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School Composting Resource Package

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention
Division of Consumer and Transportation
Composting Program
Revised April 2016

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THE GREEN TEAM Activities and Lesson Plans Alignment with the Massachusetts Science and Technology/Engineering Curriculum Framework, April 2016
COMPOSTING

Grade	Strand	Learning Standard	Climate Change Activities	Composting	Light Bulb	Slash Trash	Clean Air Idling Reduction Prototype Vehicle
PreK	Earth and Space Sciences	**PreK-ESS2-1(MA).** Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things.		X			X
		PreK-ESS2-2(MA). Observe and classify non-living materials, natural and human made, in their local environment.		X		X	
		PreK-ESS3-1(MA). Engage in discussion and raise questions using examples about local resources (including soil and water) humans use to meet their needs.	X	X		X	
		PreK-ESS3-2(MA). Observe and discuss the impact of people's activities on the local environment.	X	X	X	X	X
PreK	Life Science	**PreK-LS1-3(MA).** Use their five senses in their exploration and play to gather information.		X			
		PreK-LS2-3(MA). Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs.		X			X
PreK	Physical Sciences	**PreK-PS1-1(MA).** Investigate natural and human-made objects to describe, compare, sort and classify objects based on observable physical characteristics, uses, and whether something is manufactured or occurs in nature.		X		X	
		PreK-PS1-3(MA). Differentiate between the properties of an object and those of the material of which it is made.		X		X	
		PreK-PS1-4(MA). Recognize through investigation that physical objects and materials can change under different circumstances.		X	X	X	
K	Earth and Space Sciences	**K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment.	X	X	X	X	X
K	Life Science	**K-LS1-2(MA).** Recognize that all plants and animals grown and change over time.		X			
G1	Technology / Engineering	**K-2-ETS1-2.** Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.		X		X	X
G2	Life Science	**2-LS2-3(MA).** Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live.		X			
G2	Physical Science	**2-PS1-1.** Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.		X		X	
		2-PS1-2. Test different materials and analyze the data obtained to determine while materials have the properties that are best suited for an intended purpose.		X		X	
G3	Life Science	**3-LS1-1.** Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen.		X			
G3	Engineering Design	**3-5-ETS1-1.** Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet.		X	X	X	X
		3-5-ETS1-2. Generate several possible solutions to a design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.		X	X	X	X
		3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution.		X	X	X	X
G4	Life Science	**4-LS1-1.** Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.		X			
G4	Technology / Engineering	**3-5-ETS1-3.** Plan and carry out tests of one or more design features of a given model or prototype in which variables are controlled and failure points are considered to identify which features need to be improved. Apply the results of tests to redesign a model or prototype.		X		X	X
		3-5-ETS1-5(MA). Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem.		X	X	X	X

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G5	Earth and Space Sciences	**5-ESS3-1.** Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process.	X	X	X	X	X
G5	Life Science	**5-LS2-1.** Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water and soil in the environment to (a) show that plants produce sugars and plant materials, (b) show that animals can eat plants and/or other animals for food and (c) show that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil.		X			
		5-LS2-2(MA). Compare at least two designs for a composter to determine which is most likely to encourage decomposition of materials.*		X			
G5	Physical Science	**5-PS1-4.** Conduct an experiment to determine whether the mixing of two or more substances results in new substances with new properties (a chemical reaction) or not (a mixture).		X			
G6	Technology / Engineering	**6.MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.	X	X	X	X	X
		6.MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.		X		X	X
		6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution.		X		X	X
		6.MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution.		X		X	X
G7	Earth and Space Sciences	**7.MS-ESS3-4.** Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment.	X	X	X	X	X
G7	Life Science	**7.MS-LS2-1.** Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the size of populations in an ecosystem.		X			
		7.MS-LS2-2. Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems.		X			
		7.MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes.		X			
G7	Technology / Engineering	**7.MS-ETS1-4.** Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose.		X			X
		7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.		X		X	X
G8	Earth and Space Sciences	**8.MS-ESS3-5.** Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.	X	X	X	X	X
G8	Life Science	**8.MS-LS1-5.** Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.		X			
G8	Physical Science	**8.MS-PS1-1.** Develop a model to describe that (a) atoms combine in a multitude of ways to produce pure substances which make up all of the living and nonliving things that we encounter, (b) atoms form molecules and compounds that range in size from two to thousands of atoms, and (c) mixtures are composed of different proportions of pure substances.		X			
		8.MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.		X			X

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HS	Earth and Space Sciences	**HS-ESS2-6.** Use a model to describe cycling of carbon through the ocean, atmosphere, soil, and biosphere and how increases in carbon dioxide concentrations due to human activity have resulted in atmospheric and climate changes.	X	X	X	X	X
		HS-ESS3-2. Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social and environmental cost-benefit ratios.	X	X	X	X	X
HS	Biology	**HS-LS1-7.** Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new bonds form, resulting in new compounds and a net transfer of energy.		X			
		HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem.	X	X			
		HS-LS2-4. Use a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment.		X			
		HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.	X	X		X	X
		HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience.	X	X			
		HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.	X	X	X	X	X
HS	Technology / Engineering	**HS-ETS1-1.** Analyze a major global challenge to specify a design problem that can be improved. Determine necessary qualitative and quantitative criteria and constraints for solutions, including any requirements set by society.	X	X	X	X	X
		HS-ETS1-2. Break a complex real-world problem into smaller, more manageable problems that each can be solved using scientific and engineering principles.	X	X	X	X	X
		HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, aesthetics, and maintenance, as well as social, cultural, and environmental impacts.	X	X	X	X	X
		HS-ETS1-6(MA). Document and present solutions that include specifications, performance results, successes and remaining issues, and limitations.	X	X	X	X	X

Outline for a Composting Presentation

These are the essential points your presentation should include. Fill in the details based on your experience and the level of your students. To illustrate the magical nature of the decomposition process, pass out samples of finished compost for students to observe, touch and smell. Ask them to guess what the original ingredients were. Their answers will indicate how much they already know about composting and provide a nice lead-in to a more detailed presentation or discussion.

What composting is:

- Managing the natural recycling system of decomposition, which converts organic material into humus.

Why compost:

- Produce valuable soil supplement; return organic matter to soil;
- Reduce amount of waste needing disposal by landfill or incineration;
- Save on disposal costs;
- Save on garbage bags and leaf bags;
- Reduce pollution created by waste collection vehicles;
- Other (add your own).

Who does the majority of the work:

- Soil organisms: microorganisms (bacteria, actinomycetes), molds, fungi, earthworms, insects.

Requirements of the decomposers:

1. **Food**. Organic material, ideally in a carbon:nitrogen ratio of 30:1. A "recipe" of three parts "browns" to one part "greens" (by volume) is best because it approximates a 30:1 carbon to nitrogen ratio and prevents odors from developing. Maximize surface area by shredding or chopping.

Yes		No
Brown	**Green**	
Fall leaves	Grass clippings	Meat, bones, fat, grease
Straw	Weeds (without seeds)	Peanut butter, oils
Brown hay	Fruit and vegetable scraps	Dairy products
Paper	Manure (not dog or cat)	Branches
Coffee filters	Coffee grounds, tea bags	Diseased plants
Sawdust	Egg shells	Cooked foods w/butter or sauce
Wood chips	Bread and grains (if bin	Dog and cat manure
Wood ash	is rodent resistant)	Weeds gone to seed
(thin layers)	Seaweed	Weeds that spread by roots and runners

2. **Air.** Oxygen is needed by aerobic organisms. Anaerobic organisms produce gases that smell like rotten eggs.

3. **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 leaves rustle, they're too dry. If material is

not damp, the composting process will stop.

4. **Volume.** Pile should be large enough to maintain heat, minimum of 3'x3'x3' (one cubic yard).

Bins

- Help pile hold in heat and moisture;
- Look neater than loose piles;
- In urban areas, a rodent-resistant bin must be used;
- Wide variety of styles to choose from;
- Many municipalities distribute compost bins through the Department of Environmental Protection's recycling grant program and may donate compost bins to schools; contact your local recycling coordinator to check availability.

How to make compost:

- Choose a shady location; if in sun, cover pile to prevent drying;
- Use a bin - select a style appropriate for your situation;
- Layer the materials in the bin in 2"-8" layers;
- Sprinkle soil or finished compost between the layers;
- Wet leaves and other material if it is not moist (should feel like a damp sponge) as you add them;
- Try to build pile so air can penetrate inside;
- If composting vegetable scraps, fill the bin three-quarters full with leaves or other high carbon material first and bury food 8" deep;
- Turn or stir the material in the bin occasionally to introduce fresh oxygen supply.

How and when to use compost:

- Compost ready in 6 months to a year;
- Should look like dark brown, crumbly soil, can't recognize original ingredients;
- Apply about 3" deep to soil and mix in with top 4" of soil, about a month before planting time;
- Mix equal parts compost, soil and sand to make a potting soil mix;
- Till under in fall, will break down over winter. Soil will be ready to grow great crops by spring.

Free brochures on home composting are available from Massachusetts Department of Environmental Protection, 617-292-5834, or on-line at www.state.ma.us/dep/recycle.

A 17 minute how-to video entitled "Home Composting; Turning Your Spoils to Soil" should be available at your local library. If it is not, your or the librarian may call the DEP Composting Program at (617)292-5834 to request one.

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.

BACKGROUND 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.

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.

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.

EXTENSIONS:

1. Grow seedlings using the finished compost. Make different blends with potting soil, using pure potting soil as a control.
2. Design and build a compost bin.
3. Divide the class into groups. Have each group prepare a logbook and record the daily temperature of the pile for two months. Other observations should also be made, such as organisms seen, odors detected, moisture content, color, and amount of decomposition.
4. Discuss the results, addressing questions such as: How is composting related to the concept of recycling? Can composting make a difference in the amount of waste needing disposal? Why don't more people compost? What would make it easier for people to compost?
5. Have each student choose and research one decomposer organism in depth, then make 5-minute presentations to the rest of the class.
6. Using the C:N ratio for leaves (60:1) and grass clippings (20:1), have students calculate how many parts leaves to grass clippings would result in a C:N ration of 30:1.

NECESSARY COMPONENTS OF A COMPOST PILE

Composting is not difficult—most of the work is done by organisms that live in the soil and on the surface of organic material. The smallest and most numerous of these decomposers are naturally occurring bacteria. They are assisted by molds, fungi, mites, beetles, centipedes, millipedes and, perhaps most popular among gardeners, earthworms. All of these creatures play important roles in the food web of the compost heap. If your compost pile is in contact with the soil, these organisms will migrate up into the organic material. If your compost pile is contained and has a floor, place 2 inches of nonsterile soil in the bottom of the container before adding organic material.

Successful composting is simply a matter of providing the conditions in which the decomposer organisms will flourish. Like you, they need food, air, water, and a habitable temperature. If you keep these requirements in mind, you will compost successfully.

Food

What you add to your compost pile will provide the food for the decomposers. All organic material contains carbon and nitrogen in varying amounts. The microorganisms need carbon for energy and nitrogen to reproduce, and they are most productive when the ratio of carbon to nitrogen is approximately 30 to 1 (30:1). To achieve a good carbon-to-nitrogen ratio, keep in mind that brown, woody materials, such as autumn leaves, straw, and cornstalks ("browns"), are high in carbon, and should be mixed or layered with damp, green materials, such as weeds, grass clippings, or vegetable scraps ("greens"), which are high in nitrogen. A recipe of three parts "brown" material to one part "green" material (by volume), will result in an overall carbon to nitrogen ratio equal to or greater than 30:1. A C:N ratio equal to or greater than 30:1 will not normally result in offensive odors. High-carbon materials may be successfully composted alone, but high-nitrogen materials composted alone will result in a gooey, odorous mess. Maximize surface area by shredding or chopping the material.

OK To Put in Compost Pile		**Keep Out of Compost Pile**
Brown	**Green**	
Fall leaves Straw Brown hay Paper Coffee filters Sawdust Wood chips Wood ash (thin layers)	Grass clippings Weeds (without seeds) Fruit and vegetables scraps Manure (not dog or cat) Coffee grounds, tea bags Egg shells Bread and grains (if bin is rodent resistant) Seaweed	Meat, bones, fat, grease Peanut butter, oils Dairy products Cooked foods with butter or sauce Dog and cat manure Branches Diseased plants Weeds gone to seed Weeds that spread by roots and runners

Air

If your compost pile is too wet or too compact, anaerobic organisms will take over, creating odors of ammonia or rotten eggs. To keep your compost pile from developing unpleasant smells, oxygen must be available so that aerobic organisms will thrive. Oxygen can be supplied to the inside of the pile by turning it regularly, or air passages can be built into the pile by using coarse material on the bottom. The New Age Composter has a cone-shaped floor that continuously provides air to the bottom of the pile.

Moisture

Decomposer organisms require a moist environment. The composting material should contain about 50 percent moisture, which should make it feel as damp as a wrung out sponge, but not dripping wet. If material is not damp, the composting process will stop. If material is too wet, air spaces will be filled with water, resulting in anaerobic conditions and odors.

Habitable temperatures

As the organisms go to work, they produce heat, which causes the temperature in the pile to rise. This creates a good environment for other heat-loving organisms to multiply, increasing the population of decomposers. To maintain its heat throughout the year, the compost pile must have sufficient mass. One cubic yard (27 cubic feet) is the minimum volume needed to maintain the heat of composting through the winter. If you don't have enough material to make a pile that large, the pile will freeze in the winter but the organisms will revive when warm weather returns and the composting process will resume.

Refer to the following chart if you should have problems with your compost pile.

COMPOSTING TROUBLE-SHOOTING CHART

Symptoms	Problems	Solutions
Pile not decomposing	Too dry	Moisten till damp
Pile smells rotten and/or attracts flies	Too wet Wrong materials in pile	Mix in dry, woody materials Remove meat, bones, etc.
Rodents or other animals attracted to pile	Food scraps in open bin and/or not buried Wrong materials in pile	Use rodent-resistant bin Bury food scraps at least 8" deep Remove meat, bones, etc.

Composting is easy!

To make compost, just follow these simple steps:

1. Add three parts "browns"...

Fall leaves, straw, salt marsh hay, shredded paper and cardboard (newspaper, paper towels, paper plates, paper bags), chipped brush, sawdust, pine needles (pine needles should not make up more than 10% of total material in pile).

...and one part "greens"

Grass clippings, weeds (not laden with seeds), vegetable and fruit wastes, seaweed, eggshells, coffee grounds and filters, tea bags, manure (horse, cow, rabbit, chicken, goat, gerbil, etc).

2. Mix or layer materials.

After every 12" or so, add a few shovelfuls of rich soil or compost.

3. Keep it damp and aerated.

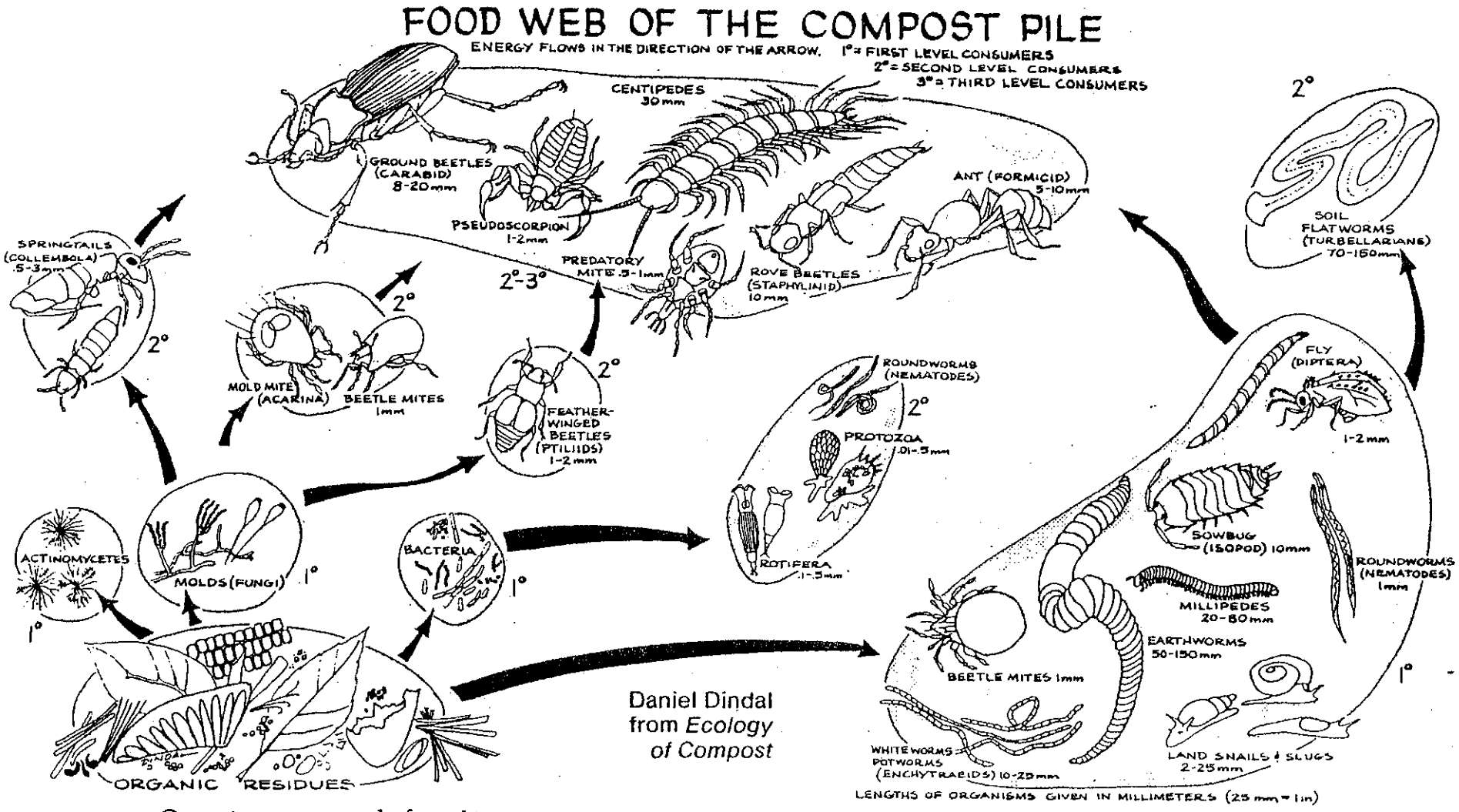
Wait a few months, and voilà...black gold!

For best results, and to keep out odors and pests,

DO NOT ADD:

- Meat, bones, fat, grease, oils
- Peanut butter
- Dairy products
- Cooked foods with sauces or butter
- Dog and cat manure
- Diseased plants
- Weeds gone to seed
- Weeds that spread by roots and runners (vines)

Prepared by the Massachusetts Department of Environmental Protection



Organisms commonly found in compost. Energy flows from organism to organism as one is eaten by the other in a natural recycling system.

VARIATIONS ON A THEME - HOW TO MAKE COMPOST

THEME: Composting...
* reduces the amount of organic material requiring landfilling or incineration
* produces a valuable soil supplement containing nutrients and other beneficial qualities
* provides an opportunity to observe nature at work

GOAL: Students observe how different factors affect the composting process and learn how to construct a good compost pile

METHOD: Making a compost pile correctly; making compost piles in which key components are varied

SUBJECTS: Biology, ecology, horticulture, math, chemistry

SKILLS: Analysis, experimentation, prediction, observation

MATERIALS:

1. Organic materials including at least one type of high carbon material (e.g., brown leaves, straw, sawdust, cardboard, paper) and at least one type of high nitrogen material (e.g., grass clippings, fruit and vegetable scraps, weeds, seaweed)
2. One to six compost bin(s), depending on how many variations your class creates. Many communities sell low-cost compost bins through the Department of Environmental Protection's recycling grant program; some donate compost bins to schools. A garbage can with holes drilled in the sides and bottom may be used as a compost bin, also. Smaller containers such as 5-gallon buckets may be used for the variations.
3. Six shovelfuls of finished compost or outdoor soil for each compost bin. (If small containers are used for variations, less soil will be needed).
4. Two or three paper cups containing finished compost
5. Compost thermometer
6. Gloves, rakes, shovels

TIME: Two one-hour sessions for set-ups, several months for observations

GETTING STARTED
What are the essential components for successful composting?

BACKGROUND
There are many different ways to compost successfully. There are only four key components to the composting process, but if any one of them is left out, composting may not occur at all, or it may create odors. This activity teaches students how to compost successfully, and to try variations which leave out key components, thus illustrating the importance of each.

1. To illustrate the transformative nature of the decomposition process, pass around the paper cups containing finished compost for students to observe, touch and smell. Ask them to guess what the original ingredients were. Their answers will indicate how much they already know about composting and provide a good introduction to the topic of how to make compost.
2. Review with the students DEP's Home Composting brochure, "Necessary Components of a Compost Pile," and "Composting is Easy!" As a group, make a compost pile based on the information given, using an aerobic compost bin. This will be your control pile (one session).
3. Working in teams, build additional compost piles based on the variations described in the worksheet (one session).
4. Have each group prepare a log book and record the daily temperature of its pile and the control pile for two months. Other observations should be made also, such as organisms seen, odors detected, moisture content, color, amount of decomposition.
5. Discuss the results, addressing the questions on the worksheet and broader questions such as: How is composting related to the concept of recycling? Can composting make a difference in the amount of waste needing disposal? Why don't more people compost? What would make it easier for people to compost?

Extensions:
1. Have the students design compost bins which satisfy the requirements of the decomposer organisms and the needs of people who might use the bins. This could be a group or individual project. Select the best bin, have the class build it and use it.
2. Grow seedlings using the finished compost. Make different blends with potting soil, using pure potting soil as a control.
3. Have each student choose and research one decomposer organism in depth, then make 5 minute presentations to the rest of the class.
4. Using the C:N ratio for leaves (80:1) and grass clippings (20:1), have students calculate how many parts leaves to grass clippings would result in a C:N ration of 30:1.

VARIATIONS ON A THEME - HOW NOT TO MAKE COMPOST!

Worksheet

Keeping all other components as instructed in the home composting brochure, make compost piles which vary in one key component as described below. Variations 1 and 4 will not produce odors. Variations 2, 3 and 5 are likely to produce odors. You can illustrate the principles involved without creating nuisance conditions by making miniature piles for variations 2, 3 and 5 using 5-gallon buckets or similar containers instead of full size compost bins.

1. Not Enough Moisture
Make the compost pile with dry ingredients only. Do not add moisture. Use a bin with solid cover to keep rainwater out, or cover the bin with plastic.

2. Too Much Moisture
Make the compost pile, soaking the materials with water as they are placed in the bin. Water should drip from the material when it is picked up. Add water every day for one week. **This variation may produce strong odors, depending on how much moisture is retained in the pile. Make observations after one week, then mix enough dry, brown leaves into the pile so that it is moist, not dripping. If it smells, cover with 2" of soil and let sit for one month without turning.**

3. Too Much Nitrogen, Not Enough Carbon (C:N Ratio Too Low)
Make the compost pile using only high nitrogen materials. Use anything from the "green" list. Continue this variation for one week only. **This variation may produce strong odors, depending on the size of the pile. After one week, mix twice the volume of brown leaves into the pile of high nitrogen material. Cover with 2" of soil. Let sit for one month without turning.**

4. Too Much Carbon, Not Enough Nitrogen (C:N Ratio Too High)
Make the compost pile using only high carbon materials. Use anything from the "brown" list. This variation will not create unpleasant odors.

5. Not Enough Air
Make the compost pile in an airtight container, such as a garbage can with a tight-fitting lid, or a smaller container. Do not open the lid for one week. **This variation may produce odors, depending on the material used, the size and the airtightness of the container. After one week, mix twice the volume of brown leaves into the container. If it smells, cover with 2" of soil. Let sit for one week without turning. Place material into aerobic bin (or drill holes in the garbage can every 2") and continue composting.**

Questions:
1. Why didn't anything happen to the dry pile?
2. Why did the wet pile start to smell?
3. Why does an excess of high nitrogen materials in a compost pile result in odors?
4. Why doesn't an excess of high carbon materials in a compost pile result in odors? Why does it take longer to decompose?
5. Why does a lack of oxygen result in odors?

Answers:
1. Without adequate moisture, the decomposer organisms cannot thrive.
2. Water fills air spaces, aerobic organisms die. Anaerobic organisms take over, releasing odorous gases (hydrogen sulfide, ammonia).
3. Too much nitrogen can cause the organisms to multiply very quickly, use up all the available oxygen, and die off. Anaerobic organisms then take over, releasing odorous gases. Also, excess nitrogen will be converted to ammonia.
4. An excess of high carbon material necessarily implies a shortage of nitrogen, which limits the speed with which the organisms reproduce. This makes it unlikely that the conditions which result in odors (as described above) will develop.
5. A lack of oxygen results in odors because such an environment encourages the growth of anaerobic organisms, which release odorous gases.

INDOOR COMPOSTING WITH EARTHWORMS (VERMICOMPOSTING)

Composting is a controlled process of decomposition used to transform organic material such as kitchen scraps, yard wastes and paper products into humus. Humus, or compost, is a dark, soil-like substance that enriches soil with nutrients, increases moisture retention, improves structure and provides a good environment for beneficial soil organisms. Composting is usually done outdoors, but the process can easily be adapted for indoor use. So you can compost even if you don't have a yard, or if you don't like going out to a compost bin in the snow, or if you want to produce the highest quality compost there is: vermicompost!

What is vermicomposting?

Vermicomposting is simply composting with earthworms. Earthworms speed up the composting process, aerate the organic material in the bin, and enhance the finished compost with nutrients and enzymes from their digestive tracts. The best kind of earthworm to use is the red worm, also known as "red wigglers" and "manure worms". These worms thrive in decomposing organic matter such as leaf piles, compost heaps and old manure piles. They are smaller than nightcrawlers and are reddish brown in color. Red worms are native to Europe but have become naturalized throughout the U.S. Red worms are a good indicator of fertile soil because their presence indicates high organic matter content and a lack of toxic substances in soil.

Red worms make composting indoors feasible because they are very efficient processors of organic waste; they eat and expel their own weight every day. Even a small bin of red worms will yield pounds of rich compost, also known as worm castings. Finished compost can be harvested in as little as two to three months. Redworms are extremely prolific. It takes about three weeks for fertilized eggs to develop in a cocoon from which two or more young worms can hatch. In three months the worms become sexually mature and will start breeding. Within a year you'll be able to give worms away to get a friend started! And you'll never have to buy bait for trout fishing again!

Where can I get a worm bin?

There are several mail order catalogs that sell worm bins, such as Real Goods, Seventh Generation and Gardener's Supply. Worms and bins are also available from the suppliers listed below. The least expensive way to obtain a worm bin is to make one from a plastic or wooden container by drilling air holes in the sides and top. Plastic containers can be purchased from a hardware or department store. Get one with a lid. Since worms do not like light, an opaque container is preferable to a translucent one, unless the bin is kept covered with a dark cloth. The larger the container, the more material you will be able to compost. A deep bin is preferable to a shallow one because it allows more room for layering and burying fresh material.

# People	Quantity of Worms	Bin Size
1 or 2	1 lb.	15"h x 1.5'w x 2'l
2 or 3	1 lb.	15"h x 2'w x 2' l
4 to 6	2 to 3 lbs.	15"h x 2'w x 3.5'l

How do I convert the bin to a worm bin?

Drill holes approximately 3" apart in the sides and cover of the bin. The holes should begin approximately 4" from the bottom of the bin. Diameter of the holes is not important, but they should not be wider than 1/8". Some guides recommend drilling holes in the bottom of the bin for drainage, but this is optional. If you provide drainage holes, you will need a tray to catch excess moisture. If you do not provide drainage holes, you will need to add extra dry material if the bin starts to develop puddles in the bottom. Red worms thrive in a very damp environment (at least 50% moisture), but puddled water will eventually result in odor formation.

How do I prepare the bin for the worms?

First, you will need bedding for the worms. Red worms can survive and breed in many kinds of bedding materials. The worms eat the bedding as it decomposes, turning it to compost along with the kitchen scraps you add. The bedding should be a high carbon material, such as fall leaves (best if small or shredded), shredded paper (such as newspaper, paper towels, napkins, paper bags), ground cardboard or peat moss. Make sure to mix peat moss with other bedding as it is too acidic to use alone. Bedding can be a combination of the above materials. Dampen the bedding until the moisture content is 50% (as damp as a wrung out sponge). It is important to keep the bedding this damp or the worms will die. Mix a few handfuls of soil or finished compost with the bedding. The bedding should fill the bin about 3/4 full. Vegetative wastes are buried underneath the bedding, which filters out any odors from the decomposing material below. The whole mixture will turn to compost in about 3 months. Now it's time to add the worms!

Where can I get Redworms?

Redworms can be ordered from the following suppliers and outlets:

Cape Cod Worm Farm
30 Center Ave.
Buzzards Bay, MA 02532
(508) 759-5664

Mass Natural Fertilizer
P.O. Box 363
Westminster, MA 01473
(978) 874-0744

Mary Appelhof*
Flowerfield Enterprises
10332 Shaver Rd.
Kalamazoo, MI 49002
(616) 327-0108

You may also find a commercial source of redworms in your area by checking the Yellow pages under the heading "Fishing Bait." Be sure to ask for redworms or red wigglers.

In nature, redworms can be found in decaying leaves, manure piles or other organic material, such as compost piles. If you have access to such areas, you can collect your own redworms. A few

handfuls are enough to start a bin, but add only small amounts of food scraps until the worm population increases enough to handle more (3-4 months).

*The above vendors offer several types of commercial worm bins and "worm kits" currently on the market, in addition to classroom curricula on worm composting. A "worm kit" includes a bin, worms, and accessories.

What do I feed them?

Worms will eat just about any type of kitchen waste including vegetables, fruits, coffee grinds, tea bags and eggshells (crushed.) Do not add meat or meat byproducts. Bury the food scraps completely, so that they are always covered by bedding; this prevents development of odors and fruit flies. Don't add more food scraps than the worms eat in several days. The worms can't eat the food until it starts to decompose, so it may take a few months for the bin to get up to speed. For fastest decomposition, chop the food scraps into small pieces.

Can worms live outside during colder months?

Worms prefer temperatures between 40 and 80 degrees Fahrenheit. If you live in an apartment building they can live quite happily out on the balcony until temperatures drop to 40 degrees. After that they should be taken indoors. Basements or garages that don't freeze are good locations for worm bins.

How do I harvest the finished compost?

After about three months you'll notice that the volume of materials has dropped substantially and the original bedding is no longer recognizable. At this point the finished compost and worms can be moved over to one side of the bin and new bedding added to the vacant side. Put new food wastes into the fresh bedding **only** so the worms will move from the finished compost in search of new food. After two weeks or so remove the lid under a bright light source. The worms are sensitive to light and will burrow away from it. Scoop out the finished compost a few layers at a time and place in a plastic bag or container until you're ready to use it. Latex gloves are very convenient for this task. Now add fresh bedding and the process begins again!

How can I use the finished compost?

Vermicompost, or worm castings, provides nutrients to your plants and helps the soil hold moisture. Growth trials indicate vermicompost has a more beneficial effect on plants than compost produced without worms, although the reasons for this are still not entirely understood. Vermicompost can be used in a number of different ways:

1. Mix it into the seed row when planting.
2. When transplanting, add a handful of vermicompost to the hole you have dug for the plant.
3. Use as a top dressing, placing a layer of vermicompost around the base of plants (but not in contact with the stems).
4. Mix with potting soil and sand (1/3rd each) for house plants.
5. Give a quart away (with the worms still in it) to someone else who wants to start vermicomposting.

Resources

Worms Eat My Garbage, Mary Appelhof, Flower Press, Michigan, 1982, 100 pp. Available from:

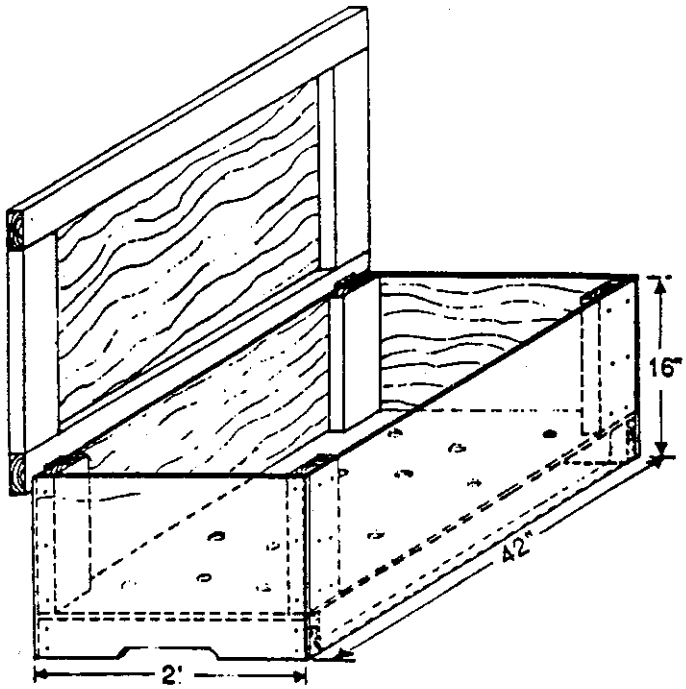
The Green Planet 22 Lincoln St. Newton Highlands, MA 02161 (617)332-7841	Bramen Co., Inc. 45 Mason St. Salem, MA 01970 (978)745-7765	The Village Store 999 Main St. Westport, MA02790 (508)636-2572

If you go to your local garden supply store and request that they order Worms Eat My Garbage, The Rodale Guide to Composting (Rodale Press) or Let It Rot! (Storey Publishing), then those books will be readily available to others in your community.

An excellent web site is the Vermicomposting Forum at
www.oldgrowth.org/compost/forum_vermi1/index.cgi

Produced by the Massachusetts Department of Environmental Protection Composting Program,
One Winter Street, Boston, Massachusetts 02108.
Revised December 2006

1 - 2 - 3 WORM COMPOSTING BIN



This system is designed for composting vegetable food wastes using red worms. Food wastes and worms are "bedded" in shredded and moistened newspaper, cardboard, peat or brown leaves. The worms turn both food wastes and bedding into a high-quality compost suitable for use on house plants, seedlings or general garden use.

To maintain this system simply rotate burial of food wastes throughout the bin. Every 3-6 months compost should be moved to one side of the bin and new bedding added to the empty half. At this time start burying wastes in the new bedding only. Within one month worms will populate the new bedding, finished compost may be harvested and the rest of the bin can be rebedded. During the winter worm bins should be kept in a cool indoor space such as a basement or warm garage to avoid freezing. A properly maintained worm bin is odorless. Bins may be placed in a shady outdoor space the remainder of the year. Flies may be controlled by placing a sheet of plastic over the bedding. Prevent the presence of fruit flies by burying the food scraps completely, so that they are always covered by bedding. This bin can be built for about $35 with new wood and hardware, or less using recycled materials. Worm bins can also be made from wooden boxes or other containers. Any worm bin must have drainage in the bottom and a tight fitting lid to keep moisture in and pests out. A starter batch of worms can be purchased at a small additional cost, or find some in an old compost pile ! **Seattle Tilth** sells red worms at the Backyard Composting Demonstration Site. For more information see Mary Appelhof's book, Worms Eat My Garbage, also available from Seattle Tilth.

Compost!

For information on King County's composting demonstration sites or waste reduction, recycling and composting programs, call the King County Solid Waste Division at 296-6542.

Our appreciation is extended to the Seattle Engineering Department's Solid Waste Utility and the Seattle Tilth Association for allowing King County to utilize this material which was designed for their Community Education Program.

This bin is sized to suit a family of four-six people generating about seven pounds of food waste each week.

Materials:

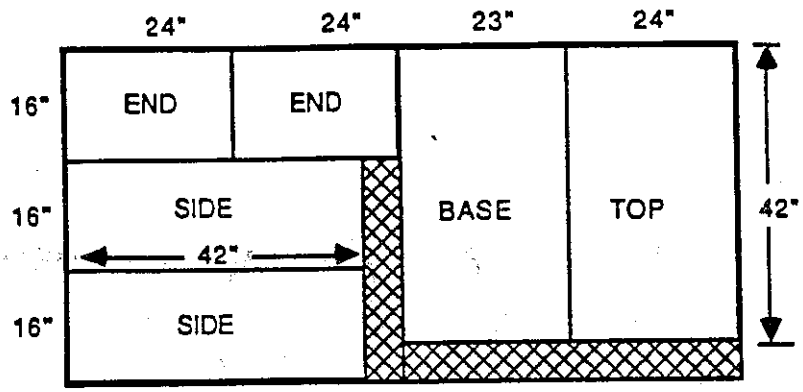
1 1/2" sheet of plywood
1 12 foot 2x4
1 16 foot 2x4
2 lbs. 6d galvanized nails
1/2 lb. 16d galvanized nails
2 galvanized door hinges

Tools:

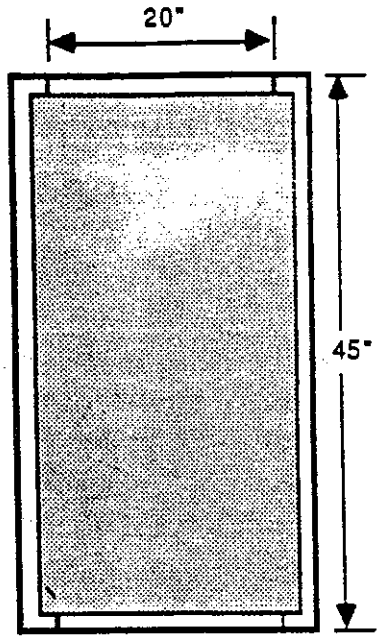
Tape measure, skill saw or rip hand saw, hammer, saw horses, long straight edge or chalk snap line, screwdriver, and drill with 1/2" bit.
Use eye and ear protection.

Note: Do not use wood that has been pressure-treated or treated with toxic preservatives. Non-toxic wood preservatives are available.

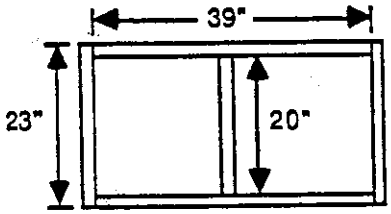
Construction Details:



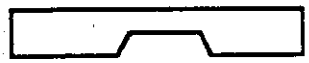
4' X 8' SHEET OF 1/2" PLYWOOD



TOP LID 2 X 4 FRAME WITH PLYWOOD COVER



BASE FRAME 2X4s ON EDGE


END BASE BOARDS CAN BE NOTCHED FOR HANDHOLDS

Measure and cut plywood as indicated in drawing above. Cut the 12 foot 2x4 into five pieces: two 39", two 23", and one 20" long. Nail the 2x4s together on edge with two 16d nails at each joint as illustrated in the Base Frame diagram. Nail the plywood base piece onto the 2x4 frame.

Cut four 1 foot lengths out of the 16 foot 2x4. Take each plywood side piece and place a one foot 2x4 under each of it's ends so that the 2x4 is flush with the top and side edges of the plywood, and nail the boards into place. Nail the side pieces onto the base frame. To complete the box, nail the ends onto the base and sides. To reinforce the box make sure there is a nail staggered at least every 3 inches wherever plywood and 2x4s meet. Drill twelve 1/2" holes through the bottom of the box for drainage.

To build the lid, take the remaining 12 foot 2x4 and cut it into two 45" pieces and two 20" pieces and lay them flat, short pieces on the inside as indicated in diagram above, so that the plywood top is inset from the edges of the 2x4 by 1-1/2" all the way around the perimeter. Nail the plywood onto the 2x4 securely. Place the hinges on the backside of the box at both ends on the 2x4s, and on the under side of the 2x4 lid frame, so that the lid will stand upright when opened.

2 X 2 EARTHWORM COMPOSTING BIN

This bin will accommodate the needs of one to two people generating about four pounds of food waste each week.

MATERIALS

1 - 1/2" sheet of plywood
36 - 2" ardox galvanized nails
Non-toxic wood preservative

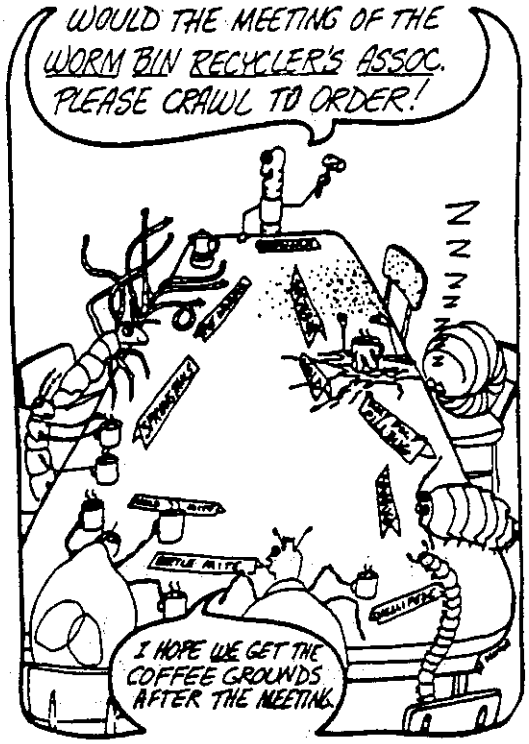
TOOLS

Same as for larger bin.

CONSTRUCTION:

Cut four pieces of plywood 23 1/2" x 8" for the sides. Nail them together, overlapping at the corners.

Cut one piece of plywood 24" x 24" for the bottom. Secure the bottom to the sides using about five nails per side. Drill twelve 1/2" holes in the bottom for aeration and drainage.



Use a dark plastic sheet over the top of the bedding as a cover or make a lid out of the remaining plywood.

This design sheet was originally produced for the Community Composting Education Program in Seattle, Washington.

It is being distributed as part of COMPOST ONTARIO, a project run by the Recycling Council of Ontario with funding from Barclay Recycling Inc. and the Ontario Ministry of the Environment.

Recycling Council of Ontario
489 College St., Suite 504
Toronto, Ontario M6G 1A5

October 1990

For more information about worm composting and bin-sizing, refer to: Worms Eat My Garbage by Mary Appelhof. Flower Press, Michigan, 1982.

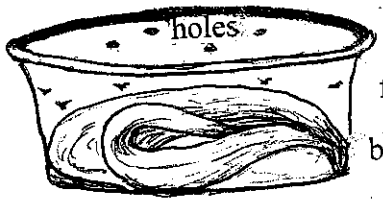
How to Control Fruit Flies and Fungus Gnats

Fruit flies and fungus gnats are the most common flying insects found in and around compost bins. These insects are not dangerous or harmful; however, their presence can be a nuisance, particularly indoors. A little information about the food and environments these insects are attracted to can be used to help us control their presence in places where they are not wanted.

Fruit flies

There are many species of fruit flies, ranging in size from 1-2 mm. They can be recognized by the rather bulbous shape of their lower bodies, which is frequently an orange or light brown color. They are relatively slow flyers, often hovering around fruit or juice.

Indoor compost bins (worm bins) provide favorable conditions for the reproduction of these insects, but occasionally fruit flies seem to appear in our kitchens as if by spontaneous generation, even without the presence of a worm bin. This is because they can travel into our homes, unbeknownst to us, as larvae on the fruit we buy. The adults lay their eggs, invisible to the naked eye, on bananas and other fruits, which later hatch while the fruit is in our fruit bowls. If we put fruit skins containing fruit fly larvae into our worm bins, we soon have a healthy population of fruit flies in and around the worm bin. It is advisable not to add any more food to the worm bin until the fruit flies are gone. Since banana peels seem to be the most common bearer of fruit fly larvae, some people prefer to compost banana peels in outdoor bins only.* Banana peels are also beneficial to rose bushes as a source of potassium and can be buried directly into the soil around the plants (not more than three skins per rose bush per week).



Fortunately, fruit flies have an excellent sense of smell and are strongly attracted by bananas. A simple, nontoxic, inexpensive, humane way to trap them is to place a banana peel inside a clear plastic container and make three or four holes in the cover with a standard round toothpick. Be sure to pull the toothpick all the way through the plastic and wiggle it around to make a hole large enough for a fruit fly to crawl through. Place the plastic container in or near the fruit bowl, not inside the worm bin. (If the worm bin is not in your kitchen, place the fruit fly trap on a surface above the worm bin; if it is inside or too close to the worm bin, the odor of the banana peel will not be distinct enough to attract the fruit flies as effectively). Within 24 hours, about 99% of the fruit flies will be inside the plastic container, having entered the holes and not found their way out. Each day, take the container outside and release the fruit flies, unless you are a biology teacher or entomologist and want them for genetics experiments. After three or four days, the fruit flies will be gone (if no additional banana peels or other potential source of larvae have been added to the worm bin).

Some species of fruit flies are larger than others. If you see fruit flies crawling around on the surface of your plastic container but not going inside, make the holes larger.

*If fruit flies become a nuisance in an outdoor compost bin, this indicates that the ratio of food scraps to high carbon material is too high. Add enough high carbon materials, such as brown leaves, shredded paper or cardboard, until this material comprises at least 50% of the total material in the bin. Try to keep about 12" of high carbon material on the surface of your pile, under which the food scraps are buried.

Fungus gnats

Fungus gnats are also members of the fly family, usually about 1 mm in size. They can be recognized by their all-black, rather "skinny" bodies, compared to that of fruit flies, and their "gnatlike" manner of flying. They can sometimes be observed crawling on the bedding in a worm bin, often while mating. They seem to be attracted to light, because their bodies can often be found on window sills.

Fungus gnats are attracted to moisture and fungus, and are therefore attracted to compost bins, indoors or out. The soil in which houseplants are potted can also provide an environment in which fungus gnats can flourish, so they may be found indoors even when there is no indoor compost bin. They may be frequently seen around outdoor compost piles, but they stay in the vicinity of the compost, so aren't normally considered a nuisance.

There currently seems to be no method for trapping fungus gnats. Instead, their presence can be controlled by eliminating what attracts them, moisture and fungus, from the area where the gnats are not wanted. Since both moisture and fungus are important elements of the composting process, they must not be eliminated entirely. One option that is quite effective is to keep the indoor compost bin uncovered and let the top layer of bedding dry out, while keeping the layers beneath at the 50% moisture necessary for active composting. This way, the fungus gnats tend to stay below the surface of the worm bin, where it is damp, and don't venture up to the surface enough to be noticeable.

If fungus gnats seem to be coming from your houseplants, this may indicate too much moisture. Try letting the plants dry out a little more.

Prepared by the Massachusetts Department of Environmental Protection
Bureau of Waste Prevention
1997

WHO EATS WHO?

DESCRIPTION Students are introduced to the concept of nutrient cycling.

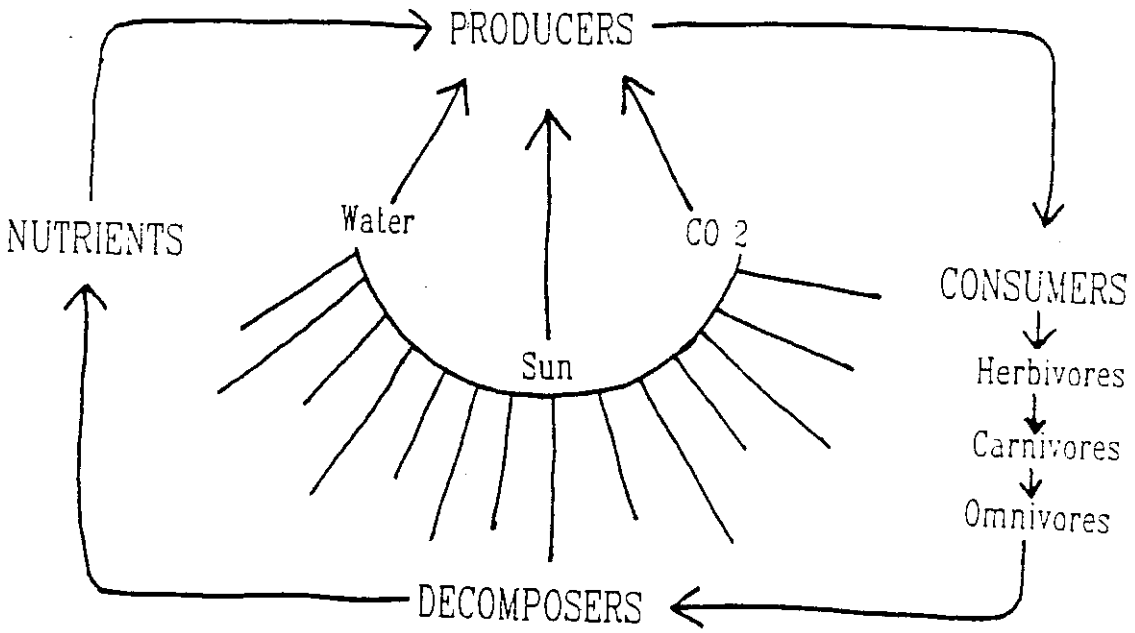
OBJECTIVE Students must arrange cards, representing different parts of a nutrient cycle, in the order that energy (food) flows through an ecosystem.

GRADE 2-6

TIME One class period

BACKGROUND INFORMATION Plants are termed producers because they are the only organisms that can synthesize food energy from inorganic substances. Plants convert sunlight, water and carbon dioxide into simple sugars. This process is called photosynthesis. Animals cannot produce their own food. They are called consumers because they have to consume food from an outside source. There are three levels of consumers: herbivores or plant eaters, carnivores or meat eaters and omnivores who eat both animals and plants. Organisms that consume dead plants and animals are termed decomposers. Through digestion, decomposers convert the dead bodies of plants and animals into humus containing necessary plant nutrients.

MATERIALS Chalkboard
One set of energy flow cards per group. *To make a set of cards, include a picture or the written names of a type of producer (oak tree), herbivore (deer), carnivore (mountain lion), omnivore (racoon), and decomposer (earthworm) along with soil, water, sunlight and carbon dioxide.*



Who Eats Who?

DISCUSSION

Draw the skeleton of a nutrient cycle on the board. Students will help you fill in the information. Ask students where does food come from? Introduce photosynthesis and the idea that plants produce food. Fill-in "producer" on the diagram. Ask for examples of animals that primarily eat plants, primarily eat animals and eat both plants and animals. Fill-in "herbivore", "carnivore" and "omnivore" on the diagram, as these are three different kinds of consumers. Ask what happens when the producers and consumers die. Why aren't we tripping over dead dinosaurs? Ask for examples of animals who eat dead things. Fill-in "decomposer" on the diagram. The decomposers convert the dead bodies of plants and animals into humus, containing nutrients available to plants. Fill in "humus" as the last slot to complete the cycle.

PROCEDURE

1. Students are separated into small groups and given a packet of cards with pictures or the written names of a type of producer, herbivore, carnivore, omnivore and decomposer along with soil, water, sunlight and carbon dioxide.

2. Each group must arrange the cards in the proper order showing how energy flows through an ecosystem.

EXTENSION

Students can write a poem or song naming who eats who.

Performing a School Waste Audit

OBJECTIVE

(1) To introduce students to the concept that garbage does not simply disappear once it is collected, (2) to teach students about the components of the waste stream and their relative quantities, and (3) to have students analyze the waste from their classroom, lunchroom, or entire school building.

METHOD

One or more of four options:

Option A - Have teacher in classroom save trash for one week without informing students.

Option B - Have each student collect his or her trash and carry it around for one week.

Option C - Have students conduct one-day audit of classroom or food service waste.

Option D - Have students examine contents of school dumpsters and analyze them.

BACKGROUND

For too long, Americans have been able to put their waste on the curb and watch it disappear when refuse trucks picked up and carried it off. There is little knowledge about where it goes or what happens to it once it gets where it is going. There has also been little incentive to conserve, generate less waste, and monitor the hazards of waste that have been discarded. For example, we have carelessly thrown away hazardous materials such as lead-based paint, motor oil, nail polish remover, and oven cleaner without realizing the potential threat to the groundwater these materials pose when dumped in landfills with inadequate safety features—they can leak into groundwater. Such groundwater contamination threatens the safety of many of this country's drinking water sources. (See the "Landfill in

SUBJECTS:

Social studies, mathematics, science, environmental science, home economics

FORMAT:

Teacher directed activity carried out over approximately a week but totalling one to three periods, at teacher's option; some Options, e.g., B, C, & D can also be done by individual or student teams who will report their findings

a Pop Bottle" activity for an explanation of this problem.)

In addition, Americans have become a "disposable society." Products that used to be manufactured to last a lifetime are now designed to be thrown away after only one use. For example, now there are even disposable cameras. Convenience is touted as being the most important quality of many products, even of dangerous, hazardous, or toxic products which harm the environment.

How aware are we of the waste we generate? Studies have been done to analyze both the contents of the national waste stream and the waste streams of schools. Paper makes up the largest component of schools' waste streams. (See charts on national and school waste streams at the end of this activity.)

Each American throws away about three to four pounds of waste per day. Each student produces about a half pound of waste per school day. All of this adds up to a problem because America's old landfills are filling up quickly and leaking hazardous chemicals into the groundwater, and new, safer landfills are very costly to construct.

PRE-ACTIVITY QUESTIONS

Share with students the following story:

Next year your little brother will attend our school for the first time. He wants to know what it's like to go to school. For instance, what kind of lessons do teachers assign? Is the work difficult? Do kids get to do some fun things like music or arts and crafts? He wants to know what kind of food students eat and whether snacks can be eaten in class. How do you think your brother can find out about our class and our school? (Take some suggestions, then quiet them down by whispering.) No, you won't believe it! All he's going to do is look through our garbage can at the end of every day. Wow, he'll learn so much about us. What math lessons were you assigned? What art project were you working on? What did you have for lunch? Did you ace your spelling test again? Record students' estimates to the following questions and at the conclusion of the lesson compare them with the actual waste audit figures.

A. How many times do you drop something in the garbage can each day? How much waste do you think you generate in one school day? In one whole day?

B. Where does the garbage go after you throw it away? Do you think about the items you have thrown away after they are in the garbage? What kinds of things do you throw away every day?

C. How much waste do you think this class produces in one day? Is it necessary?

D. Consider a visit to the school dumpster when it is empty. Then after the activity, and shortly after your first visit, look at how quickly the school dumpster fills up. Where does this stuff go?

MATERIALS

* The waste generated in classrooms and food service areas
* Plastic garbage bags for students to contain their wastes
* A scale for weighing materials (younger children will need a balance scale)
* Washable plastic tarp
* Gloves and goggles for dumpster audits
* "Selected Component percent in Total Waste Stream by Producers" handout (end of activity)
* Permission Slip (end of activity)

PROCEDURE

After going through the pre-activity questions, tell the students that your little brother found a whole week's worth of your class's garbage. Yikes! I wonder how long it would take him to sort through that? Then ask the students how much waste they think the class would generate in a week, and write the guesses (in numbers of bags and/or pounds) on the board.

Option A:

Without telling the students, save the trash generated in the classroom for one week. You may want to enlist the maintenance person's help, so that he/she will know that you are not going to need your trash picked up for a week; possibly

he/she could pick it up as usual but save it for you somewhere away from the classroom.

Bring in the actual amount generated and discuss how it compares with the guesses. Count the pieces of paper. Look at the paper; are we really using it or wasting it? Sort to find out what are the largest waste categories. Well, if garbage is in the trash can and it's not intercepted, where does it go? Write LANDFILL in large letters on the classroom trash can and put a frowny face on it. What would we do if there was no trash can to throw these items into?

Option B:

Have each student bring a garbage bag to school on Monday. Inform students they must carry with them in that bag any trash that they generate during the week. NOTE: You will need to set ground rules for: (1) Whether students are to add the materials they generate at home as well, necessitating that they take their garbage bags to and from school daily or store in two bags; (2) If you are including food waste, be sure that students do not store the bags in lockers or other areas where vermin, cats, dogs, or other animals might be attracted to the contents; and (3) Suggest double or triple bagging to prevent tearing and spilling.

At the end of the week, have students weigh their bags of garbage to see how much they generated. Ask them to classify how much was paper, how much was food waste, etc. They don't have to weigh these individual components—just estimate them. Ask students the following questions: Who had the most/least trash? Who had reusable/recyclable/compostable materials?

Option C:

Have students collect all the waste that they make in one day in the classroom and put it someplace so that the maintenance staff does not throw it away. The next day, have students analyze what they generated: what percent was paper? aluminum? food wrapping? organic material? What could have been recycled or reused? In what ways could they generate less?

Coordinate with food service staff to have students collect waste from the cafeteria at one lunch period. Have two types of clearly marked containers wherever trash cans are located: one for food refuse and one for non-food refuse. Have a monitor or two stand by the containers to make sure the garbage is separated properly. Make sure that this is announced to the students eating lunch both at the beginning and towards the end of the lunch period—explain what you are doing and why you are doing it. Weigh the food waste and the non-food waste generated; then, go through the non-food waste to determine how much of it could have been recycled.

Option D:

Get permission from parents and principals to have students examine the contents of school dumpsters. (See sample permission slip at the end of the activity.) Provide them with safety goggles and heavy gloves. Spread out a washable plastic tarp and have students dump the contents of garbage bags from the dumpster onto the tarp. Sort it into categories: paper, plastic, metal, organic, recyclable, nonrecyclable. Chart your results and compare them with the national average for the components of a school waste stream. (A chart of national data follows this activity.)

Note: Younger students will most likely do better on a smaller scale such as the individual and/or class audit.

It may be necessary to have several adult helpers supervising the students. Or an alternative would be to have only part of the class sorting each day.

DISCUSSION/QUESTIONS

Begin the discussion by asking students, "Well what would your little brother have learned about us? Our garbage tells a lot about our habits. What was in our garbage?"

A. How much of the garbage was paper? Aluminum? Food wrapping? Organic material? Other?

Younger children might want to put them in order from least to greatest.

B. What garbage could be eliminated? Excess packaging? Paper napkins? Disposable eating utensils? How can your shopping habits affect what you end up throwing away?

C. What materials are recyclable? What materials can be recycled in your city?

D. What materials are practically reusable? What are easy ways to get reusable items back into use?

E. What materials that were thrown away could have been recycled?

F. In what ways could students and staff create less waste? What can you do in your home?

G. What effect did carrying their waste around for a week have on students? For example, were they surprised by the weight and volume of the waste they collected? Did it lead them to think more actively of ways to reduce waste? What if everyone had to carry their waste around with them all the time? Would we make less or encourage manufacturers to change the design of products (e.g., variety pack chips) or modify our purchasing habits? These are topics that can be addressed to students for their evaluation.

FURTHER STUDY

A. Plan ways to implement a food waste collection/composting program in the school. What containers would be needed? What education of students would be required? What kind of signs? Where could materials be composted? Draw up a plan that includes doing a search for useful literature (e.g., magazines—*Recycling Today, Resource Recycling, BioCycle),* contacts with the school administration, the local county extension service, the county planning commission, the municipality, etc. to discuss the requirements for a composting site. Contact the California Integrated Waste Management Board's Schools Section, (916) 255-2296, for information on starting a composting program at your school/district.

B. With your students, brainstorm a list of waste reduction activities/tips. Have students pledge to do one of these things and record their pledge on a chart which the teacher will save. Check back with students in a month to see if they are fulfilling their pledge.

C. Publicize the results of your waste audit—either in the school newsletter or local paper. (Refer to the lesson "Program Promo? Try a Logo/Slogan Contest.") Also publicize waste reduction tips—asking the community to participate.

ACKNOWLEDGEMENTS

Our thanks to Anne Claire Broughton for writing this activity.

School Composting Program Outline
Massachusetts Department of Environmental Protection

I. Introduction

Nichole Cirillo (617) 574-6865
MA Department of Environmental Protection

Ann McGovern (617) 292-5834
MA Department of Environmental Protection

II. The Benefits of Composting

A. Waste stream reduction
- diversion from incineration and landfilling

B. Production of compost
- beneficial soil supplement

C. Environmental awareness
- recognizing role and responsibilities; empowerment to effect change

D. Education
- science, math, civics, language arts

III. How Does Composting Work?

The first step to take in setting up a composting program is to familiarize yourself with the different types of composting systems and how they work.

Composting - controlling the natural recycling system of decomposition, which converts organic material into humus.
- Outdoors - traditional methods
- Indoors - same principles, smaller scale, w/red worms

Requirements: Organic material (vegetative only), moisture, oxygen, bin (should be rodent-resistant). A thermometer is optional but recommended (provides measurable indicator of biological activity within pile).

Three types of composting programs are appropriate for schools: leaf and yard waste, cafeteria, and vermicomposting (worm composting).

A. Leaf and Yard Waste Composting

1. How does it work? Outdoor system, bin optional but recommended

2. What waste can it compost? Leaves, grass clippings, weeds, sawdust, seaweed, other vegetative material

3. What tools are needed? Bin(s), pitchfork (or hoe/cultivator), gloves

B. Cafeteria Composting

1. How does it work? Outdoor system in rodent-resistant bin(s)

2. What waste can it compost? Vegetative material (prep and/or meal leftovers), paper products (napkins, bags, plates, cups). Must include high carbon material (leaves, straw, paper, shredded cardboard, sawdust)

3. What tools are needed? Collection container(s), rodent-resistant compost bin(s), pitchfork (or hoe/cultivator), gloves

C. Vermicomposting

1. How does it work? Indoor system replicating outdoor system w/red worms

2. What waste can it compost? Small amounts of vegetative material (fruit and vegetable scraps) and high carbon material (shredded paper/cardboard, leaves)

3. What tools are needed? Collection container, worm bin (aerobic), red worms, hand cultivator, gloves

IV. Developing Your Composting Program

In planning your school's composting program you will need to do some investigating. The information you collect will help you to determine the type and size of your composting program. Remember also that before you begin planning your composting program, it is important to get permission from your school's administration.

A. Form a Planning Committee

Be inclusive - involve all groups!
- prevents conflicts
- builds ownership through responsibility

B. The Waste Audit - Assessing the Need

To help you choose the proper composting program, you will need to consider the amount and type of waste your school generates.

1. Data Collection

- Focus: determine type and quantity of compostable material generated
  - types of compostable waste include vegetative food waste, (cafeteria and prep waste), leaf and yard waste, nonrecyclable paper products (napkins, paper towels), sawdust

- Method: simple or complex, depending on the age of students
  - K through 6: 1) Compost Brainstorm; 2) Compostables in a Bag; 3) Inverted Trash Can
  - 7 - 12: 1) Examine Dumpster; 2) Interview School Waste Hauler

2. Data Projection

- Focus: project total quantity of waste generated over the school year
  - remember: seasonal fluctuations; school breaks

3. Data Analysis

- Focus: use the information collected to determine the type and size of composting program that is right for your school.

  - How much waste you generate will allow you to determine the number of bins you need

  - What types of compostable waste you generate will allow you to determine the type of composting program you select

  - Where your school is located will help you to determine the available feedstock and location of outdoor bins

C. Select a Bin

1. Factors to consider:
   - Rodent-resistance (floor and cover and openings less than 1/2")
   - Cost/availability (may be donated by municipality participating in DEP's compost bin grant program)
   - Materials on hand (wood, wire, cement blocks, pallets) for constructing your own
     - capacity
     - design (should enhance composting process and be easy to use)
     - other (appearance, recycled content)

D. Where to Locate Your Bin

1. Cafeteria/ Leaf and Yard Waste
   - distance from structures/residences of 50 - 100 ft.
   - well-draining area
   - minimum 100 feet from wetlands
   - within school grounds: convenient access; room for growth; security

2. Vermicomposting
   - distance from students
   - central location or in-class
   - back-up location (in case of flies)
   - cool, dark, etc

E. Waste Collection and Separation System

1. Focus: Develop a system that will allow you to separate compostables from non-compostables

2. Method: Varies depending on the abilities of students
   - separate at source of generation
   - students do their own separating
   - use of a monitor
   - essentials: containers (height, support, mobility, location, signage)

F. Work Distribution

Listed below are some of the tasks associated with a composting program. These tasks can vary depending on the size and type of the program. We encourage you to role play to see which you will need.

1. Jobs: 1) monitor; 2) carrier/feeder; 3) recorder; 4) supplier 5) tracker

2. Distribution
   - several grades take responsibility
     - mentoring
   - getting time off to do the work

3. Recruiting Volunteers
   - PTA
   - other teachers, staff
   - clubs

G. Building Ownership of the Program

1. Don't be a one-person band - share the program

2. Integrate curriculum
   - use compost program as material for all subjects

3. Composting Club

H. Program Funding

1. Costs
   - bin (up to $40) (seek donated or subsidized bin)
   - pitchfork, hoe or cultivator ($20)
   - thermometer ($15-30)
   - aprons/gloves ($2-10)
   - collection containers ($2-20)
   - monitoring supplies (clipboard, paper)

2. Grants
   - federal (EPA)
   - state (DEP bin grant program)
   - private / local
   - documenting merit through a Cost/Benefit Analysis

3. Community Funding
    - School / PTA
    - Gardening clubs
    - Stores
        - garden supply
    - Equipment manufacturers

4. Fundraising Events
    - sell compost or seedlings

V. Communicating Your Program

Three groups you need to communicate to:

1. Student Body
    - activities to kick-off event: play; bulletin board
    - identification: aprons, gloves, photos
    - recognition: ceremonies, party, certificates

2. Faculty / Staff
    - keep informed
    - offer opportunities for involvement

3. Community
    - composting days
        - sell or give away compost / seedlings
    - community plantings
    - conduct composting workshops
    - growing partnerships
        - community garden

VI. Complete the Cycle Through Gardening

1. Harvest finish compost (after three months to one year, depending on process)
    - Give to students for home gardens at end of school year
    - Use compost in classroom or outdoor growing projects
    - Conduct growth trials using different growing mediums (with and without compost, different types and amounts of compost)
    - Contribute compost to community garden(s)

VII. A Matter of Health - Things to Keep in Mind

A. DEP / BOH Notification

- Notify DEP and local Board of Health about your composting program (not necessary for small, classroom projects). DEP may provide assistance.

B. Microorganisms

- Soil organisms (bacteria) are primary decomposers; wear gloves and wash hands after adding materials/turning/harvesting the compost

C. Wildlife/Rodents

- **Do not add meat, bones, dairy products to the compost pile**
- Bury vegetative food scraps in center of pile
- Use a rodent-resistant compost bin

D. Molds / Fungi

- Molds and fungi are also primary decomposer organisms. Spores become airborne when the composting material is turned or aerated
- People with asthma and mold allergies should not turn the compost
- If composting indoors, check if any students have allergies/asthma. If so, keep the worm bin in a different location from the classroom. Students with asthma/allergies may participate and observe the process but should not stir or agitate the material in the bin.

COMPOSTING CURRICULA AND OTHER RESOURCES

Below is a list of curricula and other resources you may find helpful for your composting program. Prices are approximations.

Composting Curricula

Composting Across the Curriculum: A Teachers Guide to Composting ($8.50), 1992.

A comprehensive curricula for composting for grades K-6 with some activities for older kids and adults.

Marin County Office of Waste Management
10 North San Pedro Rd.
Suite 1022
San Rafael, CA 94903
(415) 499-6647

Worms Eat Our Garbage: Classroom Activities for a Better Environment ($19.95), 1993.

A guide to worm composting in the classroom for grades K-12; filled with great activities and projects for all ages.

Flowerfield Enterprises
10332 Shaver Rd.
Kalamazoo, MI 49002
(616) 327-0108

Composting: Wastes to Resources ($7.70), 1990.

A guide to composting for grades K-12 who want to set up an outdoor composting program; includes posters and activities.

Media Services Distribution Center
7 Cornell Business and Technology Park
Cornell University
Ithaca, NY 14850
(607) 255-2080

The Wonderful World of Wigglers: Exploring the Mysteries of the Mighty Earthworm Through Stories and Activities for the Curious Child ($14.95), 1994.

Worm composting classroom activities for grades 5-10; includes enlarged drawings of a worms anatomy.

Common Roots Press
Food Works
64 Main St.
Montpelier, VT 05602
(800) 310-1515

General Composting Information

Backyard Composting - Your Complete Guide to Recycling Yard Clippings, 1992. ($6.95)

Harmonious Press
PO BOX 1865-100
Ojai, CA 93024
(805) 646-8030

Worms Eat My Garbage: How to Set Up and Maintain a Worm Composting System, 1982. ($8.95)

Flowerfield Enterprises
10332 Shaver Rd.
Kalamazoo, MI 49002
(616) 327-0108

Audio/Visuals

Home Composting: Turning Your Spoils to Soils (Video), 1992. 17 minutes, VHS

Available at your local library or may be borrowed from the Department of Environmental Protection by calling (617) 574-6865.

Wormania! (Video), 1995. 26 minutes, VHS; comes with Wormania! Teaching Guide (48 pp). ($38.40 postpaid)

Features close-ups of live earthworms in their natural habitat. Models and graphics cover how worms move, their role in soil ecology, how worms breed, and how to set up a worm bin for composting organic waste.

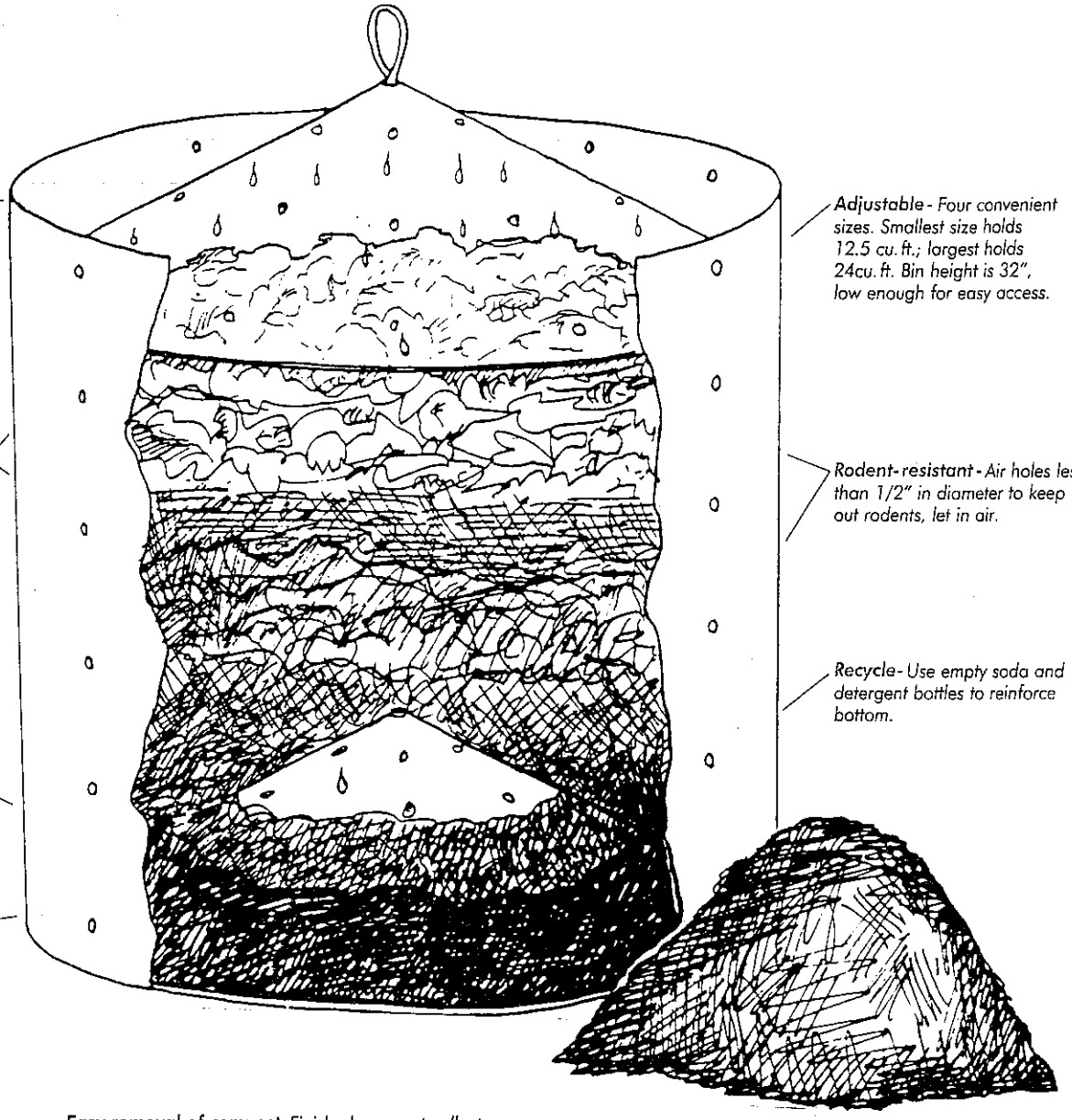
Flowerfield Enterprises
10332 Shaver Rd.
Kalamazoo, MI 49002
(616) 327-0108

Home Composting Slide Presentation, 1991. ($35.00).

A 45 min. slide show illustrating the biology and techniques of home composting.

Robert Kozlowski
Dept. of Floriculture and Ornamental Horticulture
20 Plant Science Bldg.
Cornell University
Ithaca, NY 14853
(607) 255-1791

The New Age™ Composter



Sturdy- *Constructed of thick, rugged recycled plastic.*

Color- *Green or black (Municipal programs-black only)*

Unique top and bottom cones virtually eliminate need for turning- *Bottom cone brings air into the center of the pile, speeding up aerobic activity, top cone holds in heat and moisture.*

Fast and efficient- *Produces finished compost in as little as 60 to 80 days.*

Secures to ground- *Metal stakes hold composter in place.*

Adjustable- *Four convenient sizes. Smallest size holds 12.5 cu. ft.; largest holds 24cu. ft. Bin height is 32", low enough for easy access.*

Rodent-resistant- *Air holes less than 1/2" in diameter to keep out rodents, let in air.*

Recycle- *Use empty soda and detergent bottles to reinforce bottom.*

Easy removal of compost- *Finished compost collects around the bottom cone where it can be removed as needed from above, or all at once by opening up the bin.*

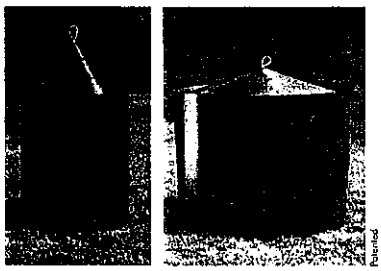
New England Plastics Corp.

Makers of the New Age Composters

126 Duchaine Blvd.
New Bedford, MA 02745
Phone: 508-998-3111
Fax: 508-995-8895

- **Assembles in 10 minutes**- No tools required.
- **Saves money**- Can produce 800 lbs. of nutrient-rich compost every six months.
- **Lifetime warranty**- Durable and UV resistant, will last for years.
- **Made in USA**- Made of 100% recycled plastic bottles collected from local recycling programs.

Fits easily into any car.



Adjusts from 12.5 to 24 cubic foot capacity to accommodate small or large households.

THE EARTH MACHINE

21ST CENTURY HOME COMPOSTING

SPECIFICATIONS

MODEL NAME:
The Earth Machine

MODEL NO:
EM30051

COLOURS:
~~Forest Green~~, Solid Black

MATERIAL:
Manufactured with up to
50% recycled materials collected or processed in Massachusetts

U.P.C. #
77249930051 – Black
77249930052 – Green – Not available due to 50% recycled content requirement

ASSEMBLED DIMENSIONS:
33" x 33" x 34"
838mm x 838mm x 863mm

ASSEMBLED CAPACITY:
80 Gallons
.3 cubic meters (approx.) = 11 Cubic feet

UNIT PACK:
One per carton

CARTON DIMENSIONS:
32" x 17" x 32"
826mm x 445mm x 826mm

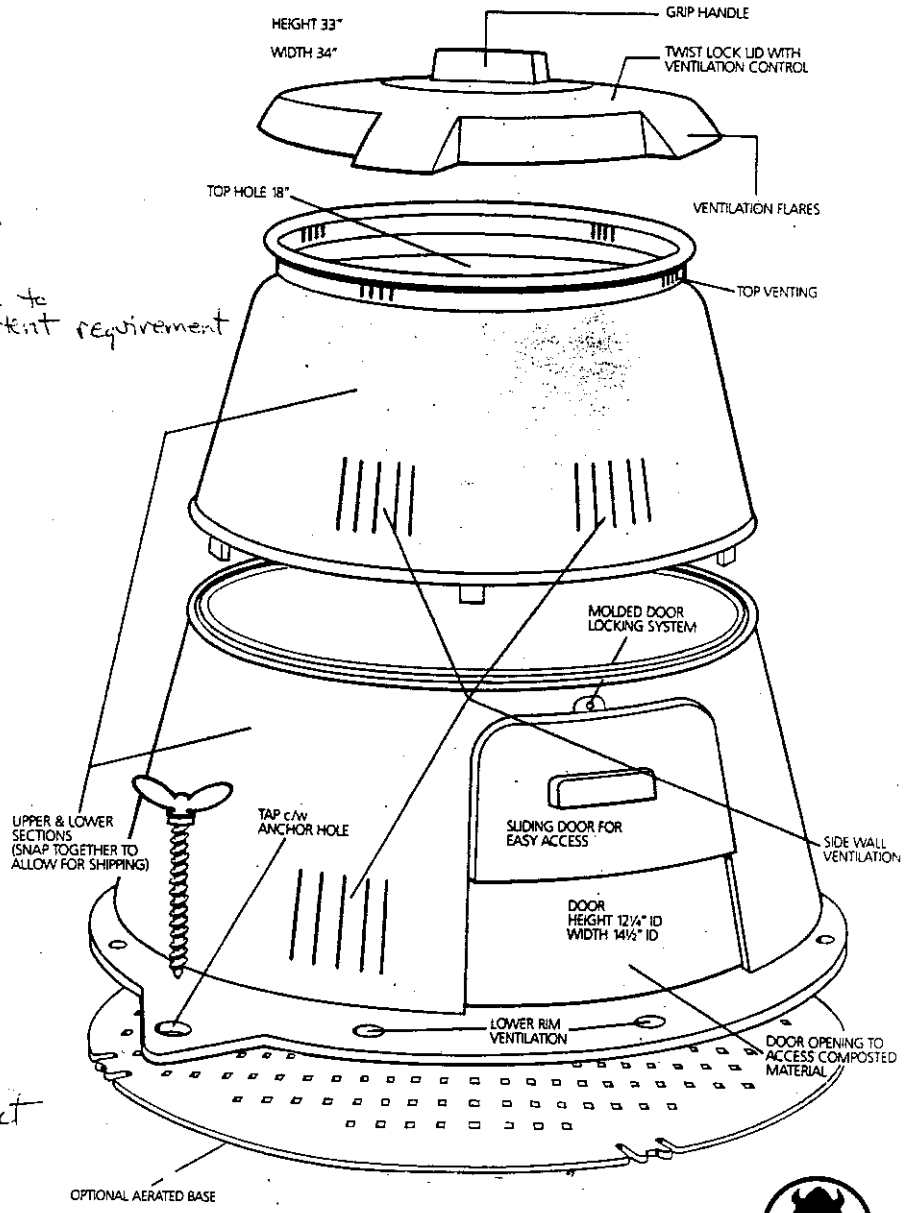
QUANTITY PER 48 FT. TRUCK:
228 pcs.

BULKPACK:
25 sets per pallet 33" x 60". Consisting of 1 stack of 25 tops, complete with lids and 1 stack of 25 bottoms each with attached poly bag containing door, 4 pegs and full colour instruction manual.

QUANTITY PER 48 FT. TRUCK:
650 pcs.

WEIGHT OF ASSEMBLED UNIT:
16 lbs.

OPTIONAL BASE: Included under state contract
Aerated high density polyethylene for added rodent resistance.



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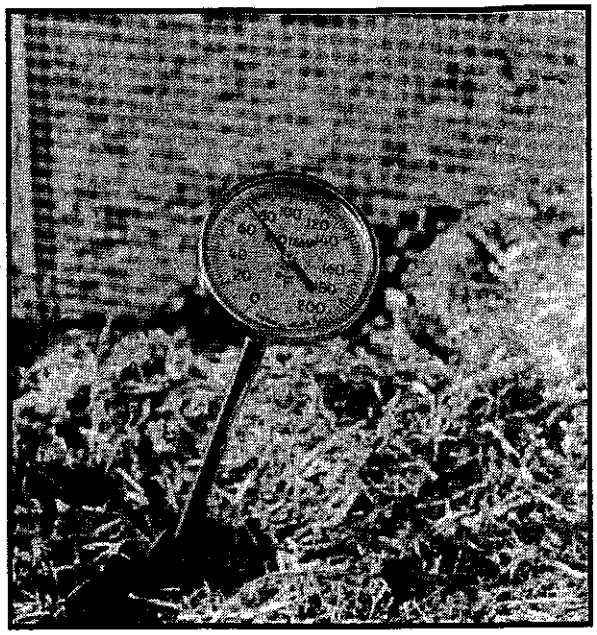
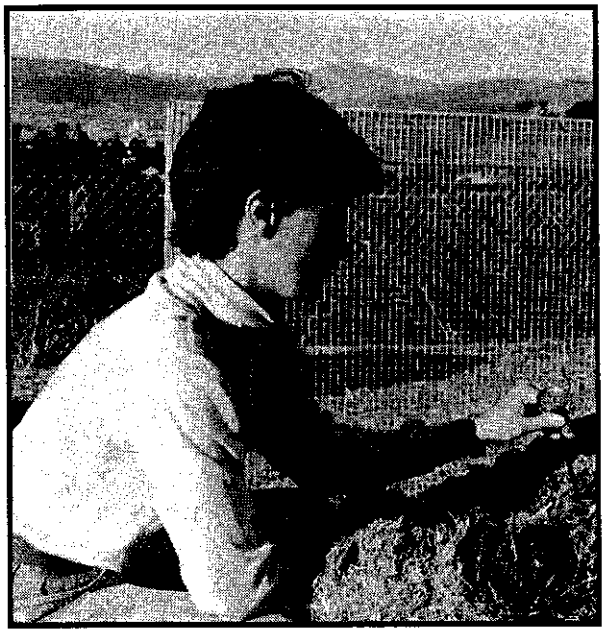
Printed on recycled paper.

REOTEMP®

BACKYARD COMPOST THERMOMETER





- ✔ Rugged, all stainless steel construction
- ✔ Unbreakable plastic crystal
- ✔ Easy-to-read 2" diameter dial
- ✔ 20" pointed stem for easy insertion
- ✔ 0° to 200°F standard temperature range
- ✔ Very accurate (±1% of scale)

The **REOTEMP** Backyard Compost Thermometer is ideally suited for monitoring interior temperatures of your compost bin. Our standard model comes with a temperature range of 0° to 200°F and a 20" long stainless steel stem with a pointed tip for easy insertion. Optional temperature ranges are available.

To Order:

Ask for Model G20P.

Distributed by:

REOTEMP® INSTRUMENT CORPORATION

11568 Sorrento Valley Road, Suite 10 • San Diego, CA 92121 U.S.A.
Telephone (800) 648-7737 • FAX (619) 481-7150

REO*TEMP*® COMPOST EQUIPMENT ORDER FORM EFFECTIVE 9-15-94

BIMETAL DIAL WINDROW THERMOMETERS		PRICE	QTY	AMOUNT
A72PF	(72" Stem, 0/200F, 5/16" dia.)	$ 218.00		
A60PF	(60" Stem, 0/200F, 5/16" dia.)	$ 167.00		
A48PF	(48" Stem, 0/200F, 5/16" dia.)	$ 116.00		
A48P	(48" Stem, 0/200F, 1/4" dia.)	$ 104.00		
A36PF	(36" Stem, 0/200F, 5/16" dia.)	$ 84.50		
A36P	(36" Stem, 0/200F, 1/4" dia.)	$ 65.00		
A24PF	(24" Stem, 0/200F, 5/16" dia.)	$ 69.50		
A24P	(24" Stem, 0/200F, 1/4" dia.)	$ 58.00		

BACKYARD COMPOST THERMOMETER

G20P	(20" Stem, 0/200F, 1/4" dia.)	$ 24.88		

COMPOST CHART RECORDING THERMOMETER WITH POINTED TIP

CRT-36	(36" Stem) Temp ____ Time Period _____	$ 435.00		
CRT-48	(48" Stem) Temp ____ Time Period _____	$ 446.00		
CRT-60	(60" Stem) Temp ____ Time Period _____	$ 463.00		

ELECTRONIC DIGITAL THERMOMETERS AND PROBES

7001K	Handheld Digital Thermometer for Thermocouple probes	$ 176.50		
701KF	Pocket Thermocouple Thermometer	$ 106.50		
FRK36	36" Fast Response Thermocouple Probe	$ 172.50		
FRK48	48" Fast Response Thermocouple Probe	$ 185.00		
FRK60	60" Fast Response Thermocouple Probe	$ 209.50		

MOISTURE METER

MM36	36" Probe with handle	$ 85.00		
MM48	48" Probe with handle	$ 92.50		
MM60	60" Probe with handle	$ 99.50		

COMPOST VIDEO

Composting for the 90's		$ 24.95		

WE ACCEPT VISA/MASTERCARD

ACCT# _____

EXP. DATE _____

SIGNATURE _____

Shipping & Handling (IN THE CONTINENTAL U.S.)	$6.00
Special Box Charge for Stems 48" and Over	$15.00
Tax (in California only) 7% X Amount	
TOTAL	

MAKE CHECK PAYABLE TO: **REO*TEMP*®** INSTRUMENT CORPORATION

YOUR SHIPPING ADDRESS AND PHONE NUMBER _____

Company

Address City State Zip Code

Name Phone Number

REO*TEMP*® will ship your order via UPS within one week of its receipt.
To Order by Phone: call us at 1-800-648-7737 or fax us at 619/481-7150.
To Order by mail send order form to address below.

REO*TEMP*® INSTRUMENT CORPORATION 11568 Sorrento Valley Rd., Suite 10 • San Diego, CA 92121

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- 30x/8x microviewer. A low-cost, engaging, and easy-to-use instrument for exploring inner space. Appropriate for elementary through university levels! Several Microcosmos activities require its use. Special discounted price, $7.
- Timeline ribbons. Set of 5 different-colored, wide ribbons, each 5 yards. Designed to accompany the Microcosmos' Earth History exploration. $15.
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- Algal bloom postcards. Designed to accompany the "Before you say 'microbes" exploration. $5/dozen
- Black and white laminated poster for the classroom. Fosters inquiry and discussion through the theme "The greatest inventors in the history of the planet can all fit within a small dot..." $12 or 3 for $30.
- Microcosmos color T-shirt. Two views of the earth -- one "recent" with the cyanobacteria-produced oxygen atmosphere, and one ancient with the myriad pigments created by purple sulfur and green bacteria and Archaean thermophiles -- are prominent below the word "Microcosmos," each letter in the form of a beautiful microbe. Deep blue background. Available in m, l, xl. $20.
- Microcosmos sweatshirt. Same design as the T-shirt. Heavyweight 50% cotton. Available in xl (equivalent to large) and 2xl (equivalent to xl). $30.
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- Book: Power Unseen: How Microbes Rule the World by Bernard Dixon. Features scores of vignettes about the influence of microbes in history, medicine, ecology, and technology. Great contribution to microbially-based integrated curriculum development. Special discount, $13.

Use the coupon on the back panel with your check made out to *Microcosmos*, or forward a purchase order. Send to: Microcosmos, Boston University School of Education, 605 Commonwealth Avenue, Boston, MA 02215. Fax number is 617-353-3924. Be sure to include correct shipping: $1 per $15 worth of order.

Available directly from the publisher -- Kendall/Hunt, 4050 Westmark Drive, Dubuque, IA, 52004, 1-800-228-0810 -- are the two core books of Microcosmos life science teaching: Inner Space Journeys to Life on Earth: A Standards-based Companion for Science Educators ($10.95) by D. Zook and the Microcosmos Curriculum Guide ($34.95) by the Microcosmos Team.

Coming soon!

An exciting new classroom teaching tool -- THE MICROCOSMOS DISCOVERY WINDOW: A MICRO-LIFE GROWTH CHAMBER. This is a dynamic vehicle for promoting experiments and inquiry-based learning while discovering the spectacular pigmented growth of microbial communities. Look for announcements or write and get on our mailing list to receive information later on this upcoming significant contribution to science learning!

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	quantity	price of each	total cost
30x microviewers		$ 7	
ribbons		$ 15	
transparencies		$ 20	
algal bloom cards		$ 5	
poster		$ 12	
T-shirt	size:	$ 20	
sweatshirt	size:	$ 30	
Life as Geo Force		$ 10	
Coloring Book		$ 8	
Power Unseen		$ 13	

Shipping based on $1 per $15 of order. Total shipping: $_____ Total order $_____

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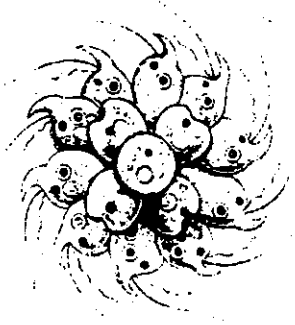

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MICROCOSMOS

Price list and order form...

America the Beautiful Fund

725 15th St. NW, Suite 605, Washington, DC 20005 (202)638-1649

Seeds that Grow Hope 1980- 2010

FREE SEEDS!

Celebrating 30 Years of planting the Seeds that Grow Hope!

America the Beautiful Fund is offering grants of FREE SEEDS! to community groups striving to better our world through gardening. Grow fresh nutritious food for the hungry. Teach children about the wonders of nature in a habitat garden. Beautify parks, roadways and neighborhoods. Plant the Seeds that Grow Hope and promote healthy living, environmental stewardship and community pride! There are a thousand ways to improve your community's quality of life through gardening!

These are 2008 and 2009 seeds with germination rates of 92-95%. Grants of 100 to 6,000 seed packets are being offered on the basis of availability and relative need. America the Beautiful Fund is also offering **The Green Earth Guide** on CD-ROM containing illustrated gardening instructions and ideas on involving the whole community in your project. For nutritional information, harvesting, storage and eating tips we offer **Gardening for Optimal Nutrition** published by the Cortisa Press which is available to you at more that HALF OFF the cover price of $2.25! Also we are able to supply your group with **GLOVES** thanks to a generous donation from Wells-Lamont. Now you can really dig in! With an annual Membership contribution you will also have access to technical assistance via our toll free member hotline and announcements of special events and grants.

To receive a grant of the Seeds that Grow Hope:

1. **Write** a short letter describing your project
2. **Fill out** the application form below
3. **Enclose** a check for shipping and handling
4. **Mail** your letter, application and check to the address above

Contact Name

Organization Name

Project Name

Street Address for UPS delivery (No PO Boxes Please)

City State Zipcode

Phone Number Fax Number E-Mail Address

Shipping and Handling fees

First set of 100 packets = **$14.95**

____Additional set(s) of 100 x $5 each = _____

Please specify amounts below:

Vegetable_____**Flower**_____**Herb**_____

(Limit of **25 Herb packets per 1,000 packets**)

Membership Contribution = _____

Your gift will enable us to ship seeds to needy projects across the country!

Green Earth Guide

CD- ROM ($10.00) = _____

Gardening for Optimal Nutrition

10 for $10

30 for $25 =_____

250 for $125

Gloves

_____Set(s) of 12 pair for $10/set

mixed sizes and styles =_____

TOTAL =_____

Nominate your group or best volunteer for an American Star Award!!

America the Beautiful Fund American Star Awards are given annually to honor the most outstanding projects and volunteers that have planted the Seeds That Grow Hope to improve their communities. Send a letter describing your accomplishments and some pictures to: America the Beautiful Fund, ASA Committee, 725 15th St. NW, Suite 605 Washington, DC 2005 or email your letter and pictures to katie@america-the-beautiful.org

Be A Citizen Scientist!!

The Field Campaign for Citizen Scientists is looking for gardeners to report on their local life cycles of garden plants, shade trees, wildflowers and weeds to gauge how climate change is affecting the world around us. If you want to participate in this exciting and important study, go to www.budburst.org . When asked "How did you hear about us?" select America the Beautiful Fund!

America the Beautiful Fund wants you to stay healthy!!

As a member of America the Beautiful Fund you can apply for discounts on doctors, hospitals, prescriptions, lab tests, and more. Take advantage of this health savings discount plan at www.healthylife.optimumhealthallies.com and enter the password: America the Beautiful Fund.