

Compost is nature's way of recycling

Grades: (3-7)

Time: 60-90 minutes

Overview

Students identify and understand the role of organics or outdoor materials in making compost and learn the uses for compost and benefits of composting. Teachers please note: The decomposition process can take weeks or months, depending on the materials you use. This activity is designed to guide you in making an outdoor compost pile. It can be modified to be a compost bin or system that suits you.

Materials

Compost fact sheet (below)

compost bin

Food scraps

bread

eggshells

twigs

grass

coffee grounds

tea bags

autumn leaves

potting soil

shredded

newspaper

Rake, shovel, or long stick (to mix the compost)

Long-stemmed thermometer (3-foot stem)

A variety of colored markers.

paper and pencils

Procedure

1. Warm-up: Organize students into six groups. Explain that each group will be working on one specific area of composting: adding compost starter material, adding water and mixing, adding food scraps, Water mixing compost pile, monitoring the temperature of the pile, and recording these steps and making project observations Explain, "These groups will work together during the entire project as we learn how the compost is made."

2. Write the word COMPOST on a Whiteboard with a marker.

Ask the students, "What do you think the word COMPOST means?" In a different colored marker, write their responses. If the class doesn't have a definition, look in the Glossary. Read that definition aloud to the students, write it on the chart paper, and discuss it with them.

3. Ask the students, "Can you think of reasons why people have compost systems?" Get their responses and guide them into a discussion about recycling organic materials. For example, you might say: "Composting is nature's way of recycling. It's a natural process that takes place all around us. All organic matter will eventually

decompose. When a leaf falls to the ground, it is eaten and digested by bacteria, fungi, centipedes, beetles, and worms. Compost is what these organisms leave behind, and it becomes part of the soil where its nutrients are absorbed by plant roots to help make new leaves." After you're finished explaining this, ask if the students have any questions.

4. Tell the students, "We are going to watch a video about compost. As you watch it, think about the definition that we discussed and see if there is any new information in the video."

5. Watch a composting video.

6. After you've watched the video, discuss it with the class and look for new information that can be added to your chart paper. (examples of what you can and can't place in a compost system)

7. Explain to the class, "We are going to make our own compost pile to see how composting works. The first step is to collect organic materials.

Since I knew we were going to be doing this activity, I have some things we can use, like [continue with your actual list of compost materials]. We'll use these to make our compost pile."

8. Once you've gone over the materials, ask, "Has anyone ever heard of a microorganism?" Use the Glossary to define it. Then explain that for microorganisms to create compost from organic material, they need water and oxygen. Continue to explain that microorganisms are naturally present in the environment and will readily establish themselves and thrive in a compost pile.

9. Bring the class to the composting area or compost bin. Distribute the Compost fact sheet to each group.

Read through the steps with the class; ask if there are any questions.

10. Distribute the compost starter material, water, food scraps, paper and pencils, and other necessary tools to the appropriate groups and explain to the class, "To create a compost pile, we'll follow each of the steps we've just discussed."

11. Each group proceeds with its specific tasks in building the compost pile (refer to the Compost fact sheet for details):

- The compost starter group adds twigs/small branches/ autumn leaves (or other compost starter material) to the compost bin.
- The watering group adds the appropriate amount of water to the bin and mixes the materials.
- The food scraps group adds the collected food scraps and other materials for composting.
- The mixing group mixes the compost pile.
- The temperature group uses the thermometer to take a reading at the center of the pile. The group can make a chart on which they record the date and the temperature taken on each date. They can then compare their findings over a period of time, and share them with the class.
- The recording group takes notes on these steps and records any observations.

12. Explain to the class that they'll be stirring the pile and adding materials once a week over a long period of time. Tell them that the final product will be compost that they can add to soil to grow seeds and plants, or mix with existing soil in the schoolyard.

13. Wrap-up: After completing the compost pile, return to the classroom. Explain, "Each group will discuss the questions I'll be writing on the board. You've got ten minutes to discuss them, then you'll share your answers and ideas with the whole class."

Class Questions (write on the board):

- Why did we start the compost pile with leaves, potting soil, or shredded newspapers?
- Why do you think compost needs air and water?
- What organic materials do you think will decompose the fastest? The slowest?
- How does composting reduce the amount of waste you would have thrown out?

Homework

Ask the class to organize a part of their journal or to create a separate journal for observations they have on the composting process. Explain, "When you see that something has begun to decompose, please record what you saw in your journal. You can write and draw it. Are there any questions?"

Additional Discussion Points (after 2-4 weeks):

- What materials are decomposing the fastest? Why?
- Has the temperature in the compost pile changed? If so, how?
- What else have you seen in the compost pile that's interesting to you?
- What are some of the observations you've made in your journal?

Composting Fact Sheet

Composting incorporates the 3Rs, i.e. reduce, reuse and recycle. It reduces the quantity of garbage by diverting organic waste from landfill, which in turn reduces the amount of leachate, odors and greenhouse gases. It allows us to reuse materials, giving a new lease of life to unwanted 'garbage', by converting it into beneficial nutrients, hence regenerating the soil and plants. The natural biological process of composting recycles organic matter back into the environment.

What is composting?

Composting is a method of solid waste management whereby the organic component of the solid waste stream is biologically decomposed under controlled conditions to a state in which it can be handled, stored, and/or applied to the land without adversely affecting the environment (BioCycle 1991).

In simple terms it is the art of creating humus very quickly by speeding up the natural decomposition process. This is achieved by creating optimal conditions for microbes and small invertebrates to naturally break down organic waste from the kitchen or garden in a compost bin or heap. The end product after several months is a dark colored earthy material called compost. Further decomposition over time and re-combination with clay minerals and various organic molecules will produce humus.

Benefits of composting

Compost is good for plants and improves the condition of the soil. It inoculates the soil with vast numbers of beneficial microbes, which can extract nutrients from the mineral soil making it available to plants. Compost also holds nutrients in the soil until plants can use them, increases the organic content of poor soils, retains moisture in sandy soils and loosens and aerates clay soils making it porous. Composting also saves valuable landfill space.

The compost community

The compost heap harbors a rich and diverse community, which can be divided into three levels of consumers. These creatures are intricately linked into a complex food web.

Micro-organisms are the primary level consumers or decomposers of decaying matter, and consist of bacteria, fungi and actinomycetes (a close relative of the fungi). Bacteria are responsible for the initial breakdown of the organic material and for a large part of the heat energy released in the compost heap. They extract carbon as the energy source from the decaying matter and use nitrogen to build up their mass.

During composting, the population of the micro-organisms changes as the temperature rises. A succession of different groups of microbes enters the heap. The microbes can be divided into three different groups, according to the temperature ranges that they operate within. The early colonizers are called psychrophiles, and work best at about 13° C. They release a small amount of heat energy and allow the mesophiles to take over. The mesophiles thrive best between 20-30° C, and heat up the compost for the next group of bacteria. The thermophiles actively carry out the composting process between 40-70° C.

The fungi and actinomycetes are also microscopic and generally act on the cellulose, lignin and other organic components of plant material. Their presence are indicated by fine cobweb like threads called mycelia that permeate the decomposing matter.

Another group of primary consumers are the roundworms (nematodes), whiteworms, earthworms, small snails and slugs, small beetle mites, millipedes, fly larva (diptera) and sowbug (isopod).

The primary level consumers are predated upon by the secondary and tertiary level consumers. Members consist of rotifers, protozoa, roundworms, flatworms, mites, springtails (collembola), beetles (ptiliids & carabid), centipedes, spiders and ants.

How does composting work?

Decomposition can occur in two different ways, depending on the availability of oxygen.

Aerobic decomposition: This is the process whereby the breakdown of organic matter occurs in the presence of oxygen (air). Bacteria and fungi are the main agents responsible for aerobic decomposition in open compost heaps or in compost bins that have good ventilation. There should be no objectionable odors produced. Composting is generally completed in a few months and the process speeds up if the materials are regularly turned over.

Anaerobic decomposition: Decomposition can still occur in very low oxygen levels, albeit at a very slow rate. Under such conditions, the breakdown of organic matter is carried out by specialized anaerobic bacteria and fungi. This can happen if the compost bin is not well ventilated and it can take longer than 6 months to complete the composting process. It can also produce unpleasant odors and attract vermin.

Aerobic decomposition makes composting easy. All that is needed is the right conditions for the microbes to digest the organic matter. To help us build up a successful compost heap, think simply of ADAM, which stands for: Aliveness, Diversity, Aeration and Moisture.

Aliveness reminds us that the materials suitable for composting must come from things that were once living i.e. organic in nature. Inorganic things like glass and metals cannot be composted. Although animal products are also organic in nature, they should be avoided as well. They tend to produce environmental health risks like bad smelling odors, attract flies, maggots, vermin and can spread diseases.

Diversity is important. Try to include as many different types of plant matter as possible as this will enrich the end product. If the compost is made only from a few limited sources of plant matter, it can be lacking in a sufficient variety of nutrients. Diversity also encourages the development of a healthy and complex compost community.

Aeration is crucial. Aerobic composting microbes are living organisms and require air. When insufficient ventilation occurs, the anaerobic bacteria take over and produce undesirable foul smelling gases. Bulky materials like twigs, pine cones, straw and dry leaves provide plenty of air passages. Turning the compost heap with a garden fork or spade every now and then also ensures adequate aeration.

Moisture promotes microbial activity and helps disperse them throughout the compost heap. Ideally it should be as moist as a wrung-out sponge or about 45% by wet weight. In drier climates water has to be added occasionally to prevent the compost from drying out. Do not allow it to become soggy as the organic plant matter may clump together and prevent air from getting in. Ensure there is sufficient drainage space for excess water to flow out. It is good to cover the compost heap with a sheet to keep it moist at a comfortable level for the microbes to thrive and also to prevent too much rain infiltrating into the compost heap.

As the composting process develops, the temperature in the middle of the heap will rise to about 55-60°C, destroying pathogens and parasites over several weeks. Initially the pH of the heap is slightly acidic, but as the temperature exceeds 40°C, ammonia is produced and the compost becomes alkaline. Eventually it will become almost neutral or slightly alkaline. If anaerobic condition sets in, the acidity level rises and adding some lime will be helpful.

To keep a compost heap warm for a longer period of time, it should have a minimum size of about 1 cubic meter. This size gives it sufficient mass and insulation for the billions of heat-generating microbes to thrive. Smaller piles cannot insulate themselves well enough to retain the heat for long. If the compost heap is too big, it becomes hard to handle and has a greater chance of producing pockets of anaerobic activity and will quickly start to smell bad. Moreover, the heat generated may be too high making it unsuitable for some of the microbes to function at their optimum.

What kind of container can I make my compost in?

Compost bins and enclosures can be made out of just about any material, such as plastic bins, metal drums, wire mesh, bricks and timber to form enclosures. Containers keep the compost neat, organized and out of reach of pests. It is important that there are sufficient holes or air spaces for air circulation. The bin must not have a bottom as this will prevent soil microbes from moving into the compost heap and also prevents drainage of water. It should have a lid to stop unwanted vermin and flies from getting to the contents. Compost heaps within an enclosure should be covered with some sheeting material like an old carpet or tarpaulin to help keep moisture in and pests out.

Anaerobic composting digesters are airtight bins that keep the moisture in and prevent unpleasant odors from escaping. Water is to be added if it is dry. Soil is also introduced to boost up the supply of microbes. Rotating drums or tumblers are designed to make hot, fast compost.

Different ways of managing your compost

Compost can be effectively managed in a variety of ways. Some common methods including the advantages and disadvantages are as follows

TYPE
COMPOST HEAP



ADVANTAGES

- Low technology
- Costs nothing
- Easy access
- Easy to turn over

DISADVANTAGES

- Untidy
- Not vermin proof
- Needs covering
- Not portable

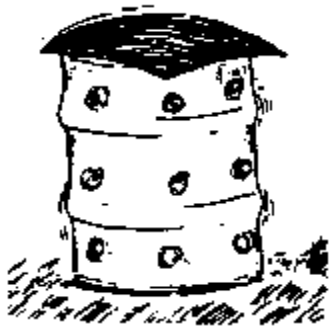
COMPOST ENCLOSURE



- Easy to make
- Cheap
- Easy access
- Easy to turn over
- Tidy

- Not vermin proof
- Needs covering
- Not portable

COMPOST DRUM



- Neat and tidy
- Good drainage
- Portable
- Cheap
- Easy to make
- Vermin proof
- Suitable for small gardens

- Somewhat slow composting
- Poor aeration
- Medium volume
- Hard to turn over

COMMERCIAL PLASTIC COMPOST BIN



- Neat and tidy
- Good drainage
- Portable
- Reasonably inexpensive
- Suitable for small gardens
- Vermin proof

- Somewhat slow composting
- Poor aeration
- Medium volume
- Hard to turn over

ROTATING COMPOST BARREL



- Rapid composting
- Large volume of compost produced
- Easy to turn over
- Portable
- Vermin proof
- Some costs involved
- Poor drainage

THREE-UNIT CONTAINERS



- Easy to turn over
- Neat and tidy
- Large volume of compost produced
- Vermin proof
- Some construction time and cost
- Not portable


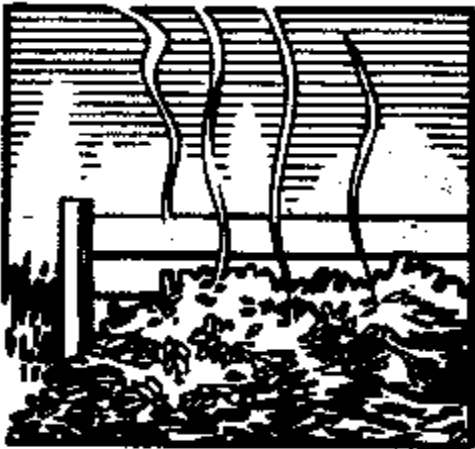

What can I compost?

As composting is a biological process, only organic material of biological origin can be composted. However, not everything should be composted even though they may be organic. Organic compounds of non-living origin, like plastics, cannot be composted. Putting the wrong material into compost can create health and environmental problems. A rule of thumb is to use only plant matter and avoid animal and inorganic matter. Below is a list of common things that make good compost as well as some materials to avoid.

What can be composted	What cannot be composted
Vegetable and fruit scraps	Meat and dairy products
Fallen leaves	Diseased plants
Tea leaves and tea bags	Timber products treated with chemicals
Coffee grounds	Droppings of meat eating animals e.g. dogs
Vacuum cleaner dust	Fats or oils
Soft stems of plants	Magazines
Dead flowers	Large branches from trees
Used vegetable cooking oil	Weeds with seeds or underground stems
Egg shells	Bread or cake
Old newspapers (shredded)	Bones
Lawn clippings	Plastics
Sawdust and wood ash	Metals
Tissues	Glass

Sometimes it is recommended that manure be added into the compost heap to enrich the end product, especially if there is a large component of paper and wood material.

How can I solve my compost problems?

PROBLEM	CAUSE(S)	SOLUTION(S)
 <p data-bbox="224 783 678 863">Compost takes too long to break down</p>	<ul data-bbox="808 302 1040 457" style="list-style-type: none"> • Too dry. • Not right mix of 'greens' and 'browns'. • Not enough air. 	<ul data-bbox="1141 302 1425 730" style="list-style-type: none"> • Add water. • Add equal amounts of 'greens' or 'browns'. • Turn more frequently. Add some compost worms (about 1,000) to the heap. Punch some holes in the container. Place a length of slotted agricultural pipe in the heap.
 <p data-bbox="332 1318 462 1367">Smelly</p>	<ul data-bbox="808 869 1031 999" style="list-style-type: none"> • Too wet. • Too acidic. • Insufficient air. 	<ul data-bbox="1141 869 1425 1087" style="list-style-type: none"> • See below. • Add some wood ash or dolomite to neutralise the heap. • Turn more often. Rebuild with some dry materials.
 <p data-bbox="354 1875 443 1911">Flies</p>	<ul data-bbox="808 1373 1084 1745" style="list-style-type: none"> • Most of the flies in and around a compost heap are small vinegar flies which are quite harmless. • If the flies are house flies or blowflies, then they are being attracted by meat, dairy foods or manure. 	<ul data-bbox="1141 1373 1425 1591" style="list-style-type: none"> • Cover organic waste with a thin layer of soil, grass or leaves. • Avoid adding these materials.



Too wet



Rats or mice



A lot of Slater's or ants

- Too much water has been added.
- Organic waste too moist.
- Inadequate drainage.

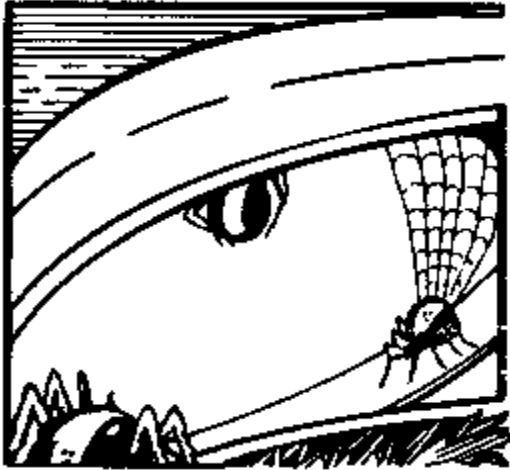
- Improve the drainage under the heap.
- Mix in some dry material such as dry grass clippings or shredded newspaper.
- Improve the drainage under the heap.

- Attracted by uncovered food and/or warmth of heap.

- Cover each addition of food with a layer of soil.
- Place the bin on a layer of fine wire mesh.
- Set traps around the bin.

- Heap is too dry.

- Add water or some moist organic materials.



Spiders under the lid

- Attracted by invertebrates, most likely small flies.
- Have a handle on the top of the lid. Check for spiders before placing your hand under the lid. Wear gloves.
- Cover each addition of food with a layer of soil.

What is mulch?

Compost and mulch are different. Mulch is applied to the surface of the soil and generally not rich in plant nutrients, as usually one type of material is used. Compost is generally derived from a variety of organic materials over time, making it rich in nutrients, and can be dug into the soil to feed the plants.

Mulching is the simplest way to recycle green organic waste at home. The materials can be chopped or shredded into small pieces and left on garden or vegetable beds or in flower pots. Ideally the mulch should be sufficiently thick, about 10 cms.

Mulching suppresses weeds, enriches the soil, retains soil moisture by reducing water loss from soil evaporation, encourages the multiplication of the microbial and invertebrate community, reduces or prevents soil erosion and protects plants from the cold.

Organic materials suitable for mulching at home are grass clippings, leaves, straw, bark, wood chips, tree prunings and sawdust. Since organic mulches progressively break down, they need to be topped up regularly. Mulches can also be made from inorganic materials, e.g. gravel, pebbles and plastics.

References

<http://www.indra.com/~topsoil/>

BioCycle, 1991, *The BioCycle Guide to the Art and Science of Composting*, JG Press, Pennsylvania USA.

Gould League of Victoria Inc, 1995, *Composting Made Easy, A Guide for Schools*.

In-Sink-Erator & Griffith University Waste Management Unit, undated, *Fact Sheet Background Information on Composting*.

Recycle 2000, November 1998, *1998 Metropolitan Waste Analysis*.

Recycle 2000 Fact Sheets.