Nature: The Great Recycler

Nothing in nature is wasted or sent to a landfill. Nature recycles organic material (anything produced by a living organism) through a combination of biological and chemical processes. Microorganisms, insects, and worms help decompose (break down) dead plants and animals, returning nutrients to the earth so that other plants may grow. When we compost at home and work, we are utilizing these natural processes. The following series of leaflets have been created to show you how simply it can be done and steps to ensure your success.

Composting is Easy!

Composting your yard and kitchen waste doesn't have to be expensive or inconvenient. A compost bin can be as simple as a chicken-wire enclosure or a hole dug in the ground. Why not visit the compost demonstration garden here at MUN Botanical Garden to get some ideas for your own house or apartment.

The Benefits of Compost

Adding kitchen and garden wastes to a compost bin reduces the volume of garbage sent to landfills each year. Here in the province of Newfoundland and Labrador we are becoming increasingly aware of the problem of landfills running out of space, leaching pollutants to the surrounding environment, all the while costing towns and municipalities large tax revenues. A landfill is viewed as a blot on the landscape and few of us want to live next to one. Since almost 50% of our wastes are made of organic matter, which can be composted, everyone can play an active role in decreasing the size of our landfills.

Adding organic waste to a composter also enables us to return valuable organic matter back to the earth. When compost is added to soil, it can become a very useful and valuable source of nutrients. Here are some examples:

Many areas of Newfoundland and Labrador have poor soil. Finished compost, when added to soil is a valuable source of nitrogen, potassium and phosphorus, as well as trace elements such as iron, manganese, copper, zinc and boron. These are all very important for plant growth. Purchasing fertilizers and soil can be expensive in our province. Composting is not.
The Benefits of Compost (Continued)

When organic matter is added to soil, as in the case of adding compost, it helps soils hold or retain water. This means you will not have to water your garden as much or as often. (Even during wet weather we often experience drying winds throughout our province).

When you apply chemical fertilizers to your garden, the rain will sometimes wash them away. To re-apply is often a time consuming and expensive task. Compost helps bind or hold the nutrients in the soil. Not only do they not wash away, but the valuable nutrients are then available as needed, over the long term.

When you mix compost with your soil, you loosen the soil and help increase the air spaces. The compost itself is in turn made up of a variety of particle sizes and a large number of microorganisms. Increased air spaces and a greater amount of microbes mean less compact soil, healthier plants, and easier growth for roots. Healthier plants in turn mean less diseases and greater resistance to pests. Better root growth not only helps your plants thrive, but enables it to withstand the effects of our winter ‘freeze and thaw' weather, when plants can literally be pushed out of the ground if the roots are too shallow.

Every season, compost created from deciduous leaves (called leaf mold) is mixed with peat and other soil amendments, and is spread across our flower beds at MUN Botanical Garden. Not only does this add much needed organic matter to our flower beds, the compost acts like a mulch, smothering emerging weeds and discouraging the growth of others.

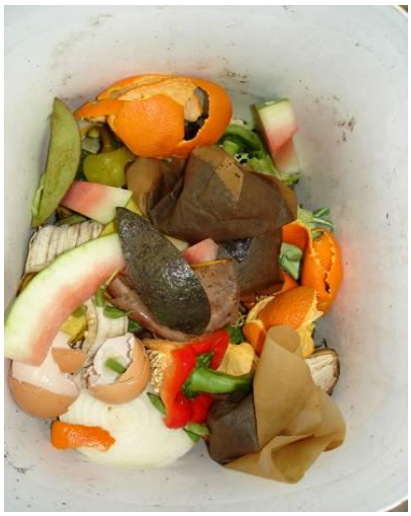
Adding compost to your garden soil also stretches the growing season both in spring and fall. This is important in our province during our short growing season. The darkened soil absorbs more heat from the sun. Soil rich in humus warms up faster in the spring and stays warm longer in the fall.

Adding compost to your soil adds many beneficial microorganisms to your garden and creates an environment conducive to their growth.

Let's Compost!

The following is a list of items that can be composted. The smaller the items, the faster the compost process. Therefore, it is recommended that you try to shred, crush or cut items into smaller pieces if possible.

KITCHEN WASTES



- Fruit peelings and scraps
- Vegetable peelings and scraps
- Eggshells
- Tea bags
- Coffee grounds
- Used paper coffee filters
- Stale bread
- Cooked pasta (No sauce!)
- Paper napkins, paper towels
- Shredded paper / cardboard packaging

YARD WASTES

- Lawn clippings
- Leaves
- Plant debris
- Old potting soil

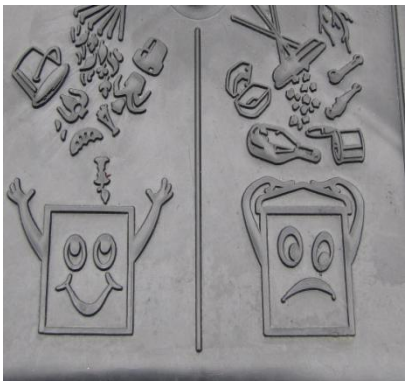
HOUSEHOLD ITEMS

- Houseplant trimmings
- Pet fur
- Dryer lint
- Hair
- Shredded newspaper and cardboard
- Vacuum bag contents
- Wood ashes
- Sawdust and wood shavings

Are there items you should not compost? Yes!

What NOT to Compost

While the following items will decompose, they can cause problems. To avoid pests and odors it is best NOT to add the following:



- Dairy products (milk, cream, yoghurt)
- Meat, cheese, fish, bones
- Fats (including grease, oil, lard, butter, margarine, or mayonnaise)
- Sauces that include any of the above
- Pet wastes

Also avoid adding:

- Large pieces of wood, thick branches, or heavy cardboard – these will take a long time to decompose and will take up space in your bin.
- Invasive weeds such as morning glory or gout weed
- Plastic, rubber, metals, glass and ceramics will not decompose.

Composting works faster and smells better when you add your compost materials in layers of "browns" and "greens".

Browns are dry, absorbent and fibrous. They are also rich in the element carbon which is an essential energy source for the decomposing organisms in your pile. These include dry leaves and grass, straw, wood chips, sawdust, shredded paper, cardboard and egg cartons.
Greens are fresh, moist materials rich in nitrogen. Nitrogen is vital for growth and reproduction of the decomposing organisms. Without it, they cannot break down materials high in carbon. Greens include fresh grass clippings, plant trimmings, fruit and vegetable scraps, coffee grounds, tea bags, egg shells and houseplants.

For more information on building and maintaining your compost pile, please refer to Information Leaflet #4 of this series.

The Compost Bin

When starting a compost project at home or work, the selection of a compost bin is an important decision. There are a large variety of bins to choose from, and your choice is up to you. However, there are other considerations, such as its location and size, which should be considered carefully before proceeding. Here are some tips to help your decisions.

1. Location of the Compost

In the province of Newfoundland and Labrador we often experience long winters, cool springs and cold, wet autumns. Therefore, to extend the compost season as long as possible, it is very important to position your bin in a sunny, sheltered spot. The warmer temperatures will encourage greater microbial activity, which will speed the compost process. A compost bin located in the shade will remain cool, lengthening the process.

While a sunny location is important, your bin should also be accessible and convenient to use. Many families keep a small waste collection bin near the kitchen door, and empty this once a week in the compost bin positioned further away. The choice is yours.

A well drained area is also essential. Many people find it more convenient to raise the bin slightly off the ground using pieces of wood or a pallet.

2. Size of the Compost

While the size of your bin is related to the amount of material you wish to compost, a popular compost bin size is approximately 30 inches (76 centimeters) wide by 30 inches deep by 30 inches high. When your compost bin is smaller, the pile does not tend to heat up or "cook" properly and a bigger pile may be harder for many people to manage.

However, if you plan to compost on a larger scale, you can adjust your bin size accordingly, or create more than one bin.

3. Type of Compost Containers

The type of container you use is a personal choice. It has been our experience at MUN Botanical Garden that the simplest model is usually the best choice. Depending on the location of your bin, you may decide on an attractive looking bin, or a purely functional one. Why not drop by the compost demonstration garden located outside the Friends' wildlife garden here at MUN Botanical Garden to get some ideas.

To Purchase or Build?

Many ready-to-use models are available for purchase from hardware and garden centers. At times the large variety can be confusing. It is best to select a type that fits your budget, keeping in mind that a compost bin does not have to expensive. As long as it is sturdy, the correct size, and has a lid that will stay put, it should work. Some plastic bins may not be rodent-proof. If rodents are a problem, simply lining your bin with chicken wire can do the trick. Here is a sample of some of the many types of composts that can be used:

Converted Garbage Can

By simply puncturing holes in a metal or plastic garbage can, you can create a bin. You may want to cut out the bottom, add some wire mesh and raise it slightly off the ground using pieces of wood or a pallet.

Wire-mesh Container

You can build a bin by simply tying together 3-4 feet of wire mesh into a circle. You may wish to secure it to the ground to ensure it doesn't tip over. The advantage of this model is the excellent air flow and affordable price.

Wooden Pallet Container

This simple, cost-effective model also recycles wooden pallets, which are sometimes available for free from retail outlets. Simply position four pallets in an upright position, and tie together to form a square. You can add a pallet floor for stability.

Compost Pile

While definitely not wind or rodent proof, the simple compost pile costs nothing, requires no set-up and works well. Because it is considered by some to be unattractive, it may be better situated in an out-of-the way location. Ideally, it should be in a sheltered spot to prevent the wind from blowing it away. For aesthetics, you may wish to limit this type of composting to leaves, grass and other yard waste.

Rotating Barrel

This type of bin can be purchased or made. It is rotated by simply turning a handle, making aeration and mixing an easy task. Education staff here at the Garden has noticed children (and adults) really enjoy using this composter.

Building Your Compost Pile

Once you have decided on an appropriate bin, locate it in a suitable area, and started collecting your compost items, you are ready to start piling it up. Keep in mind that there are three key ingredients in maintaining a compost bin. These ingredients are:
1. The right amount of "greens" and "browns"
2. The right amount of oxygen
3. The right amount of moisture

1. Greens & Browns

Composting works faster and smells better when you add your compost materials in layers of "browns" and greens".
Browns are dry, absorbent and fibrous. They are also rich in the element carbon which is an essential energy source for the decomposing organisms in your pile.
Greens are fresh, moist materials rich in nitrogen. Nitrogen is vital for growth and reproduction of the decomposing organisms. Without it, they cannot break down materials high in carbon.

Browns	Greens
- Dry Leaves	- Fresh grass clippings
- Dry Grass	- Plant trimmings
- Straw	- Fruit / vegetable scraps
- Wood chips	- Houseplants
- Sawdust	- Tea Bags
- Shredded paper / cardboard / egg cartons	- Egg Shells
- Shredded newspaper	- Coffee Grounds

If you have too little nitrogen, the microbes cannot break down the carbon, and the composting process will slow down. Conversely, if there is too much nitrogen for the microbes to use, the nitrogen will be lost to the atmosphere as ammonia gas.

2. Oxygen

The microorganisms that do much of the work in your compost bin are living creatures. Like many living creatures, they require oxygen to survive. The process of creatures using air when they break down material is called aerobic decomposition. If not enough air is provided, organisms that do not require oxygen survive and the process of anaerobic (without oxygen) decomposition occurs. Not only is this process much slower, but bad odours are often produced.

3. Moisture

The microorganisms that do much of the decomposition work also need water to survive, as do all living creatures. If your compost pile is allowed to dry out, the microbes cannot work or survive. Conversely, too much moisture is also not recommended. If a compost is water-logged or too wet, all the air spaces fill with water, which promotes decomposition without air, which in turn slows the process and produces a bad odour.

As you can see, oxygen and moisture are linked when keeping a compost pile. Here are a few tips to help prevent problems:

- If possible, turn your compost regularly with a pitchfork to keep air circulating through the layers.
- Keep your pile as moist as a wrung-out sponge. You may have to water it during dry weather, and turn it if there's lots of rain.

When aerobic (using oxygen) microorganisms have sufficient browns, greens, air and moisture, they give off heat when they are active. Detecting an increase in temperature is a simple method to determine if your compost is working. While using a thermometer is more accurate, you can often detect the heat by simply feeling inside your compost. The heat has an added advantage. The combined heat of millions of microorganisms will speed the decomposition process. It can also make your compost hot enough to kill unwanted spores, seeds, and harmful bacteria.

Humus: Garden Gold!

The finished product of the composting process is sometimes called humus. It should be dark in color, crumbly in texture, with an earthy smell. Compost is considered mature humus when the biological process of decomposition has slowed. Most particles of waste should be completely broken down.

Using compost before it is ready is not recommended and can in fact harm your garden plants. When the organic matter is breaking down, microbe activity is still very high. These microbes will use up oxygen needed by plant roots to grow. Also, if the browns or carbon continue to break down, it will take important nitrogen from the soil, leaving the roots deficient in nitrogen.

Generally, with proper maintenance, you'll be able to collect your first batch of soil-enriching humus within a summer. With fewer turnings and without layering, the process may take up to two years. The time involved will vary greatly according to a number of factors. These are:

1. The ratio of browns and greens (carbon and nitrogen)
2. The amount of moisture
3. The amount of oxygen
4. The temperature of the compost pile
5. The particle size of your waste

(For more information, please refer to Information Leaflet #4 of this series.)

Gardeners who simply can't wait might consider having two bins, side by side – one for fresher material, and one to sit and "mature".

Using the Finished Product

Compost should not be considered a fertilizer in itself. Most fertilizers have higher levels of some elements than most compost. However, added to soil, compost does increase the organic matter or nutrients in the soil. Hence, it could be considered an excellent amendment or additive. For more information on uses of compost, please refer to Information Leaflet #1 of this series.

Winter Composting

The winter weather in Newfoundland and Labrador can start early in fall and last throughout spring. While the process of decomposition will slow down greatly or even stop when temperatures drop, you can continue adding waste to your compost pile throughout the winter. Even in mid-winter the large leaf piles at MUN Botanical Garden remain warm in the middle, indicating decomposition is occurring.

Here are some winter-composting tips:

1. Position your compost bin in a sunny, wind-sheltered spot.
2. Make sure your bin is accessible in the snowy weather.
3. In the fall, remove finished compost and dig it into your flower and vegetable beds.
4. Stockpile bags of leaves, and use them throughout the winter to layer with the "greens" as usual.
5. Start a worm compost bin or vermicomposter inside your house. As long as you keep the worms warm, they will break down your kitchen waste for you throughout the year.

If you decide to stop composting in the winter, you can store your kitchen scraps in a covered bucket or garbage bin outside. When spring arrives, dig them into your heap and cover them with a layer of soil or dry leaves. Keep in mind that kitchen scraps are high in nitrogen and need to be mixed with lots of dry leaves, grass, paper or other "browns" in order to compost properly. (For more information on building your compost, please refer to Information Leaflet #4 of this series).

Vermicomposting: Composting with Worms

Worms can turn kitchen waste into a nutrient-rich soil conditioner called vermicompost. Vermicompost is a mixture of worm castings (droppings) and decomposed organic material. This small-scale form of composting is ideal for apartment-dwellers and those who lack space for an outdoor compost bin. Vermicomposting also extends the composting season, an important consideration in our northern climate. Worms kept indoors will continue to consume waste when outside compost piles are frozen.

What You Will Need

1. Container

The size of the container and the number of worms needed depends on the amount of waste added. Try to get a rough estimate of the amount of kitchen waste you produce in a week. A worm bin should be about a foot deep and provide one square foot of surface area per pound of waste.

Number of People	Quantity of Worms	Bin Size
1 or 2	1 lb	1 ft x 1.5 ft x 2 ft
2 or 3	1 lb	1 ft x 2ft x 2 ft
4 to 6	2 – 3 lbs	1ft x 2ft x 3.5 ft

Plastic bins are suitable for a small number of worms but they may require drainage holes. Wooden boxes are more absorbent and provide better insulation.

Worms like a dark, moist environment. Cover your bin with a piece of moistened burlap sacking and a sturdy lid.

The location of your bin is important to the success of the project. A worm box makes an excellent addition to any kitchen, basement, laundry room, shed, or garage. Outdoor bins should have a lid and the worms need to be protected from extreme temperatures. Select a shady location and move them indoors when winter comes. We have noticed at MUN Botanical Garden that they do not like drafts or cold temperatures and will actually migrate from the bin if they are not comfortable. Worms are cold-blooded creatures are do require some external heat to stay active. However, they should never be placed directly near a heat source.

2. Worms

Red wigglers (*Eisenia fetida* and *Lumbricus rubellus*) are the best worms for vermicomposting. They are much smaller and thinner than earthworms and they don't seem to mind being kept in captivity. Some people call them "redworms", "manure worms", "brandling worms", or "trouters".

The red wigglers used at MUN Botanical Garden were generously donated by Bill Glynn of Trouters Special Worm Farm in Bay Bulls. Mr. Glynn has been raising worms and vermicomposting in Newfoundland for many years. He sells worms, bedding, castings and containers to the public. He is also an endless source of knowledge and advice. At time of printing, there are no other worm farms in our area.

3. Bedding

Your worms will eat everything you put in the bin, including their bedding! Use a variety of materials to provide them with more nutrition. The following materials make ideal bedding:

- Shredded newspaper
- Shredded cardboard
- Shredded fall leaves
- Chopped straw
- Dried grass clippings
- Peat moss
- Add a couple of handfuls of sand or soil to provide your worms with grit for their digestive systems.

4. Food Waste

Feed your worms the same kitchen waste that you would add to your outside compost heap. Bury wastes and vary the location of each deposit to avoid overloading your bin. Finely chopped food will be broken down more quickly than large chunks. Do not add meat, fish, dairy products, or fats. Citrus fruit peels take a long time to break down so add them sparingly. For more information on what to compost, please refer to Compost Information Leaflet #2 of this series.

Harvesting Vermicompost

Red wigglers will convert waste into vermicompost within a few months. The compost is ready to be harvested when there's little original bedding left and the food scraps have been converted to brown and earthy-looking worm castings.

Move the finished compost to one side of the bin and place new bedding in the space created. Bury fresh food waste in the new bedding. Your worms will gradually migrate to the new food and fresh bedding, leaving the finished compost to be skimmed off.

Using Vermicompost

- Sprinkle into a seed row when planting
- When transplanting, add a handful of vermicompost to the hole.
- Use as a top-dressing or mulch around the base of plants
- Mix half and half with potting soil for your houseplants.

Vermicompost Potting Mix Recipe

- 1 part worm castings for nutrients
- 1 part peat moss to help hold moisture
- 1 part perlite to aerate the soil
- 1 part sand or garden soil for bulk

Common Questions…

Will it smell?
Not if air can circulate through the layers.

- Drill holes in plastic bins and line with mesh
- Raise the bin above the floor
- Choose bedding that will not mat down (newspaper tends to get soggy)
- Turn the bedding every two weeks
- It is best to compost only recommended wastes: dairy products, fats, and meats can cause unpleasant odors.

How can I avoid fruit flies?
Fruit flies can become a problem if a high amount of fruit waste is put in the compost. The problem may be compounded if the lid is opened quite frequently as in a classroom setting. The following procedures may prevent this problem:

- Bury all food waste
- Avoid adding too much slow-decomposing fruit waste like citrus peel
- Don't overload your bin
- Keep the surface of the compost covered with a piece of burlap and a lid

To Solve a Fruit Fly Problem:

Place a flypaper coil next to the box or spray the surface with a fine mist of Safers soap every second day for one week.

Try a fruit fly trap: Cut a plastic pop bottle in half and fill the bottom with an inch of vinegar. Fit the top of the bottle upside down into the bottom so that the neck is just above the vinegar.

Compost versus Fertilizer

Plants need water, sunlight, and nutrients to grow. Three important nutrients are nitrogen (N), phosphorous (P), and potassium (K).

Nitrogen (N) is used to make protein and chlorophyll by the plant. It is important for good leaf development and vegetative growth. Too little nitrogen causes slow, spindly growth. Leaves may turn yellow due to lack of chlorophyll – the green pigment which helps plants make food. Phosphorous (P) is vital for the growth of root and stem systems. When little of this nutrient is present in the soil, seedlings may not become well established.

Potassium (K) plays an important role in the plant's metabolism. It is involved in resistance to chill, drought, and disease. Lack of potassium may result in brown, scorched patches on leaves. Leaves may also roll inwards or downwards

Compost also provides nutrients, but usually at lower concentrations than chemical fertilizers.

Compost does, however, release nutrients to plants over the long-term, whereas chemical fertilizers are a short-term solution and must be reapplied regularly over the growing season. Extensive use of chemical fertilizers has also been linked to environmental degradation. Excess fertilizer can leach out during rain and end up in local rivers and ponds. Fertilization does not replace the value of soil improvement, which involves adding organic material.

Worms: A Gardener's Best Friends

Worms dig tunnels which allow air and water to penetrate the soil and improve root development. They are also living miniature compost factories! During digestion they secrete chemicals which free nutrients necessary for plant growth. Worm castings (or droppings) contain five to eleven times more available nitrogen, phosphorous, and potassium than the soil they ate to make the castings.

A Word about Good Worm Stewardship…

By removing worms from their natural habitat, you're taking responsibility for their care and well-being. Worms, like any creature kept in captivity, will die if neglected. Before starting your vermicomposting project, please ensure that everyone involved is ready to be a good worm steward!

The Biology of Worms

Worms can live up to about a year in a worm bin. Because the worm's body is about 90 percent water, if a worm dies in the worm bin, it will shrivel up and become part of the compost rather quickly.

Worms are hermaphrodites, which means they are both male and female at the same time. However, worms still need to mate. Two worms attach to each other for a few minutes, and several days later, both produce a cocoon or egg case. The cocoon eventually separates from the worm. Inside the cocoon, two to five baby worms may be found. The baby worms live in the egg case for at least three weeks, sometimes longer depending on the surrounding conditions. In the winter time, for example, baby worms may stay in the cocoon for many weeks until the temperature warms up again. When the baby worms eventually crawl out, they are the thickness of a piece of thread and about 1 centimeter long. Usually the worm appears white, as they have not yet developed enough blood (pigmentation) to be seen. In two or three months, worms are mature.

True or False?

Worms breathe through their skin? True

Cutting a worm in half will make two worms: False
(Cutting a worm in two will eventually kill it.)

Red wigglers can eat their weight in food every day : True

Worms have teeth: False

Worms are blind: True
(Worms don't have eyes and so they cannot see. They are, however, sensitive to bright light – that's why they burrow into the earth.)

Worm Facts

How long does a worm live?
In the wild, most worms live for a year. Worms must survive cold weather, droughts, and predators. In captivity, some worms have lived for as long as four and a half years!

What does the early bird have in common with the worm?
Both birds and worms have a muscular gizzard which contains small particles of grit. When the muscles of the gizzard contract, these hard particles help grind food into smaller bits, which are easier to digest. Worms in captivity need to be provided with a handful of sand or grit to help them digest your kitchen waste.

Have you ever wondered why worms are slimy?
Worms need air to survive, but unlike people, they don't have lungs. Instead they breathe through their skin! Oxygen enters their bodies by dissolving in the moist layer that covers them. If a worm dries out, it can't breathe.