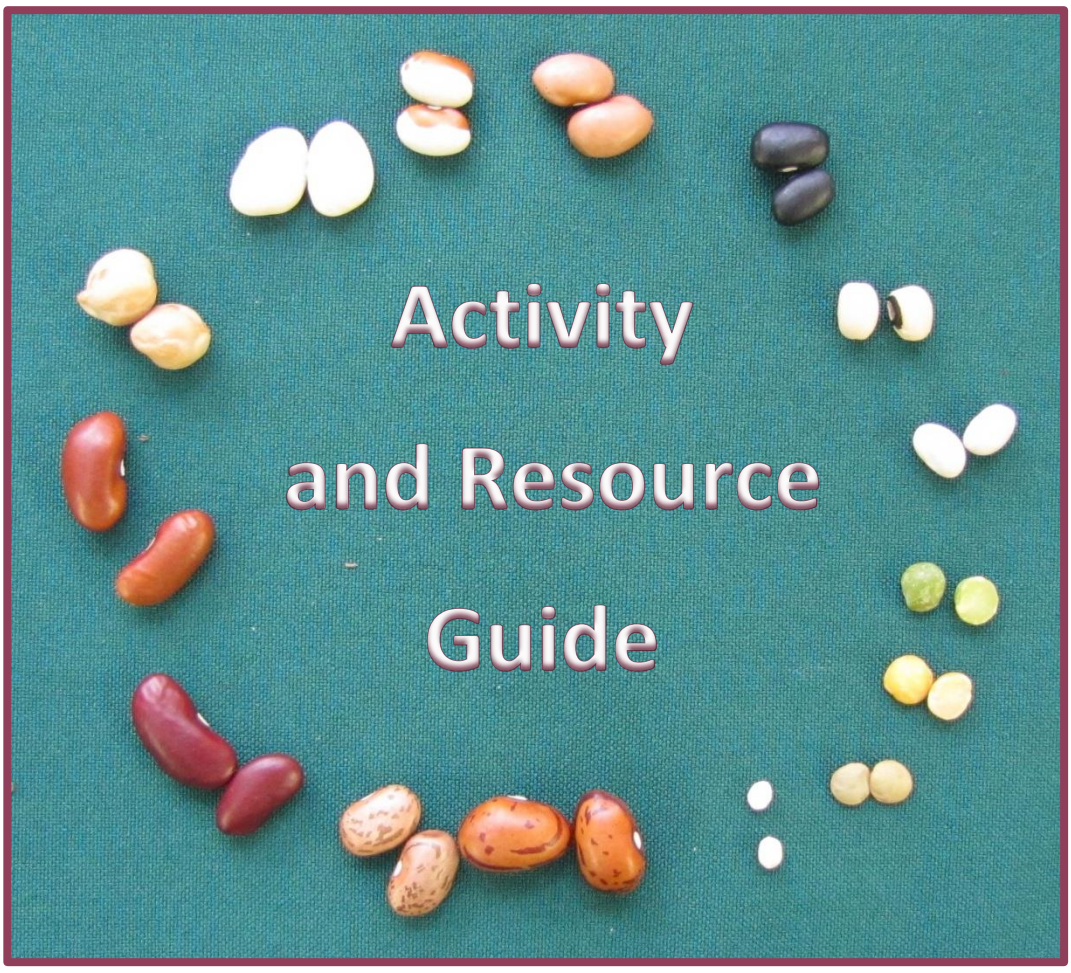
From Garden to Classroom



MUN Botanical Garden
Memorial University of Newfoundland

NSERC CRSNG

From Garden to Classroom
Activity and Resource Guide

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Foreword

MUN Botanical Garden is committed to providing research and education which supports the conservation of plant diversity and its sustainable use. Integral to the research and education is a knowledge, understanding, and concern for plants, their habitats, and the threats they face. Yet it is evident that as our world becomes more modern, our relationship with the plant world weakens. Within communities around the world, local skills and knowledge of plant lore, including its uses, properties, and even basic identification are all but disappearing.

This fact is alarming, considering that the implementation of biodiversity conservation and sustainability depends upon an informed, concerned community of citizens promoting these principles. How many of us think of plants when we eat? Yet all the food we eat, directly or indirectly is derived from plants. Our air, medicine, clothing, and building materials depend on plants. Today, more than ever, our leisure and recreation is linked to our natural environment. Simply put, will the children of today grow up to be a generation of policy makers and decision-makers that neither know nor care about our environment? Will they be unaware of the link between human survival and sustainable development?

Unfortunately, the answer could be yes unless our attitudes on plant education change drastically. While it is acknowledged that the need for change starts in the classroom, what steps have been taken to effectively enhance and increase botany in the curriculum? More importantly are teachers, particularly early childhood, primary and elementary, adequately trained in this field of science? Feedback from teachers, youth group leaders and even parents indicate that they are not. School administrators are already faced with such overwhelming concerns as decaying infrastructures, teacher shortages, overcrowding and loss of music and art programs. Plant education is just not a priority.

As educators, what can we do? Start with the basics. Utilize activities that can teach us, the teachers, and open the eyes of many students, from pre-school onward. This *From Garden to Classroom Activity & Resource Guide* was created through funding provided from a grant awarded through the PromoScience program of the Natural Sciences and Engineering Research Council (NSERC). The following activities and resources, which have been a mainstay of the Botanical Garden's education program for almost 40 years, were researched and tested over a three-year period and compiled in a guide for educators. The activities and resources are easy, simple, inexpensive, and can use materials recycled from home, work or school. While using these activities in the classroom may not make a budding botanist out of every student, it will certainly be a good first step in creating a generation of conservationists.

Anne Madden, Education Coordinator,
Memorial University of Newfoundland Botanical Garden
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A sincere thank you to all the teachers and students who have participated in a Botanical Garden education program. Our education programs could not happen without you.

Table of Contents

1. Introduction

Would you like to help your students explore our natural world? Would you like to bring our natural world into your classroom and incorporate more activity-based learning across the curriculum? This *From Garden to Classroom Activity and Resource Guide* is intended to assist educators do all that and more. It includes hands-on activities and resources for the Newfoundland and Labrador school curriculum.

The activities and resources included in this guide were components of the *From Garden to Classroom* Outreach Education Program. This outreach program was presented to schools in the Northeast Avalon region from 2009 - 2011, thanks to the support of the Natural Sciences and Engineering Research Council (NSERC) PromoScience funding program. During that time, several *Botanical Boot Camp* teacher training workshops were offered at the Botanical Garden, and on the west coast of Newfoundland, utilizing these activities and resources. This guide was compiled and developed based on feedback from both the outreach program and the teacher workshop participants.

While all programs supplement the science curriculum, we encourage teachers to make connections to other subject areas. Feedback, stories and suggestions are always welcome and are an integral part of the development of this education program. Comments may be forwarded to:

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Figure 1: Some students release butterflies into MUN Botanical Garden that they raised in their classroom. Visiting schools to the Garden are often local. The From Garden to Classroom outreach program enabled schools who could not easily organize a field trip to the Garden experience some of what the Garden has to offer.

A. Program Objectives

The objectives of the *From Garden to Classroom* education programs were to develop and provide outreach and teacher education resources in natural sciences, including botany, ecology and environmental conservation and biodiversity through interactive and activity-based programs, employing experiential learning for youth grades K-6, using age-appropriate, curriculum-linked learning materials.

The program was aimed at engaging students and teachers and motivating participants to take action and implement positive changes both in and outside their schools, within their homes and throughout their community.

This program allowed the Botanical Garden a unique opportunity to supplement the science curriculum, engage young people in hands-on activities and hopefully encourage proactive attitudes and behaviour in areas of environmental protection, conservation and enhancement. These programs were developed and expanded across the curriculum; not just in the areas of science education, but also language arts, math, social studies, etc.

While the range and number of topics covered depended on the curriculum, all concepts related to the theme of bringing the Botanical Garden (and its expertise) to the classroom. In turn, the knowledge and experiences students gained in the classroom would hopefully promote a responsible and pro-active attitude towards the environment.

Figure 2: Making newspaper flowerpots with a Kindergarten class at St. Edwards Elementary

Most importantly, we hope students will develop respect and a keen interest in natural sciences and our local environment. While the primary objective was to engage the student; teacher education and support was critical to the success of this program. The teacher workshops and web development were intended to supply the much-needed training and support for educators and community leaders, province-wide.

B. Program Content & Curriculum Connections

The *From Garden to Classroom* program incorporates environmental stewardship practices presently promoted and used at MUN Botanical Garden. Topics such as Newfoundland ecology, native plant and habitat conservation, botany, composting, waste reduction, food sustainability, and environmental monitoring, in a format appropriate to each grade level and curriculum, was presented during the school outreach programs and in the *Botanical Boot Camp* teacher training workshops. Ongoing input from educators has played a key role in determining the program content. The core components of this pilot program were initially determined from teacher feedback received during the Botanical Gardens' school program presentations (1974-2009).

Thanks to funding from Natural Sciences and Engineering Research Council (NSERC) PromoScience funding program, MUN Botanical Garden was available to visit schools and also offer teacher-training workshops from 2009 – 2011, bringing the Garden's expertise and some excellent activities to supplement the curriculum and make learning fun! The feedback and research compiled during this education program, has resulted in this draft of our *From Garden to Classroom Activity and Resource Guide.*

Figure 3: Kindergarten children at St. Matthews learn about vermicomposting

K – 6 curriculum connections are specified on the Botanical Gardens' website and are not listed in this guide, primarily due to space limitations, but to also keep up with the changes as they apply to the school curriculum. While the scope of this project did not allow the opportunity to extend the outreach and research to intermediate and secondary classrooms, we encourage all educators to have fun with these activities in and outside the classroom.

2. How To Green Your Thumb

A. Making Soil – Composting 101

Introduction:

As a centre for education and research, MUN Botanical Garden has promoted composting, not just to home gardeners but to people of all ages, including teachers and school children. All information in this *From Garden to Classroom* program is based on the compost research and education, ongoing at MUN Botanical Garden since it was created in 1971. Because there was no soil located on site to build flower beds, our first challenge was to create it. In fact, the existing soil was so contaminated with lead, devoid of nutrients, compacted, and in some locations, strewn with buried garbage, it had to be replaced. So, a compost pile was started and over time, many more were created. MUN Botanical Garden has been composting ever since, creating most of the soil we use in our gardens today.

Throughout the *From Garden to Classroom* Outreach Program, education staff visited schools and offered several Botanical Boot Camp teacher workshops, featuring compost education and activities. Modifications, based on teacher feedback during the boot camps, have been applied to the Garden's compost education program.

Composting is a way in which people use the natural process of decay to produce a rich, fertile soil. Students become fascinated with composting. They get to touch dirt, hold worms, build compost piles, set-up and explore worm bins, analyze what they've eaten for lunch, and plant seeds. While doing all of this, children learn a new appreciation of natural cycles and resources, and the importance of respecting our environment.

Composting can even happen throughout the entire school year: in the school yard and inside the school, including the teachers' lounge and in every classroom. Most importantly, composting inside or outside the school is easy and fun, once you get the hang of it.

i) Getting Started - Nature: The Great Recycler

Nothing in nature is wasted or sent to a landfill. Nature recycles organic material (anything produced by a living organism) through a combination of biological and chemical processes. Microorganisms, insects, and worms help decompose (break down) dead plants and animals, returning nutrients to the earth so that other plants may grow. When we compost at home and at school, we are utilizing these natural processes.

Composting can happen outside the school and also inside the classroom. While there are similarities with both processes, the planning and set-up for each project is different. While vermicomposting (also known as indoor worm composting) can start as a classroom project, the outdoor bin should include input and support from the entire school community. Both projects require the following:

1. Enthusiastic people willing to learn and get their hands dirty
2. A compost bin
3. Food scraps
4. Some buckets or food storage containers (recycled)

The following information is intended as a guide to getting started and maintaining a compost unit at your school. While researching this topic is recommended before you embark on a project, please remember, the best way to learn is to just do it. Reach out to your school and local community for advice and help. Local gardeners are often happy to share their skills, as are other gardening and conservation organizations. For more information, please see the resources section of this manual.

Please remember, you don't have to be an expert. Mistakes will occur; that is part of the learning. As the Irish author James Joyce said: "Mistakes are the portals of discovery." Get ready to embark on a journey of discovery and fun.

ii) Why Compost? The Benefits of Composting

Your first step in starting a compost program, indoors or out, is to build a team of enthusiastic supporters. While most people understand why compost programs are important, many are surprised at how far reaching the benefits can be.

Figure 4: Garden debris in the compost

While some schools start a compost program simply to provide soil for a school garden project, few realize what a dramatic effect composting can have on students, teachers, and even the local community. In order to demonstrate principles of conservation and stewardship, it is important for students to perform hands-on activities which support conservation. By reducing the amount of garbage we produce, and hence the amount of organic matter dumped in the landfill, students immediately recognize the value (and power) of taking action to create a change in their school and community. It is also important for students to experience the seasonal cyclic changes in nature; of spring growth and winter die-back. Collecting and composting garden debris, just as everything in nature is composted, enables students to connect to this concept very clearly.

Adding kitchen and garden wastes to a compost bin reduces the volume of garbage sent to landfills each year. Landfills require valuable land and can leach pollutants to the environment, all the while costing towns and municipalities large tax revenues. A landfill is viewed as a blot on the landscape and few of us want to live next to one. Since over one third of our waste is made of organic matter, which can be composted, everyone can play an active role in decreasing the size of our landfills.

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

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

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

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

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

Figure 5: Composted leaves make a great mulch by keeping weeds down and adding nutrients into your soil

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

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

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

iii) The Compost Bin

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

Location of the Compost:

In the province of Newfoundland and Labrador, we often experience long winters, cool springs and cold, wet autumns. Therefore, to extend the compost season as long as possible, it is very important to position your bin in a sunny, sheltered spot. The warmer temperatures will encourage greater microbial activity, which will speed the compost process. This is contrary to advice offered for other provinces in Canada, where a sunny location could be too hot. We have found that a compost bin located in the shade will remain cool, lengthening the process.

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

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

Size of the Compost:

While the size of your bin is related to the amount of material you wish to compost, a popular compost bin size is approximately 1 meter x 1 meter x 1 meter. When your compost bin is smaller, the pile does not tend to heat up or "cook" properly and a bigger pile (i.e. larger than 1.5 m X 1.5 m X 1.5 m) may be harder for some groups to manage and may have aeration problems. However, if you plan to compost on a larger scale, you can adjust your bin size accordingly. If you are just starting out, create one bin at a time, as needed. For an indoor, worm bin, please read the vermicomposting section.

Type of Compost Containers:

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

MUN Botanical Garden to get some ideas. A resource list, including links to compost bin plans and models is included in this unit.

To Purchase or Build:

Many ready-to-use models are available for purchase from hardware and garden centers. At times the large variety can be confusing. It is best to select a type that fits your budget, keeping in mind that a compost bin does not have to expensive. As long as it is sturdy, the correct size, and has a lid that will stay put, it should work. Some plastic bins may not be rodent-proof. To keep rodents out of wooden or plastic bins, simply line your bin with chicken wire.

Here is a sample of some of the many types of composts that can be used.

Converted Garbage Can:

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

Wire-mesh Container:

You can build a bin by simply tying together 1-2 meters of wire mesh into a circle. You may wish to secure it to the ground to ensure it doesn't tip over. The advantage of this model is the excellent air flow, affordable price and the fact that you can see into the bin. When plants grow from this bin, it looks like a pretty planter.

Wooden Pallet Container:

This simple, cost-effective model recycles wooden pallets, which are sometimes available for free from retail outlets. Simply position four pallets in an upright position, and tie together to form a square. You can add a pallet floor for stability. Again, lining it with wire mesh will help keep out rodents.

Wooden 2 or 3 Bin System:

These bins are made on site and can be scaled to your property and needs size. By having multiple bins, one side could be decomposing older material while you add new material to the other side. You can also store shredded leaves in one side, which can be used to balance out your kitchen scraps when you add them to the compost on the other side. The plans to build a 3 Bin System can be found on the MMSB website: www.mmsb.nl.ca

Compost Pile:

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

Rotating Barrel:

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

Plastic Commercial Bin:

These bins can be bought from many garden centres and are easy to assemble and set up. Some are square like in the photo to the left, and others are large and round. They are often black to encourage heat production inside the bin. Some communities subsidize the purchase price of a composter to encourage their use. Please check to see if you qualify on the MMSB website: www.mmsb.nl.ca
You can also contact your city to see if they have this program in effect.

iv) Building Your Compost Pile

How Does it Work?

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

1. Greens & Browns:

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

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

Browns	**Greens**
Dry leaves	Fresh grass clippings
Dry grass	Plant trimmings
Straw	Fruit / vegetable scraps
Wood chips	Houseplants
Sawdust	Tea bags
Shredded paper / cardboard / egg cartons	Egg shells
Shredded newspaper	Coffee grounds

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

2. Oxygen

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

3. Moisture

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

Putting It All Together

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

- When adding your food scraps, layer the browns and greens. If you only add greens, the pile gets too soggy, there is no air and no nutrients available for the growth and reproduction of the organisms.
- You can turn your outdoor compost regularly with a pitchfork to keep air circulating through the layers. However, unless we are having many days of rain, the balance of browns and greens should prevent any problems. You don't need to turn a worm bin.
- Keep your pile as moist as a wrung-out sponge. You may have to add more greens during dry weather, and add more browns and/or turn the pile more often if there is lots of rain.
- **If your bin is dry, do not water it**. Remember, a balance of browns and greens does more than help retain the correct moisture level. Browns (carbon) are an energy source for the decomposers and greens (nitrogen) are needed for growth and reproduction of the decomposing organisms. Adding water will not help your compost process in the long run. This is especially true for worm bins. Our experience as education staff has taught us that overwatering a worm bin is one of the most common mistakes made.

How Long Will it Take?

Decomposition time is determined by five factors:

1. Ratio of “browns” and “greens”
2. Amount of oxygen
3. Amount of moisture
4. Temperature of compost pile
5. Particle size of waste

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

Figure 6: A mesh wire bin allows oxygen to flow through the compost, which helps it break down faster

When organic matter is added to a compost bin, the rate of decomposition is also determined by its size and constituents. Small food scraps will break down faster than large scraps, just as wood will not break down as fast as paper. The smaller size of the items, the faster the food will be composted. Therefore, it is recommended that you try to shred, crush or cut items into smaller pieces if possible and avoid adding materials which will be slow to break down.

What TO Compost

Figure 7: Kitchen compost scraps

Lunch and Snack Wastes:

- Vegetable peelings and scraps
- Eggshells [1]
- Fruit peelings and scraps [2]
- Tea bags
- Coffee grounds
- Used paper coffee filters
- Cooked pasta (No sauce!)
- Paper napkins, paper towels
- Shredded paper / cardboard packaging

[1]Avoid use of any allergens including egg shells if they exist in your classroom.

[2]Teachers have pointed out that the collection of organic matter after snack time can result in 25 apple cores in your compost collection bucket. We do not recommend adding that much acidic fruit on a daily basis, especially if you are using a worm bin. It is best to add a variety of items and even avoid such slow composting items as orange peels, which can go moldy in worm bin before they break down. Possible solutions could be to bring some compost from home which is not acidic and to operate more than one bin at your school, so the fruit scraps can be used. Another solution is through education. By identifying the large variety of food scraps which can be composted and offering these suggestions to parents and children, your compost bin may be healthier and so may your student's school lunches and snacks. Please check our Grocery Store Botany section for some ideas.

Yard Wastes:

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

Figure 8: Plant debris in the compost

Household Items:

- Houseplant trimmings
- Pet fur[1]
- Dryer lint
- Hair
- Shredded newspaper and cardboard
- Vacuum bag contents
- Sawdust and wood shavings

[1]Avoid use of any allergens including pet fur if they exist in your classroom

Figure 9: Household compostables

What NOT to Compost

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

- Stale bread (mold can become a health issue)
- Dairy products (milk, cheese, yoghurt)
- Meat, poultry, fish, bones
- Fats (including grease, oil, lard, butter, margarine, or mayonnaise)
- Sauces that include any of the above
- Pet wastes

Also avoid adding:

- Large pieces of wood, thick branches, or heavy cardboard – these will take a long time to decompose and will take up space in your bin.
- Invasive weeds such as morning glory or gout weed
- Plastic, rubber, metals, glass and ceramics

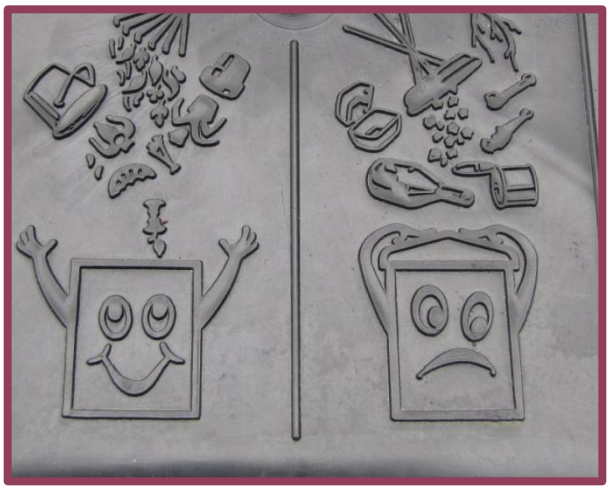


Figure 10: Certain household items shouldn't be composted

v) Using Your Compost

Humus: Garden Gold!

Figure 11: Finished compost will be a rich dark colour

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

Using compost before it is ready is not recommended and can in fact harm your garden plants. When the organic matter is breaking down, microbe activity is still very high. These microbes will use up oxygen needed by plant roots to grow. Also, if the browns or carbon continue to break down, it will take important nitrogen from the soil, leaving the roots deficient in nitrogen. Generally, with proper maintenance, you'll be able to collect your first batch of soil-enriching humus within a season, depending how you maintained your pile. Please see 'How long will it take?' on page 20 for more information on the length of time it will take the pile to break down. For more details on using compost, please see the Vermicompost section.

Composting All Year (Including Winter):

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

Here are some winter-composting tips:

1. Position your compost bin in a sunny, wind-sheltered spot.
2. Make sure your bin is accessible in the snowy weather.
3. In the fall, remove finished compost and dig it into your flower and vegetable beds.
4. Stockpile bags of leaves and use them throughout the winter to layer with the "greens" as usual.
5. Start a worm compost bin or vermicomposter in your classroom. Please see the next section for more information.

If you decide to stop composting in the winter, you can store your kitchen scraps in a covered bucket or garbage bin outside. When spring arrives, dig them into your heap and cover them with a layer of soil or dry leaves. Keep in mind that kitchen scraps are high in nitrogen and need to be mixed with lots of dry leaves, grass, paper or other "browns" in order to compost properly.

vi) Making Soil in the Classroom – Vermicomposting

Vermicomposting: Composting with Worms

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

Figure 12: Worms are a great classroom pet

Vermicomposting or composting with red wiggler worms, is happening right now, in many classrooms in Newfoundland and Labrador. The worm bin is used cross-curricular, as a learning tool. More importantly, the students are welcoming the worms into their classroom; feeding them, caring for them, monitoring their habitats and happily sharing their lunch scraps with them. The students adopt these critters as pets. Over the years, artwork created by students about their worms has clearly demonstrated how these students feel about a creature normally ignored, reviled or stepped on in the school yard. Education staff at the Botanical Garden have also been surprised to hear reports from parents that their children ask for healthier lunches, so they can also participate in the feeding and care of worms. In other words, worms can't eat chips and candy bars, so students don't want to either!

Your classroom worm bin will quickly become a source of discovery, delight, and hands-on fun. Stewardship happens naturally; and so does learning. When caring for worms, children are convinced they know one worm from the other, and will even name them. The reality is that the death of a worm will not cause the trauma often experienced with other classroom pets. One teacher attending our Botanical Boot Camp teacher workshop explained to our group that her worms graduate with her class every year and the students proudly demonstrate to their new teacher how capable they are in worm care! Needless to say, this level of excitement and enthusiasm quickly spreads to their homes and the local community.

What You Will Need

1. Container:

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

In the home, we recommend the following formula:

Number of People	Quantity of worms	Bin size
1 or 2	450g (1lb)	30x45x60cm (1x1.5x2ft)
2 or 3	450g (1lb)	30x60x60cm (1x2x2ft)
4 or 6	900g-1.35Kg (2–3lb)	30x60x105cm (1x2x3.5ft)

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

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

The location of your bin is important to the success of the project. A worm box easily fits into any classroom or staff room. Your bin should have a lid and the worms need to be protected from extreme temperatures. We have noticed at MUN Botanical Garden that they do not like drafts or cold temperatures and will actually migrate from the bin if they are not comfortable. Worms are cold-blooded creatures and do require some external heat to stay active. However, they should never be placed directly near a heat source. If your bin is plastic and sitting on a floor or table, make sure the surface is not cold, or the worms will migrate upwards. Several layer of newspaper under the bin can act as an insulator.

2. Worms:

Red wigglers (*Eisenia fetida* and *Lumbricus rubellus*) are the best worms for vermicomposting. They are much smaller and thinner than earthworms and they don't seem to mind being kept in captivity. Some people call them "redworms", "manure worms", "brandling worms", or "trouters". The red wigglers used at MUN Botanical Garden were purchased from a local worm farm. For more information on worm suppliers, please visit the Botanical Garden's webpage.

Figure 13: Red wiggler worms

3. Bedding:

Figure 14: Shredded paper makes great bedding

Your worms will eat everything you put in the bin, including their bedding! You can use a variety of materials to provide them with more nutrition. We have been successfully using shredded office paper, produced at the Botanical Garden. Please keep in mind that if you collect bedding from outside, such as leaves or other garden debris, critters such as insects may tag along.

The following materials make an ideal bedding: shredded office paper, shredded newspaper, shredded cardboard, shredded fall leaves, chopped straw, dried grass clippings, peat moss. Add a couple of handfuls of sand or soil to provide your worms with grit for their digestive systems.

4. Food Waste:

Feed your worms the same kitchen waste that you would add to your outside compost heap (please see page 21). Finely chopped food will be broken down more quickly than large chunks. Do not add meat, fish, dairy products, or fats. Citrus fruit peels take a long time to break down so add them sparingly.

Simple Steps to Vermicomposting:

When you have gathered your supplies and selected a location, follow these steps:

1. Place the bin in its location
2. Fill the bin with bedding
3. Pull back the bedding from one corner of the bin and add your worms to the floor of the bin
4. Add a handful of food scraps in the same location of your worms
5. Cover the food and worms with your bedding. Mark the location with a popsicle stick. If using a piece of burlap, cover the bedding with this material.

6. Check the worms every day or so. If they are 'settled' or happy, they will form a mass around the food.

7. In a few days, add another handful of food, adjacent to the first pile. Always add the food scraps close to the last pile. If the worms are not happy (i.e. the habitat is not ideal), they may attempt to leave the bin. It sometimes takes several days for worms to settle. Leaving the lid off and the lights on for the first few days and nights sometimes solves this problem. Check the temperature and drafts in your classroom, as they do not like the cold.

Figure 15: Harvesting worm compost

Harvesting and Using Vermicompost:

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

There are several ways to harvest your worm bin. You can empty all the contents onto a tarp, keep the lights on and shape the pile into a pyramid. Every now and then, remove the top of the pile, which will contain mostly castings. Reshape the tip of the pyramid. The worms will keep migrating away from the light. Eventually, you will remove most of the castings and only worms and some bedding will remain, which can be added to your bin with fresh bedding and food.

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

Using Vermicompost:

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

Compost should not be considered a fertilizer in itself. Most fertilizers have higher levels of some elements than most compost. However, added to soil, compost does increase the organic matter or nutrients in the soil. Hence, it could be considered an excellent amendment or additive.

Compost versus Fertilizer:

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

Nitrogen (N) is used by the plant to make protein and chlorophyll. It is important for good leaf development and vegetative growth. Too little nitrogen causes slow, spindly growth. Leaves may turn yellow due to lack of chlorophyll – the green pigment which helps plants make food.

Phosphorous (P) is vital for the growth of root and stem systems. When little of this nutrient is present in the soil, seedlings may not become well established.

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

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

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

Vermicompost Potting Mix Recipe:

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

Common Questions:

Will the worm bin smell? Not if air can circulate through the layers. To increase air circulation:

- Don't water the bin
- Drill holes in plastic bins and line with mesh
- Raise the bin above the floor
- Choose bedding that will not mat down

It is best to compost only recommended wastes. Dairy products, fats, and meats can cause unpleasant odors.

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

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

To Solve a Fruit Fly Problem:

- Place sticky flypaper strips under the lid of the box
- Make a fruit fly trap: Cut a plastic pop bottle in half and fill the bottom with an inch of vinegar. Fit the top of the bottle upside down into the bottom so that the neck is just above the vinegar.

vii) Common Compost Critters

The Outdoor Bin:

The school compost pile, when located outside, will become home to many composting critters. They all contribute to the decomposition process. Soil invertebrates, including insects, together with bacteria, fungi, and other microbes, work together (and sometimes eat each other) to create a complex food web or energy pyramid. In your indoor worm bin, decomposition is usually accomplished by the worms you added, and some microbes, as there are usually no other critters present.

Opportunities for exploration and analysis of the outdoor compost bin are endless and can be applied across the curriculum. If your students try to monitor life in a compost pile, do they notice changes over time? How long is it before you locate the first invertebrates? What happens to them when the pile heats up? Do you find different organisms later on, after the pile cools down?

Different communities of microorganisms prevail, or are more numerous during the various composting phases. Mesophilic (medium temperature) microorganisms start the compost process as they break down the soluble, readily degradable compounds. The heat they produce causes the compost temperature to rapidly rise.

Once the temperature increases to about 40°C, the mesophilic microorganisms are replaced by thermophilic (heat-loving) organisms. If temperatures reach 55°C and above, human or plant pathogens are destroyed. During this stage of decomposition, the high temperatures speed up the breakdown of proteins, fats, and complex carbohydrates like cellulose and hemicellulose, the major structural molecules in plants. As the supply of these high-energy compounds becomes depleted, the compost temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of "curing" or maturation of the remaining organic matter.

The population of critters in your compost bin can be divided into three categories:

- Primary Consumers: These are organisms which eat the food and plant waste (organic residue) which you add to your compost pile. These organisms include actinomycetes, bacteria, earthworms, fungi, millipedes, mites, nematodes, slugs, snails, sowbugs and whiteworms.

- Secondary Consumers: These are organisms which eat the primary consumers and include some beetles, mites, nematodes, protozoa, rotifera, springtails, and soil flatworms.

- Tertiary Consumers: These are organisms which eat secondary consumers and include ants, beetles, centipedes, and predatory mites.

Additional information on compost critters, including activities to help students explore the compost pile are posted on MUN Botanical Garden's website.

The Worm Bin:

When you create a vermicompost or worm bin, the most common critter you should see is worms. At MUN Botanical Garden, we consider worms to be a gardener's best friend. Information is provided here to help you understand and hopefully provide excellent care to these little creatures.

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

A Word about Good Worm Stewardship:

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

The Biology of Worms:

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

Worms are hermaphrodites. That means they are both male and female at the same time. However, worms still need to mate. Two worms attach to each other for a few minutes, and several days later, both produce a cocoon or egg case. The cocoon eventually separates from the worm. Inside the cocoon, two to five baby worms may be found. The baby worms live in

the egg case for at least three weeks, or sometimes longer, depending on the surrounding conditions. In the winter time, for example, baby worms may stay in the cocoon for many weeks until the temperature warms up again. When the baby worms eventually crawl out, they are the thickness of a piece of thread and about 1 centimeter long. Usually the worm appears white, as they have not yet developed enough blood (pigmentation) to be seen. In two or three months, worms are mature.

True or False?

Worms breathe through their skin.	True
Cutting a worm in half will make two worms.	False (Cutting a worm in two will eventually kill it.)
Red wigglers can eat their weight in food every day.	True
Worms have teeth.	False
Worms are blind.	True (Worms don't have eyes and so they cannot see. They are, however, sensitive to bright light – that's why they burrow into the earth.)

Worm Facts:

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

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

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

viii) Compost Glossary

A

Acid: A substance with pH between 0 and 7. Red wiggler worms prefer a slightly acidic environment, with a pH slightly less than 7. (See alkaline or base)

Actinomycetes: A type of bacteria which normally lives in the soil; also called actinobacteria. Their thread-like filaments resemble fungus. They play an important role as decomposers.

Adsorption: The attachment of a particle, ion, or molecule to the surface of a solid such as soil or compost.

Aerate: To add oxygen. Air is vital for microbial aerobic (oxygen) metabolism. Compressed soil or compost does not usually have much air. Aerating your soil or compost by turning it, poking holes in it or fluffing it will produce the best results.

Aerator: A compost aerator is a tool used to loosen compost, which enhances the flow of air and moisture.

Aerobic: A term which means requiring air or oxygen. An organism or a biochemical process is aerobic if relies on the presence of oxygen.

Air-dry: This term, when it refers to the state of dryness of a compost or soil, is an adjective and it is a verb when it means to allow the compost to reach equilibrium in moisture content with the surrounding atmosphere.

Alkaline: A substance with pH between 7 and 14. Basic or base is another term for a substance with this pH value.

Ambient temperature: This term is used to describe the temperature outside the compost pile.

Anaerobic: A word that means “without air”, or occurring in the absence of oxygen. When the composting process is anaerobic, the process is slow and marked by a bad odour.

Annelid: Any member of the phylum Annelida, which contains segmented worms.

Arthropod: The phylum of invertebrate animals that are distinguished by their jointed appendages. This group includes insects, arachnids and crustaceans. Many types of arthropods can be found in composters.

B

Bacteria: Microscopic, single-celled organisms which lack a nucleus. They are found everywhere and are important decomposers.

Base: See alkaline.

Batch composting: Refers to a type of composting where all of the ingredients are added at once rather than continuously over a period of time.

Bedding: Any material used in worm composting, such as shredded paper, leaves or peat moss, which is water-retentive and non-toxic for the worms can be used as bedding material.

Beneficial micro-organisms: Any microscopic (not visible without magnification) organism, which is helpful in maintaining a healthy balance in the decomposition process. These organisms can include bacteria.

Biodegradable: This is a term used to describe organic materials which are able to break down, decay or decompose into smaller compounds, usually through the action of living organisms.

Biology: The study of living things.

Biomass: The total amount or mass of living organisms in an ecosystem, population or designated area. This also refers to the culmination of living matter such as in composts, the forest, etc.

Biosphere: The biosphere includes all living organisms and their environment, including any dead organic matter produced by them. It can also refer to all regions of the surface and atmosphere of the Earth, or any planet, including the atmosphere (air) and hydrosphere (water)

Browns: When we compost, we refer to materials that are organic (i.e. once living) and also rich in the element carbon as 'browns'. Carbon is an essential energy source needed for the decomposing organisms in your pile. Browns are dry, absorbent and fibrous. These include dry leaves and grass, straw, wood chips, sawdust, shredded paper, cardboard and egg cartons. We also refer to as these as brown materials. Conversely, materials high in nitrogen are referred to as "greens". Both are required for your compost pile.

Bulking agent: This is any material which is used in the compost pile or bin to maintain air spaces between particles.

C

Carbohydrate: A molecular compound of carbon, hydrogen and oxygen, most of which is formed by green plants and constitute a major class of animal foods. Three categories of carbohydrates are sugars, starches, and cellulose.

Carbon: This is a naturally occurring element which is contained in all plants and animals. It is a basic building block for life on earth. It is represented by the letter "C" in the periodic table of the elements. During decomposition, carbon is released, to be reused by plants and animals. Organic materials high in carbon are referred to as "browns", such as dried leaves. The carbohydrate sugar, or glucose, is made up of oxygen (O), carbon (C) and hydrogen (H). When broken down, it can be used as energy by plants and animals. Carbon also combines with oxygen to make carbon dioxide, which is the product of human breathing needed by all plants to survive.

Carbon to Nitrogen Ratio (C:N ratio): The ratio of the weight of organic carbon to the weight of total nitrogen in soil, compost, or other organic material. This ratio affects how quickly microorganisms will work. In the compost pile, bacteria, like all living organisms, require more carbon than nitrogen. Achieving a carbon-to-nitrogen ratio of about 3:1 is ideal for the backyard pile composting and for increasing the speed of the compost process.

Carnivore: A heterotroph that eats only animal material or flesh.

Castings: Worm feces. This includes undigested organic matter, bacteria, and soil that have passed through worm digestive systems. In the worm bin, it looks and smells like soil.

Centipedes: These are arthropods which belong to the class Chilopoda. They are often found in outdoor compost bins. Their bodies are long and flattened, with many-segments; each segment has one pair of legs of which the foremost pair is modified into poison fangs. They are often confused with millipedes.

Cellulose: The main component of plant cell walls. It is composed of a series of organic compounds containing carbon, hydrogen, and oxygen which form chains of 1000-10,000 glucose molecules. Cellulose forms the fibrous and woody parts of plants and makes up over half of the total organic carbon in the biosphere.

Clay: Mineral particles, less than 0.002 mm in diameter that are an important component in soil. The term 'clay' can also refer to any soil consisting of more than 40% clay, and less than 45% sand, and less than 40% silt.

Clippings: A term which usually refers to the cut portion of grass or plants. Fresh clippings are a source of greens or nitrogen.

Compact: Pressed together or compressed. In a compost pile, when the contents are compacted, there is a reduction in the oxygen content, which adversely affects the compost process.

Compost: Organic matter that is undergoing decomposition or has resulted from decomposition. Compost adds nutrients, minerals and beneficial soil organisms to the soil, improving soil composition and structure.

Compost Activator: An additive which starts or increases the decomposition rate in a compost pile. They include enzymes, bacteria, blood meal and nitrogen-rich fertilizers.

Compostable Material: Any organic material that can be composted, such as fruit and vegetable food scraps, paper towels, thin cardboard, non-waxy paper, coffee grinds and tea bags, grass clippings and garden trimmings.

Composter: A unit or bin used to create compost.

Composting: This is an aerobic process which mimics nature by 'recycling' or breaking down organic material. Aerobic composting enables us to recover the nutrients from nitrogen-containing food scraps and garden waste (green waste) and from carbon-containing dried leaves, sawdust, hay, and paper (brown waste).

Compost Bucket: A small bucket, usually used indoors, for temporarily storing composting scraps before they are added to the compost bin or composter. They can range from a store bought aluminum bucket to an ice cream tub to a small plastic garbage pail.

Compost Tumbler: Large-capacity bin on a base that rotates and mixes compost.

Compost tea: This is an extract made by soaking finished compost in water. It is often used to fertilize plants.

Conduction: The transfer of heat by physical contact between two or more objects or substances, such as in a compost pile or in the soil.

Contaminant: An unwanted material in a compost bin which does not help, and may even hinder the compost process. Physical contaminants include glass, plastic, and stones, and chemical contaminants include trace heavy metals and toxic compounds.

Curing: The term curing refers to the final stage of decomposition in a compost bin. It occurs after a period of rapid decomposition, in which slow chemical changes make the compost more suitable for use with plants. After the curing process, compost is referred to as cured compost.

D

Debris/Detritus: Dead organic matter.

Decay: See decomposition.

Decompose: see decomposition

Decomposer: An organism that feeds on and breaks down organic materials into simpler chemical compounds. An example would be red wiggler worms.

Decomposition: The process by which organic materials chemically break down into simpler compounds. This process is vital to new growth and the continued survival of living organisms since it is the main process by which nutrients are recycled in the natural world.

Degradable: This means being able to be broken down through chemical decomposition, e.g. plastics degrading in sunlight.

E

Earthworms: Belong to the Phylum Annelida, these are the segmented worms. Most of the 3000 identified species are terrestrial (they live in the soil). Red worms, *Eisenia foetida*, are the type of worm used in vermicomposting.

Ecosystem: This refers to all the living things in an area and the way they interact with each other. The word ecosystem is short for ecological systems. It includes plants and animals interacting with their non-living environments (i.e. the weather, sun, soil, etc.) A compost bin is an ecosystem.

***Eisenia foetida*:** Scientific name for the most common red worm used in vermicomposting.

Enchytraeids: Small, white, segmented worms commonly found in vermicomposters.

Environment: This is the air, water and land in or on which people, animals, plants and all living creatures survive. It includes a complex network of factors (such as soil, climate, and living things) that influence the form and the ability of living creatures, including ecological communities to survive. For example, composting organisms require oxygen in their environment to survive and reproduce.

Enzymes: Protein molecules produced by living cells that are capable of acting as a catalyst for biochemical reactions. Enzymes speed up the rate at which organic compounds decompose. Most enzymes are very specific, acting only on certain molecules. Bacteria and fungi in the soil, air, and compost bin use enzymes to dissolve and decompose organic material which helps to recycle and disperse nutrients from dead organisms and reintegrate them into the food chain.

Erosion: The depletion or loss of soil, usually caused by wind, water or human activity. Using compost on your vegetable and flower beds can help prevent erosion.

F

Feces: Waste discharged from the intestines of an animal. Worm castings found in a vermicompost are considered feces.

Fertilizer: This is a natural or chemical substance which is spread on soil or given to plants to sustain and/or enhance the plant growth.

Food chain: A sequence of organisms which feed on each other, starting with either green plants or organic material as the primary energy source. This includes all of the interrelated predator-prey and consumer-resources relationships in an ecological community.

Food web: The network of interconnected food chains. This includes all of the interrelated predator-prey and consumer-resources relationships in an ecological community.

Friable Soil: A term used to describe soil which is easily crumbled, healthy and excellent for growing plants.

Fruit Fly Traps: A small container used to trap unwanted fruit flies, which usually uses a vinegar solution. These traps are sometimes used to help control fruit flies in a vermicompost bin.

Fungi: A group of living organisms, which are neither plant nor animal and include molds, mildews, smuts, rusts, and mushrooms. Fungi lack chlorophyll, and usually feed on dead organic matter and are important in composts because they break down tough debris like cellulose, and they grow well during the curing stage, when moisture and nitrogen levels are low. The term 'fungi' is the plural form of the word fungus.

G

Greens: These are fresh, moist, organic materials rich in nitrogen. Greens include fresh grass clippings, plant trimmings, fruit and vegetable scraps, coffee grounds, tea bags, egg shells and houseplants. Also referred to as green materials. Nitrogen is vital for growth and reproduction of the decomposing organisms.

Greenhouse gases: Greenhouse gases are trace gases such as methane, ammonia, carbon dioxide and carbon monoxide. They control energy that flows in the Earth's atmosphere by absorbing infra-red radiation. By doing so, they trap heat energy in the atmosphere and therefore can be attributed to climate change.

Growing medium: Any medium whereby a living organism can grow. With plants, the most common growing medium is soil. There are a wide variety of other media suitable for plant growth including coco-fiber, rock wool, perlite, vermiculite, sawdust, water, and even air.

H

Habitat: A home of a living creature. It is the place or type of place where a plant, animal or other living organism lives or grows. When we maintain a worm compost bin, we create a habitat for the red wiggler worms.

Harvesting: Removing ready-to-use compost or worm castings from the compost bins.

Heavy metals: Metallic elements with high molecular weights including cadmium, lead, copper, mercury, chromium, silver, and zinc. High concentrations of heavy metals in soil can be toxic to plants or to animals that eat the plants or soil particles.

Heavy Soil: Dense soils made of silt and clay that are often very fertile but require soil amendments to improve structure as well as oxygen and water penetration.

Herbivore: An organism that eats only plants and plant material.

Heterotroph: An organism that cannot produce its own food and must obtain nourishment by consuming other organisms or organic matter.

Humus: At MUN Botanical Garden, humus is also referred to 'garden gold'. It is the finished product of the composting process and is usually dark in color, crumbly in texture, with an earthy smell. Compost is considered mature humus when the biological process of decomposition has slowed. Most particles of waste should be completely broken down.

Hyphae: Branched or unbranched chains of cells, as in fungi and actinomycetes.

I

Inoculant: Please see Compost Activator

Inorganic material: Minerals, rocks, metals, or other material which do not contain any carbon-to-carbon bonds. They are usually derived from a non-living source and do not decompose.

Invertebrate: An animal or organism without a backbone or spinal column. Includes all insects and worms.

Irrigate: To add water.

K

Kitchen waste: Food waste such as eggshells, vegetable and fruit scraps and peelings, and coffee grounds.

L

Landfill: A depression in the ground filled with waste. When full, it can be covered up to look like part of the landscape.

Leaf-Pile Composting: A method of composting whereby large piles of leaves are allowed to slowly decompose over a period of time, requiring up to several years to fully decompose.

Lime: Calcium compounds which are sometimes added to soils to increase the pH (i.e. neutralize the acidity). When composting, it is important not to throw fresh ashes on the compost as they will act as quick lime (CaO), which is caustic and will destroy all microbial life within the pile.

Lignin: In wood, lignin cements cellulose fibers together and protects them from chemical and microbial decomposition. Lignin is actually a series of complex organic polymers which are resistant to microbial decomposition. In other words, they take a long time to break down in a compost pile.

Loam: This is an ideal soil for gardening and agriculture. It is often created by mixing existing soil with soil amendments and compost. It is made of a combination of sand, silt and clay in roughly equal proportions. Loam is high in nutrients and humus and is able to retain more water than other soils while still allowing it to flow freely. Loam may come in different varieties usually described by the different proportions of constituent particles such as sandy loam, clay loam, silty loam, or sandy-clay loam, etc.

M

Macro-fauna: The term ‘macro’ comes from Latin and means large. The term ‘fauna’ is also from Latin and means animal. Any invertebrate living in the soil, visible without magnification, and is large enough to create its own burrow or tunnels is considered macrofauna.

Macro-nutrients: Nutrients which are needed by organisms in relatively large proportions. For example, plants use carbon, oxygen, and hydrogen, which is obtained from the air and water. In addition, nitrogen, phosphorous, and potassium (N-P-K) are absorbed from the soil by the plant's roots.

Macro-organism: See Macro-fauna.

Mature Compost: When compost has undergone decomposition and is in the process of stabilization, it is said to be mature. It must complete both the phase of rapid decomposition, as well as the longer curing phase during which slow chemical changes make the compost more suitable for use with plants.

Metabolism: The exchange of matter and energy between an organism and its environment, and the transformation of this matter and energy within the organism.

Metabolize: (verb) See metabolism

Meso-fauna: Invertebrates living in the soil or compost which are intermediate in size, are referred to as meso-fauna. These creatures live in the air-filled pores between soil or compost particles but generally do not create their own spaces by burrowing.

Mesophiles: Intermediate or moderate temperature-loving organism. In other words, organisms which grow best in moderate temperature environments (10–40°C) and generally include bacteria and other microbes living in soil, food, and animals. Beer, yogurt, and cheese are examples of foods that rely on mesophilic microorganisms for their preparation.

Mesophilic: (verb) See mesophiles

Methane gas: This is a greenhouse gas produced by landfills when organic matter decomposes without oxygen (anaerobic). When we compost with oxygen, we cut down on the amount of methane gas produced. Methane gas contributes more to climate change than carbon dioxide.

Microbial: Relating to microorganisms or organisms not visible without magnification.

Microbe: See microbial

Micro-fauna: Any invertebrates living in the soil or compost, which are small enough to live in the thin film of water surrounding soil or compost particles, are referred to as micro-fauna. These include soil protozoa and other microscopic fauna that are very small and not visible without magnification through a microscope or lens.

Micro-nutrients: Elemental nutrients needed by organisms in relatively small proportions. In plants and animals, micro-nutrients are needed for healthy growth and bodily functions. Micro-nutrients needed by plants include iron, zinc, molybdenum, copper, cobalt, manganese, sulfur, chlorine and others. Many plant ailments are due to a lack of certain vital micro-nutrients. One of the functions of fertilizers, compost and other soil amendments is to increase the amount and variety of micro-nutrients in soil to improve overall plant health.

Millipedes: Arthropods in the class Diplopoda. They found in outdoor compost bins and are often confused with centipedes. Millipedes have a cylindrical, segmented body covered with hard integument. Two pairs of legs are attached to each segment.

Mites: These tiny arthropods belong to the class Arachnida. They can be found in compost bins and have eight leg-like jointed appendages.

Moisture Content: The weight of water in a material divided by weight of solids in a material.

Mulch: Any material such as compost, bark, wood chips, or straw that is spread on the soil surface to conserve soil moisture, suppress weed growth, moderate temperature changes, or prevent soil erosion.

Mycelia: Branching networks of fungal hyphae or filaments.

N

Nematodes: Elongated cylindrical worms parasitic in animals or plants or free-living in soil or water.

Nitrogen: A colorless, tasteless, odourless element represented by the letter “N” on the periodic table of elements. Composting materials high in nitrogen are called "greens". After nitrogen is released into the soil during the process of decomposition, plants absorb it and use it to further the compost process. Examples of nitrogen-rich materials used in a compost pile are food scraps, grass clippings, animal manures. In the atmosphere, nitrogen, which exists as a colorless, tasteless gas, forms approximately 78% of the Earth's atmosphere and is present in all living things

Nutrients: Any substance that provides nourishment.

O

Omnivore: A heterotroph that eats plants, other animals, fungi, etc.

Organic: Any organism, including plants and animals that is, or was at any time, alive. Organic means it was made from something living or expelled from something living. The term organic is also used to describe agricultural (food) and plant production methods which do not use toxic fertilizers, pesticides, genetic engineering, synthetic hormone stimulation, antibiotics and other practices such as irradiation and the spreading of treated sewage.

Organic material/matter: Material that has come from a plant, animal or organism that is or was once alive. It can be broken down through decomposition. Examples include food scraps, garden trimmings, paper and cardboard, dust and hair.

Oxidation: A chemical reaction in which an atom loses electrons or increases in oxidation number.

Oxygenate: The process where oxygen is added.

P

Pallet unit: A type of composter made from wood pallets.

Pathogen: Any organism capable of producing disease or infection in another organism.

Percolation: The downward movement of water through pores in rock, soil, or compost.

Permeability: The ability of a soil to allow the movement of water through its pores.

Pest: Any unwanted or harmful organism that is dangerous, damaging or irritating. Beneficial insects and microbes can be used as natural pest controls.

Pesticide: Any substance used to control or kill pests. Pesticides come in many forms, including chemical and organic solutions, biological agents such as microbes and viruses, and predatory insects such as praying mantis. Many chemical pesticides are toxic to humans and animals and should be used with caution.

pH: A measurement of the acidity or alkalinity of an aqueous solution. pH measures the activity of dissolved hydrogen within a substance and is expressed on a scale from 0 to 14. A pH less than 7 is considered acidic, 7 is neutral, and more than 7 is alkaline/basic. Normally, the pH range for finished compost is between 6 and 8.

Photophobic: This means sensitivity to light and an aversion to sunlight or well-lit places. Worms are normally photophobic.

Phytotoxicity: A measure of the ability of a substance to suppress seed germination, injure plant roots, or stunt plant growth.

Pore: An open area between particles of compost or soil, filled by air or water.

Porosity: The percentage of the total soil or compost volume that is occupied by open spaces rather than solid particles.

Potash: Potash is really nitrogen (N), Phosphorus (P), and Potassium (K). These are the macronutrients necessary for plants to survive and grow. These ingredients are usually listed on fertilizers and soil amendments with a number, for example 7-9-5, representing the percentage by weight of each nutrient contained in the product. Nitrogen is the macronutrient necessary for vegetative growth above ground, phosphorus is vital to root growth, fruit and flower development, and disease prevention and potassium is important for strong, healthy plants. It contributes to disease resistance and protects plants from cold as well as water loss during periods of heat and drought.

Potting Mix: When soil and other ingredients are mixed to create a medium to grow plants in containers or a garden, it is often referred to as a potting mix. A common potting mix includes compost (for nutrients), peat moss (for biomass), sand (for soil structure), and perlite (for drainage). Soil amendments, fertilizers and homemade compost are ingredients one can use to modify an existing potting mix or to create an entirely new one, depending on the specific needs of the plant.

Pruning: Cutting and trimming plants to remove dead or damaged branches or to control and direct new growth.

Protozoa: Single-celled, animal-like microorganisms belonging to the kingdom Protista. While many species live in water or aquatic films surrounding soil or compost particles, they are represented in almost every kind of habitat

Psychrophiles: Organisms, including bacteria which can survive, grow and thrive in cold temperatures (below 21C).

R

Red Worms: Also known as red wiggler worms or *Eisenia foetida.* These small, red invertebrates thrive in manure compost and garbage. They are commonly used in vermicomposting.

The 5 R's: This refers to the internationally recognised philosophy for managing waste, called the 'waste management hierarchy' or the '5 R's (reduce, reuse, recycle, recover and residual management).

Reduce: to use or make less of an item.

Reuse: The use of a product more than once in its original form for the same or a new purpose.

Recycle: The process of reclaiming used products and objects, transforming them into raw materials and remaking them into new and different products.

Recover: Regaining materials or energy content of waste matter in a usable form without any pre-processing, such as in the recovery of nutrients through composting or the recovery of energy through burning waste.

Residual Management: Final treatment and/or disposal of a waste material that has not been reused, recycled or recovered. It is normally disposed to a landfill.

S

Sand: Sand is a soil component consisting of mineral particles between 0.05 mm and 2.0 mm in diameter, and the term can also be used to refer to soil which is composed of more than 85% sand and less than 10% clay.

Screening: The process of passing compost through a screen or sieve to remove large pieces and to improve the consistency and quality of the end product.

Secondary consumers: Organisms that eat primary consumers (i.e. carnivores).

Silt: A soil component consisting of mineral particles between 0.002 mm and 0.05 mm in diameter. It can also refer to a soil composed of more than 80% silt and less than 12% clay.

Soil amendment: Any material added to soil to improve or change its characteristics. Soil amendments are utilized when physical properties such as structure, aeration, nutrient and water retention, and drainage need improvement. The main function of soil amendments is to provide a better environment for the roots so they can grow and absorb nutrients more easily. Compost is a common soil amendment.

Soil food web: This is the community of organisms living all or part of their lives in the soil. It describes a complex living system in the soil that interacts with the environment, plants, animals and people. The food we eat is connected to the products we put into the soil and the effects of these products on its inhabitants.

Soil-less mix: A mixture used for container gardening that contains no soil. Soil-less mixes are commonly made of peat moss, vermiculite or perlite, and fertilizers. Sand, compost and other mineral soil amendments are often used in soil-less mix recipes.

Soil test: A measure taken of the soil to determine pH and Nitrogen-to-Phosphorous-to-Potassium (N-P-K) ratios, often done in labs or with home soil test kits. Soil tests are important in determining what plants work best in a specific native soil and for understanding any nutrient and pH deficiency soils may have.

Sow bugs: Arthropods in the subphylum Crustacea. They can be recognized by their flattened elliptical bodies, often capable of being rolling into a ball. They are known as pill bugs or carpenters.

Springtails: Arthropods in the subclass Collembola. They are primitive and wingless and can be found in compost bins.

Stabilization: A stage in the compost process when the compost pile does not reheat or give off bad odors.

Sustainable/Sustainability: This refers to meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. It takes social, cultural, environmental and economic factors into consideration.

T

Temperature profile: A graph of temperature changes that occur during the compost process.

Thermophiles: Organisms, including bacteria, that grow and thrive at high temperatures (40°C). They are commonly found in decomposing organic material such as compost and peat moss, as well as in natural hot spots such as geothermal hot springs and deep sea vents. Thermophiles can withstand intense heat and actually utilize this heat to help break down compounds which they metabolize.

Thermophilic: This term can be used to describe both heat-loving organisms that exist in a temperature range between 40°C and 90°C, as well as the phase of composting that takes place at temperatures exceeding 40°C.

Tilth: The physical condition of soil relative to the ease of plant growth. It can generally mean tilled earth, but to gardeners, it is the overall health or needs of a soil when growing certain plants. A soil with good tilth is easily worked, has a good pH and structure, and allows for maximum aeration, nutrient and water retention as well as easy root penetration.

Top dressing: The act of applying compost to surface soil to enhance it. Topdressing improves soil quality gradually as each successive layer builds upon the last.

Turning : In a compost pile, mixing and agitating the organic material.

Turning unit: When composting, several holding units are built next to each other, so that compost can be turned from one into the next.

V

Vermi: From the Latin meaning 'worm'.

Vermicasts: This is the solid waste produced by worms, more often call worm castings. (see worm castings)

Vermicompost: (Noun) The product obtained through decomposition of organic matter by microorganisms and worms.

Vermiculite: A mineral that is used in potting soil to keep the mixture light and porous.

Vermiculture: Worm farming for the purpose of harvesting worm castings from a vermicompost. (See Worm Farming)

W

Weeds: plants that are unwanted or considered to be a nuisance.

Worm castings: Worm excrement, or the digested and excreted food products from worms, is a rich source of plant nutrients. These castings are five times richer than most fertile soil and are full of helpful microorganisms. The castings also contain mucus which helps retain nutrients, so they are not washed away during rain and they also help stimulate microbial life within the soil, which aids decomposition and overall soil health. As a soil amendment, worm castings are often used not only for nutrients but also to improve soil structure and oxygen/water penetration.

Worm Composter: A compost bin which uses red worms to aid in decomposition is often referred to as a worm composter. (See Vermicompost)

Worm farming: This is the aerobic process of using red worms in an artificial ecosystem to convert organic waste into nutrient-rich fertilizer. Worm castings are produced after worms digest food and paper waste. It provides beneficial nutrients (nitrogen, phosphorus and potassium) for the soil in order to encourage plant growth. (See vermiculture).

Worm tea (worm wee): The liquid produced by worms in a compost bin; also referred to as liquid plant food or vermi-liquid. It contains high amount of minerals and nutrients.

Y

Yard waste: Grass clippings, dead plants and leaves, weeds and brush.

Yield: The amount of plants, grass or crops a lawn or garden produces.

ix) Useful Composting Resources

Composting Council of Canada. <www.compost.org> (accessed November 2011).

Multi Material Stewardship Board (MMSB). <www.mmsb.nl.ca> (accessed November 2011).

Resources from MUN Botanical Garden:

- Composting Pamphlet – Full composting information is available as leaflets, both on the MUN Botanical Garden webpage <www.mun.ca/botgarden>, and as paper leaflets. Please inquire at the visitor services desk for a copy.

- Composting Basics Power Point <www.mun.ca/botgarden>

- How to Maintain a Vermicompost Bin <http://www.youtube.com/watch?v=CoKxVp6XrNQ >

B. Growing Plants - Propagating in the Classroom

Propagating is the process of increasing your volume of plants. This is most commonly done by planting seeds, but we show below how it can also be done by dividing and cutting. All of these activities can easily be done in the classroom and used when learning about plants. For specific activities please see section 3-D: Get growing Activities. For more information on basic plant structure please see section 3-B: Grocery store botany.

i) Sprouting Seeds

Planting seeds may seem simple (drop a seed in soil, water it, and watch it grow) but our experience has been, that unless a teacher has had previous experience, they are very hesitant to try this in the classroom. Most are worried about "getting it right", but there is no better way to act like a scientist than with a little trial and error. Below are a few tried, tested and true ways we have sprouted seeds with all ages in all settings. Nothing is 100% guaranteed and failure may often not be your fault (seeds aren't perfect either), but the excitement of seeing a little green sprout pop through the dark soil is worth the effort.

Sprouting Seeds: Method #1

Sprouting seeds in a clear container lets you see the roots and leaves emerge from the seed. Although this may not guarantee the long-term success of your plant, it allows you to watch the normally hidden process of germination.

Materials:

- A clear container made from glass or plastic, such as a disposable cup or a jar
- Paper towel
- Three or four large seeds: dried, un-cooked beans such as kidney beans are our favourite*
- Spray bottle with water

*Dried peas and beans from the grocery store can be safer for young children to handle, as packaged seeds may be treated with fungicides to increase germination rates.

What to do:

1. Place a strip of paper towel all the way around the inside of the jar.
2. Scrunch up some more paper towel and put it inside the first strip so it fills up the jar.
3. Spray the paper towel until it is damp but not wet. If you can see standing water at the bottom of the jar, it is too wet. Drain out any excess water.
4. Place the seeds between the paper towel and the jar so you can see them clearly.
5. Place your container in an area that is free from drafts and keep damp.

Figure 16: A kidney bean (seed) has just sprouted roots inside a clear plastic cup with wet paper towel. Cellophane was used to help keep the paper towel moist over a weekend.

Figure 17: A ten day old kidney bean sprout is starting to lose its seed coat because the leaves are emerging.

What you will see:

As the beans absorb water they will get bigger until a little root comes out. Then the bean will start to send up little leaves. When the leaves poke out above the paper towel, you can carefully take out the whole plant and plant it in some potting soil. Be sure to put it in a sunny location and keep watering as necessary.

Sprouting Seeds Method #2

Figure 18: Seeds are placed on a wet paper towel to start germination

Another way to watch seed sprout is in a clear plastic bag.

Materials:

- Seeds
- Plastic bag (does not need to be sealable)
- Paper towel
- Spray bottle with water

Place a folded piece of paper towel inside the bag, and spray until damp, but not too wet. Place the seeds on the paper towel and put in an area that is free from drafts and keep warm. Check the bag daily to ensure the paper towel does not dry out. Within a few days the seed will start to send out little roots and shoots. At this point you can plant it in some potting soil where it will continue to grow.

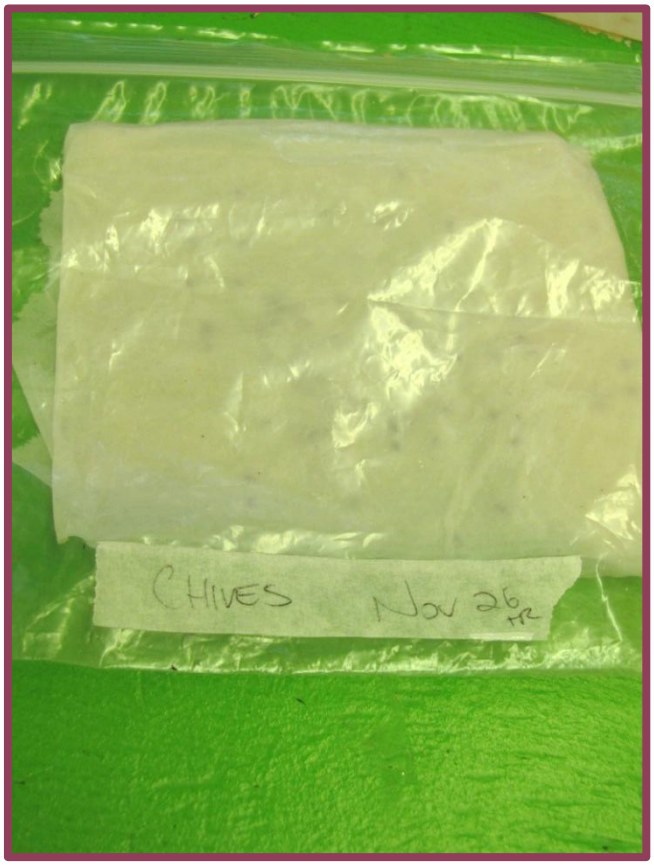


Figure 19: Chive seeds are small so the bag method helps you keep track of them

This method can work, but is not as favoured as the cup method by Garden staff. If the paper and seeds are kept too wet, without any airflow, then it is likely mould will appear.

Sprouting Seeds: Method #3 – The Way Nature Intended

The most common way to sprout seeds is by putting them directly into soil. Although you can't watch the beginning of the sprouting process, there are fewer disturbances to the plant by letting it grow where it sprouted.

Materials:

- Seeds
- Pot or Container (see Be a 3R Gardener on page 58)
- Sterilized potting soil (*Figure 20*)
- Spray bottle with water

Fill your container with soil. We always encourage handling the potting soil with bare hands because it smells great, feels soft and gives everyone an opportunity to be allowed to touch dirt – dirt don't hurt! Of course if someone has an allergy, eczema, or an open cut then we do offer disposable food-handling gloves. Fill the container to the top and press down gently with the back of your fingers to tamp the soil. Seeds, like us, need air to breath so a gentle tamping will remove the big spaces but allows little ones to remain.

Poke a hole in the centre of the soil with your finger. The hole should be about twice the depth of the width of the seed (i.e. a kidney bean is about 0.5cm thick – so plant it about 1cm down) but no more than half way down your pot. This does not need to be exact; it's more important to be sure the seed roots have space to go down, and enough soil above the seed to be sure it can be covered. Drop the seed in the hole and cover it up with extra or surrounding soil.

Figure 20: Potting Soil vs. Garden Soil

Potting soil can be bought from garden centers and most grocery stores. Do not use soil dug up from outside for indoor plants. Outdoor soil has bugs, microscopic organisms and possible plant diseases that could harm your young sprouts or the bigger critters may decide to leave your pot and head elsewhere in your classroom.

You can sterilize you own garden soil for indoor use by following one of the methods below.

Oven Method
Use a sieve with 5mm openings to sift moist soil into a deep dish baking tray. Remove and discard large debris. The soil can be up to 7.5cm deep in the pan. Bake at 400°F for 30 minutes.

Microwave Method
Sift moist soil as in oven method and place soil in a roasting bag. Seal it to stop soil from contaminating the microwave. Pierce a few small holes in the bag. Cook on high for 10 minutes.

Figure 21: A kidney bean emerges from the soil a week after being planted.

Place your pot where you will remember to take care of it and add enough water so that the soil is as moist as a rung-out sponge – damp feeling, but not sopping wet. If you accidently over-water your pot, the water will hopefully run out the drainage holes. It is advisable to put a dish under the pot to catch any of this over-spill. If you haven't already, when your sprout emerges, put your pot in a sunny location or under a grow lamp if you have one.

Extend the learning:

- Germinate the seeds under different conditions to see how abiotic (non-living) factors affect growth. For example, germinate the seeds in light, in darkness, at varying temperatures or depths in the soil, etc.
- Try this activity with a variety of seeds; younger children find larger seeds easier to handle. A soup mix containing a variety of dried beans is fun to use, as are sunflower seeds, and dried corn. If there are no peanut allergies, try growing bird seed. Packaged seeds are also easy to use; be sure to wash hands after handling.
- Younger children may enjoy testing objects to see if the objects are indeed seeds. Watch non-germinating objects carefully for mould and discard if mould appears.
- Test to see if a seed came from a monocot (the embryo has a single cotyledon or seed leaf) or a eudicot (the embryo has two seed leaves or cotyledons). Germinate corn (monocot) and peas or beans (eudicots) and compare the differences.
- Allow your plant to grow; water and tend it, including providing a tall stick for your climbing plants to wrap around and take hold. Vary the growing conditions (i.e. abiotic

or non-living factors) for the plant to see if you can affect growth (i.e. temperature, light, nutrients, water, etc.).

- When the flower is produced, examine it with a magnifying glass. Can you see the male and female parts of the flower? Please see Chapter 3 for a diagram. If you brush the male pollen onto the female part of the flower (pollination), a fruit (i.e. a pea or bean pod) will form. Examine the seeds inside the fruit. If you grew peas or beans, you can even eat them!
- When students are caring for the plants, encourage them to measure and chart the changes and growth. Record findings with digital photography and drawings.

Figure 22: The flower of a kidney bean plant

- Discussions of the changes can lead to opportunities for more science experiments. Encourage the students to ask questions and test their hypotheses.
- Try planting the same type of seed at different depths to see what works best.
- Water your plants different amounts to see what it likes best.
- Try different soil types.
- Put garden soil in a pot, water it and see what magically appears (dormant seeds).

Figure 23: The fruit (the green bean) of a kidney bean plant

ii) Dividing

Dividing is the process of taking an original plant and splitting it into two plants at the root level. In your garden this works well for hostas and lilies, but in the classroom there are a few more children friendly plants that this works for.

The aloe plant is a great one to have around because its leaf juices can be used on any accidental burns to cool the skin. The aloe doesn't need much extra care and with little effort will start to send up new shoots around the base of the original plant.

To divide a small potted plant, use a sharp knife and cut down into the soil between the parent plant and the new shoot. Lift the new shoot out of the soil holding it by the leaves. Compact the soil of the parent plant where you took out the shoot, so there isn't a hollow around its base. Repot the new shoot in a new, clean pot by adding soil and then poking a finger or pencil into the dirt to make space for your new shoot. Drop the new shoot into the soil so that the surface line will be the same as it was before. Compress the soil around the shoot to hold it in place. Water and provide sunlight as you would with any plant.

Figure 24: An aloe plant and its 3 divided shoots replanted

iii) Cutting

Getting cuttings is the best way to share a favourite plant. Some plants work better than others, but you may be able to get many plants to root with a little rooting hormone. Getting and using rooting hormone may not be possible in the classroom, so you can attempt to grow cuttings with something that will root easily. One common plant in Newfoundland that will root quite easily is the willow.

Figure 25: Cutting a willow branch

To take a cutting of a willow use sharp pruners or secateurs to snip off a branch no thicker than the size of your index finger. Cut the branch where it divides from the main stem to cause the least amount of disturbance to the plant.

Figure 26: For the best health of your cutting and the original plant it is important to have a sharp clean cut

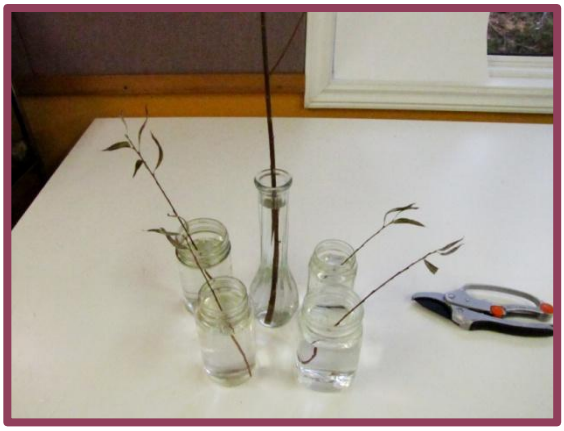


Figure 27: Various sized willow branches cut and put into jars of water

If your branch is long you can cut it into multiple pieces, but always make sure each piece has a bud closer to the tip. Roots will start growing at a leaf node – the bump on the branch where leaves branch off, so cut with a node close to what will be the bottom of your plant.

Your branches can be put into either water or soil. When in water you can start to see the roots growing, but planting the branch in soil will causing less disturbance if you want to continue growing the willow. When putting the branch into soil, be sure to remove any leaves that may be at the node and plant the branch so the leaf node is under the soil.

C. Be A 3R Gardener

i) Newspaper Flowerpots

We have posted a video on how to make the Newspaper Flowerpot on YouTube: http://www.youtube.com/watch?v=56odr54ClcA&feature=related

If you grow plants from seed, you always need more pots. Making flowerpots out of newspaper is a simple and inexpensive way to make starter pots while also reusing newspapers. You can also use the pots to transplant seedlings started elsewhere.

Materials:

- Old newspapers
- Masking tape
- Small empty container such as a plastic juice or water bottle. A pop or soup can may also be used, but be careful of sharp edges.

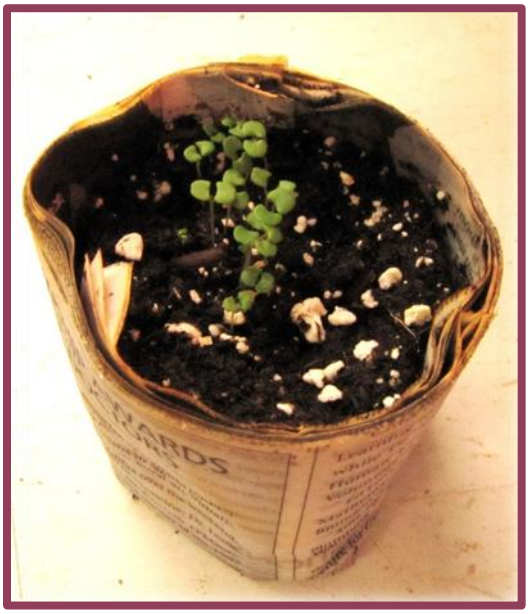
Figure 28: Newspaper flowerpot materials

What to do:

1. Fold a sheet of newspaper lengthwise so it is 8-10 cm (3-4 in.) wide. (*Figure 30*)
2. Roll the newspaper around the bottle so that you make a cylinder. (*Figure 29*)
3. Tape the cylinder together lengthwise along the join.
4. Slide your cylinder part way down the bottle.
5. Using the bottle to hold the paper's shape, fold in the ends of the cylinder like you are wrapping a present. You now have a bottom to your pot. Tape securely.
6. Press the bottle down on a table to flatten out the bottom.
7. Write your initials or date on the tape then slide your new pot of the bottle!

Figure 30: Folded length of newspaper

Figure 29: Newspaper cylinder around bottle



Notes:
We have been doing this activity with adults and children at MUN Botanical Garden for over twenty years. You can be creative and make larger pots; be sure to reinforce the larger pot with extra layers of newspaper. We find the smaller pots are easier for children to handle.

Figure 31: The pots do dry out more quickly than plastic pots, so keep an eye on your seedlings.

Figure 32: These little pots can be used to start a variety of seeds. When the seedlings are big enough to be transplanted, you can simply take the masking tape off and gently peel away the paper.

ii) Recycling other containers

Many store-bought plants come in simple plastic or clay pots which can be used over and over (the plastic ones can be recycled if they break). By putting the word out to co-workers, family and friends it's easy to collect enough for the classroom. It is important to make sure all containers are clean and disease free. You can do this by washing the pots and then rinsing them in a solution of 2Tbsp (30mL) of bleach per litre of water. This kills any diseases which may harm your plant.

If you don't have any store-bought pots around you can make your own like we did in the *Newspaper Flowerpot* activity on page 58, or you could reuse a container from around your home or school.

Reused containers are free and plentiful if you know where to look (start with your classroom recycling bin!). If your pot is watertight (plastic) the most important part is to make sure your container has drainage holes. Since these reused containers were not intended as pots you will need to cut a few holes in the bottom.

Figure 33: Half of a clam shell food container used as a sprouting tray. By using the whole clam shell you can make your own mini greenhouse. This will keep extra moisture and warmth inside while the seeds are sprouting. **When your plants start to grow tall cut off the top of the shell and use it to plant new seeds!**

Below is a basic list of suitable containers – challenge your students to come up with more!

- Clam shell food container
- Plastic, paper or styrofoam cups (coffee garbage from your lunchroom!)
- Egg carton (it will get soft when wet so put it where it doesn't need to be moved)
- Yogurt cups
- Ice cream containers

Figure 34: An egg carton seedling tray

The containers below are difficult to make holes in the bottom but could be used when trying to grow roots in water or forcing buds like in our *Springing into Leaf* activity on page 133.

- Old plastic food storage containers (Tupperware, Ziplock)
- Glass jars – maybe not the best for the classroom, but since they can't be recycled in Newfoundland they are an ultimate "reusing" item.

Figure 35: Carrot tops sitting in water in a food storage container

Figure 20: A sweet potato sitting in water in a glass jar. Note the white marks at the bottom – this is the beginning of roots starting to form.

3. Botany for the Classroom

Botany can be a scary topic for those who know little about the biology of plants, but it doesn't have to be. Children and adults alike often prefer to learn about animals over plants because the former have many more similarities to us, while plants seem very different. Surprisingly, we have much more in common than we think. Also, plants being a necessary part of our everyday lives, as in food, mean they are readily available to study, admire and enjoy.

Below is a simple diagram of the parts of a flower. Do not feel that is important to memorize the botanical structure names, but use this as a reference for understanding the reproduction of a flowering plant.

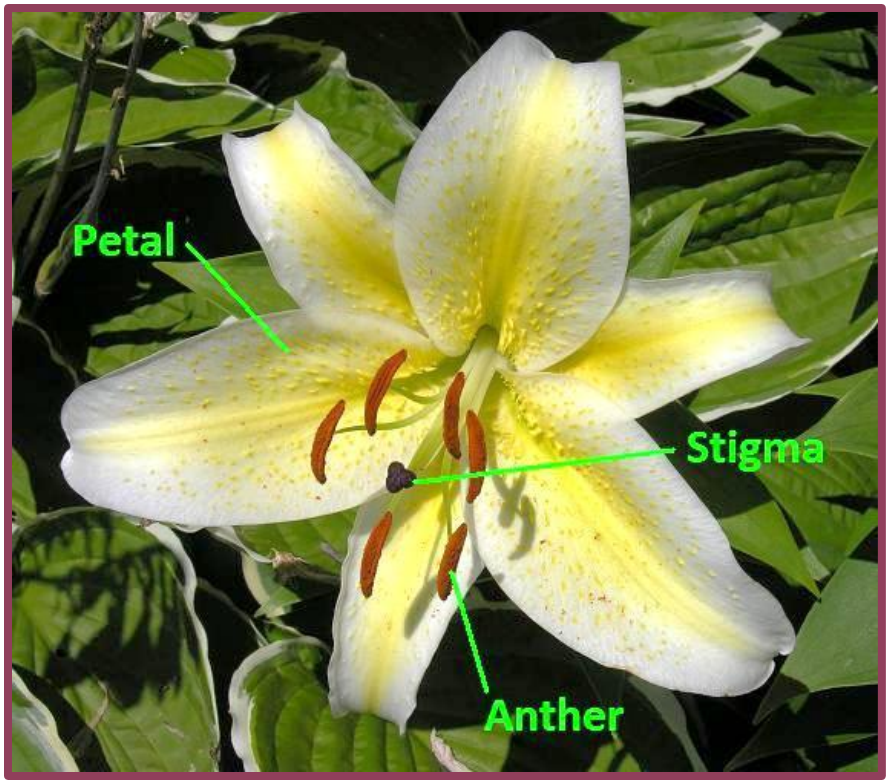


Figure 36: Some parts of a flower

Petals – used to attract pollinators (bugs etc.) who transfer pollen from one plant to another

Anther – the male part of a flower that contains pollen, which are needed for reproduction

Stigma – the female part of a flower which is sticky to receive the pollen during fertilization

Botany of a plant:

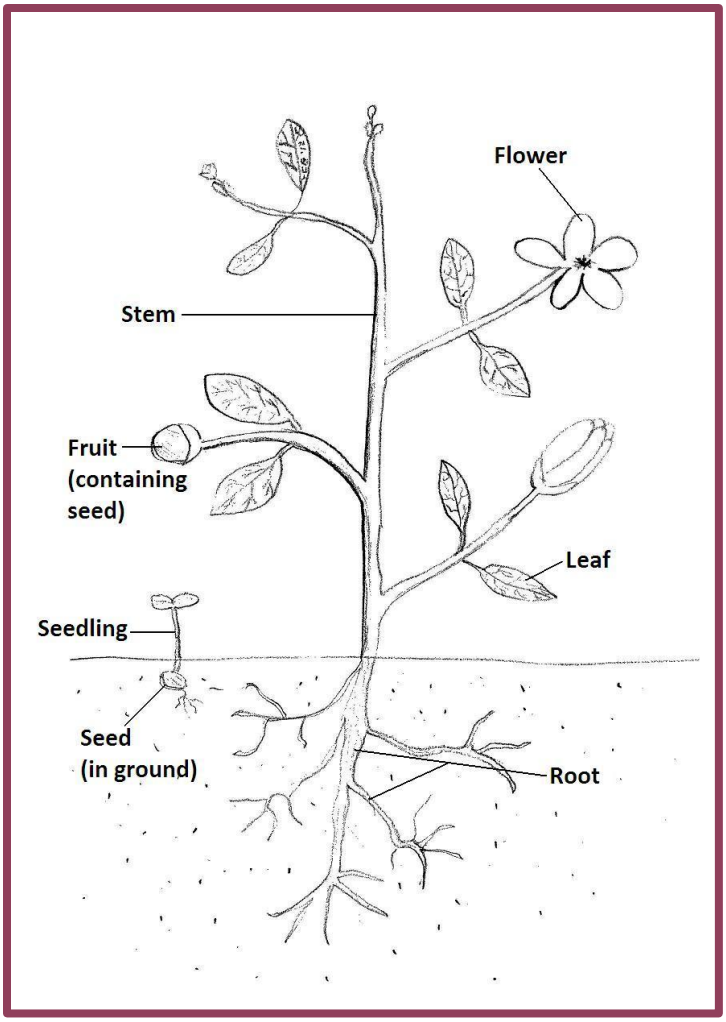


Figure 37: Parts of a plant in various stages

Root – The underground part of a plant that absorbs water and nutrients from the soil and holds the plant in place

Stem – The (usually) above ground part of a plant that supports the plant and transports water and nutrients. It might be woody, like a tree trunk, or fleshy, like a stalk of a clover

Leaf – The (usually) green, thin, flattened structure arranged along the stem or twig. This is also the kitchen of the plant – where sunlight is changed into sugar to feed the plant (photosynthesis).

Flower – The sexual part of a plant, which is often showy to attract pollinators

Fruit – The fertilized ovary of a plant, meaning the part that contains the seeds

Seed – A baby plant; the part of a plant that if planted will produce a new plant. Often many of our food seeds have been refined (white rice) or roasted (nuts) and will not be able to produce a new plant

Seedling – A sprouted seed that contains no more than one set of leaves

A. Grocery Store Botany

Food plays an important part of our lives. Not only is it necessary for our survival, but food plays an integral role in our cultural identity, society, health and well-bring. Many of our cultural values are expressed by the foods we eat and the way we grow, prepare, and share our food. Many important holidays, festivals and celebrations focus on our traditions of food and the sharing of a meal. Indeed, our food traditions are often linked to our local geography and history, just as emerging food trends are linked to our interactions with other cultures. Equally important is the need for accessible, reliable, safe and sufficient food supplies for our population, otherwise known as food security.

> The Food Security Network of Newfoundland & Labrador (FSN) is a provincial, membership-based, non-profit organization whose mission is to actively promote comprehensive, community-based solutions to ensure access to adequate and healthy food for all. Their members include individuals and organizations throughout the province who are involved in; health care, education, farming, community development, family services, anti-poverty work, emergency food aid, school nutrition programs, and environmental protection. For information about the Food Security Network of Newfoundland & Labrador, please visit their website http://www.foodsecuritynews.com or email: info@foodsecuritynews.com.

We eat food every day and in most cases, it is a very pleasurable part of our lives. Children eat food in school every day. By incorporating the following everyday activities into the school curriculum, we enable our students to discover their own culture, traditions, health, geography, and even botany, just to name a few examples.

Most of us are not aware of how closely our food supply is linked to plants. Almost everything that we eat comes from plants in one way or another; even when we eat meat, we eat animals which have fed on plants to grow and survive. So, when we learn about the food we eat, we can become scientists, dabbling in botany, ecology, agriculture, zoology, etc. One very simple way to initiate a botanical discussion is to just look at your snack or lunch at school. For example, let's start with everyone's favourite – cookies. Think about what plants and plant parts we eat when we enjoy a chocolate chip cookie. Flour comes from wheat (usually), which is the seed of the wheat plant. Sugar usually comes from either sugar cane (the sap of a grass plant, which is very high in sucrose) or sugar beet (this is a variety of *Beta vulgaris*; other varieties include the familiar root vegetable beet or beetroot and the leafy chard). Chocolate comes from the seed of the cacao tree (*Theobroma cacao*), and may also include sugar and milk. If the cookie contains eggs and milk, remember that while these are animal-based foods, animals need to eat plants to survive!

Figure 38: The immature broccoli flowers

Some foods may be obviously plant-based (e.g., broccoli spears or carrot sticks) but it may not be obvious what part of the plant we are eating. Broccoli is a familiar vegetable, but many people are surprised to learn that the part we eat is actually the immature flower head! When investigating the parts of the plant, it may be helpful to refer to common foods. Carrots, beets and turnips are all root vegetables, but the potato is not. Potatoes are actually modified underground stems. Ginger and turmeric also come from modified underground stems, not actual roots. Asparagus is another common vegetable of which we eat the stem. It is often thought that we eat the stem of the celery plant, but it is actually the petiole, or stem of a leaf (or leaf stalk). Many different types of plant leaves are part of our diets. We eat lettuce, spinach and other leaves in salads, steam or boil vegetables such as cabbage, kale and endive. Even the onion bulb (garlic too!) is actually the swollen bases of the leaves we see above ground.

Figure 39: An eggplant is a fruit because it contains seeds

Fruits and seeds comprise a large part of our diets. Botanically speaking, a fruit is a part of a flowering plant that develops from the ovaries of the plant. More broadly, a fruit is the structure of the plant which contains its seeds, which means that bean and pea pods, tomatoes, and avocadoes can all be considered fruits. Seeds, especially wheat, rice, corn and other grains, are an extremely important part of our food supply.

We eat fruits and seeds every day. When school starts each autumn, we see fruits and seeds being produced all around us, including in our gardens, in the forests and in farmers' fields. Many plants use seeds to make new plants.

Think about where you have seen different seeds. In an apple, an orange or even in a flower? Where else? In the grocery store, when you buy peas and beans (frozen, canned or dried) you are buying seeds.

What is a seed? A seed is like a new little package of life. On the outside it is covered with a seed coat which protects what's inside. Inside the seed the embryo, a new little plant, is waiting to grow.

Flowers:

Some plants have flowers. The main function of a flower is to produce seeds. A flower sometimes has male (boy) and female (girl) parts. A commonly yellow dust, called pollen, comes from the male part of the flower. This part of the flower is also known as the anther. The pollen must land on the female's flower part, which is also known as the stigma, before a seed can grow. This process of uniting the pollen and ovary is called pollination. Once united, a seed begins to form. This is called fertilization.

Some animals are very important pollinators, including bees, butterflies, wasps, birds and even bats. These pollinators are attracted to the bright colours and sweet smells of the flower and feed on the nectar and pollen found in the flowers. Flowers are designed so that when the right pollinator visits to feed, the anther will deposit pollen on their body. When visiting another flower, the pollinator touches the stigma and leaves behind the pollen from the first flower. Some flowers could be self-pollinated, but for genetic diversity it is better that they be pollinated by a neighbour.

Sometimes flowers are wind pollinated. These flowers are usually found on the tops of trees where the wind easily disperses the pollen.

Fruits & Seeds:

When one or many seeds are made in a flower, different parts of the flower sometimes change to build a covering around the seed. This covering that surrounds the seed is called a fruit. Fruits come in all different sizes, shapes, and colours. There are many different kinds of fruits. Blueberries and raspberries are fruits. So are apples, oranges, tomatoes and cucumbers.

Figure 40: You can see the remnants of the pear flower at the bottom of the fruit (right)

Some fruits are dry. Wheat seeds are grains; dandelion seeds, called achenes, are attached to feather-like plumes. Maple tree 'keys' or 'helicopters' are called samaras. Achenes and samaras depend on the wind for dispersal.

Do seeds need fruits? In order to grow into a new plant (regenerate), seeds often need to move away from the parent plant. When a flower makes a fruit around its seeds, the seeds have a better chance to travel long distances (disperse).

Some fruits such as blueberries and cherries are fleshy. Often they are very colourful and tasty. When these fruits are eaten by wildlife, the seeds in the fruit pass though the animals' digestive tract and back to the soil. Most plants that rely on wind dispersal of their seeds are often not eaten by animals. This is because the plant doesn't need an animal to eat it to spread their seeds, so they don't need to be tasty.

Figure 41: A white spruce cone that has opened and released its seeds

There are some plants that make their seeds in cones. These plants are called conifers. Seeds found in cones are usually not covered. This is different from the seeds made in flowers that have a fruit around them. The seeds of the cones are often found on the inner side of the cone-scales.

Sometimes figuring out 'what-part-of-a-plant-is-what' does require help from a specialist. In this case, we relied on botanists, or plant scientists, to help us draft a chart to make this easier. The boxes following have been divided into the major parts of a plant: root, stem, leaf, flower, fruit, seed and seedling. We encourage you to have fun with your students using this information, no matter what grade level you are teaching.

i) What Am I Eating?

The following activities, charts, resources and references have been developed to assist teachers when incorporating food across the curriculum. So have fun and play with your food.

Figure 42: Growing kitchen food items in our classroom

Root

– The underground part of a plant that absorbs water and nutrients from the soil and holds the plant in place.

- *Beet*
- *Carrot*
- *Cassava root (tapioca)*
- *Chicory root*
- *Jerusalem artichoke (sunchoke)*
- *Licorice root*
- *Parsnip*
- *Radish*
- *Rutabaga*
- *Sweet potato*
- *Turnip*
- *Yam*

Stem

– The (usually) above ground part of a plant that supports plant and transports water and nutrients. It might be woody, like a tree trunk, or fleshy, like a stalk of a clover

- *Asparagus*
- *Bamboo shoots*
- *Broccoli stem*
- *Kohlrabi*

Stem Bark:

- *Cinnamon*

Stem Sap:

- *Sugar (dehydrated sugar cane sap)*
- *Maple Syrup (Maple tree sap)*

Underground Stem:

- *Ginger (rhizome)*
- *Turmeric (rhizome)*
- *Potato (stolon)*

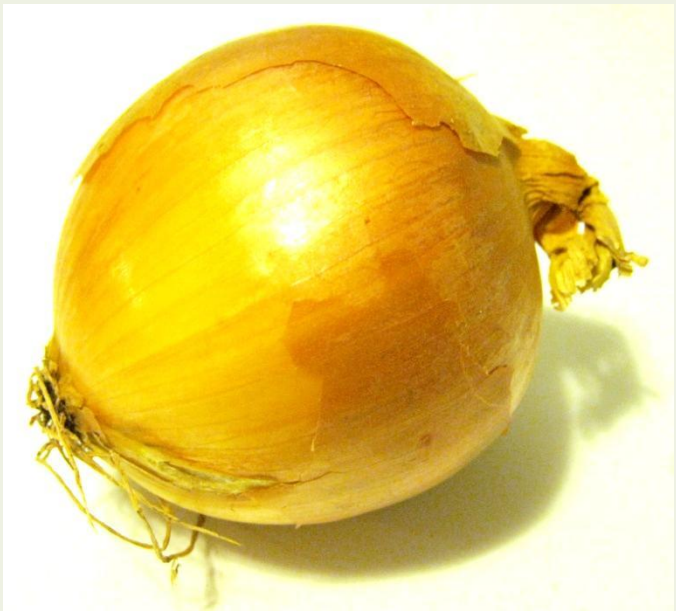
Leaf

- The (usually) green, thin, flattened structure arranged along the stem or twig. This is also the "kitchen" of the plant – where sunlight is changed into sugar to feed the plant (photosynthesis).

- *Beet greens*
- *Brussels sprouts (auxiliary bud)*
- *Cabbage (bud)*
- *Chinese cabbage*
- *Collards*
- *Dandelion greens*
- *Kale*
- *Lettuce*
- *Onion bulb (bud)*
- *Spinach*
- *Swiss Chard*

Herbs:

- *Basil*
- *Bay leaf*
- *Chicory*
- *Chives*
- *Cilantro*
- *Dill*
- *Oregano*
- *Parsley*
- *Peppermint*
- *Rosemary*
- *Sage*
- *Savoury*
- *Spearmint*
- *Thyme*



Beverages:

- *Tea*

Petiole (leaf stalk):

- *Celery*
- *Rhubarb*

Flower

– The sexual part of a plant, which is often showy to attract pollinators.

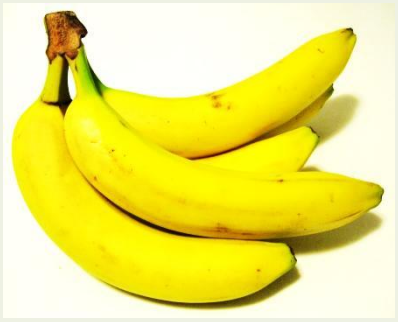
- *Artichoke (bud)*
- *Broccoli (immature)*
- *Capers (bud)*
- *Cauliflower (immature)*
- *Cloves*
- *Jasmine (for tea)*

Figure 43: Nasturtiums are common garden plants, but both the leaves and flowers can be added to a salad and have a delightful peppery taste

Fruit

– The fertilized ovary of a plant, meaning the part that contains the seeds.

- Apple
- Apricot
- Avocado
- Banana
- Bean pod
- Blackberry
- Blueberry
- Cantaloupe
- Cherry
- Cucumber (pickle)
- Date
- Ear of corn
- Eggplant
- Fig
- Grape (raisin)
- Grapefruit
- Green bean pod
- Lemon
- Lime
- Olive
- Orange
- Pea pod
- Peach
- Pear
- Peppers (bell and hot)
- Pineapple
- Plum (prune)
- Pomegranate
- Pumpkin
- Raspberry
- Squash
- Tangerine
- Tomato
- Watermelon



Whole Grains[1]:

- Barley
- Oats
- Rice
- Rye
- Wheat

Spices (dried fruit):

- Aniseed
- Caraway
- Cardamom
- Peppercorn (Black pepper)
- Vanilla (fruit of orchid)

[1] For a grain to be considered a fruit it needs to contain the bran and germ as well as the seed. All grain fruits only contain one seed per fruit.

Seed

– A baby plant; the part of a plant that if planted will produce a new plant. Often many of our food seeds have been refined (white rice) or roasted (nuts) and will not be able to produce a new plant.

- Almond
- Brazil nut
- Cashew
- Coconut
- Pine nuts
- Pistachio
- Sunflower seeds
- Walnut

True Nuts[2]:

- Beech nut
- Chestnut
- Hazelnut

Grain kernels:

- Barley
- Corn
- Oats
- Rice
- Rye
- Wheat

Legumes:

- Green bean seed
- Kidney bean
- Lima bean
- Pea
- Pinto bean
- Peanut

Spices:

- Coriander
- Dill Seed
- Mustard seed
- Nutmeg
- Mace (aril [seed coat] covering nutmeg seed)
- Poppy seed
- Sesame seed

Beverages:

- Cacao seeds (chocolate)
- Coffee beans (coffee)
- Cola nuts (cola drinks)

[2] A nut in botany is a simple dry fruit with one seed (rarely two) in which the ovary wall becomes very hard (stony or woody) at maturity, and where the seed remains attached or fused with the ovary wall.

Seedling

– A sprouted seed that contains no more than one set of leaves. Food seedlings are often sprouted only in water.[3]

- *Alfalfa sprouts*
- *Bean sprouts*
- *Cress*

[3] Please note that if attempting to grow these that there is a risk of bacteria (salmonella) growing in the high moisture and dense conditions. Please see activity on page 90.

Extend the Learning

Can you think of other foods that are not on the list? Which category do they fit into? If you have trouble placing a plant please contact the Garden and we will try our best to help you figure it out.

What food comes indirectly from plants?
Anything that eats a plant (or eats a creature that eats plants):
Animal products: Meat, fish, dairy, fats, honey
Bacteria: yeast (eats sugar), fungi: mushrooms (consume decaying animal or vegetable matter)

What does not come either directly or indirectly from plants?
Salt, water (although there is a lot of water in plants)

ii) Grocery Store Flyer Activity

There are many grocery store botany activities, which can re-use our weekly newspaper grocery store flyers. For example, students can cut out photos of fruit and vegetables when learning about the parts of a plant using the "Grocery Store Botany" information. The flyers can also be cut up to show food groups, when learning about healthy eating, composting, etc.

The following data was collected from local grocery store flyers. While learning about food sustainability, students and other program participants traced the origins of fresh produce sold in local grocery stores and identified the time of year when local produce was more readily available.

The question was raised: Would fresh produce be available in our province year-round without importing food from around the world? This information was used in social studies, when researching information about countries which supply our food and maps were created, identifying where exactly our lunch or snack came from. This activity was also integrated into the math curriculum, as students calculated the mileage involved in getting foods to our province and examined the prices of fresh produce and how costs were affected by the country of origin. Students could also discuss our lack of availability of local food, and how this increases our carbon footprint. Comparing sources of food and prices can be extended by a trip to a local farmers market or farm.

Figure 44: Hannah, an eco-education intern, talks about plants and where they come from with visiting students

Below is an example of the grocery store data that was collected:

January		
ITEM	**ORIGIN**	**PRICE**
Cherries	Chile	$3.47/lb
Cantaloupe (Large size 12)	Guatemala	2/$5.00
Red or Green Seedless Grapes	Chile	$3.49/lb
Blackberries (6oz)	Mexico	2/$5.00
Watermelon (Mini size 8)	Guatemala	$4.49
White Potatoes, 10 lb bag	Atlantic Canada	$4.99
Carrots (2 lb bag)	Atlantic Canada	$2.29
Turnip	Atlantic Canada	$0.69/lb
Navel Oranges (Large size 48-56)	California	$1.49/lb
Cara Cara Oranges (3 lb bag)	USA	$5.49
Minneolas (3 lb bag)	USA	$5.49
Pummelo Grapefruit (Large size 18)	USA	$1.99
Lemon (size 95)	USA	$0.89
Organic Oranges (3 lb bag)	USA	$5.49
Tomatoes, Vine ripened field	Flordia	$1.29/lb

August		
ITEM	**ORIGIN**	**PRICE**
White Potatoes, 10 lb bag	Atlantic Canada	$3.77
Large Celery, bunch	Atlantic Canada	$1.69
Sweet Bi-colour Corn	Atlantic Canada	5/$1.99
Greenhouse Tomatoes	Atlantic Canada	$2.49/lb
White Cauliflower, bunch	Atlantic Canada	$2.49
Field Cucumbers, each	Atlantic Canada	$0.89
Green Onions, bunch	Atlantic Canada	$0.69
Green Asparagus	Mexico	$3.79/lb
Large Plumcots	USA	$2.79/lb
Large Apricots	USA	$2.79/lb
Whole or Sliced White Cremini Mushrooms, 227 g	Canada	$2.49
Cara Cara Seedless Oranges, 3 lb bag	Canada	$3.99

Note the Cara Cara oranges: In August they are cheaper and have a closer origin. Also on average, more of the sale produce comes from Atlantic Canada in August.

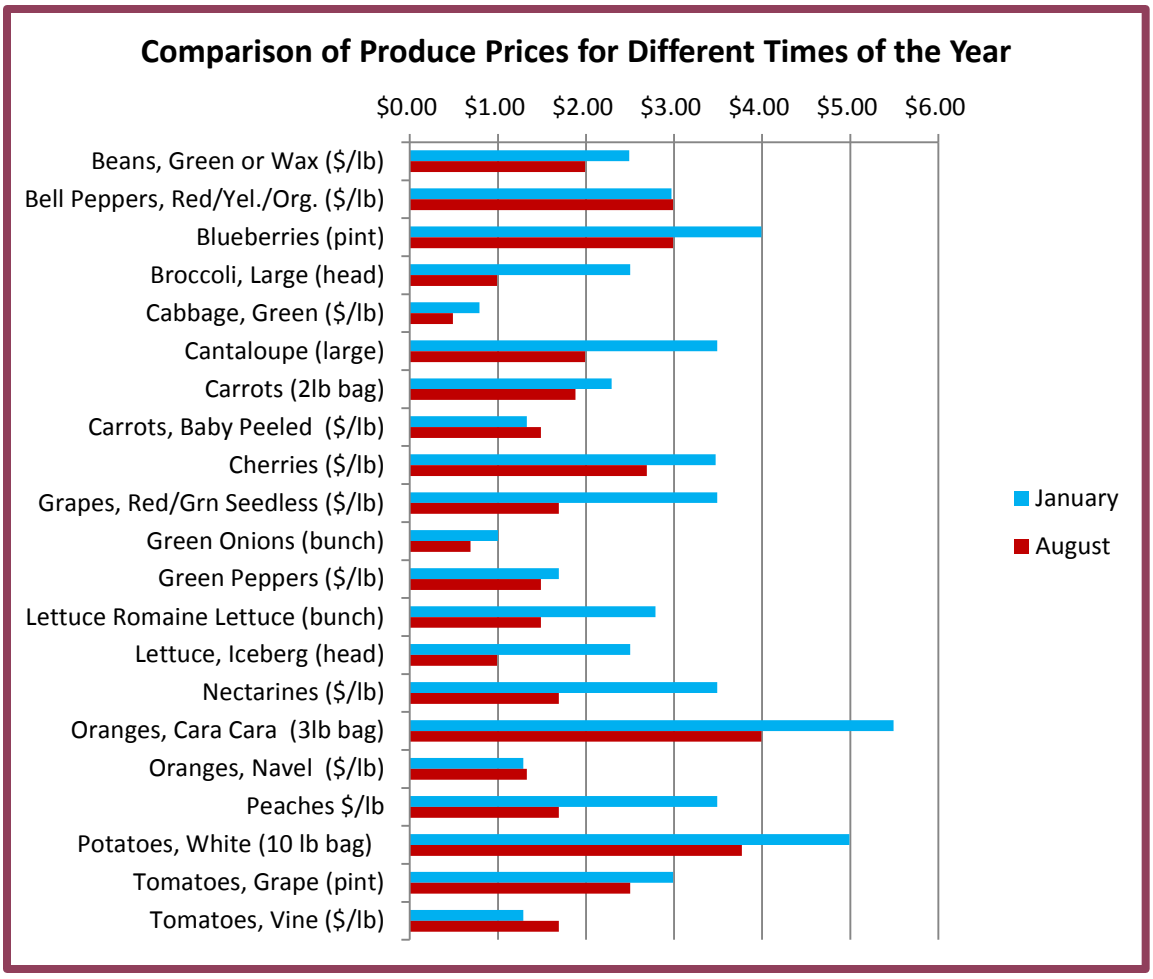


Figure 45: On average, similar produce costs more in January than in August

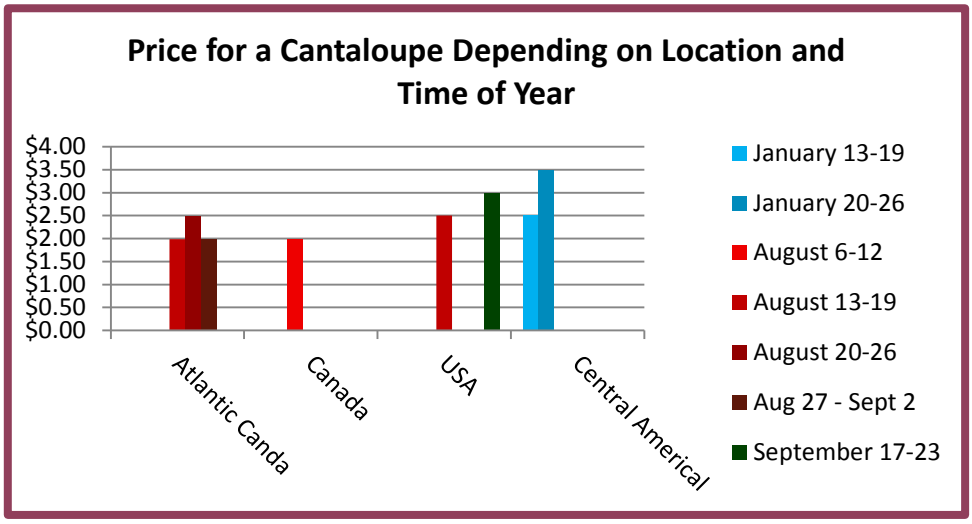


Figure 46: On average, cantaloupe travel further to our tables in January than in August. They also, subsequently, cost more.

B. Grow My Lunch

We often don't think about what we are eating while we are eating it, but lunch time could be a great learning opportunity. In some of our group programs we have chatted with children about what they are going to eat and then what part of the plant that is. This gets children thinking and will often spark lunch time conversation that continues the learning. In the *Snack Time Botany* activity that follows we asked the children to let us know what they were eating for their lunch or snack. Sometimes the answer wasn't obvious. Children are impressed to learn they are really eating seeds when eating a chocolate chip cookie. This often sparked more questions of "So when I'm eating _____ what part is that?"

Children are often surprised and excited to learn they can grow food that they can find in most kitchens. When we show our summer staff that this can be done, they start germinating seeds from their leftovers. Below is a list of common kitchen items that could be grown:

Dried Beans
Dried Corn
Dried Peas
Dried Lentils
Flax
Sesame seeds (untoasted)
Barley
Whole Grain Rice

Figure 47: Chopping up hot peppers

Seeds from:
Peppers (bell or hot)
Tomatoes
Cucumbers
Squashes
Pumpkins
Citrus fruits (oranges, lemons, etc.)
Apples (will need a cold treatment)
Eggplant
Pears
Avocado
Watermelon
Sunflower

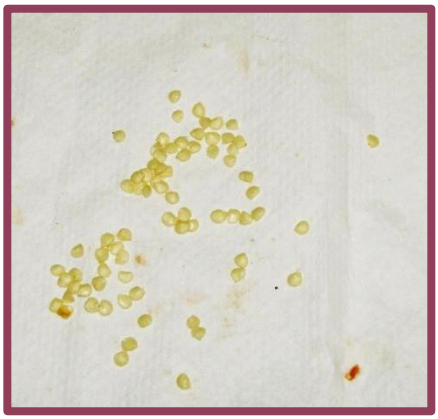


Figure 48: Pepper seeds

Often if left unattended these may grow on their own:

Onions
Carrots/parsnip
Potatoes
Turnip
Radish
Beets
Sweet potato
Ginger

Figure 49: Garlic growing on its own

Figure 50: Beet, radish and parsnip tops will grow roots and shoots when on stone in a plate of water

i) Snack Time Botany

Group 1

SEEDS	FRUIT	STEMS	LEAVES	FLOWERS	ROOTS	OTHER
wheat 6 oats	apple x4 tomato x3 blueberries peas lemon x2 strawberry grapefruit cranberry	sugarcane x3 cinnamon			sugar beet	chicken cheese honey cream cheese

Group 2

SEEDS	FRUIT	STEMS	LEAVES	FLOWERS	ROOTS	OTHER
wheat x3 oats corn cocoa bean	apple x2 cucumber grapes mango orange peach pepper raspberry strawberry x3 tomato vanilla watermelon	sugar cane onion	lettuce		sugar beet carrot	yogurt butter milk cheese x2 ham x2 water x2 bacterial culture

Group 3

SEEDS	FRUIT	STEMS	LEAVES	FLOWERS	ROOTS	OTHER
wheat x3 cocoa bean	apple banana x5 cherry lemon orange peach pear raspberry x2 strawberry x2 watermelon	sugar cane x3			sugar beet carrot	milk yoghurt eggs x3

Group 4

SEEDS	FRUIT	STEMS	LEAVES	FLOWERS	ROOTS	OTHER
wheat x3 cocoa bean x3 vanilla rice	banana x2 peach x2 blueberries grapes strawberry cherry sweet pepper orange apple	sugar cane x3 potato	lettuce basil spinach	broccoli	sugar beet	chicken x2 cheese x2 yogurt eggs

C. Get Growing Activities

These activities are specific examples of the different parts of a plant that can be easily grown in the classroom. Please see chapter 2, section B on the general knowledge necessary for growing in the classroom.

i) Root

Roots and Shoots

Many root vegetables, like turnips, carrots and parsnips, will root easily and send up fresh leaves. This project works well with all root vegetables.

Figure 51: Carrot tops sitting in water

Materials:

- A carrot
- A sharp knife
- A shallow dish with some small pebbles or marbles

Method:

1. Cut about 5 cm (2 inches) from the leaf end of the carrot.

2. Fill the bottom of the dish with pebbles and add enough water to cover the pebbles. Place the turnip top on the pebbles. Place in a sunny spot, and keep the dish topped up with water.

What you will see:

Green leaves should appear on top of the carrot within a week of setting it in a shallow dish of water.

Eventually, little roots will appear from the bottom of the carrot, and you can plant it in some potting soil.

Extend the Learning:

Continue to let the carrot grow in soil. Carrots are biennials, meaning they live for two years. Like most biennials they will flower and set seed in their second year only. We eat first year carrots, so by planting one you have to wait one season for it to set seed.

Try this activity with turnips or parsnips.

Figure 52: New roots have formed at the bottom of the carrot

ii) Stem

Fresh Ginger

Powdered ginger is used to flavour ginger ale and make gingerbread, but did you know that it comes from a rhizome (a type of underground stem)? You can find fresh ginger in most grocery stores and sprout it so that you can always have fresh ginger on hand.

Materials:

- Fresh ginger - choose the plumpest, healthiest-looking piece possible
- Glass jar or drinking glass
- 3 toothpicks
- Sharp knife

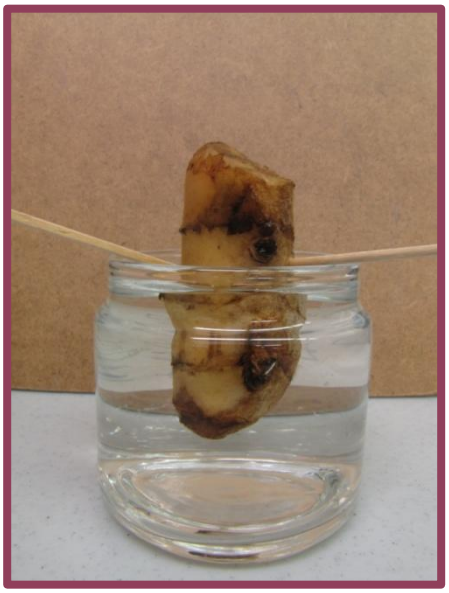


Figure 53: Ginger resting in a jar of water

Method:

1. Cut a piece of ginger about 8 cm (4 inches) long.
2. Poke the toothpicks into the piece of ginger like the spokes of a wheel.
3. Put the ginger in the glass so that the toothpicks rest on the rim and support it, and fill the glass with water.
4. Place in a well-lit spot out of direct sun, and keep the water level topped up.

What you will see:

Green shoots will soon sprout, and small roots will grow downwards

If you wish, you can then transplant the ginger to a large pot filled with rich potting soil. After several months, the original rhizome will grow new fat parts. You can dig this up and slice off some of the new section, and use it in cooking.

Figure 54: A shoot growing up from a piece of ginger that has been planted in soil

iii) Leaf

Celery Straws

We use straws to pull water up into our mouths. How do plants get water to their leaves?

Materials:

- Fresh celery stalk with several leaves
- Clear container (glass or plastic jar)
- Red or blue food colouring
- Paring knife

Method:

1. Cut about 2 cm (1 inch) off the bottom of the celery stalk.
2. Fill the jar with about 5 cm (2 inches) of water.
3. Add food colouring until the water is dark blue or red.
4. Put the celery in the jar, cut end down. Let stand for twenty-four hours.

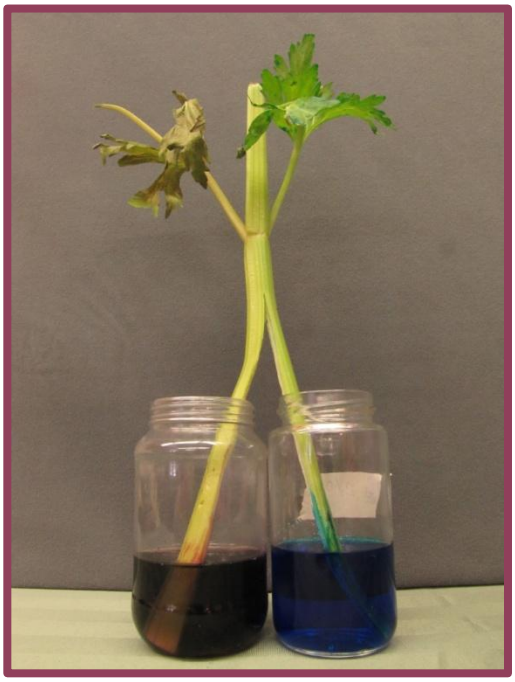


Figure 55: A celery plant split in two at the base and put into two different coloured water jars. Note the difference in the colour of the leaves.

What you will see:

The tips of the leaves will change color. Why do you think this happened? If you cut through the celery stalk about 5 cm (2 inches) above the first cut, what can you see? Try this same experiment using a white carnation.

Figure 56: A slice of celery that has been sitting in red water has red xylem tubes

Extend the learning:

This activity demonstrates that plants have a circulatory system, which enables them to move water (and nutrients) throughout the plant. It also demonstrates to younger children that plants are indeed alive. Phloem tissue conducts food produced in the leaves to the rest of the plant while xylem tissue conducts water and mineral salts from the roots. The xylem tissue also gives strength to the stem.

iv) Flower

Pumpkin Flowers

Figure 57: A sprouted pumpkin seed

We know that pumpkins make great jack-o-lanterns and pies, and that their toasted seeds make a yummy snack, but did you know their vines will produce large, beautiful flowers? Pumpkins actually produce different boy and girl flowers and both are needed to be able to produce a pumpkin.

Materials:

- Pumpkin seeds
- Pot or container
- Potting soil
- Watering can/jug with water

Method:

1. Collect fresh (unroasted) pumpkin seeds either from inside a pumpkin or a package of store bought seeds.

2. Fill your pot with soil, and then make a hole in the centre for the seed. Drop the seed into the hole and cover it up.

3. Water the soil so it feels moist but not sopping wet. Put the pot in a sunny, warm location.

4. Continue to water you plant as necessary. The seed will sprout and will continue to grow as long as it is kept watered. Eventually a yellow flower will appear.

Figure 58: A young pumpkin plant

Figure 59: A pumpkin flower

What you will see:

With enough time and care a pumpkin flower will bloom. Because they are large, you will be able to see the different parts of the flower.

Extend the learning

Try using different seeds from different pumpkins. What can you change to make your plant grow better? Did a male, female or both flowers appear on your plant?

v) Fruit

Fruity Beans

To grow a plant to the point of fruiting can take a long time: at minimum a whole season, and over 5 years for an apple tree! However, there are plants, like beans, that can grow much faster. If you have the time in your classroom, it is very easy to grow beans, which are fruit that contain the seeds we often eat.

We have had a lot of success with kidney beans, but do try others to see how they compare.

Materials:

- Dry kidney beans
- Pot or container
- Potting soil
- Watering can/jug with water

Figure 60: Kidney Bean plant

Method:

1. Fill your container with soil and push a finger into the centre to make a whole for the bean.
2. Drop a bean into the hole and cover with extra soil.
3. Water until the soil feels like a wrung out sponge.
4. Place the pot on a window sill or under grow lights.
5. Continue to keep watered as necessary.

Figure 61: Kidney bean flower

What you will see:

Within a week the seed will have sprouted and will start producing leaves. Within a month a flower will appear. Kidney bean flowers need to be pollinated by bugs, so all it may take is one fruit fly in your classroom. This is how all of ours have been pollinated, but you can also do it yourself with a little paintbrush. Brush the pollen from the anthers onto the stigma. If this worked a little green bean will start to grow. You have now grown fruit!

Extend the Learning:

Keep watering your plant and let the bean grow to full size. It can be picked off now and eaten like a green bean. Open up the bean to see the bean seeds inside. If you stared with a red kidney bean the seeds will be red! If you leave the bean on the vine in about 3 months from when it was planted the fruit will dry up. You can harvest the bean seeds for growing your next crop or use them in cooking like normal, dried kidney beans.

Figure 62: Kidney bean fruit

Figure 63: Kidney bean plant with dried fruit

Figure 64: New kidney bean seeds inside dried fruit pod

vi) Seed

Pomegranate Plants

Materials:

- ripe pomegranate
- sharp knife
- potting soil
- a little tray for starting seeds*

*A recycled container from the deli or bakery works well for this activity, especially if it has a clear lid; this is a fun way to make a mini-greenhouse or terrarium.

Figure 65: Pomegranate fruit is around the size of a grapefruit

Figure 66: The pomegranate is filled with juicy red seeds. Be careful where you are opening the fruit because it will squirt out the red juices!

Method:

1. Slice off the calyx end of the pomegranate. The calyx end is where the pomegranate flower was, and if you look closely you should see the dried up remnants.

2. Break open the pomegranate and separate the red, fleshy seeds.

3. Fill your tray with moist potting soil and poke little holes for the seeds. Plant the seeds and cover with soil.

4. Mist gently and place in a warm spot. To keep the soil moist, it is best if the tray is covered.

5. Mist daily and your seeds should sprout in about two weeks.

Figure 67: Above: seeds with the aril removed (we ate ours!); Below: seeds with the aril still on

What you will see:

Small plants will sprout from some of the planted seeds.

Figure 68: Pomegranate seeds sprouted in half a clam shell foot tray

We found that the seeds sprouted more quickly when the juicy red aril (seed coating) was removed. The easiest (and most fun) way to do this is to pop them into your mouth and spit out the seed. The word pomegranate means 'seeded apple.' The seeds are crushed to make grenadine syrup and are rich in antioxidants. Their native habitat is southern Saudi Arabia and Yemen.

Extend the Learning

What other plants can you harvest the seeds from? Why do some plants produce lots of seeds and others just one? For example, think of how many seeds are in a pumpkin compared to an avocado.

vii) Seedling

Chia – not just a pet!

The most common (and fun!) seedlings to sprout are chia seeds – which were popularized by the chia pet. You don't need to go out and pay big bucks for a silly clay figurine to try this sprouting. Chia seeds are healthy and filling and can often be found in health food stores or aisles, as well as bulk food stores in the seed section (near the sesame seeds). The seeds are tiny, which doesn't make them good for individual growing like kidney beans, but are great for mass growing (remember how you spread the wet seeds onto the chia pet?).

Below is an attempt we did in our classroom that you can try in yours:

Materials:

- ¼ tsp. of Chia seeds
- Shallow dish
- Jiffy pot* / paper towel
- Butter knife
- Water

**A jiffy pot is a small pot made out of fibrous organic material (usually peat and wood fiber). This makes it great at wicking water, and will decompose if put in soil. They are often used for starting plants.*

Figure 69: You will need a shallow dish and a jiffy pot

Figure 70: Chia seeds are very small

Method #1:

1. Put about 1 cm of water in your dish.
2. Soak the jiffy pot under running water.
3. Put the jiffy pot upside down in the dish.
4. Spread seeds as evenly as possible over the jiffy pot. (If you have lots of seeds you could roll the wet pot in the seeds to cover it.)
5. Keep dish filled with water as necessary.

Figure 71: Put your jiffy pot upside-down

Figure 72: Spread on the chia seeds

Method #2:

1. Fold up 2 sheets of paper towel and put into bottom of shallow dish.
2. Add water to paper towel so it is moist.
3. Evenly sprinkle chia seeds over paper towel.
4. Keep paper towel moist as necessary.

Figure 73: Sprinkle chia seeds on wet paper towel

What you will see:

Chia seeds are mucusy, meaning they will absorb water quickly and become sticky. Do not touch the seeds after adding water or they will come off on your finger.

Figure 74: A wet chia seed

After a few days the seeds will sprout, eventually growing like chia pets do. To harvest the sprouts cut them off your growing medium and add them so salads and sandwiches.

Figure 75: Two week old chia on the jiffy pot

Figure 76: Two week old chia in the tray

Sprouts – not just for vegetarians!

Sprouting is a great way to have fresh, crunchy veggies in the middle of winter right in your kitchen. There are many devices that can make sprouting easier; from simple sprouting trays to expensive sprouters that know when to mist your plants and give the right amount of warmth and light. Sprouting can be very easy and cheap by using a few things you have around the house. Please be advised that there is a risk of bacteria (salmonella) growing in the high moisture and dense conditions, so any sprouts that turn brown or start to smell musty must be composted and not eaten. Below are some popular varieties that could be tried in the classroom.

Bean sprouts are common in Asian cooking and are a great crunchy stir fry topper. Have you ever wondered what those sprouts sprouted from? The majority of the time you are actually eating a baby mung bean plant. Dried mung beans can be bought from many bulk food stores and are a medium sized green bean. Many other types of beans are often sprouted and eaten, but the mung bean sprout is the typical "bean sprout".

Alfalfa sprouts are common with vegetarians. They make an excellent alternative to lettuce on any sandwich and are also great in a salad. Alfalfa seeds are small and can be bought in a package from some health food or vegetarian food stores.

In the activity below we have sprouted mung beans because they are easier to buy and larger (good for children).

Materials:

- Seeds (we have used dried mung beans)
- Wide mouth glass jar
- Square of plastic screen mesh
- Wide elastic band
- Shallow dish
- Pop bottle top
- Tea towel

Figure 77: Materials for sprouting

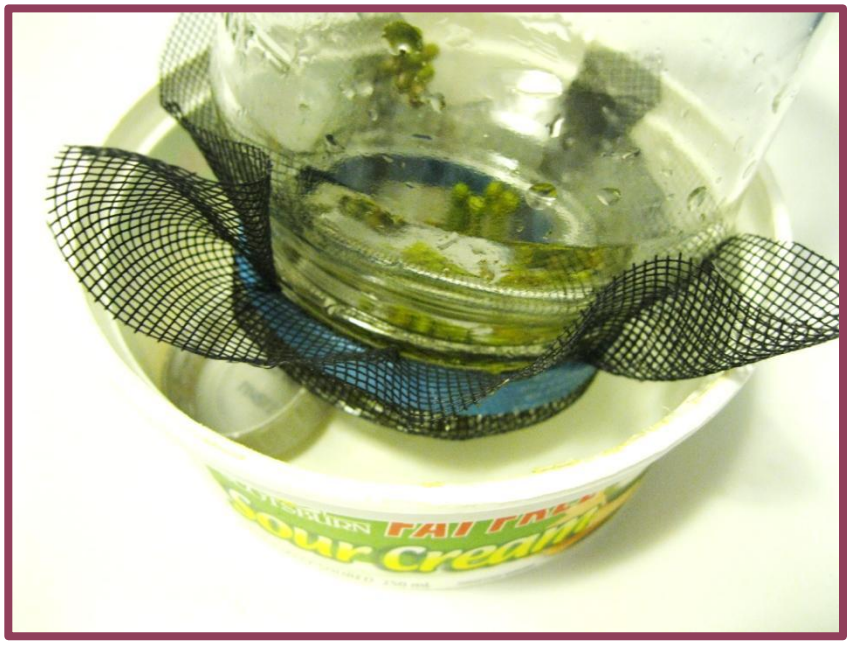
Method:

1. Select an amount of beans that will fit within the opening of your jar. Remove any seeds that are imperfect. The bean on the right has been broken in half so will not grow.


2. Put the beans in the jar, then cover with the screen mesh. Put the elastic band over the mesh to hold it in place. Make sure the mesh is tight and flat along the top.

3. Fill the jar with water, swirl and drain. Repeat a few times. Leave the jar half filled with water and let sit for 8-12 hours. This soaking period can often be done overnight.


4. When finished soaking, drain the jar and sit it upside down in the shallow dish to allow any remaining water to drain. Use the pop bottle top to prop up one side of the jar so air can flow in and out. This also prevents water from sitting in the dish and backing up into the jar.



5. Cover the jar and leave it in a room temperature spot. A slightly cool location will also be fine. Rinse and drain the beans 2-3 times a day. Continue to keep them covered when resting.

What you will see:

Within two days the beans will swell and start to grow. Every day the sprouts will get bigger. The beans can be eaten at any point once they have sprouted, but it is important to watch out for sprouts that go brown and/or musty. These must not be eaten. Commercially grown bean sprouts are usually 5-7.5 cm long and are grown under very precise growing conditions. Do not expect to be able to replicate them.

Extend the Learning

Try growing the beans in a variety of conditions (in soil, in warm air) to see how they respond. How much bigger does a bean get after a night of soaking? What will happen if the beans are left sitting in water?

In Asia, mung beans are grown where there is pressure from the top to replicate the weight of soil on the sprout. This helps encourage the stems to grow thick and long. Try growing mung beans under wet paper towel to see if you can get this method to work.

Figure 78: Four day old mung bean sprouts

D. Wild Edible Plants of Newfoundland and Labrador

i) Introduction

With the growing awareness of the benefits of eating locally, there is increased interest in wild edible plants. From your back yard to the back woods, there is a wide variety of plants that can provide a nutritious supplement to your daily diet. Generally, these plants are pesticide free, are not transported hundreds or thousands of kilometres, are unprocessed, and are free for the picking.

The five common parts of a plant that are generally consumed are the roots, greens, flowers, fruits and seeds.

1) Fleshy roots can be dug up, peeled and used as a carrot substitute in soups or cooked dinners. Some roots make excellent coffee and tea substitutes.
2) Greens fall into three groups: those used fresh in salads, those boiled and used as a substitute for spinach or cabbage and those that are dried and used as tea. They are generally picked early in the season before they get too tough. Some plants offer edible stems. They can be peeled and used like celery in soups.
3) Certain flowers can be used to brighten up salads, stir fries, omelettes and desserts.
4) Fruits can be eaten fresh off the bush, made into juice, jams, or jellies, fermented to make wine or dried to make tea.
5) Seeds can be ground and used as a nutritional additive to flour or they can be toasted or eaten raw.

Figure 79: Sweet gale leaves and nutlets can be used as a spice

Whichever way you chose to enjoy them, knowing that you gathered your own food will make it taste that much better. Besides the added nutritional benefits, gathering your own food has both physical and mental benefits, so get out and let your stomach lead the way.

WARNING

Eating anything from the wild should only be done under the **supervision of an expert.**

Children should be taught not to put any plants in their mouths and all plants should be kept away from infants.

Educating yourself in identification of both the **edible** and the **poisonous** plants is a good way of avoiding **deadly** mistakes.

ii) Do's and Don'ts of Plant Foraging

1) **IDENTIFICIATION!!** Do not use any plants that you cannot positively identify. Learn to recognize and avoid common poisonous plants and do not assume that plants that resemble edible plants are edible.

2) Forage with a partner – always let someone know where you are going and when you plan to be back.

3) Learn how to **cook/prepare** the plants properly – some may be toxic if cooked improperly.

4) Do not pick in **polluted** or **highly disturbed** areas such as heavily traveled highways, contaminated waterways, or areas that have been sprayed by herbicides. Plants growing in these conditions may have toxic accumulations of chemicals or pests/pathogens.

5) Some plants have edible parts and poisonous parts on the same plant; make sure you **KNOW the difference!**

6) Sample unfamiliar edible plants **sparingly at first**. Individuals may have different reactions to wild plants; something that is safe for one person may not be safe for another.

Figure 80: The yew berries are edible but the pit in the centre is toxic

7) There is no foolproof test for determining either edible or poisonous plants. **Animals are NOT a reliable indicator** of edibility.

ii) Conservation – Pick with care

Preservation of natural habitats should always be a priority of wild edible plant enthusiasts. Plants should be gathered in a way that preserves the ecosystem overall. Lee Allen Peterson (1977) has listed a few points in his edible wild plant field book to keep in mind when collecting edible plants:

1) Uncommon and rare species should only be used in cases of emergencies.

2) Some species are common in some areas of its range and uncommon in others; know what the status of the plant is in your area.

3) Resist the urge to collect more than you will use.

4) Always leave enough for the next person and to ensure the plants survival into the next growing season

5) When collecting any other part of the plant besides the root, leave the root intact.

6) When collecting leaves from perennials do not take all the leaves, they are needed so that the plant can manufacture enough food for the winter months.

7) Try and impact the surrounding ecosystem and vegetation as little as possible.

8) Fragile habitats such as bogs, alpine tundra and dune communities are particularly sensitive to disturbance and should be entered with care or not at all.

Obtaining a copy of all the listed plant species in your area or speaking with a local expert should help edible plant enthusiasts avoid picking or damaging rare plants and ecosystems.

Figure 81: Please try not to walk through bogs when collecting because each footstep may crush sensitive plants and will leave imprints in the mosses

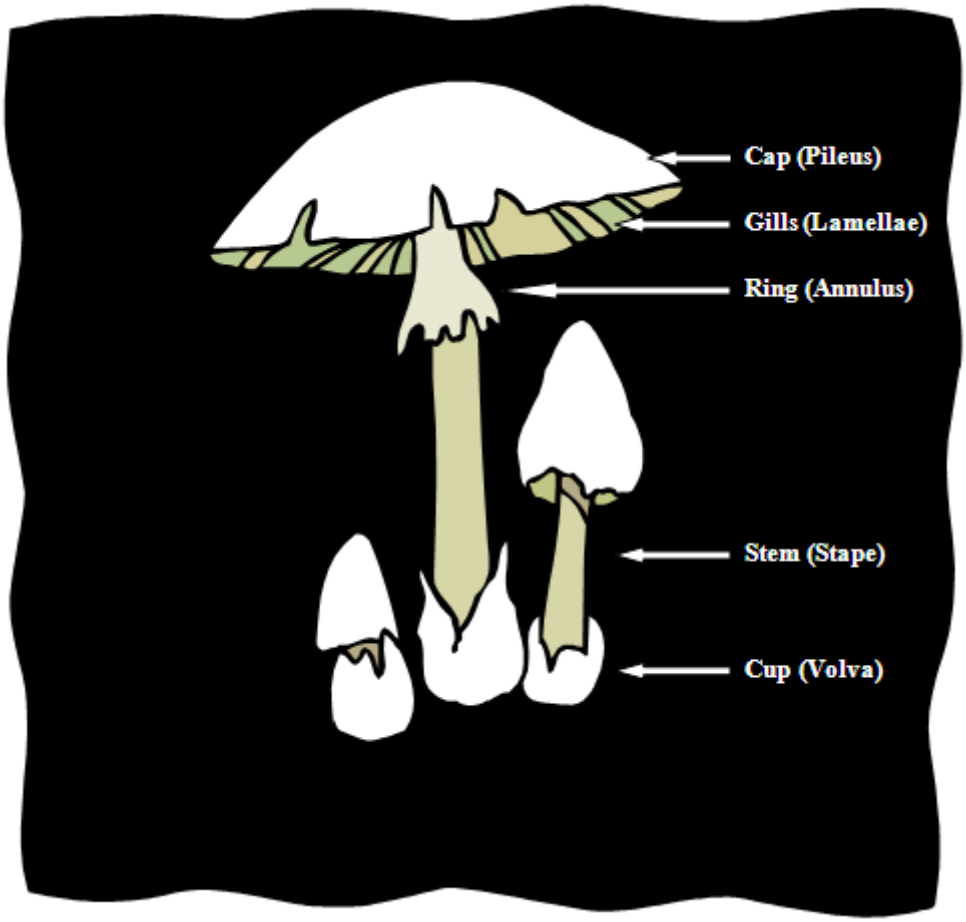
iv) Notes on Mushrooms

- **NEVER** pick and eat a mushroom that has not been correctly identified by an expert.

- **NEVER** eat an all-white or an all-brown mushroom.

- **NEVER** let children handle mushrooms without supervision.

Amanita bisporigera, destroying angel, is the cause of 99% of mushroom related deaths. It is an all-white mushroom and it is commonly found in Newfoundland and Labrador.



- *Amanita spp*. can be identified by their cup or volva (as see in the picture above), therefore be sure to dig up the entire mushroom when collecting and identifying, **DO NOT** crack off at the stem.

v) List of Some Poisonous Plants**

Adapted from Peterson Field Guides (1977) "Edible Wild Plants"

Figure 82: Stinging nettles cause a burning sensation to the skin

Plants That Cause Dermatitis

Cow Parsnip - *Heracleum maximum*
Eyebane – *Euphorbia maculate*
Giant Hogweed - *Heracleum mantegazzianum*
Nettles – *Urtrica* spp.

Internal Poisons

Anemone – *Anemone* spp.
Arnica - *Arncia* spp.
Arrow grass – *Triglochin* spp.
*Azelea – *Rhododendron* spp.
*Baneberries – *Actaea* spp.
Blue flag Iris – *Iris versicolor*
Buttercups – *Ranunculus* spp.
*Canadian Yew – *Taxus canadensis*
Celadine – *Chelidonium majus*
Clematis - *Clematis* spp.
*Common Tansy – *Tanacetum vulgare*
Daphne – *Daphne mezereum*
Dicentra – *Dicentra* spp.
Dogbanes – *Apocynum* spp.
Elderberry – *Sambucus*
Foxglove – *Digitalis purpurea*
Holly – *Ilex* spp.
Horsetail – *Equisetum* spp.
Hydrangea – *Hydrangea* spp.
*Jimsonweed – *Datura stramonium*
Larkspur – *Delphinium* spp.
*Laurel – *Kalmia angustifolia, K. polifolia*
Marsh-marigold – *Caltha palustris*
Lobelia – *Lobelia* spp.
*Mistletoe – *Phoradendron flavescens*
*Monkshood – *Acontium* spp.
*Nightshades – *Solanum* spp.
*Rhodondendron – *Rhododendron* spp.
Snow-on-the-mountain – *Euphorbia marginata*
Vetchling, Wild pea – *Lathyrus* spp.
Spurge – *Euphorbia* spp.
Water-hemlock – *Circuta* spp.
*Wild cherries – *Prunus* spp.
Wild Lupine – *Lupinus perennis*

Figure 83: The entire foxglove plant is poisonous if ingested

**Known fatalities*

*** This is NOT an exhaustive list; please refer to a reliable field guide for further information on poisonous plants in your area.*

vi) List of Some Edible Newfoundland Plants

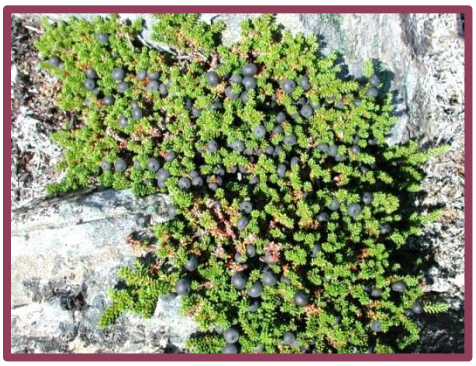
*** (NL) indicates that the plant can be found in both Newfoundland and Labrador, (N) or (L) indicates than it is just found either in Newfoundland or Labrador.**
**** 'i' Indicates that the species is introduced or non-native**

Alpine bilberry – *Vaccinium uliginosum* (NL)
Alpine bilberry, known locally as ground hurts, are found throughout the province on exposed barrens, headlands and mountaintops. Plants form low mats with rounded, blue-tinted foliage. The pinkish flowers, which are produced in May-June, are usually hidden under the shrubs. They develop into blue berries by late July. While they look much like our wild blueberries, the fruit are solitary, not clustered, and each berry has a short, thread-like 'bill'. The berries can be used in the same manner as the standard blueberries.

Alpine bistort – *Bistorta vivipara* (NL)
This small plant produces narrow, deep-green leaves and a tiny spike of minute white flowers atop 10-15 cm stems in July. The plant is unusual in producing little nut-like bulbils on the flower stem below the tiny flowers. This plant is most common along the Great Northern peninsula but occur atop the highest hills and along high ocean cliffs Island-wide. The leaves are edible but the little bulbils and the small tuberous root are most commonly eaten as a soup or salad additive.

Bakeapple, cloudberry – *Rubus chamaemorus* (NL)
Bakeapples are choice berries relished by many Newfoundlanders. In the wild, bakeapple are confined to drier bogs. Plants produce just 1-3 hand-shaped or 5 lobed leaves and a terminal white, 5-petaled flower in June. Plants are either male or female with only the females producing the solitary salmon-orange raspberry-like fruit. They ripen in August and may be eaten fresh or made into preserves.

Blackberry – *Rubus canadensis* var. *canadensis* (N)
There are several species of blackberries in Newfoundland but R. canadensis is perhaps the most common. Plants produce arching canes with scattered prickles. Axillary clusters of 5-petaled white flowers are produced in July followed by delicious black raspberry-like fruit in October. They are ideal for eating fresh or making into preserves.



Black crowberry – *Empetrum nigrum* (NL)
This is a mat-forming evergreen shrub common in bogs, open woodlands, barrens and coastal headlands throughout Newfoundland and Labrador. Leaves are needle-like, alternate and 3-7 mm long and the flowers are inconspicuous and grow in the axils of the upper leaves. Crowberries can be eaten directly from the plant. They are quite juicy but do not have very much flavour.

Blueberry – *Vaccinium angustifolium* (NL)
This province-wide, low shrub is commonly found among woodland clearings, on barrens and burnovers. Clusters of white to pinkish, urn-shaped flowers are produced in June. The berries begin ripening by late July and are ideal for eating fresh, but are also used for jams, jellies, tea, desserts, baking and wine. Few berries have as high an anti-oxidant content as our wild blueberries

Burdock – *Arctium minus* (N) i
Most children are familiar with burdock as the seed heads will stick to your clothes and hair! This alien invasive species of disturbed habitats, is a biennial; in the first year plants produce a large leafy rosette while in the second year they produce tall (1 m), multiple-branched stems with numerous rounded pink, thistle-like flowers. The edible portion of this plant is the taproot of the first-year plants. It is considered a delicacy in Japan where it is called 'gobo'. The roots are peeled and placed in a bath of vinegar water for 20 minutes before cooking. They have a sweet mild flavour similar to oysters or asparagus. The flower stalks, which taste like radish, may also be peeled and eaten raw or cooked.

Cattail – *Typha latifolia* (NL)
To spot a cattail stand look for the furry, white, seed heads from the previous year on top of long stalks. The leaves are grass-like, relatively broad and often dull grey-green. The cattail is thought of as one of the most important wild foods because of its variety of uses throughout the year. The young shoots, known as "Cossack's asparagus", can be peeled and added to salads, soup, stir-fry and sandwiches. The top, male, portion of the flower head can be steamed or simmered much like corn. The pollen can be collected and used as a nutritious addition to flour. In the fall, winter and spring, the underground rhizome, which stores food, can be eaten raw, baked or boiled.

Chickweed – *Stellaria media* (NL) i
This common weed is found through the province, mostly in garden situations. Plants form a tangled mat 10-20 cm high. The fragile stems are somewhat trailing with pairs of small, oval leaves. The flowers are tiny and shaped like white stars. The stems, leaves and flowers can be used in salads, soups and stir-fries.

Chokecherry – *Prunus virginiana* var. *virginiana* (N)
In Newfoundland, chokecherry is not as common as the pin cherry, but it is considered to be the most widely distributed tree in North America. The leaves are oval in shape with a pointed tip. The white flowers are produced in short, hanging clusters. The fruit are dark purple-black. Chokecherries are also quite sour but make an excellent jam when sugar is added. Warning: the leaves of chokecherry are poisonous.

Clover – *Trifolium species* (NL) i
The province has three edible common clovers; alsike clover (T. hybridum), red clover (T. pratense) and white clover (T. repens). The flowers of clovers can be used fresh or dried to make a sweet tea. The leaves can also be used to make a grass tasting tea. Flowers and leaves can be added to salads and young plants can be eaten as greens.

Coltsfoot – *Tussilago farfara* (NL) i
Coltsfoot is an alien invasive species which is found in disturbed habitats. The flowers superficially resemble dandelions and bloom in early spring. The long-stalked, broadly heart-shaped leaves emerge after most of the flowers have died. Coltsfoot is an expectorant and has traditionally been used as a treatment for coughs and colds as a tea. The flowers, stalks and young leaves can be steamed, sautéed or used in soups.

Common Comfrey – *Symphytum officinale* (N) i
Comfrey is a coarse perennial with large, somewhat hairy elliptical basal leaves. Flower stems reach 1m or taller with numerous pendant white to lilac tubular flowers in August-September. The leaves may be cooked as a green all season and the flower stems may also be blanched.

Cow parsnip – *Heracleum maximum* (NL)
Cow parsnip is among our largest-sized herbaceous wildflowers in Newfoundland. Plants produce large, trifoliate (3-leaflets) with deeply serrated margins. In July-August they send up 1-2 m hollow stems topped with large flat clusters of many minute white flowers. This plant is part of the celery family and the young, peeled stems can be used as a celery substitute. WARNING: because the outer skin contains a skin irritant is it important to only eat young, peeled shoots, that have been handled with care.

Crackerberry, Bunchberry – *Cornus canadensis* (NL)
Crackerberry is a common sight in Newfoundland forests. This plant is easy to identify in that the "flower" is located above a whorl of six, broad, green leaves. The 'flower' is actually a cluster of flowers surrounded by four, white petal-like bracts. The cluster of flowers produces juicy (but lacking in flavour), bright red-orange fruits that can be eaten from plants in the autumn.

Cranberry – *Vaccinium macrocarpon* (N)
Cranberries are more restricted, usually growing in wet seepage areas near the coast. They are also trailing but not as wiry and have more densely packed leaves. Their flowers are terminal on the stems, blooming in July. They also produce a tart red berry after the first hard frost. Their berries are best picked in November when the fruit are at their ripest. The fruit will not ripen further once picked. They can be used for jams, jellies, pies, baking and wine.

Creeping snowberry – *Gaultheria hispidula* (NL)
The snowberry is a delicate creeping shrub that grows in forests throughout Newfoundland. This plant has small stiff hairs on the stem, under the leaves and also on the fruit. The leaves are leathery, small and oval in shape. The minute, whitish flowers are usually hidden under the plants. The distinctive egg-shaped, white berry has a wintergreen flavour and can be added to salads and fruit dishes or can be made into a preserve. The berries and the leaves may also be used to make a refreshing tea.

Dandelion – *Taraxacum officinale* (NL) i
A common but underappreciated plant that grows in disturbed, sunny habitats throughout North America. The roots can be peeled, sliced and boiled in salted water. They can also be baked in the oven, grated and used to make a caffeine free coffee substitute. Roots and leaves have traditionally been used to strengthen and cleanse the body. Leaves can also be added to salads or be eaten as greens, and are best picked before the plant flowers. Flowers can be added to salads or used to make wine.

Dewberry, Plumboy - *Rubus pubescens* (NL)
Dewberries belong to the same genus as raspberries. They creep along the ground in damp, open woodland areas and are usually less than 20 cm high. The leaves have three toothed leaflets. The flowers, which bloom in June, are white to pinkish in colour and develop into bright red, raspberry-like fruit in August. It may take some time to collect these fruits since they are individually produced, but they make excellent pies, jams and jelly.

Dock – *Rumex crispus* (NL) i, *Rumex longifolius* (NL) i, *Rumex obtusifolius* (N) i, *Rumex pallidus* (NL)
There are several species of dock in Newfoundland, both introduced and native. They produce reddish-tinted, coarse-textured leaves that have long stalks and oval to elongate blades. Their ribbed stems are hollow and may reach to 1.5 m, producing a dense 'spear' of tiny white to pink flowers that develop into rusty-brown 'fruits' that resemble coffee grounds. Look for them just about anywhere! Spring leaves can be steamed or boiled as a green or used in soups. They are too tough to eat raw.

Dogberry, mountain-ash – *Sorbus americana* (N), *Sorbus aucuparia* (N) i, *Sorbus decora* (NL)
There are two native species of dogberry in Newfoundland, along with the introduced European dogberry. They develop into trees up to 10 m in height. Their leaves are compound with many oval leaflets. In June, they develop flat-topped clusters of cream-white flowers that develop into clusters of orange-red berries in September. Dogberries are rather bitter and are best harvested after frost. The seeds contain a toxin called amygdalin (also found in cherry and plum seeds) so the fruit are only useful for jellies. They are also useful for wines and brandies.

Evening primrose – *Oenothera biennis* (N)
Evening primrose is an introduced biennial plant found in waste places, roadsides and often, beaches. In the first season plants produce a flat rosette of leaves while in their second year, they produce an upright stem 1-1.5 m with numerous, relatively large, 4-petaled yellow flowers in August-September. Flowers are often closed during the day but open fully in late afternoon. Early spring leaves may be cooked like cabbage or dandelion greens. The roots of first-year plants may be used like carrots but boil them in two changes of water first, then peel.

Fireweed – *Chamerion angustifolium* (NL)
Fireweed is a pioneer species and is commonly found in open fields, pastures and forest clearings throughout Newfoundland. Many narrow, wrinkled leaves are attached to the single stem and the magenta, pink or sometimes white flowers grow in a loose spike at the top of the stem. The fresh young stems may be prepared like asparagus while flowers can be dried and used for tea. This plant was formerly named Epilobium angustifolium.

Highbush Cranberry – *Viburnum opulus* subsp. *trilobum* (N)
Highbush cranberry is not particularly common in Newfoundland. They grow mostly along rich river bottoms in central and western parts of the island. Flat-topped clusters of white flowers are produced in June followed by drooping clusters of shiny red berries in autumn. The tart fruit are at their best after frost. They may be used for jams and jellies.

Japanese knotweed, Mile-a-minute – *Fallopia japonica* var. *japonica* (NL) i
The agressive Japanese knotweed is also known locally as 'mile-a-minute' or 'September mist'. They are robust plants which may reach 2 m or more. The spring stems are reddish. Mature stalks are hollow and the leaves are somewhat rounded. Sprays of tiny white flowers are produced among the upper leaf axils in September. Early spring shoots (under 20 cm) may be prepared like asparagus and the rhizome can be peeled and cooked or roasted.

Juniper – *Juniperus communis* (NL), *Juniperus horzontalis* (N)

There are two juniper species in the province, J. communis and J. horizontalis. (Note: larch or Larix spp. are sometimes referred to as Junipers which is misleading). These are evergreen shrubs that have unique, blue, berry-like cones. A few juniper berries can be used as flavouring in a variety of dishes, especially wild game. They are used to flavour gin. Warning: Juniper berries contain a powerful resin and should only be used sparingly and avoided by pregnant women.

Labrador tea – *Rhododendron groenlandicum* (NL)

This evergreen shrub is found throughout Newfoundland and Labrador. The leaves and flowers have traditionally been used to make tea. The leaves are thick, leathery and the underside has a distinctive mat of rusty hairs. It is recommended to collect leaves early in the spring before any growth starts. To make the tea, steep the leaves in hot water for 5-10 minutes. WARNING: When making the tea it is important not to boil the tea leaves as this causes a harmful alkaloid to be released.

Lamb's-quarters – *Chenopodium album* (NL) i

Lamb's-quarters is an annual which has somewhat fleshy, arrow-shaped leaves, not unlike its close relative, spinach. Lamb's-quarters are a weed of waste places, roadsides and gardens. It has grey-green leaves and can reach a metre in length. Its flowers are rather nondescript. The leaves may be eaten raw in salads or steamed as a green.

Marshberry, Small cranberry – *Vaccinium oxycoccus* (NL)

Marshberries are widely distributed across the province, growing in any open, damp areas. They have wiry, trailing stems with widely-spaced tiny leaves. Their flowers, which are produced in the leaf axils, are pink and star-like. They bloom in June-July, followed by brown speckled berries that turn red after the first hard frost. Their berries are best picked in November when the fruit are at their ripest. They can be used for jams, jellies, pies, baking and wine.

Northen wild raisin – *Viburnum nudum* var. *cassinoides* (N)
The wild raisin, which can reach 3 m or higher, grows in moist soils throughout Newfoundland. The leaves are dark green, shiny, opposite and turn red in the fall. The yellowish-white flowers are produced in flat-topped clusters in June. The fruits change from cream to pink to purplish-black and resemble dried currants when fully ripe. Fruit can be eaten from the plant or they can be cooked, however, they do contain a large central seed.

Ostrich fern – *Matteuccia struthiopteris* var. *pensylvanica* (N)
Fiddleheads are a spring delicacy. While most unfurling fern fronds are called fiddleheads, the edible fiddlehead comes specifically from the ostrich fern. This fern is rare on the Avalon but can become quite common along streams and wet woodlands in western Newfoundland. When mature, plants produce a vase-shaped clump of large (1 m) feather-shaped fronds. The fiddleheads are harvested while still only a few inches tall and are best steamed for about 10 minutes. They are high in iron and potassium.

Partridgeberry, lingonberry – *Vaccinium vitis-idaea* (NL)
The partridgeberry, which is also known as the mountain cranberry or lingonberry, is found on barrens throughout Newfoundland. This plant is an evergreen, creeping shrub with shiny, leathery leaves. Pink, urn-shaped flowers are produced in June-July and develop into tart, red berries by mid-September. The berries can be eaten from the plant or be used in pies, jams, baked goods and even wine.

Pin cherry – *Prunus pensylvanica* var. *pensylvanica* (NL)
This large shrub or small tree (3-8 m) is found throughout the province in burnt-over areas, open woodlands or roadsides. The flowers are small, white and grow in clusters of five to seven. The leaves are toothed and somewhat lance-shaped. The fruit is light red, have a single seed and ripen throughout August. They are quite sour but when sugar is added they make an excellent jam. Warning: the leaves of pin cherry are poisonous.

Raspberry – *Rubus idaeus* subsp. *strigosus* (NL)
Raspberries grow in cleared areas such as roadsides or clearings in the woods. The prickly canes reach 1-2 metres high and the leaves have 3-7 leaflets. Small, white flowers with five petals grow in loose clusters. These ripen throughout August and September into the familiar red, thimble-like fruit. Raspberries contain vitamins A, B and C, calcium, phosphorus and iron. They can be used to make jams, pies, wine, or eaten fresh off the bush.

Roseroot – *Rhodiola rosea* (NL)
Roseroot is not common in eastern Newfoundland but can be abundant in northern areas. The plants usually grow near the ocean. The leaves are fleshy, blue-tinted and arranged in a whorl-like pattern up the length of stems which may reach 15-40 cm. The flowers, produced from May to July, are small and produced in a terminal cluster. Plants are either male or female. Males have yellow flowers while females are orange to purplish. The leaves may be consumed early in the season as a salad additive.

Sea-rocket – *Cakile edentula* subsp. *edentula* var. *edentula* (NL)
Sea-rocket is a low, somewhat trailing annual plant found among fine cobblestone or sandy beaches across the province. Plants produce fleshy, spoon-shaped leaves and clusters of tiny white or pale purple, 4-petaled flowers all summer long. The leaves have the flavour of horseradish and are quite peppery. They may be used in salads while the small rounded seedpods can be pickled and used like capers.

Seaside plantain – *Plantago maritima* subsp. *juncoides* (NL)
Seaside plantain is a common coastal plant throughout the province, usually growing within reach of the ocean spray. In fact, they may even be covered by saltwater during high tides. Plants produce rosettes of narrow, fleshy leaves. The flowers are rather inconspicuous and are arranged on narrow, brown, rattail-like flower stems. The young leaves have a mild salty flavour and may be used in salads and soups.

Serviceberry, Chuckley-pear – *Amelanchier* species (NL)

There are six species of this genus found throughout Newfoundland and one species of the six is found in Labrador. On the Prairies, they are known as saskatoons. They are small shrubs (2-5 m) with bright green, oval- shaped, toothed leaves. They are found in a variety of habitats including roadsides, woodlands, barrens and pond and stream margins. Chuckley-pears are among the earliest-blooming shrubs, producing masses of white, 5-petaled flowers. These later develop into purple fruit. They can be eaten fresh or used in sauces and pies.

Sheep sorrel – *Rumex acetosa* (NL) i

Sheep and garden sorrel are common 'weeds' in waste places and garden settings. Plants have reddish-tinted leaves that are shaped like arrowheads. The flowers are reddish but rather insignificant. The leaves have a sour taste and may be eaten raw or cooked as a green. They are rich in vitamin C.

Shepherd's-purse – *Capsella bursa-pastoris* (NL) i

This annual has a low rosette of leaves with wiry upright stems. It produces tiny, white, 4-petaled flowers. Plants in late summer may overwinter as a rosette. It is a common agricultural weed. The leaves of this cress and mustard relative are generally eaten raw in salads or cooked in soups.

Southern Seabeach Sandwort – *Honkenya peploides* subsp. *robusta* (NL)

This perennial plant always grows along sandy portions of beaches. The foliage is yellowish-green with fleshy, oval-shaped leaves which are produced in pairs along a 20-40 cm trailing stem. The flowers are small and white, produced in the upper leaf axils and terminal clusters. The leaves may be consumed at any time as an addition to a salad or pickled as a relish.

Squashberry – *Viburnum edule* (NL)

The squashberry is an erect or straggling shrub which is found along brooks, wet thickets and edges of woods. The leaves, which are vaguely reminiscent of maples, are opposite, three-lobed and toothed. The flowers are white and grow in clusters. The berries are red and contain a single large seed. They can be eaten from the plant or can be used to make jelly

Stinging nettle – *Urtica dioica* subsp. *dioica* (N) i
The stinging nettle is found in disturbed areas across Newfoundland and gets its name from the stinging hairs that cover the plant. This plant grows in clumps and has somewhat hairy, deeply toothed, lance-shaped leaves. Collect leaves (wear gloves) before the plants flower as they may be toxic afterwards. It is recommended to boil the leaves before use. The young leaves can be steamed and eaten as greens, added to soups and stews or dried to use in tea

Strawberry – *Fragaria virginiana* subsp. *glauca* (NL) (Northern wild strawberry)
***F. virginiana* subsp. *vesca* (N) (Woodland strawberry)**
Wild strawberries are common in disturbed areas throughout Newfoundland. The small plants are easily recognized by their trifoliate (3-leaflet) leaves. In May-June, they produce small white 5-petaled flowers that develop into small but very sweet berries by July and early August. They are wonderful for eating fresh or may be made into preserves or wine.

Sweet gale – *Myrica gale* (NL)
This is a common, low shrub of bogs and wet areas throughout the province. Sweet gale is a small, branched deciduous shrub with dull, spoon-shaped leaves. The fruits are waxy, conelike nutlets which can be used as a peppery sage-like spice. The leaves can be used the same way as store-bought bay leaves or they can be dried and made into a tea. Warning: sweet gale fruit contain a powerful resin and should only be used sparingly and avoided by pregnant woman.

Violets – *Viola blanda* (NL), *Viola cucullata* (N), *Viola labradorica* (NL), *Viola macloskeyi* (NL), *Viola nephrophylla* (N), *Viola renifolia* (NL)
All native violets have edible leaves useful in salads or soups. Their flowers may also be used as a colourful garnish in salads. Most violets grow in damp areas such as seepages, pond or river margins or damp forests. They are low plants 10-25 cm with somewhat heart-shaped leaves held atop long leaf-stalks. They produce white to purple flowers mostly in June.

Wild Mint – *Mentha arvensis* subsp. *borealis* (NL)

There are several species of 'wild' mint in Newfoundland. They have distinctive square stems and paired leaves which are oval in outline. Most grow in wet areas along streams and ditches and spread rapidly by underground stolons. Their white to pale pink flowers are minute, held tightly in clusters on the upper leaf axils and terminally. All parts of the plant produce the distinctive mint fragrance when bruised. Leaves may be dried for use in cooking or used fresh in salads and beverages.

Wild rose –*Rosa* species (*R. nitida, R. virginiana*) (NL)

Roses have been traditionally used as a medicine, food, cosmetic, liquor and potpourri. Rose hips are a source of vitamins C, B_3 and D, bioflavonoids, beta carotene and zinc. They can be eaten raw or can be used to make sauce, jelly or tea, but beware of the "hairs" in the centre. The flower petals can be used to make tea, jams, muffins and syrup or they can be candied or added to salads and sandwiches.

Wintercress – *Barbarea vulgaris* (NL) i

Wintercress is a common weed of waste places across Newfoundland and Labrador. Plants are biennial, producing a flat rosette of leaves in their first season then upright stems to 1 m in their second. Plants bloom in May-June with upright stems of numerous small yellow flowers. The leaves of first year plants may be boiled as a green while their flowers may be used as a garnish in salads.

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4. Trees Are Terrific Program

A. Trees Are Terrific

During the school year, introducing children to the plant world can be a challenge, particularly here in the province of Newfoundland and Labrador. Winter often starts early and spring arrives late, leaving little time for any teacher to work with the plant world outdoors. Non-woody, herbaceous plants die back each fall, to be quickly covered with snow. While plants can certainly be studied in the classroom, for many of us, the joy of botany is exploring the great outdoors. This is especially true for children.

So, what do you do when there is a blanket of snow and or ice covering everything in sight? Look up and see the trees. No matter what the month of the year, trees are always there; and children love to play amongst them. If guided, they will even grow to love getting to know them better.

Trees are Terrific is based on a popular education program for families and school groups at MUN Botanical Garden. The original school program comprised of a short indoor presentation, followed by a nature hike to Oxen Pond. Information included: the parts of a tree, its life cycle, its relationship to us and the natural world, as well as its importance to us. Throughout the hike, some simple tips on identifying Newfoundland and Labrador trees and shrubs were covered. An integral part of the program was simply getting up-close and personal with some of our common trees and shrubs.

While it is fun and educational to visit the Botanical Garden or a nature park to learn about trees, we encourage all teachers to take the students out and do some hands-on exploring on your own. The "Going on a Nature Walk with Children" in the Teacher Resources section of this guide provides some hints on leading your class on an expedition into the woods or around the schoolyard. Because trees stay put year after year, and exhibit changes on a seasonal basis, they are ideal specimens to visit over and over again. You will find these trees quickly become your friends, and the children will be happy to visit them. Most students will be unaware of the wonderful learning experiences you and the trees are offering them. Coupled with the development of keen observational skills, your class will also grow to be stewards of the environment.

The following resources and activities have been included to assist teachers and students as they explore and make discoveries about trees and shrubs. These include: *What is a Tree?*, *The*

Importance of a Tree, *Let's be a Tree*, *Leafy Arts and Crafts*, *Tree Math - Measuring Trees*, *Budding Botanist*, *Alder Activity*, *Newfoundland Evergreen Key*, and *Newfoundland Trees and Shrubs Key*. These activities and resources are intended to be adapted to various age groups and learning environments. We encourage you to test them out for yourself and your group, and to modify and expand them to suit your needs. Please let us know how you do. We would love to hear from you.

B. What is a Tree?

A tree is a plant. Unlike its herbaceous counterparts, that die back each fall and re-grow each spring, trees remain visible all year long. They are woody. Any woody plant with a single stem or trunk, and a distinct crown is usually called a tree.

In most parts of the world a tree is only considered a tree if it grows to a height greater than 5-6 meters (15-20 feet). In Newfoundland and Labrador, this rule does not apply. Trees are often much shorter than that. In other parts of the world, woody plants growing less than 6 meters tall are generally considered shrubs. Perhaps a better definition of a shrub in our province would be a woody plant (of any size) with more than one stem or trunk.

Figure 84: Black spruce cone

Conifers

Conifers are often called evergreens, but this is not exactly accurate. Conifers are trees that produce cones. The seeds of the tree are produced within the cone. Spruce and fir are common Newfoundland trees that are evergreens and conifers. The common larch tree (which is sometimes called tamarack) is also a conifer. It produces needles, but it is not an evergreen. It drops its needles each fall and grows new ones each spring.

Evergreens

Evergreen trees continually drop their older leaves or needles and produce newer ones on their outermost twigs where growth occurs. Therefore, they appear green all year long. Again, spruce and fir are common examples of trees that are evergreens and produce needles. The garden plant rhododendron is an example of an evergreen. It stays green all year, yet it produces leaves, not

Figure 85: An example of an evergreen - a rhododendron

needles. Examples of native evergreens that have leaves are: bog rosemary, Labrador tea, leatherleaf, creeping snowberry, twinflower, sheep laurel, cranberry and partridgeberry.

Deciduous

Deciduous trees drop their leaves or needles each fall, and grow new ones from buds each spring. Common examples are maple, dogberry, willow, birch and as mentioned above, the larch.

Figure 86: The Japanese maple is a deciduous tree

Parts of a Tree:

1. Leaves & Needles: contain green chlorophyll cells where the photosynthesis process takes place. We usually use the term 'needle' when referring to the leaf of a conifer. We sometimes call the leaves the 'kitchen' of the plant, where food is produced.

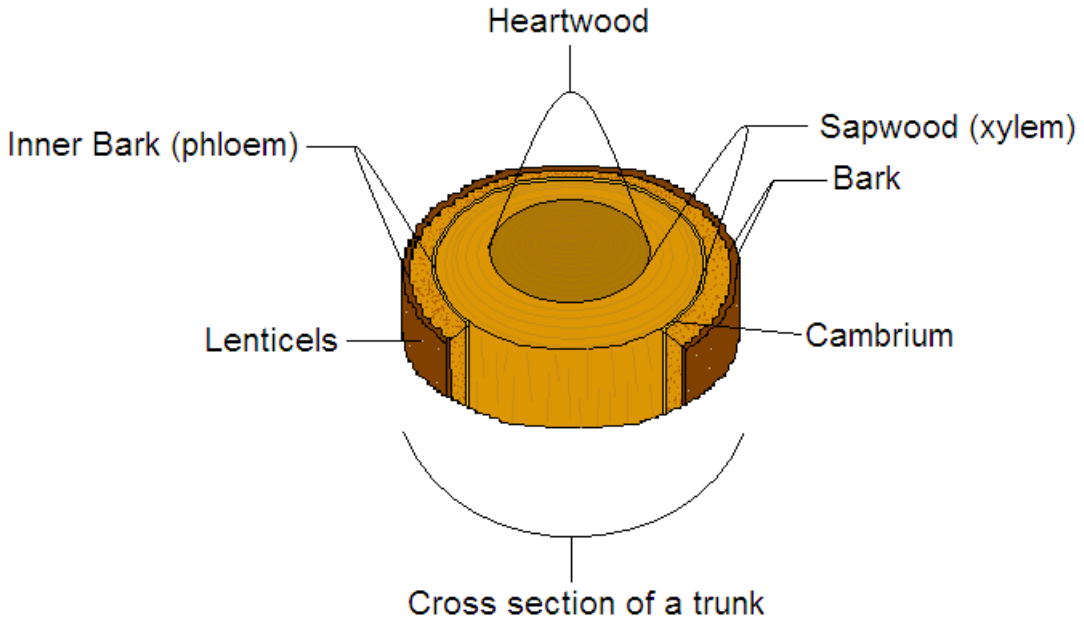
2. Twigs: are the branch tip's yearly growth to support new buds, flowers and the leaves.

3. Branches: have two functions: primary branches originate from the trunk to give the tree its basic form, and secondary branches originate from the primary branches to grow more energy-producing leaves.

4. Trunk: provides the main support and exchange area, or "roadway", for water and nutrients traveling between the roots and food-producing leaves and growth layers.

5. Bark: a tree's outermost layer; it acts as a protective layer against environmental threats, much like the skin on our bodies.

6. Lenticels: are pores in the bark which allow gas exchange between the atmosphere and the inner layers of a tree.



7. Inner Bark: also known as phloem; it consists of channels or vessels where nutrients and food are carried to needed growth areas.

8. Cambrium: the thinnest layer of the trunk, at only one cell width thick; where the sapwood and inner bark are produced, resulting in an increased tree circumference.

9. Sapwood: also known as the xylem layer; it contains vessels where water is carried between the roots and the leaves.

10. Heartwood: is essentially dead wood located in the center of the tree that gives strength and support to the outer living layers of the tree.

11. Roots: there are generally two types of root systems: taproots and fibrous roots. The taproot system consists of one primary root growing vertically into the soil with smaller, secondary roots branching out horizontally. The fibrous root system sends out multiple horizontally reaching roots of a shallower depth.

    Both root systems are used to anchor above- ground growth, absorb and store water and nutrients, and produce certain necessary compounds. The roots which are needed for absorbing water and nutrients have tiny microscopic hairs to assist in the process. When teaching about roots, we often say “our roots are in our boots”, as this helps young children remember where most roots are located.

Figure 87: Sometimes trees fall over and expose their roots

C. The Importance of a Tree

Trees are part of many different habitats in Newfoundland and Labrador. They are important to us as humans, but also to animals, ecosystems and even cities. Here is our top ten list of the importance of trees.

1. **Trees absorb noise pollution**: Big cities produce lots of noise from cars, construction, subways, and airplanes. Trees planted in cities can be used to block and absorb some of this noise pollution that is unhealthy for people and animals.

2. **Trees produce oxygen for us to breathe**: Through the process of photosynthesis trees produce oxygen as a by-product. Oxygen allows for life on earth.

3. **Trees provide homes and food for birds, animals and people**: Birds make nests using parts of trees and plants and some birds have their nests in trees. Many animals including squirrels, mice, and beavers either live in or use trees to make their home. As humans we use trees to build houses and as fuel to heat our homes.

4. **Trees can help control flooding**: Trees can intercept large amounts of water from flash flooding. Their roots can hold the water and release it more slowly so as to limit flood damage.

5. **Trees absorb pollution through their roots**: Trees absorb nutrients and water through their roots in order to grow, but they also can absorb dangerous chemicals and pollution in the soil. This process is called phytoremediation!

6. **Trees keep environments cool with their shade**: Tree shade can cool rivers, animals, humans and cities. Shading rivers reduces the growth of harmful algae blooms and keeps the water cool for fish species. It reduces the need for air conditioning which in turn reduces our energy bill which is good of the environment.

7. **Trees reduce soil erosion**: One of the first steps in controlling erosion is to plant trees and grass. Tree roots can bind the soil together, absorb excess water that would erode the soil and act as a windbreak that can stop soil from being blown away.

8. **Trees clean the air**: Trees intercept particles in the air such as dust, volcanic ash, and pollutants like carbon monoxide and sulfur dioxide that can be harmful to the environment. They are able to retain these particles through the process of respiration.

9. **Trees are a carbon "sink"**: Through photosynthesis trees use carbon dioxide to convert sun energy into food energy to grow. Carbon dioxide is a factor in climate change. A forest is considered a carbon storage area or 'sink' that can use as much carbon as it produces, therefore carbon dioxide isn't available to contribute to the greenhouse effect and climate change.

10. **Trees are beautiful**: Trees can increase property value by beautifying a neighbourhood; they have spiritual significance to many groups of people; and they have been used for artistic inspiration for 1000's of years.

Figure 88: Trees are important for many reasons

D. Activity: Let's be a Tree!

A simple activity to demonstrate the parts of a tree is to literally become one, linking the parts of a plant to our own bodies. This game can be played standing up or sitting down, but it helps if the teacher can stand up to demonstrate.

1. Root in My Boots:
Point to your feet (or wiggle your toes), saying "my roots are in my boots" and explain that roots go into the ground and hold the plant there. Ask the children if they ever saw a tree going for a walk. They will think this is very funny, as they form mental images of such a scene. People don't have roots, just boots, so we can walk or move around.

2. The Trunk:
As you point to the torso or trunk of your body, explain that the main stem of a tree is called a trunk.

3. Bark:
The tree is covered and protected by bark, just as our body is covered by our skin.

4. Branching Out:
Children will quickly hold out their arms to resemble tree branches as we point out that our arms are like branches. Then wiggle your fingers to show that they are like twigs or stems, and that our fingernails could represent leaves.

4. The Crown:
Just as we wear a crown on our head, so is the top of the tree called a crown.

Extend the Learning:

A fun language arts activity is to identify the different meanings for some of these words. For example, the word 'trunk': a tree trunk (or main stem); an elephant's trunk (or proboscis); a storage trunk (or chest, case, box, crate); a car's trunk (storage compartment in the rear); the trunk of our body (or our upper body, torso, chest); the trunk of a road or electrical or communication network (the main part of a system which has branches or subsidiary parts leading away); blood vessel or nerve trunks (which refers to the main part, before branching occurs); swimming trunks (shorts usually worn by men for swimming); a column's trunk (which is the main part or shaft of an architectural column); or a ship's trunk (the part of a boat cabin which is located above the deck), etc. Think about the variety of meanings for such common words as 'bark', 'leaves', 'crown', etc.

E. Leafy Arts and Crafts

1. Leaf Press

Materials:
Old telephone books or old newspapers, two pieces of card stock or plywood, some leaves (either fresh or fallen dried leaves).

Procedure:
Collect some leaves from the school yard or while on a nature hike. Lay the leaves flat between the pages of the phone book or between the sheets of newspaper. Stack the newspaper sheets between the cardboard or wood. Lay something heavy on your leaf press. Check every few days. If the paper is damp, move the leaves onto dry paper (or the leaves may get moldy). Once the leaves are dried and flat, you can use them for a variety of projects

2. Leaf Rubbings

Materials:
Paper scraps, leaves, crayons

Procedure:
Put a leaf on a flat surface, like a desk or counter-top. Cover the leaf with a piece of paper.
Rub a crayon back and forth on the paper over the leaf. Magically, a leaf image will appear.

Figure 89: Children, with MUNBG staff, colour on the leaf rubbing table

Note: This has been a favourite activity in the MUN Botanical Garden display room for decades. We simply collected several types of leaves, we then dried them in a plant press (or old phone book), placed each leaf on a piece of cardboard, and covered each one with MACtac (a clear, adhesive film). Nowadays we laminate the dried leaves. Children have been happily rubbing these leaves for years. Broken crayons, with the paper peeled off, give the best results. We only used recycled scrap paper.

3. Multi-Color Leaf Stamps

Materials:
9" X 12" white paper, markers, scissors, Styrofoam dinner plates or sponge, pencils, Handi-Wipes and leaf pattern (optional).

Procedure:
Students can trace around a leaf on a plate with a pencil or they may draw their own leaf. After tracing, cut out the leaf. Next, ask the students to color all over their leaf using a marker or paint and quickly print it on their paper. Students can then wipe off the leaf stamp using a Handi-Wipe and apply another color.

When applying the second color on top of the first leaf print, make sure the shapes are aligned correctly. They can continue this procedure with 2 more colors, making sure they wipe off each color after it has been printed. The results are really pretty and the students love the tie-dye effect created on the Handi-Wipes!

4. Autumn Canvas

Materials:
Leaves, poster board, glue, plastic wrap

Procedure:
Go on a nature walk and collect leaves. Dry the leaves by pressing them between paper and applying weight (old phone books work very well). Once the leaves are dried (a few days to a week), affix them to a piece of poster board with glue. Overlap the leaves so that the entire board is covered. You can stretch plastic wrap or a used plastic bag (keep out of young hands) around the front to keep the leaves from breaking, or simply hang the canvas on the wall.

Alternatively, make small leaf canvases and use them as greeting cards. You can laminate the cards to prevent the leaves from crumbling off over time.

5. Finger Paint Leaves

Materials:
Go on a nature walk and collect a wide assortment of leaves. Additional supplies include: finger-paint, newspapers, and white paper

Procedure:
Ask each student to find the bumpy side of a leaf -- the side with the raised veins. Show them how they can use their fingers to spread a thin layer of finger-paint on the bumpy side of their leaves. Talk about how this side of the leaf feels. Ask children to put their leaves, paint-side down, on white paper, place newspaper pages over them, and press to make prints. Children can then remove the newspaper, peel off the leaves (with clean fingers), and marvel at their colourful leaf prints. Compare the physical characteristics of children's leaf prints. Place the prints on a large piece of craft paper to make a fall class mural.

6. Leaf Guide Book

Materials:
Leaves collected on a nature walk, wax paper, iron, coloured craft paper, stapler

Procedure:
Go on a nature walk and collect fresh leaves. Dry the leaves. Cut wax paper so that it is the same size as a sheet of office paper (8.5 x 11 inches). The paper will need to be big enough so that it can be folded around the leaf.

Fold wax paper in half (8.5 x 5.5 in). Place leaf inside the wax paper (with fold of paper to the right and leaf facing up). Press leaf in wax paper with an iron. Stack wax papers (with fold of paper to the right). Use coloured construction paper for the book cover, by folding in half. Insert the stack of wax papers into the craft paper, so that the fold of the wax paper is pointing out. Apply a staple at the fold side of craft paper to secure the leaves in the wax paper. Label pages of the leaf guide book with the name of the leaves.

7. Dried Leaf Owl

Materials:
An assortment of dried leaves, 8.5 X 11 inch piece of white cardboard, glue, glue brush, large picture of an owl, optional: adhesive picture hook

Procedure:
Dry the leaves. Trace a picture of an owl (or draw your own) onto the piece of cardboard, using all the space available. Place the leaves on your drawing, and keep rearranging them until you have the picture just as you want it. One by one, glue each leaf on to your picture using different sizes and shapes of leaves to make your picture interesting. When dry, attach optional adhesive picture hook to the back and hang.

8. Leaf Mobile

Materials:
Leaves, branches, shellac, string for tying, glue

Procedure:
Collect fresh, well-shaped leaves and two or three branches about 2 feet long. Dry the leaves. Shellac each leaf surface on one side and let dry, then repeat for the other side. Tie branches together in the middle, so that they cross one another. Cut different lengths of string and glue the shellacked leaves to one end of the string. Tie strings to the ends/middle of the branches.

9. Leafy Critters

Materials:
Leaves, seeds, other collectibles, pictures of animals, glue, construction paper

Procedure:
Collect leaves and dry them. Let the children look at pictures of animals (or other things) and ask them to create creatures from the leaves (or seeds or other collectibles) by gluing the leaves on to a piece of craft paper. (Some may find it easier to draw an outline first)

10. Foliage Frames

Materials:
Popsicle sticks or matting board, leaves, seeds, and other collectible items

Procedure:
Create a frame using popsicle sticks or choose a matting frame. Decorate the frame with leaves, seeds or other collectibles and place over the artwork.

F. Tree Math – Measuring Trees

The following are fun activities to do while playing in the school yard or going on a nature hike. Most students will be so busy enjoying playing outside, that they will forget this is a math lesson. The activities demonstrate how to determine the measurement of the trunk, crown, and height of a tree using vertical and horizontal measurement. They also demonstrate how practical and fun math really is. As you can see, there are several methods to try; some seem easier than others.

Materials required: Lengths of string, rulers, paper, pencils, meter sticks, trees.

It may be easier to assign students partners or working groups ahead of time.

Ask the students: "How can we measure something that is bigger than us, using tools that are smaller than us?" Most students will be very intrigued that these simple techniques actually work. If there is interest, allow students time to experiment and play with methods to measure larger objects, before you start the activity. They may surprise you with their findings!

Measurements

A. Measuring the Circumference of a Tree

Method #1: (We call this the "Hug-a-tree" method)

1. Select a tree with a small circumference.
2. Let each child hug the tree, with a partner noting where the hands or arms overlap.
3. Let each child step back from the tree, extending arms fully in a straight line.
4. The partner then should use a string to measure the child's arms, being sure not to measure beyond the overlap points.
5. Measure the piece of string with ruler and record.
6. Children love to compare tree size with others (with their arms outstretched). You will hear a lot of "My tree was THIS big".

Method #2

1. Measure from the ground to 1.3 meters (approximately 4.5 feet) high on the trunk.
2. At that height, wrap a string around the trunk. Mark the string where it overlaps and measure the length of the string. This is the circumference of the tree.

B. Measuring Tree Height

Method #1

1. Walk away from the tree, bend over and sight the tree top between your legs. Stop when you can see the top of the tree while in this position.
2 Mark the spot where you stopped
3. Measure the distance from your spot to the tree.
4. The approximate height of the tree will equal your distance from the tree.

Method #2 (Also known as the 'Stick Method')

1. Stand next to the tree and mark your height on the tree trunk with ribbon or tape.
2. Take several giant steps back from the tree. Hold a stick up before you in an outstretched hand in front of your face. Sight the height of your mark on the tree and mark this on the stick with a pencil.
3. Count how many times this height goes up the tree.
4. The approximate height of the tree will equal the number you counted in step #3 multiplied by your height.

Method #3

1. Group students in pairs.
2 Student #1 should stand at the base of a tree.
3. Student #2 should back away from the tree, holding a ruler in front in a vertical position. (It is very important to keep your arm straight in this exercise).
4. Stop backing away when the tree and the ruler appear to be the same size. (Close one eye to help line it up.)
5. Next, have the student #2 turn his/her wrist so that the ruler looks level to the ground and is in a horizontal position. Don't forget to keep the arm straight.
6. Student #1 should walk to the spot that is seen as the top of the ruler. Be sure the base of the ruler is kept at the base of the tree.
7. Measure the distance student #1 walked. This is the tree's height.

Method #4

1. Designate one student to do the measuring.
2. Measure the distance between the measurer's eye and hand at the end of his/her outstretched arm.

3. Make a stick the same length as the distance in #2.
4. The measurer should stand on level ground facing the tree, holding the stick outstretched in his/her hand vertically, making sure that the length of the stick above his hand equals the distance from his hand to his eye (measured earlier).
5. The measurer then backs away slowly, holding the stick steady, until he can "see" the top of the stick reach the top of the tree and the bottom of the stick the base of the tree.
6. Once he stops backing away and reaches this point, mark the spot where the measurer is standing.
7. Using a tape measure or string, measure the distance between the base of the tree and the spot marked on the ground. The distance you measure is the tree's approximate height.

Method #5 (Also known as the 'Shadow Method')

With this activity, not only do you estimate a tree's height by comparing the length of its shadow with the length of our own shadow, but you also get to go outside and enjoy a sunny day.

1. Pick a tree standing alone. Locate its shadow.
2. Measure the distance from the base of the tree to where the shadow ends. Call this value 'A'.
3. Stand where the shadow of the tree ends and get a partner to mark where the student's shadow ends.
4. Measure from the base of the student to where their shadow ends. Call this value 'B'
5. Measure the actual height of the student. Call this value 'C'.
6. Tree height is equal to the tree shadow length multiplied by (the student's height divided by the student's shadow length)

Tree height = A X (C/B)

Extend the Learning:
Ask the students if shadows change throughout the day / seasons. Will this affect the measurements and overall results? Devise an experiment to test this. Collect data over time and record and graph the results.

C. Measuring the Crown (Canopy) of a Tree

Method #1

1. Find the tree's five longest branches.
2. Put markers on the ground beneath the tip of the longest branch.
3. Find a branch that is opposite it and mark its tip on the ground.
4. Measure along the ground from first marker to the second marker.
5. Record the number and label as the crown.

Method #2

1. Place small markers such as stakes or sticks in the soil underneath the canopy, or outermost branch tips circling the tree.
2. Visualize two imaginary lines passing through the center of the canopy, one indicating the longest distance across the crown and the other indicating the shortest.
3. Use a length of string or measuring tape to measure the distances of these imaginary lines.
4. To determine your tree's average crown width, add both of your measurements together and divide the resulting sum in half.

Tying it all Together

Children can compare answers before they go back to class. Be sure and allow time for each person to take several measurements, especially if they are working in pairs or groups.

Measuring becomes most meaningful when the results are displayed, and a map or a chart shows the results of the group project. Students can make bar graphs using information gathered outside and they can create maps showing the biggest trees, and smallest trees. If the equipment is available, record the GPS coordinates of each tree. The data collection could continue for years if the trees are located in or near the school property. Digital photos can also be used to record the growth and changes of the trees.

Extend the Learning:

Many tools and techniques have been devised over the years to measure the height and altitude of many objects. Students may be interested to explore this topic further. Local professionals may also be available to visit the class and demonstrate how these tools are used in the workplace.

G. Budding Botanists

BUDDING BOTANIST ACTIVITY: Springing Into Leaf (&/or Flower)

Materials:

- A pair of sharp hand pruners or secateurs
- Jars or containers of various sizes
- We also highly recommend obtaining a copy of Native Trees and Shrubs of Newfoundland and Labrador, by A. Glen Ryan

Procedure:

Cut some small branches or twigs from a tree or shrub. Put a wet rag or paper towel around the end until you get it into water. Simply re-trim the twig edge if it dries out. If possible, make a note of where you found the plant, its height, width and general characteristics (i.e. drooping stems, bright red branches, etc.). A photograph of the entire plant will enhance the classroom follow-up.

Figure 90: Larch location photo

Figure 91: Close up of larch branch

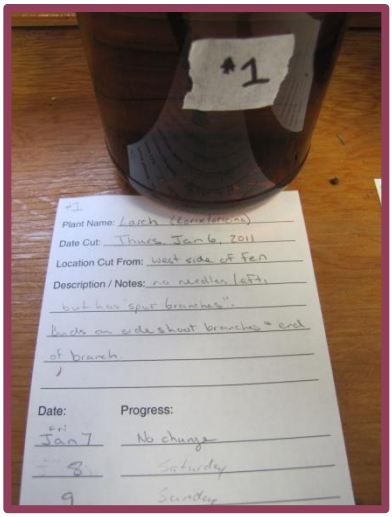


Figure 92: Larch data sheet

In The Classroom:

Place the branches in a jar filled with room-temperature water. Place the jar near a window if possible. Check the water levels daily. If the water gets sour, wash the jar with hot, soapy water, rinse well and add new water and plant again. It's that simple! Observe what happens daily.

Figure 93: Larch branch sitting in water

Figure 94: Larch buds opening after being indoors for two weeks

Some Advice on Collecting Plant Materials:

When cutting a branch from a tree or shrub, it is important to minimize damage to the plant. Using sharp hand-pruners, remove branches to their points of origin or attachment. When you prune the branch back to another branch, or prune a branch from the trunk, you are thinning. This can actually encourage growth throughout the tree and can help with better air circulation, improved sunlight penetration, and less wind resistance. Never remove several branches from a single plant (unless you are an experienced pruner). If the plant is young and/or it is the only one of its kind in an area, we usually leave it alone. Also, do not try to cut large branches. Smaller twigs are easier to handle and their removal will cause less damage to the plant. Never twist or snap off the branch, as this will also damage the tree.

Plants should never be tampered with in any parks, nature reserves, public gardens, or private property without prior permission. Let your friends, neighbours and co-workers know you will accept donations. When collecting plants, sketches or photographs of the original plant can enhance the learning later on in the classroom.

What Is Happening?

The students will see some cone-shaped knobs or buds sitting at the tip of each branch (the terminal buds) and sometimes along the sides of the branches (lateral buds). Explain to the students that these contain "spring", or this season's leaves and stems and sometimes flowers. They were actually formed on the tree in the fall.

Figure 95: A terminal bud on a balsam fir

Have the students look closely under the bud. You should see a leaf-scar, or mark left when the leaf fell off last fall. Buds and leaf scars vary from plant to plant and can help you identify the plant, even before the flowers and leaves emerge. This bud-opening process is something magical that happens on tree and shrub limbs every spring. Each day, re-examine the twigs. Over time, the buds which are usually small and dark, will swell, turn green and open to reveal an emerging leaf or flower. Continue to make observations, measure and record results. Don't forget to stand back and admire "spring" as it blooms in your classroom. Ask the students to express how it makes them feel – verbally, through poetry, drawings, etc.

Let The Fun Begin!

Let the children spend time every day examining each branch. Encourage touching, smelling, sketching, measuring, tabulating and graphing the data. Digital photos are a wonderful way to record the changes. Magnifiers make it even more interesting.

At first glance the description of one twig will match the description of another (i.e. brown, woody, etc.). As they look closer and start making comparisons, their observational skills will greatly improve. Do plants and animals depend on each other? Find out by placing a white sheet of paper under the jar to see if your branch had any hitchhikers (you may see tiny dark specks called frass or insect droppings).

Some European and Scandinavian countries celebrate spring traditions by decorating branches of deciduous trees placed in water. Have the students investigate these customs as part of social studies. Do different countries use different trees? Create decorations for your branches in the classroom. These decorations can make lovely gifts.

Freshly emerged leaves and flowers on a chuckley pear or other common Newfoundland shrub or garden plant look beautiful, especially after a long winter and they can brighten any room. As the leaf and flower buds swell and open, ask the students to describe how this makes them feel. Do the fresh green leaves remind them of spring? Name the four seasons of the year, identify characteristics of each season and compare them. If these buds formed last year, has the tree been ready and waiting for spring all this time?

Ask the students if we can manipulate how the buds open. Temperature (of the room and water), light, and the amount and quality of water are just some factors that can be varied. Positioning the branches in different parts of the classroom may also affect results. For example, if new leaves open on a branch placed in a hot window, will the leaves shrivel? Will it do better or worse if you vary the amount of water in the jar? What if the water quality varied? If we add tiny amounts of salt or oil to the water, does this affect the plant? Do you think the salt and oil spilling off roadways affects plants in the wild? Collect and decorate "vases" for the classroom using recycled materials. See how creative the containers and the decorations can be. The sky is the limit here.

Identification of your Plant:

Compile all the data once the leaves and/or flowers have emerged. (The plant piece will eventually die and can be discarded into a compost bin.) When analyzing the data, see if the plant can be named or identified from your observations. If not, do not worry. The main objective of this project is to learn to be skilled plant observers, not memorize names. The

students will actually get to know their branch quite well. Winter twigs can be hard to identify, but you may be able to do so by using the keys on pages 146 & 147.

Ask the students to speculate (i.e. hypothesize) on how the entire plant really looks. Is it tall, short, and bushy, etc.? If you have photos of the plant growing outside or can bring the children to the tree or shrub, so much the better. You may find that they will get quite excited, like meeting an old friend. Play nature detectives: if you trimmed branches from several plants, let the students compare the photos to the branch to see if they can make the correct match. Compare sketches or photographs taken the first day the branches were immersed in water and compare with the plant once the leaves have emerged. Can they match them correctly?

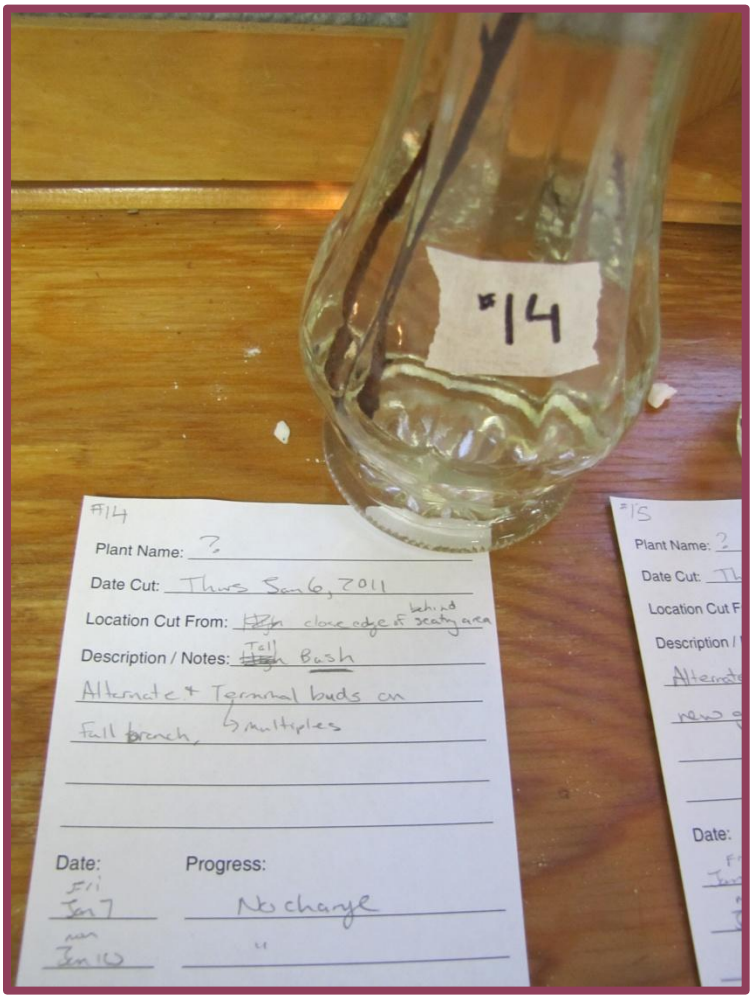


Figure 96: An unidentified plant data sheet

If you cannot identify your plant, feel free to assign your own common name, based on its physical characteristics, where you found it, feedback from the students, etc. The class can even hold a vote. You can explain that all plants have two sets of names: its scientific name, which is its official name; and common names, which vary from community to community. In Newfoundland and Labrador we have many unique common names that are understood only by the local people. If you have a native tree or shrub, it will be depicted in the book "Native Trees and Shrubs of Newfoundland and Labrador" by A. Glen Ryan.

How will you know if it is native or an introduced plant? There is no simple answer to this question. If it is growing in a garden, there is a good chance the plant is not native (but there are no guarantees). Similarly, if it is growing behind your cabin, it might be native. Having said

that, garden escapes are common, even from one hundred years ago, so any plant growing near an old settlement, graveyard or cow pasture could be introduced. Local gardening centers, gardening clubs and botanical gardens can help you identify your plant. Try to supply a synopsis of your data, including sketches and photographs if available to aid in identification. The good news is, you and your students will quickly become skilled observers and you will learn each plant's identity as you go.

Extend the Learning

Visit trees and shrubs in your school garden and local park on a regular basis throughout the year with your students. Have students observe, measure, record and graph all findings. Examine the buds in the fall (yes, they are formed before winter sets in), and watch them all winter. When spring arrives, make a point of examining the buds daily, noting the changes. Compare the growth to the cuttings forced into bloom indoors.

The following page is a sample of our record keeping form.

Figure 97: Young larch cones resemble flower buds

Plant Name:_____

Date Cut: _____

Location Cut From: _____

Description / Notes:

_____

_____

_____

_____

Date:	Progress:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

H. Alder Activity: Getting Up-Close and Personal With a Newfoundland Plant

Introduction:

The following activity is intended to assist teachers, youth group leaders and parents who are introducing children to the world of plants. The activity should be modified to fit the age level and learning experience best suited to your needs. As with all MUN Botanical Garden programs, your feedback is most welcome.

Mountain alder, also known as green alder in some areas of Newfoundland and Labrador, is one of the most common roadside shrubs in our province. It is an excellent plant to study, as it is common, plentiful, and familiar to most people. Despite the fact that people love to hate it because it can be difficult to remove from roadsides and gardens, alder is actually quite an interesting and valuable shrub. Some wildlife are attracted to it for its food value, shelter and camouflage so you never know who may be browsing and hiding among its leaves and stems. It is also a valuable pioneer species in ecological succession and also assists in preventing soil erosion.

Getting Started:

Teachers may wish to start by collecting some fresh-cut branches and observing the changes that occur when placed in water with their students. (Please see the *Budding Botanist* activity on page 133 for more details.)

Once you become familiar with alder, you can practice using a key to identify alder. This will help to sharpen plant identification skills. (For more details on using a key, please refer to the *Identifying Alder: Using a Key* activity, on page 144.)

Figure 98: If this is your first time identifying alder, especially in winter, look for small dried woody 'cones', on the plant. This is last year's fruit.

Getting To Know Alder:

Common Name: Mountain or Green *Alder*
Scientific Name: *Alnus viridis* (Chaix) DC. in Lam. & DC. subsp. *crispa* (Dryand, ex Aiton) Turrill ex. Aiton

Alder is described in A. Glen Ryan's book *Native Trees and Shrubs of Newfoundland and Labrador* on pages 60 - 61, complete with detailed illustrations of the flower, leaves and buds. Ryan used the older scientific name *Alnus crispa* (Ait.) Pursh. The new name has *crispa* as the subspecies. With new advances in genetic testing, scientific name changes are a common occurrence. Don't let this intimidate you! To avoid frustration, try and use the most current sources and names, but keep in mind using the old scientific names or synonyms in researching plants is completely acceptable. The speckled alder, *Alnus rugosa* (DuRoi) Spreng, is also depicted in Ryan. Speckled alder has also undergone a name change to *Alnus incana* (L.) Moench supsp. r*ugosa* (DuRoi) R.T. Clausen. This species is not as common as mountain alder and does not grow on the Avalon or Great Northern peninsulas. An easy way to tell the species apart is by their leaves. Mountain alder has a toothed leaf margin with 7 – 8 pairs of veins on each leaf; where as speckled alder's leaf margin is toothed and at times double toothed with 10 or more pairs of veins on each leaf. View the illustrations in Ryan to clearly see the difference.

To locate mountain alder in the wild, look for an upright shrub and because alder is so common, you can usually see several shrubs in an area. Its habitat varies, growing near water, or in wet areas, but it is also common in cutover areas, along rocky banks, roadsides and other dry areas. It is usually one of the first shrubs to grow in an area that has been clear-cut as it is a common pioneer species.

While mountain alder can grow as high as 2 - 3 meters, please keep in mind that plant growth can be quite stunted in our province. So its height and growth can be quite varied. Mountain alder is considered a shrub, not a tree. Shrubs are woody plants with many stems starting from the ground, which curve outwards from the base; whereas trees are woody plants with one main trunk that supports many branches. The appearance of the twigs can vary, depending on their age. Young twigs are brown, sticky and have a few white marks or lenticels on them. Older twigs are smooth and greyish. The tips of the buds are brown and appear sharp and pointed.

If this is your first time locating mountain alder look for small dried woody 'cones', on the plant (*Figure 98*). These are not actually cones but last year's fruit. Ryan describes alder as a "coarse" shrub.

Figure 99: **Male and female catkins on a Mountain Alder**

The Flowers:

The male and female flowers of this shrub are found in separate catkins on the same plant (*Figure 99*). Catkins are a specialized flower clusters. Male catkins are long, and drooping, rusty brown in color, with yellow pollen. The female catkins are shorter, erect, and green. The flowers normally bloom during April and May, as the leaves expand. Only the male catkins are exposed in the winter. Female catkins are protected in the buds. If you bring a branch of this plant inside during the winter, the flowers will come out and you can even see the pollen.

The Fruit:

The fruit appear as small winged nutlets in woody 'cones'. The nutlets mature in the fall, but the 'cones' stay on the shrub all winter. These 'cones' are sometimes used in Christmas wreaths and decorations.

All About Alders: I'll Bet You Didn't Know……

Pioneer Plants:

Pioneer plants, such as mountain alder, are the first plants to colonize an area after a disturbance (fire, construction, etc.), they jumpstart ecological succession. Initially, the growth of longer-lived species such as white spruce may be affected due to the shade provided by an alder thicket. Over time, the spruce will successfully thrive. This will mark the beginning of the end of the alder thicket.

Figure 100: Leaves, fruit and 'cones' of Mountain Alder

Alders & the Soil:
Many areas of Newfoundland have thin, poor soils. When trees are cut, fall or burn down, soils often quickly wash away with the rains or are blown away with our constant winds. Slopes can quickly erode before regrowth can occur. Alders are important in preventing soil erosion, and they also serve as excellent windbreaks.

Alders are important in returning nitrogen to the soil. Fungi living in nodules on the alder roots can convert atmospheric nitrogen to usable nitrogen in the soil in a process called nitrogen fixation. Nitrogen is needed by many plants to grow. The leaves of the plant are unusually rich in nitrogen and an annual deposit of leaves each fall returns valuable nitrogen back to the soil. It has been calculated that the combined processes of the alder roots and the alder leaves can add up to 160 kilograms of nitrogen per hectare of soil each year. In this sense alders can be used to fertilize larger groves of commercially important trees.

Alder Wood:
Alder wood that has excellent heating value. A source of wood is readily available since alders can be mowed every three to five years and will re-sprout indefinitely.

Studies in the 1960's at the University of Maine also point to the use of alder as a good pulpwood. Yields were as good as or significantly better than other commonly used species of hardwood. Alder chips could be used in the production of chipboard or other wood products that are in demand.

Importance to Wildlife:

Mountain alders are an important food source for wildlife. You never know who you may meet when you visit an alder patch.

If you quietly stand by an alder thicket, you may see and hear many birds foraging amongst the branches. Alder seeds are a favourite winter food source for a variety of birds including pine siskins, American goldfinches and common redpolls and alder buds are often browsed by ruffed grouse.

Snowshoe hare (referred to as ‘rabbits’ by most locals) and moose commonly eat alder leaves and stems. While it is not their preferred food, these animals use mountain alder to supplement their diet in the winter and early spring. Locating stems that have been browsed by these mammals can be a fun activity. Be sure to check stem and buds growing high up on the shrub because with high snow levels, snowshoe hare can reach branches far from the ground.

Can you tell the difference between a twig nibbled by hare and by moose? The cut made by the hare is much sharper and cleaner because they use their sharp front teeth. Moose rip at the stem more, often leaving a strip of bark behind because they use their back gnawing teeth.

Alder is a 'host plant' for the native green comma butterfly. The butterfly lays its eggs on the alder leaves. When the eggs hatch, the caterpillars will eat the alder leaves before pupating and then turning into a butterfly. Green comma butterflies are common woodland species that over-winter as adult butterflies in Newfoundland (i.e. they 'hibernate' all winter as an adult butterfly). They will emerge as soon as the temperature warms up in the spring and along with the mourning cloak and Milbert's tortoiseshell, can be one of our first butterflies for the year.

Traditional Medicinal Uses:
Bark teas were used by the Mi'kmaq to combat diphtheria, a very serious and contagious disease which is now controlled thanks to vaccinations. Stems were boiled and chewed to relieve hemorrhages and to promote rapid healing of wounds, fractures or dislocations.

Acadian Indians also brewed a tonic by boiling the bark until the water turned a reddish brown. A small glass full of the concoction would be drunk every day to prevent anemia, to purify the blood and to prevent skin disease and boils.

In the Flower Garden:
The horticulture staff at MUN Botanical Garden use alder cuttings every year to create a frame to support the growth of taller perennials. As the plant grows, the alder is hidden amongst its greenery. With our constant winds, this homemade frame keeps our plants standing upright all season.

Figure 101: Carl, the Head Gardener at MUNBG, sets up an alder frame in the spring for perennials to grown through.

Identifying Alder: Using a Key

Dichotomous keys are used in many different disciplines including botany. They consist of a series of paired descriptions, called couplets. Beginning with the first pair, you must read each couplet carefully and choose the description that best describes your plant. At the end of each of your chosen description there will be a name or a number letting you know where to find the next couplet. You repeat the procedure until the couplets have been exhausted and you are left with the genus and species or common name of your plant.

Keys can at times be challenging. A good tip when using keys is to have a botanical or biological dictionary on hand. This can help with deciphering difficult terminology. We have included the key sequence for mountain alder using the "Key to the Common Newfoundland Trees and Shrubs" by Dr. M.A.J. Collins. A. Glen Ryan's book "Native trees and shrubs of Newfoundland and Labrador" also has a key that can be used to identify alder within that text.

The correct key sequence for mountain alder in the Collins key is – 1b, 8b, 11b, 12a, 13b, 14b, 15a, 16a, 17b.

I. Newfoundland Evergreen Key

This simple key can be used when doing the *Springing Into Leaf* activity and when learning to identify some common shrubs and trees in Newfoundland and Labrador

1.	a.	Normally trees, cones often present	2
	b.	Normally shrubs, cones absent	6
2.	a.	Needles very long and thin 5cm + ...	3
	b.	Needles shorter than 2.5cm	4
3.	a.	Needles in pairs from a common base	**Red Pine**
	b.	Needles in 5's from a common base	**White Pine**
4.	a.	Needles less than 1.2 cm narrow, bark without resin blobs, cones drooping	5
	b.	Needles more than 1.2 cm wider, bark covered with resin bubbles, cones erect	**Balsam Fir**
5.	a.	Twigs covered with brown hair, cones almost spherical	**Black Spruce**
	b.	Twigs hairless, cones long 3.8 cm + ...	**White Spruce**
6.	a.	Needles thin and sharp, painted green above and white ..... below	**Dwaf Juniper**
	b.	Leaves not sharp needled	7
7.	a.	Leaves green above, covered with hairs below	8
	b.	Leaves green above and below	9
8.	a.	Leaves twice as long as broad, underside covered with rust colored hairs	**Labrador Tea**
	b.	Leaves at least 4 times as long as broad, underside covered with white hairs	**Bog Laurel**
9.	a.	Leaves bright green, waxy in appearance, less than 1.2 cm wide	**Leatherleaf**
	b.	Leaves dull green, oval shaped, quite often with brown patches on leaves	**Sheep Laurel**

Reference:

Collins, Dr. M.A.J. 1976. *Winter Ecology*. Oxen Pond Botanic Park, Memorial University of Newfoundland.

J. Common Newfoundland Trees and Shrubs Key

This simple key can be used when doing the *Springing Into Leaf* activity and when learning to identify some common shrubs and trees in Newfoundland and Labrador

1.	a.	Buds opposite, branches opposite	2
	b.	Buds and branches not opposite, either alternate or ..... scattered around stem	8
2.	a.	Branches brittle and light, no terminal bud, and no lateral .. buds near tip	***Sambucus pubens*** **(Red Elderberry)**
	b.	Branches flexible, terminal bud present, lateral buds near .. tip	3
3.	a.	Twigs wine or red colored, buds small	4
	b.	Twigs not wine or red colored, buds larger	5
4.	a.	Twigs and older branches red in color, buds slightly stalked, usually small shrubs in moist areas	***Cornus stolonifera*** **(Red Osier Dogwood)**
	b.	Only young twigs red, older branches light grey, buds not ... stalked, usually tall shrubs or trees	***Acer spicatum*** **(Mountain Maple)**
5.	a.	Buds brownish in color, long and thin, normally terminal .... buds 1.2 cm or more in length	***Viburnum cassinoides*** **(Northern Wild Raisin)**
	b.	Buds reddish or black, oval in shape, terminal buds less ..... than 1.2 cm in length	6
6.	a.	Buds domed in shape, black, normally tall trees	***Fraxinus nigra*** **(Black Ash)**
	b.	Buds roughly oval and red, normally shrubs	7
7.	a.	Buds longer than broad, terminal bud less than 0.5 cm, ... twigs stout, not bearing berries	***Acer rubrum*** **(Red Maple)**
	b.	Buds almost spherical, terminal bud about 1 cm, twigs ..... slender, quite often bearing red berries	***Viburnum edule*** **(Squashberry)**
8.	a.	Buds normally 1.2 cm in length or longer	9
	b.	Buds normally 0.6 cm or less in length	11

9.	a.	Buds large, blackish in color and sticky ……	***Sorbus sp.*** **(Dogberry)**
	b.	Buds not so large, not black or sticky ……	10
10.	a.	Buds large and brown, definitely aromatic, not bearing ……. berries, normally trees	***Populus balsamifera*** **(Balsam Poplar)**
	b.	Buds long but thin, brown or purplish, quite often bearing . single black berries, normally shrubs	***Amelanchier sp.*** **(Chuckley Pear)**
11.	a.	Buds closely pressed onto stem, and not possessing more .. than one bud scale	***Salix sp.*** **(Willows)**
	b.	Buds not closely pressed onto stem, and often possessing 3 or more bud scales	12
12.	a.	Buds normally 0.6 cm or slightly more ……..	13
	b.	Buds normally 0.3 cm or less ……..	18
13.	a.	Normally 2 types of buds on older trees, smaller leaf buds . and fatter flower buds, older bark definitely greenish	***Populus tremuloides*** **(Trembling Aspen)**
	b.	Trees or shrubs, possessing only one type of bud, but ……. sometimes possessing immature catkins, older bark whitish, grey or brown	14
14.	a.	Buds slim, spindle shaped, purplish or brown, sometimes … bearing single black berries, but no catkins	***Amelanchier sp.*** **(Chuckley Pear)**
	b.	Buds not slim, normally nearly pointed oval, brownish in …. color, sometimes possessing catkins but not berries	15
15.	a.	Trees or shrubs, usually possessing catkins without bitter … almond taste	16
	b.	Small trees or tall shrubs, not possessing catkins, twigs ……. with bitter almond taste	***Prunus virginiana*** **(Choke Cherry)**
16.	a.	Small or large shrubs, possessing buds and immature ……. catkins, and old ‘cones’ old bark brown to grey	17
	b.	Small or large trees, sometimes possessing catkins but not . cones, old bark normally whitish	***Betula sp.*** **(Birch)**
17.	a.	Larger shrubs of wet areas, with rounded, obviously …… stalked buds, and drooping catkins	***Alnus rugosa*** **(Speckled Alder)**
	b.	Smaller shrubs common in a variety of habitats especially .. roadsides and abandoned fields, buds pointed, not normally stalked, catkins erect	***Alnus crispa*** **(Downy Alder)**
18.	a.	Young twigs covered with obvious fine white fuzz, …… sometimes bearing single black berries, buds about 0.3 cm	***Pyrus floribunda*** **(Chokeberry)**
	b.	Twigs not covered with white fuzz, and not bearing black … berries, buds about 1.5 mm	19

19.	a.	Several minute buds at tip of each twig, quite often ..... infected with 'Black Knot' fungus (black swellings on twigs)	***Prunus pennsylvanica*** **(Pin Cherry)**
	b.	Only 1 terminal bud, not infected with Black Knot	20
20.	a.	Trees, stems covered with straw colored scales, buds small dark brown, quite often bearing cones	***Larix laricina*** **(Tamarack)**
	b.	Small to large shrubs, with ashy grey older bark, tips of ..... twigs purplish or brown, not bearing cones	***Nemopanthus mucronata*** **(Mountain Holly)**

Reference:
Collins, Dr. M.A.J. 1976. *Winter Ecology*. Oxen Pond Botanic Park, Memorial University of Newfoundland.

Figure 102: Pin cherry is easily identified by the black knot fungus

5. Teacher Resources

A. Going on a Nature Walk with Children

At MUN Botanical Garden, nature walks have always been an integral component of our education programs. When the Garden opened its gates over 30 years ago, visiting schools and youth groups were our main audience. Today, even though we have expanded our offerings to include Parents and Tots, Junior Naturalist Camps, and Sunday Family Days, to name a few, the nature walk has proven time and again to be the highlight of the many programs, enjoyed by adults and children alike.

While it is obvious that a nature walk is a welcome change from the classroom, not to mention an opportunity to get outside, enjoy some fresh air and get some exercise, its real benefits go much deeper. In fact, a simple nature walk can open one's senses to the natural world in a way few other activities or games ever could. This awareness stimulates a natural curiosity, a love of learning, and may initiate a very positive and long-lasting personal connection to our natural environment. Over time, a heightened sense of respect, caring and appreciation for our world, our natural habitats and the creatures that inhabit them will also be fostered.

But the benefits do not end there. A wide variety of subjects, not just science, may be integrated when going on a nature walk. Over the years, education staff have been called upon and have quite successfully developed nature walks that integrate Language Arts, Social Sciences, and even math! The learning opportunities derived from a nature hike are endless and only limited by one's imagination.

For example, grade 4 teachers can utilize nature hike activities when studying the Habitats unit in the science curriculum, and the Exploration units in the social studies curriculum. Similarly, grade 3 teachers can link the Plant Growth and Changes and the Exploring Soils science units with the social studies Provincial Identity units. Language arts, math, art, music, health and physical education can all be incorporated in the nature hike.

MUN Botanical Garden and many other facilities offer schools a variety of curriculum-linked education programs that include a guided nature walk. While all teachers are welcome to book a program with us, we do not want the nature walk experience to end there. Instead, we encourage all teachers, from Kindergarten to secondary levels, to branch out on their own and make the nature walk a regular experience with students. The leader does not have to be a botanist, scientist or any kind of expert. In fact, many teachers may be surprised to find they

learn with the students. In turn, students enjoy learning with the teacher and occasionally, through sharing experiences, they may take on the role of educator.

The following outline is intended as an introduction for educators, and youth group leaders who would like to incorporate nature walks into their curriculum or program. Parents may find some of the information helpful as well. The Garden's education staff welcomes inquiries and feedback. Experience is often the best teacher. So please remember: there is no right or wrong method to leading a walk, and each teacher will develop their own style. Students will also vary in their responses. Have fun with it. The rest will follow.

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Teacher Tips:

1. Select a Route

Please keep in mind that this type of outing may be a very new experience for many students, and some may find it difficult to focus the first time out. We find it is often preferable to keep the first excursion very short and very simple (without any high expectations for anyone). The students will adapt quite quickly to this type of activity, and over time both teacher and child will grow to be "expert nature detectives".

If you are fairly new at this, pick a familiar route. You will be more comfortable leading a group through familiar terrain, and will probably have more interesting stories to recount from your own experiences. Children find our local, cultural history, particularly our own, to be a fascinating point of discussion, and love to hear about "the old days." Of course these stories can be easily incorporated into social studies and language arts activities.

You do not need pristine wilderness with spectacular views to lead a fun walk. In fact, exploring your school yard, or nearby city park will be logistically easier to arrange and any discoveries will be all the more exciting to the students. A nature walk right in your city or town is also fun, and opens everyone's eyes to the fact that nature is everywhere, even if it is just 'weeds' growing in the cracks of the sidewalk.

If you are planning a trip to a park or nature reserve, please contact their staff ahead of time, particularly if you would like the children to do some activities, including collecting. Some parks have restricted access or may even be closed on certain days. Others may charge admission. Most parks do have regulations regarding collecting, so it is always best to check with local authorities first.

If you want to allow the children some free time to play and explore, not all parks are suitable and many have strict rules regarding staying on the trails, etc. Also, you want to make sure children will not get lost or encounter a dangerous situation. Again, your school yard or local park sometimes offers the best location.

2. Preparation

It is always best to plan your route ahead of time, particularly with children's groups. Points to consider:

- Is transportation required to the site? If not, is it safe to walk to the site (sidewalks, crosswalks, etc.)? f transportation is required, is it available? Is there adequate parking?

- Is the route appropriate for your age group? Is it too long, too steep, slippery, near dangerous areas, etc.? Would extra adults be required to ensure safety? Particularly near populated areas, ensure there is no glass or other litter that could cause an injury.

- Check the trail surface. Is the area known to be muddy after a rainfall? If so, please make sure your group wears appropriate footwear. Exploring mud puddles can be fun for students of all ages.

- Walk your route several times if possible. Note any areas you would like the children to explore, collect from, etc. Seasonal changes can occur quickly, especially in the spring. What was once brown earth can be suddenly covered in new tiny green seedlings. (Note: Children enjoy returning to an area many times to discover changes during the seasons).

- Check your school or organization's policy on outings. Transportation, insurance, extra supervision, allergy alerts, and permission forms are just some of the policies you should be aware of before venturing out.

Be prepared for changes in your itinerary. We usually plan more stops and activities per walk than are needed. That way, if you must cancel one activity, you have other options to fall back on. It has also been our experience that while one group of students will enjoy one aspect of your walk, another group will not be as interested. So it is always best to be flexible. If you

find your group is particularly interested in one area or activity, it may be to your advantage to keep with that area as long as interest is high, even if it means some activities are dropped.

3. Get the Group Prepared

Make a list of what each child needs to bring. It has been our experience that less is better in this situation.

Recommend:

- Each student should be dressed for the weather, including appropriate footwear, hat and layered clothing.
- Provide a container for your collections.
- Bring snacks if you plan to stop and eat. Don't forget to pack up your garbage.
- Something dry to sit on (i.e. a plastic grocery bag) is often useful.
- The leader should also bring a cell phone, and a small first aid kit, including any medications required by the students, just in case an emergency arises.

Other tips:

- Some teachers like to use activity or question sheets, to help keep the children focused on the activity. While these can be effective, don't hesitate to sometimes leave the papers at school, so that the students will focus more on the outdoors and less on the sheet of paper.
- Equipment such as a compass, GPS, and other electronic gear may interest older students, and will help link the activity with math, geography, social studies, etc.
- A homemade map can be a lot of fun.
- Have extra gear on hand if you can - very rarely do all children come prepared. Letters home may help.
- Cheap magnifying glasses can help make things fun.

4. Before Your Walk

Time spent preparing the class for the trip, even a short one, is well worth the effort. Not only will students understand more fully what is expected from them, it can actually increase interest and excitement. Time should also be spent addressing any fears or concerns.

Explain in detail the intended route, duration and activities. This will alleviate everyone asking the same questions over and over. Encourage the students to think about what they may see, hear and smell today.

Classroom Activity:

If you find it a challenge to have every student come prepared for your hike, there is a simple activity you can do. Present two packed knapsacks to the class or group. One knapsack should be over-filled with inappropriate items (the sky is the limit here; the sillier the better). The other should contain items needed for the outing (snack, bottle of water, hat, rain jacket, etc). Unpack each knapsack and let the students decide what should stay and what should go. Older students can prepare these as an assignment. The group can provide feedback after a hike and make suggestions for materials to bring along.

Rules:

Outline all the rules beforehand. We find it helps to be firm at the beginning, making it clear that only the students who follow the rules can participate in the activity. Allowing time for discussion of safety rules does help the student remember them and provides an opportunity to express opinions and reservations.

An example of some safety rules:

1. Stay with your partner and/or hold your partners' hand at all times.
2. While walking, everyone is expected to stay in line (or be a caterpillar).
3. Stay with the group at all times.

While safety is a top priority, it is also important to impress upon them the importance of being a friend to nature and the community. A walk with your group through a park or any area should not disrupt others and should not cause harm. At MUN Botanical Garden, we teach the following rules of respect as a guideline for interacting with each other and our community.

Some Rules of Respect:

1. We will treat everyone and everything as we would like to be treated.

2. We will not pick or collect anything, unless our leader gives us permission.

3. We will stay on all paths and trails at all times and will only wander off if given permission to do so. To avoid damaging plants and tiny creatures, we will try to step gently at all times.

4. Any live animals (i.e. bugs) that are collected will be handled gently and released as soon as possible. (It is not advisable to try to collect any birds, amphibians, mammals, or stinging insects).

5. We will try to keep voices low so animals do not get scared away and others in the park are not disturbed by the noise. If we are very quiet, we may spot more wildlife. Keeping voices low, also helps us hear what is happening around us.

6. This park (or school grounds, playground, etc.) is home for some plants and animals. Today, we are the visitors. When visitors come to our own home, how do we like them to behave? What are some things you like or dislike visitors doing in your home? Do you think the plants and animals (and other park users) would like us to behave a certain way today? Generally, by connecting the student's home and community to that of a plant or animal's habitat, they will understand more clearly how their behaviour can have a positive or negative effect on their surroundings.

5. On the Walk

A sample of some activities and games used on nature walks at the Botanical Garden has been included in this section. Feel free to modify them to suit your needs. Garden staff would love to hear your suggestions and feedback.

While any number of these activities can easily be incorporated into the walk, we do stress the importance of keeping initial experiences simple. As mentioned previously, a nature walk may be a new experience for many students. By keeping the first outing short and not too strenuous, many common problems can be avoided. One game that we recommend be tried on every outing, particularly the first, is the sensory warm-up game, described below. We play it with almost all the children's groups that visit the Garden. The contrast in behaviours and attitudes before and after the game can be quite dramatic.

Sensory Warm-up Game

This game has been adapted from the wonderful book *Sharing Nature with Children*, Volume 1, written by Joseph Cornell. (For more information, please check the Sharing Nature Foundation website at <http://www.sharingnature.com/index.htm>)

Most people are not used to listening and looking for wildlife. The best way to be a nature detective is to 'sharpen the senses'. We need our eyes, ears and even noses open, but it might be best to keep our mouths closed. Once we talk, we are distracted and we cause others to be distracted. Most importantly, we will miss any wild creatures around us. By playing sensory games, we reveal more clearly to the students what is happening in our environment. It has been our experience, with the nature camps at the Botanical Garden, children will become very keen to observe their surroundings once they realize how much fun it is.

The simplest warm-up game (and our favourite) is played as followed:

1. Explain the following rules first.
2. Instruct all participants to stand in a comfortable position; once comfortable, their feet must remain still.
3. Ask everyone to make two fists and hold up their hands so they are visible to the leader.
4. No talking at all, please.
5. Explain that every time a noise is heard, they are to count silently, using their fingers.
6. Once they have counted to ten, they must silently wait for the rest of the group to finish.
7. Final rule: The game is played with eyes closed.
8. Go over the steps one more time, leaving the eyes for last (make sure everyone is comfortable with this).
9. Start the game with "Ready, set, listen."

Play only for as long as the game holds their interest. For older students, they can be called "out" if they move, talk or open their eyes. Play the game in the classroom before and after the recess bell sounds. Students quickly realize that by not talking and "turning off" all their senses, except hearing, they discover many sounds around them that they were not aware of. They will notice that even when they did not speak or move, they could still hear each other. Discuss which sounds you heard and point to the directions the sounds seem to come from.

Scavenger Hunts

Scavenger hunts can be played several ways. The easiest method is to give the children a list or set of instructions of objects to find (I spy). For example: count the evergreen (or Christmas) trees; count the trees with red / yellow / brown leaves; find the tallest tree (or building) and count the benches near it; or count the number of red (or yellow, or green, etc.) objects you can find. Another variety of this game is to actually collect the objects. Common objects to collect would be leaves, twigs, seeds, rocks, soil (bags required), moss, etc. In a controlled area you could also instruct them to use other senses besides sight. For example, to rub the tree needles between their fingers and smell, feel the wood on the bark of a tree, listen to the rustle of the leaves, etc.

"Un-nature" Walk

Find objects not associated with nature; objects could include fences, benches, signs, etc. Be careful the children don't handle litter. A popular activity with our summer camps each year is to set out silly objects on the trail and let the children find them. They love this game and over time develop keen observational skills. Some objects can be easy to find, while others can be more challenging. Place them everywhere from the ground up to the trees.

Nature Detectives

Give students samples or pictures of objects (i.e. dried leaves, seeds, etc.). Their mission is to find the objects. Have them use a map or make one to find the object. If you have access to a compass, show them how to use it as they follow a map. A variety of this game is to give each pair or group of children a different object. Another variety is to just reveal clues about the object, or a scrambled word list, and they must figure it out.

Nature Art

Ask students to collect objects (i.e. leaves) that they can use to create a collage or craft. As part of a math exercise, have the children sort, measure, and compare their collections before they create with them.

Story Time

No matter what the age group, we have found that students love to have a story time when outside. If possible, this is an ideal time to eat snacks. The break is very refreshing, particularly for younger students and it is often during this quiet time that we notice birds and other critters. If your walk has a theme, a story will enhance the theme even more. While reading from a book is always fun, telling a story from memory is also fun and can stir imaginations. Older students may like to invent stories related to the site.

Photography

If available, using a camera can be a fun way to record findings and experiences. Digital cameras reduce the cost of processing and let you view your images immediately. The images can be used in a multitude of ways, even on your own website! This activity can also be incorporated into their technology program. Primary and elementary students can post photos on the wall and write text to explain their discoveries and experiences during the hike. This also helps them share their experiences and discoveries with their friends and family.

Plantwatch

This program enlists volunteer observers to record flowering dates (phenology) of early-flowering plants in spring. This data is combined with nationwide data and used to track any climate change that may be occurring. For more information on Plantwatch Newfoundland and Labrador, please visit the Botanical Garden website.

Creature Counting

How many trees, bugs, birds or even dead leaves can you find? Observe them and record your findings (digital cameras are great for this). If you can safely touch and measure, do so. If you are looking at trees, do bark rubbings. If listening for birds, try to quietly imitate their songs.

6. Back to Class

Discuss the trip and encourage children to reveal their likes and dislikes. Their feelings can be conveyed in artwork, journal entries, reports, poems and even fictional stories. Display their work. Make a webpage or PowerPoint presentation. Be sure to use any photos taken on your hike.

Sort, measure, count, compare and record any collections. These are all activities that children love to do with any new found 'treasures'. Communication of their findings can be facilitated with a variety of graphs, tables, etc. Use their treasures to create decorations, crafts or simply to create collections.

Try to name and/or describe any creatures found. Don't worry if you don't know the exact name of the species. Make up your own name, based on your observations. This is a wonderful activity to do with trees and shrubs throughout the school year. Each time you visit the plant, seasonal changes can be observed and noted. Conduct research in the library to see what else you can learn about your subject.

If you have chosen to participate in Plantwatch, tagging your plant and visiting your observation area on a regular basis is fun for all students.

Creating a "Nature Notes" or a scrapbook of their findings, observations, feelings and creations is an excellent activity to tie it all together and create some lasting memories.

Make plans for another walk in the near future. This time, let the students help you, including selecting a theme, and planning activities. Create maps, research the history of the area, or select a story to be read on the next trip. If you are returning to an area, ask the students if they can suggest ways to encourage or help the local wildlife. If seasonal changes have occurred, discuss what impact that may have had on the area.

Eventually, you may feel comfortable enough to initiate a nature walk on a moment's notice. Taking advantage of an unexpected mild sunny day in the middle of winter, or spontaneously embarking on an expedition, will not only lead you and your students on the road to learning, but will create lasting memories for all.

Finally….

If you are a teacher or youth leader and have led a hike into your school yard or beyond, we would love to hear from you. Please share your stories, suggestions and ideas with us. If you use this resource information for your group, class or simply with your own children, we would very much appreciate your feedback.

Happy Trails!

Figure 103: On a nature walk with the Parent and Tot program at MUN Botanical Garden

B.Appendix: Plant Names of Common Newfoundland Plants

Scientific Name	Common name(s)
Abies balsamea	balsam fir
Acer spp.[1]	maple
Andromeda glaucophylla	bog rosemary
Betula spp.	birch
Chamaedaphne calyculata	leatherleaf
Gaultheria hispidula	creeping snowberry, capillaire
Kalmia angustifolia	sheep laurel, lambkill, gold-withy, goo-witty
Kalmia polifolia	bog laurel
Larix laricina	larch, tamarack, juniper
Ledum groenlandicum	Labrador tea
Linnaea borealis	twinflower
Picea glauca	white spruce
Picea mariana	black spruce
Rhododendron spp.	rhododendron
Salix spp.	willow
Sorbus spp.	dogberry, mountain ash
Vaccinium macrocarpon	large cranberry
Vaccinium oxycoccus	small cranberry, marshberry
Vaccinium vitis-idaea	partridgeberry, lingonberry

[1] spp. indicates the word species. This is used when there are multiple species in the genus that are being referenced.

C. Glossary

Term	K – 6 definition	7 – 12 definition
Biology	The study of living things.	The branch of science dealing with the study of the growth and processes of living things.
Botany	The study of plants.	A branch of biology dealing with the study of plant life.
Botanist	A person who studies plants.	A scientist who studies plants.
Branch	The arm of a woody plant, such as a tree or shrub.	A woody structure connected to the trunk of a tree or shrub. Large branches are known as boughs and small branches are known as twigs.
Bract	A small leaf that can look like a brown scale. It is usually found on the flowers of a plant.	A small scale-like leaf associated with a flower cluster.
Bud	The small growth on a stem which develops into a leaf or flower.	An underdeveloped leafy stem, flower or flower cluster protected by scales.
Calyx	The green 'leaf' like parts of the flower under the petals.	The outermost part of the flower, usually green and composed of sepals that are fused or free.
Catkins	A small cluster of male or female flowers. Catkins can be found on willow, birch and alder.	A scaly-bracted cluster or spike of flowers usually having a flower of only one sex.
Dichotomous key	A chart that helps identify a plant by giving two options at a time.	A sequence in biology used to categorize species using logical choices. Two sentences that are mutually exclusive are called a couplet or a lead. These alternatives lead to a further couplet until the species is identified.
Flower	The part of the plant that has petals and that makes fruit and seeds; a blossom. Flowers often have a pleasant smell and are often white or colourful.	The reproductive structure found in flowering plants. They consist of a calyx (sepals), corolla (petals), androecium (male parts) and gynoecium (female parts).

Fruit	A part of a plant that may be edible that contains seeds. Fruit is usually sweet and can be eaten raw.	Botanists use the term fruit to describe both edible parts (oranges, apples, strawberries) and inedible fruit (acorns, maple tree seeds).
Genus	A group of closely related species (living creatures).	A group of closely related species which is the first word in a scientific name for a living organism. This word is always capitalized. Plural: genera. In Newfoundland we have the mountain alder (*Alnus crispa)* and the speckled alder (*Alnus rugosa*). Both are from the same genus (*Alnus*), but are different species (*crispa* and *rugosa*).
Herb	A plant that isn't woody and has many uses for people, such as to flavour food, produce medicine, etc.	A herbaceous plant (non-woody) which is valued for its medicinal properties, flavours, scents or other uses.
Herbaceous	A plant that isn't woody. It usually dies back each fall and reappears each spring.	A non-woody plant that lives for one or two years and dies back to the ground over winter.
Introduced or non-native plant	Plants that weren't originally from their current location.	A plant species growing outside of its natural distribution; usually caused by human activity.
Lateral buds	A bud that is on the side of the twig instead of the end (terminal bud).	A bud that is on the side or length of the twig instead of the end (terminal bud).
Leaf (Leaves)	Usually green and found on branches, leaves are how the plant collects energy from the sun to make food to grow.	Leaves are the site of photosynthesis in which the plant uses light energy to convert carbon dioxide to sugar and oxygen. They can come in many shapes including needle, compound, simple and toothed.
Leaf margin	The edge of the leaf.	The outer edge of the leaf, which could be smooth, toothed, lobed etc. The structure is used in identifying different types of plants.
Leaf scar	A mark left on a twig from a leaf that has fallen off. It is usually crescent moon shaped.	A mark left on a twig at the point of attachment of a fallen leaf, often crescent shaped.

Native plant	Plants that are growing in an area that has been recorded as their home for thousands of years.	Plants that are indigenous (endemic) to a given area in geological time.
Petiole	A leaf stem.	The stalk or stem of a leaf, which connects it to the plant. Celery is an example of a petiole.
Pioneer species	The first plants to appear. When land has been cleared of plants after a fire or construction, the first plants to start growing are called pioneers.	Plant species which colonize previously un-colonized land, usually leading to ecological succession.
Rhizome	An underground stem.	A horizontal, underground stem capable of producing the shoot and root systems needed for vegetative reproduction.
Roots	The usually underground part of a plant that absorbs food and water in order for the plant to grow. They also hold the plant into the ground.	The part of the plant that lies beneath the surface of the soil, although some roots can be aerial (growing above the ground). It doesn't have leaves but it does have root hairs that enable the plant to absorb water and nutrients from the soil in order to grow. Roots also hold the plant in the soil and hold the soil intact.
Seed	A baby plant which can grow into a new plant.	An embryonic plant enclosed in a covering called a seed coat. If given the proper light, water, and nutrients, a seed will grow into a new plant.
Seedling	A young plant that is grown from a seed.	A young plant that had developed out of an embryo from a seed.
Shrub	A woody plant that has more than one stem and is short in height.	A woody plant that has multiple stems, opposed to a tree that has one main trunk. They are usually short in height, but this can differ depending on environmental conditions.

Species	A group of living creatures that are similar and will easily mate.	Living organisms belonging to a group which have common characteristics and can usually interbreed in natural conditions. The species name is usually listed second after genus and is not capitalized. The abbreviation for one species is "sp." or plural as "spp." In Newfoundland we have the mountain alder (*Alnus crispa)* and the speckled alder (*Alnus rugosa*). Both are from the same genus (*Alnus*), but are different species (*crispa* and *rugosa*).
Stem	The main part of a plant that grows up from the ground and supports the branches, leaves, flowers and fruit. Stems can be green and soft or woody and hard.	Above ground structures that support branches, leaves, flowers and fruit. Some plants do have underground stems. They function to move nutrients and water up and down the plant from the soil. Stems can be green and soft or woody and hard.
Stolon	A slender stem growing above the ground which can produce roots and branches; often called a 'runner' with strawberries.	A specialized, slender horizontal branch which serves to propagate an organism, such as a strawberry runner. Roots and aerial branches are produced at specialized nodes.
Succession	Steps in time where a field can change into a forest.	A process where an ecological community transforms itself until a stable community is formed.
Terminal bud	Growth found at the tip of a branch.	A young flower or leaf covered by scales found at the tip of a branch.
Tree	A woody plant with one trunk, many branches and usually grows tall.	A woody plant that has a long main trunk, many branches and usually grows tall.
Trunk	The main woody stem of a tree which comes up from the ground.	The main woody stem of a tree which supports all the branches of the tree.

D. Useful Resources

MUN Botanical Garden offers educational programs for students including bookings at the Botanical Garden, school outreach, and teacher workshops. Educational resources are also available on out web page < www.mun.ca>

MUN Botanical Garden. *Breaking Ground – Biodiversity in the Schoolyard: A Resource Manual for Newfoundland and Labrador Educators*. <http://www.mun.ca/botgarden/group_prog/Breaking_Ground_Booklet.pdf> (accessed November 2011).

Maunder, J. 2010. *Digital Flora of Newfoundland and Labrador*. <http://digitalnaturalhistory.com> (accessed November 2011).

Plantwatch Newfoundland and Labrador. <http://www.mun.ca/botgarden/plant_bio/PW/> (accessed November 2011).

Ryan, A. Glen. 1978. *Native Trees and Shrubs of Newfoundland and Labrador*, Department of Parks Division, Department of Tourism, province of Newfoundland, St. John's.

Sharing Nature Foundation. <http://www.sharingnature.com/index.htm> (accessed November 2011).

E. Curriculum Connections

For current curriculum connections for the *From Garden to Classroom Activity and Resource Guide* please visit the Education section of the MUN Botanical Garden's webpage at <www.mun.ca/botgarden>.

6. Summary

Your Feedback is Welcome:

The *From Garden to Classroom* program incorporates environmental stewardship practices which have been promoted and used at MUN Botanical Garden since its inception in 1971. The Garden's education programs are the basis for many of these activities. We hope the *From Garden to Classroom* program will provide a unique opportunity to engage young people in hands-on activities, which may encourage proactive attitudes and behaviours in areas of environmental protection, conservation and enhancement.

The hands-on activities are curriculum-designed; while all programs supplement the science curriculum, we encourage teachers to make connections to other subject areas.

Feedback, stories and suggestions are always welcome and are an integral part of the development of this education program. Comments may be forwarded to Anne Madden, education coordinator, MUN Botanical Garden (amadden@mun.ca).

Figure 104: Newspaper flowerpots on the windowsill at St. Mary's Elementary