De"compost"ition

Adapted from Increasing Solid Waste Awareness in the Classroom: Lessons in Resource Recovery, by Jennifer Cotner, Cornell Cooperatative Extension of Genesee County

Back to Trash Goes to School

GRADE LEVELS: 9-12

SUBJECT AREAS: science, ecology

CONCEPT: Decomposition of organics.

OBJECTIVE: To develop an understanding of the decomposition process and the parameters which influence the rate at which it occurs.

MATERIALS:
* 2 compost piles, of the same size and made up of materials in the same stage of decomposition. (In the fall, have students bring in grass clippings, leaves, and food wastes.)
* pitch fork or shovel
* nitrogen fertilizer
* thermometer

KEYWORDS: decompose, aerobic, anaerobic, humus

BACKGROUND: Can you think of a system of recycling which is already being practiced in nature? Have you ever walked through the woods and spotted an old log? And did you take a closer look to find all kinds of neat creepy, crawly critters? What you were witnessing was a form of "composting", recycling back to the soil the nutrients that were once a part of the plants and animals.

In decomposition, microorganisms in the form of bacteria, protozoa, fungi, and invertebrates are able to break down dead plants and animals to obtain energy. They also release many of the nutrients back into the environment for the benefit of future plants and animals. Two types of decomposition can occur in composting:
with oxygen
dead vegetation + oxygen + water --> carbon dioxide + water + energy + heat
without oxygen
dead vegetation + water -->carbon dioxide + methane + hydrogen sulfide + energy

Both processes are called respiration, the metabolic transformation of food into energy. Process 1, however, occurs in the presence of oxygen and is called aerobic respiration. Process 2 occurs in the absence of oxygen and is called anaerobic respiration. Aerobic respiration occurs at a faster rate than anaerobic respiration because bacteria are able to metabolize more quickly in the presence of oxygen and heat.

Study the two formulas and answer the following questions:

1. If respiration occurs at a faster rate in the presence of oxygen and heat, and if oxygen is available from the atmosphere, where does the heat come from? *(The working organisms produce heat.)* When would the compost eventually slow down? *(When all available nutrients are consumed.)*

2. What would you conclude about a pile of decaying vegetation if it began to smell like rotten eggs? *(It does not have enough oxygen and has gone anaerobic.)* Why do you think landfills smell? *(They are compacted, not aerated).*

3. How does a system become anaerobic when our atmosphere contains 21% oxygen? *(The material is compacted or too wet, inhibiting exchange of oxygen with the atmosphere).*

4. If I wish to speed up decomposition, what would I do? *(Add oxygen by turning the pile).*

5. An anaerobic system can reach temperatures near 160 degrees F. How could this be beneficial? *(It kills some weed seeds and pathogens.)*

You can build a compost pile bin easily by constructing a frame out of wood or chicken wire and filling it with leaves, yard clippings, and even food wastes. Do not include meats, fats, or milk products because they will attract animal pests.
Two essential ingredients for your compost pile are oxygen and moisture. To provide oxygen, turn your pile every week or so, especially if you smell a rotten egg odor or if the compost feels cool to the touch. Moisture could be provided naturally or artificially, but do not soak the compost pile. Soaking fills up air spaces and can cause the pile to become anaerobic quickly.

The optimal size for a compost pile is at least 3 feet x 3 feet x 3 feet. This provides enough mass to maintain proper temperatures for composting.

Another important ingredient is nitrogen, which may be provided from the atmosphere, or usually from organic matter. Nitrogen is an essential element with which bacteria make amino acids, and therefore, enzymes. Enzymes enable the bacteria to break down organic matter faster. Another idea is to shred leaves, kitchen waste etc., making them smaller. This increases the amount of surface area which can be colonized by the microorganisms, therefore increasing the rate of decomposition.

PROCEDURE: Design a "controlled" experiment by comparing decomposition rates between two compost piles. A controlled experiment is one which enables you to answer a specific question by testing only one criterion while leaving all other criteria constant. For example:

Question	Experiment
Which environment results in faster decomposition rates: aerobic or anaerobic?	Turn one compost pile periodically, while leaving the other pile to rest.
Does an increase in surface area result in a faster decomposition rate?	Shred materials before adding to one compost pile, while adding materials to the other pile whole.

Does an increase in nitrogen result in a faster decomposition rate?	Add nitrogen fertilizer between layers of compost material in one pile only, or add more nitrogenous material such as grass clippings or food wastes.
Does atmospheric temperature affect decomposition rate?	Measure the rate of decompositionin a compost pile in the early fall compared with the winter.
Does the pile generate heat? How does the temperature change when the pile is turned?	Using a glove, insert a thermometer deep into the compost pile.

FOLLOW-UP:
Start a school composting project, or encourage students to compost at home.