The Power of Plants

A Curriculum Resource for Ontario Teachers

BEAN
Biodiversity Education and Awareness Network

Forward

Making sense of the natural world and exposing children, particularly elementary students, to nature has never been more important. You, the teachers of our Ontario youth, have been tasked with this challenge, and we all deeply respect and appreciate your passion, hard work and dedication. The goal of this curriculum-linked package of activities and lessons about plants and botany is two-fold: 1) to help you, our teachers, provide fun, interactive and scientifically rigourous learning programs and activities for your students, and 2) to raise awareness about the importance of biodiversity in everyday life.

The package has six distinct activities that explicitly relate to students in Grades 3, 4, 5 and 6. It is our intent to connect the learning objectives, methods and outcomes of each activity to specific curriculum links from the most recent Ontario Curriculum (revised 2013). We outline how each activity satisfies these curriculum links so that you can be assured that your students are meeting expectations of the Ontario Ministry of Education. The package was authored by Bethany Kempster, OCT, M.Sc., Royal Ontario Museum Teacher, with support from the broader Biodiversity Education and Awareness Network (BEAN) which includes membership from the Ontario Ministry of Education. The entire package is available in both French and English, and can be downloaded for free from the BEAN website: *www.biodiversityeducation.ca*

We chose plants and botany as the focus of this curriculum package because this group of organisms is specifically identified in the curriculum (Grade 3), and because plants form the foundation of our natural and built ecosystems and hold a wealth of information about natural history processes. As well, children love and are amazed by plants: from early spring flowers (ephemerals) to giant Sequoias, the largest organism on earth, to the kelp forests of our near-shore oceans – all act to inspire youth to respect and appreciate our natural world.

On behalf of Bethany Kempster, the Royal Ontario Museum, the Ontario Ministry of Education and the broader BEAN group, I hope you enjoy and find useful this learning package. Your feedback is important to us, so please do send comments and future suggestions to our group. Enjoy!

Sincerely

Dave Ireland
Managing Director, ROM Biodiversity
Chair, Biodiversity Education and Awareness Network

ROYAL ONTARIO MUSEUM MUSÉE ROYAL DE L'ONTARIO

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1. Drawing Plants for Science and Pleasure (pg. 6)

Botanical art and floral art use the same subject but have very different objectives. In this activity students will explore these different art forms by creating two artworks using the same plant as a reference. Artists' statements will express the intentions and design decisions inspired by the art form and floral specimen.

Curriculum Links*:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 3 – The Arts: Visual Arts
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- Grade 4 – The Arts: Visual Arts
- Grade 5 – The Arts: Visual Arts
- Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity
- Grade 6 – The Arts: Visual Arts

2. The Secrets Revealed by a Classroom Herbarium (pg. 17)

A herbarium is a collection of pressed and preserved plant specimens. In this lesson students will collect and preserve plant specimens to create a class herbarium and explore the different uses for a herbarium.

Curriculum Links:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity

3. Seed Dispersal Olympics (pg. 28)

By dispersing their seeds away from the parent plant and into new areas, plants can reduce the pressures of competition and can expand their range. In this activity, students will explore some mechanisms used by plants to disperse their seeds by creating model fruit and evaluating the relationship between the fruit's structure and its dispersal ability.

Curriculum Links:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities

4. A Global Fruit Salad (pg. 35)

Despite living in the province containing Canada's most productive farmland, Ontario imports more food products per capita than any other province. In this lesson students will explore the concept of "food miles", visit a farm, farmer's market, or grocery store and write a newspaper article or editorial summarizing their findings.

Curriculum Links:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 3 – Social Studies: People and Environments, Living and Working in Ontario
- Grade 3 – Language: Media Literacy
- Grade 3 – Health and Physical Education: Healthy Living
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- Grade 4 – Social Studies: People and Environments, Political and Physical Regions of Canada
- Grade 4 – Language: Media Literacy
- Grade 4 – Health and Physical Education: Healthy Living
- Grade 5 – Social Studies: People and Environments, The Role of Government and Responsible Citizenship
- Grade 5 – Language: Media Literacy
- Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity
- Grade 6 – Social Studies: People and Environments, Canada's Interactions with the Global Community
- Grade 6 – Language: Media Literacy
- Grade 6 – Health and Physical Education: Healthy Living

5. Getting to Know a Tree (pg. 45)

Despite being instantly recognized as "trees", students often know little beyond this basic descriptor. In this lesson students will examine the leaves, identify the species, make bark rubbings, measure girth, calculate age, and approximate the height of a single tree. Tree profiles are then collected to create a class encyclopedia.

Curriculum Links:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 3 – Mathematics: Measurement
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- Grade 4 – Mathematics: Measurement
- Grade 5 – Mathematics: Measurement
- Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity
- Grade 6 – Mathematics: Measurement

6. You Can Count on Dendrochronology (pg. 54)

The seasonal growth rings formed as a tree grows preserve an historical record reflecting the growing conditions during its life. In this activity, students will examine tree rings and discover the secrets preserved within its growth rings.

Curriculum Links:

- Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity

7. Glossary of Terms (pg. 61)

DRAWING PLANTS FOR SCIENCE AND PLEASURE

The Big Idea:

Botanical illustration and floral art use the same subject matter but have very different objectives. In this activity students will explore this difference by using the same plant to create a detailed botanical drawing and an artistic floral artwork. The botanical drawing will focus on objective detail and accuracy, while the floral artwork will be a subjective impression of the plant, with an artistic focus chosen by the student. Student written artist statements will express the personal feelings and ideas inspired by the specimen and by the process of representing it in these two contrasting ways.

Learning Goals:

- Create an accurate botanical drawing of a particular plant and label the plant's parts
- Create a two- or three-dimensional floral artwork that express personal feelings and ideas inspired by the same plant
- Explain how elements and principles of design communicate meaning or understanding
- Identify the major parts of plants and describe their purpose and function

Teacher Background Information:

Dried plant specimens housed in herbaria (see activity #2) are often supplemented with detailed botanical sketches that show the appearance of the live plant in the field. Botanical sketches are a form of visual note-taking used by botanists. Sketches are often used to capture aspects of a plant that cannot be preserved in a dried specimen, that are difficult to render accurately in words, or that can only be observed with equipment like a microscope. Botanical sketches can be made by anyone who understands the fundamentals of plant anatomy, looks carefully at a plant, and represents what they see in botanical terms.

Botanical sketches are the visual notes used to create a botanical illustration. Botanical illustrations are polished artistic depictions of a plant that are ready for publication. The primary goal of botanical illustration is not aesthetics, but scientific accuracy. An illustration must be so precise that it can be used to distinguish between two similar plant species. Botanists who are describing new species or writing manuals for plant identification include detailed illustrations along with their descriptions of the plants. Creating botanical illustrations requires both an understanding of plant anatomy and the formal artistic training needed to provide technical mastery of the medium being used. Some botanists are skilled enough to create their own illustrations, while others hire trained scientific illustrators to prepare them.

Photography is becoming increasingly useful as a way to capture the appearance of a plant or its parts. Even so, photography cannot replace botanical sketches and botanical illustrations. This is because sketches and illustrations focus the eye on the most important information, such as the shape of a leaf in outline, the pattern of the veins in a leaf, or the arrangement of the parts of a flower in three dimensions. Even if the photographer is skilled and botanically sophisticated, the camera is unable to selectively capture significant features or charatersitcs, the way that a sketch or illustration does.

The need for scientific accuracy separates botanical illustration from floral art. Floral art is the artist's interpretation of a flower or plant. Flowers and plants have been the focus of many great artists spanning centuries. Consider the art of Impressionists like Claude Monet and Post-Impressionists like Vincent van Gogh, or modernists like Georgia O'Keeffe and Andy Warhol. Since the goal of these paintings was aesthetic, accuracy was not always necessary or intended. The flowers in these paintings are valued instead for their beauty and the emotions that they inspire in those that admire them.

Time Needed: Time required to complete two art projects will depend on the age of the students and the medium chosen
Site Needed: Classroom
Group Size: Individual

Materials:

- Clipboard for taking notes
- Samples of botanical sketches and illustrations (see below), or visit the Botanical Artists of Canada, *http://www.botanicalartistsofcanada.org/members-galleries*
- Samples of floral artwork (provided below)
- Detailed photographs of plants, or real plants from the garden or the store. Plants with simple structures include tulips, lilies, apple flowers, tree or shrub branches with leaves and possibly flowers (maples, oaks, dogwoods), buttercups, and red clover. Plants with more complicated structures include sunflowers, bergamot, goldenrod, and dandelions.
- Plant identification guide (provided below)
- Magnifying glasses or microscopes
- White paper for sketching (1 per student)
- Pencils (1 per student)
- Erasers (1 per student)
- Rulers
- Materials for floral artwork

Activity Procedure:

Getting Ready:

1. Ensure that students already know the names and functions of the different parts of a plant. Guiding questions: *What are the different parts of a plant? What is the function of the various parts?* For more depth, expand this discussion to include differences in flowering and non-flowering plants or vascular and non-vascular plants.

2. Assessment for Learning Tool: Students sketch and label a typical plant without using a reference image.

3. Show the students examples of botanical sketches, botanical illustrations, and floral illustrations. Have the students describe what they see in the different pieces. Guiding questions: *Is the plant drawn realistically? How has the plant been rendered? Could this artwork be used by a botanist to identify a plant? How has the artist made use of elements and principles of design such as colour, texture, or symmetry? Does the artwork evoke any emotion?*

4. Students sort the images into the two groups – botanical art and floral art. Introduce the concept and goals behind botanical art and floral art.

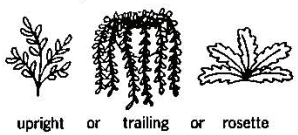
PLANT IDENTIFICATION GUIDE

WHERE?

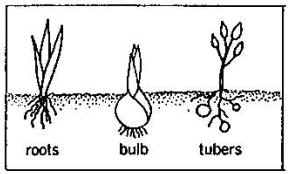
house or garden or woods

WHAT KIND?

woody or nonwoody

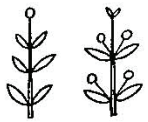


UNDERGROUND STRUCTURES

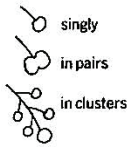


FRUIT AND FLOWERS

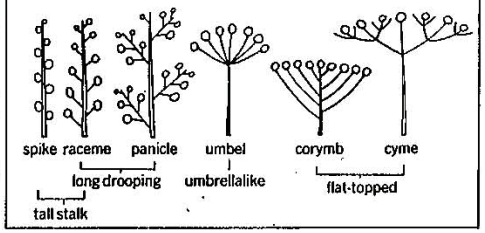
PLACEMENT



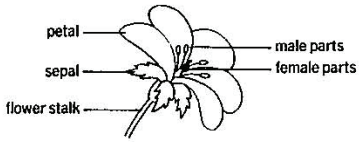
GROUPING



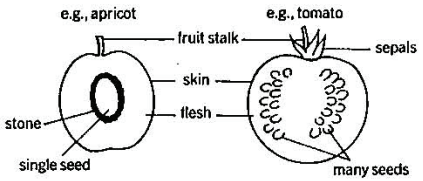
SHAPE OF CLUSTERS



PARTS OF THE FLOWER

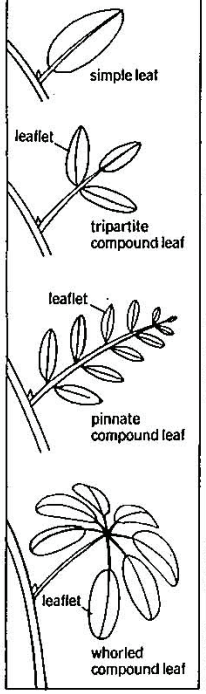


PARTS OF THE FRUIT

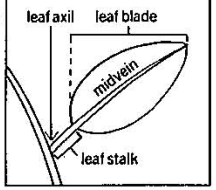


LEAVES

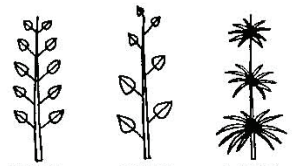
SIMPLE OR COMPOUND



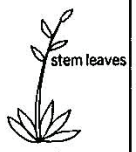
PARTS



ARRANGEMENT



POSITION

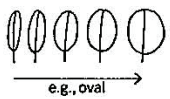


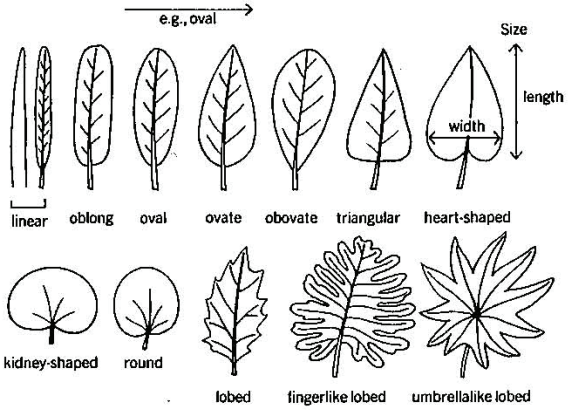
PLAIN OR PATTERNED

COLOUR?

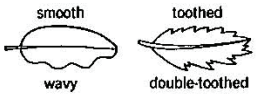
SHAPE Overall

each shape ranges from narrow to broad

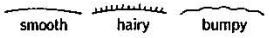




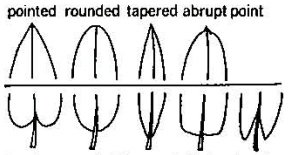
Margins



Surface Texture



Tips



Bases

Credit to Celia Godwin from Plant Alert

Hands On:

1. Using photographs or living plant specimens, students carefully examine the specimen using magnifying glasses or microscopes. Use the "Plant Identification Guide" as a reference tool to identify details of the leaf (such as arrangement, shape, veination patterns, etc), the flowers (such as colour, numbers of petals, shape of petals, numbers of stamens, etc), and the stem (such as hairs, markings, etc). Have the students make note of these characteristics on the plant identification guide.

2. Using the botanical sketches as examples, have the students identify what must be included in a botanical drawing. The drawing should include all parts of the plant and each part must be portrayed as accurately as possible with attention to pattern, texture, size and scale. Note that no background is included. The drawing may be of the entire plant, or may be of individual plant parts.

3. To create the botanical sketch, students draw and label the plant as carefully as possible on the thick white paper. If desired, students can include side drawings of magnified details.

4. Assessment as Learning Tool: Circulate as the students sketch and help students identify any major inaccuracies or details that may have been overlooked.

5. The second art project has no limitations other than the subject matter, which is the same plant used in the botanical sketch. Instead of focusing on realism, students will instead consider the elements and principles of design like colour, scale and proportion, pattern and texture, space, and contrast. The medium, artistic focus, and time devoted to the project are at the sole discretion of the students and classroom teacher.

Reflection:

1. Assessment of Learning Tool: Does the botanical drawing include all the plant's parts? Are the details such as shape and size accurate? How closely does the drawing resemble the original specimen?

2. Assessment of Learning Tool: Does the floral artwork show the application of the principles of design? Has the space been filled adequately? Is there evidence of planning? Is the artwork completed to the best of the student's ability? Does it convey any message or emotion?

3. Have each student write an artist's statement comparing and contrasting the two pieces of art. Have the students brainstorm what might be included in the artist statement. Considerations include: How are the two pieces of art the same? How are the two pieces of art different? What was the intention behind each piece of art? What media did you choose? Why did you make these choices? What design choices did you make? Why did you make these choices?

4. Assessment of Learning Tool: Is the artist statement thoughtful? Have they compared and contrasted the two pieces of art considering media used, design choices, intention behind each piece of art, outcome, etc?

Curriculum Links:

Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants

- 2.2 Observe and compare the parts of a variety of plants
- 2.6 Use appropriate science and technology vocabulary in oral and written communication
- 2.7 Use a variety of forms to communicate with different audiences and for a variety of purposes

Grade 3 – The Arts: Visual Arts

- D1.1 Create two- and three-dimensional works of art that express personal feelings and ideas inspired by the environment or that have the community as their subject
- D1.2 Demonstrate an understanding of composition, using principles of design to create narrative art works or art works on a theme or topic
- D2.2 Explain how elements and principles of design are used to communicate meaning or understanding in their own and others' art work

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities

- 2.6 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.7 Describe structural adaptations that allow plants and animals to survive in specific habitats

Grade 4 – The Arts: Visual Arts

- D1.1 Create two- and three-dimensional works of art that express feelings and ideas inspired by their interests and experiences
- D1.2 Demonstrate an understanding of composition, using selected principles of design to create narrative art works or art works on a theme or topic
- D2.2 Analyse the use of elements and principles of design in a variety of art works, and explain how they are used to communicate meaning or understanding

Grade 5 – The Arts: Visual Arts

- D1.1 Create two- and three-dimensional art works that express feelings and ideas inspired by their own and others' points of view
- D1.2 Demonstrate an understanding of composition, using selected principles of design to create narrative art works or art works on a theme or topic
- D2.2 Explain how the elements and principles of design are used in their own and others' art work to communicate meaning or understanding

Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity

- 2.5 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.1 Identify and describe the distinguishing characteristics of different groups of plants and animals, and use these characteristics to further classify various kinds of plants and animals

Grade 6 – The Arts: Visual Arts

- D1.1 Create two-dimensional, three-dimensional, and multimedia art works that explore feelings, ideas, and issues from a variety of points of view
- D1.2 Demonstrate an understanding of composition, using selected principles of design to create narrative art works or art works on a theme or topic
- D2.2 Explain how the elements and principles of design are used in their own and others' art work to communicate meaning or understanding

Polytrichum piliferum Hedw.

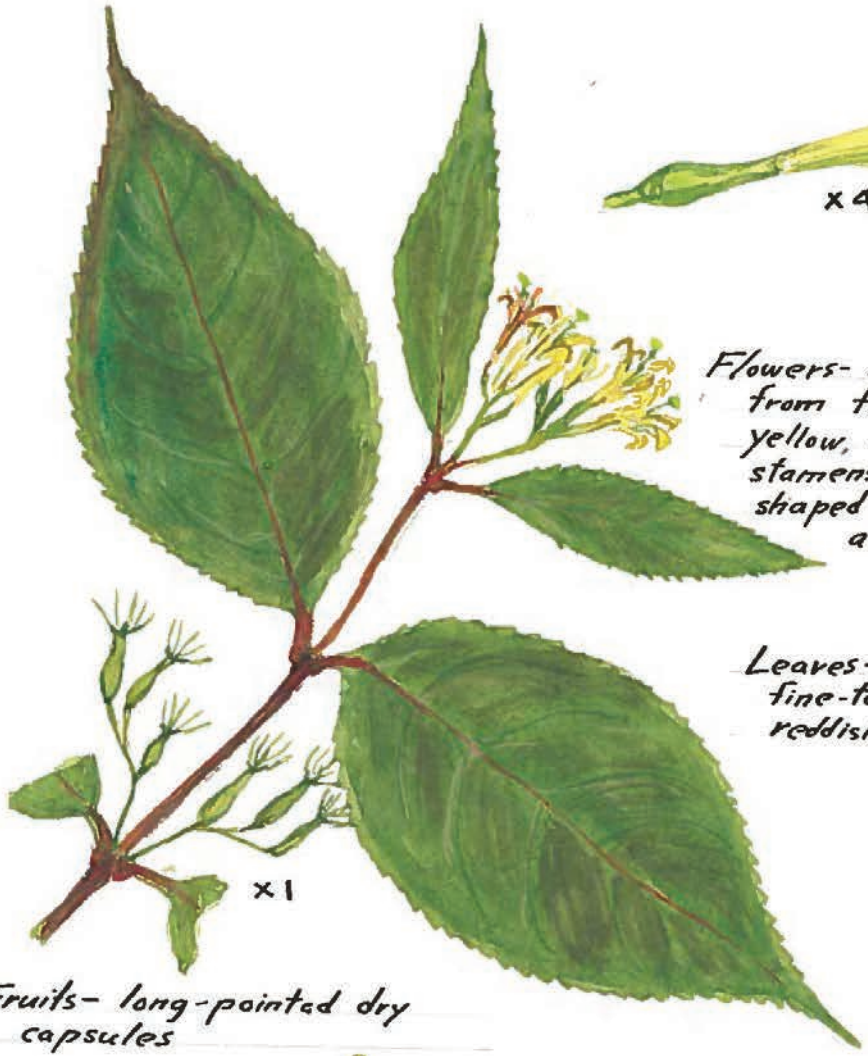
Angmagsaluk (south east coast) GREENLAND

Gus Yaki July 1978

8524

Northern Bush Honeysuckle

Flowers- loose clusters of 3 or 4 from terminal leaf junctions, yellow, 5 petals, 5 prominent stamens, from long trumpet-shaped corolla turning reddish at maturity.



Leaves- opposite, long-pointed, fine-toothed, hairless, distinct reddish stems.

Fruits- long-pointed dry capsules

Twigs - Light brown, papery bark, ridge running down from leaf scars, brown scales separating old growth from new twigs, new growth twigs reddish.

July 15/1961

6159-8

Red-Osier Dogwood.

Buds- Long, narrow, two-scaled, slightly downy.

X3

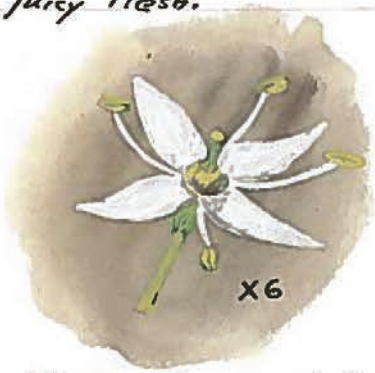
Twig- Slender, smooth, shiny, bright red Pith white

April 22/61

X1

Oct. 1/1961

Fruit- Waxy greenish white berries containing large single oval seed, dark with green veins, surrounded bywhite juicy flesh.



X6

Flowers- Small, white, in flat-topped clusters, 4 petals, 4 stamens, lacking petal-like bracts, 1 style.

X1

June 11/61

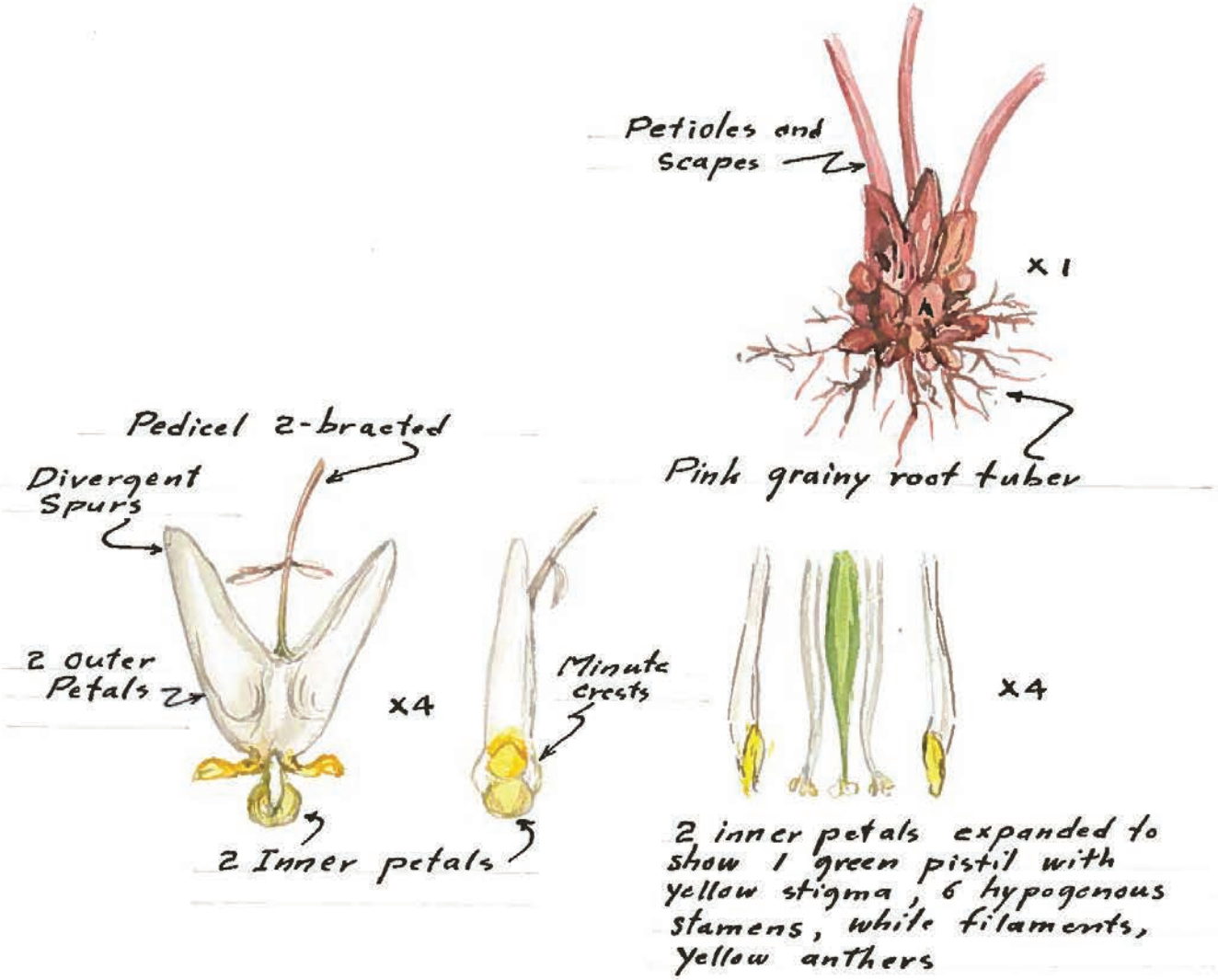
Leaves- Eliptic, 3-5 Pairs of veins following leaf margins, sometimes silky beneath. Opposite.

Duchman's Breeches Dicentra cucullaria

Poppy Family Papaveraceae

Form of plant - Single petioles and flower scapes rise from a pinkish, grainy root tuber about 1" in diameter. Plant grows about ten inches tall.
Leaves - Ternately compound and disected, feathery, grayish green, pink petioles, smooth.
Flowers - Flower scape terminates in a raceme of about 4 to 10 nodding delicate white flowers. Slight fragrance. Two outer petals united to form somewhat heart-shaped bag with rather pointed, widely divergent spurs. Two inner petals with minute crests enclose pistil and 6 hypogonous stamens. Wings on the two outer petals are bright yellow. Pedicel of each flower carries two tiny pinkish bracts.

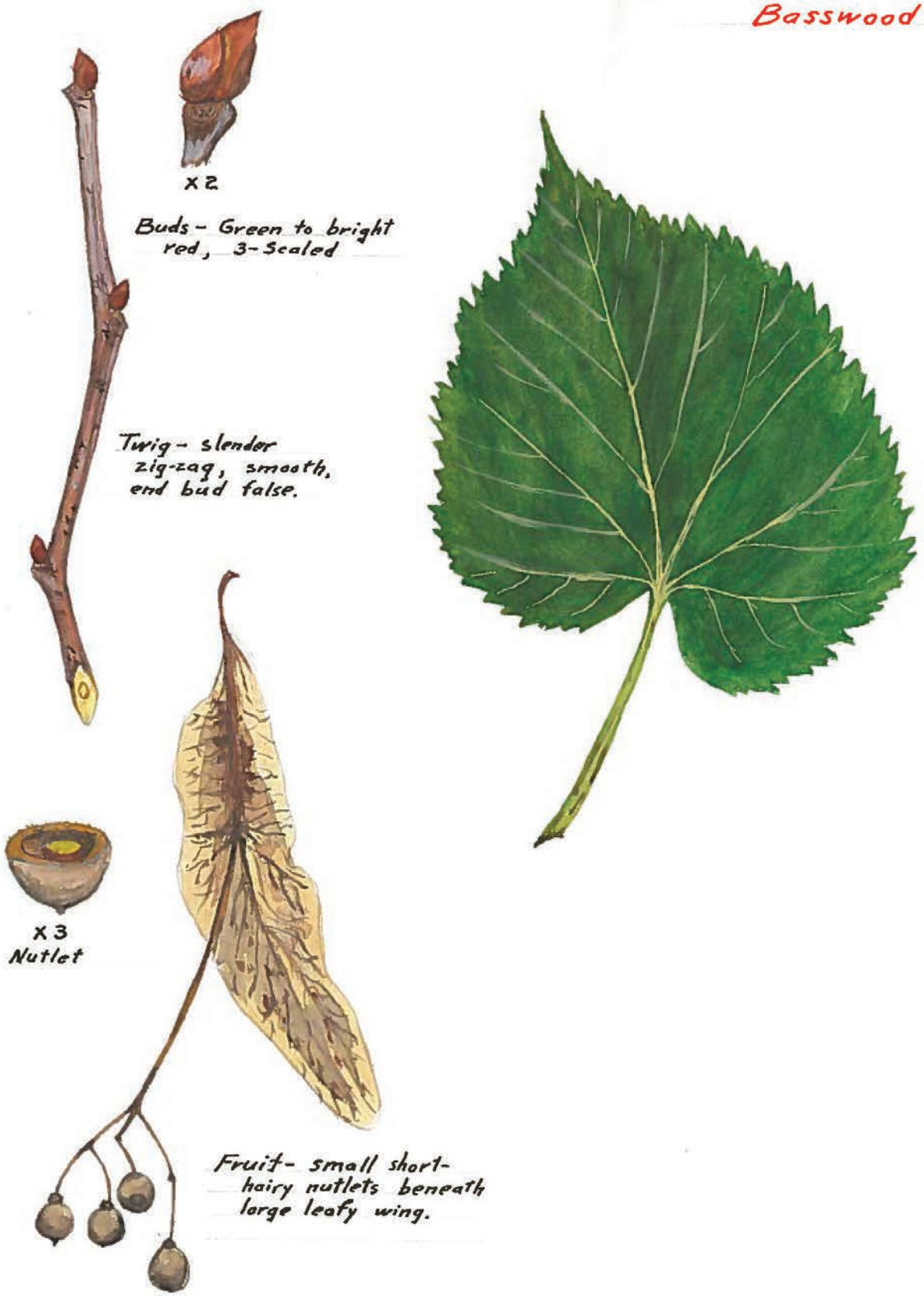
A feathery, delicate plant of the rich woodlands, very similar to Squirrel Corn. Divergent spurs and grainy tuberous root are best distinguishing features. Fragrance is very slight. Found growing in very early May.



May 3, 1964.

4964

Basswood



March 4/61

THE SECRETS REVEALED BY A CLASSROOM HERBARIUM

The Big Idea:

A herbarium is a collection of pressed and dried plant specimens used, for example, to identify plants, describe new species, and chart the geographic distribution of a plant species. In this lesson students will collect and preserve plant specimens to create a class herbarium representing a local habitat. Student groups will then brainstorm and give brief oral presentations about the different uses of herbarium collections.

Learning Goals:

- Learn how to collect and preserve plant specimens to create a herbarium
- Discover the different uses of a herbarium
- Observe and compare the parts of a variety of plants

Teacher Background Information:

While the absolute number is unknown, the International Union for the Conservation of Nature (IUCN) reports a global estimate of between 300–325 thousand species of plants. Scientists maintain voucher specimens for each of these species in plant collections in plant libraries called herbaria. A herbarium (plural: herbaria) is a collection of individually preserved, identified, and labeled plant specimens (both whole plants and plant parts) that are arranged in a systematic way, and that, under the right conditions, will last almost indefinitely.

After a plant specimen has been collected, it is spread flat on sheets of newsprint and dried, usually in a plant press. The pressed and dried specimens are mounted on sheets of stiff white mounting board. Labels are added that contain essential information such as date and place found, plant description, habitat, and the name of the collector. The specimens are then arranged, usually according to plant family, and stored in dark, air tight containers. Many collections have now been digitized, so that their data are accessible via the internet. Visit the Green Plant Herbarium at the Royal Ontario Museum at http://data.canadensys.net/ipt/resource.do?r=trt-specimens, or the National Herbarium of Canada at *http://nature.ca/en/research-collections/our-collections/botany-collection* for examples.

An established herbarium may be used by a wide variety of individuals including plant taxonomists, ecologists, agriculturists, archaeologists, police, and the general public. Because the plant specimens in a herbarium have been identified by experts, they are used as reference material to confirm the identity of unknown plants, describe new species, and to create field guides, identification manuals and plant distribution maps. Specimens dating back decades and centuries are used by biologists to determine the historical geographic distribution of individual species of plants and to track any changes in an area's vegetation over time. Changes in occurrence can show if a plant species has disappeared (become extirpated) from one area or appeared (been introduced) in another. Knowledge of changes in plant distributions can help biologists to identity impacts of human activity and climate change, and to identify and chart species at risk and invasive species.

The ROM's Green Plant Herbarium

The Green Plant Herbarium housed at the Royal Ontario Museum (ROM) houses more than 400,000 vascular plant specimens and 100,000 bryophyte (moss, liverwort, and hornwort) specimens. The collection includes specimens from around the world, but its strength is in Ontario plants, of which it has the largest and most comprehensive collection of any herbarium.

This immense collection has developed over the last 170 + years from specimens made and deposited by professional, student and amateur botanists. One of the earliest single specimens was collected in Toronto in 1837. One scrapbook contains specimens collected by British botanist Joseph Dalton Hooker while serving as assistant surgeon (and botanist) aboard the HMS Erebus on its circumnavigation of Antarctica (visit: *http://labs.eeb.utoronto.ca/dickinson/EEB299Y_2002/*). Another contains specimens from the Canadian arctic donated by members of the parties searching for survivors of the doomed Franklin Expedition to the Northwest Passage (visit: *http://labs.eeb.utoronto.ca/dickinson/EEB299Y_2004/*). More recent specimens include those collected to document the biodiversity and plant communities of the Niagara Escarpment and the Hudson Bay Lowlands.

Time Needed: 1 week (4 class periods of active time, with time to dry specimens before mounting them)
Site Needed: Outdoor green space for plant collection, classroom, room to store drying specimens
Group Size: Suitable for individual or small groups

Materials:

- Examples of herbarium specimens (provided below)
- Two webbed straps with buckles 75-100 cm in length
- Two wooden frames (e.g. plywood), a professional press is 12" x 17", a half size press is 8.5" x 12"
- Corrugated cardboard cut into pieces the same size as the frame (2 per specimen)
- Blotting paper cut into pieces the same size as the frame (2 per specimen)
- Newsprint folded in half to be the same size as the frame (1 per specimen)
- Heat source (light bulb or portable heater)
- Spades for digging up specimens
- Envelopes for loose seeds
- Plant identification guides
- White glue
- Paint brushes
- Thick white paper for mounting (1 per specimen)
- Labels (provided below)
- Pencils
- Cameras (optional)
- Computers with internet access (optional)

Activity Procedure:

Getting Ready:

1. Ensure that students know the names and functions of the different parts of a plant. Guiding questions: *What are the different parts of a plant? What is the function of each part?* For more depth, consider expanding this discussion to include differences between flowering and non-flowering plants or vascular and non-vascular plants.

2. Show students real or photocopied herbarium specimens. Introduce the concept of a herbarium. Guiding questions: *What parts of the plant have been collected? How have the specimens been preserved? How have the specimens been mounted? What information has been included on the label? Why is the label necessary?*

3. Teacher preparation: Before collection day, identify an area from which students will be allowed to collect their specimens. Take note of any dangerous or irritating plants like poison ivy or stinging nettles or any locally rare species that should not be disturbed. Examples of suitable collecting locales include manicured lawn, school garden, agricultural field, meadow, parking lot, etc. If no habitat can be located, use purchased plants or grow plants in the classroom and press them when large enough.

Hands On:

1. On collection day start by showing the students any plants that should be avoided. Guiding questions: *What sort of plants should not be collected?* Explain the five percent collecting rule. Never collect a specimen unless there are at least twenty individuals. Take a photograph instead if there are few. Consider marking these plants or areas with some kind of flag or safety cone.

2. Demonstrate how to properly collect a sample. Do not pull plants indiscriminately; identify one specimen and only remove that one plant. Collect as much of the plant as possible (e.g. stem, leaves, roots, flowers, seeds etc). Plants with deep roots can be dug up using a spade. Brush off any loose dirt from the roots. Any loose seeds can be collected in an envelope.

3. Students collect their specimens and fill in the label containing all the pertinent information about their plant (see labels below).

4. In the classroom, lay the plant out on half of the folded newsprint and using fingers, spread and smooth the flowers and leaves. Try to show the top and bottom of flowers and the top and bottom of leaves. Make sure the entire specimen fits on the final mounting paper. Fold or bend the specimen if necessary to make it the right size and minimize overlap of plant parts. If the plants cannot be pressed until a couple days after collection, store them with a damp paper towel in a sealed bag in a refrigerator.

5. Assessment as Learning Tool: Circulate as students are preparing their specimens to make sure they are arranged properly. Once the plants start drying, they cannot be repositioned without causing damage.

6. Fold the top of the newsprint over to cover the plant specimen.

7. Follow these steps to fill the plant press. Lay the straps parallel to each other on the ground. Place one frame on top of the straps and perpendicular to them. Cover with a piece of corrugated cardboard, then a piece of blotting paper. Place newsprint with the plant inside on top of the blotting paper and then cover with a second piece of blotting paper and a second piece of cardboard. Repeat this process until all the plants have been added then cover with the 2nd frame. Pull straps around the frame and tighten.

8. Place the plant press on its side over a heat source so that the warm air flows upward through the holes in the cardboard. A light bulb or a portable heater makes a good heat source. The press should be placed at least 30 cm above the heat source to be safe. A metal frame from a filing cabinet works well as a stand. It takes 24 hours to several days for plants to dry, depending on their thickness.

9. Once the plants are dried and pressed, remove them from the plant press and students mount them on thick white paper using white glue and paint brushes. Have the students decide which side of the plant shows its features the best. Flip plant over and place it on the mounting board so that none of the plant hangs over the edge of the board. Glue the labels onto the paper as well. Store blotters, cardboards, wooden frames, and straps for reuse.

10. Once the glue has fully dried, have the students create a class herbarium visual display.

Reflection:

1. Assessment of Learning Tool: How well did each student or group create their herbarium specimen? Did they follow the rules while collecting the specimen? Is the label properly filled out? Has the specimen been mounted properly?

2. Once the classroom herbarium is on display, students now brainstorm the different uses of a herbarium. Guiding questions: *What information is stored in a herbarium? How can this information be used? What sorts of people might use a herbarium? As ideas are generated, write them on the board.*

3. The students break into small groups of three to five students. Each group is assigned one of the following roles: a scientist studying the plants in a meadow; a teacher planning a field trip for her students; an artist; a doctor whose patient became sick after a camping trip; a police detective solving a crime committed outdoors; or an author writing a plant identification guide. Each group now brainstorms and researches ways in which a herbarium would be of use.

4. Assessment as Learning Tool: Circulate as the students are brainstorming. Ensure that all students are given the opportunity to participate. Consider having each group assign or take turns with roles like secretary or researcher.

5. Once brainstorming and research is complete, each group gives a brief oral presentation on their findings. The oral presentation could be in the form, for example, of a verbal report, a short play dramatizing the use of the herbarium, or a commercial advertising the usefulness of the herbarium.

6. Assessment of Learning Tool: How well did the group work together? Did each student have the opportunity to participate? Was the information presented correct, thoughtful, and creative? Was the presentation audible? Was eye contact made with the audience? How well did the presentation deliver the message?

Curriculum Links:

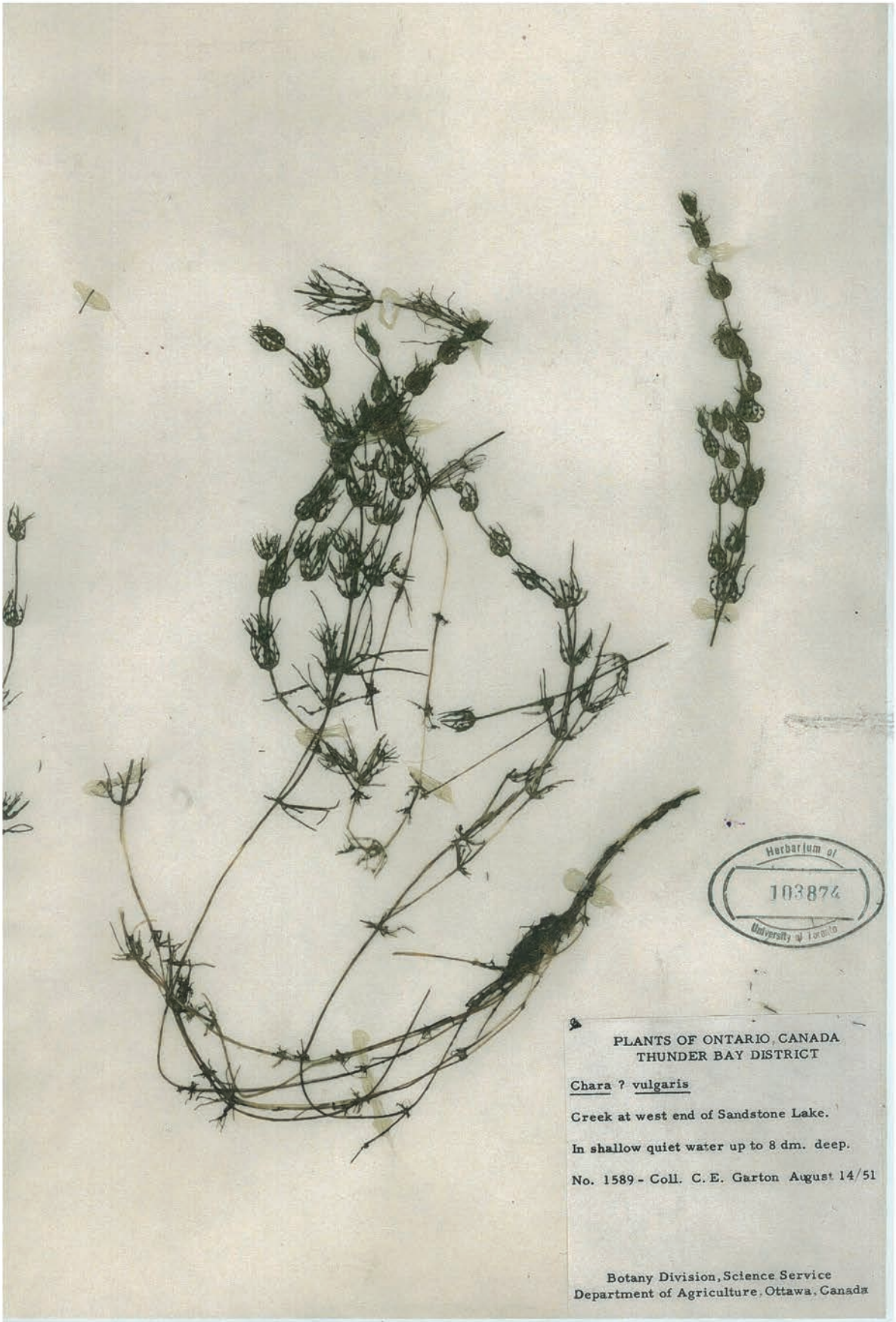
Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- 2.2 Observe and compare the parts of a variety of plants
- 2.7 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.2 Identify the major parts of plants and describe how each contributes to the plant's survival within the plant's environment

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- 2.6 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.7 Describe structural adaptations that allow plants and animals to survive in specific habitats

Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity
- 2.3 Use scientific inquiry/research skills to compare the characteristics of organisms within the plant or animal kingdoms
- 2.5 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.1 Identify and describe the distinguishing characteristics of different groups of plants and animals, and use these characteristics to further classify various kinds of plants and animals


ROYAL ONTARIO MUSEUM
TRT 282157
DEPARTMENT OF BOTANY
Fam.: 132
Linaceae
Linum lewisii Pursh
Canada Alberta Strathcona Co.
Clover Bar, east of Edmonton
Lat.: 53° 35' N Lng.: 113° 16' W
Coll.: P. Cotterill 2008/08/08.
Green Plant Herbarium (TRT)
Royal Ontario Museum


ROYAL ONTARIO MUSEUM
TRT 244026
DEPARTMENT OF BOTANY
Gentianaceae
Fam. 246
Bloodvein River Watershed Botanical Survey
Menyanthes trifoliata L.
Canada Ontario Kenora Dist. Woodland Caribou Provincial Park
Vascular Plant Herbarium (TRT)
Royal Ontario Museum



PLANTS OF ONTARIO, CANADA
THUNDER BAY DISTRICT

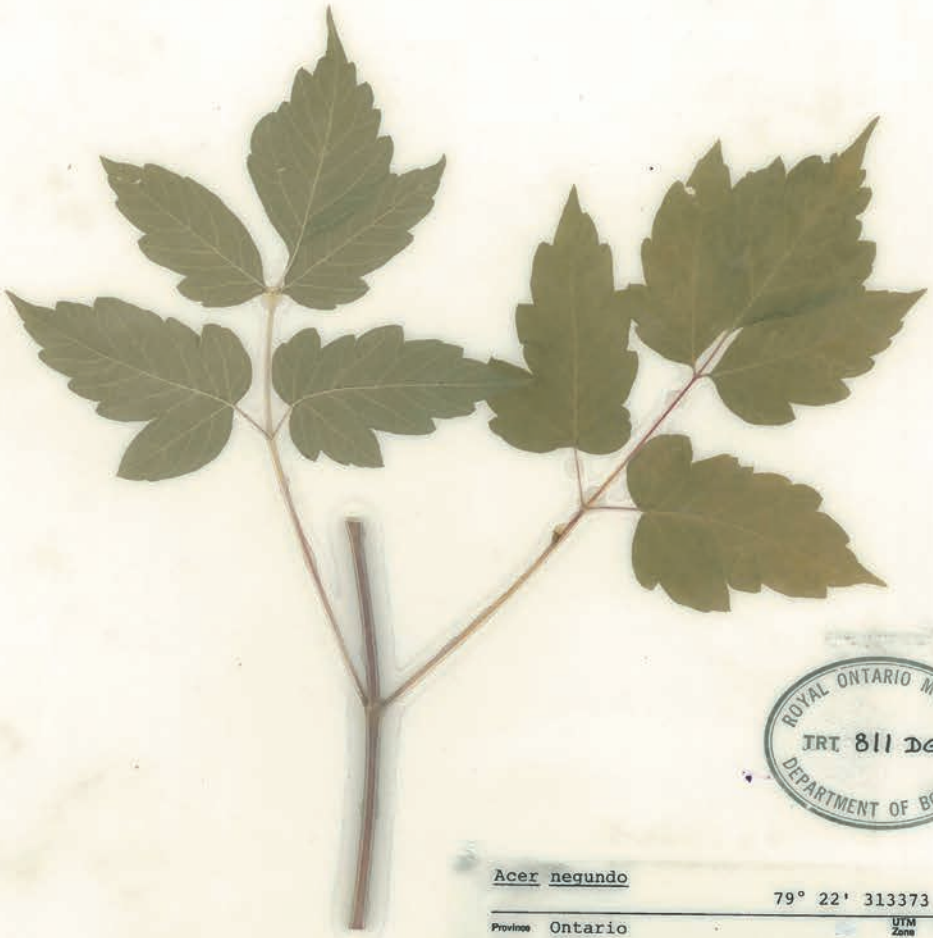
Chara ? vulgaris

Creek at west end of Sandstone Lake.

In shallow quiet water up to 8 dm. deep.

No. 1589 - Coll. C. E. Garton August 14/51

Botany Division, Science Service
Department of Agriculture, Ottawa, Canada



Acer negundo

79° 22' 313373 43° 41'

Province Ontario — UTM Zone — Grid Sq. — North

County York

Habitat Moist woods and stream border. Growing with sugar maple, white elm and basswood.

Locality Toronto ravines — Site No.

Date Sept. 18, 1988 — Collector & No. D. Metsger L. Gad — DG008

Herbarium & Acc. No. — Det. by DAM & LG

Date seen — Flower — Fruit October

Notes Common name = Manitoba maple

Populus deltoides

79° 22' 313373 43° 41'

UTM Zone | Grid Sq. | North

Province Ontario

County York

Habitat Sandy bank bordering a stream bed; surrounded by grasses and herbs.

Locality Toronto ravines

Loc. No.

Date Sept. 21, 1988 Collector & No. D. Metsger DG009

Herbarium Labels:

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

Name of Plant:

Location Collected: *Country, Province, Location Name*

Habitat:

Specimen Notes: *e.g. Colour, height, condition of plant*

Date Collected:

Name(s) of Collector(s):

SEED DISPERSAL OLYMPICS

The Big Idea:

Seed dispersal is a mechanism used by plants to reduce competition and increase the probability that at least some of their offspring will survive to maturity. In this activity, students explore some mechanisms used by plants to disperse their seeds. Students create model seeds, evaluate the relationship between the seed's structure and its dispersal ability, and participate in the "Seed Dispersal Olympics."

Learning Goals:

- Examine seed dispersal mechanisms in a variety of plants
- Discover the causes and consequences of overcrowding
- Design and build model seeds for a variety of seed dispersal mechanisms (wind, gravity, exploding, carried by animals)

Teacher Background Information:

Since individual plants are rooted in one place, they move around from one generation to the next by dispersing their offspring. If all the offspring are growing in one location, the probability that they are all killed in a single event is higher than if the offspring are spread over a larger area. Similarly if all the offspring end up competing with each other or other plants (including the parent plant) for resources like sunlight, water, and space, the chance of surviving to reproductive age is also reduced. It is in the parent plant's best interest, therefore, to disperse their offspring into new areas.

A seed is a tiny multicellular embryonic plant along with some stored food covered in a protective covering called a seed coat. Plants have evolved many techniques to aid in seed dispersal. In some cases, seeds are enclosed in a fruit. Some plants rely on animals like birds and rodents eating the fruit. These animals then unknowingly disperse the undigested seeds through their feces. The feces themselves provide a nutrient-rich medium for the young plant to germinate. Seed predators like squirrels collect and hoard fruits containing seeds in hidden caches. The seeds in these caches are usually well-protected from other seed predators and if left uneaten will grow into new plants. Other fruits are carried great distances by water, like the coconut which may travel hundreds of kilometres from the parent tree. Some plants like the burdock fruit are covered in tiny hooks and latch onto the skin, fur, or clothing of an unsuspecting passing animal that carries them to new locations. The touch-me-not has seeds contained inside a capsule that explodes when touched, scattering the seeds away from the plant. Dandelion fruits use the wind to aid in seed dispersal. The seeds are suspended from feathery "parachutes" that are carried on the wind. The fruit of maple and ash trees have wings (winged fruits are called samara) that let them float on air like mini helicopters. Plants like ferns and mosses make spores instead of seeds. Spores vary in size, but are usually unicellular and rarely reach over one mm in diameter. Most spores are so small that they can be dispersed on air currents, and may travel across entire continents and oceans. Regardless of the mechanism used, the end result is the same – the seeds are carried as far away as possible from the parent plant.

Some plants have the ability to disperse their seeds over remarkable distances, letting them spread quickly into new environments. In areas prone to frequent disturbances like flooding or erosion, dispersing offspring at greater distances increases the likelihood that some of the offspring will survive. If these plants are not native to the area they may become invasive. Invasive plants are introduced species that survive without human assistance and negatively impact native biodiversity by reproducing aggressively and taking over, to the exclusion of other plants. Invasive species are one of the greatest threats to biodiversity in the province of Ontario. For example, a single plant of the invasive purple loosestrife (*Lythrum salicaria*) can produce upwards of 2.7 million seeds every year. These tiny seeds are easily spread by water, wind, wildlife and humans. Introduced into North America from Asia and Europe, it invaded Ontario wetlands and formed dense stands with thick mats of roots covering vast areas. In the years since its introduction, purple loosestrife has now become a model for successful biological pest control. Five species of beetles were identified that eat purple loosestrife. Purposeful infestations of these insects were so successful that purple loosestrife has been eradicated in some areas!

Stopping Invasive Species in Ontario

The Ontario Invasive Plant Council (OIPC) along with the Ontario Ministry of Natural Resources (OMNR) and the Canadian Food Inspection Agency work to predict and curtail the introduction of new invasive species and to monitor and promote control or eradication of those species that are already here. Methods of control differ from species to species so it is important that any attempts to rid a site of an invasive species are done following established guidelines and protocols available from these organizations. Visit the OIPC's webpage at *http://www.ontarioinvasiveplants.ca* to learn more about invasive plant species in Ontario such as Garlic Mustard, Common Buckthorn, and Dog-strangling Vine.

Time Needed: 3 class periods
Site Needed: Classroom
Group Size: Single or partners

Materials:

- Examples or pictures of different seeds and fruit (e.g. sunflower fruit, dandelion fruit, maple keys, coconuts, apples, peas, acorns, burrs, touch-me-nots etc)
- Stop watch
- Magnifying glasses
- Electric fan
- Piece of cardboard (1m long and 30 cm wide)
- Meter sticks
- Artificial fur (1m by 1m)
- Small heavy objects to represent seeds (pennies, nickels, washers etc) (1 per student)
- Supplies to construct model fruit (e.g. paper, cardboard, tape, scissors, glue, pipe cleaners, elastic bands, binder clips, popsicle sticks, string, Styrofoam balls, etc)
- Design worksheet (provided below)

Activity Procedure:

Getting Ready:

1. Ensure that students already understand the basics of plant reproduction. Guiding questions: *How do plants reproduce? What are some of the structures involved in plant reproduction?*

2. Introduce the idea of competition. Guiding questions: *What do plants need to stay alive? How do plants obtain these resources? What happens if there are not enough resources available? How can plants reduce the stress of competition?*

3. Introduce the concept of seed dispersal as a way to avoid overcrowding and decrease the chance of all the seedlings being killed in a single event. Students examine a variety of different seeds and fruits (pictures or real examples) with magnifying glasses. Guiding questions: *What does the fruit or seed look like? What type of dispersal does it use (e.g. wind, floating, stick to animals, etc)? What characteristics do seeds or fruit using the same dispersal mechanism share?*

Hands On:

1. Each student will be given a 'seed' (e.g. a nickel) that needs to disperse as far from the parent plant as possible. Explain that the students are going to design and build fruits to disperse their seeds. The fruits will then compete in the "Seed Dispersal Olympics." The four categories are "longest roll" (gravity dispersal), "furthest air float" (wind dispersal), "stickiest" (animal dispersal), and "best explosion" (propulsion dispersal). Demonstrate how each dispersal mechanism will be judged.
    - "Longest roll" is measured by releasing the fruit at the top of a ramp (approximately one meter long and 30 cm high) and measuring how far it rolls before stopping.
    - "Furthest air float" is measured by placing a stationary fan on a desk or table. Using a step stool, students drop the fruit 30 cm above the top of the fan and measuring how far the fruit travels.
    - "Stickiest" is measured by how well the fruit sticks to a piece of artificial fur. At marked 15 cm increments on the floor, students toss their fruits at the fur attached to a wall and see if it sticks. If it does, they back up another 15 cm increment and try again.
    - "Best explosion" is determined by placing the fruit on a table and measuring how far the seed or fruit moves by its built-in explosive mechanism.

2. Students work alone or in partners. Each student/team designs one fruit that will compete in one seed dispersal challenge.

3. Show the students the supplies they have to work with. Depending on cost and availability, some supplies can have amount limits placed upon them.

4. Students start by filling in Part A of the worksheet. They sketch and label the fruits they are going to build and write a short paragraph explaining what design concepts have been considered in the planning phase.

5. Assessment as Learning Tool: Students explain their designs and what dispersal factors they have considered.

6. Once the design of the fruit is complete, students build the fruit using the provided materials.

7. After the fruit has been built, students can test the dispersal ability of their fruits and modify their designs as necessary. Once the students are happy with the final design, they fill in Part B of the worksheet.

8. When all the fruits in the class have been constructed, the Olympics can begin. Each student/team takes turns testing their fruit in front of the other students to see which fruit from each category wins the seed dispersal Olympics and would be the plant most likely to survive in the wild. Each fruit will have two chances to compete, with the better result being the fruit's official entry. After his/her fruit has competed in the Olympics, the student/team fills in the results in Part C of the worksheet. Students complete the assignment by filling in Part D on the worksheet.

Reflection:

1. Discuss the consequences of seed dispersal. Guiding questions: *What modifications helped with seed dispersal? What modifications did not help? What happens if a plant cannot disperse its seeds? What happens if a flood kills all the plants in an area? How would seed dispersal help the species survive?*

2. Assessment of Learning Tool: Collect the worksheets and the model fruit. Did he/she fill out all four sections on the worksheet? Are the drawings detailed and labelled? Did he/she consider more than one factor when designing the fruit? Did he/she modify the design after testing? How well did the fruit perform? Does the fruit show evidence of creativity? Is the fruit well constructed? Does the fruit's design show evidence of planning and application of scientific knowledge?

3. **Possible extension:** Introduce the concept of invasive species. Guiding questions: *What happens if one species of plant is a better seed disperser than another species of plant living in the same habitat? What would happen if this species did not belong in the native habitat? What role does seed dispersal play in allowing invasive species to spread?* Students could participate in an invasive species plant pull. Visit the Garlic Mustard Removal page at: *http://biodiversityeducation.ca/biodiversity-day/ibd-toolkit/gm-removal/* for more information.

Curriculum Links:

Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants

- 2.2 Observe and compare the parts of a variety of plants
- 3.1 Describe the basic needs of plants, including air, water, light, warmth, and space
- 3.6 Describe ways in which plants and animals depend on each other

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities

- 3.7 Describe structural adaptations that allow plants and animals to survive in specific habitats

Name:_____

Seed Dispersal Olympics Worksheet

PART A: Planning My Fruit

Dispersal Type: _____

I am going to build a fruit that looks like this:

Things I considered when designing my fruit: _____

_____

_____

_____

_____

_____

_____

PART B: Building My Fruit

The final fruit that I built looks like this:

The fruit I built differs from the fruit I drew in Part A in the following ways: _____

_____

_____

Part C: Testing My Fruit

Distance travelled on first try: _____

Distance travelled on second try: _____

Part D: Reflection

How well did your seed disperse? _____

_____

_____

A GLOBAL FRUIT SALAD

The Big Idea:

Despite living in the province with Canada's most productive farmland, Ontario imports more food products per capita than any other province! In this lesson students will concoct a hypothetical fruit salad, calculate how far different fruits travel to get to our plates, and discuss the consequences of shipping food long distances. These concepts will be reinforced first hand by a trip to a farm, farmer's market, or grocery where students will investigate how produce is grown, shipped, and sold in Ontario. A newspaper article or editorial will summarize their findings.

Learning Goals:

- Describe conditions needed to grow different types of fruits and vegetables
- Discover why southern Ontario has the best farmland in Canada
- Learn that "food miles" describes the distance food travels before it reaches our plates
- Explore the environmental and nutritional consequences of shipping food long distances
- Visit a farm, farmer's market, or grocery store and learn how food is grown, shipped and/or processed
- Write a newspaper article, editorial, or graphic summarizing their discoveries

Teacher Background Information:

Most people in Ontario buy at least some of their fruits and vegetables from a grocery store. But from where does the store get its produce? Was the tomato on your sandwich grown in the field of an Ontario farmer, or has it come from distant Mexico?

The province of Ontario is home to the majority of the best farmland in Canada. Most of this farmland is located near the shores of Lake Ontario. Because so much of Ontario's farmland is located further south than farms anywhere else in Canada, Ontario is home to all of Canada's "class A climatic potential" farmland, and most of its class B land as well. This rich farmland is located close to huge urban markets with millions of mouths to feed. Despite our agricultural bounty, Ontario imports three dollars of food products for every two dollars of food that we export. Despite having the most productive soils in Canada, we import more food products per capita than any other province!

"Food miles" describes the distance travelled by our food. The average distance travelled by food has increased dramatically over the past fifty years. Waterloo Public Health calculated that the average distance traveled by 58 foods commonly eaten in the city of Waterloo is 4,497 km. These vast distances happen because we want seasonal produce year round, we want food as cheaply as possible, and we consume more processed food. Massive companies are able to source and import the cheapest food possible. If growing or processing food is cheaper in other countries, companies save money using foreign produce and workers even if the food must be shipped half-way around the world to reach our plates.

The Toronto non-profit organization Foodshare purchased the same dinner ingredients at a grocery store and farmers' market. They calculated that imported food items travelled an average of 5,364 km, versus 101 km for food items grown locally. In fact, the global trade of food and goods accounts for thirteen percent of the world's energy use. It is estimated that we put almost ten kcal of fossil fuel energy into transporting our food for every one kcal of energy we get from eating our food! The movement of food across the globe in trains, airplanes, ships, and transport trucks is a huge contributor to greenhouse gas emissions. If a city the size of Toronto consumed locally grown food where possible, greenhouse gas emissions from transportation would be reduced by about 500,000 tons per year. This has the environmental impact of removing 162,000 cars from our roads.

Purchasing locally grown food where possible is not only a good environmental choice, but also a delicious choice! Locally grown produce often tastes better. Because fruits and vegetables have a shorter distance to travel, they are allowed to ripen on the plant and develop better texture and flavor. Produce that must be shipped long distances is often harvested unripe, treated with preservatives, and then treated with chemicals to force ripening.

Time Needed: 5 class periods
Site Needed: Classroom, field trip to farm, farmer's market, or grocery store
Group Size: Individual

Materials:

- Large map on Ontario
- Large map of the world
- Highlighters
- Pushpins or tape
- Calculators
- "My Global Fruit Salad" worksheet (provided below)
- "How Far has my Fruit Travelled" worksheet (provided below)
- Interview worksheet (provided below)
- Cameras (for field trip)
- Notepaper (for field trip)
- Pencils (for field trip)
- Examples of different types of articles in newspapers

Activity Procedure:

Getting Ready:

1. The concept of food miles and food systems can range from simple to very complex. Adjust content and expectations as required. Ensure that students can describe some connections between features of the natural environment and the type of land use that is established in that region (e.g. forestry in Northern Ontario, farming in Southern Ontario).

2. Show the students a map on Ontario. Students identify where their school is located. Guiding questions: *What are some major landforms in your region? How is the land used in your area? What industries does your area support? How does the land support human needs and wants?*

3. Discuss farming in Ontario. Guiding questions: *What do plants need to grow? What can farmers do to help their crops grow?* Using the map of Ontario, help the students identify where the best farmland is located in Ontario. Pictures of these areas may help. *What temperature/weather/climate do farms need to be successful? Where in Ontario are there few or no farms? Why are there few or no farms in these regions?*

4. Discuss what fruits and vegetables we grow in Ontario. Guiding questions: *What fruits and vegetables can we grow in Ontario? Do you know anyone that lives on a farm? Does anybody grow vegetables in his/her garden or on his/her balcony? What fruits and vegetables can we not grow in Ontario? Why not?* If students are not familiar with a variety of fruits and vegetables, pictures, plastic toys, or actual specimens could be used to help guide the conversation.

5. Introduce the concept of food miles. Guiding questions: *If we cannot grow a fruit or vegetable in Ontario, where does the grocery store get it from?*

Hands On (part 1 – Food Miles):

1. Discuss why fruits and vegetables are an important part of our diet. Guiding questions: *Why is it important to eat fruits and vegetables? What nutrients do we get from fruits and vegetables?*

2. Hand out the worksheet "My Global Fruit Salad". Students circle five fruits they would use to build their ideal fruit salad. For younger grades, the class can work together to create a class fruit salad.

3. Assessment as Learning Tool: Make a list on the chalkboard with two categories "Can Grow in Ontario" and "Can Not Grow in Ontario." Students predict where each of the twenty fruits can be grown during the summer. Younger grades can tape the pictures of each fruit on the board under the two category headings.

4. Handout the "How Far has My Fruit Travelled?" worksheet. Students highlight the five fruits they selected and discover where each fruit was grown. Younger grades can do this step together as a class.

5. Attach a large map of the world on the wall. Students use pushpins or tape to attach pictures of each type of fruit onto the map to visualize how far away fruits must travel to reach our grocery stores. If appropriate, students can determine the latitudes and longitudes of these countries.

6. Discuss the temperature/weather/climate in the countries now identified on the map. Guiding questions: *Why can humans grow pineapples and coconuts in the Philippines and not in Canada?* As different countries are being discussed, use the opportunity to see if any students in the class are from or have visited these countries. Guiding questions: *What was the weather/climate like in that country? Did you eat any of these fruits while in that country? Did the fruits taste the same or different than the same fruits bought in an Ontario supermarket?*

7. Return to the "How Far has My Fruit Travelled?" worksheet. Students add up the total distance travelled by the five fruits in their salads to determine total food miles travelled. Since distances can be quite large, consider using calculators. Enter this distance on the worksheet. Younger grades can take turns using the calculator to calculate the class's food miles.

8. **Possible extension** – over the course of the unit, month, or school year, have students bring in produce stickers from home and add them to the map to get a visual representation of how for produce in Ontario travels.

Reflection (part 1 – Food Miles):

1. Discuss seasonality of produce. The distances in this activity reflect distances travelled by fruit in the summer. Guiding questions: *Where does the grocery store get fruits and vegetables in the winter? Would the distance fruit travels be longer or shorter than in the summer? What sorts of fruits and vegetables could you eat in the winter if you only ate local produce?*

2. Discuss the impacts on the taste of food when humans transport food thousands of kilometers. Guiding questions: *How does food taste when it is shipped long distances? How do we ensure that food is not rotten when it reaches the supermarket?*

3. Discuss the impacts on the environment when humans transport food thousands of kilometers. Guiding questions: *How is food shipped from one country to another? What are the impacts on the environment when food is shipped long distances? What pollutants do trucks and airplanes emit into the atmosphere? What impacts are increasing levels of carbon dioxide having on the Earth? How do we balance human needs and wants while protecting the environment in Canada and around the world?*

Hands On (part 2 – Field Trip):

1. Arrange a visit to a local farm, farmer's market, or grocery store. Ideally, arrange to have someone at the destination give the students a tour of the facility with a focus on how food is grown, packaged, and/or shipped. If possible have the discussion include the impact of growing and/or of purchasing local fruits and vegetables. Guiding question: *Why might a grocery store not be able to carry local food all year round?*

2. Before the trip, in class, introduce the reason behind the field trip to the students. The students are going to be investigative journalists and are tasked with creating a newspaper article on how food reaches our tables. They could focus on how food is grown, packaged, and/or shipped depending on where they visit and what they learn.

3. Help the students compile a list of appropriate questions to ask on the field trip. Possible questions include: *What foods do we grow in Ontario? Where do farmers send their produce? How do stores get their produce? What does the food look like when a store/famer's market receives it? Do stores try and purchase local produce?* Students record these questions on the interview worksheet. If more than one person is being interviewed, adjust accordingly.

4. On the field trip have students take turns asking the questions generated in class. Older students could write down the answers for themselves and younger students may depend on an adult to record the answers. Students can draw pictures of what they encounter, or if cameras are available and permitted, take some pictures to accompany the report.

Reflection (part 2 – Field Trip):

1. Back in class, students examine some newspapers and identify different ways in which information is presented. Guiding questions: *What are the different types of articles? What is the function of the different types of articles? How is information presented? How are graphics presented? When are facts used and when are opinions used?*

2. Students decide how they are going to present the information they have gathered during the investigation. Material could be presented, for example, as an article, an interview, a graphic explaining how food travels from farm to table, an editorial about when eating local produce may be a good choice, or an investigation to see if people can identify local food in a taste test. and/or illustrations could be included in the article. If appropriate, students conduct research before writing their newspaper article.

3. If desired, the completed assignments could be published in a class newspaper and distributed to other students, parents, or given out at a local farmer's market.

4. Assessment of Learning Tool: Assess the newspaper article. Is the information correct and at the appropriate grade level? Is the writing done at the appropriate grade level? Have the conventions and techniques for the media form been followed? Is the approach creative?

Curriculum Links:

Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- 3.5 Describe ways in which humans from various cultures, including Aboriginal people, use plants for food, shelter, medicine, and clothing
- 3.7 Describe the different ways in which plants are grown for food, and explain the advantages and disadvantages of locally grown and organically produced food, including environmental benefits

Grade 3 – Social Studies – People and Environments: Living and Working in Ontario
- B1.1 Describe some major connections between features of the natural environment of a region and the type of land use and/or the type of community that is established in that region
- B3.5 Describe major types of land use and how they address human needs and wants

Grade 3 – Language: Media Literacy
- 3.1 Identify the topic, purpose, and audience for media texts they plan to create
- 3.2 Identify an appropriate form to suit the specific purpose and audience for a media text they plan to create
- 3.4 Produce media texts for specific purposes and audiences, using a few simple media forms and appropriate conventions and techniques

Grade 3 – Health and Physical Education: Healthy Living
- C1.1 Demonstrate an understanding of how the origins of food affect its nutritional value and environmental impact
- C3.1 Explain how local fresh foods and foods from different cultures can be used to expand their range of healthy eating choices

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- 2.6 Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.1 Demonstrate an understanding of habitats as areas that provide plants and animals with the necessities of life
- 3.3 Identify factors that affect the ability of plants and animals to survive in a specific habitat

Grade 4 – Social Studies – People and Environments: Political and Physical Regions of Canada

- B2.1 Formulate questions to guide investigations into some of the issues and challenges associated with balancing human needs/wants and activities with environmental stewardship in one or more of the political and/or physical regions of Canada
- B2.5 Evaluate evidence and draw conclusions about issues and challenges associated with balancing human needs/wants and activities with environmental stewardship in Canada

Grade 4 – Language: Media Literacy

- 3.1 Describe in detail the topic, purpose, and audience for media texts they plan to create
- 3.3 Identify conventions and techniques appropriate to the form chosen for a media text they plan to create
- 3.4 Produce media texts for specific purposes and audiences, using a few simple media forms and appropriate conventions and techniques

Grade 4 – Health and Physical Education: Healthy Living

- C3.1 Identify ways of promoting healthier food choices in a variety of settings and situations

Grade 5 – Social Studies – People and Environments: The Role of Government and Responsible Citizenship

- B2.2 Gather and organize a variety of information and data that present various perspectives about Canadian social and/or environmental issues, including the perspective of the level (or levels) of government responsible for addressing the issues
- B3.6 Explain why different groups may have different perspectives on specific social and environmental issues

Grade 5 – Language: Media Literacy

- 3.1 Describe in detail the topic, purpose, and audience for media texts they plan to create
- 3.2 Identify an appropriate form to suit the specific purpose and audience for a media text they plan to create, and explain why it is an appropriate choice
- 3.4 Produce a variety of media texts for specific purposes and audiences, using appropriate forms, conventions, and techniques

Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity

- 3.6 Identify everyday products that come from a diversity of organisms

Grade 6 – Social Studies – People and Environments: Canada's Interactions with the Global Community

- B3.6 Identify and locate on a map countries and regions with which Canada has a significant interrelationship, and use longitude and latitude to locate cities in these countries/regions
- B3.7 Identify countries/regions with which Canada has a significant economic relationship and some of the reasons why close relationships developed with these countries/regions and not others
- B3.9 Describe some ways in which Canada's interactions with other regions of the world have affected the environment

Grade 6 – Language: Media Literacy

- 3.1 Describe in specific detail the topic, purpose, and audience for media texts they plan to create, and identify challenges they may face in achieving their purpose
- 3.3 Identify conventions and techniques appropriate to the form chosen for a media text they plan to create, and explain how they will use the conventions and techniques to help communicate their message
- 3.4 Produce a variety of media texts for specific purposes and audiences, using appropriate forms, conventions, and techniques

Grade 6 – Health and Physical Education: Healthy Living

- C3.1 Explain how healthy eating and active living work together to improve a person's general health and well-being and how the benefits of both can be promoted to others

Name: _____

My Global Fruit Salad

Circle five fruits (shown below) that you would use to make your perfect fruit salad.

 Banana	 Kiwifruit	 Strawberry	 Grapes
 Apple	 Mango	 Blueberry	 Pineapple
 Orange	 Peach	 Raspberry	 Avocado
 Grapefruit	 Pear	 Cherry	 Coconut

Name: _____

How Far has my Fruit Travelled?

Fruit	Country	Average Distance (km)
Banana	Ecuador	5 100
Strawberry	Ontario, Canada	100
Kiwifruit	New Zealand	14 500
Grapes	Ontario, Canada	100
Apple	Ontario, Canada	100
Mango	India	11 300
Blueberry	Ontario, Canada	100
Pineapple	Philippines	13 100
Orange	United States	3 300
Peach	Ontario, Canada	100
Raspberry	Ontario, Canada	100
Avocado	Mexico	3 600
Grapefruit	United States	3 300
Pear	Ontario, Canada	100
Cherry	Ontario, Canada	100
Coconut	Philippines	13 100

The distance travelled by our food is called food miles. Add up the distance travelled by the fruit in your. How far did your fruit salad travel?

Name: _____

Interview Worksheet

Name of person being interviewed: _____

Question	Answer

GETTING TO KNOW A TREE

The Big Idea:

Despite being instantly recognizable as "trees", students often know little about trees beyond their basic identity. This is especially disappointing as more than half of the province of Ontario is covered by trees! In this lesson students will become experts on a single living tree specimen. They will examine its leaves, identify its species, make bark rubbings, measure girth, calculate its age, and approximate its height. Each tree profile is then collected together to create a class encyclopedia.

Learning Goals:

- Explore the variety of trees growing in Ontario
- Identify tree species using identification guides and websites
- Make a bark rubbing
- Measure tree girth and use simple mathematics to calculate its age
- Estimate the height of the tree using an established method

Teacher Background Information:

The province of Ontario is home to approximately 85 billion trees; after all 66% (71.1 million ha) of Ontario is covered in forest. This represents 17% of Canada's total forests and 2% of the world's forests! Our most common tree is the black spruce (37%), followed by poplar (21%), and jack pine (12%). While Ontario is home to over ninety native tree species, there are an estimated 100 000 species of trees worldwide, representing twenty-five percent of all living plant species.

True Trees are woody perennial plants that live for many years and have both primary growth (in height) and secondary growth (in width). The woody tissue is formed from specialized vascular tissue called xylem that conducts water and minerals from the roots to the stem, and becomes hardened, providing support. The tallest living tree on Earth is currently a 116 m tall coast redwood (*Sequoia sempervirens*) named Hyperion in Redwood National Park, California. The tallest known broad-leaved tree is a mountain ash (*Eucalyptus regnans*) growing in Tasmania with a height of 97 m. The largest tree by volume is currently a giant sequoia (*Sequoiadendron giganteum*) known as the General Sherman Tree in Sequoia National Park in California. Only the trunk is used in the calculation and its volume is estimated to be 1,487 m^3. In other parts of the world, many palms, bananas and some bamboos could also be considered trees. They, however, do not fit the true definition because they don't have secondary growth, their stems are the same width from ground to tip.

Below the ground, the tree's roots branch and spread out widely to anchor the tree and to collect water and nutrients. Because they are subterranean, roots are often of little help when identifying a tree species. Some trees, however, do have roots that are above ground. These roots either stabilize the tree or help it obtain oxygen in waterlogged soils. The elongated stem (or trunk) of trees grows to such tremendous heights because of the never-ending competition for sunlight; the taller the tree, the more sunlight it receives. Leaves are the photosynthetic part of the plant and are consequently found at the top or crown of the tree. Leaves come in a wide variety of shapes and sizes, and are most frequently used during tree identification. The different leaf shapes have evolved because of different environmental conditions. For example, needles are hardier than broad leaves and have evolved to survive in habitats that are colder and where water is scarcer.

Trees for Toronto

Canada's largest city, Toronto, is home to more than 217 different kinds of trees! Queen's Park, located behind the Ontario Legislative Building alone has over 300 trees representing approximately 50 different species. Nearly 20 species of trees found in Queen's Park are native to Ontario. The others are species that originate elsewhere, primarily Europe and Asia.

Visitors to Queen's Park will see four signs telling the history of the park and its trees. This initiative, called "Trees for Toronto," was launched by the Royal Ontario Museum and the City of Toronto. The purpose of "Trees for Toronto" is to plant trees in Queen's Park and to create a tree identification and awareness program across Toronto. Online tree species fact sheets are being developed for the trees of Toronto park by park, starting with Queen's Park and Toronto Islands. Each species fact sheet provides key features for identification and fascinating facts.

More than 100 trees in Queen's Park have been labeled with tree plaques that provide the latin name, Common name, Family, Origin, status in Ontario and an image of the leaf shape. Similar plaques have been placed on trees on the Toronto Islands and will be used in other Parks around the city. The Royal Ontario Museum maintains a database of plaque information with up-to-date names of all the tree. Visit *http://www.rom.on.ca/en/collections-research/centres-discovery/biodiversity/trees-toronto* and click on the fact sheet link for more information.

Time Needed: 4 class periods
Site Needed: Outdoor area with trees, classroom
Group Size: Groups of two

Materials:

- Envelopes or bags for sample leaves (1 for each team)
- Crayons
- Pencils
- Strong easy-to-see tape (e.g. duct tape)
- Measuring tapes (1 for each team)
- Getting to Know a Tree worksheet (provided below)
- Clipboards (1 for each team)
- Calculators (optional, but recommended)
- Metre sticks (1 for each team)
- 30 cm rulers (1 for each team)
- Cameras (optional)
- Tree identification books, identification keys, or computers with internet access
- Supplies to create tree profile pages

Activity Procedure:

Getting Ready:

1. Discuss trees, their characteristics, and their role in the environment. Guiding questions: *What are the largest plants in the world? Can you name some different types of trees? What are the parts of a tree? What are the functions of the different parts of a tree? How is a tree different from a grass, a strawberry plant or a tulip? Why do trees grow so tall? How are trees able to grow so tall? What are some differences between deciduous and coniferous trees?*

2. Assessment for Learning Tool: Students sketch and label a tree and describe the function of the different parts.

3. Teacher preparation: Locate an outdoor area where the students can closely examine a tree. Ideally there would be a variety of tree species. Students must be able to approach and touch the trees. Consider the school's property, local parks, the neighbourhood, etc

4. Teacher preparation: Some students may be allergic to tree nuts. If this is the case, identify any potential threats and adjust plans accordingly.

Hands On (part 1 – In the field):

1. Students work in teams of two. Explain that each team is going to closely study a tree, and write a profile for that tree. All the entries are going to be put together to create a class encyclopedia of trees in the area.

2. Take the class to the outside area where they will be working. Each team selects a tree to study. If there are not enough trees, increase the size of each team.

3. If cameras are available, have each team take photos of their tree.

4. Each team now makes observations to help identify their species of tree.Students start by collecting a sample leaf or small branch. For very tall trees, look for leaves that have fallen to the ground. On the worksheet, draw a single leaf. If possible, trace the leaf to get an accurate outline, and then add in veins and other details freehand. Place the leaf in a bag or envelope for identification back in the classroom. If there areany seeds, flowers, fruits or nuts from the tree, collect them as well.

5. Students next make a bark rubbing. Demonstrate the technique first. Place the worksheet against the bark of the tree and rub the crayon against the paper in the correct box. Press hard enough that an impression is made, but not so hard that the paper rips.

6. Students now measure the girth (circumference) of the tree. Demonstrate the technique first. Measure one metre up from the ground using a metre stick and use a piece of tape to mark this height. Now use a tape measure to measure the distance around the trunk of the tree in centimeters at this one metre mark. Guiding questions: *What units of measurement are we using? Why would millimetres or kilometres not be appropriate? Why should we all measure at the same height up from the base? What could the girth of the tree tell us about its age?* Students complete this measurement and record it on the worksheet.

7. Show the students how to calculate the age of the tree. Botanists have determined that every 2.5cm of girth corresponds to approximately one year's growth. To calculate age, students divide the girth of the tree by the number 2.5. Demonstrate the calculation. A calculator is recommended for this step. Students complete this calculation and record it on the worksheet.

8. Using only the metre stick as a guide to how long a meter is, have each team guess the height of their tree. Record this number on the worksheet. Guiding questions: *What height did you estimate? Do you feel confident with this guess?*

9. Show the students how to better estimate the height of the tree using an approved technique. Discuss that guessing tree height is not scientifically acceptable and directly measuring tree height is difficult because it is difficult to climb to the very top of a tree. Scientists have instead developed techniques to more accurately estimate the height of a tree. The following method uses a comparison of ratios to estimate height. Demonstrate the following method.

    i. Student#1 measures one metre up the trunk of the tree from the ground. The student places a marker (like duct tape) on the tree to identify this spot.

    ii. Student#2 holds a 30cm ruler vertically in his/her hand. Student#2 walks away from the tree until he/she is able to fit the entire tree (from ground to the tallest branch) within the ruler.

    iii. Holding the ruler out, student#2 measures (in cm) the height of the tree from the tree's base to the highest branch. Student#1 records this number on the worksheet.

    iv. Staying in the same spot and holding the ruler the same distance from his/her body, student#2 measures (in cm) the height of the tree from the tree's base to the one meter marker put in place by student#1. Student#1 records this number on the worksheet.

    v. Use the formula below to calculate the height of the tree (in metres) on the worksheet.

$$\text{Tree Height (m)} = \frac{\text{Measured Tree Height (cm)}}{\text{Measured Tree Marker Height (cm)}}$$

10. <u>Assessment as Learning Tool:</u> Circulate as students are filling in the worksheet with drawings, rubbings, measurements, and calculations. Help them spot if any numbers seem unlikely. Any errors not spotted now are likely to end up on the final profile page.

Hands On (part 2 – In the classroom):

1. Print off the tree pictures and give them back to each team.

2. Students now identify their trees using the photographs, leaves, and seeds collected. Depending on the age and skill of the students, the teacher could do identification with the entire class or have them do it on their own. Possible ways to identify the trees include tree identification books or internet sites (see below). If students complete this step independently using books or keys, they may need some additional vocabulary to complete this step. Use the Plant Identification Guide included in the "Drawing Plants for Science and Pleasure" activity.
    - Visit the Ministry of Natural Resources "Tree Atlas" which can be downloaded as a pdf for free at: *http://www.mnr.gov.on.ca/groups/lr/@mnr/@climatechange/documents/document/276611.pdf*
    - Visit "Trees for Toronto" from the Royal Ontario Museum. It is available for free at: *https://www.rom.on.ca/en/collections-research/centres-discovery/biodiversity/trees-toronto*
3. Assessment as Learning Tool: Have the students accurately identified the tree species?

Reflection:

1. Working together as a class, find or create a map of the study area. It might be professional map (e.g. one produced for a local park), a drawing, or a collage of photographs. Have each student locate and identify their tree on the map.

2. Explain that each team is now going to use the data collected to create a one page profile of the tree they studied. Guiding questions: *What information should be included on the profile page? What information should not be included? What are some different ways the information be displayed? How might people use this class tree encyclopedia in the future?*

3. Students design and create their tree profile page using the available supplies (e.g. cut and paste, computer graphics, etc).

4. Once the class map and individual tree profiles are complete, collect them in a binder to create a class encyclopedia. If the activity is done for two or more years, a year-by-year record of the trees in the area will develop.

5. Assessment of Learning Tool: Assess the profile pages. Is the necessary information included and accurate? How well is the information presented? How useful is the profile page? How creative is the design of the profile page?

Curriculum Links:

Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants

- 2.2 Observe and compare the parts of a variety of plants
- 3.2 Identify the major parts of plants and describe how each contributes to the plant's survival within the plant's environment

Grade 3 – Mathematics: Measurement

- Estimate, measure, and record length, height, and distance, using standard units draw items using a ruler, given specific lengths in centimetres
- Compare standard units of length, and select and justify the most appropriate standard unit to measure length

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities

- 3.3 Identify factors that affect the ability of plants and animals to survive in a specific habitat
- 3.7 Describe structural adaptations that allow plants and animals to survive in specific habitats

Grade 4 – Mathematics: Measurement

- Estimate, measure, and record length, height, and distance, using standard units
- Select and justify the most appropriate standard unit to measure the side lengths and perimeters of various polygons

Grade 5 – Mathematics: Measurement

- Select and justify the most appropriate standard unit to measure length, height, width, and distance, and to measure the perimeter of various polygons

Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity

- 3.1 Identify and describe the distinguishing characteristics of different groups of plants and animals, and use these characteristics to further classify various kinds of plants and animals

Grade 6 – Mathematics: Measurement

- Demonstrate an understanding of the relationship between estimated and precise measurements, and determine and justify when each kind is appropriate
- Estimate, measure, and record length, area, mass, capacity, and volume, using the metric measurement system.
- Select and justify the appropriate metric unit to measure length or distance in a given real-life situation

Name: _____

Getting to Know a Tree

Drawing of a Leaf:

Bark Rubbing:

How far around is the trunk? This is called girth.

My tree is _____ cm all the way around.

How old is my tree? Divide the girth of the tree (number measured above) by the number 2.5.

Age of tree = Girth of tree ÷ 2.5

My calculations:

My tree is _____ years old.

Some trees can grow over 100 m tall. I estimate that my tree is _____metres tall.

How tall is my tree? This formula will give me a better estimate.

The height of the tree from the base to the highest branch is _____ cm.

The height of the tree from the base to the one metre marker is _____ cm.

Use this formula to calculate the height of the tree.

Tree Height (m) = Measured Tree Height (cm) ÷ Measured Tree Marker Height (cm)

My calculations:

The tree is _____ m tall.

YOU CAN COUNT ON DENDROCHRONOLOGY

The Big Idea:

Every season, growth rings form that create an annual record reflecting the growing conditions during the life of the tree. Climactic information like moisture and temperature, and growth challenges such as crowding, fire, or animal damage can be determined by the science of dendrochronology. In this activity, students will examine the tree rings of an American Beech *(Fagus grandifolia)* and discover the secrets hidden in its growth rings.

Learning Goals:

- Learn that dendrochronology is the study of tree rings
- Examine tree rings to investigate the life history of a tree
- Investigate how plants react to their environment

Teacher Background Information:

Dendrochronology is the science of analysing the patterns of growth rings found in the horizontal cross section (or "tree cookie") of the wood in a tree's trunk. Bark is found on the outside of the cross section and is not wood. Just inside the bark is the cambium, a thin layer of living tissue that separates the bark from the wood. The woody tissue is arranged in concentric rings around the pith (the juvenile wood found in the centre of the tree). In young trees, all of the wood is used in the transportation of sap and is called sapwood. As the tree matures and increases in girth, the sapwood is no longer used for transportation and matures into heartwood. In many tree species, the heartwood is darker in colour because of accumulated materials in the cell walls called extractives. The sapwood, in contrast, is usually a lighter neutral shade.

Growth rings are the result of seasonal growth in the cambium. One ring generally indicates one year in the tree's life. The ring-like appearance is caused because the growth rate changes throughout the seasons of the year. The inner portion of a growth ring forms in the spring when growth is relatively rapid. The resulting wood is less dense and is usually lighter in colour. This is called "early wood." The outer portion of the growth ring is the "late wood" and is produced in the summer and sometimes into the autumn. Growth is slower and produces denser wood which is usually darker in colour. Since growth rings require seasonal growth, they are more commonly found in trees growing in temperate climates than tropical climates. Some tropical trees create growth rings reflecting changes in growth between the dry and rainy seasons. Trees don't need to be cut down to obtain a tree ring sample. The most practical method to get a sample without harming the tree is to drill a small hollow with an increment corer. The increment corer makes an unbroken sample 5mm in diameter from the outside of the tree all the way to the centre of the tree.

Over the course of the tree's life, the growth rings form an annual record reflecting the climatic conditions during which the tree grew. Wide rings result from adequate moisture and a long growing season. Narrow rings may result from a drought or cooler than normal temperatures. Growth challenges such as crowding, flooding, or growing on a slope, and scars from forest fires, lightening strikes, or insect attacks are also preserved. Trees growing in the same geographic area tend to have similar patterns in their ring widths. This means that growth ring patterns from multiple trees can be matched ring for ring. Tracing tree ring patterns from living and dead trees back through time allows historical growth ring records to be built up for that region. Growth ring inspection was originally done via visual inspection, but now computers are programmed to do the matching. In some areas of the world, tree ring records now date back many thousands of years. Because dendrochronology can provide the absolute date at which tree rings were formed it has applications in paleoecology (to determine aspects of past ecosystems), archaeology (to date the wood in old buildings), and radiocarbon dating (to calibrate radiocarbon ages).

The ROM's Giant Tree Cookie

Visitors to the Royal Ontario Museum's Life in Crisis: The Schad Gallery of Biodiversity encounter a 2.3 m tree cookie from a 500-year-old Douglas-fir from British Columbia. The Coast Douglas-fir is the second tallest conifer in the world. Maximum heights of 100–120 m and diameters up to 4.5–6 m have been documented. The species commonly lives more than 500 years and occasionally more than 1,000 years. This particular tree was alive when Johannes Gutenberg invented the printing press in the 1440's and was still growing four centuries later when Charles Darwin published the On the Origin of Species in 1859. It was eventually cut down at the turn of the 19th century.

Photo Credit: Brian Boyle, © ROM

Douglas-firs (*Pseudotsuga menziesii*) are a preferred species for dendrochronology in western North America because they have exceptional circuit uniformity, meaning that the rings are usually concentric around the middle. The rings are also well defined with a sharp definition between the early wood and late wood. Because of their distribution from Canada to northern Mexico, they are ideal for large-scale climate reconstructions.

Time Needed: 1 class period
Site Needed: Classroom
Group Size: Individual

Materials:

- Tree Growth Cards (provided below)
- American Beech tree cookie (provided below)
- Magnifying glasses
- Pencil crayons (red, orange, yellow, green, blue, purple)
- "The Life of an American Beech Tree" worksheet (provided below)
- Pencils
- Real tree cookies (optional)

Activity Procedure:

Getting Ready:

1. Ensure students understand the basics of tree growth and plant anatomy. Guiding questions: *What are the parts of a tree? How does each part contribute to the tree's survival? What do trees need to grow? What conditions are best and worst for tree growth? How do plants produce their own food? How do trees in Canada survive the winter?*

Hands On:

1. Show the students some tree cookies (real or photocopied). Introduce the concept of dendrochronology. Guiding questions: *What part of the tree are these from? Why do these rings form? Are the older rings near the bark or the centre of the tree? How can we determine how old this tree is? Why are the rings not uniform in size from year to year? What conditions would cause wide rings to grow? What conditions would cause narrow rings to grow? What problems would cause scars?*

2. Assessment as Learning Tool:
   a. Cut out the Tree Growth Cards (provided below).
   b. On the blackboard or poster paper draw a small circle in the middle of the board. This is the pith, the juvenile wood found at the centre of the tree.
   c. Students take turns selecting a card, reading it aloud, and drawing the next growth ring on the tree (reflecting the conditions from the card).
   d. Each student then explains why they drew the ring the size they did.

3. Hand out the worksheet "The Life of an American Beech Tree." Students examine the American Beech tree cookie and answer the questions on the worksheet. Students either complete it independently, or complete it together as a class.

Reflection:

1. Assessment of Learning Tool: Collect and assess "The Life of an American Beech Tree" worksheet.

Curriculum Links:

Grade 3 – Science and Technology: Understanding Life Systems, Growth and Change in Plants
- 3.1 Describe the basic needs of plants, including air, water, light, warmth, and space
- 3.4 Describe how most plants get energy to live directly from the sun and how plants help other living things to get energy from the sun
- 3.8 Identify examples of environmental conditions that may threaten plant and animal survival

Grade 4 – Science and Technology: Understanding Life Systems, Habitats and Communities
- 3.3 Identify factors that affect the ability of plants and animals to survive in a specific habitat
- 3.7 Describe structural adaptations that allow plants and animals to survive in specific habitats

Grade 6 – Science and Technology: Understanding Life Systems, Biodiversity
- 2.3 Use scientific inquiry/research skills to compare the characteristics of organisms within the plant or animal kingdoms
- 3.1 Identify and describe the distinguishing characteristics of different groups of plants and animals, and use these characteristics to further classify various kinds of plants and animals

Tree Growth Cards:

There was a lot of rain in the spring.	There was a forest fire!	The summer was very hot and dry.	A volcano erupted and made the sky dark for an entire year.
There was too much rain in the spring.	The tree was attacked by caterpillars that ate all the leaves.	The summer was perfect – warm with enough rain.	A disease made the leaves grow poorly this year.
There was plenty of rain in the spring and summer.	A disease made most of the leaves fall off.	There was a lot of sunlight this summer.	The roots could not reach enough water.
This spring was too dry.	This year was too cold.	It was cloudy almost every single day.	The tree was struck by lightning!
This growing season was very dry.	The winter lasted a long time and spring was very short.	The growing season was very long this year.	Other trees crowded out this tree and it did not get enough sunlight.
This year was too wet and the ground was always soggy.	The winter was very warm and the tree started growing very early in the spring.	The growing season was very short this year.	Other trees crowded out this tree and it did not get enough water.

Name: _____

The Life of an American Beech Tree

A tree grows new wood every year in the form of rings. These growth rings tell the story of the tree's life. The study of tree rings is called dendrochronology.

1. How many centres does this tree have? _____ Colour the centres of the tree in yellow.

   What happened to the tree during its early life to make it look like this? _____

   _____

2. The bark from one of the small saplings is now trapped inside the tree. Colour the trapped bark in orange.

   How did you find the trapped bark? _____

3. Using a magnifying glass, count the rings to find out how old this tree was. The number of rings tells the trees age.

   How old was this tree? This tree is _____ years old

4. Using the colour red, colour in the tree's growth ring that matches your current age (eg. if you are nine years old, colour in the growth ring from the tree's ninth year).

5. The **heartwood** is the darker wood found in the centre of the tree. Label the heartwood on the tree cookie.

   The **sapwood** is the lighter coloured wood found at the outside of the tree. Label the sapwood on the tree cookie.

6. Fat growth rings show that the tree grew very a lot during that year. Colour three fat growth rings in using the colour green.

   Name two factors that might cause high growth. _____ _____

7. Narrow growth rings show that the tree didn't grow very much that year. Colour three narrow growth rings in using the colour blue.

   Name two factors that might cause low growth. _____ _____

8. This tree was injured (perhaps by insects or fungus) which caused areas with strange growth rings or stains. Colour the damaged areas in purple.

Glossary of Terms:

Alien Species: Plants, animals, and micro-organisms that have been accidentally or deliberately introduced into areas outside their native range. Synonyms include introduced, non-native, and exotic.

Botanical illustration: The art of depicting the true form, colour, and details of plant species. Their creation requires an understanding of plant morpholog and mastery of artistic techniques.

Botanical sketches: A form of visual note-taking used to capture aspects of a plant.

Bryophyte: Nonvascular plants comprising the true mosses and liverworts. (compare to vascular plant)

Cambium: The layer between the xylem and phloem of most vascular plants that gives rise to new cells and is responsible for secondary growth.

Dendrochronology: The science of analysing the patterns of growth rings found in the horizontal cross section of the wood in a tree's trunk.

Extirpated: A species which no longer exists in a certain geographic area, though it still exists elsewhere.

Extractives: Accumulated materials in the cell walls of heartwood that give it a darker colour than sapwood.

Food miles: The distance food is transported from the time of its production until it reaches the consumer.

Girth: The circumference around an object, such as a tree trunk.

Heartwood: The wood of a tree trunk that no longer conducts water and nutrients and serves primarily for structural support.

Herbarium: A collection of dried plants that are mounted and classified systematically.

Increment borer: A specialized tool used to extract a section of wood tissue from a living tree without causing major injury to the tree.

Introduced species: A species that is brought to an environment where it did not live before. Introduced species can cause great problems for native species and for people.

Invasive species: A non-native species that is so reproductively successful and aggressive that it can dominate an area, often to the point of becoming a monoculture. It interferes seriously with the natural functioning and diversity of the eco system where it becomes established, negatively impacting native biodiversity, the economy and/or society, including human health. Examples include dog strangling vine, garlic mustard, white clover, common buckthorn, and tartarian honeysuckle.

Native species: A species that occurs naturally in a given area or region.

Phloem: Tissue in vascular plants that transports organic nutrients (especially sucrose) to all parts of the plant as needed.

Glossary of Terms (cont'd):

Pith: A tissue in the stems of vascular plants composed of soft, spongy cells which store and transport nutrients throughout the plant. The juvenile wood found in the centre of the tree is pith.

Samara: A usually one-sided, winged fruit, as of the elm or maple.

Sapwood: The wood used in the transportation of sap.

Seed: A tiny multicellular embryonic plant along with some stored food covered in a protective covering called a seed coat.

Spore: Single-celled reproductive units of plants such as ferns and mosses.

Tree Cookie: Horizontal cross section of the wood in a tree's trunk.

Vascular plant: Any plant that has the vascular tissues xylem and phloem.

Xylem: Tissue in vascular plants that transports water to all parts of the plant as needed.