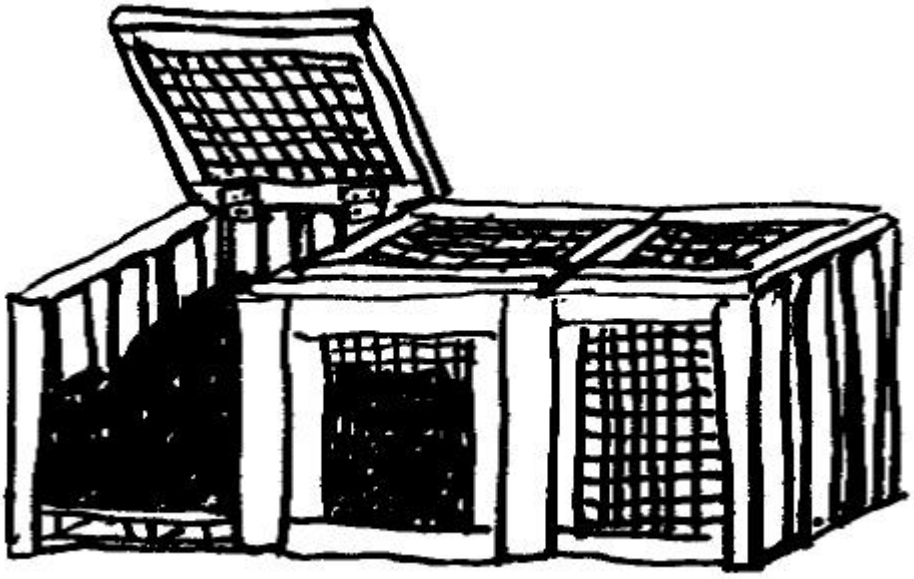
COMPOSTING

at New Hampshire Schools:

a "How to" Guide



Spring 1997

NEW HAMPSHIRE GOVERNOR'S RECYCLING PROGRAM

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INTRODUCTION

Students are great recyclers. They recycle their aluminum cans and they recycle their paper. But what about their food waste, those cafeteria left overs from preparing the students' breakfast and lunch? This material can be recycled through composting!

Why Compost at Schools?

Composting is nature's way of recycling. It is the natural process of organic materials (i.e., food, leaf and yard waste) breaking down into a valuable soil amendment, just as a leaf does on the forest floor. Between 6 to 14 percent of the daily waste in a school is compostable food scraps. Composting these organic materials cannot only save money by reducing the school's disposal costs, but can also strengthen an environmental science program with hands on science activities. Educators can play a major role in teaching students about the values of composting both in the school and at home, while providing a great example of a natural life cycle.

School Composting Can:

- Re-use organic material, a valuable natural resource;
- Save money by reducing the school's waste disposal costs;
- Create a valuable soil amendment for planting or mulching;
- Provide an opportunity for students to study the biology and chemistry of how the composting process works;
- Provide students with an example of a natural life cycle, and;
- Give students a feeling that they can help make a difference.

Testing School Composting in NH!

In order to test whether backyard composting was possible for New Hampshire schools, the NH Governor's Recycling Program and the NH Department of Environmental Services have conducted the "Composting at New Hampshire Schools" pilot program at the New Boston Central School and Belmont High School since March of 1995 (see Appendix A for an overview of these schools).

Primary Goal: To develop a school composting program that can be easily duplicated by other NH schools with a minimal investment of time and money.

Secondary Goal: To educate students in science, math and solid waste issues by learning how to compost and demonstrating the possible environmental and economic advantages of composting.

What to Expect in This Guide?

This Guide is based on the knowledge gained from the two pilot programs. It is designed to provide users with background information to help decide if they want to start composting, as well as how to set up, operate and promote a school composting project. The Appendices include information sheets, tracking forms, etc. from the pilot. Please use them in any way which is helpful.

In addition, the Guide can assist teachers in educating students in science, math, and solid waste issues. Appendices include a list of the "New Hampshire Curriculum Frameworks" that the Guide addresses and several composting-related classroom activities. Throughout the Guide, you will find markers referring to an activity in the Appendices that best relates to that section of the Guide.

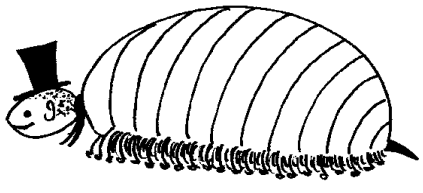
As always, for any further questions, please do not hesitate to call the NH Governor's Recycling Program at (603) 271-1098 or the NH Department of Environmental Services at (603) 271-3712.

GETTING STARTED

Starting a school composting program can be fun and easy. However, an understanding of how school composting works and whether or not composting is an option for a specific school is needed before starting.

What Does it Take to Compost?

School cafeterias produce food waste from two sources.



1. Preparing meals ("prep scraps")
2. Students' leftovers ("plate scrapings")

The operation of a school composting program involves -

1. Collecting the food wastes (we recommend starting with "prep scraps")
2. Depositing them into a composting bin
3. Mixing them with a bulking agent (i.e., leaves or wood shavings)
4. Ensuring the combination of food waste, bulking agent and moisture is correct
5. Deciding how to use the finished compost

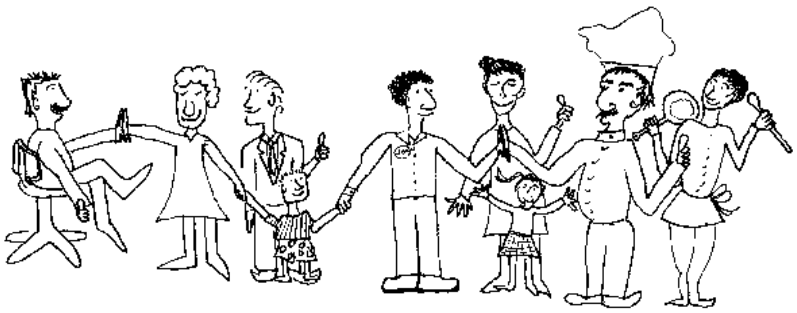
Although the operational steps listed above are simple, there are many small details of setting up, coordinating, and operating a school composting program. It is essential to address these details for a successful program.

Can Your School Compost?

The NH Department of Environmental Services encourages food waste composting activity throughout the state by allowing kitchen wastes to be composted at the same location that they are generated without any permitting requirements. Consequently, no State permit is required for a school to compost their food waste on the school grounds.

The checklist below can help a school community decide if it should compost.

- **G** Is there a school lunch program?
- **G** Does the school administration support a composting project?
- **G** Is there one person willing to be the point of contact for the program and keep the program going?
- **G** Do teachers, maintenance, or other involved staff support composting?
- **G** Is the kitchen staff willing to place the food waste in a separate container?
- **G** Can an adequate site for the compost bin be found on the school grounds?
- **G** Are there people (staff, local volunteers, or students) willing to construct and/or maintain the composting bins?
- **G** Can enough bulking material be made available to mix with the food waste?



NH Experience: A typical reaction among school principals and teachers may be that composting will attract wild animals and consequently put children at risk. Therefore, a focus of the pilot programs was to determine if this was true. Many precautions were taken to avoid attracting pests (see page 11). No wild "critters" have been seen around the compost bins and there has been no evidence of any visits occurring at night. However, do not take this issue lightly; offer to stop composting food if any problems develop.

Activity #1

possible financial savings to the school, rather than just emphasizing "being good for the environment."

3. Let staff people know it is not the intention to create more work for them in their daily routine, and that feedback is needed on how to avoid that.

4. Be sure that everyone understands how composting works and what a school composting program involves.

5. Do not force the issue. If people are not receptive, it may not be the right project or the best time to start.

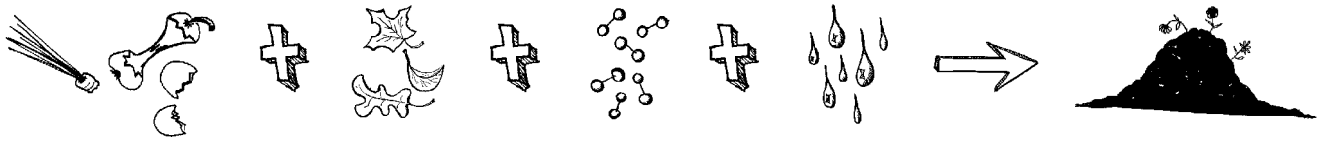
Time to Get Organized!

Once a decision is made to compost and the full support of all involved parties is obtained, it is time to organize a composting committee and solicit volunteers to participate in the program. The following are suggestions on ways to get the word out to the school and community for moral support, and financial and/or physical help.

- Notify other environmental type school organizations/clubs;
- Use school and community newsletters;
- Notify the Student Council;
- Use the school's public address system for announcements;
- Contact local Garden Clubs, Conservation Commissions, Recycling Committees, etc.;
- Make announcements at school related meetings, and;
- Contact local Public Works, Recycling Contractors, and Coordinators.

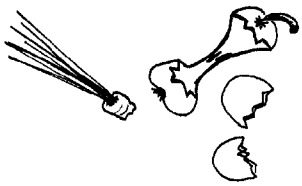
NH Experience: The composting committee in New Boston consisted of the Sixth Grade Science Teacher, School Secretary, Hot Lunch Director, Lunch Helper, and New Boston Transfer Station Manager and Assistant Manager. In Belmont, the committee was made up of the Technology Education Teacher, Physical Science Teacher, Food Service Director, Head Custodian, and selected students from the Environmental Club.

THE COMPOSTING EQUATION



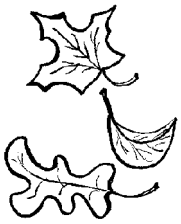
Compost is the result of organic waste material decomposing through the actions of soil micro-organisms. The micro-organisms which create compost need relatively large amounts of carbon material (leaves, wood chips, etc.), small amounts of nitrogen material (food waste, fresh manure, grass clippings, etc.), air and moisture to thrive and actively do their job.

Food Waste = Nitrogen



Most of a school's compostable food wastes are high in nitrogen and can include bread, fruit and vegetable scraps, coffee grounds, and eggshells. Fresh green grass clippings are also a source of material high in nitrogen. Meats, dairy products, oils, fats, and bones should be avoided when composting because they will take a long time to decompose and are likely to create odor and attract pests.

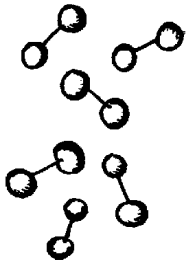
Bulking Agent = Carbon



Either wood shavings (available by the bag from a grain store) or fall leaves (keep in mind oak leaves decompose more slowly than maple leaves) are good materials to use as a bulking agent since both are high in carbon. Ensure you have access to enough dry bulking agent for the entire school year. If the plan is to use leaves, this may require stockpiling many bags.

NH Experience: The New Hampshire pilot schools started their composting programs in March of 1995 using mulch hay as a bulking agent. After 3 months of composting, much of the food was breaking down but the hay was not. Belmont continued to experiment using hay as a bulking agent, while in September, New Boston switched their bulking agent to leaves. New Boston used a ratio of one part food to one part leaves (by weight) and by 3 months, both the food and leaves had broken down to a finished compost product. Belmont's hay continued to show little breakdown, so they reused their partially decomposed hay by mixing it again as a bulking agent with the food waste.

Compost's Micro-Organisms Need Air!



As with all living things, the compost's micro-organisms need oxygen to survive and do their work. The compost bin must be able to supply plenty of air. If a pile is larger than four square feet, the material in the center will be too compressed to allow air to reach the middle. Turning a pile from one bin to another is one way to aid in ventilation.

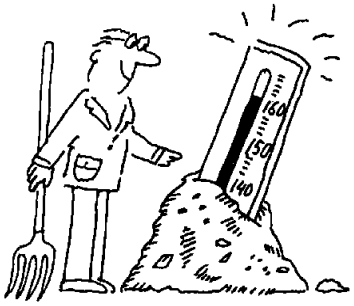
NH Experience: At both pilot schools, the turning of the compost pile from one bin into the next took about 45 minutes and was done anywhere from twice a week to once a month, depending on the temperature of the pile and the availability of people to do the turning.

Moisture Is Important!

The micro-organisms in a compost pile work best when the pile is as moist as a wrung-out sponge. Sitting in direct sun all day may dry out the pile and the microbes will die. However, during heavy rains, too much water may make it soggy, keep the oxygen out of the compost, and drown the microbes.

NH Experience: New Boston achieved the right amount of moisture by using a tarp to cover the bins in the winter (to keep out the snow) and exposing the bins to partial sunlight and rain during the rest of the year. Belmont experimented with not using their tarp, and due to a rainy fall, found that the compost was a little too wet. For additional moisture control research, students attached plywood tops to the bins, which resulted in compost that was a little too dry by the end of the summer.

Heat Means Compost Action!



Micro-organisms generate heat as they decompose organic material. Pile temperatures between 90°F and 150°F indicate rapid composting. A composting thermometer (see page 19) is the best way to keep track of the temperature deep inside the pile to indicate whether the compost pile is active.

Refer to Activity #2

Temperatures below 90°F indicate the pile is not actively composting. This may be because . . .

1. The pile needs to be turned to get more oxygen into the center;
2. The pile is too wet or too dry for the micro-organisms to do their work;
3. The pile needs more nitrogen material, i.e., green grass clippings, food waste, and manures to feed the micro-organisms; or
4. The pile is done composting and is now "finished" compost.

Refer to Activity #3

Above 150°F indicates the pile is too hot and should be turned to avoid burning up the big and little organisms.

NH Experience: With much fanfare, both New Hampshire pilot schools were able to celebrate active decomposition with a jump in temperature to almost 130" after just 17 days of mixing food waste and bulking agent in the composting bins.

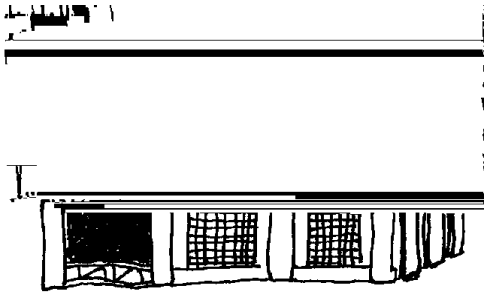
THE COMPOST BIN

The needs of a school compost bin are a little different than the needs of a household's backyard compost bin. Issues to consider when deciding what type of compost bin is right for a school include: the quantities of food waste generated; attracting wild animals to the school; and extra finances to buy or build a fancy compost bin.

Ready-made and easy-to-assemble bins can be purchased at local hardware and garden supply stores. Keep in mind that these bins are typically used by single households, therefore, depending on the amount of food waste the school produces, you may need multiple bins, which can be expensive.

When constructing compost bins, there are a number of designs which can be easy and fun to build. There are "holding units," such as snow fencing, wire fencing or hardware cloth tied in a circle to contain the compost pile. However, for the larger quantities of food waste a school generates, a "turning unit," a series of three or more bins that allows wastes to be turned regularly from one bin to the next, may be more appropriate.

NH Pilot Programs Use 3 and 4 Bin Turning Unit



Before choosing a compost bin design for the "Composting at NH Schools" pilot program, the successes and failures of other school composting programs throughout the United States were researched. Some schools had tried using the ready-made bins, however, they were unable to handle the large quantities of food waste. Others built elaborate multiple bin units with buildings around them, however, that required a large financial investment. For the New Hampshire pilot programs, it was decided that a three or four bin "Turning Unit" made from re-used wooden pallets and lined with hardware cloth would best address a NH school composting program's needs because:

- It can handle the large quantities of food waste and, if necessary, can be easily expanded by adding another bin.
- It is easy to line the pallet bins with hardware cloth to keep out unwanted animals.
- Reusing wooden pallets to make the bins keeps the composting program's costs down, and is a form of recycling!

> NH Experience: In New Boston, building the compost bins was a community collaboration of school faculty/staff and local transfer station staff and family. In Belmont, the students in the Technical Education class were able to use some of their skills constructing the compost bins with minimal supervision. At both schools, the preparation, construction, and clean up time totaled about 5½ hours for five to ten people.

How To Avoid Attracting Animals

Whenever composting food waste, and especially in a situation where there will be children around, additional care should be taken to avoid attracting animals. Some suggestions for accomplishing this are to:

- Line bins on sides, top and bottom with hardware cloth or chicken wire.
- Stay clear of food wastes that are high in protein and fat such as meats, oils, fish scraps, and dairy products.
- Place food wastes into the center of the pile so that no food is exposed.
- Turn the compost pile frequently to keep it actively composting.
- Maintain the bins over time! Holes or weaknesses can become an open invitation for some unwanted critter's dining experience.

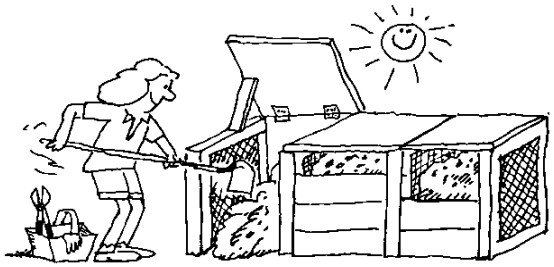
> NH Experience: In Belmont, the ½ inch hardware cloth lining the inside of the pallets and covering the fronts and tops of the bins, proved to be more than adequate in keeping out any pests. However, in New Boston sagging wire had to be reinforced on the tops after several cats had been found sleeping there while enjoying the heat from the compost below!

How To Keep Costs Down

A wood and wire three bin "Turning Unit" made from virgin lumber can cost approximately $300. However, a similar three bin "Turning Unit" that also meets all the school's composting needs can be made from re-used pallets and hardware cloth or chicken wire for about $150 (see Appendix B).

Another way to keep costs down is to solicit donations for bin materials, money and/or labor from local organizations and/or businesses. Also consider the possibility of grant programs supplementing a school composting budget.

How Many Compost Bins Will Be Needed?



Depending on the size of the school and the type of food served (i.e., quantity of fresh fruits and vegetables), a school kitchen feeding 100 to 800 students can average 5 to 30 pounds of "prep scraps" per day. Most of these schools will need a turning unit with four bins. The first bin will be used for "new" food waste, the second bin will hold actively composting food waste, the third will contain finished compost, and the fourth can be used for extra capacity during winter months. Additional bins may be added for bulking agent storage.

Schools with more than 800 students should plan on a five or six bin turning unit in order to have space to compost the extra amount of food waste generated. However, to see if your school has more than an average of 30 pounds per day, you may want to do a school food waste audit by collecting and weighing "prep scraps" for one week before building the compost bins.

Refer to

Activity #4

A very small school with less than 100 students can use a turning unit with three bins instead of four, or call the NH Governor's Recycling Program (271-1098) or the NH Department of Environmental Services (271-3712) for information on alternative composting methods.

NH Experience: For both the New Hampshire pilot programs, the three bin composting unit made from reused wooden pallets would have been sufficient for the volume of food waste they produced. However, just in case more space was needed, a fourth bin was built at both schools, and became very handy to store the bulking agent.

Where Should the Compost Bins Be Placed?

Compost bins should be placed on a flat grass or soil surface. To assist with keeping the compost moist, but not too moist, it is best if the bins are facing south for heat, but are partially shaded to keep the compost from drying out. For convenience, being close to the lunchroom and/or kitchen exits and a water supply, without being too close to a frequently traveled area, is ideal. Remember that access to the bins in the winter and snow plowing requirements should be considered.

The amount of space needed for composting depends on the size and number of bins used. Generally speaking, the four bins (each four feet square) in the pallet system need an area at least 20 feet across by eight feet deep for bins, bulking agent storage, and maneuvering. If placing the bins near a wall or fence, be sure to leave enough space for a person to walk behind the bins to keep the area clean.

Before making any decisions as to where to locate the bins, the most important step is to check with the food service, custodial and grounds keeping staff.

NH Experience: In Belmont, everyone appreciated that the bins were conveniently placed near a door outside the Technical Education classroom and only a few feet away from a routinely plowed driveway. In New Boston the composting bins were placed at the far end of a large parking lot, partially under some trees. Although there were no complaints about having to travel the distance (about 100 yards), the students bringing the food from the kitchen to the compost bins felt that the bins could have been a little closer to the school.

FOOD WASTE COLLECTION

Food waste makes up approximately 6 to 14 percent of a school's waste stream. However, this includes all food waste - "prep scraps" and "plate scrapings" (see page 2). Composting is most likely a new and different activity for schools. Consequently, it is important to begin as simply as possible (i.e., avoid contamination, fewer people requiring training and smaller quantities of food). It is suggested to start composting only "prep scraps" until you feel comfortable with the composting process. To get an understanding of how much food waste this will be, consider collecting and weighing it for a week. This will help with planning a collection schedule and the number of compost bins needed.

> NH Experience: At Belmont High School, "prep scraps" were approximately ½ pound per student per month, while at New Boston Central School, "prep scraps" were approximately one pound per student per month.

What Happens in the Kitchen?

When kitchen "prep scraps" are being composted, it is important to have the support and cooperation of the kitchen staff. The job of the kitchen staff is to keep compostable food scraps separate from other waste materials. Education is the key to keeping this a relatively simple task.

A few ideas on how to gain the support of the kitchen staff are:

- Be aware of the kitchen staff's needs and minimize inconvenience for them.
- Pay attention to where most of the food gets prepared for convenient placement of the collection containers.
- Provide clear signage to minimize confusion. Students may want to be involved in creating attractive signs for compost containers.
- Outline the "do's and don'ts" of the types of food accepted.

Use the following do's and don'ts for separating food waste.

DO's	DON'Ts
Breads	Oils
Fruit Scraps	Fats
Coffee Grounds	Bones
Vegetable Scraps	Meats
Crushed Egg Shells	Dairy Products

Meats, dairy products, oils, fats, and bones should not be composted because they will take a long time to decompose and may attract pests to the compost bins. In addition, anything nonbiodegradable, i.e., plastic forks, wrappers, cups, etc., will not break down in the compost pile.

Refer to Activity #5

NH Experience: Both pilot programs were designed so that the only responsibility of the kitchen staff was to place the "prep scraps" into a separate container. The New Boston Central School kitchen staff found this new routine required less time and energy than the garbage disposal that they had been using previously. There was also the added advantage of the septic tank requiring less maintenance.

In many schools, the food waste is usually disposed of by adding it to the other solid waste they generate while incurring obvious added disposal costs for the school. Once a food waste composting program is underway, there will be the obvious benefit of saving money from avoided waste disposal costs. Another food waste disposal method commonly used in schools is to flush it down the garbage disposal, grinder or "pigger" with water. When a school switches from this disposal method to composting the food waste, there will be a savings incurred by not only extending the life of their leach field and septic tank but also requiring less maintenance and cleaning.

In What Will Food Waste Be Collected?

Food waste is relatively wet and heavy. Consequently, collection containers need to be:

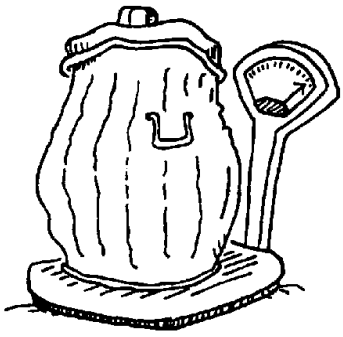
- Water Proof - To keep wet food from leaking and for easy cleaning.
- Light Weight - For ease of lifting, weighing and carrying by students and/or staff.
- Covered - To control odors and avoid attracting fruit flies.

To help determine the proper size container needed, consider the size and strength of the person lifting and transporting the food waste, as well as the amount of food waste produced at the school. A few options for food collection containers are:

- 5 gallon buckets: Oftentimes it is easy to find 5 gallon plastic buckets which are discards of bakeries, grocery stores or drywall contractors (sometimes referred to as "sheetrock" or "mud" buckets). These buckets can usually be obtained at a low cost and are easy to handle, wash, and place in a convenient spot for kitchen staff. Don't forget the lids!
- 33 or 55 gallon garbage cans with or without wheels lined with a plastic bag: These can be obtained at most hardware or department stores or through a supplies catalog that maintenance uses. They can be handy for large quantities of food waste. For heavy duty wheels, a dolly can be attached to a garbage can with bungee cords.

> NH Experience: The New Boston Central School used 5 gallon buckets with lids. This size was desirable because the elementary students were able to handle them on their own and easily place them in a wagon to pull across the parking lot to the compost bin site. The high school students and the kitchen staff at Belmont chose a 55 gallon plastic garbage can lined with a plastic bag. If the can was heavy, two students would carry it together to the compost bins. The plastic bag made it possible to weigh the food by tying a knot in the bag and hooking it on a scale.

How Much Food Waste Is Composted?



Record the food waste's weight to document how much food is being diverted from the school's waste stream and to estimate how much bulking material is needed (see Appendix C1 - C4). A standard bathroom scale can be used by placing the bucket of food waste on the scale and then subtracting the weight of the bucket, or standing on the scale with the bucket of food waste and subtracting the weight of the person and the bucket. Although it may be a little more expensive, a hanging scale typically purchased at a local hardware or feed store can also be used.

Who Will Collect the Food Waste?

The job of the food waste collector is to collect the buckets of food waste from the kitchen staff, record their weight, and bring them to the composting bins. This task provides an opportunity to involve the students, consequently giving them responsibilities and ownership of the program. Selecting reliable volunteers for the collection of food waste is critical. Willing and eager participants are key.

The collection process can be part of the regular classroom routine and responsibilities. Teachers can set up rotating schedules for students to follow, giving everyone a chance to participate. The environmental club, student council, or other similar student organizations may also be a resource for volunteers. An individual may also enjoy the responsibility of food waste collection.

NH Experience: At Belmont High School, Environmental Club students have a scheduled time to be "in charge" of composting and this has worked well, with the students maintaining full responsibility of the project. The New Boston Central School initially had the 6th grade science class students take turns with the food waste collection and composting responsibilities. After several months, the novelty of the assignment wore off, and the responsibilities were given to a special needs student and his aide. This resulted in a tremendous learning experience for the student. Both schools documented their total time associated with all composting responsibilities (including turning the compost from one bin into the next) to be only 1½ hours per week.

When preparing the collection routine for the volunteers, remember to:

- Set a regular schedule for collection volunteers.
- Create clear and precise instructions for the food collectors.
- Spend time educating collectors about their duties and responsibilities.
- Collect the food waste containers on a schedule which fits the kitchen staff's needs.
- Keep everybody happy! Do not create more work for the cafeteria or the custodial staff. Their support is critical in the success of the composting program.

> NH Experience: In New Boston Central School, food waste was initially picked up after lunch every day. However, arrangements were later made for every other day on Monday, Wednesday, and Friday. This new schedule was satisfactory with the kitchen staff as long as the students were consistent with their pickup routine and did not forget.

What About Plate Scrapings?

Collecting plate scrapings or "post consumer" food is very different from collecting prep scraps or "preconsumer food." Plate scraping collection involves educating the entire student body. It also requires a fair amount of monitoring at the garbage cans. Students need to understand the correct way to sort their plate waste in order to keep out contaminants, such as meats, plastic straws, napkins, etc.

Many New Hampshire schools are interested in composting food collected from the students' cafeteria plate scrapings. Although plate scrapings were not included in the New Hampshire pilot programs, research of a few schools that do separate plate scrapings has provided some of the following suggestions on getting started.

- Watch the students' routine in the cafeteria in order to develop an efficient traffic flow and avoid a backup of students at the food separation point.
- Educate the garbage can monitors about the "do's and don'ts" of separating plate scrapings for composting. They need to be present near the garbage cans at every lunch period to serve as a friendly reminder to the students.
- Create signs so the students can refer to the list of "do's and don'ts" and prepare themselves for the correct procedure. A mounted example on poster board of what

to put in each garbage can will help the students identify the correct places to put things.

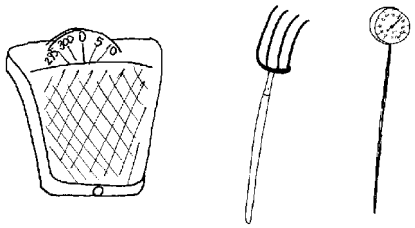
Deciding to compost school cafeteria plate scrapings can be an excellent opportunity to educate everyone in the school about food waste composting and potentially save even more money on disposal costs. For more detailed information on incorporating plate scrapings into your school's composting program, please contact the NH Governor's Recycling Program or the NH Department of Environmental Services.

COMPOST BIN OPERATION

The following information pertains to a school using the three or four bin turning unit for their school composting program.

What Equipment Is Needed?

A few basic pieces of equipment are needed for the composting operation. Refer to the check list below for suggestions on what is needed and where to get it.



- **G** Pitch Fork (for turning the compost) - Hardware or garden supply store
- **G** Tarp (for covering the bins to keep out rain or snow) - Hardware or department store
- **G** Bungee Cords (to fasten the tarp to the bins) - Hardware, camping, or department store
- **G** Compost Thermometer (to take the temperature of the compost) - Feed or garden supply store
- **G** Hanging or Bathroom Scale (for weighing the amount of food waste you place in compost bins) - Feed, hardware, or department store
- **G** Bib or Coveralls (to protect the clothing of the bin operator) - Retail Store

Let's Compost!

Once the bins are constructed, the bulking agent selected, and composting equipment obtained, you can begin composting.

Refer to

Activity #6

A suggestion for extending your composting season is to insulate the bins before November. Stacking bales of hay or attaching rigid insulation board around the bins before the compost temperature drops below 100°F are two ways of insulating the bins.

> NH Experience: To experiment with extending the active composting season further into winter, the bins in one of the pilot schools were insulated on November 20, 1995 with 1 inch styrofoam insulation board with an R value of 5. However, the compost bins were not active at the time the insulation was applied (bin temp was about 45°) and the temperature did not increase again until the spring thaw.

"FINISHED" COMPOST

In anywhere from six weeks to one or two years, you will be able to enjoy one of the greatest benefits of a school composting program: "finished compost!"

Is the Compost Finished?

Compost is finished when the materials placed in your bin have transformed into a crumbly brown "soil." The compost pile will be close to air temperature and the compost should feel like good garden soil with a sweet, clean aroma. If the compost is still "cooking," it will be too "hot" to use on young plants.

Should the Compost Be Tested?

It is not necessary to have the finished compost analyzed. However, for those interested, a soil analysis of the end compost product can be done at UNH for a fee. They will provide a comprehensive analysis covering the minerals and salts present and overall plant nutrient value of the finished product.

NH Experience: A finished compost sample was taken from the New Boston Central School bins in June of 1996 and analyzed at the UNH Analytical Services Lab. The Soil Scientist commented on the excellent C:N ratio of 12:5 and that the compost sample was a nutrient rich media that looked like an excellent growth medium for plants (see Appendix D).

How to Use the Compost?

How compost looks and how it will be used determines whether or not it needs to be screened. Most uses of compost, i.e., landscaping, mulching, and gardening projects, do not require screening. However, if screening is desired, half-inch hardware cloth can be used to pass the compost through.

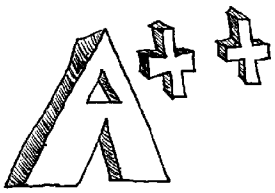
Because the finished compost is valuable, it most likely will be in great demand. Compost can be used as a rich soil amendment or mulch for:

Refer to Activity #7

- landscaping projects or class planting projects;
- greenhouses or vocational programs;
- school grounds landscaping (work with the maintenance staff);
- home gardens (for the school community); or
- a fund raiser for the school (some teachers may want to incorporate this into their math, business, accounting or art curricula).

NH Experience: New Boston Central School has a Christmas tree planting program, in which the students plant seedlings every year and then dig them up and sell them to the public a few years later. This was an ideal situation to use the finished compost as a mulch to enrich the soil around the trees and to protect their roots in the winter.

PROGRAM EVALUATION



Changes will probably be made throughout the program making it more efficient each step of the way. However, once the project has been up and running, take some time to meet with those involved, evaluate the program, and see if there are ways it can be streamlined. Encourage the cafeteria staff, students, faculty, and maintenance to spend time discussing what they like and dislike about the program. This feedback will help the program to run smoothly. With school composting, getting the people involved and excited is really important. If the process goes smoothly, the group of composters will be happier. Make sure they know that their input is valued and important.

EDUCATION - KICK-OFF - PROMOTION

A successful composting program needs to educate all of the active participants. Have an event or activity to mark the start of the program, and keep the motivation going throughout the program's life.

Education Is Key!

Education can begin when the idea of a school composting program is first conceived and continue as an ongoing process. Some school composting education ideas to think about are:

- Teach people (faculty, staff, and students) the basic concepts of composting, i.e., compost formula, what can be composted, etc.
- Relate composting to the basic solid waste management concepts of "reduce, reuse, recycle" - Composting is nature's way of recycling!
- Help people in the school and community learn the importance of the program and how it can impact the school through school or community wide events.
- Include education in school assemblies and individual classroom presentations.
- Utilize informational resources that are available, including the UNH Cooperative Extension, community recycling coordinators, state recycling representatives, and a composting video and guide in each New Hampshire community library entitled "Turning Your Spoils to Soil." The NH Governor's Recycling Program also has a number of educational materials which can help incorporate composting into the

reading, 'riting, and 'rithmetic of every day classroom learning and curriculum (see page 48).

Kicking It Off!

Having a specific time set aside to celebrate the start of the school composting program will help ensure the enthusiasm and follow through with all active participants. Some suggestions for a kick-off are:

- Invite the press to cover the kick-off event.
- Organize a "compost bin building" event on the day of the kick-off and invite the community to participate.
- Kick-off the project in conjunction with other community events, like Earth Day or Arbor Day.
- Make posters and other public information materials to publicize the event.
- Invite keynote speakers, i.e., local Conservation Commission members, UNH Cooperative Extension Educators, Garden Club members, landscapers, organic farmers, state or local environmental representatives, etc., to endorse the composting project and to help illustrate the importance and impact of the project.
- Invite professional performers to entertain and educate students and staff about composting and other environmentally related issues.

> NH Experience: In Belmont, the kick-off event was in conjunction with the High School students building the composting bins. Before construction began, a brief "What is composting?" presentation was given to the participating classes by the NH Governor's Recycling Program and the NH Department of Environmental Services. Two reporters from local newspapers attended the event to take photos and interview the students (see Appendix E).

Don't Forget Promotion!

Once a school composting program is implemented, the new routines can become second nature to the participants and the program basically runs itself. However, to get the full benefit of the program, it is important to keep the motivation going. Some suggestions for ongoing promotion are:

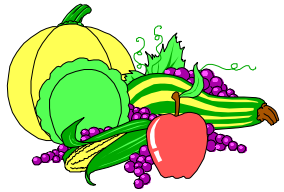
- Keep the motivation for the project going by providing recognition to participants, i.e., kitchen staff and collection and composting crew, for a job well done.
- Use the public address system to make announcements about the project's milestones.
- Post graphs or charts indicating how much food is being diverted from the waste stream.
- Get more press coverage highlighting results.
- Plan a celebration focusing on use of the end product (i.e., a tree planting on Arbor Day utilizing the compost to plant the tree).
- Help other schools who may be interested in learning the benefits of implementing a composting program.

Good Luck!

School composting is an excellent way to recycle an important and plentiful organic waste. All who are interested in this concept are heartily encouraged to pursue it. There are many potential volunteers throughout the school and community to help make it a reality.

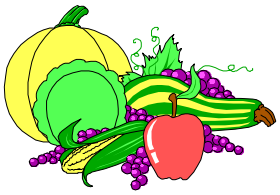
So, good luck with school composting. Remember, this is not the end of the "Composting at New Hampshire Schools" guidance. This is just the beginning of available school composting assistance and resources.

P.S. When you start your school composting program, please contact the NH Governor's Recycling Program at (603) 271-1098 or the NH Department of Environmental Services at (603) 271-3712. We would like to keep track of the schools in New Hampshire that are composting, and are always happy to answer any questions.



APPENDIX A
COMPOSTING AT NH SCHOOLS:
PROGRAM OVERVIEW

School Information	Contact Person	Construction Crew	Operation Crew	Bins / Bulking Agent	End Product	Pounds Diverted
Belmont High School 255 Seavey Road Belmont, NH 03220 (603) 267-6525 630 Students Grades 7-12	John Frick Tech. Ed. Teacher John Moulin Principal	Students in Technology Education class & teacher	Students	4 bin unit, insulated in November Hay	None yet	1995 = 682 (2 months) 1996 = 2,662 (10 months)
New Boston Central School 15 Central School Road New Boston, NH 03070 (603) 487-2211 384 Students Grades R-6	Dan Jamrog Gr. 6 Science Teacher Rick Matthews Principal	Faculty, school staff, & Transfer Station Attendants	Special Education student & teacher's aide	4 bin non-insulated unit Hay 1st year Leaves 2nd year	Excellent; used on student's marketable tree program	1995 = 868 (2 months) 1996 = 3,594 (10 months)



APPENDIX B
COMPOSTING AT NH SCHOOLS:
3 BIN COMPOSTING UNIT
MADE FROM REUSED WOODEN PALLETS

Instructions

In our pilot program, our design was a three bin turning unit made from pallets and hardware cloth. Donated pallets were covered with hardware cloth and connected to each other using "L" brackets. The tops and fronts of the bins were made from hardware cloth attached to wooden strapping for lightness, easy maneuverability, and maximum ventilation (see diagram of bins). Usually, a compost bin will sit right on the ground to maximize contact with micro-organisms. However, a floor was used in the pilot program to keep rodents and any other pests out of the compost. Therefore, the materials list is based on a three bin unit with floors.

The tops were attached to the bins using hinges. We screwed a piece of strapping along the back of the top of the bins to provide a common site of attachment for the tops. The separately built front was fitted to slide into two tracks on the sides of the unit. The tracks were constructed by using a 1" x 1" and a 1" x 6" to form a slot into which the door could slide up and down (see diagram). Safety gate hooks were used to fasten down the tops keeping in mind that raccoons have been known to unhook a regular hook and eye.

Hint: Measure your pallets before you bring them to the school. Wooden pallets are not always made the same size. For ease in putting together the bins, it is important to have the pallets as close to the same size and as square as possible.

Materials List

To Borrow:

- ✔ 1 - Heavy Duty Staple Gun (i.e., Arrow T-25)
- ✔ 2 - Battery Powered Drills - One for drilling holes and one for screwing screws (Electric drills and extension cords are OK if electricity is near by)
- ✔ 1 Pair - Heavy Duty Wire Cutters
- ✔ 1 - Hand Saw (Powered saw and extension cord are OK if electricity is near by)
- ✔ Measuring Tape

To Buy or Have Donated (local hardware or lumber supply store)

- ✔ 10 - Wooden Pallets* (<u>All the same size</u>)
- ✔ 13 - 1" x 3" x 8' Strapping or Furring Strip
- ✔ 4 - 1" x 1" x 3½' Lumber (14 linear feet total)
- ✔ 2 - 1" x 6" x 12' Lumber (24 linear feet total)
- ✔ 1 Box of 100 - 8" x 1" Flat Phillips Head Screws
- ✔ 1 Box of 50 - 8" x 1½" Flat Phillips Head Screws
- ✔ 20 - 10" x 3" Flat Head Screws
- ✔ 20 - 3½" "L" Bracket
- ✔ 6 - 2½" Safety Gate Hooks
- ✔ 6 - 3" LT Narrow Hinge, Tite Pin
- ✔ 1 Box 1,000 - **d**" Staples
- ✔ 1 - 100' x 48" roll of ½" Gauge Hardware Cloth or Equivalent Chicken Wire

* For free pallets, shop at your local recycling center/transfer station, businesses, and department, grocery, or hardware stores, or call Donation Depot at (603) 645-9622.

Bin Building Steps

Step 1. Measure, cut, and staple the hardware cloth or chicken wire onto one side of eight pallets for bottoms, backs and sides of bins. Two of the pallets will need hardware cloth or chicken wire on both sides to serve as inside walls. Use plenty of staples for strength, placing one every few inches.

Step 2. Lay the hardware cloth or chicken wire covered pallets in place, as illustrated in the diagram (with the wire sides on the inside of the bins), making sure all corners meet. If necessary, do one bin at a time.

Step 3. Use one drill to drill the holes in the pallets for the corner brace screws, and the other drill to screw in the 1" screws, fasten one corner brace along each corner between pallets as illustrated in the diagram.

Step 4. Cut four pieces each of 1" x 1" and 1" x 6" lumber the same height as the front of the bins.

Step 5. Fasten a precut 1" x 1" centered vertically on the front of each vertical pallet of the bins with two 3" screws as illustrated in diagram. (This is to create the runners for the doors.)

Step 6. Fasten precut 1" x 6" centered on top of the 1" x 1" with two more 3" screws as illustrated in diagram. Repeat for all 4 fronts on bins (you have just made the slots that the front doors will slide into).

Step 7. Measure for front door dimensions and cut pieces of strapping as illustrated in the diagram. Keep in mind that you want the door to fit loosely so it is easy to slide it in and out.

Step 8. Fasten strapping together with 1½" screws to make the door as illustrated. Use spare strapping as a corner brace, or use corner braces, purchased at a hardware store.

Step 9. Measure, cut and staple hardware cloth or chicken wire to the inside of the door and slide door in place in the front of the bins. Repeat for all three bins.

Step 10. Lay strapping along the top of the back of the bins and fasten to the top of the pallets with 1½" screws.

Step 11. Measure for tops the same as the front doors, keeping in mind that the top should lay over the door so that the door cannot be opened unless the top is up. Another option is to make one long top to cover the first two bins and a single top for the third bin. This is so you can open and prop up the top of the

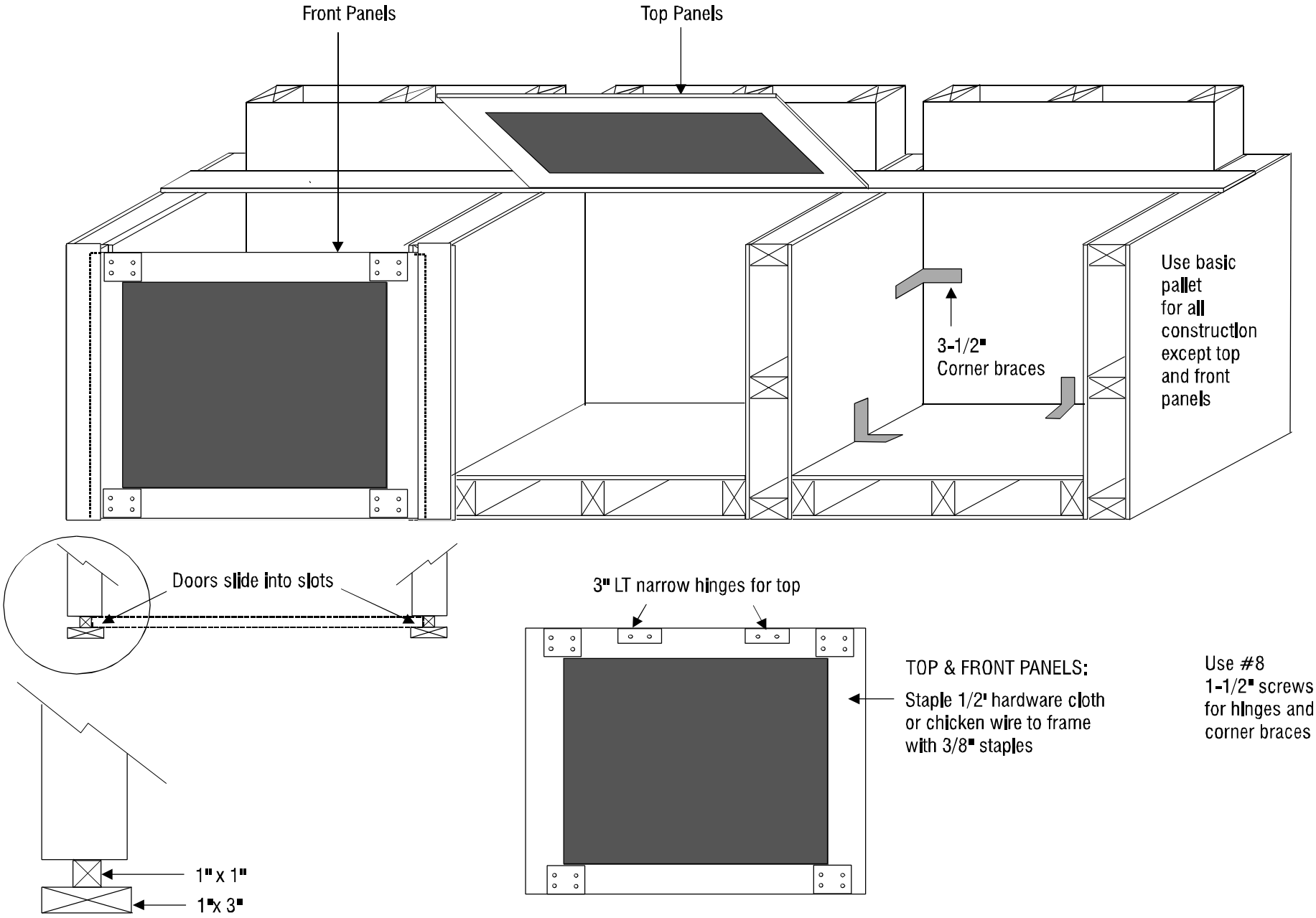
middle bin from the left side rather than throwing it open from the front of the bins.

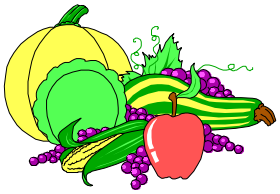
Step 12: Fasten together strapping for tops and staple hardware cloth or chicken wire the same as the doors.

Step 13: Place tops on top of the bins, then line up and attach two hinges to the back pieces of strapping and each top as illustrated.

Step 14: Attach safety gate hooks from each side of the front edge of the tops to the pallets on which they rest.

Step 15: You are ready to compost!


Front Panels
Top Panels
3-1/2"
Corner braces
Use basic
pallet
for all
construction
except top
and front
panels
Doors slide into slots
1" x 1"
1"x 3"
3" LT narrow hinges for top
TOP & FRONT PANELS:
Staple 1/2" hardware cloth
or chicken wire to frame
with 3/8" staples
Use #8
1-1/2" screws
for hinges and
corner braces



APPENDIX C
DOCUMENTS TO COPY

Forms similar to these documents were used by the two schools participating in the "Composting at New Hampshire Schools" pilot program.

- The "Tracking Form" (C1) was used to record the food's weight and several other procedures or observations associated with the compost bin operation.

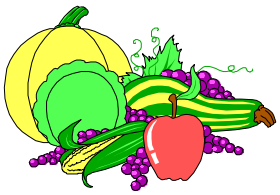
- The "Overview" (C2) was used as a handout to all the composting program participants, i.e. kitchen help, maintenance, teachers, etc., for an understanding of what the program was about and everyone's responsibilities.

- The "Reminder Notes" (C3) were attached to a conveniently located clip board as a brief reminder of the participants' responsibilities.

- The "Composting at NH Schools Trouble Shooting" chart (C4) is available not only to be conveniently located on the clip board and referred to for daily compost maintenance, but will also be a helpful tool to refer to when learning about how composting works.

Please feel free to make copies of these documents to use with your school composting program.

APPENDIX C1



SCHOOL COMPOSTING OVERVIEW

What Is Composting?

Composting is nature's way of recycling. It is a natural process of organic materials, such as food, leaf and yard waste, breaking down into a valuable soil amendment. Between 6 to 14 percent of the daily waste in a school can consist of compostable food waste.

What Is This Project?

The school's compostable food waste will be placed in a separate container from "noncompostable" waste and mixed with a bulking agent (leaves or wood shavings) in an outside bin for composting. This will help to get food waste out of the garbage can, where it is useless, and into a compost bin, where it will break down into a very useful fertile soil-like material.

Part 1 - Kitchen Collection

In the kitchen, food waste for composting needs to be kept separate from other materials. Please use the containers provided for food waste collection. Using the lids on these will help control odor and any potential fruit fly problems. A food waste collector will check with kitchen staff routinely to monitor the amount of food waste generated. When separating food waste for composting, here are a few things to remember:

DO's
Breads
Fruit Scraps
Coffee Grounds
Vegetable Scraps
Crushed Egg Shells

DON'Ts
Oils
Fats
Bones
Meats
Dairy Products

Why? Meats, dairy products, oils, and fats compost very slowly and create odors that are likely to be offensive, as well as attract animals to the bins.

Part 2 - Food Collection

The job of the food collector is to collect the containers of food waste from the kitchen staff, record their weight, and bring them out to the composting bins. When collecting food waste, here are a few things to remember:

1. Check with kitchen staff to see if containers need to be emptied.
2. Weigh food waste and record weight on tracking form.
3. Take food waste out to composting bins.

Why? Promptly removing the food waste from the kitchen is not only being considerate, but a necessity because the kitchen staff has Board of Health regulations about cleanliness they have to follow.

Part 3 - Bin Operator

The job of the bin operator is to mix the food waste into the bin, and to be sure it is covered with bulking agent so that no food waste is left exposed. You will need to add an equal weight of bulking agent for each container of food. When operating the bin, here are a few things to remember:

1. Open the bin, insert the compost thermometer into the center of the food waste and bulking agent, and record the temperature.
2. Stir the food and top layer of bulking agent that is already in the bin (from the last food waste deposit) with the pitchfork.
3. Add the food waste from the container, mixing it in with the food waste and bulking agent you just stirred and spread the material in the bin evenly.
4. Cover the mixed food waste and bulking agent with a layer of new bulking agent, making sure no food waste is visible.
5. Be sure to securely replace the door on the bin.

Why? The bulking agent will need to be mixed with the food waste to achieve the appropriate carbon/nitrogen ratio and provide oxygen for the composting process, to avoid odor problems, and not to attract pests and insects.

Part 4 - Compost Coordinator

The job of the compost coordinator is to make sure the composting process is working well. This is a very important part of the project and can help to eliminate any potential problems. When coordinating the compost project, here are a few things to remember:

1. Check the moisture of the bin; it should be as moist as a wrung-out sponge.
2. Check the temperature of the bin and record it on the tracking form. When inserting the thermometer into the compost, grasp the stem about 6" back from the point and push (DO NOT push the head of the thermometer). Once the stem goes in 6", grasp the stem 6" farther back, and push again. Repeat until the stem is completely inserted. This method will avoid bending the stem. Once the thermometer is inserted in the pile, wait at least 45 seconds before reading the temperature. When finished using the thermometer, return it to its box.
3. If the temperature is under 100°F, or over 150°F, mix the whole bin (too hot kills off compost bacteria, too cold means the compost process has slowed down).
4. If in doubt, check "Troubleshooting" (Appendix C4).
5. Record any comments/observations on tracking form.

Why? Moisture is needed for the microbes to work and too much moisture will keep the oxygen out. The hotter the pile, the faster the composting (100+), but too hot (150+) kills off compost bacteria.

When Bin #1 is full, notify the "Compost Starter" designated in Appendix C3.

When Bin Is Full

1. Transfer all material from Bin #1 into Bin #2 using the pitchfork.
2. Be sure to securely replace the top and front of the bin.

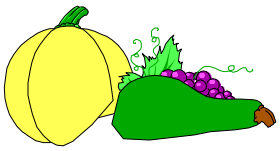
Part 5 - Compost Starter

The job of the compost starter is to start a new composting bin by setting the appropriate materials in the bin and to turn the contents of a full bin into an empty bin. Along with these ongoing responsibilities, make sure there is plenty of bulking agent available until the process will have to be repeated again. When starting the compost, here are a few things to remember.

To Start Bin #1 Again

1. Place 6"-10" of bulking agent in the bin as a base. This will absorb any excess moisture from the food waste.
2. Scatter the food waste over the entire bulking agent surface.
3. If you are using leaves for a bulking agent, you will not need to "seed" (add micro-organisms to) your compost. If you are using wood shavings, you may want to "seed" your compost. To "seed," sprinkle and mix approximately 1 five gallon bucket full of animal manure (cow, sheep, horse, chicken, or rabbit . . . . do not use dog or cat manures) or existing compost or leaves into the food waste and bulking agent. A "compost activator" sold at feed and hardware stores can also be used.
4. Cover the food waste with a layer of bulking agent, making sure no food waste is visible.
5. Be sure to securely replace the top and front of the bin.

Why? The well mixed food waste and bulking agent will aid in the composting process and help keep odors down and pests away.



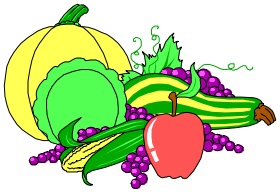
2. Stir the food and top layer of bulking agent (i.e., leaves or wood shavings) that is already in the bin (from the last food deposit) with the pitchfork.
3. Add the food from the container, mixing it in with the food and bulking agent you just stirred and spread the material in the bin evenly.
4. Cover mixed food and bulking agent with a layer of new bulking agent, making sure no food is visible.
5. Securely replace the top of the bin.
6. Return the container and clipboard to kitchen. Rinse the container clean.

Compost Coordination

The compost coordinators are: _____

1. Check the moisture of the bin, it should be as moist as a wrung-out sponge.
2. Check the temperature of the bin and record it on the tracking form.
3. If the temperature is under 100^{O}F, or over 150^{O}F, mix the whole bin (too hot kills off compost bacteria, too cold means the compost process has slowed down).
4. If in doubt, check "Composting Troubleshooting" section in this Guide (page 40).
5. Record any comments/observations on the "Tracking Form."

When Bin #1 is full, notify _____



SCHOOL COMPOSTING
TROUBLE SHOOTING

SYMPTOMS	CAUSES	SOLUTIONS
Compost has rotten odor	Not enough air and/or too much moisture.	Turn pile and/or add more bulking agent.
Compost has ammonia odor	Too much nitrogen (lack of carbon).	Add bulking agent.
Center of pile is dry	Not enough moisture and/or too much bulking agent.	Turn pile, moisten, and/or add more nitrogen, e.g., food wastes and/or green grass clippings.
Pile temperature is too low (<100°)	Not enough nitrogen, air, and/or pile is too small.	Add more nitrogen, i.e., food wastes and/or green grass clippings, turn pile and/or increase pile size.
Pile temperature is too high (>150°)	Not enough air, and/or pile is too large.	Turn pile and/or reduce pile size.
Pile is attracting animals	Presence of meat scraps, dairy or oils, not covering food waste well, and/or holes in composting bin that animals can get through.	Avoid meats, dairy and oils, cover other food wastes with bulking agent and/or repair any holes in composting bins.

APPENDIX D
COMPOST TESTING

UNIVERSITY OF NEW HAMPSHIRE

Department of Plant Biology
College of Life Sciences and Agriculture
Nesmith Hall
Durham, NH 03824-3597
Fax (603) 862-4757

July 3, 1996

Governor's Recycling Program
2 1/2 Beacon Street
Concord, NH 03301

To Whom It May Concern:

I have been asked to provide input regarding the recent assay (enclosed) of your compost sample by our UNH Analytical Services Laboratory.

pH

The pH of 6.5 is within the normal boundaries for composts and should pose no problem in terms of satisfactory plant growth.

Soluble Salts

The soluble salts level of 1.97 mmhos/cm should pose no problem relative to salt stress on plants. Generally, I view a reading of 2.00 mmhos/cm as the critical level beyond which salts may pose a problem. A relatively high reading such as present in your compost indicates a nutrient rich media; usually potassium is the element which contributes most significantly to the salt reading.

Nutrients

Nutrient levels are high as one would expect from the salt index reading. There should be abundant nutrient supply present for satisfactory plant growth during the early part of the growth cycle. Supplemental nutrients (eg. nitrogen) may be needed for the complete growth cycle but composts often has significant amounts of slow-release nitrogen so this may not be necessary.

The total N is relatively high (1.07%) so a nitrogen reserve is certainly present. The phosphorus and potassium reserves are not so abundant so supplemental additions of P and/or K fertilizers may be important for best crop growth.

C:N Ratio

The C:N ratio of 12.5 indicates an excellent ratio whereby abundant nitrate-N should be present or able to be released for satisfactory plant growth. If the C:N ratio is > 20:1, one can expect immobilization of nitrate-N as microbes compete with plants for the available N.

If you have questions on this assay, please feel free to call me at 862-3220. Overall, it looks like an excellent growth medium for plants.

George O. Estes
Spaulding G48
UNH

Client:

[redacted]

GOVERNORS RECYCLING PROGRAM
2 1/2 BEACON STREET

CONCORD, NH 03301

Reported July 1, 1996
Form: 81
Report program: Soil
Report route: George Estes

Test Results for New Boston (Lab number 4460)

			Low	Optimum	High	Very High
pH	6.5					
SMP Buffer pH	6.8					
Magnesium (Spurway)	270	ppm	H			
Calcium (Spurway)	687	ppm	H			
Potassium (Spurway)	1390	ppm	H			
Phosphorus (Spurway)	111	ppm	H			
NO3-N (Spurway)	290	ppm	H			
NH4-N (Spurway)	15	ppm	L			
Sol. Salts (G.house)	1.97	mmhos/cm	H			
Org. Matter (LOI-550)	25.6	%				
Organic-C	13.3	%				
Estimated C/N Ratio	12.9	%				
Ash	74.4	%				
Estimated CEC	12.2	%				
Estimated Base Sat.	75.5	%				
Estimated Ca Sat.	28.0	%				
Estimated Mg Sat.	18.4	%				
Estimated K Sat.	29.1	%				
Nitrogen	1.07	%				
Phosphorus (Dry ash)	.22	%				
Calcium (Dry ash)	.7	%				
Magnesium (Dry ash)	.15	%				
Potassium (Dry ash)	.3	%				

For questions on the above contact: George Estes, Plant Biology
Spaulding Life Science Center, University of New Hampshire, Durham, NH 03824 603-862-3220

Phone Numbers

County Extension Offices

Belknap	603-524-1737
Carroll	603-447-5922
Cheshire	603-352-4550
Coos	603-788-4961
Grafton	603-787-6944
Hillsboro	603-673-2510
Merrimack	603-796-2151
Rockingham	603-679-5616
Strafford	603-749-4445
Sullivan	603-863-9200

Department of Plant Biology

Extension Office	603-862-3200
Compost testing lab	603-862-3212

These offices are normally open 8:00 am to 12:00 noon, and 1:00 pm to 4:30 pm Monday through Friday except on holidays.

COMPOST TESTING

University of New Hampshire

Effective July 1, 1995

Analytical Services Lab
Spaulding Life Science Center, G-54
Durham, New Hampshire 03824
603-862-3210

composted materials.

Sampling and Submitting Composts for Analysis

Compost samples for analysis should be obtained with care. The collection procedure should yield a representative sample of the windrow or pile. The bulk of the sample should come from the interior of the windrow or pile. Take samples from a number of locations, mix them together and place about 2 cups in a plastic bag or clean plastic container. It is not necessary to dry the sample. **Submit samples for testing as soon as possible after**

and NH4-N (Spurway)	
Soluble salts	
Total Nitrogen	
Organic Matter (LOI)	
Total carbon, C:N ratio*	
Ash, CEC and base saturation*	$36.00

Additional tests -

Dry Matter (and calculated moisture)	$6.00
Total Ca, Mg, K, and P	$23.00
Heavy metals (acid extracted)	
Pb, Cr, Ni, Cd, Cu, Zn (per element)	$5.00

*Calculated values.

APPENDIX E
NH PRESS COVERAGE

School Composting Plan Could Lead to Heap of Savings

by ED PUFFER
Staff Writer

BELMONT - Take a school cafeteria's food scraps - the ones cut out during preparing meals. Put them in a pile in the sun. Invite some worms and other organisms over. What do you get?

The state hopes you get money - money that you save by not throwing those things away.

Belmont High School, which has long saved its kitchen scraps for compost, is now part of a pilot program being run by the Governor's Recycling Program. Saving kitchen scraps is known to create good compost and the state wants to know if composting is actually cheaper than bagging the stuff and sending it out as regular trash.

On Wednesday, students and state workers teamed up to build composting bins that they then installed at the southern end of Belmont High School, just outside the woodshop run by teacher John Frick. The bins will be filled with kitchen scraps that are cut out during the preparation of school breakfasts and lunches. Meat and dairy products are not included and neither is any food left over after a meal.

"We're keeping pretty close records as to how much food can be diverted from the waste stream and turned into a re-useable product," said Sherry Godlewski of the state Department of Environmental Services. "Belmont's going to be using a lot of the students to help with the project."

"Our second goal would be to educate students about composting," said Barbara McMillan of the Governor's Recycling Program. "They're going to let it compost, mix it, take its temperature every day."

Frick's students will be in charge of the compost, as they have been for some time. Frick has benefitted by taking items home for his own compost pile, but he is glad to give that up for the state program.

"We average 15 to 20 pounds per day," said student Josh Mazzei. "We take some of it and grind it up in a food processor and put it in the worm container."

The worm container is located in the back of Frick's shop. It is a small box with paper, food scraps and red worms. The worms eat their own body weight every day and what they eat turns into a very fertile soil.

"It's great for indoor composting. There's no odor," McMillan said. "We'd like to see these in every single home."

The other schools involved in the project are New Boston Central School, Wentworth Elementary School and Keene's Franklin Elementary School.

Belmont's compost will be used at the school to fertilize trees and plants on the school grounds.

"Take a look around. We've got lots of things we can do to make things look nice," said Principal Howard Murphy. "I garden myself and know the value of good soil."

Murphy said residents who are interested in composting can always call and see the school's composting program.

"People are certainly welcome to see how it works," Murphy said. "It's funny because it's not the kids who need to learn lessons like that, it's the adults."

(Article reprinted with permission from the Laconia Citizen)

GLOSSARY OF TERMS

Actinomycetes -- Micro-organisms that have the characteristics of both fungi and bacteria. Actinomycetes create cobweb-like growths throughout the compost and give compost an earthy aroma.

Aeration -- The process by which the oxygen-deficient air in compost is replaced by air from the atmosphere. Aeration can be enhanced by turning compost.

Aerobic decomposition -- Decomposition of organic wastes occurring in the presence of oxygen, making possible conversions of material to compost.

Anaerobic decomposition -- Decomposition of organic wastes occurring in the absence of oxygen. Causes production and release of methane gas.

Bacteria -- In a compost pile, the micro-organisms that do most of the work to decompose wastes. Hardworking bacteria cause the compost pile to heat up.

Biodegradable -- Capable of being broken down by micro-organisms (bacteria and fungus) into simple compounds that act as fertilizers in the soil (plant and animal remains are biodegradable). Another word for biodegradable is compostable.

Bulking agent -- Material, such as leaves, wood chips or shavings, added to compost primarily to help create good pore structure for air flow. Often provides part of carbon source as well.

Carbon -- An element that is abundant in wood chips, sawdust, straw, and leaves. Carbon provides energy for living things.

Celsius (C) -- A temperature scale in which 0° C is freezing and 100° C is boiling.

Compost -- A rich soil-like mixture that is produced when organic materials break down.

Composting -- The natural conversion of most organic materials into humus by the activity of micro-organisms, and an effective solid waste management technique for reducing the organic portion of waste.

Decomposition -- The breakdown of organic waste materials by bacteria and fungi into simpler components (e.g., carbon dioxide, water, and inorganic solids).

Disposal -- The discharge, deposit, injection, dumping, incineration, leaking, or placing of any waste into or on any land, air, or water medium.

Dump -- An open and unmanaged disposal site used prior to sanitary landfills where waste materials were burned, left to decompose, rust or simply remain.

Environment -- All the conditions, circumstances, and influences surrounding and affecting the development or existence of people or of nature. One's surroundings, inside or out-of-doors.

Fahrenheit (F) -- A temperature scale in which 32°F is freezing and 212°F is boiling.

Fungi -- Organisms such as molds, yeast, and mushrooms that feed on dead organic matter.

Humus -- That more-or-less-stable organic fraction of the soil matter remaining after the major portion of added plant and animal residues have decomposed. Humus is usually dark in color.

Invertebrate -- An animal without a backbone, such as an insect or worm.

Kitchen waste -- Food scraps, such as potato peels, apple cores, moldy food, and wilted lettuce.

Landfill -- A large outdoor area for waste disposal. Landfills where waste is exposed to the atmosphere are called open dumps; in sanitary landfills, waste is layered and covered with soil

Micro-organism -- A tiny living thing that is so small you need a microscope or magnifying glass to see it. Micro-organisms help break down organic wastes.

Millipede -- A tiny worm-shaped animal with many pairs of legs. Millipedes live in soil and compost.

Mite -- A tiny animal, or arachnid, no bigger than a pinhead, that lives in soil, plants, and compost.

Mulch -- A covering, such as leaves, straw, peat moss, or compost, that is placed on top of the soil in gardens and around trees to suppress weeds, keep soil moist, and keep plant roots cool in summer and warm in winter.

Nitrogen -- An element that is found in food scraps, grass clippings, and manure. Nitrogen is used by living things for growth.

Nutrient -- A food ingredient that supplies energy for living and growth.

Organic -- Made from living organisms, such as plants and animals. Organic substances include tree leaves, wool from sheep, and any other materials containing the nonmetallic element carbon (like diamonds and graphite, which are pure carbon in different forms).

Pill bug -- A small animal that lives in moist soil and rolls up in a little ball when it is threatened or scared.

Plate Scrapings -- The food waste left on plates after a meal

Potworm -- A small worm that lives in soil and compost.

Prep Scraps -- The food waste produced from preparing meals

Recycle -- To pass through a cycle again; to collect and reprocess manufactured materials for reuse either in the same form or as part of a different product.

Resources -- A supply of something that can be used or drawn upon. Something that can be used to make something else -- wood into paper, iron ore into steel, old newspapers into cardboard.

Roundworms (nematodes) -- Small worms (less than one centimeter) that prey on fungi spores, protozoa and each other and are very good for compost.

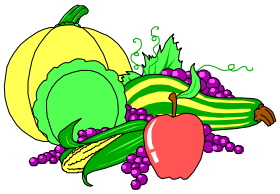
Solid waste -- Any unwanted non-liquid material that is discarded from households, industries or communities.

Turning -- In a compost pile, mixing and moving the organic material.

Turning unit -- Multiple composting holding bins built next to each other.

Waste stream -- All materials and resources being thrown away.

Yard and garden wastes -- Grass clippings, dead leaves, small branches, and weeds.



COMPOSTING RESOURCES

All these resources are available on loan to New Hampshire educators through the NH Governor's Recycling Program by calling (603) 271-1098.

Brochures or Handouts

- "Backyard Composting" An educational “how to” backyard composting brochure. Also available through your County Cooperative Extension.
- "Worming Your Way to Better Compost!!!" An 8 page handout explaining the“ABC’S” of worm composting and where to get worms, worm bins and worm books.

Video Tapes

- "Home Composting, Turning Your Spoils to Soil" (17 minutes) Teaches Home composting of household food and yard waste. "Composting to Reduce the Waste Stream" guide included. Also available through your local public library, County Cooperative Extension.
- "It's Nature’s Way: The Composting Solution" (6 minutes) Overview of how composting of household waste works, emphasizing its parallel to degradation in nature.
- "The Magic of Composting" (13 minutes) Features a compost fairy who teaches a skeptical man about the basics and benefits of composting.
- "Vermicomposting" (25 minutes) A simple demonstration of setting up, feeding, maintaining, and harvesting your worm bin for food waste composting.
- "Wormania" (26 minutes) An entertaining and educational video featuring “Worm Woman” Mary Applehof explaining how worms can help the environment and step by step “how to” for a food waste worm composting bin.

Curriculum

The following composting related curriculum are available for loan through the NH Governor’s Recycling Program’s “Educational Lending Library.” Please call for more information.

- "Compost Learning Guide: Teacher’s Guide" Grades 4-8
- "Composting: Wastes to Resources" Camp Age
- "Composting in the Classroom: A High School Teacher’s Guide for Indoor Composting Activities" Grades 9-12
- "Earthworms: Nature’s Recyclers" Grades K-6
- "4-H Composting Education Program" 4-H Groups
- "Scraps to Soil: A How-To Guide for School Composting" Grades 3-6
- "Squirmy Wormy Composters" Grades K-6
- "Worms Eat My Garbage" Grades K-12
- "Worms Eat Our Garbage" Grades 2-8
- "Worms in the Classroom Activity Ideas" Grades K-12

TRADE ORGANIZATIONS and ASSOCIATIONS

This is a listing of Trade Organization and Associations that serve the composting and solid waste industry.

COMPOSTING COUNCIL
114 South Pitt Street
Alexandria, VA 22314
(703) 739-2401; Fax (703) 739-2407
e-mail: comcouncil @aol.com

This council was established to improve public and market acceptance of composting processes and products.

ENVIRONMENTAL ACTION FOUNDATION
6930 Carroll Avenue
Tacoma Park, MD 20912
(301) 891-1109

The Environmental Action Foundation works with the human side of the environment, such as air, water and land.

KEEP AMERICA BEAUTIFUL
101 Washington Boulevard
Stamford, CT 06901
(203) 323-8987; Fax (203) 325-9199
web site: http://www.kab.org

Keep America Beautiful is a national, nonprofit, public education organization dedicated to improving waste-handling practices in North American communities.

NATIONAL RECYCLING COALITION
1727 King Street, Suite 105
Alexandria, VA 22314-2720
(703) 683-9025; Fax (703) 683-9026

The National Recycling Coalition is a nonprofit organization whose members include businesses, recycling and environmental organizations, state and local governments and individuals.

SOLID WASTE ASSOCIATION OF NORTH AMERICA
PO Box 7219
Silver Spring, MD 20910-7219
(301) 585-2898; Fax: (301) 589-7068
web site: http://www.swana.org

The Solid Waste Association of North America is a nonprofit educational organization of 5,800 solid waste management professionals.

EPA-New England
JFK Federal Building
Boston, MA 02203-0001
(617) 573-5720

The EPA's Office of Solid Waste deals with the legislative side of the solid waste industry. They provide regulations and guidelines to municipalities on recycling, composting, etc.

LOCAL

DONATION DEPOT
New Hampshire College
2500 North River Road
Manchester, NH 03106-1045
(603) 645-9622; Fax (603) 645-9666
web site: http://
www.nhc.edu/admin/depot/depot.htm
e-mail: eatonfr@nhc.edu

Donation Depot plays the matchmaker between organizations who have useful equipment and/or materials for which they no longer have a use and nonprofits who can use these goods.

EARTH DAY NH
PO Box 266
Amherst, NH 03031-0266
(603) 672-5441; Fax (603) 673-6250

Earth Day NH is a nonprofit group that promotes environmental education and acts as the state wide Earth day coordinator.

NH DEPARTMENT OF ENVIRONMENTAL SERVICES
6 Hazen Drive
Concord, NH 03301-6509
(603) 271-2900; Fax (603) 271-2456
web site:
http://www.state.nh.us/des/descover.html
e-mail: b_mcmillan@des.state.nh.us

The Department of Environmental Services (DES) is responsible for implementing waste disposal laws for the state. DES provides technical assistance to communities, schools, and businesses; conducts educational programs on solid waste management and recycling; and provides guidance for starting recycling programs.

NH GOVERNOR'S RECYCLING PROGRAM
2½ Beacon Street
Concord, NH 03301-4497
(603) 271-1098; Fax (603) 271-1728
web site: http://www.state.nh.us/recycle/homepage.html
e-mail: recycle@osp.state.nh.us

The Governor's Recycling Program provides technical assistance, stimulates and promotes new recycling ideas, and has developed databases on municipal recycling activities in New Hampshire and markets for the state's recyclables.

NH MATERIALS EXCHANGE
Business and Industry Association of NH
122 North Main Street
Concord, NH 03301-4918
(603) 224-1517; Fax (603) 224-2872
web site:
http://www.wastecapnh.org/nhme.htm
e-mail: exchange@wastecapnh.org

The NH Materials Exchange which is operated by WasteCap of New Hampshire, diverts waste from municipal landfills by providing a means for materials to be exchanged for reuse between businesses, municipalities, nonprofit groups, and individuals.

UNH COOPERATIVE EXTENSION
59 Taylor Road
Durham, NH 03824-3587
(603) 862-1520; Fax (603) 862-1595
http://ceinfo.unh.edu

UNH Cooperative Extension is part of a nation-wide Land Grant University System which provides educational outreach to families and individuals throughout the state, with an office in each of the ten counties.

WASTECAP PROGRAM OF NEW HAMPSHIRE
Business and Industry Association of NH
122 North Main Street
Concord, NH 03301-4918
(603) 224-1517; Fax (603) 224-2872
web site: www.wastecapnh.org
e-mail: reconinfo@wastecapnh.org

WasteCap is a pro-active, nonregulatory program providing businesses with the technical assistance necessary to recognize and act upon opportunities for solid waste minimization and recycling.

K - 12 SCIENCE CURRICULUM FRAMEWORK

To assist New Hampshire teachers in meeting specific curriculum requirements, this Guide and accompanying activities were examined for correlation to the "NH Science Curriculum Frameworks." For the resulting suggested correlations, please refer to the outline below and the New Hampshire Department of Education's K-12 Science Curriculum Framework.

1. Science as Inquiry

1a. Yes, both elementary and secondary

2. Science, Technology and Society

2a. Yes, elementary; secondary - could be applied to measuring with analog equipment
2b. Could apply to both elementary and secondary if teacher chose to explore composting organisms with microscopes, or testing the pH of compost etc.
2c. Yes, elementary; secondary - could fulfill if teacher chose to elaborate with activities.
2d. N/A
2e. Could fulfill both elementary and secondary if teacher chose to elaborate
2f. N/A

3. Life Science

3a. Yes, some of elementary and some of secondary
3b. Yes, some of elementary and some of secondary
3c. Yes, some of elementary and some of secondary
3d. Yes, some of elementary and some of secondary

These all relate to a portion of the overall life science standards (i.e., anatomical structures, food webs, requirements of organisms/processes etc.)

4. Earth/Space Science

4a. N/A
4b. N/A
4c. Related to both elementary and secondary via Earth's resources, water supply, human induced factors which contribute to changes in Earth etc.

5. Physical Science

5a. N/A for elementary, perhaps tangentially in secondary
5b. Perhaps tangentially in both elementary and secondary (i.e., change in substance = decomposition)
5c. Perhaps tangentially in both elementary and secondary (i.e., energy transformation)
5d. N/A
5e. N/A

5f. N/A

5g. Perhaps tangentially for both

6. Unifying Themes and Concepts

6a. Both elementary and secondary - tangentially

6b. Both elementary and secondary - tangentially

6c. Both elementary and secondary - tangentially (i.e., worm bin model of what happens in a forest or outdoor compost; the bin as a model of a natural process)

6d. Yes, both elementary and secondary

BY THE SKINS OF OUR BANANAS

Activity #1

A Comedy about a (Possible) Tragedy

Cast of Characters:

The Banana Bunch

Beulah - strong-willed, loud voiced, a leader
Bitsy - shy, sweet, small voiced
Biggy - big but very agile & sweet tempered
Bopper - a rocker, a roller
Blanid - an artist, a dreamer
Bubba - a cut-up, a joke-teller
Bix - musical, mature, easy (has a saxophone, clarinet, fultaphone -- wind instrument of choice, real or imagined; the sounds from it are real or vocalized by Bix to sound like the instrument he plays)

They are all dressed like bananas. Being dressed like a banana is hard work, so part of the charm of each character is dealing with the "costume" while staying in character.

The Landfill

Approximately 10 students whose roles are unspoken but central to the play. They are dressed in black trash bag tunics and wear plastic mesh potato or onion sacks over their heads, with the face area cut out in a rectangle so that the audience can see their ever shifting expressions. Throughout the play they stand in a semi-circle, absolutely still; they look straight ahead at the audience, never at each other. Their faces bear unhappiness and misery; they are continuously changing, from scowl to scariness, then boredom, anything unpleasant.

The Compost Heap

Approximately 10 students who are dressed in newspaper tunics and wear hats adorned with flowers, grasses, wheat, leaves, and other natural materials. Throughout the play they stand in a semi-circle and sway gently, their faces full of happiness and pleasure, their expressions continuously changing as they look at each other and at the audience, one bright, content face after another.

The Everybody Family

Everymom
Everydad
Everybrother
Everysister

They are dressed in street clothes. They begin as environmentally disrespectful, irresponsible waste-generators and, in the course of the play, grow to become responsible stewards of Earth's resources, beginning with banana skins.

The Recycling Angel

Male or female, the Recycling Angel is dressed in recyclables from head to feet. (The challenge to props and costumes is to fashion a body suit and wings that will be both hilarious and instructive: as a suggestion, each wing tip could have a 6-pack of empty aluminum cans, for example, joined by string by their pop-tops, and hanging from a spring attached to each wing tip so that the cans sway and clank when the Recycling Angel walks, leaps, gestures.) The angel is patient and loving, but firm about getting the Everybodies to do their part.

Plot:

The Bananas all want their skins to go to a compost heap, not the landfill. They know that their skin will become part of some wonderful new plant someday. But in the landfill, nothing good will come of them. They'll just sit there and sit there for a million years, uselessly. Because the Everybody Family is not enlightened about recycling, composting, or other resource wise choices, they throw everything in the trash, and it is landfilled.

The Banana Bunch decides to call upon the Recycling Angel to help educate the Everybody Family about the virtues of recycling and composting and the vices of landfilling.

In the end, the Everybodies -- young and old -- see the light and begin to run an environmentally responsible household. One by one, the banana skins jump gleefully into the compost pile. Immediately afterward, a bright flower, a tree, etc. grows up out of the pile.

All is well. The Bananas are together in the compost and the Everybodies are model recyclers and waste reducers. The Recycling Angel flits happily through the audience passing out instructions on how to compost, recycle, etc.

Scene 1:

Takes place on a table where the Banana Bunch all sit "bunched" together, apparently joined at their heads to a common stem, then separating as each disengages to get up and present his or her perspective about wanting his/her banana skin to go the landfill after being used by one of the Everybodies on breakfast cereal.

Scene 2:

Takes place in the Everybody Family's house. All over the floor are pieces of "trash" -- paper plates, aseptic juice boxes, Styrofoam egg cartons -- very few recyclables. This is clearly a household waiting for deliverance by the Recycling Angel.

Scene 3:

The semicircle of the landfill and the semicircle of the compost heap are the two central images on stage. It is here that the play's main conflict and action take place.

(Activity reprinted from "Closing the Loop: Integrated Waste Management Activities for School and Home" with permission from Chadbourne & Chadbourne, Inc., 8554 Haskins Road, Chagrin Falls, OH 44023-1823)

MICRO-ORGANISMS

Leading Question

Can you identify micro-organisms responsible for the composting process?

Procedure

1. Fill a tray with dry soil. Fill another with soil plus 5-10% organic matter, well mixed. Insert six slides vertically into each container, as in Figure 1.

2. Six slides in each container will permit observation of each sample at the end of one, two and three weeks. Each observation requires two slides, one stained dark and one stained light. Adjust the moisture content to about 20% water by adding a volume of water corresponding to about 1/5 of the volume of soil. Keep moisture content as constant as possible by adding water as needed.

3. After one week, two slides from each container will be studied according to the following procedure. Dig soil away from one side of the slide, then tilt the same slide toward the hole and lift it out as in Figure 2.

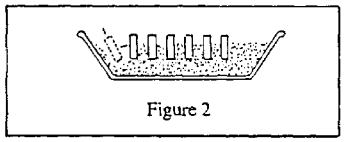


Figure 2

4. The slide will now have a film of soil and micro-organisms on one side. Clean the other side with a cloth. Label the slide with a wax pencil and prepare a second slide in the same way.

5. The preparation of the slide is "fixed" by passing the slide over a flame - one or two passes should be sufficient. Stain one slide dark, using gentian violet or methylene blue. Stain the other slide light, with eosine.

6. Examine each slide for the presence of bacteria with the low and high powers of a microscope. If present, spirilla will probably not be seen unless the field is darker. Sketch the observations and have students compare them to Figure 3 in order to identify the morphological class of the bacteria.

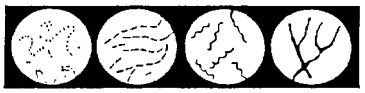


Figure 3: Common Morphological Classes of Bacteria

7. Have students determine whether there are differences in the number of the types of micro-organisms in the two samples.

8. At the end of the second week, repeat the procedures with another pair of slides from each sample. Have students determine if the number and types of bacteria in the samples have changed significantly and help them to account for the changes.

9. At the end of the third week, repeat the procedures and make further observations. Have students relate their observations and conclusions to composting.

Evaluation

Number of samples found.

Extensions

A. Share the food web of compost pile with students. Discuss its ramifications on composting and, if possible, assemble some of the consumers for direct observation.

B. Culture samples on nutrient agar in petri dishes. Observe what grows.

C. Grow a mold garden.

(Activity reprinted from the "AVR Teacher's Resource Guide: For Solid Waste and Recycling Education" with permission from the Association of Vermont Recyclers, PO Box 1244, Montpelier, VT 05602-1244)

Activi

DISCOVER COMPOST ANIMALS

Micro-organisms and soil animals, such as worms and insects, break down the organic material in your compost pile to form compost. But many other animals that don't eat wastes also live in your compost pile.

What do these animals eat? They eat the micro-organisms and animals that break down the compost! Still other animals eat the animals that eat the microorganisms and animals that eat the organic wastes.

A food web is a group of organisms that feed on or are eaten by each other. Here is a diagram of the food web in your compost pile.

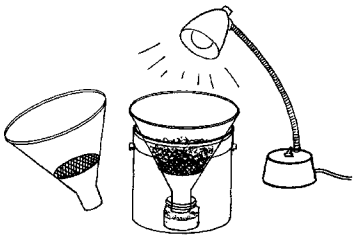
Would you like to observe some of the animals that live in your compost pile in person? You can do so by making an insect trap called a Berlese funnel.

What You Need

- small piece of window screen
- large diameter funnel
- small jar with soapy water
- container to hold funnel (a small plastic bucket will work)
- compost sample
- light source
- hand lens for dissecting
- record sheet
- pencil

What to Do

1. Cut the screen to the diameter of the funnel about two-thirds of the way down from the top of the funnel. Place the screen into the funnel.
2. Fill the jar half full with soapy water. Put the jar in the bottom of the container.
3. Put the funnel with screen into the container so that the bottom of the funnel is suspended above the jar with soapy water.



4. Put the compost sample into the funnel.
5. Place the light source over the top of the funnel. Leave for several hours or overnight. The soil animals will crawl away from the light source to the bottom of the compost in the funnel. Then they will fall into the soapy water and die.
6. Pour the excess soapy water out of the jar. Observe the soil animals with the naked eye, under a hand lens, or with a dissecting microscope. Do you recognize any of the animals from the diagram of the compost food web? Record your observations.

Record

1. Draw a picture of the animals that you see in your compost sample.
2. Can you name any of the animals?
3. What role do these animals play in the food web?

(Activity reprinted from "Composting Wastes to Resources" with permission from the Cornell Waste Management Institute, 468 Hollister Hall, Ithaca, NY 14853-3501.)

Activity #4

GARBAGE BAG RECIPE

Concept
Solid waste is everything we find useless and throw away

Grade Level
K-3

Objective
Students will define solid waste, identify major components of the waste stream, and begin to question their throw-away habits.

Method
Students will create a classroom trash bag.

Materials
Waste basket, typical trash items from the attached trash bag recipe

Subjects
Language Arts, Science, Social Studies

Skills
Reasoning, logical thinking, sorting and classifying

Time
One class period

Background
Composition studies at Vermont landfills have indicated that almost 60 percent of what we throw away still has value and could be reused, recycled, or composted. Diverting these resources from the waste stream begins with recognizing the resource potential of what we throw away each day. This activity sets the stage for many more by creating a classroom prop you can use over and over for different reasons.

Leading Question
What kinds of things do we throw away?

Procedure
1. Begin by examining the objects in the classroom trash can. Discuss the differences between trash in different places. What kinds of trash would be found in the cafeteria or in different rooms at home?
2. Cut up the attached list so that each child has only one or two items. Ask them to bring either the item itself or a drawing of the item pasted on cardboard to class the next day.
3. When all the components have been assembled, the garbage bag can be used for different lessons. The contents can be sorted and classified by different packaging types, objects with different resource bases, biodegradable or nonbiodegradable, made from renewable or nonrenewable resources, recyclable or reusable, etc. What can they be recycled into? How could they be reused?

Evaluation

What is waste? (things we don't use or want anymore) What are resources? (things that we don't use or need or value) Name one thing that is waste or one thing that is a resource. Name one thing you throw away which could be a resource instead of a waste.

Extensions

A. WHO WANTS TO GO TO THE DUMP? Hand one trash object to each student, and have all the students stand together in a group representing one large trash bag. The teacher can be the trash collector who will take it away. Describe what happens at a sanitary landfill and ask if anyone really wants to go to the dump. If not, they can be rescued by thinking of a way they can be reused or recycled. Try to save all the items of the trash bag by thinking up alternatives. Discuss ways to redesign products that cannot be recycled or reused. Continue until all the students have been rescued.
B. Make a trash can display showing the typical breakdown of different types of trash, as in the attached illustration. Use magazine cutouts for a collage. Also bring in the real things.
C. Find magazine pictures of things that get thrown out after one use and things that last a long time. Make posters or a display of the two types. Compare each throw away object to the same object fifty or one hundred years ago. (razors, paper napkins, paper grocery bags, ballpoint pens, etc.)

(Activity reprinted from the "AVR Teacher's Resource Guide: For Solid Waste and Recycling Education" with permission from the Association of Vermont Recyclers, PO Box 1244, Montpelier, VT 05602-1244)

INGREDIENTS OF GARBAGE BAGS

This list represents the contents of a typical three-pound residential trash bag, as determined by the Vermont solid waste composition studies done in 1986.

one paper plate

one glass jar

an old rag

some junk mail

plastic fresh produce bags

styrofoam cup

newspaper

one plastic detergent bottle

one apple core

dead branches and/or leaves

cardboard cereal box

brick pack juice container

plastic-coated cardboard milk carton

styrofoam egg carton

fast-food restaurant packaging

one brown paper bag

one aluminum can

a disposable diaper

corrugated packing box

six-pack ring

plastic film

plastic margarine tub

one banana peel

some dead flowers

cardboard egg carton

chicken bones

plastic cider jug

coffee grounds

Activity #5

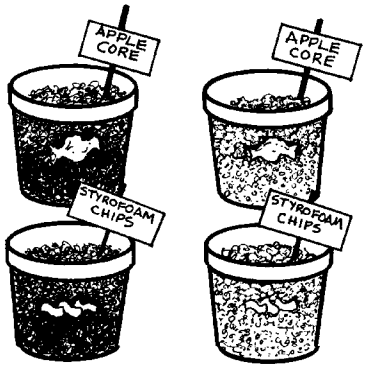
WATCHING WASTES ROT I

Some wastes break down faster than others in a compost pile. Some materials never break down in a compost pile.

Micro-organisms and soil animals do most of the work of breaking down wastes in compost. Do you think wastes will break down if these organisms are not present? How long will it take?

What You Need

flower pots
compost sample
sterile potting soil, perlite or vermiculite (sterile mix)
organic wastes, such as orange peels and apple cores
paper wastes, such as paper napkins and paper bags
plastic wastes, such as styrofoam chips and plastic bags
labels that stick on the posts
record sheet
pencil



What to Do

1. Fill half the flower pots half full with compost. Fill the other half of the pots half full with sterile mix.
2. Gather your organic, paper, and plastic wastes. Place one-half of each waste in a pot with compost and the other half in a pot with sterile mix. For example, place one apple core in a compost pot and one apple core in a sterile pot. Place three styrofoam chips in another sterile pot. Label the pots with the names of the wastes.
3. Cover the wastes with compost or sterile mix, filling the pots. Add water to all the pots so that the compost and sterile mix are damp but not wet to the touch. Check your pots every few days to be sure they are still moist.
4. After one week, examine the wastes in each pot. Which wastes are decomposing? Cover the wastes again, and continue to check them once a week for as long as you want. Record your observations.

Record

1. Record the name of the item that you buried in the pot.
2. Describe the condition of the item buried in compost each time you check it, i.e., how decomposed the item looks, what color it is, and whether or not you see fungi on it.
3. Describe in the same way the condition of the item buried in sterile mix.
4. Which items decomposed most quickly?
5. Which items didn't decompose at all?
6. In general, did items decompose more quickly in compost or sterile mix? Why do you think this is true?

(Activity reprinted from "Composting Wastes to Resources" with permission from the Cornell Waste Management Institute, 468 Hollister Hall, Ithaca, NY 14853-3501.)

Activity #6

WATCHING WASTES ROT II

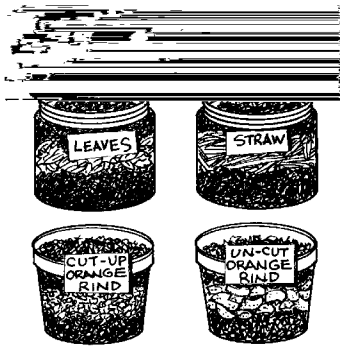
The organisms in a compost pile need air. When there is not enough air, the organisms die. New organisms that can survive without air come into the compost pile. These new organisms produce a gas that has a nasty smell.

The organisms in a compost pile also need to be able to get at the wastes to break them down. Is it easier for the organisms to get at large pieces of waste or small pieces?

Let's investigate how long it takes to break down wastes in the presence and absence of air. Let's also see how long it takes to break down wastes of different sizes.

What You Need

wide-mouth jars
compost sample
organic wastes (you may use one of several kinds of wastes)
flower pots
labels for jars and pots
record sheet
pencil



What to Do

1. Fill two wide-mouth jars half full with compost. Place equal amounts of a particular waste in each jar. Then fill the rest of both jars with compost, burying the waste. Fill the first jar with water and place a lid on the jar. Add just enough water to the second jar so the compost is damp but not wet to the touch. Leave the second jar exposed to air. (Check on the second jar every few days to make sure the compost is still moist, but do not over water.)

2. Repeat the procedure with other wastes. Label each jar with the name of the waste placed in it.

3. Take two more equal portions of a particular waste. Cut the first portion into small pieces. Leave the second portion uncut. Fill two flower pots half full with compost. Place the cut-up waste in the first pot and the uncut waste in the second pot. Cover the wastes with compost, filling the pots. Add water to the pots so that the

compost is damp but not wet to the touch. Check your pots every few days to be sure they are still moist, but do not over water.

4. Repeat the procedure with other wastes. Label each pot with the name of the waste placed in it and whether the waste is cut or uncut.
5. Check your wastes after two weeks. Which wastes are decomposing? Record your observations.

Record

1. Record the name of the item that you buried in the jar or pot and whether or not it was exposed to air. Describe the condition of the item buried in the compost. Include such things as how decomposed the item looks, what color it is, and whether or not you see fungi on it. Make the same observations noting whether or not the item was cut or uncut.
2. Did items decompose faster in the jar with air or the jar with water?
3. Was there a smell coming from either jar? If yes, what caused the smell?
4. Were items more decomposed when they were cut or uncut? Why?

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Activity #7

MINICOMPOST

Concept
Organic waste can be recycled to enrich soil for growing more organic matter.

Objective
Students will learn about recycling organic matter.

Method
Students will build a model compost pile in a classroom terrarium.

Materials
Aquarium, organic wastes, soil (not potting soil), thermometer, trowel or large spoon, 1-2 dozen red earthworms

Subject
Science

Skills
Sorting and classifying, inferring, predicting, observing

Time
One class period to a full year.

Background
"When we mention recycling, we often think of recycling glass bottles, aluminum cans and newspapers. But another 50% of the household garbage we throw out also can be recycled. These recyclables are food scraps, leaves, grass clippings and other biodegradable organic wastes. Organic wastes can be recycled by composting. Simply stated, composting creates optimal conditions for decomposition to occur. Decomposition is the biochemical process by which bacteria, fungi and other microscopic organisms break organic wastes into nutrients that can be used by plants and animals. Decomposition occurs in nature whenever a leaf falls to the ground or an animal dies. It is essential for the continuation of life on earth. The result of decomposition in a compost pile is a nutrient-rich humus that is excellent for improving soil quality and plant growth."

Recycling Study Guide

Leading Question
What do you do with food scraps?

Procedure
1. Assemble a variety of organic wastes including the following: manure and green grass clippings, sawdust, hair, wood ash, leaves, kitchen food scraps, etc. Avoid meat scraps, dairy products, fats and oils which inhibit decomposition, cause odors, and can attract pests. Chop the organic wastes into small pieces. You can leave some large pieces of the same materials to compare

rates of decomposition between large and small items. Why might there be a difference?

2. Alternate layers of the materials as follows (amounts are approximate): one inch of soil, two inches of organic waste, sprinkle of manure or green grass clippings, sprinkle of water, repeat.
3. Cover with an inch of soil. Water the pile enough to make it moist but not soggy. It should feel like a damp sponge (it feels moist, but you can't squeeze water out of it).
4. Add the earthworms and observe their behavior.
5. Place your compost pile where it will be at room temperature (not in direct sun). Gently mix the compost once a week to aerate it. Use a thermometer to test the temperature of the pile (for consistency, do it at the same location and depth at the same time each day). Make a graph of the results.
6. Discuss composting. How does it reduce the amount of waste you would have thrown out? What do you think happens to organic wastes that end up in the landfill? Is the landfill a gigantic natural compost pile, or are there problems with placing large amounts of organic materials in landfills?

Evaluation

Students will identify the ingredients of a compost pile.

Extensions

A. Construct a compost pile at home to use for the family garden.

B. Begin a school garden. Use the soil you've made to plant some flowers or vegetables.

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Necessary Components of a Compost Pile

Soil: contains micro-organisms that help decomposition

Organic Wastes: such as leaves, food scraps, and grass clippings. Wastes should be varied, including materials with both carbon and nitrogen. By alternating layers of high-carbon and high-nitrogen materials, you can create good environmental conditions for decomposition to occur.

Nitrogen: many of the organisms responsible for decomposition need nitrogen, thus nitrogen is necessary for rapid and thorough decomposition. Nitrogen is found naturally in many organic wastes, such as manure and green grass clippings, as well as in many commercial fertilizers.

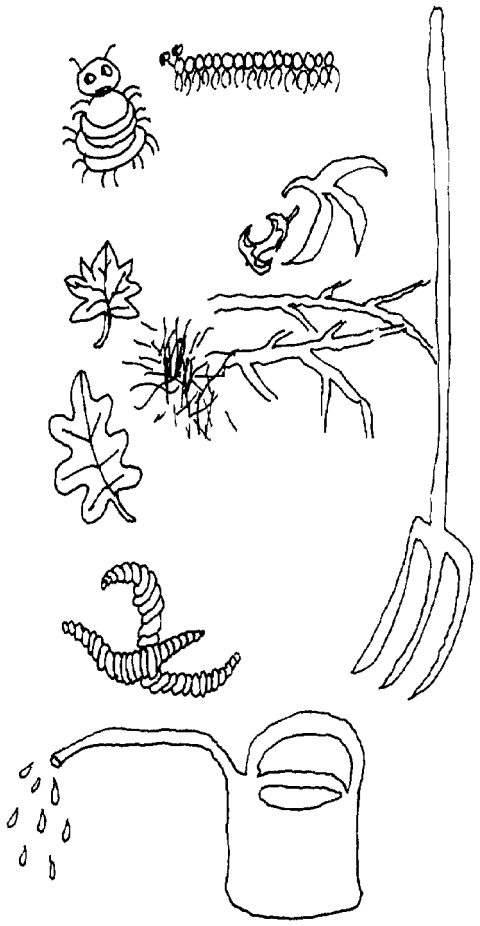
Worms: they eat the waste, helping to break it down; make droppings, which enrich the soil; tunnel through and aerate the waste, facilitate decomposition, and eventually die and become part of the compost.

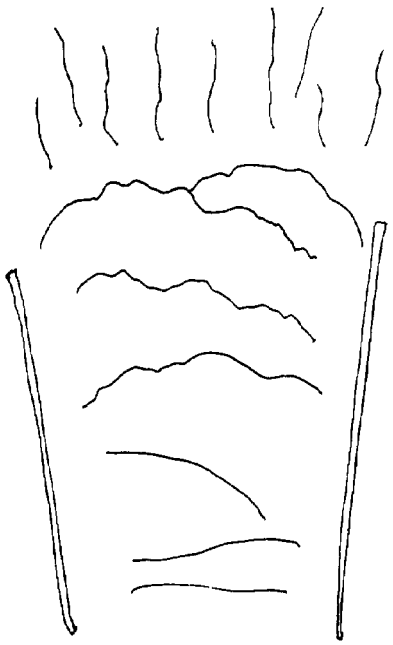
Air: the biological activity of fungi, bacteria, small insects, and other organisms results in decomposition. Most biological processes require adequate amounts of oxygen.

Time: decomposition takes time. To speed up decomposition, aerate your pile every few days; otherwise just leave it and wait.

Heat: heat is produced by chemical reactions resulting from increased biological activity that occurs during decomposition. Heat helps sanitize compost by killing certain organisms (i.e., weed seeds, pathogens, harmful insect larvae).

Mass: in order to generate enough heat for optimal decomposition, the pile must contain at least one cubic meter of organic material. Thus, the temperatures generated in an aquarium compost pile may be different from those generated in one that is larger.





Activity 8

PLANTING WITH COMPOST: EXPERIMENTS WITH COMPOST MATURITY

When Can We Plant in the Compost?

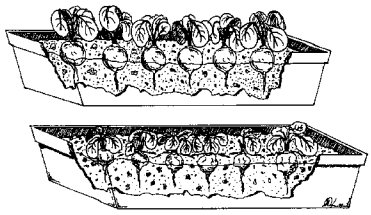
By Patrick Cushing

Background

If done aerobically, composting usually takes about 10-30 days. In the classroom, you may not be able to have optimum conditions and therefore this process could take longer. With limited space and possibly less than ideal composting conditions, you may have immature compost when you are finished with your composting.

Before compost can be used with plants, it should be mature. Immature compost may contain substances toxic to plants. Most of these toxic substances are intermediate compounds of the composting process. They may suppress seed germination, inhibit root growth, and decrease crop yields. If the compost were to continue to maturity, these compounds would be chemically converted into non-toxic substance.

In addition, immature compost has the tendency to further decompose, depleting oxygen in the soils, reducing root respiration, and leading to the production of H_2S and NO_2 - by anaerobic bacteria. These compounds cause odors and are toxic to plants.



Many methods have been proposed to determine when a compost is mature. There is a noticeable temperature change as composting occurs. After the cool down period, maturation occurs. Mature compost often is covered by a layer of gray actinomycetes, it attracts few insects, and it appears and smells like rich soil. One scientist claims that a simple taste test can be performed, as immature compost has a strong after-taste. (This method can be dangerous and is not recommended!) Other more formal tests of compost maturity include enzyme activity and nitrate and ammonia concentrations.

While these formal tests may give you a handle on one or more of the properties of your compost, the true test of a compost's worth is in the planting. If healthy plants can

grow in the compost, then you will have successfully composted organic waste into a usable material.

An easy experiment to perform is a germination experiment. Seed germination is relatively quick (depending on the type of seeds), and if time permits you can grow the plants to maturity and observe the compost's effects on plant growth as well as germination.

Materials

potting trays
light source (fluorescent)
light timer
potting soil (sterile)
compost
radish seeds
tomato seeds

Procedure

Preparing the Compost/Soil Mixture

1. Obtain compost at various stages of maturity. If you have only one batch from your classroom work, you can purchase finished compost from a company such as Agway.
2. Determine the percent compost you want to test. Use more than one mixture. Try one which is heavy in compost (70-100%) and one that is light (perhaps 25%). This will give your students more data to observe.
3. Determine the amount of each mixture you will need. Be sure to have enough to grow twenty seeds in each mixture.

Planting Your Seeds

It is best to follow the specific planting instructions provided with your seeds. We used the following basic set-up in our radish and tomato experiments.

1. Plant your seeds ½ to 1 inch deep in the soil. Water them so that the soil is completely damp yet drains well. Continue to water every 3 to 4 days as the soil dries.
2. Place the plants in an area of ample sunlight. If this is not possible, set up a fluorescent light source above the plants to ensure adequate light. It is helpful to hang the lights by hooks on a chain. This way as the plants grow you can raise the

lights. Start with the light about 6 inches from the plants. A timer is helpful so that the plants will receive the same amount of light each day.

Making Observations

1. Observe the plants daily, looking for germination. Record the day and time you notice that germation is beginning.
2. After the plants germinate, begin measuring the plants and record the data as average height vs. day after germination.
3. Observe the general health of the plants, making notations about differences you see with the plants.
4. Keep these plants alive for some time to see how growth occurs in the different compost mixtures. When you are finished with the growth experiments and no longer wish to grow the plants, cut the plants off at the soil level and mass them for each of the compost-soil mixtures. This will give you one final bit of data on the plants.
5. Graph the germination rate results (number of days after planting vs. number of plants germinated).

Discussion

From these experiments, your students can plan new experiments and truly become inquisitive scientists. They can continue using various ages of compost, or they can design experiments based on other factors. It may help your students to do a literature search on germination to find out what factors affect germination and how compost quality could effect germination rates.

Suggestions for Further Experiments

1. Wash the compost with water and use this water to germinate seedlings between pieces of filter paper.
2. Add vitamins to the compost/soil mixtures to see if they influence the germination rate.

Activity reprinted from "Composting In The Classroom: A High School Teacher's Guide for Indoor Composting Activities" with permission from the Cornell Center for the Environment, Cornell University, 11 Rice Hall, Ithaca, NY 14853-3501, and Patrick Cushing, 31 Edgewood Park, New Rochelle, NY 10801.