

# “Green for Life” 4-H LANDSCAPE HORTICULTURE PROJECT

Composting - Activity Guide





Learn to do by doing

### 4-H Pledge

I pledge:

My HEAD to clearer thinking,

My HEART to greater loyalty,

My HANDS to larger service,

My HEALTH to better living,

For my club, my community and my country

### 4-H Grace

(Tune of Auld Lang Syne)

We thank thee Lord, for blessings great

On this, our own fair land.

Teach us to serve thee joyfully,

With head, heart, health and hands.

## INTRODUCTION

The 4-H Composting Activity Guide has been designed with two age groups in mind:

- Junior: 8 to 10 years of age
- Intermediate: 11 to 14 years of age

Each activity has been designed for both age groups. These activities are meant for members to have an opportunity to learn, evaluate, make decisions, communicate and develop confidence.

### **Each activity has the following format:**

Title

Topic

Learning Outcomes

Time

Materials/Resources

Instructions

Suggestions

Discussion/Comments

Processing Prompts

Each activity in the 4-H Composting Activity Project has learning outcomes identified at the beginning of the activity, and processing prompts at the end. To gain a better understanding of why these were added to every activity, we have included the following section about experiential learning.

## **Experiential Learning**

Experiential learning is a model that, simply put, consists of action and reflection. Research shows that learning is often best achieved when it is fun, active, interesting and easy to understand. Participating in fun activities creates a sense of togetherness within a group, helping members relate to one another as well as allowing the group to relax, feel safe and at ease. Through guided reflection and discussion, activities with meaning often help individuals understand concepts and skills more than if the same meaning was presented in a lecture format.

A leader can help 4-H members and groups learn by leading activities with meaning. These activities can then be processed to help the group find the meaning. These lessons can then be applied to other areas of the members' lives – helping them to transfer the meaning from the activity to the real world and every day life.

The following 4-H Composting Activity Guide includes learning outcomes at the beginning of each activity. Members will discuss and explore the meaning behind the activities and transfer these insights, through the help of the 4-H leader, into their everyday lives, whether it be in sports teams, school groups, community groups or at home with family. The 4-H leader can facilitate this by using the processing prompts listed at the end of each activity.

### **What is Processing?**

Processing is when individuals reflect, describe, analyze and communicate what they have or will be experiencing in an activity.

Each activity has processing prompts. There will be a list of questions to ask regarding concept to focus on a group discussion. Some or all of the questions can be used to process the activity. Feel free to add your own processing prompts if you feel there is a specific topic that you would like to discuss.

When using the Activity Guide, processing is most easily done with the group when sitting or standing in a circle, and when the group is attentive and focused on the discussion.

When questions are designed properly and used thoughtfully, discussion questions can be an effective learning tool that promotes creativity as well as generated meaningful interaction and understanding for the member. Processing can be fast or slow depending on the group and the activity.

## **A Note on Health & Safety**

It is important to practice good hygiene. Many of the exercises will involve touching waste materials, compost and soil. Remind children not to touch their eyes and mouth after handling materials.

Handwashing should be encouraged after each exercise. Soap and lather hands for at least 15 seconds before rinsing.

It is not necessary to wear gloves to touch compost. Using gloves helps protect hands but is not a replacement for handwashing.

It would be best for immunocompromised individuals to not partake in the exercises.

Once the experiment is done, sanitizing the area post clean-up and ensuring all waste materials are put in the right homes is recommended.

## **Content**

1. Waste or Resources? What's in your bin?
2. Compost Workers – Who's in your bin?
3. Ingredients for Composting Success
  - i. The "Greens" and the "Browns"
  - ii. Water and Air
  - iii. Temperature: Turning up the Heat
  - iv. Size Matters
4. Composting in Miniature - Building a Composting Prototype
5. Getting Composting Started in your Backyard
6. Trouble-Shooting
7. It's Finished! Harvesting Your Compost
8. Putting Worms to Work
9. Compost Tea
10. Making & Watching Grass Grow
11. Mulch – It's a Cover-up
12. Compost is Soil Food
13. Composting Systems of all Sizes

*Exhibit I - List of Educational Resources*

*Exhibit II – Provincial, Territorial & Federal Ministries of Environment and Agriculture*

## **Waste or Resources? What's in your bin?**

### *Topic*

Learning what and how much gets thrown out in the garbage

### *Learning Outcomes*

To gain awareness about the quantity and type of materials that get thrown out and what could otherwise be done to avoid sending them to be buried in landfills

### *Time*

30 – 60 minutes, depending on the quantity of waste to be sorted

### *Materials/Resources*

- garbage collected for one week
- weigh scale
- gloves
- plastic drop sheet
- containers to separate different materials
- waste audit sheet and pencil/pen
- optional: calculator

### *Instructions*

1. Weigh the garbage that's been collected for one week. Make note if anything special occurred that week to change the amount and type of garbage that might have been produced.
2. After spreading out the plastic drop sheet and putting on your gloves, empty the bag(s) of garbage on the sheet and start sorting the material into waste categories (eg. plastic, paper and cardboard, metal, compostables, other).
3. Put each waste category into a separate container and weigh each of them separately (*Hint: when added together, the weight of all the contents should match with the original amount weighed as garbage.*)
4. Calculate the proportion that each category represents of the total weight to determine overall waste composition. Compare your results with others to see what might be similar and where there are differences.
5. Identify what alternatives-to-landfill exist for each of the categories or specific materials in the garbage eg. recycling, composting.

### *Discussion/Comments*

- Would there be any changes to the amount or type of garbage produced based on the seasons of the year or holidays or any other particular activities (eg. moving)?
- Why is it important to reduce the amount of materials sent to landfill?
- What benefits can be realized by recycling or composting?
- What makes recycling or composting successful? (eg. communication, infrastructure, markets for the materials, cleanliness of the recyclable materials)
- What are the ways to reduce or eliminate waste in the first place?

### *Processing Prompts*

Are there any categories which could be further divided into sub-categories? eg. plastic: plastic bottles, film, styrofoam, trays, etc. Are there different management options for these sub-categories? eg. reduce, reuse, recycle

Could any materials be re-used again or are there alternative options which could have avoided the waste in the first place (eg. re-usable cups, shopping bags, eating the food before it spoils, using rechargeable batteries instead of one-time-use options)?

What kind of products are made from materials that are recycled and composted?

## **Composting ... Nature's Way of Recycling**

Composting is a natural biological process by which organic material is converted into a soil-like product or humus (pronounced "hue-mous") called compost. The composting process works with the help of micro-organisms such as bacteria and fungi, combined with air and moisture, to break down organic material.

Composting is the recycling of organic materials. Anything that used to be a living entity, be it a carrot, leaves, coffee grounds or a banana peel, can be recycled through the composting process. While any organic material will naturally decompose over time, composting is a focused scientific approach, using the factors involved in decomposition to control the process in a more deliberate manner.

### **Factors of Influence**

To make composting work properly and create compost, it is important to be aware of and manage the many factors that can influence the speed, process quality and end result.

Like us, the organisms responsible for breaking down or decomposing the organic materials, need food, air and water. Preparing the organic materials properly as well as providing the right conditions or environment for their work helps speed up and effectively manage the process.

### **Food**

The organic materials are the food for the bacteria and other organisms, getting energy (carbon or C) and nourishment (nitrogen or N) to function and build cell structure. All organic materials have both carbon and nitrogen composition albeit at different levels.

Carbon-rich materials are most often brown and dry such as leaves or dried grass. Nitrogen-rich materials are often green and would usually also be moist such as fruit and vegetable peels, coffee grounds and freshly-cut grass.

Finding the right balance of ingredients --- referred to as the carbon:nitrogen ratio (C:N ratio) --- helps trigger the composting process. Generally, the sought-after C:N ratio for composting is between 20 – 30:1; meaning 20 to 30 parts carbon to one part nitrogen. If the ratio goes above 30, meaning too much carbon or "browns", the composting process will slow down. If the ratio goes below 20, there is too much nitrogen creating ammonia and unpleasant smells. Combining 1-to-2 parts of "browns" with 1 part of "greens" will get the general ratio for the composting mix.

## **Air**

The organisms need oxygen to function, especially the aerobic bacteria and decomposers. Frequent turning or aerating of the compost pile enables oxygen to be added. When there is enough air, they can work fast, eating the organic materials. When oxygen becomes used up or depleted, without additional turning, the anaerobic bacteria takes over and the decomposition process slows down. The anaerobic bacteria also produce unpleasant odours which smell like rotten eggs.

## **Moisture**

A thin film of moisture or water on the materials is needed by the micro-organisms to function. It is in this medium that they do their decomposition work. If the compost pile is too dry (less than 40% moisture), the process slows down. If the pile becomes too wet (more than 60% moisture), the excess water fills in the air spaces or pores between the materials, drowning the aerobic decomposers and enabling the anaerobic decomposers to dominate, again resulting in the production of unpleasant smells and the slowing down of the composting process.

The compost pile should be at a moisture level of between 40 and 60%, most often described as feeling "as moist as a wrung out sponge".

## **Temperature**

The temperature of the compost pile gives a great indication of the decomposition activity of the micro-organisms. They give off heat as they work, causing temperatures to rise. As the temperature increases, the conditions change, with different types of micro-organisms taking over, being able to live better in these hotter conditions. Temperatures will begin to drop as the organic matter is consumed, resulting in the process slowing down. The further addition of organic materials as well as turning of the pile will help reinvigorate the process.

External air temperatures also have an impact, with the warmer months of Spring-Summer-Fall increasing decomposition activity and the coldness of Winter slowing down the composting process.

## **Particle Size and Surface Area**

The speed or rate of decomposition is affected by the organic matter's particle size. Chopping or shredding the material --- ideally to about 5 cm pieces --- helps increase surface area. With a larger surface area, more organisms can be present to feed on the organic material, thereby speeding up composting.

## **Compost Workers – Who's in your bin?**

### *Topic*

Discover what organisms are involved in composting organic materials

### *Learning Outcomes*

To gain an understanding of the organisms involved in the composting process and how the conditions in the compost pile affect them

### *Time*

30 – 60 minutes

### *Materials/Resources*

- information materials about the organisms involved in the composting process
- gloves
- partially finished compost
- microscope or magnifying glass to examine the compost more closely
- utensil such as a spoon or tweezer
- container(s) or plastic sheet(s)

### *Instructions*

1. Place some of the compost on the sheet or container and break up the compost into smaller pieces, turning it over to look for any organisms and other signs of life, comparing what you see to the list of organisms that could be possibly found in compost.
2. Pick up any organisms that you might see, separating each into a separate container
3. Once collected, take a magnifying glass to examine them more closely
4. To look at the really small organisms that could be found in compost, take some compost and place it under a microscope. Describe what you find.

### *Discussion/Comments*

- How many different types of soil wildlife did you find? Describe them based on shape, size, activity.
- What role does each soil creature or organism play in the compost process?
- What conditions need to exist in the compost pile for each type of organism to exist?
- Describe another web of life where different types of beings co-exist.

### *Processing Prompts*

- When you find an organism, how does it move? What is it doing? Describe what it looks like. Draw pictures of the organisms found.
- Describe the compost. How big are the pieces? Is the colour the same throughout? Is it dry or moist? What does it smell like? Can you identify any materials that aren't finished composting?

## The Food Web in the Compost Pile

The combination of micro- and macro-organisms is responsible for the breaking down of the organic material, transforming it into compost. Each has its role and makes its appearance when conditions are right for its survival and ability to contribute to the composting process. They can be classified by timing of appearance: first, second and third level decomposers with the first level being mostly microscopic in size and the latter two levels feeding off the former and being more visible.

## The Workers in the Compost Pile

The decomposition of the organic materials in a compost pile is done by many different organisms – some visible such as earthworms, ants, centipedes and sow bugs; others so tiny that they can only be seen through a microscope. The former group is often referred to as “macro-organisms” while the “invisibles” are known as the micro-organisms. Together, they each have a role to play during the transformation process of organic residuals into compost.

For composting to happen, it's important to create the right conditions or environment for this workforce to show up, thrive, concentrate on their tasks and make things ready for others to take over. Some appear early in the process while the appearance of others is a sign that the compost is ready for use.

## About the Micro-Organisms – First Level and Chemical Decomposers

Bacteria, fungi and actinomycetes are amongst the first to appear in the decomposition process. There is a chemical process, breaking down the tissue of the organic materials to make way for others.

**Bacteria** is everywhere, each of them so small that it takes millions of them to make up a gram by weight. Provided with the right conditions and the carbon-nitrogen food source of the organic materials, they multiply quickly.

There are many bacteria species and types involved, with their appearance based on the oxygen content of the compost pile and influenced by the temperature as well.

Aerobic bacteria need oxygen to function. Anaerobic bacteria make their appearance when moisture levels are high and there is little air. Smells of ammonia and rotten eggs are signs of the presence of anaerobic bacteria.

Temperature-wise, **Psychrophiles** appear first, working in cooler temperatures in the range of less than 0° (as low as -18°C) and being most active in the 13°C range.

**Mesophiles** do most of the decomposition work, existing in temperatures between 15°C and 40°C and thriving in the 23 - 32°C range. Their activity, like those before them, continue to increase the temperature of the compost pile.

**Thermophiles** love it hot, taking over in temperatures of 40 - 45°C and continuing up to conditions of 70°C. They can't exist much beyond 70°C. By turning the compost pile and allowing air to be added, their environment is cooled down, enabling them to continue to function.

## **Actinomycetes**

Second in numbers to bacteria, actinomycetes are also bacteria, resembling fungi in appearance. They show up post that of bacteria and fungi, some during the thermophilic stage but most active when the composting process is heading towards completion, liking moderate temperatures and conditions that are not acidic or too wet. They are important in the breaking down of the tougher, more resistant decomposable organics such as cellulose and lignin. They are responsible for the pleasant earthy smell associated with finished compost.

## **Fungi**

Fungi, like actinomycetes, help break down the more resistant organic materials such as cellulose and lignin. Often filament-like and whitish/grey as they lack the photosynthetic pigment, they are most active in the final stages of composting and are found more in the outer layer of the compost pile, reflective of its' lower temperatures.

## **About the Macro-Organisms – Second & Third Level and Physical Decomposers**

The macro-organisms are larger, more visible members of the composting workforce, with most making their appearance in the latter stages of composting when initial material breakdown has been done but further decomposition is still required and the temperatures are not as hot. Earthworms, sow bugs, millipedes, snails and slugs, nematodes, springtails, spiders, centipedes, mold mites and beetles are types of macro-organisms in composting.\* Known as physical decomposers, they chew, dig, churn, mix, suck, grind and digest the organic matter as well as eat the micro-organisms.

\*Some of these creatures, such as earthworms, also directly consume organic material, they can also be classified as first level decomposers.

## **The Food Web in the Compost Pile**

There's a whole world of amazing creatures that can be found in a compost pile, all working to make compost happen. Some, like earthworms, ants and sowbugs, can be easily seen while others, like bacteria and fungi, are so small that only a microscope will help you find them. Their lives are connected with each other – some have to get the composting started while others take over in the middle of the process and some at the end when compost is finished. For composting to happen, it's important to create the right environment or home for each of them.

### **The INVISIBLES and the VISIBLES**

#### *i. Micro-Organisms – The Invisibles*

Bacteria, fungi and actinomycetes are really tiny but so important to making compost happen. They eat the organic materials by breaking them down, relying on air and water for help.

There are different types of bacteria involved in composting, making their appearance at different temperature levels. When the composting process is just getting started, the **psychrophiles** get to work. As they work, the heat from their bodies begins to heat up the compost pile. Eventually, it gets too hot from them and the **mesophiles** take over, being replaced when it gets really hot with the **thermophiles**. As their activity continues to heat up the compost pile, it begins to be really uncomfortable for them as well. And just like a fan helps us in dealing with hot days in the summer, the way to keep them working is to turn the compost pile and get air into the materials.

**Actinomycetes** are also a form of bacteria. They show up when the work is almost done, taking on the job of breaking down the tough woody and cellulose materials. They give off a very pleasant earthy smell which is a big clue that the compost is ready for use.

**Fungi**, like actinomycetes, help break down the tougher organic materials such as cellulose and lignin. They are white/grey in colour and often look like long, thin white threads. They live on the outer edges of the compost pile, preferring these cooler temperatures.

#### **ii. Macro-Organisms – The VisibleS**

We are more familiar with the visible creatures that can be found in a compost pile as we often see them wandering in our garden and in our soil. They arrive at the compost pile when the bacteria and fungi have gotten the organic materials in a shape that is easier for them to eat and when the temperature of the compost pile is no longer too hot. Earthworms, sow bugs, millipedes, snails and slugs, nematodes, springtails, spiders, centipedes, mold mites and beetles are types of macro-

organisms in composting. They do all kinds of activities to dig, churn, grind, chew and eat through the organic materials to get the organic materials on their way to becoming compost.

## Ingredients for Composting Success

### i. The “Greens” and the “Browns”

#### *Topic*

Identify the materials needed for successful composting

#### *Learning Outcomes*

To understand the types and combination of materials needed for composting

#### *Time*

30 minutes to prepare; monitor on a weekly basis for 2 months

#### *Materials/Resources*

- gloves
- a collection of different organic materials
  - i. from the kitchen: fruit and vegetable trimmings, soiled paper, coffee grounds and filters, tea leaves and tea bags, egg shells
  - ii. from the garden: leaves, grass, plant trimmings, small branches
  - iii. other: shredded paper, facial tissue, cardboard
- scissors or small knives
- plastic drop sheet(s)
- a minimum of six 2 litre container(s) with lids, perforated to allow for air circulation
- sticker or piece of paper taped on each container to record contents, start date and original weight
- weigh scale
- Optional: Camera to record changes over time

#### *Instructions*

1. Gather a variety of organic materials from different locations within and around the home.
2. Separate them according to how quickly you think they will break down, classifying them as either primarily “green” or “brown”.
3. Subdivide each category to demonstrate how the size of the material can impact the speed of decomposition. For this, cut up one half of each category into smaller pieces.
4. Place the materials in the containers as follows:
  - i. Container 1: Greens (as is)

- ii. Container 2: Greens (cut in smaller pieces)
  - iii. Container 3: Browns (as is)
  - iv. Container 4: Browns (cut in smaller pieces)
  - v. Container 5: Equal mixture of Greens and Browns (as is)
  - vi. Container 6: Equal mixture of Greens and Browns (cut in smaller pieces)
5. Weigh each container and record on lid including start-date and contents.
  6. Once a week, re-examine and weigh each container, identifying any changes.
  7. After two months, summarize your findings based on visible and weight changes to materials.

### *Discussion/Comments*

- Where can you find organic residuals at home? at school? at work?
- Describe the similarities and differences between "greens" and "browns".
- What impact does the size of the material pieces have on the speed of decomposition?
- What impact is realized by combining the "greens" and "browns"?
- What changes do you observe on the materials over the duration of the exercise?

### *Processing Prompts*

Which materials are breaking down faster or staying as is? Why might this be? Is there a difference in moisture content between various materials?

What is the ideal size for the materials to enable breakdown? What happens if the pieces are too small or too big?

What are the noticeable differences in the containers over the duration of the exercise?

## Materials for Composting

**Alfalfa** – good nitrogen source

**Apples** – source of phosphorous and potash (potassium)

**Banana skins** – source of phosphorous (P) and major potassium (K), decay quickly

**Blood meal**

**Bone meal**

**Citrus waste**

**Coffee grinds**

**Corn cobs** – will take a long time to break down unless finely shredded

**Food waste** – vegetables and fruit – nitrogen-rich material, decompose faster when they are chopped into smaller pieces. Dig into centre of material and cover with carbon-rich material or soil.

**Grass Clippings** – best left on the lawn where they directly return the nutrients to the grass. As they can clump and get slimy, add no greater than 12 cm to the bin and then a layer of “browns”; mixing them together helps

**Hair** – good source of nitrogen, mix with other materials. Do not use if hair has been chemically treated

**Hay and straw** – high in carbon, chop or shred and wet for faster composting. Straw is better for air circulation as the stems are hollow and stiff.

**Manures** (horse, sheep, cow, chicken and guinea pigs)

**Mushroom Compost**

**Newspaper** – best to recycle, contains no nutrients but when shredded can serve as carbon material

**Sawdust, wood shavings** – good carbon-rich material. Takes longer to break down.

**Weeds** – Best to use when green and no seed heads. Pernicious/perennial weeds should be dried before adding to compost.

**Wood ashes** – excellent source of potassium. Sprinkle directly into garden soil.

## Materials NOT for Backyard Composting

**Barbecue ashes/coal**

**Cooked food waste**

**Crab grass** – requires thorough drying before adding to compost bin or it will grow again

**Dairy products** (eg. butter, cheese, mayonnaise, salad dressing, milk, yogurt, sour cream)

**Dishwater** – most dishwashing soaps contain perfumes, greases, sodium

**Dog, cat feces** – may contain disease organisms

**Fats, grease and oils** – putrify and smell bad as they break down

**Fish scraps** – attract animals and breaks down more slowly

**Grains** – may contain fats which give off odour in their breakdown and attract rodents or other pests

**Kitty Litter** – likely to contain disease organisms

**Meat, bones**

**Peanut Butter**

**Weeds that have gone to seed** – it is unlikely that high enough temperatures will be reached for sufficient time to breakdown the weed and kill the seed

**Weeds like morning glory and buttercups** – may live on in the compost unless thoroughly dried

**DO NOT COMPOST MEAT, FATS, DAIRY PRODUCTS**

*Source: Greater Vancouver Regional District (now Metro Vancouver) Compost Resource Manual*

## Ingredients for Composting Success

### ii. Water & Air

#### *Topic*

Identify the conditions needed for successful composting

#### *Learning Outcomes*

To understand the impact of air and moisture content on the composting process

#### *Time*

30 minutes to prepare; monitor on a weekly basis for 2 months

#### *Materials/Resources*

- gloves
- a collection of different organic materials
  - i. from the kitchen: fruit and vegetable trimmings, soiled paper, coffee grounds and filters, tea leaves and tea bags, egg shells
  - ii. from the garden: leaves, grass, plant trimmings, small branches
  - iii. other: shredded paper, facial tissue, cardboard
- scissors or small knives
- plastic drop sheet(s)
- a minimum of four 2 litre container(s) with lids, with one lid not perforated
- sticker or piece of paper taped on each container to record contents, start date and original weight
- weigh scale
- trowel or stirring stick
- water
- measuring cup
- Optional: Camera to record changes over time

#### *Instructions*

1. Prepare organics by chopping into small pieces (approx. 2-3 cms in length or cubed).
2. Mix equal parts "greens" and "browns".
3. Place the materials in containers as follows:
  - i. Container 1: Materials as combined (no extra water added)
  - ii. Container 2: Materials as combined *plus* ½ cup of water, blended into mix

- iii. Container 3: Materials as combined *plus* 2 cups of water, blended into mix
- iv. Container 4: Materials as combined *plus* enough water (measure amount) to fully cover the mix, blended into mix. Use the lid with no perforation on this mix.

4. Weigh each container and record on lid including start-date and moisture content.

5. Once a week, re-examine, stir the contents and weigh each container, identifying any changes.

6. After two months, summarize your findings based on visible, weight and other noticeable changes to materials.

### *Discussion/Comments*

- Describe the similarities and differences between the different containers.
- What impact does the amount of water and air have on the speed of decomposition?
- What changes do you observe on the materials over the duration of the exercise?

### *Processing Prompts*

Which combination seems to be leading to the quickest breakdown of materials?

What happens when there is too much water or not enough?

What are the noticeable differences in the containers over the duration of the exercise?

## **Ingredients for Compost Success**

### iii. Temperature - Turning Up the Heat

#### *Topic*

Discover the importance of temperature to the composting process

#### *Learning Outcomes*

Learn how temperature can change in a compost pile and how to influence its' rate

#### *Time*

30 minutes preparation; one week of monitoring and turning

#### *Materials/Resources*

- Large compost pile (minimum of one cubic metre). Contains layers of both 'green' and 'brown' material.
- Thermometer (preferably long-handled or alternatively, a candy or meat thermometer)
- Paper and pencil/pen to record temperature and other observations
- Gloves
- Shovel or pitch fork

#### *Instructions*

1. To record the initial temperature baseline, do three readings. With gloved hands, place thermometer in 3 sections of the compost pile (surface, halfway, centre). As well, record the temperature of the ambient air surrounding the pile.
2. Turn the pile with a shovel or pitch fork to mix and aerate the materials.
3. Re-do the temperature readings to identify any changes.
4. Add one layer of 'greens' and turn it into the pile, making sure it is fully covered. Make sure that the compost pile is moist like a wrung-out sponge. If it is too dry, add water and turn it in.
5. After four consecutive days, turn the compost pile again.
6. Continue to record temperatures on a daily basis for the week (ideally at the same time each day).

### *Discussion/Comments*

- Is there a difference in temperature in the different areas of the compost pile? If so, what are they? What could cause this?
- Did the turning of the pile have any immediate impact on the temperature readings? Was there any change in temperature the following day?
- What were the temperature readings and what was the range?
- If there is no noticeable difference between the outer and central temperature of the compost pile, what does this mean?
- Would the season of the year have any impact on the temperature of the compost pile? If so, why and what impact does this have on the rate of composting?

### *Processing Prompts*

On a daily basis, record the temperature while also describing the material's appearance. Graph the results to notice trends.

Why is adding the extra "greens" important to temperature?

## Ingredients for Compost Success

### iii. Size Matters

#### *Topic*

Discover the importance of the size of materials to the composting process and rate

#### *Learning Outcomes*

Learn how the size of the material can influence its' rate of decomposition

#### *Time*

30 minutes preparation; two weeks of monitoring

#### *Materials/Resources*

- Banana peels, orange peels, apple skins and cores, carrot peels and tops, leaves and other organic materials
- Knife
- Cutting board
- At least two (2) wide mouth glass jars with lids
- Garden soil and/or Finished compost
- Water

#### *Instructions*

1. Split the organic materials into 2 equal sections, with each part having samples of the same material (ie. a banana peel in both sections)
2. Cut one of the sections into small pieces (2 cm).
3. Fill the glass jars halfway with garden soil or finished compost
4. Place the sections in their own jar, filling it to the top and mixing it with the soil or compost. Label each jar, indicating of the size of the pieces (eg. "small pieces"; "large pieces")
4. Add water to the soil medium so that it is moist (not wet or soggy)
5. Put the jars in the same place for one week, making sure that the soil remains moist.
6. After one week, remove the contents of each jar, ensuring that they remain separate. Look for any differences between the two sections.

7. Put the materials back into their containers and wait another week, examining for further differences.

### *Discussion/Comments*

- Does the size of the organic material make a difference to the rate of composting? If so, what is that difference?
- Was there any difference in the decomposition rate among the materials that were selected?
- Did other conditions in the jar's environment impact the rate of decomposition?

### *Processing Prompts*

On a weekly basis, record your observations about the organic material's appearance, making note of size, colour, texture.

Does size impact the rate of decomposition of "greens"? "browns"? both?

## Composting in Miniature - Building a Composting Prototype

### *Topic*

Learning how the composting process works

### *Learning Outcomes*

To develop an understanding of the composting process and the impact of material composition, air & water as well as changes over time

### *Time*

Initial preparation = one hour; monitoring over the course of four-to-six months

### *Materials/Resources*

- Plastic drop sheet
- For each "bin", two 2-litre plastic pop bottles
- Garden soil or finished compost
- Organic residuals (equal portion of "greens" and "browns". Refer to Section on "Ingredients for Composting Success – The 'Greens' and the 'Browns' ")
- Water
- Gloves
- Nylon stocking or fine screen
- Tape
- Rubber Band
- Thermometer
- Ruler
- Optional: Camera to record changes over time

### *Instructions*

#### i. Building the Mini-Compost Bin

*As a guide for cutting and construction, follow the illustrations below.*

*\*\* Adult supervision and involvement is highly recommended. \*\**

- Using a razor blade or knife, cut the plastic bottles along indicated lines per the illustration (which are approximately halfway down the length of the bottle). *Note:* make small additional cuts in one of the bottle sections to fit one section into the other.
- Cut additional holes for aeration, taping small pieces of nylon stocking over them.

- Place a piece of nylon stocking, attaching it with an elastic band, over one of the bottle spouts.
- After filling the container with the organic materials (per below), put the pieces together per the illustration.

ii. Filling the Mini-Compost Bin

Note: The filling is a layering process, similar to making lasagna, with each layer being approximately 2 – 3 centimetres in thickness.

- Start with a thicker layer of garden soil or finished compost (about 5 centimetres)
- Layer 2 cm of green materials, followed by 2 cm of brown materials (basically covering the green materials). Make sure that the organic materials have been cut up in small pieces.
- Continue this layering process (green followed by brown) until filling the lower plastic bottle.
- Lightly water the contents such that it is as moist as a wrung-out sponge.
- Put the top bottle section on the lower, placing the cap on the top bottle.
- Over time, water could build up at the base. This can be re-circulated from the top to help keep the composting material moist. If needed, add extra water to keep the contents moist.
- Once a week, remove the top bottle section, check the height and temperature of the “pile”, stir up the contents (this provides to air to the pile) and put the pieces back together again. Identify and record any changes.
- After four-to-six months, summarize your findings. Use any finished compost in your garden and turn it into the soil.

*Discussion/Comments*

- What changes do you observe over time?
- When (eg. what week or month) did the materials complete the composting process, having turned into compost?
- What’s the importance of layering?
- Do you see the appearance of any soil wildlife? If so, when, what types and under what conditions?
- Describe the final product based on look, feel and smell.

### *Processing Prompts*

On a weekly basis, record the height and temperature while also describing the material's appearance. Graph the results to notice trends.

What factors impact the composting process? What's the importance of mixing? moisture content? temperature?

## Getting Composting Started in Your Backyard

### *Topic*

The steps involved in setting up a compost bin in the backyard

### *Learning Outcomes*

Understand the factors and process involved to start composting in the backyard

### *Time*

60 minutes

### *Materials/Resources*

- Backyard Compost Bin (often accessible by contacting the composting/recycling department in your municipality or region)
- Gloves
- Shovel
- Branches or sticks
- Organic materials from the kitchen and garden (avoid any meat, fish, dairy or fats/oils/grease). Using a dedicated container to collect kitchen scraps offers a convenient way to accumulate organic residuals for your compost bin.

### *Instructions*

1. Look in your backyard for an open spot that has good drainage, access to sun and is convenient to access.
2. Turn the soil in the location where the compost bin will be set up.
3. After placing the compost bin, cover the floor of it with a layer of small branches. This will allow for air movement and drainage.
4. Alternate or layer "greens" and "browns" (usually no more than 15 cms per layer), always finishing the layering with "browns" or a layer of finished compost or garden soil to completely cover up the kitchen scraps and/or "greens".

### *Discussion/Comments*

- What factors should be considered when choosing the location of your compost bin? What is the importance of each of them?
- Why is it important to layer the materials in the compost pile? Why should food scraps be completely covered up?
- How can air and water be added to the compost pile? Why is this important?

- How can the composting process be accelerated?

*Processing Prompts*

What are the ways to make backyard composting convenient?

What equipment is needed to maintain a compost bin?

How do you affect the working conditions of a compost bin?

## How to Compost

Home composting can be done with the use of a "build your own" or with a commercial unit, often available through your municipality.

An important first step to getting started is to place your composter in a sunny area with good drainage. Make sure that the location is convenient and accessible year round.

### Getting started...

1. Turn the soil in the location where the composter will be.
2. After placing the composter, cover the floor of it with a layer of small branches. This will allow for air movement and drainage.
3. Alternate wet (e.g. kitchen scraps) and dry (e.g. yard material) waste.
4. If available, add some "finished" compost, garden soil or a compost starter (available at most garden centres) to the pile. This helps speed up the start of the composting process.

### Clues on Composting

- The composting process works best when the organic pieces are small. Weeds and trimmings should be shredded.
- Don't add thick layers of any one kind of waste. Grass should not be more than 6 cm deep, leaves up to 15 cm deep (cut or chop or dry and crumble them). If you can, let grass dry first or mix it with dry, coarse material such as leaves to prevent compacting.
- The composter contents should be moist like a wrung-out sponge. If the contents are too dry, it will take overly long to compost; and if too wet, the contents may begin to smell.
- Turn or mix the compost every couple of weeks or each time you add new material. This keeps the compost well aerated.
- Composting can be done in the winter. You can add materials to your composter all winter long. The breakdown process slows down or stops when the pile is frozen, but it will start up again in the spring. Thorough turning in the spring will reactivate the pile. Empty the composter in the fall to make plenty of room.

## Trouble-Shooting

Composting is not difficult but sometimes the process requires a little extra attention. Here are some easy solutions to correct certain situations which might occur.

- If the pile does not decrease in size or generate heat, composting may need a boost. If the pile is dry, add water - mixing thoroughly. If the pile is wet and muddy, spread it in the sun and add dry material. Remember to save "old" compost to mix with incoming material.
- If the centre of the pile is damp and warm, but the rest is cold, the pile may be too small. Try to keep your composter as full as possible. Mix new with old, dry with wet, breaking up mats and clumps.
- If the pile is damp and sweet smelling but not heating, it may need nitrogen. Add grass clippings, table scraps or a sprinkling of organic fertilizer from the garden centre.
- If the compost pile develops a foul odour, it may not be getting enough air. Loosen up the pile, break up clumps, unblock vents and perhaps add some wood chips to help the pile "breathe". Turning the pile always helps aeration.

Compost in a container with a cover to prevent animals from getting into the composting materials. A wire mesh around the base can help to prevent pests from digging under the pile. Dig in or cover food waste immediately.

## Common Compost Problems

### You are dealing with ....

- i. a bad odour that smells like rotten eggs  
*Problem:* not enough air; pile too wet  
*Solution:* turn the compost pile; add coarse material (straw or leaves)
- ii. a bad odour that smells like ammonia  
*Problem:* too much green material  
*Solution:* add carbon-rich material (leaves, sawdust, straw)
- iii. dry throughout  
*Problem:* not enough water; too much woody material  
*Solution:* turn the compost pile and moisten materials; add fresh "greens", covering pile
- iv. damp and warm in the middle but nowhere else  
*Problem:* pile is too small  
*Solution:* collect more material and mix the old ingredients into the new pile

- v. damp and sweet-smelling but will not heat up  
*Problem:* lack of nitrogen  
*Solution:* mix in a nitrogen source like fresh grass clippings, fresh manure or bloodmeal
  
- vi. pest infestation – dogs, rodents, insects  
*Problem:* improper food scraps added  
*Solution:* don't add meat, fats, bones or other animal wastes; use a rodent-resistant compost bin
  
- vii. flies  
*Problem:* food scraps not covered  
*Solution:* place fruit and vegetable wastes in the centre of the pile, cover with soil or other carbon-rich material

Source: The Compost Council of Canada and Greater Vancouver Regional District (now Metro Vancouver)

## **It's Finished! Harvesting Your Compost**

### *Topic*

Discover the end results of composting

### *Learning Outcomes*

Learn what eventually happens when organic materials (once considered as waste) are composted

### *Time*

30 – 60 minutes following at least 2 – 3 months of active composting

### *Materials/Resources*

- Compost bin that has been used for composting for at least 2 – 3 months (if actively managed – ie. food scraps & leaves added at least once a week along with, at minimum, weekly turning and keeping the materials moist); your judgment of the appropriate timing will be based on visible clues (earthy, brown material (compost) visible rather than identifiable food scraps & leaves; the visibility of twigs and seed pits such as those from peaches is acceptable)
- Trowel
- Screen (can be made from a wooden frame with 1 cm hardware cloth/mesh wire as the base; or source a plastic tray that has a mesh base (often used for vegetables in the supermarket's produce section)
- Box, wheelbarrow or other container

### *Instructions*

1. From the bottom of the bin, shovel out the composted material, placing it on the screen which is placed over a container.
2. Shake the screen. The compost will fall through, leaving materials that have yet to be completed composting on the screen.
3. Return the unfinished materials back to the compost bin for further composting.
4. The finished compost can be applied :
  - a. to the garden's surface, in a layer of 2 to 5 cm.

- b. as a lawn topdressing, sprinkling compost over the designated space (aerating the intended area in advance helps open up space for the compost to penetrate)
- iii. as a container mix, in a ratio of approximately 1:4 (one quarter compost to one quarter potting soil)

### *Discussion/Comments*

- Based on how much the container is filled, how much compost is produced? What has happened to the difference?
- What are the benefits of composting?
- Describe how the full circle of a plant's life (eg. from seed to growth to harvest to composting to compost and back to the earth)

### *Processing Prompts*

How can you tell that the compost is ready for harvesting? What does it look like?  
How does it smell?

Are any of the composting "workers" visible in the compost pile?

## Putting Worms to Work

### *Topic*

Learn about the life and composting ways of Red Wiggler Worms

### *Learning Outcomes*

Understand the care and attention required to produce compost with the help of worms and make the process successful

### *Time*

60 minutes preparation; weekly monitoring

### *Materials/Resources*

*Please Note: worms are living creatures. If a worm compost bin is being set up, people must be assigned to ensure it is well-maintained and that food scraps are regularly added.*

- Container for Compost Bin
- Bedding (shredded newspaper, moistened)
- Vegetable and Fruit Scraps
- Red Wiggler Worms (½ kilogram of worms is a good start)
- Water
- Tarp for top of compost bin
- Soil, sand and unfinished compost

### *Instructions*

1. Review the worm facts and discuss the responsibility associated with taking care of living creatures.
2. Prepare the bin for the worms' new home, following the directions in *Worm Composting*. Be prompted by the students on the steps involved in setting up the container.
3. Weigh the container before adding food scraps. Weigh the food scraps, recording all this information in a chart that will be updated weekly.
4. Check the worm bin on a weekly basis, adding food scraps and ensuring its' cleanliness. If there is any liquid on the tray (below the container), remove it and clean the tray before putting it back in place. Continue to record the weight of both the food scraps and overall container.

5. After 2 – 3 months, check to see if the bin is ready to be harvested. If not, continue along the process. If there appears to be sufficient vermicompost, then proceed with the directions identified in *Worm Composting*.
6. Use the finished compost in plantings, conducting comparison trials similar to the one described in "Feed the Soil – Compost"

### *Discussion/Comments*

- Discuss the set of conditions that need to be in place to enable worm composting to perform at its best.
- Review the preparation of the food scraps, including the need to bury them in the bedding/covering them up to avoid exposure to air.
- Describe the worms, making note of colour, feel, shape. Observe any reaction to light, the addition of food scraps and if they have a preference for one material over another, their location in the bin.

### *Processing Prompts*

- About how many worms were originally placed in the bin? (do a count from a sample and multiply this number by the total weight to get an estimated figure)
- Did the bin change in smells over time? If so, describe.
- How do the worms react to light?
- Are you noticing any differences in the composition of the bin over time?
- How much weight was added to the bin (in its "raw" state)? How does this compare to the overall weight of the filled bin?

## Worm Composting

Worm composting or vermicomposting is a great indoor means to compost year-round, at home, school and the office. It's the composting method that puts worms to work. The organic matter is eaten by the worm, passing it through its' body and eventually excreting "worm poop" – more often referred to as worm castings. A great soil conditioner, the castings can directly be tilled into the soil or used in containers and house plants.

While there are over 2700 different types of worms, it is the Red Wiggler which is the most commonly used in vermicomposting. These worms are munching machines, eating about half their body weight in organic matter every day.

### The How's of Worm Composting

To get started in worm composting, you need:

- a container for their home, with holes drilled in the bottom for drainage and a tray for placement underneath to catch the excess liquid. The container should be covered with a lid or some physical barrier such as carpet or newsprint to minimize light and flies. The size of the container should be somewhat shallow, about 20 to 30 cm deep. Red wigglers are found more near the surface, generally feeding in the top layers of bedding. For every half kilogram of weekly food scraps, the surface area should be 1/3m<sup>3</sup> (you will have to proportion the amount of food scraps that you put in the container based on the overall bin size).
- shredded newspapers or leaves for bedding
- half a kilogram or a pound of red wigglers
- food scraps (vegetable and fruit; **no meat, fats, fish or cheese**)
- red wiggler worms (about .5kg which is approximately 1000 red wigglers)

### Making Worms Happy Workers

Like other living creatures that you take responsibility for, it's important to know the conditions and care that will enable them to thrive.

Worms like a moist, dark environment and function best at temperatures between 15° - 26°C. While they can eat a wide range of organic materials, the best foods for the habitat in which they will be living with you are raw vegetable and fruit scraps. Crushed egg shells, coffee grounds and tea leaves are also acceptable. Definitely avoid meats, fats, cheese and dairy.

In your bin, the worm population will increase over time. A mature worm (about 8 weeks old) can produce a couple of cocoons a week. About three weeks later, 2 to 4 baby worms will emerge. Their population growth will be limited to the available space and food source.

### *Sidebar*

### **Facts about Worms**

- Worms have a mouth but no teeth. Worms don't have eyes or ears, sensing happenings based on vibrations.
- They breathe through their skin, requiring a light film of moisture on their skin's surface. This slime protects them. If their skin dries out, they will die.
- They are very light sensitive, "running away" from any light source.
- Worms tunnel through the earth, helping to aerate the soil.
- During rain, worms will travel to the soil's surface to avoid drowning.
- An acre of land of good quality soil may be home to one million earthworms.
- A worm chopped in half will not survive. However, it can re-generate if the head end is severed.
- Worms can live for many years; the estimate for the life of an earthworm is about 6 years.
- A worm is both male and female – known as hermaphrodite – but requires another worm to reproduce.
- You can tell the head from the rear of a worm in a couple of ways: i. the direction that it is traveling (the worm usually goes "head first" ii. an adult worm has a band about 1/3 down the worm's body. This "collar" or slight swelling is located closest to the head. Known as the clitellum, this is part of the worm's reproductive organs, secreting a liquid which forms a cocoon around the eggs or worm embryos destined to become baby worms.
- Worms are invertebrates, having no internal skeleton made of bone. Their bodies are made up of a series of ring-like bands called annuli. Covered with small bristles or *setae*, this hair-like matter helps the worm to move.
- Similar to a "pride of lions" or a "pod of whales", a group of worms is called a "squirm of worms".

## Setting Up the Worm Bin

Choose a location for your worm bin that is convenient for you to access, avoiding temperature extremes. To make the worm bin ready for your worms' new home,

- a. tear up newspapers for bedding, avoiding colour print. Moisten the strips and place in the bin, filling  $\frac{3}{4}$  of the space. Fluff up the paper so that they do not get compacted, enabling air spaces in the bin.
- b. add a couple of cups of garden soil or sand to provide the grit for the worms' digestive process
- c. add the worms
- d. bury the food scraps in the bedding, covering it completely. A sheet of dry newspaper or cloth placed on the surface of the bin helps detract fruit flies.

## Regular Feeding

The amount of food scraps that the worms can eat through on a weekly basis depends on the number of worms available. Worms eat their body weight every two days so a half kilogram of food scraps needs a kilogram of worms. Collect kitchen scraps in a container and once a week, bury them in a section of the bin, alternating the location weekly.

Be mindful of keeping the bedding moist. If it becomes dry, dampen it with water. If the bedding is too wet and soggy, add extra newsprint.

## Harvest Time!

In just a couple of weeks, the bedding will start to become darker, reflective of worm castings. In two to three months, most of the original bedding will no longer be visible. You will know from sight when there will be enough castings to harvest and at that time, there are a couple of ways to manage the harvest:

- i. move the bin's contents to one side of the bin, filling the other with fresh bedding (moistened newspaper strips). Only put food scraps in the section with the fresh bedding. The worms will eventually migrate over to this food source, allowing for the finished compost to be harvested.
- ii. dump the bin's contents on a plastic sheet. Both natural light and a light directed on the pile will get the worms to burrow down in the pile, enabling the finished compost to be scooped on top.

Remove any cocoons or stray worms from the collected material and return them to the newly prepared bedding.

## COMPOST TEA

### *Topic*

Discover the impact of compost tea on plant growth

### *Learning Outcomes*

Learn if there are any differences in plant growth over time with the addition of compost tea

### *Time*

30 minutes preparation; regular waterings (depending on plant and surrounding conditions)

### *Materials/Resources*

- bucket
- water
- fabric for "tea bag"
- string to tie bag
- compost (if of interest, this could be extended to a variety of compost products, sourced from different recipes (eg. manure compost, vermicompost, residential compost)
- small plants eg. basil, ivy, with the number being based on the "water control" (at least one) and the "compost tea" solution (at least one)
- observation sheet to record changes over time
- 2 watering containers

### *Instructions*

1. After selecting the plants, place them in the same conditions as each other to make sure everything is the same except for the watering medium. Describe the plant and record the observations as the baseline information.
2. After making the Compost Tea (following the directions in *Compost Tea - A nourishing refreshment for your plants*), fill watering containers, one with tap water and the other with Compost Tea.
3. Water one plant with the tap water (labeling the pot to remember) and the other with Compost Tea. Use the same amount of liquid for each watering. For the Compost Tea medium, consider spraying the plant's foliage as well as watering the soil (or ... split the experiment in another part, having one plant watered with compost tea in the soil and the other, in addition to the soil, having the compost tea lightly misted on the plant's foliage).

4. Continue to water on an ongoing basis, recording observations (eg. plant growth, colour) and any differences/similarities between the two plants.
5. If there are any odours coming from the compost tea liquid, make another batch of Compost Tea.

#### *Discussion/Comments*

- Is there a difference in plant growth or colour between the plants? If so, what are they? What do you think is happening?
- How could you make enough Compost Tea for your garden plants?

#### *Processing Prompts*

Based on the time of the regular watering, record observations on the plant's appearance and growth. Build this observation deck over time.

## **Compost Tea - A nourishing refreshment for your plants**

Compost tea is a good “perk” for your plants. It’s simple to make and easy to use.

Fill a cloth bag with compost and put it in a barrel or bucket of water. Your mixture should be about one part compost to five parts water. Let it steep for about a week, swirling it around a few times and making sure that the “tea bag” is submerged.

You can then pour the “tea” over your plants. Put the compost in the bag either back into your backyard composter or spread it in the garden.

## **Making & Watching Grass Grow**

### *Topic*

Learn how grass grows

### *Learning Outcomes*

Learn what's needed to grow grass and the impact of cutting on further grass growth

### *Time*

30 - 60 minutes preparation; regular waterings (depending on plant and surrounding conditions); grass will begin to appear in about one week and will last for about 3 weeks

### *Materials/Resources*

- Old pantyhose
- Grass seed
- Empty toilet paper or hand towel roll
- Potting soil
- Decorations such as googly eyes, felt, pipe-cleaners and other craft supplies
- Elastic bands
- Waterproof Glue (hot glue gun can work; have a procedure in place to ensure its' safe use)
- Scissors
- Yoghurt, margarine or other type of open plastic container
- Water

### *Instructions*

1. Cut a 25 – 35 cm section from the stocking (stay away from the end of the stocking as it will be harder for the grass to penetrate through the reinforced section).
2. Tie one end with an elastic band, making sure it is secure.
3. Insert the paper roll in the stocking. This will be used as a funnel to help get the grass seed and soil in place.
4. Put in about 2 teaspoons of grass seed.
5. Fill with soil, adding enough to create a ball (about the size of a baseball).
6. Tie up the open end with another elastic band. The excess stocking section will serve as a wick for watering.
7. Shape and decorate the ball into a face.
8. After letting the glue dry, soak the head in water to moisten the soil.
9. Place the head in the plastic container which has been filled halfway with water. The excess stocking should be in the water.
10. Place the head near sunlight.

11. Check regularly to ensure the soil mixture is moist. You might want to mist the stocking. Do not overwater.
12. The grass will begin to appear in about one week.
13. With different heads, cut the grass to various lengths to see how the grass continues to grow.
13. The grass will grow for about 4 – 6 weeks.

#### *Discussion/Comments*

- Discuss what is needed to get grass to grow.
- Discuss the differences, if any, in how the grass grows when it is cut to different lengths.
- Describe what changes you observe over time as the grass grows.

#### *Processing Prompts*

- What is the importance of water? sunlight? soil? to grass growth?
- Are you noticing any differences to further grass growth with cutting the grass to different levels?

## Lawn Care Made Easier - Recycle Grass Clippings

Grass clippings can make up a significant portion of a household's waste. During the peak growing season, they can amount to almost 35% of all waste materials collected.

By recycling your grass clippings (or "grasscycling") and keeping them in your own yard, you are recycling in the truest sense, returning nutrients to your soil.

The added benefit of grasscycling is that you are fortifying and strengthening the turf naturally. The clippings return nitrogen and other nutrients back to the soil. And, with grass being comprised of over 90% water, the clippings supply valuable moisture to your lawn.

### Tips on Mowing and Maintaining a Healthy Lawn

- Lawns should be mowed to a height of approximately 7 centimetres (3 inches) - never shorter than 4 cm (1.5"). This will result in a good growth which keeps the grass vigorous, shades out weed seedlings and helps conserve soil moisture.
- Cut your lawn regularly. Set your mower blade high: 5 - 7 centimetres (2 - 3 inches) from the ground.
- Never remove more than the top 1/3 of the total grass blade in one cutting. "Scalping" or cutting the lawn very close is very harmful to the lawn. When too much of the leaf is cut away, the plant can begin to starve because the crown of the grass blade (located at or near the ground surface) may have been cut. A small top growth cannot support a large healthy root system which is necessary to seek out water and nutrients.
- Make sure the blade of your lawnmower is sharp. A dull blade tears the grass and makes it susceptible to disease. Mulching blades cut grass multiple times, producing very short clippings.
- Avoid excess watering and fertilizing which can be destructive to the lawn if done too often.
- If the growth is too thick or long and the amount of clippings is excessive, collect them and add in 15 cm (6") layers to backyard composters. They will help break down other yard and food waste. Fresh grass clippings are "greens" and provide nitrogen; dried grass clippings are "browns" and provide carbon. Both nitrogen and carbon are required for successful composting. Grass clippings are also useful around trees, shrubs and vegetables as garden mulch, helping to enrich and moisten the soil.
- In the Fall, mulch your leaves into the lawn. They are also an excellent source of nutrients for your lawn.

*With special thanks to the **Town of Markham**, the **City of Toronto** and **Heather Apple** of the **Canadian Organic Growers, Durham Chapter** for use of their informational materials to produce this **Compost Council of Canada** factsheet.*

## **PRACTISE CARE-FUL LAWN CARE**

*It is possible to have a healthy lawn without using synthetic chemicals simply by practicing "CARE - ful" lawn care. The principles are the same as those followed throughout the green garden: maintaining soil health and vitality, watering wisely and recycling nutrients.*

To maintain soil health, top - dress with a fine sprinkling of compost a few times during the growing season.

Lawns require approximately 1 inch of water a week. If rain doesn't provide enough water, you may need to do some supplementary watering. This should be done in the early morning on a windless day (too much water is lost to evaporation by the sun during the middle of the day or on windy days).

Place a small can by the sprinkler to see how long it takes for an inch of water to accumulate.

Set your lawn mower blades at 3 inches. This is the ideal height for grass to shade out weeds and to keep the soil cool and moist.

Cut no more than a third of the grass' height in one cutting and make sure your mower blades are sharp.

Leave grass clippings on the lawn to slowly decompose and return their nutrients to the soil. A mulching mower/blade will distribute clippings evenly throughout the lawn.

Gently remove thatch build-up in your lawn using a stiff rake. Compost the accumulated debris.

Aerate compacted soil in the spring or fall.

Leave any clover that appears in your lawn - clover fixes nitrogen in the soil and thus improves soil fertility.

Hand-pull weeds before they go to seed - this will prevent them from spreading in the garden.

## **Mulch – It's a Cover-up**

### *Topic*

Learning what mulch does

### *Learning Outcomes*

To gain awareness about different types of mulch and how mulch can be used

### *Time*

30 – 60 minutes, ongoing observation on a regular basis

### *Materials/Resources*

- outdoor space which can be set aside to conduct trial – either lawn or bare ground; squared off in equal sections
- variety of different materials that could be used as mulch/ground cover eg. bark chips, compost, rocks, straw

### *Instructions*

#### Option 1

1. In the allocated space, square off equal sections of space (like a checkerboard)
2. Depending on the number of materials available, assign one per section
3. Cover each section with enough of the specific material to “blanket” the area so that none of the ground underneath is visible  
  
→ if there is sufficient space, additional squares can be created and assigned for a mulch area that is not as thick or blanketed as the original placement
4. Visit the area on a weekly basis to record any changes (such as plant growth) based on the presence and different types of mulch

#### Option 2

1. Section off a minimum of 2 areas of similar size in the same flower garden or vegetable patch
2. In one section, place the mulch (compost or bark) around each plant. The other section should not receive mulch.

3. Visit the area on a weekly basis to record any changes in plant growth, keeping track of weather conditions that have occurred during the week

#### *Discussion/Comments*

- What types of materials can be used for mulch?
- Are there any changes in the area based on the type of mulch used?
- What benefits can be realized by mulching?
- What are the ways that mulch can be used?
- What features should be considered when selecting a particular type of mulch?

#### *Processing Prompts*

What is happening to plant growth in the area based on the specific mulch being used?

After a couple of weeks of the mulch having been placed in an area, what is happening to the ground underneath the mulch?

Are there any differences in (i) water penetration (ii) soil characteristics based on the mulch used? (iii) plant growth? (iv) anything else?

## Mulching - a fancy word for "Being on top of the Soil"

Mulching is another form of composting. A layer of organic material is added on top of the soil. It mimics what happens on the forest floor where leaves and needles drop to the ground, break down over time and then are taken back up into the plants as food. It is a very slow but efficient way of composting.

### Benefits of mulching include:

- **water/moisture conservation** - mulch acts as a sponge to hold water and nutrients close to the soil, blocking the drying effects of sun and wind to reduce evaporation by more than 70 percent. This encourages healthy plant growth, prevents drying of shallow roots and results in less watering. Mulches also attract earthworms that tunnel through the soil, providing aeration which allows for improved water absorption.
- **weed control** - thick layers can reduce germination and growth of weeds, eliminating the need for herbicides.
- **insulation** - stabilizes soil temperatures, keeping root zones cooler in summer and protects soil from heaving during winter temperature fluctuations (apply after ground has frozen). By covering bare soil, mulch prevents soil compaction and erosion caused by heavy rains and wind.  
soil enrichment - replenishes and enriches the soil as it decomposes, reducing the need for compost, manure and fertilizers. Increased organic matter results in less digging, tilling and cultivation. It improves the soil's texture: making sandy soil more water retentive and clay soil more porous. It helps to create an ideal environment for earthworms and micro-organisms, essential to healthy soil.
- **adaptable** - may be selected either for its rapid decomposition, its longevity or a combination of both. Most natural or organic mulches gradually break down and decompose to add nutrients to the soil and improve texture and drainage. This is helpful in vegetable plots. In ornamental plantings of flowers, shrubs and trees, you may prefer a more decorative and long-lasting mulch.

### Tips on Mulching

- Spread the organic material on top of the soil, around plants and on garden paths. Wood chips, leaves from deciduous trees and shrubs, lawn clippings and sawdust are suitable mulch materials around perennial plants. Around vegetable and annual flower gardens, it is best to use nitrogen-rich ("Greens") materials like lawn clippings and other green garden trimmings.
- Leave grass clippings on the lawn after mowing to add nutrients and reduce water loss.
- Annuals, perennials and vegetable seedlings can benefit from a mulch which is moved aside at planting time and then pulled back around the plant as it grows.
- Don't mulch too closely around the trunks of trees (you'll smother the roots) or too closely at the base of heat-loving vegetables and flowers (mulches cool the

soil). Mulch trees out to the drip line, which is the outer perimeter of the tree's branches.

- Mulches can be an ideal hiding place for insects such as slugs and snails. Remove or turn mulch under during the Spring to discourage egg-laying.
- Mulch should be no deeper than 5 to 7.5 centimetres (2 - 3 inches) to ensure circulation of air into the soil.
- Don't mulch with weeds containing seeds or persistent roots.

*With special thanks to the **Greater Vancouver Regional District** (now **Metro Vancouver**) and the **City of Toronto** for use of their informational materials to produce this Compost Council of Canada factsheet.*

## COMPOST IS SOIL FOOD

### *Topic*

Discover the importance of adding compost to the soil

### *Learning Outcomes*

Learn how the addition of compost can affect plant growth

### *Time*

30 minutes preparation; weekly monitoring and watering

### *Materials/Resources*

- Planting pots (with holes for drainage and trays underneath)
- Bean seeds
- Compost
- Vermiculite
- Observation sheet

### *Instructions*

1. Fill the first pot with 100% compost, labeling it accordingly.
2. Mix a half & half solution of compost and vermiculite, placing this mixture in the second pot. Label accordingly.
3. Use 100% vermiculite in the third pot. Label accordingly.
4. Plant each pot with the same type of seed. All other actions in the care and maintenance of the plants must be the same (ie. same amount of water, sunlight, etc.)
5. Following seed germination, begin to record ongoing observations, noting any similarities and differences between the different plants.

### *Discussion/Comments*

- Is there a difference in plant growth based on the potting mix medium?
- How do the results compare?
- Would there be any differences in results if different types of seeds were used?

### *Processing Prompts*

On a regular basis, record the plant growth while also describing the material's appearance. Graph the results to notice trends.

## A Mini-Backgrounder on Healthy Soil!

Quality soil can happen naturally. But it's based on one main equation: what you take out, you must put back in.

The ongoing addition of organic matter and compost provides soil with the texture, structure and nutrients needed to create a positive environment for plant growth. Compost feeds the soil, builds structure and helps provide nutrients for your plants.

### What is Soil?

Soil is a combination of many materials including:

- particles of minerals and rock;
- decaying and decomposed (humus or compost) organic matter;
- living organisms including microscopic bacteria and fungi as well as larger creatures such as earthworms;
- air and water.

A good quality soil is a balanced combination of all of the above materials. The addition of compost to soil improves the balance and creates healthy productive soil.

### The Texture of Soil

Soils contain a mixture of different sized particles of minerals and rocks.

The texture and physical properties of a soil are impacted by the size of the particles. Larger particles allow for larger spaces between each particles, resulting in a more porous soil. Smaller sized particles have smaller spaces between each particle making it harder for air to penetrate and water to drain away. These soils are said to be less porous.

Soil is described based on the most abundant sized particles present.

**Sandy** soil is composed of large particles which allow for lots of space between each particle. Water drains very quickly through sandy soils, often taking valuable nutrients with it.

**Clay** soil is composed of very small particles with very small spaces between each particle. Clay has the ability to hold water and nutrients but air cannot penetrate between these spaces, especially when they are filled with water. Poor drainage and aeration are characteristics of clay soils. Wet clay soil is difficult to work while dry clay is very hard.

**Silt** is composed of particles sized between those found in sand and clay. Silt particles are small enough that they can cause drainage problems. Wet silt is difficult to work. Unlike clay soil, silt tends to be dusty and powdery when dry.

**Loam** is the ideal blend of particle sizes. It is a balance of sand, clay and silt. Loam has the ability to hold water. Excess water, though, can drain away enabling air into the soil to provide the necessary oxygen to plant roots and the organisms found in the soil. It is easy to work, holds nutrients, has good aeration and good water-retention capacity.

The easiest way to improve soil's texture is to add compost. Compost improves water and nutrient retention in sandy soils while it improves drainage and aeration in clay soils and silt.

### **The Structure of Soil**

A soil's structure reflects how its particles hold together. Soil structure is described by words such as crumbly, clumpy and loose.

Good soil structure means that the soil has a loose, crumbly appearance. The spaces between the clumps allow water to be absorbed into the soil and any excess to drain away. Water and nutrients are retained and there is good aeration. Roots and soil organisms are able to move through the soil easily, improving aeration and allowing roots access to nutrients.

### **The Living Organisms in the Soil**

A healthy soil is alive, teeming with microorganisms such as bacteria, fungi and yeast as well as larger creatures like earthworms. They depend on the availability of air, water and nutrients in the soil to live.

In return, they are the ultimate recyclers - breaking down organic matter to release nutrients for root development and plant growth. They also mix up the soil to improve aeration, texture and structure.

### **Feeding the Soil (and Plants)**

A fertile soil is comprised of both macro- and micronutrients. Plants require both to thrive.

The macronutrients include nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S). They provide the main nutrients for plants. The first three - N, P, K - are used in the largest amounts by plants, each providing specific benefits including leaf and stem growth (N), root growth (P and K), flower and fruit development (P) and overall vitality (K).

Plants need micronutrients, also called trace elements, such as iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn). Their presence in very small quantities is essential for plant life. The balance and level of these micronutrients is critical as excesses are harmful to plants. Compost provides an available, balanced supply of these micronutrients.

## **The Essential Ingredient to Healthy Soil - Compost**

Organic matter is the soil's conditioner and food supply. Compost or humus is decomposed organic matter. Vegetable and fruit peelings, lawn and garden trimmings, manures, wood and soiled paper are all examples of raw materials which can be composted.

Finished compost can be applied to the soil in many different ways such as a soil amendment (turn it into the soil) or as a topdressing or mulch (spread compost on top of the soil and it will "disappear" over time). One to two inches or about two to five centimetres of finished compost is a good amount to include in your Spring and Fall gardening routine.

## How Does Your Garden Grow? ... Start with the Soil

*A healthy, flourishing garden begins with healthy soil. By learning as much as you can about your soil, you will be better able to match plants to your conditions.*

- You can determine the type of soil you have by conducting a simple test. The test will reveal the composition of your soil (whether it's predominantly clay, loam or sand), the nutrient levels in your soil and the soil's pH (its acidity or alkalinity).
- Scoop a handful of soil and give it a squeeze. If you have sandy soil, it will be crumbly and won't hold its shape in your hand; sandy soils don't retain much moisture. If you have clay soil, it will form a lump when you squeeze it; clay soils get sticky when wet and turn very hard when dry. Loam, the ideal garden soil, will form into a ball when you squeeze it but will break apart easily. To improve any soil – sand, clay or loam – add compost.
- Another way to determine whether your soil is clay, loam or sand is to put a handful of garden soil in a litre jar, fill it with water, shake and then leave it to settle for a day. Sand will settle to the bottom, silt will be the next layer with clay on top (organic matter will float on the water's surface). Compare the percentage of each layer to determine whether you've got loam (20% clay, 40% silt, 40% sand), clay (60% clay, 30% silt, 10% sand) or sand (5% clay, 10% silt, 85% sand).
- To test the pH levels in your garden - to tell whether your soil's pH is acidic, neutral or alkaline - a home pH testing kit is available at most nurseries. This will help you determine what plants will do best in your soil conditions.
- To determine the drainage capacity of your soil, dig a hole 1 foot deep and 1 foot wide. Fill it with water, let it drain completely then fill again until the soil is saturated. Depending on how long it takes for this last batch to drain, you've either got adequate drainage (less than 2 hours) or poor drainage (more than 2 hours).

Whatever your soil type, pH, drainage and nutrient levels, you can improve the health of your soil by adding compost. Dig in lots of compost when first preparing your garden bed for planting. In already established gardens, add a 2 – 5 cms layer of compost around your plants in spring, summer or fall.

**Source:** *For the Love of the Earth – Greening Tips from The Compost Council of Canada*

## Feed the Soil ... COMPOST!

Compost is a valuable soil amendment, containing a high organic matter content. While compost is not a fertilizer, it can contain nutrients which improve plant growth.

### What's in it for me?

Among compost's many benefits are:

- **Improved plant and root growth** ... when compost is part of the growing medium, plants can grow stronger and have higher yields. Compost adds not only organic matter to the soil but also trace elements such as iron, manganese, copper, zinc and boron which plants need to grow.
- **Reduced rate of nutrient release** ... compost binds the nutrients in the soil, ensuring that they are available over a longer time period for the plants to use them.
- **Improved soil porosity** ... Compacted soil does not allow water and air space in the soil, important features for the soil's micro-organisms to best function. Compost consists of many different sized particles, it helps break up the soil, helping to increase soil porosity.
- **Improved water-holding capacity** ... the organic matter in compost can soak up water thereby increasing the soil's water-holding capacity. This helps the soil absorb water during rain or watering, holding it for use by the plants for drier days.
- **Improved resistance to wind and water erosion** ... the increased availability of nutrients and water from compost helps plants grow, providing protection from soil erosion
- **Plant disease suppression** ... just as taking vitamins helps supply daily requirements for one's own body, adding compost to the soil helps fortify soil's health, helping it to be resistant to pests and diseases

### Making the Grade

Because of its many benefits, compost is being used in many different ways. These include: agriculture, home gardening and landscaping, grounds maintenance (eg. athletic fields, golf courses), nurseries, reforestation, land reclamation and as landfill cover.

The quality of the compost determines its use. Higher quality compost can be made when compostable materials are separated from non-compostable materials prior to composting.

In Canada, compost is classified in two general categories: A and B based on content and intended use. Category AA and A can be used in any application such as gardens, horticultural operations and the nursery industry. Category B, a lower

quality compost, is restricted for use according to applications such as land reclamation as set out by government review.

## **How to Use Compost**

Compost has many uses which make for healthier soil and improved plant growth. Plants generally should never be planted in 100% compost. While compost provides the food, the plants also need minerals, air and water that is contained in soil. Adding compost to the soil provides the combination for gardening success.

**Mulch** – spread compost around trees, shrubs and plants, about 5 cm in depth. It will breakdown over time enabling further applications at least once per year.

**Soil Amendment** – add 2 to 5 cm annually to your soil and mix it in.

**Lawn Top Dressing** – in addition to just leaving cut grass on the lawn (“grass-cycling”), add a layer of compost on top of the grass, aerating the soil in advance. Raking and watering the lawn helps the compost to settle into the soil.

**For Vegetable Gardens** – vegetable plants love compost! Add 2 to 5 cm annually and dig it in to a depth of 12 cm. Early Spring or late Fall are good times to add compost to the veggie garden’s soil to make it ready for its next growing season.

**Source:** The Compost Council of Canada

## **Composting Systems of all Sizes**

### *Topic*

Learn how organics recycling and composting is working in your community

### *Learning Outcomes*

To gain awareness about the many factors involved in organics recycling and composting and the important elements that make the system work best

### *Time*

3 – 4 hours, depending if a tour of a nearby composting facility is available

### *Materials/Resources*

- Contact your local municipal recycling coordinator, inviting them to speak to your group about their work and how the community is involved in organics recycling
- Contact your local composting or anaerobic digestion facility to see if there is an opportunity for a tour
- If neither of these options are available, utilize available videos (*list to be provided*) to optimize the discussion

### *Discussion/Comments*

- What is involved in organics recycling?
- What factors can influence the success or failure of organics recycling?
- What processes are in place at the composting facility to monitor and check progress?
- What kind of tests are involved to check on the quality of the finished compost?
- How important is education and communication to ensuring organics recycling is successful in the community?
- Are different types of organic materials processed differently?

### *Processing Prompts*

Discuss with the local municipal recycling coordinator the dynamics of any visit and how to best make use of the time and resources involved in a site visit.

## **Composting Systems of all Sizes**

Composting can be done in many ways, in a bin at home as well as systems of larger-scale and size at work or at a dedicated location. While the systems and types of organic materials might be different, the fundamentals are the same. It's all about sourcing the right organics for the appropriate system, getting them well-prepared through sizing and mixing as well as creating the appropriate environment for the microbes to do their work.

Included among the various composting systems are:

### **Backyard Composting**

This involves the set up and ongoing management of a composting unit at home. Usually located in the backyard, the compost unit helps contain the organics and are sized of sufficient volume to get the process working. You can either "build your own" or buy a commercial manufactured unit, often available directly from your local municipal recycling department.

### **On-Site Composting**

This is for the on-site management of organic materials generated by a group at the same location, such as at a farm, office building, restaurant and hospital. On-site composting avoids the costs associated with the transportation of organics. As with other systems, the establishment of efficient and effective collection as well as the ongoing maintenance of the composter are important to ensure that the process runs effectively.

### **Centralized Composting**

This involves the collection and transportation of large amounts of organic materials to a special facility where it is prepared and processed into compost. These facilities are designed to and can compost the wide range of organic materials generated in a community. Collection methods, processing requirements and the end use for the finished compost are all taken into account in the facility's design. The separation of organic materials from other recyclables and wastes help minimize contamination while the ongoing implementation of good operating procedures ensures the production of high quality compost.

Included amongst the types of centralized composting systems are:

- **Windrows** – a long row, triangular in shape and aerated on a regular basis through either manual or mechanical methods

- **Static Aerated Piles** – once mixed, the organic materials are piled and covered with an external layer of, placed over a series of pipes that can draw air in or force air out of the pile. The pile is not turned.
- **In-Vessel** – the organic material is composted inside a drum, silo, agitated bed, covered or open channel, batch container or other structure. The process conditions (such as temperature, oxygen levels and moisture) are closely monitored and controlled with the material being aerated through mechanically turning or agitation.

In addition to the above aerobic composting methods which involve a, the recycling of organic materials may also be done through anaerobic (no oxygen) conditions.

**Anaerobic digesters** convert the organic materials into a digestate which can then be further processed through composting. During the digestion process, methane and carbon dioxide --- known as biogas --- are produced which can then be converted into energy as electricity or fuel. Animal manure as well as fats, oils and greases are excellent ingredients for anaerobic digesters.

## List of Educational Resources

A GREAT FIRST STEP IS TO CONTACT YOUR LOCAL MUNICIPAL RECYCLING DEPARTMENT as well as PROVINCIAL MINISTRY OF ENVIRONMENT for:

- i. general information about organics recycling, composting and compost use
- ii. information about the specific organics recycling programs available in your area
- iii. opportunities to have speakers visit your team or have your group visit the local composting facility or other aspects of your municipality's recycling programs

### e. Literature

Build Your Own Composter

*Resource Recovery Fund Board*

<http://www.rrfb.com/build-your-own-composter.asp>

Worms Eat My Garbage: How to Set-up and Maintain a Vermicomposting System

*Mary Appelhof*

[http://openlibrary.org/books/OL3129137M/Worms\\_eat\\_my\\_garbage](http://openlibrary.org/books/OL3129137M/Worms_eat_my_garbage)

Composting for Dummies

*Cathy Crommell, The National Gardening Association*

The Real Dirt: The Complete Guide to Backyard, Balcony and Apartment Composting

*Mark Cullen & Lorraine Johnson*

Out-of-print but available through in used copies through Amazon.ca and other internet book sales sites

Composting Processing Technology

*The Compost Council of Canada*

[http://www.compost.org/pdf/compost\\_proc\\_tech\\_eng.pdf](http://www.compost.org/pdf/compost_proc_tech_eng.pdf)

Pee Wee and the Magical Compost Heap

Pee Wee's Great Adventures

Pee Wee at Castle Compost

*Lorraine Roulston*

May be ordered through [www.castlecompost.com](http://www.castlecompost.com)

## f. Video

There are a wide variety of videos available via YouTube and the Internet. Some are as follows:

### **A Composting Video Series from North Shore Recycling Program**

*North Vancouver, British Columbia*

- How Composting Works : [www.northshorerecycling.ca/composting](http://www.northshorerecycling.ca/composting)
- Siting a compost bin : [www.northshorerecycling.ca/composting/composting-101/siting-a-bin](http://www.northshorerecycling.ca/composting/composting-101/siting-a-bin)
- Carbon Sources : [www.northshorerecycling.ca/composting/composting-101/carbon-sources](http://www.northshorerecycling.ca/composting/composting-101/carbon-sources)
- Aerating Compost : [www.northshorerecycling.ca/composting/composting-101/aerating](http://www.northshorerecycling.ca/composting/composting-101/aerating)
- Deterring Compost Pests : [www.northshorerecycling.ca/composting/composting-101/carbon-sources](http://www.northshorerecycling.ca/composting/composting-101/carbon-sources)
- Harvesting and Using Compost :  
[www.northshorerecycling.ca/composting/composting-101/harvesting](http://www.northshorerecycling.ca/composting/composting-101/harvesting)

### **Green Home Makeover: Compost**

*National Geographic*

<http://video.nationalgeographic.com/video/environment/going-green-environment/green-home-makeover/compost-gg/>

### **Worm Farm by Kevin**

PBS Kids – DragonflyTV

<http://pbskids.org/dragonflytv/show/wormfarm.html>

## g. Contacts

### **The Compost Council of Canada**

16, rue Northumberland Street

Toronto, ON M6H 1P7

877 571 GROW(4769)

[www.compost.org](http://www.compost.org)

[www.growarow.org](http://www.growarow.org)

#### *British Columbia*

Recycling Council of British Columbia

Suite 10-119 W. Pender Street

Vancouver, BC V6B 1S5

Tel: 604-683-6009

Fax: 604-683-7255

Email: [rcbc@rcbc.bc.ca](mailto:rcbc@rcbc.bc.ca)

Coast Waste Management Association

1185 Rolmar Crescent

Cobble Hill, BC V0R 1L4

Tel: (250) 733-2213

Toll-free: 1-866-386-CWMA (2962)

Fax: (250) 733-2214

Email: [info@cwma.bc.ca](mailto:info@cwma.bc.ca)

SWANA (Solid Waste Association of North America) Pacific CHAPTER  
150 Beddis Road  
Salt Spring Island, BC  
Canada V8K 2J2  
Tel: (250) 538-0110  
Toll-free: 1-800-648-2560  
Fax: (250) 538 0120  
Email: [info@swanabc.org](mailto:info@swanabc.org)

*Alberta*

Recycling Council of Alberta  
Box 23  
Bluffton, AB T0C 0M0  
Tel: (403) 843-6563  
Fax: (403) 843-4156  
Email: [info@recycle.ab.ca](mailto:info@recycle.ab.ca)

SWANA Northern Lights Chapter  
Box 3317  
Sherwood Park, AB T8H 2T2  
Tel: (780) 496-5614  
Fax: (866) 698-8203  
Email: [info@swananorthernlights.org](mailto:info@swananorthernlights.org)

*Saskatchewan*

Saskatchewan Waste Reduction Council  
The Two-Twenty  
#208, 220 – 20<sup>th</sup> Street West  
Saskatoon, SK S7M 0W9  
Tel: (306) 931-3242  
Fax: (306) 955-5852  
[info@saskwastereduction.ca](mailto:info@saskwastereduction.ca)

*Manitoba*

Green Action Centre  
303 Portage Ave, 3<sup>rd</sup> Floor  
Winnipeg, MB R3B 2B4  
Tel: (204) 925-3777  
Email: [info@greenactioncentre.ca](mailto:info@greenactioncentre.ca)

*Ontario*

Municipal Waste Association  
127 Wyndham St. N., Suite 100  
Guelph, ON N1H 4E9  
Tel: (519) 823-1990  
Fax: (519) 823-0084

Recycling Council of Ontario  
215 Spadina Avenue Suite 225  
Toronto, Ontario M5T 2C7

Tel: (416) 657-2797  
Toll-free: 1-888-501-9637  
Email: rco@rco.on.ca

SWANA Ontario Chapter  
P.O. Box 9  
Hillsdale, ON L0L 1V0  
Tel: (705) 835-3560  
Fax: (705) 835-6224

*Québec*  
Recyc-Québec  
141, av du Président-Kennedy, 8e étage  
Montréal, QC H2X 1Y4  
Tel: (514) 352-5002  
Fax: (514) 873-6542  
Email: info@recyc-quebec.gouv.qc.ca

*Nova Scotia*  
RRFB (Resource Recovery Fund Board) Nova Scotia  
14 Court Street, Suite 305  
Truro, NS B2N 3H7  
Tel: (902) 895-RRFB(7732)  
Fax: (902) 897-3256  
Email: info@rrfb.com

SWANA, Atlantic Canada Chapter  
137 Chainlake Drive, Suite 100  
Halifax, NS B3S 1V3  
Fax: (902) 450-2008  
Email: info@atcanswana.org

*Prince Edward Island*  
Island Waste Management Corporation (IWMC)  
110 Watts Ave.  
Charlottetown, PE C1E 2C1  
Toll Free: 1-888-280-8111  
Local Calls: 882-0525  
Fax: 1-902-882-0520  
Email: info@iwmc.pe.ca

*Newfoundland & Labrador*  
MMSB (Multi-Materials Stewardship Board)  
P.O. Box 8131, Station A  
St. John's, NL A1B 3M9  
Tel: (709) 753-0948  
Toll-Free: 1-800-901-MMSB  
Fax: (709) 753-0974  
Email: inquiries@mmsb.nl.ca

*Territories*

**Territories**

Ecology North

5013 51 Street

Yellowknife, NT X1A 1S5

Tel: (867) 873-6019

Email: [admin@ecologynorth.ca](mailto:admin@ecologynorth.ca)

## **Provincial, Territorial & Federal Ministries of Environment and Agriculture**

### **British Columbia**

BC Ministry of Environment  
PO Box 9339, STN Prov Govt  
Victoria, BC V8W 9M1  
Tel: (250) 387-1161  
[www.gov.bc.ca/env](http://www.gov.bc.ca/env)

BC Ministry of Agriculture and Lands  
PO Box 9120, STN Prov Govt  
Victoria, BC V8W 9E2  
Tel: (250) 387-5121  
[www.gov.bc.ca/agri](http://www.gov.bc.ca/agri)

### **Alberta**

Alberta Environment  
10<sup>th</sup> Floor, Oxbridge Place  
Edmonton, AB T5K 2J6  
Tel: (780) 427-2700  
[www.environment.alberta.ca](http://www.environment.alberta.ca)

Alberta Agriculture & Rural Development  
7000 113<sup>th</sup> Street  
Edmonton, AB T6H 5T6  
Tel: (402) 742-7901  
[www.agric.gov.ab.ca](http://www.agric.gov.ab.ca)

### **Saskatchewan**

Saskatchewan Environment  
3211 Albert Street  
Regina, SK S4S 5W6  
Tel: 1-800-567-4224 (toll free in North America)  
[www.environment.gov.sk.ca](http://www.environment.gov.sk.ca)

Saskatchewan Agriculture  
3085 Albert Street  
Regina, SK S4S 0B1  
Tel: 1-866-457-2377  
[www.environment.gov.sk.ca](http://www.environment.gov.sk.ca)

### **Manitoba**

Manitoba Conservation and Water Stewardship  
123 Main Street, Suite 160  
Winnipeg, MB R3C 1A5  
Tel: (204) 945-6784  
[www.gov.mb.ca/conservation](http://www.gov.mb.ca/conservation)

Manitoba Agriculture, Food and Rural Initiatives  
545 University Crescent  
Winnipeg, MB R3T 5S6  
Tel: 1 (866) 626-4862  
[www.gov.mb.ca/conservation](http://www.gov.mb.ca/conservation)

### **Ontario**

Ontario Ministry of Environment  
1st Floor, 135 St. Clair Avenue West  
Toronto, ON M4V 1P5  
Tel: 1 (800) 565-4923  
[www.ene.gov.on.ca](http://www.ene.gov.on.ca)

Ontario Ministry of Agriculture, Food and Rural Affairs  
Ministry of Agriculture, Food and Rural Affairs  
1 Stone Road West, Guelph, ON N1G 4Y2  
Tel: (519) 826-3100  
[www.omafra.gov.on.ca](http://www.omafra.gov.on.ca)

### **Québec**

Ministère du Développement Durable, Environnement, Faune et Parcs  
Centre d'information  
Édifice Marie-Guyart, 29<sup>th</sup> Floor  
675, boulevard René-Lévesque Est  
Québec (Québec) G1R 5V7  
Télé: (418) 521-3830 or 1 (800) 561-1616  
[www.mddep.gouv.qc.ca](http://www.mddep.gouv.qc.ca)

Ministère d'Agriculture, Pêcheries et Alimentation  
200, chemin Sainte-Foy  
Québec (Québec) G1R 4X6  
Télé : (418) 380-2110  
Sans frais : 1 (888) 222-MAPA(6272)  
[www.mapaq.gouv.qc.ca](http://www.mapaq.gouv.qc.ca)

### **New Brunswick**

New Brunswick Environment and Local Government  
Marysville Place  
P. O. Box 6000  
Fredericton, NB E3B 5H1  
Tel: (506) 453-2690  
[www2.gnb.ca/content/gnb/en/departments/elg.html](http://www2.gnb.ca/content/gnb/en/departments/elg.html)

New Brunswick Department of Agriculture, Aquaculture and Fisheries  
Agricultural Research Station (Experimental Farm)  
P. O. Box 6000  
Fredericton, NB E3B 5H1  
Tel: (506) 453-2666  
[www.gnb.ca/0027/Index-e.asp](http://www.gnb.ca/0027/Index-e.asp)

**Nova Scotia**

Nova Scotia Environment  
PO Box 442  
5151 Terminal Road  
Halifax, Nova Scotia B3J 2P8  
Tel: (902) 424-3600  
[www.gov.ns.ca/nse](http://www.gov.ns.ca/nse)

Nova Scotia Department of Agriculture  
PO Box 2223  
Halifax, Nova Scotia B3J 3C4  
Tel: (902) 424-4560  
[www.gov.ns.ca/agri](http://www.gov.ns.ca/agri)

**Prince Edward Island**

Prince Edward Department of Environment, Labour and Justice  
Jones Building, 4th Floor  
11 Kent Street  
Charlottetown, PE C1A 7N8  
Tel: (902) 368-5028  
[www.gov.pe.ca/environment](http://www.gov.pe.ca/environment)

Prince Edward Island Agriculture and Forestry  
Research Station  
University Avenue  
P.O. Box 1600,  
Charlottetown, PEI C1A 7N3  
Tel: (902) 368-4145  
[www.gov.pe.ca/agriculture](http://www.gov.pe.ca/agriculture)

**Newfoundland & Labrador**

Environment and Conservation  
P.O. Box 8700  
4th Floor, West Block  
Confederation Building  
St. John's, NL A1B 4J6  
Ph: (709) 729-2664  
[www.env.gov.nl.ca/env](http://www.env.gov.nl.ca/env)

Agriculture  
Provincial Agriculture Building  
Brookfield Road  
P.O. Box 8700  
St. John's, NL A1B 4J6  
Ph: (709) 729-6758  
[www.gov.nl.ca/services/agriculture.stm](http://www.gov.nl.ca/services/agriculture.stm)

**Yukon Territories**

Environment Yukon  
Government of Yukon  
Box 2703 (V-3A)  
Whitehorse, Yukon Y1A 2C6  
Ph: (867) 667-5652  
[www.env.gov.yk.ca](http://www.env.gov.yk.ca)

Yukon Agriculture, Energy, Mines and Resources  
Government of Yukon  
Box 2703 (V-3A)  
Whitehorse, Yukon Y1A 2C6  
Tel: (867) 667-5838  
[www.emr.gov.yk.ca/agriculture](http://www.emr.gov.yk.ca/agriculture)

**Northwest Territories**

Northwest Territories Environment and Natural Resources  
Box 1320  
Yellowknife, NT X1A 2L9  
Tel: (867) 873-7401  
[www.enr.gov.nt.ca/\\_live/pages/wpPages/home.aspx](http://www.enr.gov.nt.ca/_live/pages/wpPages/home.aspx)

**Nunavut**

Department of Environment  
P.O. Box 1000 Station 1300  
Iqaluit, NU X0A 0H0  
Tel. (867) 975-7700  
[www.env.gov.nu.ca](http://www.env.gov.nu.ca)

**Federal**

Environment Canada  
Inquiry Centre  
10 Wellington, 23rd Floor  
Gatineau QC  
K1A 0H3  
Ph: 1 (800) 668-6767 (in Canada only)  
[www.ec.gc.ca](http://www.ec.gc.ca)

Agriculture and Agri-Food Canada  
1341 Baseline Road  
Ottawa, ON K1A 0C5  
Ph: 1 (855) 773-0241  
[www.agr.gc.ca](http://www.agr.gc.ca)