



Compost Lesson Plan

THEME:

Composting is the oldest form of recycling. It provides an opportunity for students to observe the decomposition process and energy cycle at work; produces a valuable soil supplement; and reduces the amount of organic material requiring landfilling or incineration.

GOAL:

Students will learn how soil organisms recycle organic wastes through composting.

METHOD:

Students will observe soil organisms in a compost sample, then fill a compost bin with organic wastes and observe the decomposition of the organic wastes into humus during the school year.

TIME:

45 - 60 minutes for discussion and bin set-up, several months for observations.

MATERIALS:

1. Compost bin
2. 3-4 large bags of wet leaves (can also use straw, sawdust, cardboard, paper). If the leaves are not wet, they will need to be thoroughly dampened during the bin set-up. If a hose is not available for use, it is more effective to dampen the leaves ahead of time. Spread the leaves out on the ground prior to a rainfall or in a location where a hose can be used. Once they are thoroughly wet, put them in plastic bags and they will stay damp until the bin set-up. Our experience has shown that when students carry buckets of water to the compost bin, the leaves do not get sufficiently damp. The leaves must be thoroughly dampened or they will not compost into humus within the school year.
3. 1-2 bags of grass clippings or other green material (such as weeds, fruit and vegetable scraps, and/or rabbit/hamster/gerbil manure). The activity will be easier to conduct if the green material is separated by material type - this makes it easier for groups of students to add the different materials.
4. Container of finished compost to pass around as sample. 1-2 cups should be adequate.
5. Container of active compost containing decomposer organisms to pass around as sample. 1 cup per group of 4 students should be adequate.
6. Dixie cups or reusable containers for passing around samples of finished compost. Dixie cups can be added to compost bin afterwards.
7. Paper plates for passing out samples. Paper plates are added to compost bin afterwards. (Plastic or other reusable plates can also be used.)
8. Plastic forks. Enough for each student.
9. Handouts: "Composting is Easy!" and "Food Web of the Compost Pile" Enough for each student - they can color them if there is extra time. Alternatively, show an enlarged poster of each of these handouts.
10. 1-2 five-gallon buckets of soil or partially composted material (not potting soil - it is often sterilized and does not contain an abundance of soil organisms desired for the compost pile).
11. Gardening gloves to wear while overseeing and helping with addition and wetting of materials, which can be messy, cold and wet.
12. Latex gloves for children who wish to use them.
13. Garden tools (Hoe and/or Garden Claw, Shovel, Rake). A short-handled (18") hoe for stirring, mixing and distributing moisture to material added to bin (a regular hoe will do). A shovel to dig up soil to add to the compost bin, and later to harvest the finished compost. A rake for gathering leaves to add to the compost bin.

Optional:

14. Microviewers (available through B.U. Microcosmos Program), to observe microorganisms in compost.
15. Compost thermometer for extension #3.

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BACK GROUND INFORMATION:

In nature, soil organisms called decomposers digest organic material such as leaves, dead plants and animals. The digestion process converts the fresh material into humus, a dark brown component of soil rich in plant nutrients. Composting is simply a matter of managing the decomposition process, and the end product is called compost. A compost pile is a teeming microbial farm. Bacteria start the process of decaying organic matter. They are the most numerous of the decomposer organisms - one tablespoon of soil contains billions of bacteria! Fungi and protozoans soon join the bacteria and, somewhat later in the cycle, earthworms, centipedes, millipedes and beetles do their parts. Each organism has a role in the food web of the compost pile. Successful composting is simply a matter of providing the conditions in which the decomposer organisms will flourish. Like us, they need food, air, water and a habitable temperature.

First level decomposers

- Bacteria do the majority of the work and are the primary decomposer organisms of a compost pile. There are three types of aerobic (oxygen-requiring) bacteria. 1) Psychrophilic bacteria (thrive in lowest temperature range - 55 degrees F or less) give off a small amount of heat as a by-product, causing a rise in the pile's air temperature. 2) Mesophilic bacteria (thrive at 70-90 degrees F) do most of the work and also generate heat as a by-product, raising the pile temperature even more. 3) Thermophiles (thrive at 104-200 degrees F) work fast and last only 3-5 days.
- Actinomycetes (higher form of bacteria similar to fungi and molds) liberate carbon, nitrogen and ammonia, making nutrients available for plants. They take over during the final stages of decomposition, often producing antibiotics that destroy bacterial growth.
- Fungi also take over during the final stages of composting when the organic material has been changed to a more digestible form.

Second level decomposers

Second level decomposers include protozoa, rotifera, nematodes (roundworms), earthworms, millipedes, sow bugs, land snails and slugs, springtails, feather-winged beetles, mold mites and beetle mites. They consume the first level decomposers. Some second level decomposers, such as earthworms, also consume the organic residue, so they can also be considered first level decomposers.

Third level decomposers

Third level decomposers include ground beetles, centipedes, pseudoscorpions and ants (ants are usually not found in a compost pile that contains adequate moisture - they are a sign that the pile is too dry). They feed upon first and second level decomposers. Some may also consume organic residue.

PREPARATORY ACTIVITIES:

Conduct one of the following preparatory activities prior to setting up the compost bin:

1. Conduct any of the activities in your Science curriculum that relate to composting, energy cycling, nutrient cycling or food webs.
2. Show the 15-minute videotape "Turning Your Spoils to Soil" which is an introduction to backyard composting and explains the science of decomposition
3. Conduct the classroom activity "Who Eats Who?" described in the Dept. of Environment Protection's School Composting Resource Package. Students are introduced to the concept of nutrient cycling and the order that energy flows through an ecosystem.

HEALTH CONSIDERATIONS:

If you are aware of any students in the class with allergies or asthma, those students should not handle compost without gloves, and should not stir the compost or put their face into the compost bin. Observing from the side of the bin should not present any problem. They can add material, but another should do the burying or stirring. Observing the compost samples without smelling or touching them should not present any problem. Students with compromised immune systems should not participate in this activity without their doctor's approval.

Students must always wash their hands with soap after adding material, stirring or handling the compost. The majority of soil organisms are harmless to humans and cannot survive our body temperature, but prevention is the best medicine. In general, working with compost does not present any more of a health concern than gardening, but it is important to wash hands after working with soil.

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PROCEDURE, PART 1:

DISCUSSION AND OBSERVATION, 15 - 20 minutes

1. Discuss the recycling programs that may exist in the classroom (mixed paper), the cafeteria (polystyrene foam trays and utensils), and at home (curbside collection of: mixed paper and cardboard; glass metal and plastic #1-7 containers; drink boxes, milk and juice cartons). Residential recycling may or may not be offered to all residents (check with municipality) - show municipal recycling flyer. Explain that composting is nature's way of recycling.
2. To illustrate the nature of the decomposition process, pass around the paper cups containing finished compost for students to observe, touch and smell.
3. Ask students to guess what the original ingredients were, and list the items on the blackboard. This will lead to a review of what materials can be composted. Their answers will indicate how much they already know about composting and provide a good introduction to the topic of how to make compost.
4. Lead classroom discussion (limit discussion if time is limited, to allow 30 - 40 minutes for bin set-up):

What is composting?

- Controlling the natural recycling system of decomposition, which converts organic material into a dark soil-like material called compost.

Why compost? Ask if students have gardens - If yes, do they or their parents compost? If no, explain that compost is great for gardens and that they can help teach their parents how to make compost. Or if there is a garden at school, tell them they will be making compost that they can add to their school garden.

- Produce valuable soil supplement; return organic matter to soil
- Reduce amount of waste to be landfilled or incinerated
- Save on disposal costs
- Save on not having to buy bags
- Reduce pollution created by waste collection vehicles
- Other (add your own)

Who does the majority of the work? Soil organisms do most of the work. Our work as composters is to give the decomposers food, air, water and a good home - they eat our garbage and turn it into compost.

- Soil organisms: microorganisms (bacteria, actinomycetes), molds, fungi, earthworms, insects
 - » Review with students the "Food Web of the Compost Pile" handout.

What do the soil organisms need? The same things we do - food, air, water, and a habitable temperature, which means making a large enough pile to keep them from freezing to death in the winter.

- Food. Organic material - general rule of thumb - anything that was once alive can be composted, for example, paper can be composted because it was originally a tree. Some organic materials, such as meat and dairy products, can create odors so they should not be added to a compost pile. Discuss what should and should not be composted. Explain recipe of 3 parts brown (high carbon) to 1 part green (high nitrogen) (all brown is ok; all green is NOT ok). (Refer to additional handouts for more information on carbon:nitrogen ratio). Material will decompose faster if chopped up or shredded (increased surface area for bacteria to colonize).
 - » Review with students the "Composting is Easy!" handout.
 - Air. Aerobic organisms need oxygen. Anaerobic organisms produce gases that smell like rotten eggs.
 - Moisture. The organisms need a thin film of moisture to live in. Compost should be 50% moisture, about as moist as a wrung out sponge. If material is not damp, the composting process will stop.
 - Volume. Pile should be large enough to maintain heat, minimum of 3'x3'x3' (one cubic yard).
5. Divide students into groups and hand out a sample of active compost materials to each group and a fork to each student to use for exploring the sample. (OPTIONAL: microviewer or hand lens, if time allows). Have students try to find and identify decomposers. Students can refer to the Food Web handout to identify organisms. List and discuss the organisms observed. Ask students what they observed about each organism, or what else they know about them. Answer questions as they arise.

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PROCEDURE, PART 2 (COMPOST BIN SET-UP):

DISCUSSION

1. To prepare for bin setup, ask the students why use compost bins (rather than open piles)?
 - Help pile hold in heat and moisture,
 - Keep animals out. In urban areas, a rodent-resistant bin must be used.
 - Looks neater than open piles.

BIN SET-UP, 30 - 40 minutes (10 - 15 minutes to set-up bin, 20 - 25 minutes to fill bin)

2. Take the class outdoors to assemble and fill their compost bin. (Choose a convenient location: close to source of water if possible and where the bin will be needed, such as near a garden. Shade is preferable to full sun. Also consider aesthetics and accessibility in winter.) Demonstrate how the bin clips work and pass them out for students to practice. Ask for volunteers to assemble the bin - floor, brace, barrel, cover. Place the soil and bags of leaves and grass near the assembled bin.
3. Divide the students into teams of 2 or 3. Have teams line up where they can see the bin. Each team takes a turn adding a layer of material to the bin, then goes to the end of the line. Students continue taking turns, rotating in line until the bin is full. Ask each new team what should be added next (soil; high carbon "brown" material, such as leaves; high nitrogen "green" material, such as grass clippings or fruit scraps; water; finished compost to "seed" the pile with organisms).
 - Layer the materials in the bin in 2"-8" layers
 - Sprinkle soil or finished compost between the layers
 - Dampen leaves and other material with a garden hose as you add them, if they are not moist (should feel like a damp sponge). A hoe is very useful for stirring leaves in bin while dampening.
 - Continue adding materials until the bin is full. Finish by sprinkling a bucket of active compost (with organisms) over the pile. Tell students these decomposers will multiply over time and decompose everything they've just put in their bin. (If active compost isn't available, finish with a bucket of soil. This contains bacteria and other decomposers that will decompose the fresh material.)

BIN MAINTENANCE AND USE

4. Fruit and vegetable scraps can be added during the school year by digging into the pile and burying them 8" deep. Weeds and grass clippings can be added and stirred into the material in the bin on an ongoing basis.
5. Check the bin monthly for dryness. Add water if the material gets dry. (You do not need to add water during the winter). If snow falls onto the cover, shake it off the cover into the bin where it will add moisture.
6. Compost will be ready in 6 months to a year. Stop adding fresh material for about a month prior to harvesting compost. The finished compost collects around the base of the bottom cone. You may need to push aside the material on top to see the finished compost below. You can tell the compost is ready when it looks like dark brown, crumbly soil and you can't recognize the original ingredients.
7. To harvest the compost, there are several options:
 - a. Push aside unfinished material and dig out finished compost from one section of the bin at a time. This is an easy way to remove what you need while leaving the rest to continue breaking down.
 - b. Remove the clips and open the bin. Or pull the bin straight up off the pile (pull out ground stakes first, if used). Set aside undecomposed material. Remove all but 3" of finished compost. Put the bin back over the floor. Add undecomposed material back to bin and continue adding fresh material.
 - c. Use option b. above, but interchange the floor and cover as follows: Pull the rope handle out of the cover. Put rocks under the cover in location for new bin set-up. Unclip or pull barrel off old pile, reassemble on top of new floor cone. Put undecomposed material in bin. Remove finished compost. Add 3" of finished compost to the newly set up bin. Wash off the floor cone; put the rope handle through the center and use as the new cover.
8. To use the finished compost, mix equal parts compost, soil and sand for a potting soil mix. Or apply a layer about 3" deep to soil and mix in with the top 4" of soil, about a month before planting time. Or add a handful of compost to each hole when planting.
9. **Before summer vacation:** Make sure material in the bin is damp. If not, add water and stir until damp throughout. When you return in the fall, material in the bin should be composted. It should have shrunken by two thirds its original volume and look like rich, black soil. Use a shovel to remove compost for garden use and for samples for new classes. Leave 3" of compost in bottom of bin as "starter" for refilling bin with new classes.