxide and the 2-carbon piece becomes ethanol (C_2H_5OH).

Answering questions

Answer the questions about what you have read and modeled on the 6.1 Exploring Different Kinds of Decomposers Handout.