

Lesson: Reduce Our Carbon Footprint, Let's Compost!

Students will:

- Be able to construct and maintain a worm composting bin for their school, classroom or home.
- Learn about the decomposition process
- Reduce their class'/school's/own carbon footprint by diverting food scraps from landfills.
- Create a tangible, beneficial product (compost) that can be used in a school garden or at home.

Grade Level

4-8 Grade

Subject Area

Applied Arts, Fine Arts & Earth Science

Activity Time

2 hours (realistic for 4th graders, less for 8th graders)

Vocabulary

Compost: Compost is composed of organic materials derived from plant and animal matter that has been decomposed. The process of composting is simple and practiced by individuals in their homes, farmers on their land, and industrially by industries and cities.

Vermicomposting: Vermicomposting is one method of composting. It uses various species of worms, usually red wigglers, white worms and earthworms to create a heterogeneous mixture of decomposing food waste, bedding materials, and vermicast.

Vermicast: Vermicast, also known as worm castings, worm humus or worm manure, is the final product of vermicomposting and is a great soil conditioner.

Soil Conditioner: Soil conditioner is a material added to soil to improve plant growth and health.

Decomposition: Decomposition or "rotting" is the process by which tissues of a dead organism break down into simpler forms of matter. The process is essential for new growth and development of living organisms because it recycles the finite matter that occupies physical space in the biome

Materials

- (1) 40 gal (minimum) non-transparent Rubbermaid® type container or 55gal plastic garbage can with tight fitting lid
- (2) Electric Drill with ¼" bit
- (3) Primer/White [Krylon®](#) type plastic-adhering spray paint (optional)
- (4) Acrylic paints & various sizes of paint brushes (optional)
- (5) Clear [Krylon®](#) Plastic Spray Paint (optional)
- (6) 20lbs of Red Wiggler worms ([worm suppliers](#))
- (7) A theme/scene to paint on the lid and outside of the container (Sustainable community, Farm, Ocean)
- (8) Lots of shredded paper (newspaper, computer paper, **not** glossy magazine paper)
- (9) Spray bottle with clean water
- (10) A stirring tool that will reach the bottom of the container (stick, wood dowel, small shovel/pitchfork, long handled spoon)
- (11) A few pounds (gallons) of food scraps, the students will save from lunch during the weeks prior (or you can bring from home if you don't want your classroom getting stinky)



Background

Food Scraps vs Trash

Food waste includes uneatable food, portions of meals and trimmings from food preparation activities in kitchens, restaurants and cafeterias. Because food waste does not decompose efficiently in landfills, it is the largest component of discarded waste by weight in the United States!

According to a study by the University of Arizona Garbage Project, each American throws away 1.3 pounds of food a day, which amounts to 474.5 pounds per year per person!

Transporting our solid waste ("garbage"), including compostable food scraps, emits green house gases into the atmosphere. The less "garbage" we throw away, the more we reduce our own carbon footprint. If half of the solid waste we generate each day is compostable food, we have the opportunity and obligation to reduce our solid waste carbon footprint by half!

Decomposition

Food decomposes like any other organic matter. Bacteria, fungi, oxygen and moisture all convert plant and animal matter back to basic organic soil nutrients--the lowest link on the food chain. Decomposition renders food unappetizing or even dangerous for human consumption. So we spend a lot of energy trying to understand food decomposition and how it can be prevented or delayed.

→ *Bacteria and Fungi Colonize the Food*

Food decomposes with help from bacteria and fungi. Collectively called saprophytes, these microbes are the primary decomposers of all dead organic matter. They are airborne or may be transferred to food by contact.

→ *Fungi are Vital to Decomposition of Plant Matter*

Fungi are often the first microbes to colonize dead organic matter and are able to decompose plant cell walls, or cellulose, making the nutrients in plant cells more accessible to bacteria. Certain fungi species inhabit the digestive systems of animals, like cattle and termites, which have diets high in cellulose, helping to digest grasses and wood for the animal. On our food, mold is the fungus on the exterior food surface.

→ *Bacteria and Fungi Feed on the Food*

All dead organic matter is potential food for bacteria and fungi. But the molecules of plant and animal matter are too large to pass through the microbes' cell membranes. The molecules must be broken down first. Enzymes secreted by bacteria and fungi break large food molecules into smaller molecules that can easily be absorbed by the microbes. The fungi and bacteria use the food energy to divide and multiply.

→ *Food Decomposition Requires Oxygen and Water*

In addition to a food source, bacteria and fungi also require water and oxygen in order to live. A short supply of either will limit the number of microbes that can live on the food. This is the principle behind vacuum packing and freeze drying as methods of preserving food. However, some bacteria, like *Clostridium botulinum*, the bacteria that cause botulism, can decompose food without oxygen, so long as water is present. In this process, called anaerobic decomposition, dangerous toxins are produced. Dented canned goods are a prime breeding ground for the botulism bacteria.

→ *Favorable Temperatures Speed Decomposition*

To slow food decomposition, a refrigerator should be set below 40 degrees Fahrenheit. Temperatures between 40 and 140 degrees Fahrenheit are ideal for food decomposition. At these temperatures microbe and enzyme activity is optimized, making food energy more available to the bacteria and fungi. Consequently they grow and multiply quickly. However, food does decompose at lower temperatures, even below freezing, though more slowly. This is why food does not keep indefinitely when stored in the

refrigerator. In cooking, food-borne bacteria are killed at temperatures between 145 and 180 degrees Fahrenheit. The exact temperature depends on the particular bacteria species.

→ *Chemical Conditions Inhibit Decomposition*

Foods that keep a long time because of high sugar, salt or acid content are not suitable for composting. High sugar, salt or acid content creates a hostile environment for fungi and bacteria. Candying, salt curing and pickling are methods commonly used to preserve food and should be avoided in a composting bin.

Getting Started:

The day before

At least 24 hours prior to this in class activity, coat the plastic container with Krylon® or other appropriate ****plastic adhering**** spray primer/white paint, should you decide to have the class paint the compost bin after it is drilled. Make sure to prime it **outside** or in a garage. (****Acrylic paint will easily chip/rub off the plastic container without a plastic adhering primer****)

The day of

Divide students into groups to work on separate parts of the compost bin. A group of 3 or 4 students could work on painting/decorating the lid while another group of 2 or 3 drill the holes in the bin. Having both groups work over some spread out newspapers will limit the cleanup required later. Another couple of students could gather newspaper and other “scratch” paper (paper from the class recycling bin) to shred. If there is no shredder available, have the students cut and tear paper into very small pieces. This is probably the most undesirable task, so have groups switch tasks part way through. All students ought to be involved in painting the container.

- 1.) Drill holes in about a 1inch grid, along the bottom of the plastic container as well as a few inches up the sides to where the lid will sit.
- 2.) Have students paint the lid and outside of the container (if properly primed)
- 3.) Allow paint to dry completely (overnight) then spray with a clear, plastic adhering paint to seal students’ artwork. Allow another 24 hours to dry.
- 4.) Find a suitable space outside the classroom to keep the compost bin (not in the sun) away from playgrounds, dumpsters and heavily trafficked areas and on preferably on a porous surface (grass, soil, sand), not concrete.
- 5.) Layer a few inches of shredded paper in the bottom of the container, then add a layer of food scraps, a layer of worms, shredded paper, food scraps, worms, repeat until nearly at the top of the container.

Viola! Your class has successfully made (and hopefully decorated) one fabulous, carbon footprint-reducing compost bin! Now all that’s left is to watch the magic happen.

From here on out

Make sure to stir the decomposing paper and food once a week, if not twice. If the compost is looking very wet, add more paper shreds (suggestion: Keep a separate plastic container of paper shreds next to the compost bin). If the compost seems very dry, mist it with de-chlorinated water (tap water that has sat out overnight) and turn it, repeatedly, until moist again.

When the Bin becomes full to the brim, cease adding anymore food scraps! It will take a few more weeks for the worms and microbes to do their work but soon enough, you will have fresh, black gold! Keep turning the compost during this time as oxygen must be stirred into the mix, regularly.

When the compost is looking finished (Dark brown to nearly black, moist “soil”) it is time to harvest! Empty the compost on a plastic ground tarp (outside), in the sun. The worms will burrow downwards to escape the sun. You can shovel the top layer of the compost into a bucket or other suitable container, until you hit worms. Repeat this process but let it be known that some manual removal of worms will need to be done! Save these worms for the next round of composting.

What now?

Now you have what farmers and gardeners call *Black Gold*. Worm castings is one of the richest and most prized soil conditioners in the world and you just made some! All it took was a few materials from the hardware store, some paper and all that food that you would have thrown away in the trash. It’s now time to think about more classroom/school projects that can utilize this wonderful material (herb/flower/vegetable garden, etc).

Conclusion

This is a great experiment for students. It can easily be turned into a Life/earth Science experiment where they weigh the amount of food scraps and paper before adding to the compost and weigh the final compost when finished, from here, you can determine the percent decomposed (consumed, evaporated and run off).

This can also be an ongoing, year-round project, where just the class or the whole school is involved, saving food scraps from the cafeteria/lunchroom in an appropriate container and adding it (along with a healthy dose of paper shreds) each day to the compost bin. A way to track progress with this year-round experiment is to weigh the food scraps each day, before adding to the compost bin (weigh the food scrap container dry and mark its weight on the inside lid, so each time it is weighed full, the students can subtract the weight of the container to find the weight of the food scraps). A running total can be kept in the corner of a blackboard or on a classroom computer and at the end of the year, the class can calculate how many lbs of CO₂ they saved, compared to throwing away food scraps in the trash:

1lb of solid waste generates 1lb of CO₂

(U.S. Energy Information administration; Independent Statistics & Analysis)

Resources

[Worms Eat My Garbage](#); Apelfhof, Mary. Flower Press, 1997

http://www.krylon.com/products/fusion_for_plastic

<http://www.cityfarmer.org/wormsupl79.html>