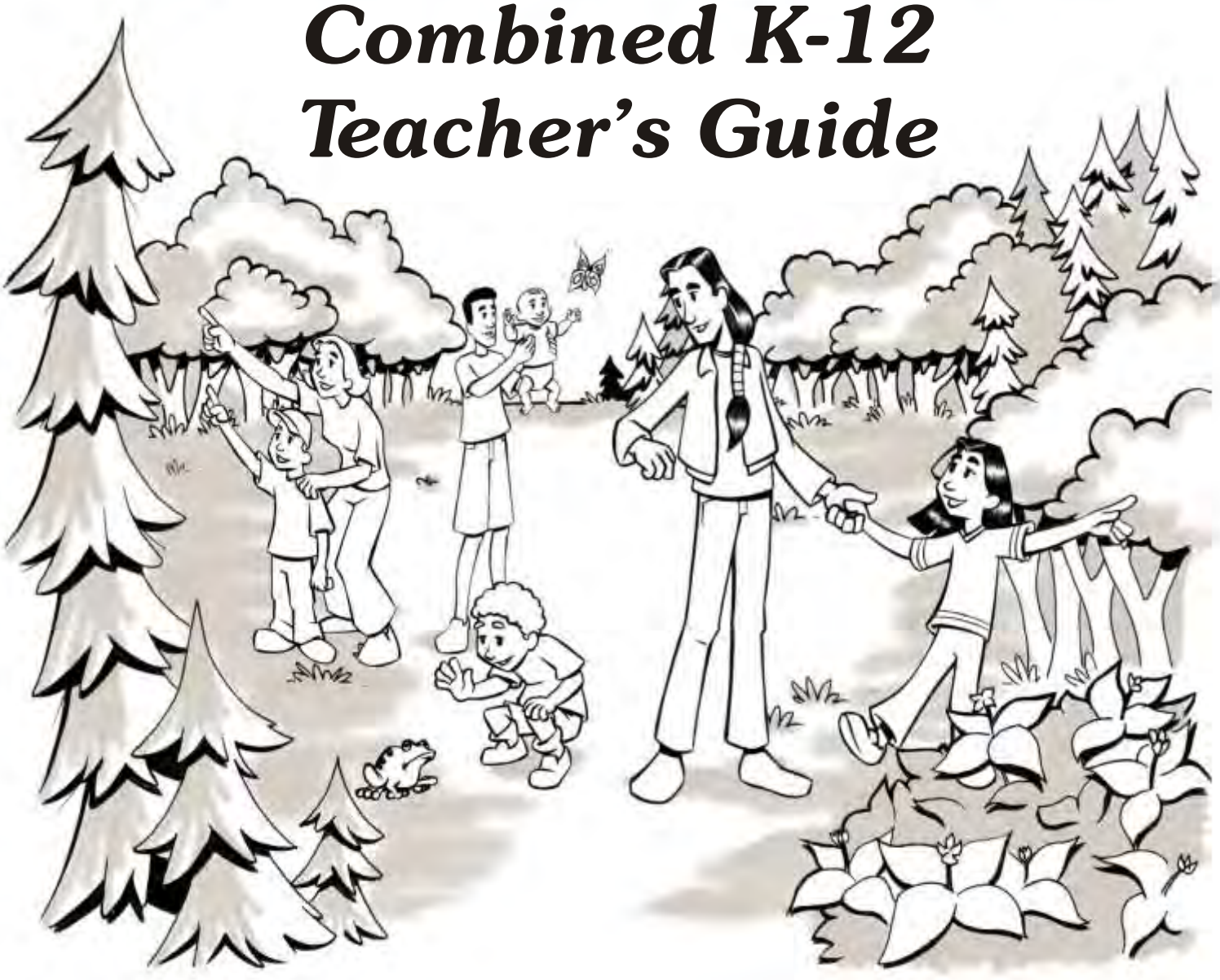
FOCUS on FORESTS

Combined K-12 Teacher's Guide



PRINTING NOTE TO TEACHERS:

HOW TO PRINT INDIVIDUAL LESSONS!

When printing out a lesson you must tell the printing dialog box exactly what pages of the entire 270 page document you want to print.

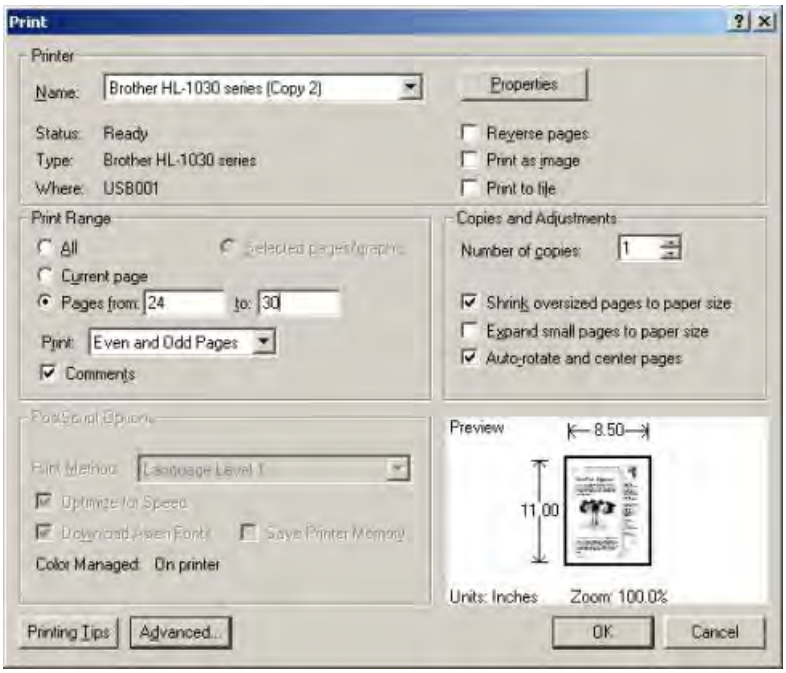
Example:
To print the lesson "**Tree Part Pageant**" from the K-4 manual you must do the following:

1. Go to the lesson and click on the first page of it.
   Note what page out of the 270 you are at. (24 of 270)

2. Scroll through to the end of the lesson. Click on the last page of it.
   Again note what page out of 270 you are now on. (30 of 270)

3. Next click print and in the print instructions put in the Pages from 24 to 30.

4. Then hit print and just the lesson "Tree Part Pageant" will print for you.



Direct Links

- If you want to go directly to the Table of Contents for the **K to 4** manual**:**
  » CLICK HERE
- If you want to go directly to the Table of Contents for the **Grade 5 to 8** manual**:**
  » CLICK HERE
- If you want to go directly to the Table of Contents for the **Grade 9 to 12** manual**:**
  » CLICK HERE

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This publication is produced on paper containing at least 30% post-consumer recycled materials.

Saskatchewan
Forestry
Association

Introduction

Forests are one of Saskatchewan's most valuable assets. Over fifty per cent of the province's total land area is covered by forest. Long before they provided any measurable economic value, forests have provided many ecological benefits which we take for granted. Forests capture solar energy, store water and nutrients, moderate local and regional climates, develop and condition soils, temper the effects of global warming, serve as important carbon reservoirs, and perpetuate biological diversity and ecological complexity. Life as we know it would not be possible in the absence of these ecological processes in forested regions of the planet.

Forests provide critically important habitat for wildlife and represent a part of our culture, history and economy. They provide the materials and resources for many industries in Saskatchewan and are a place for recreation. For many people, they are a source of spiritual well-being.

Wildlife and Ecology

Forests provide the essentials of life (food, water, shelter and space) to wildlife. The forest is a part of an intricate web of life that includes all stages of growth and succession. Unsound forest management practices can greatly alter and entire ecosystem, damaging wildlife habitat. Forest management plans are being designed to protect **critical wildlife habitat** and ensure that the forest continues to represent its rich diversity of wildlife species. Riparian and woodland caribou habitat are two examples that are being identified for long-term protection. Forest companies are working on ways of changing logging practices. This ensures that all stages of forest growth, each with its unique complement of wildlife, continues to be represented in the forest ecosystem.

The rate of forest harvesting is also under study, not only in terms of its impact on wildlife, but in terms of its influence on atmospheric oxygen and its effect on the water table.

Economics

Aboriginal people continue to pursue the subsistence lifestyle of their ancestors, supplemented by such economic activities as trapping, commercial fishing, wild rice harvesting, berry and mushroom picking, guiding and outfitting. Non-Aboriginal people also use the forest for economic gain by trapping, commercial fishing, guiding and outfitting, and collecting forest products.

Many people in Saskatchewan are employed either directly or indirectly by forest industries. They include professionals such as foresters, pilots, surveyors, cartographers, marketing analysts, economists, planners, administrators, engineers, and research scientists. Forestry also employs truck drivers, mechanics, heavy equipment operators and mill workers.

Wood Products

More that **5000 products** can be made from wood. Many are well know: lumber, pulp, all kinds of papers, furniture, toothpicks, and matches. Other products are not so well known. One wood product, vanillin, is used as a base for artificial food flavouring and in some pharmaceutical products. Other wood products include shatterproof glass, adhesives, furniture upholstery, rayon clothing and turpentine.

Paper is an extremely valuable forest product. Wood is chemically broken down and reconstituted into paper and paper-fibre products. Canadians are per capita one of the largest consumers of paper products. Roughly 35 percent of municipal waste consists of paper and paperboard products. Recycling programs, however, are reducing the amount of wastepaper going into landfills and are responsible for turning it into new products. For example, post-consumer waste – fine paper, magazines and newspapers – can be collected in community recycling programs and used by some pulp and paper mills to make new paper products. Wastepaper can be recycled seven times before the fibre becomes too short to produce good newsprint. At present, Canada recovers 31 percent of the newsprint it consumes.

Recreational Uses

Recreational value of the forest is often understated. People travel to Saskatchewan's forest throughout the year to "get away from it all" and relax. Hiking, camping, skiing, photography, bird watching, and canoeing are just a few of the recreational opportunities the forest provides. More and more, people are travelling to Saskatchewan's natural areas specifically to enjoy the scenery, the wild plants, the animals, as well as cultural aspects found in the areas, making **ecotourism** the fastest growing area of Saskatchewan's tourism industry.

Traditional Uses

The First Nations of Saskatchewan have survived for thousands of years on the bounty of the forest. Although the forest industry now employs many Aboriginal people, their subsistence lifestyle and culture are still based on a healthy forest environment. The forest and the natural environment is recognized as their spiritual mother and areas of traditional land use are intrinsic to their culture and well-being. Such areas include those used for collecting medicinal plants, for hunting and fishing, and for spiritual ceremonies. Data is currently being compiled in an attempt to map traditional land use areas in Saskatchewan.

Other Forest Products

Wood products are only one of many benefits we as humans derive from the forest. Mushrooms, such as morels and pine, and blueberries are harvested both commercially and domestically. Maple syrup derived from the indigenous Manitoba maple, while distinctively different in flavour from that of the eastern sugar maples, has a pleasant "fruity" taste. Indian peoples and early settlers were familiar with the making of maple syrup. Today, efforts are being made to revitalize production, by taking advantage of the millions of Manitoba maples provided to farmers to plant in homestead shelterbelts. Presently, there are approximately 1200 trees being tapped in the Cumberland House area, with smaller numbers in the Melfort-Nipawin area and around Indian Head.

Nature crafting comprises a muti-million dollar industry in the United States, and producers are now looking toward Saskatchewan as the source of high quality products. Leaves, mosses, cones, branches, and dried grasses collect from areas earmarked for timber harvesting are used in flower arrangements, wreaths, and other decorative pieces. The art of birch bark bitings, wherein intricate patterns are produced by biting into thin strips of bark from the white birch, is a popular Aboriginal craft. Varieties of fragrant potpourri are made out of herbs, petals, cones, bark, and berries.

Essential oils extracted from leaves and boughs are fundamental to the perfume industry and are at the core of the food flavouring industry. The herb ginseng is used in teas and health tonics heralded for their ability to increase longevity.

Echinacia root is used in medicines to build healthy immune systems and remedies made from aspen and chokecherry are used in the treatment of psoroasis.

The Challenges

Today's challenge is to apply the principle of sustainable development to the management of Saskatchewan's forest. Settlers expanded into the forest fringe areas during the early 1900's and cleared forest lands for agriculture purposes. The demand for timber placed additional pressures on the forest resource without emphasizing the need for renewal. The need to manage our impact on the forests was recognized in the 1940s with recommendations to create a forest inventory, intensify silvicultural practises, improve fire protection and plan for long term forest harvesting.

Today, we know that even thought the forest is a **renewable resource** (one that we can use time and time again), we must use it wisely. As the demand on our forest resources increases, so too must our efforts to ensure that Saskatchewan's forests will be maintained for future generations. Saskatchewan's older forest, in many areas of the province, is gradually being replaced by a new forest, which is planned and managed by professionals.

Today, **forest managers** are planning the forest that will mature 50 to 100 years from now. Forest managers are working to ensure that the forests of Saskatchewan continue to contribute not only to the economic well-being of the province, but also to the social and environmental health of Saskatchewan.

Forest managers, wildlife biologists, and land-use planners are all involved in managing our activities in the forest unit. They plan not only for the harvest and renewal of the forest, but also for conserving traditional land use areas and the a wide variety of forest environments to provide suitable wildlife habitat and recreational areas. A large part of this management revolves around the effects of fire, insects, and disease. Every year, these phenomena claim more wood than is harvested.

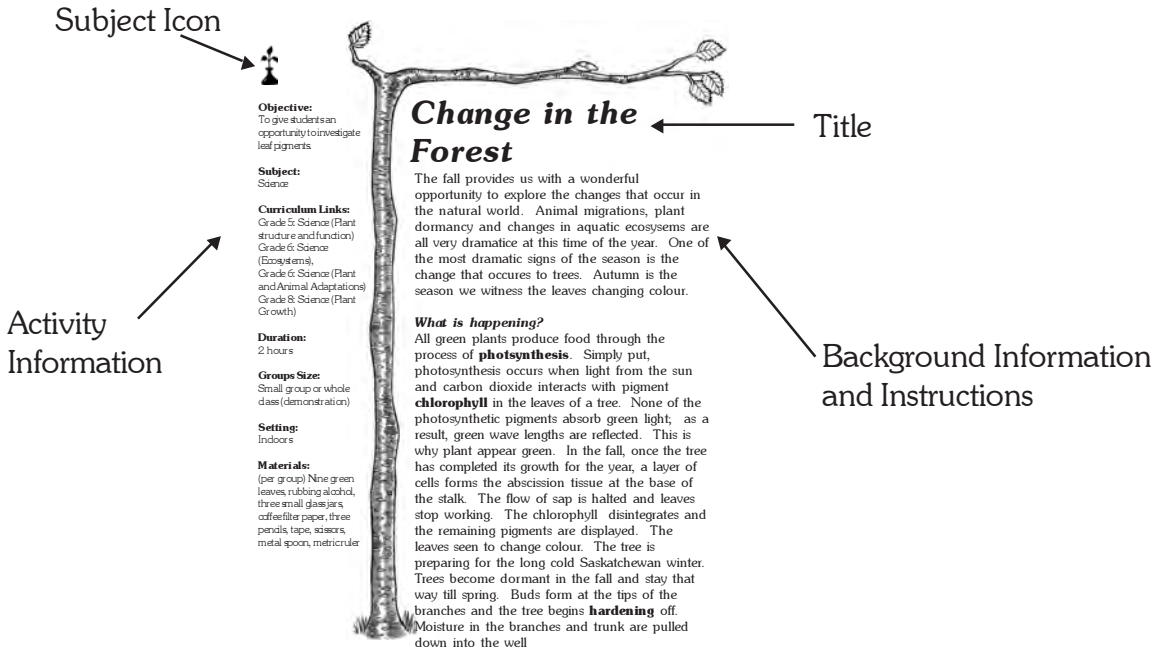
Through integrated resource management, traditional users and the general public are encouraged to provide their views on how impacts on the forest community should be managed.

Navigating the Manual

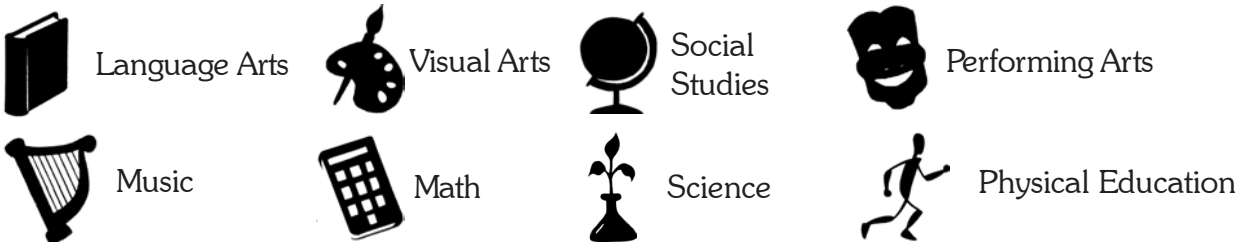
You will notice that there have been some changes to the manual which will hopefully assist you to quickly reference the material you require. First of all, each activity has icons on the top left corner of the first page. These provide you with information on what subjects or skills the activity fits with. This is different from Curriculum links because the skills used may fall across several subjects and will fulfill a variety of CEL's. For example, where the activity has an active component there will be a Physical Education icon to indicate that this may be incorporated into those lessons.

Information about the activity, its objectives, curriculum links, duration, setting and required materials is all included in the side bar on the first and second pages. This provides you with easy access to the nuts and bolts of the activity for your planning. You will also find teacher notes and resources listed in the side bar. The main body contains any background information and activity instructions. Where possible we have included any handouts or sample sheets at the end of each activity to reduce the need for an appendix. This means each activity is self contained with all pertinent information included within the activity instead of having background information and blackline masters separated from the activity. Check out our website (www.whitebirch.ca) for updated information.

Sample Page



Subject Icon Legend



Focus on Forests Activity Guide (Revised)

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Weyerhaeuser

Their generous contributions and commitment to forest education aid in the development and delivery of the Focus on Forests program.

Preface to the Revised Edition

While the popularity of the Focus on Forests program in Saskatchewan over the past ten years is a testament to the original developers, it was inevitable that a revision would occur. New knowledge on subject areas like fire ecology, ecosystem-based forest management and integrated forest management were fairly new concepts when the material was being developed in the early nineties. We now have a better understanding through research and many of these concepts are incorporated into accepted practices in Saskatchewan's forests.

Initially the plan was to revise the program in stages but after some consideration it was decided that a complete overhaul and face lift was in order. After a thorough review of the guide several activities were updated, some were removed and new ones were developed. As well, many of the tried and true were kept as is.

Besides revising the program guides we also chose to approach the packaging a bit differently. What you hold in your hand is one of three guides. Each guide is designed with different grade levels in mind The choice to seperate the guides into three was done so educators were getting valuable information that was relevant to the grades they taught instead of having a big book where only a few activities were suitable to their needs. We have also chosen to bind this edition in order that the information stays with the book.

We also chose to provide handouts in electronic format so teachers didn't need to worry about keeping their photocopy masters in perfect shape. Included in a sleeve at the end of this booklet is a CD Rom that includes all three teacher guides K - 4, 5 - 8 and 9 - 12.

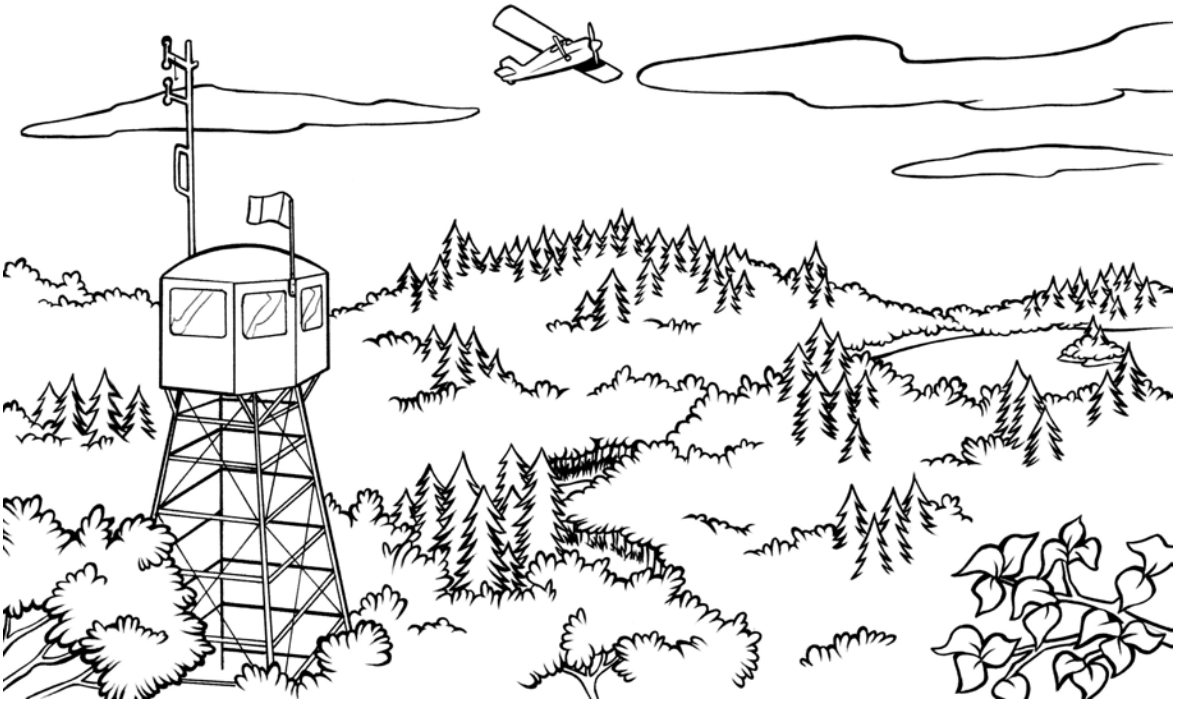
Visit our web site for updated information as issues arise at **www.whitebirch.ca**.

Finally, the product you hold in your hands was not only the work of many people but of various government agencies, non-government agencies and private companies. The Saskatchewan Forestry Association has brought together a wide spectrum of organizations who all share a deep commitment to Forest Education. These groups have forged a partnership that has assisted us in providing you, the educator, with a product that we believe is one of the most comprehensive forest education program in the country.

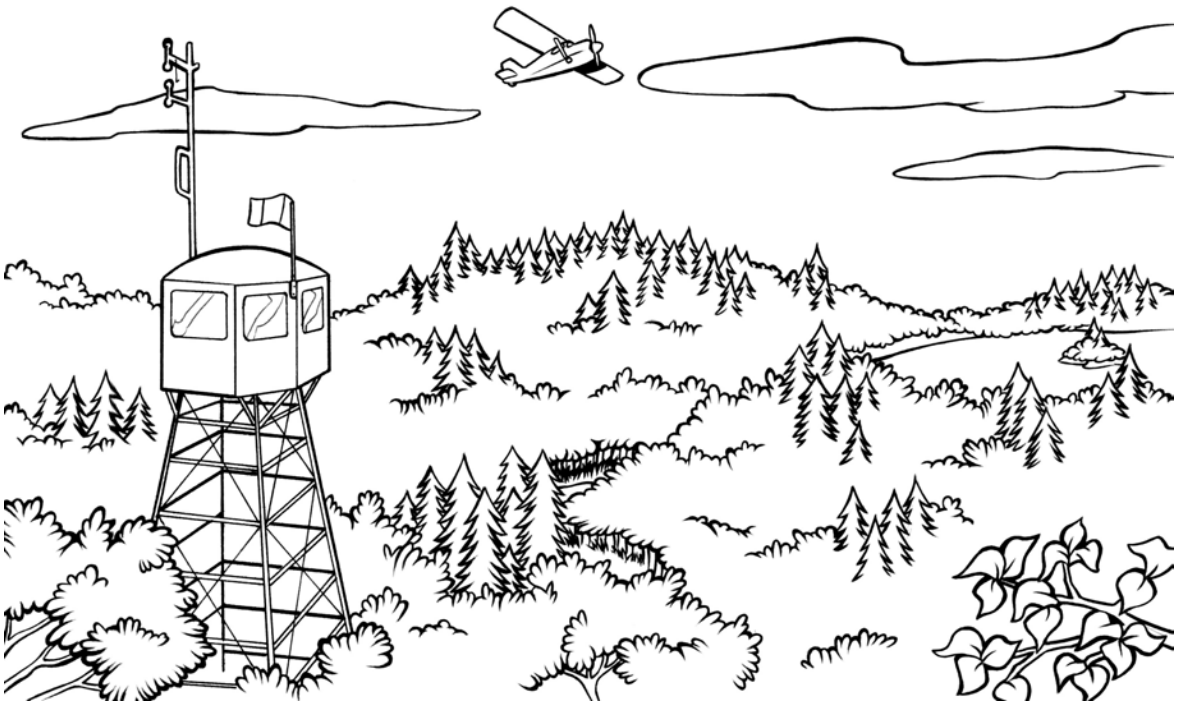
It is our sincerest hope that the material contained in this guide will help you to improve our youths understanding of the science and issues pertaining to our forests so that they make better and more informed decisions in the future.

Saskatchewan Forestry Association, 2005

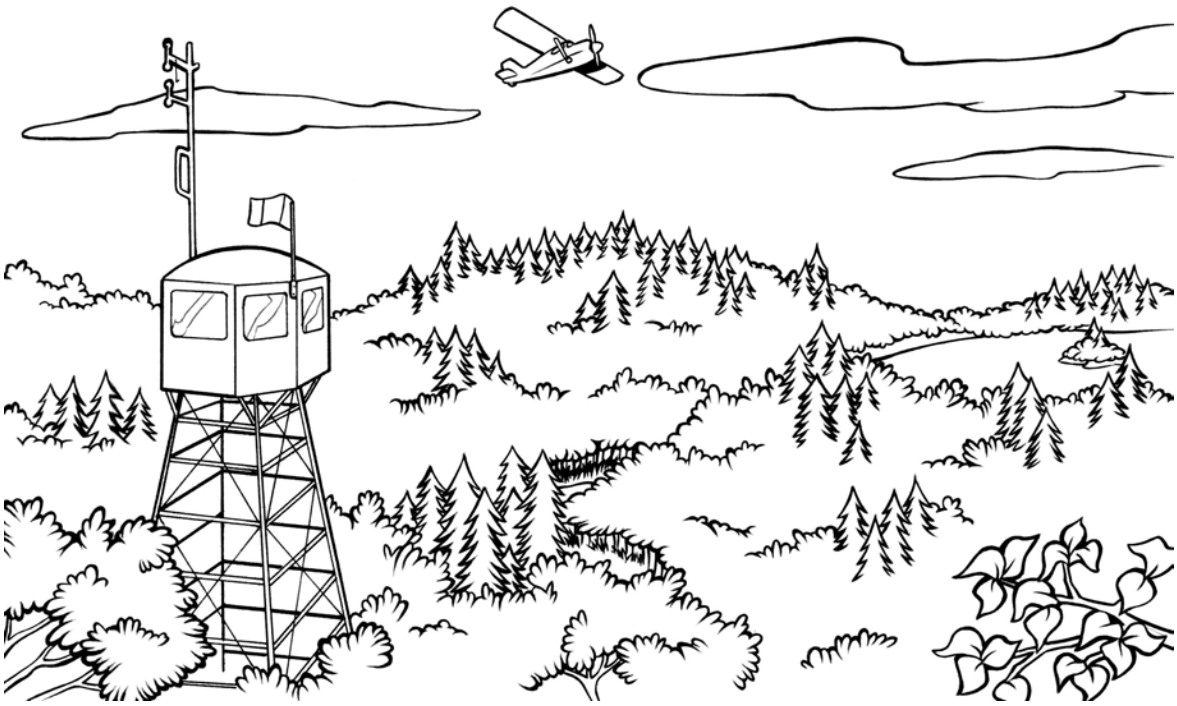
Contents Grades K to 4



Contents Grade 5 to 8

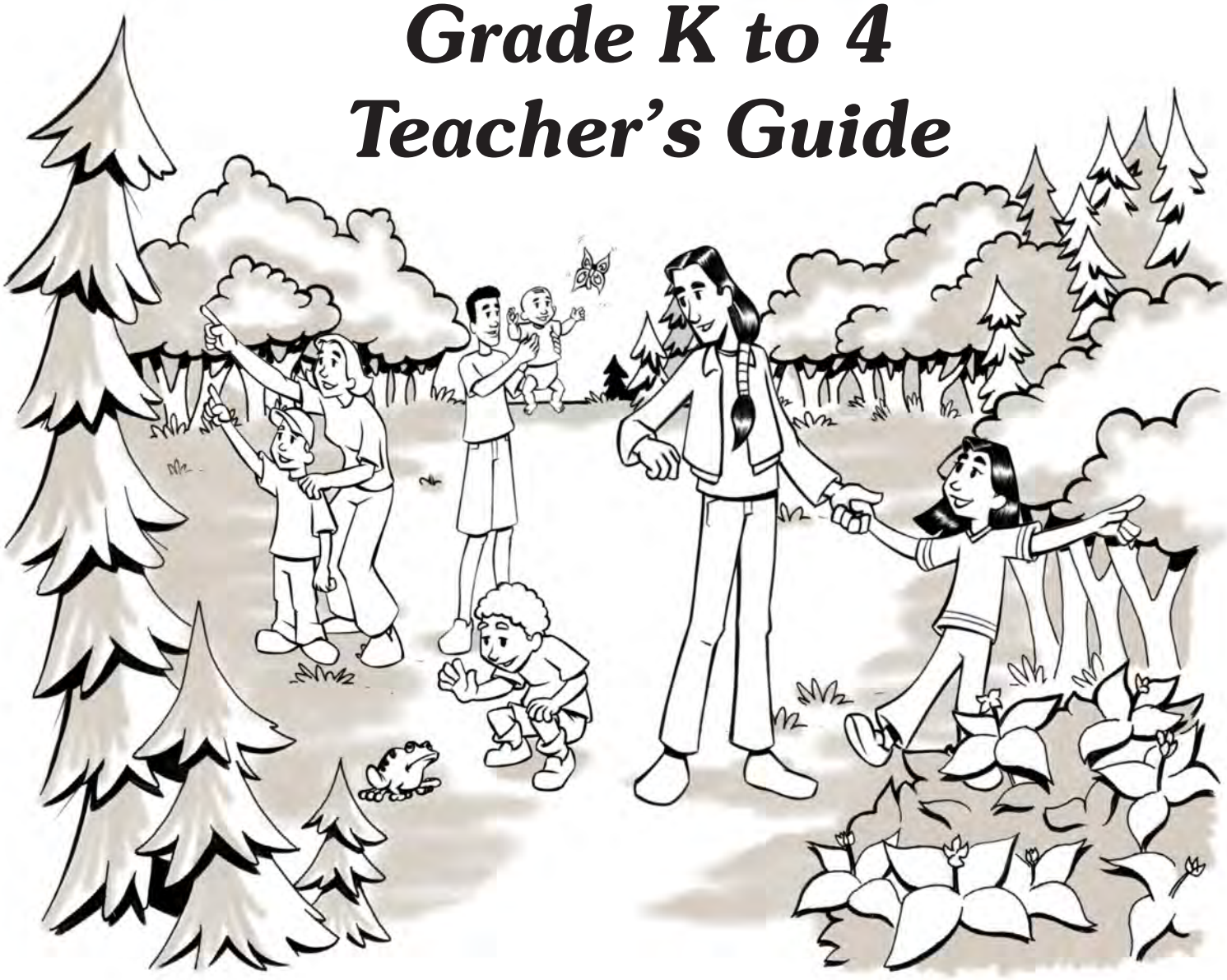


Contents Grade 9 - 12



FOCUS on FORESTS

Grade K to 4 Teacher's Guide



Small to Tall

Objectives:
To understand how a tree grows from a seed through to a mature tree.

To observe various parts of a tree in a hands-on, experiential way.

Subjects:
Science, English, Math, Drama

Curriculum Links:
Grade 1 Science, Plants
Grade 2 Science, Plant Growth
Grade 3 Science Plant Structures and Function
Grade 4 Science Cells and Systems
Grade 4 Science, Plant Diversity

Duration:
Five class periods over three to four weeks

Setting:
Classroom

A tree starts life as a tiny seed. Given the right conditions, the seed will start to **germinate**. The tree **embryo** absorbs water and splits the **seed coat**. First a tiny root grows and bends downward into the soil in response to gravity. Finally, the stem and leaves emerge from the seed coat and push their way through the soil toward the sunlight. The **seedling** then begins to manufacture its own food. Eventually, it grows into a larger tree called a **sapling**.

Each year, the tree adds a new layer of wood and bark and the trunk and branches grow thicker. The newer layers of wood are the active part of the tree where water and nutrients are moved through the tree. The older central cells of the tree eventually become inactive, but do build up deposits of various kinds of chemicals that change the colour of the cells often giving heartwood a darker colour.

Because spring growth is generally faster and the wood cells are larger, spring wood appears lighter than the darker summer wood produced later in the year as growth slows and eventually stops. One light ring together with the adjacent darker outer ring represents one year's growth. Growth rings vary in size according to each year's growing season. Their size is influenced by environmental conditions such as weather, amount of growing space, soil conditions, insect attacks and fire. Foresters study cross-sections of trees in order to learn more about the life histories of individual trees and to ascertain the history of the surrounding area.

Once a tree has reached maturity, it produces seed for the next generation. As the tree passes maturity and declines in vigour, it becomes more susceptible to insects and disease. Once the tree is dead, it eventually falls to the ground and decays. The burned or decayed remains of a tree add nutrients to the soil in which new seedlings thrive.

Materials:
Seeds of various trees with photos of mature trees (or locations with the actual mature trees)
Seeds of American elm, green ash and Manitoba maple
Clear plastic glasses with pre-drilled holes and filled with soil
Drainage tray
Enlarged photo-copy (or overhead) of tree disc cross-section
Varnished cross-section of tree trunks or area with tree stumps
Magnifying glasses
Branch of deciduous tree or shrub in bud (late fall to early spring)

ENGAGE

It's truly amazing how a huge tree can grow from such a small seed. To help students appreciate this wonder collect a number of tree seeds and the pictures of the mature trees they will become or ideally find a location where you can see some of these mature trees.

Ask the students go guess which seed becomes which tree. Sometimes the smallest seeds can become the biggest trees. Have students compare the seed to the mature tree and collect ideas from the class as to how a seed so small can grow into a tree so large. In other words, what "ingredients" does a tree seedling use to become a forest giant?

Explain that the class will be working on different activities to learn more about the different parts of a tree and how the tree grows.

EXPLORE

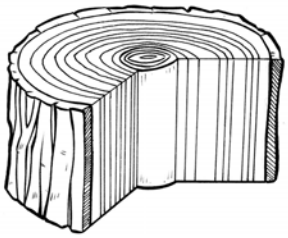
1. Roots & Shoots

Hand out elm, ash or maple seeds along with clear plastic drinking glasses (predrill holes in the bottom) filled with soil. Have the students place the seed just under the soil surface and label the glass with the type of tree, their name and the date. When the labeling is complete have students place their cups in a drainage tray and water the soil thoroughly. Place the tray in a sunny location and water when the soil dries out.
Ask the students to predict which seeds will germinate first and what they will look like when they germinate, including what is happening under ground. Observe what happens within the next few weeks and have student's compare to their predictions.
When the first leaves of the seedlings have completely emerged, gently wash the soil away from the roots of one seedling of each type and look at the emerging root system. Have students draw a

seed and the seedling labeling the various parts they see such as the seed, seed coat, root, stem, leaves, and seedling. Plant the remaining seedlings outside in an area approved for this purpose.

2. Tree Tales

While showing students a tree disc, explain that a tree will produce visible growth rings of **xylem** (water conducting cells) in its trunk as it matures. If you look at a cross-section of a tree you can see the wood produced in the first or early years of the tree's life in the very centre of the cross-section. Outside of this central area are year after year of deposited xylem cells that appear as **annual growth rings** because the wood cells produced in spring are larger and lighter than the smaller and darker wood cells produced later in the year. Under the bark layer **(actually the cambium)** we come to the last year of the trees growth. One can tell the age of the tree by counting these growth rings, as well as tell what the life of the tree was like by the size of the rings (i.e. good growth years are wider than poor years). Things like forest fires can also appear as dark **fire scars** in the cross-section of the tree.



Once students have come to understand what the different parts of a tree cross-section mean, have them investigate a prepared tree cross-section or a stump using magnifying glasses to determine the age of the tree, the growth conditions, and any other events that may have happened in the tree's life. Varnishing the cross-sections or wetting the tree stump may make the rings more distinct. Depending on the age of the classroom ask students to:

- Imagine what happened to the tree in it's life and either tell or write a story based on what happened in the life of the tree.
- Older students could be asked to research and incorporate events that happened in the country or community during the different stages of the tree's life.
- Draw a sketch of the prepared cross-section or stump and label or colour the decades that the tree lived by counting backwards from the outer ring to the very middle of the cross-section.

- Compare the exact years when small or large growth rings appeared with weather records, news stories or local histories to see what was happening in the area while these distinct periods of growth occurred.

3. Bud Busters

One of the things children may not realize is that the leaves and flowers of a tree are all neatly packaged in the buds on the tree's branches. Bring a branch from a deciduous tree that is in bud into the classroom and have the students examine it carefully. Ask them if they know where the leaves and flowers of a tree come from and write down their ideas for future reference. Then place the branch in a container of water and place it in a warm, sunny spot.

Aspen Buds

Have students sketch or make notes on what happens to the branch every day (if the buds do not swell and open within the week you may have to try another branch) noting any changes that occur. You may also wish to take pictures of the branch every week to record the changes visually. You will eventually be able to identify the flowers, leaves and thereby even the species of the tree whose branch you are observing. Look back at the predictions that students made to see how accurate they were.

EVALUATE

Depending on the age of classroom ask students do one of the following to determine how much of the tree growth and development they understood and remember:

1. Paint a montage of all the things that will happen in a forest when spring arrives, e.g. flowers and leaves will appear, seeds will germinate and grow, trees will grow taller and bigger.
2. Older students can write and illustrate a day by day account of the changes that occur in a forest as spring appears. They could also add facts about what animals and people may be doing in the forest at this time.

3. Students can be asked to present their paintings or journals in-front of the class to reinforce the learning that occurred during this activity.

EXTEND

Spring Spectacular

Based on the journals or paintings created during the evaluation portion of this activity, stage a play for the school that demonstrates the changes that occur in a forest when spring arrives. This can include everything from props, costumes and backdrops depending on how much time and effort a classroom can put into the project.

Terrific Tree Key

A natural extension of this activity is to start observing differences and similarities in trees and in so doing learn to identify local tree species. The best way to do this is for students to develop a tree key for the area they live in as outlined in the **Terrific Tree Key**.

Resources:

Sheehan, Kathryn, and Waidner, Mary. *Earth Child: Games, Stories, Activities, Experiments & Ideas About Living Lightly on Planet Earth.* Council Oak Books. Tulsa, Oklahoma. 1991.

Suzuki, David. *Looking at Plants.* Stoddart Publishing Co. Ltd. Toronto, Ontario. 1985.

Eyewitness Videos. *Tree.* Dorling Kindersley Ltd., and BBC Worldwide Americas. 1996.

Spotlight on Seedlings

ENGAGE

1. Ask your students: Do plants need light to grow? Challenge them to create their own experiments to help find the answer. Begin by asking questions such as:
   - What would happen to green plants if they didn't have light?
   - How could we find out?
   - How could we test our ideas?
   - How could we ensure that our test is fair?

   Help them think through each step of their experiments and encourage them to predict what might happen. Assist them in conducting their experiments and in reaching conclusions. Alternatively, have them try the following experiment or use it as a model.

2. Plant four or five lima bean seeds in potting soil approximately 2.5 cm from the bottom of three containers. Add enough water to soak the soil. The seeds should germinate within a week or so.
3. After the seeds have germinated, let the class decide what type and amount of light each plant will receive (e.g., direct sunlight, indirect sunlight, artificial light, no light). Keep all other variables (e.g., temperature, water) constant.
4. Label each container (date planted, type of light), place them in the chosen locations, and add water when needed.
5. Observe each plant daily with your class and record observations.
6. At the end of three to four weeks, discuss which plant grew the best. Did this have anything to do with the light conditions? What conclusions can be drawn about light conditions necessary for the growth of the bean seedlings? Do these conclusions apply to all green plants (e.g., trees)? Why or why not?

Objective
To give students an opportunity to demonstrate that green plants need light to grow after germination.

Subject
Science

Curriculum Links
Grade 1 Science, Plants
Grade 2 Science, Plant Growth

Duration
30 minutes to prepare, 3 to 4 weeks to observe

Group Size
any

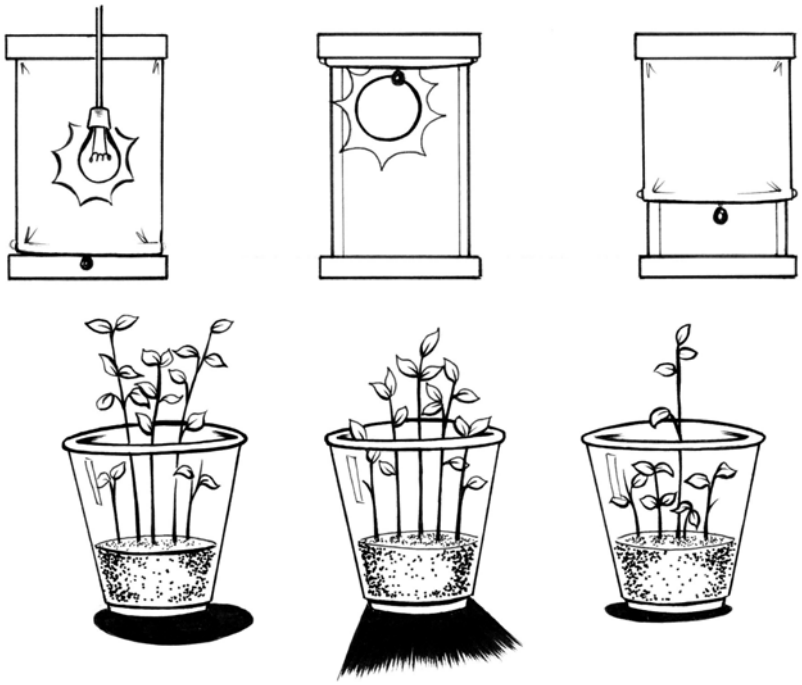
Setting
indoors

Materials
Clear containers without lids or small plant pots, potting soil, fresh lima bean seeds or mung bean seeds, water

Teaching Note
Make sure the beans are fresh or they may not germinate. Mung bean seeds germinate in 24-48 hours.

EXTEND

Take the class on a forest walk. Observe which trees grow in full sunlight and which grow in full or partial shade. Using a tree identification book, make a list of these trees according to their differing light requirements.



How Thirsty Are Seedlings?

ENGAGE

1. Ask you students: How much water do you think a plant needs to grow? Challenge them to create their own experiments to help find the answer. Begin by providing students with a handful of seeds and have students generate questions such as:
   - What do plants need to grow?
   - What could happen to plants if they didn't have water?
   - How could we find out?
   - How could we test our ideas?
   - How could we ensure that our test is fair?

   Help them think through each step of their experiment and encourage them to predict what might happen. Assist them in conducting their experiments and in reaching conclusions. Alternatively, have them try the following experiment or use is as a model.
2. Choose two students to line three identical clear containers with paper towels, cotton batting, or sawdust. Plant four to five lima bean seeds approximately 2.5 cm from the bottom of each container. Add water to 3 cm in each container.
3. Have your class decide how much water each container will receive on a daily basis (e.g., none, 50 ml, 100 ml). Label the containers accordingly. Place all containers in the same location in the classroom. Keep all other variables (e.g., light, temperature) constant.
4. Encourage students to predict what will happen.
5. Have students water each container daily with the prescribed amount of water for a period of three to four weeks. Observe daily and record observations.

Objective
To give students an opportunity to determine how much water provides the best growing conditions for a bean plant.

Subject
Science

Curriculum Links
Grade 2 Science, Plant Growth

Duration
30 minutes to prepare, 3 to 4 weeks to observe

Group Size
Any

Setting
Indoors

Materials
Clear containers, fresh lima bean seeds or mung bean seeds, measuring cup, paper towels, graph paper

Teaching Note

Make sure the beans are fresh or they may not germinate. Mung bean seeds germinate in 24 – 48 hours.

6. Which plant grew best? Did this have anything to do with the amount of water received? What conclusions can be drawn about the amount of water required for the best growth?

EXPLORE

Repeat the experiment using juice, pop, or caffeine beverages (e.g., cold tea and / or coffee) and have students hypothesize/ investigate the effects of these solutions on plant growth.

Tree Part Pageant

Trees are a fascinating part of our world, however many of us pay little attention to them and fewer yet understand how a tree actually grows and functions. An understanding of the various parts of a tree and how they inter-relate is an important step in learning how to care and protect the trees that we have in our yards, parks, and forests.

Roots: Roots spread in a vast and intricate network away from the tree itself, much like underground branches. They usually extend as far underground as the twigs spread in the crown of a tree. If laid end to end, the roots of some giant oaks would stretch more than 160 km in length. In addition to anchoring the trees to the ground, roots absorb water and nutrients from the soil. The tree uses these elements to manufacture food for growth.

Objectives:
To physically simulate the parts of a tree as suggested by a narrative.
To understand the function and relationship of the tree parts discussed.

Subjects:
Science, English, Drama

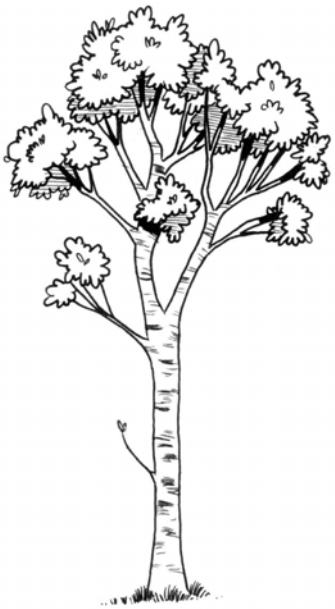
Curriculum Links:
Grade 1 Science, Plants
Grade 2 Science, Plant Growth
Grade 3 Science, Plant Structure and Function
Grade 4 Science, Cells and Systems

Duration:
One class period

Setting:
Grassy outdoor area or alternatively open indoor area

Materials:
"Tree Part Pageant" narration attached

Trunk: The trunk is the main stem of a tree. It has two main functions: to support the crown of branches, twigs and leaves and to transport food and water throughout the tree. The outer bark of the trunk protects the inside of the tree from injury and from drying out. It also acts as an insulator against cold and heat.



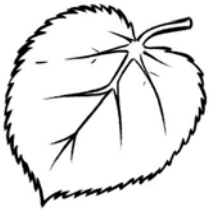
Tree trunks house an amazing system of pipelines. If you cut through the outer bark you would come to the soft inner bark or phloem. The phloem distributes food made in the leaves to every living cell in the tree. Farther into the tree's stem are more pipelines called the xylem or sapwood. The xylem distributes water up the trunk to the leaves where food is manufactured. Between the xylem and phloem is a very thin growing layer called the cambium. Every year during spring and summer new xylem and phloem cells are produced by this layer. As a tree grows, the older wood in the centre of the trunk ceases to carry sap. This inner woodis called heartwood.

This yearly growth of wood appears as annual rings. Each annual ring is made up of a light and dark bands of cells that correspond to the spring and summer grown.

Crown: The branches, twigs, and leaves constitute the crown of a tree. The branches and twigs hold the leaves up to receive sunlight, the vital ingredient needed for food production. They also support the flowers and fruit of the tree.

If you examine a leafless twig on a deciduous tree during the winter you will notice the buds of a tree. These buds contain tiny leaves and flowers. Buds are protected from freezing by a covering of moisture-conserving scales.

Leaves: Leaves are the food factories of the tree. Powered by sunlight, the green substance in leaves called chlorophyll uses carbon dioxide and water to produce carbohydrates. This process is called photosynthesis. The word photosynthesis comes from two Greek words: "photos" meaning light and "synthesis" meaning putting together. During photosynthesis, oxygen is released into the atmosphere through tiny pores called stomata. Water is also released from these pores in a process called transpiration. In one day, a large tree will release enough water vapour to produce 1300 L of water. In this way, trees act like giant air conditioners, cooling the air with water vapour and expelling oxygen, which we need to breathe.



Trembling Aspen Leaf

Leaves come in many different shapes and sizes and are attached to the twig in different ways. For example, some leaves (like Manitoba maple) are attached opposite one another. Others (like American elm) are arranged alternately on the twig. Observing the shapes and arrangements of leaves is helpful in learning to identify trees.

Flowers: Tree flowers produce fruit. Fruit encases seeds. Within each seed lies the beginning of a tiny tree. Wind, wildlife, and water disperse tree seeds.

Aspen Catkin

ENGAGE

Have students come forward to act out a task without the use of an important body part as outlined below. Ask them to:

Stand up without a skeleton

Sharpen a pencil without fingers

Walk across the room without a leg

Read a sentence or describe a picture without eyes

Talk without a mouth

Breath without a nose

Drink some water without a mouth

Suggest that the parts of a tree are just as important as the parts of our bodies when it comes to a tree successfully growing and thriving in a city or forest. Explain that the upcoming activity will help everyone to understand what the various parts of a tree are and what those parts do.

EXPLORE

Assemble students in an open grassy area (alternatively this could take place in an open indoor area) and have them sit in a large continuous circle on the ground. As you read thorough the "Tree Part Pageant" attached, select students to come forward and physically model the tree parts discussed in the narration. For example start with a student standing in the centre of the circle, with arms at his or her side, to represent the core or heartwood of the tree. Have two more students position themselves so they are surrounding the "heartwood" and ask them to make "slurping" sounds to represent the water uptake of xylem. Continue adding students who make the motions and sounds outlined for the tree part they are demonstrating.

EVALUATE

Tree Art

Ask students to draw or make a clay model of the parts of a tree based on the story they were part of acting out.

Tree Trip

Have students write a story based on the idea that they have been magically shrunk down to the size of a water droplet and are taken up through the tree roots into the xylem of the tree. Have them describe their journey though the tree to the point where they have passed through all the parts of the tree and observed what these parts do.

EXTEND

The activity "From Small to Tall" that is available through Focus on Forests will allow closer examination of the tree parts acted out in this activity.

Resources

Sheehan, Kathryn, and Waidner, Mary. *Earth Child: Games, Stories, Activities, Experiments & Ideas About Living Lightly on Planet Earth.* Council Oak Books. Tulsa, Oklahoma. 1991.

Suzuki, David. *Looking at Plants.* Stoddart Publishing Co. Ltd. Toronto, Ontario. 1985

Cornell, Joseph. *Sharing Nature with Children* and *Sharing the Joy of Nature.* Dawn Publications. Nevada City, California. 1989.

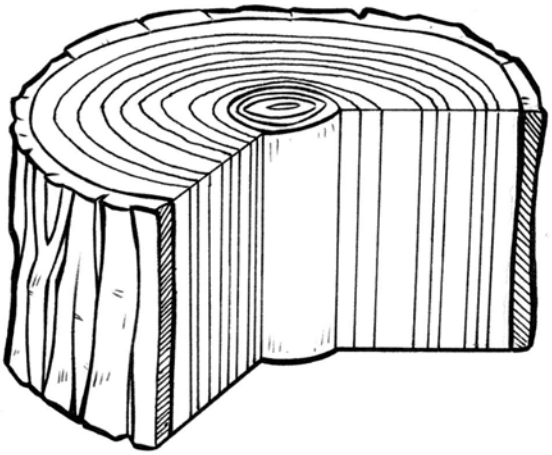
Tree Part Pageant

Just like us, a tree is made up of many parts that work together to help the tree grow and stay healthy. To understand how a tree works, we need to look at each of these tree parts and see how they connect to the others. By working together we can put on a **Tree Part Pageant** to act out all the parts of a tree. While we're having some fun we will also get a better understanding of how a tree works.

Let's start with the very anchor of the tree – its strong **taproot**. I'd like a volunteer to come and sit cross-legged in the centre of the circle. You are the taproot of the tree and you should grip the grass tightly as though you are buried deep in the ground. You may even want to growl every once and awhile just to show how tough you are. The taproot is what will keep the tree upright when strong winds and storms hit it.

Next we need someone be the strong core of the tree, which is often called the **heartwood**. I'd like someone to come and stand as tall and straight as you can over the taproot. You give the tree strength and support. The heartwood can be quite thick and should it start to rot out, the tree may simply fall down. You may want to make a deep grunt now and then to show how solid you are.

The heartwood is in turn surrounded by a layer called the **xylem** . I need two people to come up and encircle the heartwood with your arms. You are the water conducting layer of the tree, drawing water from the soil and distributing it to branches and leaves of the tree. Whenever the tree is drawing up water you should make slurping sounds and raise your hands into the air.



Now where does the xylem get its water for distributing in the tree? It comes from the **lateral root system** that spreads out from the trunk into the surrounding soil. I need four our five volunteers (preferably with long hair) to lie on the ground with your knees against the xylem layer and your arms and hair fanned out away from the trunk of the tree. The roots usually spread out at least as far as the twigs spread out in the crown of the tree. As the tree is drawing up water you should make quieter slurping sounds and wiggle your fingers.

I now need four people to act out a very thin but important part of the tree called the **cambium**. This is the layer that grows xylem cells on the one side and food conducting cells on the other side. Let's have four volunteers come up and encircle the xylem with their arms with two facing outwards and two facing inwards. As you produce new cells make the sound of a locomotive and "chug" with your arms.

On the outside of the cambium is the inner bark also known as the **phloem** of the tree. Here we need six students to encircle the cambium level with their hands raised into the air to represent not only the phloem, but also the branches and leaves of the tree. The phloem carries the food produced by the leaves in the canopy down to other parts of the tree including the roots. Make whooshing sounds and lower your hands to the ground as the tree sends food down to the other parts of the tree.

Surrounding the outside of the tree and protecting the inside layers of the tree is the **bark** layer. Let's have everyone else stand around the phloem level holding their hands in a karate fighter's pose to defend the interior of the tree and "ahyah" sounds. The bark not only protects the tree from injury, but also keeps the inner layers from drying out and acts as an insulating layer from heat and cold.

Let's review all of the different parts of a tree and see if we can remember what each part does and the action or sound you should make in the **Tree Part Pageant**:

Taproot – anchors the tree in the soil (grip ground with hands and growl)
Heartwood – provides structure and support to the tree (stand tall and straight and make the odd deep grunt)
Xylem – transports water from the roots to the rest of the tree (raise hands to the sky while make slurping sounds)
Lateral Root System – absorbs water and nutrients from the soil (make quiet slurping sounds and wiggle fingers)
Cambium – produces xylem cells on the inside and phloem cells on the outside (make locomotive sounds and "chug" arms)
Phloem – carries food produced by the leaves to the rest of the tree (make whooshing sounds while lowering hands to the ground)
Bark – protects the inner layers of the tree (make "ahyah" sounds while doing karate chops)

Now that all of us know what we need to do,
let's put it all together starting with the taproot, then the heartwood. Let's add the xylem and the lateral roots. Here comes the cambium and the phloem surrounded by the bark. There you have it . . . . a living, breathing, growing tree!

Leaf Bingo

One of the best ways to identify trees is by studying leaf characteristics since each tree species has a distictive leaf. To help understand how leaves are similar and different from each other, it is useful introduce some of the basic terminology used in describing leaves. Several common terms you may want to introduce include:

- Leaf Margin: this is the edge of the leaf blade. It can be smooth (no rough edges), wavy (undulating), toothed (having points like a saw blade). The edge of the leaf can also be lobed meaning in has very deep indentations that are almost finger-like.
- Leaf Shape: leaves come in many shapes including round, oval, heart-shaped, and lance-shaped (narrow and pointy on each end).
- Leaf Type: leaves can also be "simple" leaves where there is only one leaf per leaf stalk, or they can also be "compound" where there are many smaller leaves (also called leaflets) attached to the main leaf stalk. A compound leaf will fall as one unit with all the leaflets attached.

Objectives:
To give students an opportunity to observe and use the characteristics of leaves to identify trees.

Subjects:
Science, Visual Arts

CurriculumLinks:
Grade 1 Science, Plants
Grade 2 Plant Growth
Grade 4 Science, Plant Diversity

Duration:
One hour in class, and one hour in natural area

Setting:
Classroom for introduction, plus area with variety of tree species

Materials:
-a variety of leaves or leaf cut-outs
-shadow-puppet stage (back-lit sheet or translucent paper)
-leaf bingo cards, pens, & clipboards

ENGAGE

To introduce students to the variety of leaf characteristics that are specific to various tree species in Saskatchewan, put on a "Tree Leaf Shadow Puppet Play" using real leaves or leaf cut outs. Each tree species is introduced by reading the following narration that highlights characteristics of the leaf being shown.

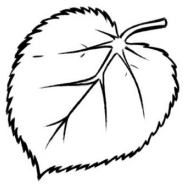
1. **Ernie the American Elm:** Ernie the American elm has big glossy leaves that look a little strange because each one is lopsided with one half of the leave being bigger than the other. Ernie's leaves are glossy looking, but feel rough to touch because the leaves are hairy. Ernie even has teeth! If you look at the edges of the leaf (also called the leaf margins) you will see that Ernie has a row of large and small teeth. It makes you wonder if Ernie's bite is worse than his bark!
2. **Alice the Green Ash:** Alice the green ash has beautiful, glossy green leaves that may have small wavy teeth or sometime be perfectly smooth. Alice is kind of tricky though, because each of Alice's leaves is actually made up of several small leaves or "leaflets" that are all attached to the centre leaf stalk. Trees like Alice will usually have seven oval leaflets per leaf.
3. **Mable the Manitoba Maple:** You probably thought that a maple should have a maple leaf like on the Canadian flag, but not Mable the Manitoba Maple. Mable's leaves might fool you when you first see them because they are also made up of leaflets like Alice's leaves. However, the big differences are that there are usually only 3 to 7 leaflets making up Mable's leaves and they usually have some jagged teeth along the leaf margins.
4. **Allan the Trembling Aspen:** Allan the trembling aspen is a kind of poplar tree and it is likely one of the most "popular poplars" as you can find him growing all over Saskatchewan. When you see Allan you may think that he's a timid fellow because as soon as there's a little wind his leaves will be shaking and quacking because he has a very flat, flexible leaf stalk. In spite of this you'll likely still love Allan, because his leaves are heart-shaped!

Teaching Note:
Not all the leaves are represented in this activity. Students will need to research and find samples of the leaves that are missing. This will allow them an opportuntiy to do some research.

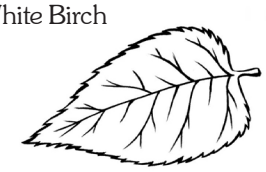
American Elm

Manitoba Maple

Trembling Aspen

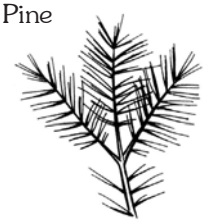


White Birch



White Spruce

Jack Pine



Tamarack

Balsam Poplar

5. Bertha the White Birch: Bertha the white birch is such a nice tree that she became Saskatchewan's provincial tree! You will be able to recognize her by her peeling white bark, but if you look at her leaves you will see that they are triangular and double-toothed along the leaf margins.

6. Sammy the White Spruce: Sammy the white spruce is kind of a prickly fellow with sharp pointy needles sticking out all over like a porcupine. Sammy is an evergreen tree, which means that he doesn't lose his needles in the winter. Sammy has dark green needles compared to the bluish needles on the other common spruce found in our towns and cities.

7. Paula the Jack Pine Tree: Paula the pine tree is also an evergreen, but she has longer needles than Sammy. She has needles in bundles of two. Trees like Paula tend to grow where it's quite dry, making her a perfect tree for many parts of Saskatchewan!

8. Terry the Tamarack: Terry the Tamarack is one of the strangest trees you'll every see. Terry has needles like a spruce or pine tree, but her needles will turn yellow and fall off the tree in the fall more like an aspen or a birch tree. Terry's needles are also in clusters of 10 to 20. The other surprising thing is the Terry's needles are very soft to touch. If you want to hug a tree, Terry or her city cousin the Siberian larch, likely give the nicest hugs in the whole forest.

9. Betty the Balsam Poplar: Betty the balsam poplar may have leaves that look very similar to white birch until you look really close. Betty's leaves are longer and more pointed with fine-toothed leaf margins. Betty does best in moist or wet soils.

10. Wilma the Willow: Wilma the willow is sometimes more like a shrub then a tree, but she is still an interesting woody plant. Wilma usually has long lance shaped leaves that have few if any teeth on the edges. It is this kind of tree that we get "Pussy Willows" from in the spring.

EXPLORE

Once the class has a good idea of what the leaves look like on many common Saskatchewan trees, take them to a natural area where they can see many of these trees in person. Have the students prepare a "Leaf Bingo" card and ask them to search the area for trees that match the leaves on the bingo card. Whenever they find a leaf that matches the characteristic that they have on their card they can mark it off . The first person finding enough leaves to cross out five squares horizontally, vertically or diagonally, calls out "Bingo" to win the game. They must then verify that they've won by showing the rest of the class where they found the leaves they crossed off their cards.

If there are leaves on the card that can't be found in your area, mention this at the start of the activity and let everyone cross them off as "free" spaces. If all of the leaves can be found in your area you could ask the students to play until they have a "blackout" and can cross off all the leaves on their bingo cards.

EVALUATE

To determine how proficient your class has become at identifying trees by their leaves, set up a series of stations that display the various leaves or leaf shapes reviewed in the exercise. Have the class identify as many leaves as they can on a sheet of paper that they hand in for review. Another option is to have each student draw and describe the most memorable tree that they discovered during the activity based on what they can remember of its characteristics.

Making a Leaf Bingo Card

Besides the variety of leaves that we find in the both urban and wilderness environments you can also include characteristics on the card. That way the student can see which characteristics match the leaves they find.

Leaf Margin
Smooth
Wavy
Fine toothed
Coarse Toothed
Lobed

Shapes
Round
Oval
Heart-shaped
lance shaped
needle shaped

Type
Simple
Compound

Arrangement
Opposite
Alternating
Paired
Singly

Resources:

Hosie, R. C. *Native Trees of Canda.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. *My Favourite Tree.* Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. *Woody Ornamentals for the Prairies.* University of Alberta. Edmonton, Alberta. 1995.

EXTEND

1. Research the leaf characteristics of other trees found in your community. There are many other trees species used in horticultural plantings, all of which can be identified by their leaf characteristics.
2. Have students do rubbings of the leaves of the various tree species studied during the activity. They can then label what kind of leaf it is and make notes about the identifying characteristics that helped them identify the kind of tree it came from.
3. In the autumn when fallen leaves are plentiful, collect and press a variety of colourful leaves and then use them to make fanciful "leaf creatures" composed primarily of leaves with some additional features drawn in for emphasis.
4. Have students make leaf prints of their favourite leaf for use as a greeting card, wrapping paper or personalized stationary:

-Place a leaf with its vein side down on a rubber stamp ink pad.
-Place a piece of paper over the leaf and using a roller, roll back and forth across the paper several times.
-Remove the paper and the leaf. Place the leaf with its vein side down on a clean sheet of paper.
-Place another clean sheet of paper over the leave and roll it.
-Remove the paper and the leaf and there's your leaf print!

Shadow Puppet Masters

Terrific Tree Key

Objectives:
To observe differences in local tree species and to learn to identify these trees by these characteristics.
To produce and learn to use a dichotomous tree key.

Subjects:
Science, English

Curriculum Links:
Grade 1 Science,Plants
Grade 2 Science, Plant Diversity
Grade 3 Science, Plant Structure and Function

Duration:
Three to four class periods

Setting:
In natural area with mature trees (spring through fall) and in the classroom (winter).

Tree keys are useful tools for identifying trees. A dichotomous key is an identification tool that presents a series of two (hence dichotomous) choices that are usually opposite traits. This type of key could be compared to a series of forks in a road that allow the user to make an accurate identification of a tree species.

We can identify trees by the features of their parts (e.g. leaves, bark, twigs, buds, flowers, and fruits) and by their shape or silhouette. For some species, a particular features stands out, e.g. the distinctive bark of a white birch. Leaves, however, are the most common feature considered when identifying a tree.

The shape of a leaf, the kind of leaf margin, the leaf type, and the arrangement of the leaves on the twig are important factors in tree identification.

Shape: Leaf blades can be long and narrow, oval, heart-shaped, spear-shaped, or circular. Poplar leaves, for example, are generally oval or circular in shape. Birch leaves are more triangular. Willow leaves are long and slender.
Leaf Margin: Leaf edges, or margins, also differ. They can be smooth, finely notched, coarsely notched or wavy. Oak leaves are lobed, while ash, poplar, and elm leaves have a toothed edge.
Leaf Type: Leaves can be simple (all one piece) or compound (divided into many separate leaflets). Birch and poplar have simple one-piece leaves. Manitoba maple and ash have compound leaves made of several leaflets.
Arrangement: On some trees, the leaves are attached alternately on the twig, Oak, poplar, and bark are three examples. On others, for example the Manitoba maple, the leaves are attached opposite each other.

Evergreen leaves can also be differentiated by shape. For example, the leaves of the jack pine are long and needle-like. Some needle-like leaves occur singly on the twig, while others occur in bunches. White spruce needles occur singly, while most pine trees have needles in clusters.

ENGAGE

Many students may not realize that trees can be as distinct as each of their classmates. Take the class to a natural area where there are a variety of mature trees and ask the group to close their eyes and take turns describing various members of the classroom. Ask the students if there are any people in the class that look similar and if so, how can one still tell them apart? Inform them that they will be learning to tell trees apart from each other by using physical characteristics, in a similar way to how we identify our friends.

Divide the group into pairs and give each pair a blindfold. Have one student blindfold the other and then lead that person on a highly varied route (listening, smelling, and touching various things along the way) before arriving at a specific tree. Have the blindfolded student explore their tree noting how it feels, smells, and even sounds. The sighted student then leads the blindfolded student back to the starting area using another circuitous root, lets that person take off his or her blindfold, and then try to retrace the path back to their tree using the sensory clues experienced in the exercise.

When all the students have tried this out, gather at the starting point and ask students to share the clues they used to identify their tree. As the class highlights these clues mention the various names for the leaf types, leaf arrangements, leaf margins, and leaf shapes that they have observed.

Leaf Shapes


Circular

Triangular 


Oval

Leaf Margins

Toothed 


Smooth

Lobed 

Leaf Types


Simple

Compound

EXPLORE

Make a "Who is that Kid?" Key

Back in the classroom, expand on the concepts introduced in the introductory activity by explaining to the class that because trees types have differences that we can see, we can compare those differences to decide what type of tree we are looking at. As an example of doing this, prepare a dichotomous "Who is that Kid?" key on a blackboard or whiteboard to identify eight students based on what they are wearing or by their physical characteristics.

Materials:
-blindfolds
-"Who is that Kid?" key" overhead or hand-out
-"Terrific Tree Key" overhead or hand-out
-Prepared tree keys appropriate to age group and location
-Various distinctive tree samples, e.g. bark, leaves, seeds, etc.

Your key could look like the sample provided at the end of this lesson. There is also a blank version of the "Who is that Kid?" key to use as an overhead or hand-out.

Make a "Terrific Tree Key"

Once students understand how a dichotomous key works, it is time to make one for the trees in your area. This can be done even if you and your students don't know the names of the species in your area. Starting in a natural area, make a "Terrific Tree Key" with your students by comparing characteristics of your tree. You may want to start with four to eight trees that are in close proximity to each other for easy comparison. As is done in the sample provided, you may want to start by looking at whether the tree has leaves (a deciduous tree) or needles (an evergreen tree) and then compare some of the following characteristics:

- if the bark peels or doesn't peel
- if the stem has thorns or not
- if the leaves are opposite or alternate
- what the leaf shape, type or margins are
- that the bark colour is
- etc.

Once you have finished inserting the contrasting activities for your key, fill in the names of the trees and shrubs you do know, or look try looking them up in one of the resource books listed at the end of this activity. When your "Terrific Tree Key" is complete, have the class try it out in other areas. Ask the students of they think the key will work in other areas than the one it was prepared in. Can they suggest why it might not work too well in another district or region?

EVALUATE

To determine how thoroughly students have understood the concept behind the activity, provide them with sample leaves from both coniferous and broadleaf trees and help them work through a hands on classification.

Another way to determine how familiar the class has become with identifying tree species is to place a series of cones, leaves, or bark from distinctive trees around the classroom to see how many of these "Tree Clues" the class can identify.

EXTEND

Tree Buddies

Ask students to choose one of the trees that they looked at as part of the tree key activity and do some research on the life history of that tree. They can draw and or write a story about the tree as though it was one of their friends or "buddies" and then present the information to the class.

Shrub Key

For some added challenge, work with the class to develop a dichotomous shrub key for the area in which they live. As there are quite a number of woody shrubs in any given area, this could be an interesting and challenging venture.

Resources:

Guide to Forest Understory Vegetation in Saskatchewan – Technical Bulletin No 9. Saskatchewan Tourism and Renewable Resources. Regina, Saskatchewan. 1980.

Hosie, R.C. *Native Trees of Canada.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Johnson, D, L. Kershaw, A. MacKinnon, and J. Pojar. *Plants of the Western Boreal Forest & Aspen Parkland.* Lone Pine Publishing. Edmonton, Alberta. 1995.

Vance, F.R., J.R. Jowsey, and J.S. McLean. *Wildflowers Across the Prairies.* Western Producer Prairie Books. Saskatoon, Saskatchewan. 1984.

Who is that Kid Sample Key

- Start Here
  - Is wearing jeans
    - Wears glasses
      - Has blonde hair → Susan
      - Has brown hair → Paul
    - Does not wear glasses
      - Has short hair → John
      - Has long hair → Martha
  - Is not wearing jeans
    - Is wearing runners
      - Has blue eyes → Samantha
      - Has brown eyes → Raymond
    - Is not wearing runners
      - Has Freckles → Kelly
      - Has no Freckles → Mark

Terrific Tree Sample Key

- Start Here
  - Tree has Broadleaves
    - Bark peels
      - Bark is white → Paper Birch
      - Bark is reddish → River Birch
    - Smooth Bark
      - Bark has green tinge → Trembling Aspen
      - Bark is silvery → Balsam Poplar
  - Tree has Needleleaves
    - Needles attached singly to branch
      - Needles pointed → White Spruce
      - Needles blunt → Black Spruce
    - Needles attached to branch in clusters
      - Needles in pairs → Jack Pine
      - Needles in clusters → Tamarack

Who is that Kid Key

Start

Terrific Tree Key

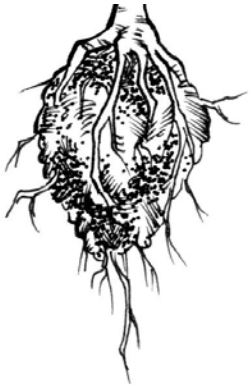
Start

A Tree for Me

Trees are the world's largest **plants** and cover approximately one-third of the earth's land surface. They often live for one hundred years – and some live for thousands! The oldest living tree known is a 4600-year-old bristlecone pine growing in the White Mountains of California.

In Saskatchewan there are over 15 different kinds of native trees, ranging from the Manitoba maple, and bur oak in the south of the province, to the balsam fir, jack pine, and white birch of the boreal forest in the north.

Tree Parts and Functions



Roots

Roots spread in a vast and intricate network, like underground branches. They usually extend as far underground as the twigs spread in the crown of the tree. If laid end to end, the roots of some giant oaks would stretch more than 160 km in length.

In addition to anchoring the tree in the ground, roots absorb water and **nutrients** from the soil. The tree uses these to manufacture food and grow.

Trunk

The trunk is the main **stem** of the tree. It has two main functions: to support the **crown** of branches, twigs, and leaves and to transport food and water throughout the tree.

The outer bark on the trunk protects the inside of the tree from injury and drying out. It also acts as an insulator against cold and heat.

Objective

To give students an opportunity to observe and describe ways in which trees grow and change during a one-year period.

Subject

Science, Language Arts, Mathematics, Visual Arts

Curriculum Links

Grade 2 Science, plant growth.

Duration

2 to 3 hours, then ongoing throughout the year.

Group Size

Small group, class

Setting

Indoors and outdoors

Materials

Class or individual log books or student-designed record-keeping sheets (one per student), metre stick and metric tape measure, drawing paper, camera, pencils, tree identification guides, magnifying glass

Tree trunks house an amazing system of pipelines. If you cut through the outer bark you would come to the soft inner bard or **phloem**. The phloem distributes water up the trunk to the leaves, where food is manufactured. Between the xylem and the phloem is a very thin growing layer called the **cambium**. Every year during spring and summer, new xylem and phloem cells are produced by this layer. As a tree grows, the older wood in the centre of the trunk ceases to carry sap. This inner wood, which is usually darker in colour than sapwood is called **heartwood**.

This yearly growth of wood appears as **annual rings**. Each annual **ring** is made up of a light and dark band of cells that correspond to the spring and summer growth. By counting these rings, you can determine the age of a tree.

The Crown

The branches, twigs, and leaves, which constitute the crown of a tree, are its "crowning glory". The branches and twigs hold the leaves up to receive sunlight, vital to food production. They also support the flowers and fruit of the tree.

If you examine a leafless twig on a deciduous tree during winter, you will notice the buds. These buds contain tiny leaves and flowers. Buds are protected from freezing by a covering of moisture-conserving bud scales.

The Leaves

Leaves are the food factories of the tree. Powered by sunlight, the green substance in leaves called **chlorophyll** uses **carbon dioxide** and water to produce **carbohydrates**. This process is called **photosynthesis**. The word photosynthesis comes from two Greek words: "photos" meaning light and "synthesis" meaning putting together. During photosynthesis, **oxygen** is released into the atmosphere through tiny pores called **stomata**. Water is also released from these pores in a process called **transpiration**. In one day, a large tree will release enough water vapour to produce more that four days' worth of water for the average person. In this way, trees act like giant air conditioners, cooling the air with water vapour and expelling oxygen, which we need to breathe.

Leaves come in many different shapes and sixes and are **attached** to the twig in different ways. For example, some leaves, like Manitoba maple, are attached **opposite** one another. Others, like the bur oak, are arranged **alternately** on the twig. Observing the shapes and arrangement of leaves is helpful in **identifying** trees.

The Flowers

Many tree flowers produce **fruit** although some produce cones. Both encase **seeds**. Within each seed lies the beginning of a tiny tree. Tree seeds are dispersed by wind, wildlife, and water.

ENGAGE

1. At the beginning of the school year, have each student or pair of students "adopt" a tree. If there are not enough trees nearby, select on deciduous and one evergreen tree for the class to study. Provide students with log books or have them create their own record-keeping sheets. Take your students to visit the trees at least once a month. Before each visit, have your students predict what changes they expect to see in the tree. Observe and record any changes in log books or on the activity sheets. Visit your trees more frequently during the spring and fall seasons when trees are undergoing many changes.
2. Have your students select an appropriate name for their new tree friends. Use a tree identification guide or key to identify the trees.
3. Take photographs of the trees each time you visit. Mount photos in chronological order on a bulletin board.
4. Have your students measure the circumference of the trees. To do this, use a metre stick to measure 1.4 m or approximately breast height up from ground level. At this level, have them measure the circumference of the tree using a metric tape re. Record the results. Repeat during each visit. Graph the results, (Note: Fast-growing trees, such as poplar, that are approximately 5 cm to 15 cm in diameter are more like more likely to show the greatest increase in circumference during a one-year period.)
5. Give each student a large sheet of paper divided into four squares. Label each square with the name of a season. Once each season, have the students draw a picture of their trees.
6. Measure and record the length of a particular twig during each visit. (Tie a piece of string around the twig to mark it.) Determine how much that twig grew during the year. In which months did it grow the most/least?

7. Have your students write poetry about their trees. Start with making a list of descriptive words ending in "ing". Then select five or six words to make a Tree Form Poem.
For example:

Shimmering
Dancing
Colouring
A

Leaf

Falls

8. Make leaf rubbings. For instructions on making a leaf print, see Leaf Bingo.
9. Look for evidence of animals living in or near the trees. See Shelter Me.
10. Are there any other plants living on the trees (e.g., moss, lichen)?
11. How does the tree help other plants, animals, and people? Look for evidence of this. See We Depend on Each Other.
12. In the spring and fall, look for the tree's seeds. How are they dispersed?
13. In the spring, observe the buds as they begin to open. Observe the flowers of the tree. Do they contain both the stamen and the pistil? Are they arranged singly or in clusters?
14. Have your students think up and conduct their own activities to help them to observe and describe ways in which trees grow and change.

EXTEND

Have your students create a bulletin board reflecting their tree studies. Update it monthly.

Tree Rummy

The more we find out about trees, the more terrific they become. Included below is some terrific tree "true or false" trivia (from the book *Native Trees of Canada*) that showcases fascinating facts about our main Saskatchewan tree species.

Objectives:
To give students an opportunity to review and reinforce the characteristics of the major tree species found in Saskatchewan.

Subjects:
Science, Language Arts, Math

Curriculum Links:
Grade 1 Science, Plants
Grade 2 Science, Plant Growth

Duration:
15-30 Minutes for Introductory Lesson with the main activity as a learning station.

Setting:
Indoors

1. White Spruce:
- likes to grow where it is somewhat shady (true)
- has a shallow root system and can blow over quite easily (true)
- can be found growing almost everywhere in Canada (true)
- is a common tree on the prairies (false – it is more a tree of the Boreal forest region)
- is one of the most important sources of pulpwood and lumber in Canada (true)
- needles are round in cross-section (false – they are square)
- cones can open from fall through to spring (true)
- roots where used by aboriginal Canadians to lace birch bark on canoes (true)
- needles make a nice tea (false – other spruce needles do, but the needles of white spruce are too aromatic to make a tasty tea)
- is an important tree for producing lumber and pulp (true)

2. Black Spruce:
- tend to have club-shaped top (true)
- can grow new trees from where its branches touch the ground (true)
- gets its name from its black needles (false – black spruce does look dark, but its needles are bluish-green)
- tends to grow in mossy bogs (true)
- tends to have up-turned branch tips (true)
- cones are long and pointy (false – they are actually quite small and egg-shaped)
- cones release seeds slowly throughout the whole winter (true)
- seed is nearly black (true)
- has long fibers in its wood that makes it ideal for the pulp industry (true)
- has thick, shaggy bark (false – mature trees have thin, scaly bark)

3. Jack Pine:
- can grow to be tall and cone-shaped to short and twisted (true)
- can cross breed with Lodgepole Pine to form a hybrid pine (true)
- needles are in clusters of five (false – they are in clusters of two)
- cones are usually straight (false – they are usually curved inwards)
- cones are sealed with a resin that usually requires the heat of a forest fire to open (true)
- wood is used for general purpose lumber and for pulp (true)
- male flower clusters can be boiled to remove resin and be eaten (true)
- was considered a lucky tree by early settlers (false – it was actually considered an evil tree, likely because crops tended to fail on the poor soil that these trees tend to grow in)

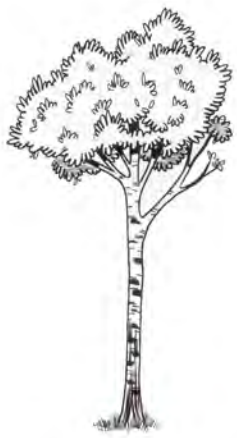
4. Trembling Aspen:
- will grow from the wide spreading root system of a parent tree especially if an area is disturbed by fire or logging (true)
- likes growing in the shade (false – it actually is very intolerant of shade and grows best in full sun)
- is often called a "nurse" tree because other trees will grow in under the shade of an aspen stand (true)
- produces lots of fluffy, white seed that can float in the air or water for great distances (true)
- leaves are round with a short, sharp tip (true)
- leaves have round stems (false – their stems are flat, which is the reason the leaves "tremble" in the wind)
- bark is pale green to almost white when the tree is younger (true)
- is not used in the forest industry because the wood is too soft (false – aspen is mainly used for pulpwood and occasionally for lumber)
- inner bark was used for pain killer by early settlers (true)

5. White Birch
- grows best in well-drained sandy or silty soils (true)
- grows best in full sun and therefore thrives in burned-over or cut-over areas (true)
- has round, smooth edged leaves (false – it has triangular or egg-shaped leaves with teeth along the edges)
- produces long worm-like bunches of seeds (true)
- twigs are a pale white colour (false – they are reddish-brown in colour)

White Spruce

Black Spruce

Jack Pine



Trembling Aspen

White Birch

Tamarack

- bark is reddish- brown on young trees, becoming white and peeling on older trees (true)
- produces a very soft wood (false – it produces a very hard wood that is often used in the furniture industry)

6. Balsam Fir

- tends to look like a church steeple in shape (true)
- tends to grow up under a canopy of aspen trees (false – balsam fir is very shade tolerant and tends to grow up under canopies of spruce)
- seedings are the only trees that can grow under the dense shade of a balsam fir canopy (true)
- tends to grow into pure stands where spruce budworm has killed the spruce (true)
- needles are flat and feel soft to the touch (true)
- bark is very rough in young trees (false – the bark of young trees is relatively smooth with many sap containing bubbles)
- produces soft, weak wood (true)
- is commonly cut and sold as a Christmas tree (true)

7. Tamarack

- is a tree of cold, wet, poorly drained soils (true)
- needs full sun to grow well (true)
- needles are light green and turn golden-yellow in fall (true)
- needles grow in clusters of 10 – 20 on dwarf twigs (true)
- needles are shed every fall (true)
- twigs are slender and brownish-orange in colour (true)
- tends to grow with a very straight grain (false – it actually grows with a spiral grain)
- wood is very strong and is used for everything from railway ties to fence posts (true)
- roots were once used to join ship ribs to the deck timbers (true)

8. Balsam Poplar

- does best on well-drained soil (true)
- compound leaves with opposite arrangement (true)
- roots form new trees by 'succkering' (false)
- drought tolerant and winter hardy (true)
- balsam poplars grow the farthest north or any of North American's hardwoods (true)
- each branch usually curves upwards (true)

- fast growing trees often used as wind breaks on the prairies (true)
- male and female flowers are found on the same tree (false)
- leaves are dark shing green above and whitish below (true)

ENGAGE

As a means of reviewing characteristics of the various tree species found in Saskatchewan present the Terrific Tree "True of False" Trivia included in the background information section. This trivia highlights interesting information about these trees and as some of the trivia is incorrect ask students if they think the trivia is "true or false" as you read each statement. For younger classrooms you may wish to use only a few of the trivia facts, however you may wish to review them all with older grades. Older students can also be divided into smaller groups and then given the trivia from each species on separate cards that they take turns quizzing each other with. The information presented in the trivia forms the basis for playing the "terrific tree rummy" card game outlined in the next section.

Balsam Poplar

EXPLORE

Have two to four students work in a small group using the "Terrific Tree Rummy" cards as a learning station based on the following rules:

1. Players each start with seven cards drawn at random from the overturned deck of cards.
2. The remaining cards are gathered into a pile and players then take turns drawing a card from the overturned pile aiming to assemble all the cards of one tree species. Note: there are seven cards for each tree species each with the same identifying symbol.
3. If the drawn card is useful, the player can add it to the species group that he/she is trying to assemble and discard a card that cannot be used in the discard pile.
4. If the player cannot use the card when drawn, it can be discarded immediately.

Balsam Fir

Materials:

- Terrific Tree "True or False" Trivia
- Terrific Tree Rummy cards copied onto heavy card and cut out

Resources:

Hickman, Pamela. *The Kids Canadian Tree Book.* Kids Can Press Ltd., Toronto, Ontario. 1995.

Hole, Lois. *Favorite Trees & Shrubs.* Lone Pine Publishing. Edmonton, Alberta. 1997.

Hosie, R. C. *Native Trees of Canda.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. *My Favourite Tree.* Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. *Woody Ornamentals for the Prairies.* University of Alberta. Edmonton, Alberta. 1995.

5. The first student to get all seven cards for the same tree species wins the game.
6. Should all the cards in the overturned pile be drawn, the discard pile can be turned over to continue the game.
7. The winning student or the teacher can finish the game by reading all of the terrific tree facts for the tree species in the winning hand.

EVALUATE

Use the Terrific Tree Rummy cards as a quiz, taking turns asking students the questions on the cards to see how many of the facts they can remember. The stories written under the extension section could also be assigned as an evaluative exercise to see what students remember about a specific tree species.

EXTEND

1. Ask students to write a "Terrific Tree Tale" based on the tree species that they found the most interesting. They might also want to do some further research about this tree species to add further detail to their story. Make sure the stories are either presented to the class or provided as a binder for further reading so that all students can take advantage of the information compiled.
2. Have students write and illustrate a comic strip that includes a "Terrific Tree" as a super hero in the story. These stories could even be developed into a great play for performance to the rest of the school.
3. Research the "Terrific Trees" of our urban forests, by looking at some of the tree species found in our urban parks, yards and streets.

White Spruce

- likes to grow where it is somewhat shady (true)
- has a shallow root system and can blow over quite easily (true)
- can be found growing almost everywhere in Canada (true)
- is a common tree on the prairies (false – it is more a tree of the Boreal forest region)
- is one of the most important sources of pulpwood and lumber in Canada (true)
- needles are round in cross-section (false – they are square)
- cones can open from fall through to spring (true)
- roots where used by aboriginal Canadians to lace birch bark on canoes (true)
- needles make a nice tea (false – other spruce needles do, but the needles of white spruce are too aromatic to make a tasty tea)
- is an important tree for producing lumber and pulp (true)

Black Spruce

- tend to have club-shaped top (true)
- can grow new trees from where its branches touch the ground (true)
- gets its name from its black needles (false – black spruce does look dark, but its needles are bluish-green)
- tends to grow in mossy bogs (true)
- tends to have up-turned branch tips (true)
- cones are long and pointy (false – they are actually quite small and egg-shaped)
- cones release seeds slowly throughout the whole winter (true)
- seed is nearly black (true)
- has long fibers in its wood that makes it ideal for the pulp industry (true)
- has thick, shaggy bark (false – mature trees have thin, scaly bark)

Jack Pine

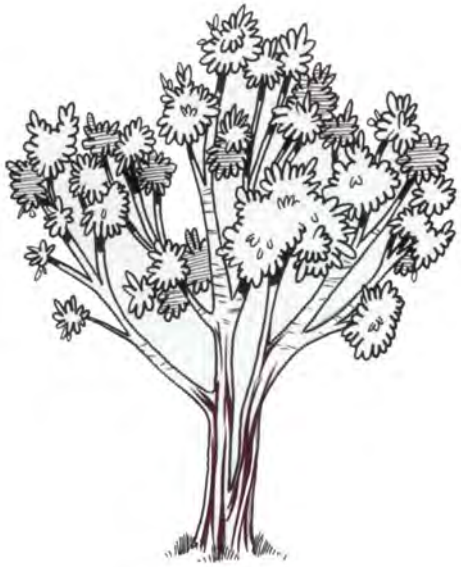
- can grow to be tall and cone-shaped to short and twisted (true)
- can cross breed with Lodgepole Pine to form a hybrid pine (true)
- needles are in clusters of five (false – they are in clusters of two)
- cones are usually straight (false – they are usually curved inwards)
- cones are sealed with a resin that usually requires the heat of a forest fire to open (true)
- wood is used for general purpose lumber and for pulp (true)
- male flower clusters can be boiled to remove resin and be eaten (true)
- was considered a lucky tree by early settlers (false – it was actually considered an evil tree, likely because crops tended to fail on the poor soil that these trees tend to grow in)

Balsam Fir

- tends to look like a church steeple in shape (true)
- tends to grow up under a canopy of aspen trees (false – balsam fir is very shade tolerant and tends to grow up under canopies of spruce)
- seedings are the only trees that can grow under the dense shade of a balsam fir canopy (true)
- tends to grow into pure stands where spruce budworm has killed the spruce (true)
- needles are flat and feel soft to the touch (true)
- bark is very rough in young trees (false – the bark of young trees is relatively smooth with many sap containing bubbles)
- produces soft, weak wood (true)
- is commonly cut and sold as a Christmas tree (true)

Black Spruce

White Spruce



Balsam Poplar

Jack Pine

White Birch

- grows best in well-drained sandy or silty soils (true)
- grows best in full sun and therefore thrives in burned-over or cut-over areas (true)
- is easily killed by fire, but will sprout from the base of the trunk (true)
- has round, smooth edged leaves (false – it has triangular or egg-shaped leaves with teeth along the edges)
- produces long worm-like bunches of seeds (true)
- twigs are a pale white colour (false – they are reddish-brown in colour)
- bark is reddish- brown on young trees, becoming white and peeling on older trees (true)
- produces a very soft wood (false – it produces a very hard wood that is often used in the furniture industry)

Tamarack

- is a tree of cold, wet, poorly drained soils (true)
- needs full sun to grow well (true)
- needles are light green and turn golden-yellow in fall (true)
- needles grow in clusters of 10 – 20 on dwarf twigs (true)
- needles are shed every fall (true)
- twigs are slender and brownish-orange in colour (true)
- tends to grow with a very straight grain (false – it actually grows with a spiral grain)
- wood is very strong and is used for everything from railway ties to fence posts (true)
- roots were once used to join ship ribs to the deck timbers (true)

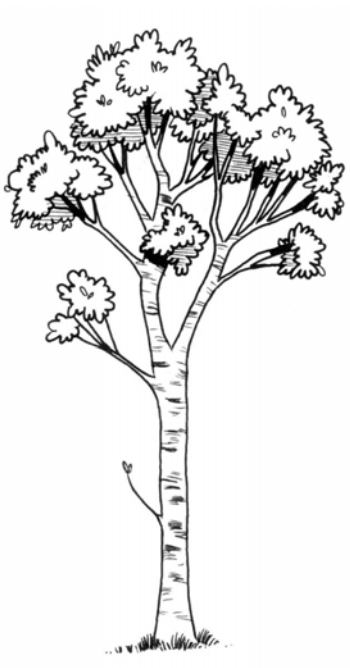
Trembling Aspen

- will grow from the wide spreading root system of a parent tree especially if an area is disturbed by fire or logging (true)
- likes growing in the shade (false – it actually is very intolerant of shade and grows best in full sun)
- is often called a "nurse" tree because other trees will grow in under the shade of an aspen stand (true)
- produces lots of fluffy, white seed that can float in the air or water for great distances (true)
- leaves are round with a short, sharp tip (true)
- leaves have round stems (false – their stems are flat, which is the reason the leaves "tremble" in the wind)
- bark is pale green to almost white when the tree is younger (true)
- is not used in the forest industry because the wood is too soft (false – aspen is mainly used for pulpwood and occasionally for lumber)
- inner bark was used for pain killer by early settlers (true)

Balsam Poplar

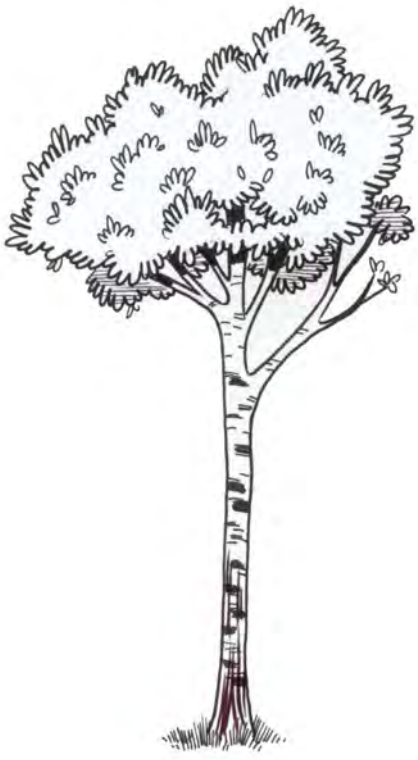
- does best on well-drained soil (true)
- compound leaves with opposite leaf arrangement (true)
- roots form new trees by 'suckering' (false)
- drought tolerant and winter hardy (true)
- balsam poplars grow the farthest north of any of North America's hardwoods (true)
- each branch usually curves upward (true)
- fast growing trees often used as wind breaks on the prairies (true)
- male and female flowers are found on the same tree (false)
- leaves are dark shiny green above and whitish green below (true)

Tamarack



White Birch

Balsam Fir



Trembling Aspen (White Poplar)

White Spruce

The cones usually drop during winter after opening and losing their seeds in fall.

White Spruce

White Spruce

This tree has needles that are square in cross-section.

White Spruce

White Spruce

This tree can be found growing almost everywhere in Canada.

White Spruce

White Spruce

This tree likes to grow where it is somewhat shady.

White Spruce

Black Spruce

This tree tends to have club-shaped top.

Black Spruce

White Spruce

This tree has roots that where used by aboriginal Canadians to lace birch bark on canoes.

White Spruce

White Spruce

This tree is one of the most important pulpwood and lumber trees in Canada.

White Spruce

White Spruce

This tree has a shallow root system and can blow over quite easily.

White Spruce

Trembling Aspen

This tree has leaves with flat stems that tremble in wind.

Trembling Aspen

Black Spruce

This tree tends to have up-turned branch tips.

Black Spruce

Black Spruce

This tree tends to grow in mossy bogs.

Black Spruce

Black Spruce

This tree can grow new trees from where its branches touch the ground.

Black Spruce

Trembling Aspen

This tree produces lots of fluffy, white seeds.

Trembling Aspen

Black Spruce

This tree has long fibers in its wood that makes it ideal for the pulp industry.

Black Spruce

Black Spruce

This tree has small, egg-shaped cones.

Black Spruce

Black Spruce

This tree has seed that is nearly black.

Black Spruce

Jack Pine

This tree can cross breed with Lodepole Pine to form a hybrid pine.

Jack Pine

Trembling Aspen

This tree is often called a “nurse” tree because other trees will grow under its shade.

Trembling Aspen

Trembling Aspen

This tree has inner bark that was used for pain killer by early settlers.

Trembling Aspen

Trembling Aspen

This tree has bark that is pale green to almost white when the tree is younger.

Trembling Aspen

Jack Pine

This tree can grow to be tall and cone-shaped or short and twisted.

Jack Pine

Jack Pine

This tree has needles in clusters of two.

Jack Pine

Trembling Aspen

This tree will grow from the wide spreading root system of a parent tree.

Trembling Aspen

Trembling Aspen

This tree has leaves that are round with a short sharp tip.

Trembling Aspen

Tamarack

This tree has needles that grow in clusters of 10 – 20 on dwarf twigs.

Tamarack

Tamarack

This tree grows in cold, wet, poorly drained soils.

Tamarack

Jack Pine

This tree was considered an evil tree by early settlers.

Jack Pine

Jack Pine

This tree generally has curved cones.

Jack Pine

Tamarack

This tree sheds its needles every fall.

Tamarack

Tamarack

This tree has light green needles that turn golden-yellow in fall.

Tamarack

Jack Pine

This tree has male flowers that can be boiled to remove their resin and then eaten .

Jack Pine

Jack Pine

This tree has cones that are sealed with a resin.

Jack Pine

White Birch

This tree produces long worm-like bunches of seeds.

White Birch

White Birch

This tree is easily killed by fire, but will sprout from the base of the trunk.

White Birch

Tamarack

This tree has strong roots that ship-builders used to join ship ribs to deck timbers.

Tamarack

Tamarack

This tree has slender, brownish-orange twigs.

Tamarack

White Birch

This tree has reddish-brown twigs.

White Birch

White Birch

This tree has triangular or egg-shaped leaves with teeth along the edges.

White Birch

White Birch

This tree grows best in full sun and thrives in burned-over or cut-over areas.

White Birch

Tamarack

This tree tends to grow with a very spiral grain.

Tamarack

Balsam Fir

This tree has smooth bark when young with many sap containing bubbles.

Balsam Fir

Balsam Fir

This tree tends to grow into pure stands where spruce budworm has killed the spruce.

Balsam Fir

Balsam Fir

This tree tends to grow up under a canopy of spruce.

Balsam Fir

White Birch

This tree has reddish- brown bark on young trees and white, peeling bark on older trees.

White Birch

Balsam Fir

This tree produces soft, weak wood.

Balsam Fir

Balsam Fir

This tree has flat, soft needles.

Balsam Fir

Balsam Fir

This tree has the only seedings that can grow under the dense shade of a balsam fir stand.

Balsam Fir

White Birch

This tree produces a hard wood that is used for making furniture.

White Birch

Balsam Poplar

This tree does best on well-drained soils.

Balsam Poplar

Balsam Poplar

This tree has compound leaves with opposite leaf arrangemnet.

Balsam Poplar

Balsam Poplar

This trees bark is greenish-brown when young, becoming grey as it ages.

Balsam Poplar

Balsam Fir

This tree is commonly cut and sold as a Christmas tree.

Balsam Fir

Balsam Poplar

This tree is drought tolerant and winter hardy.

Balsam Poplar

Balsam Poplar

This tree is a harwood that grows the farthest north of any hardwoods in North America.

Balsam Poplar

Balsam Poplar

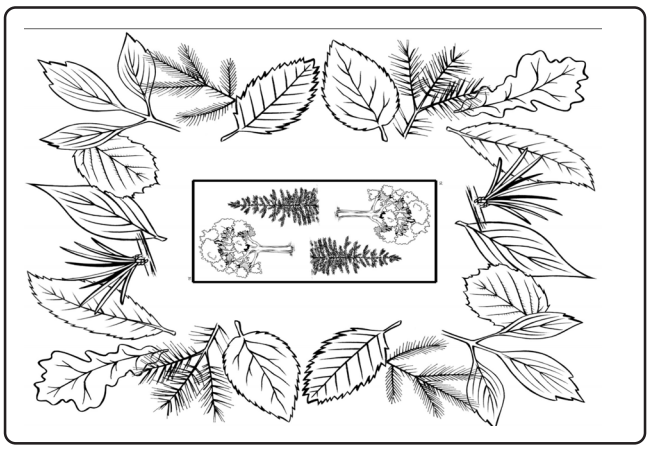
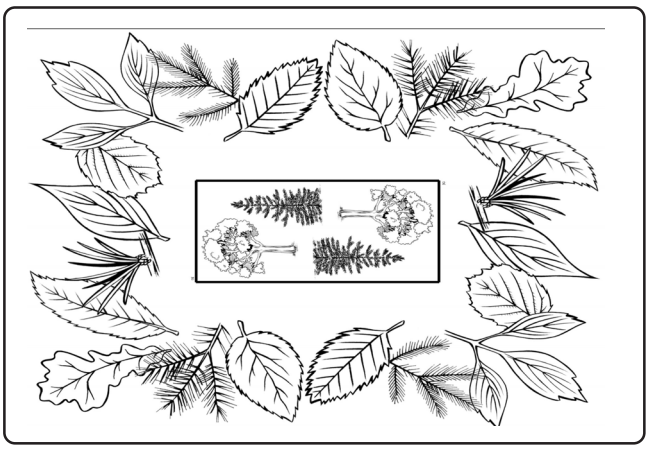
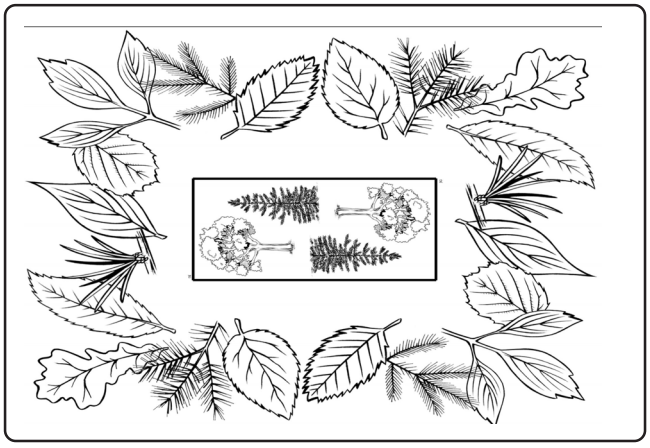
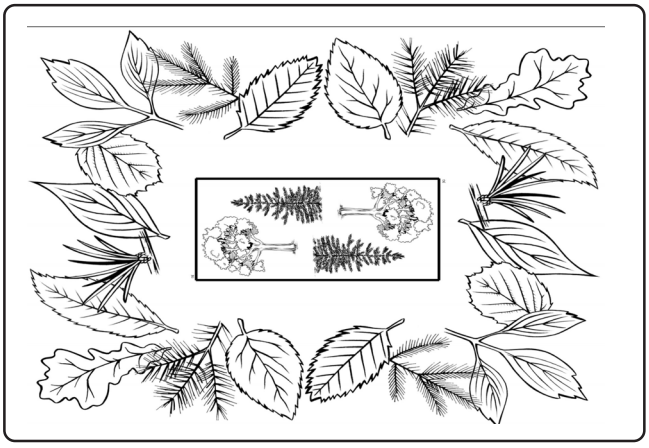
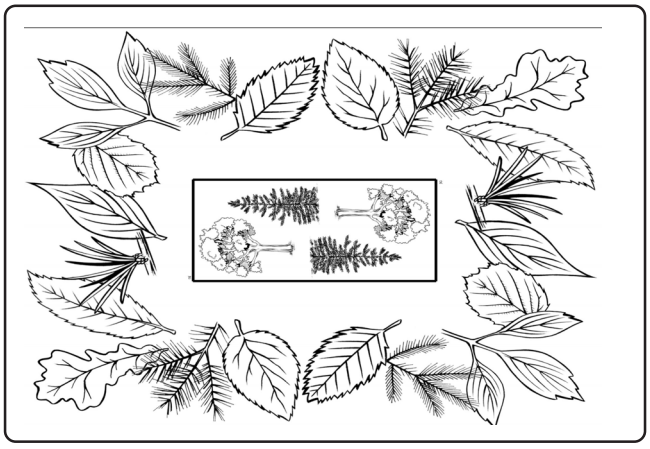
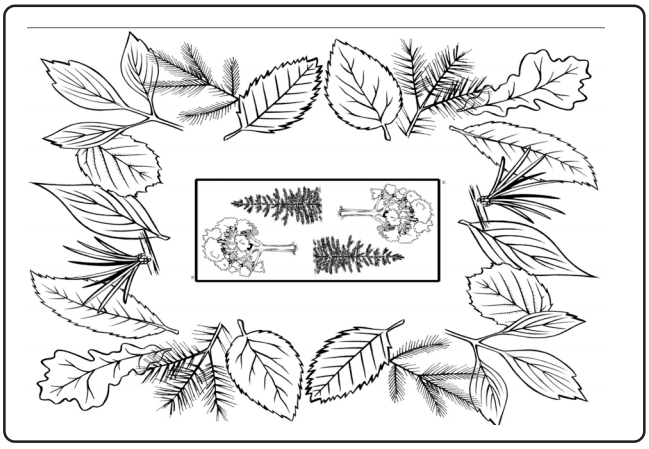
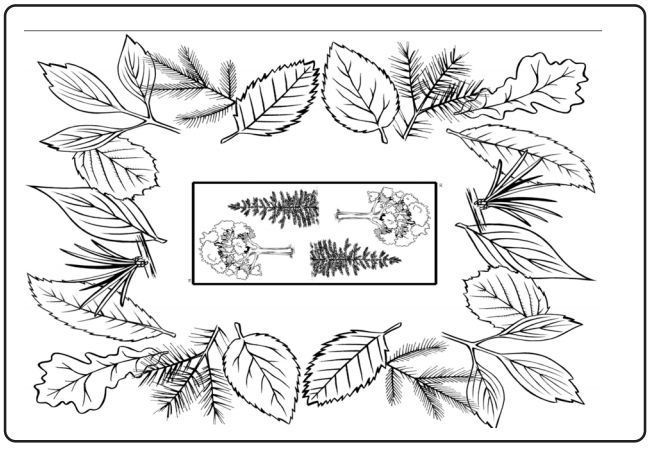
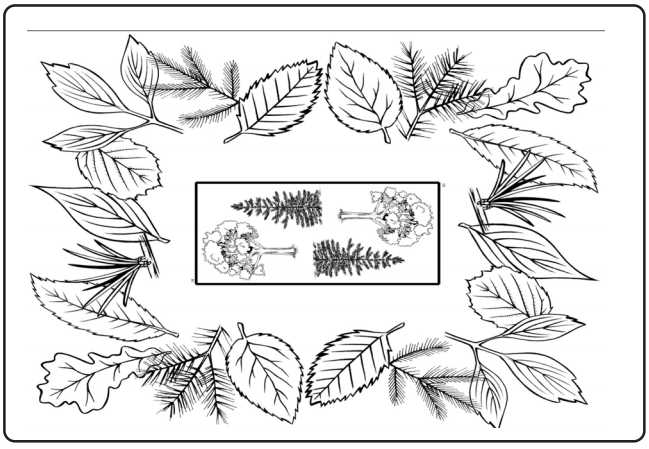
This trees branches usually curve upwards.

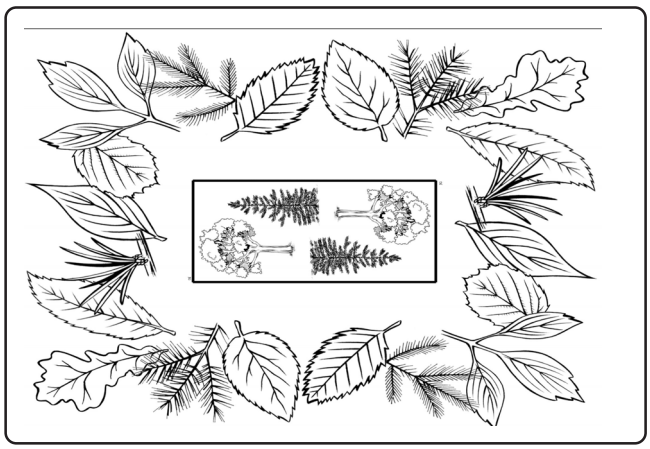
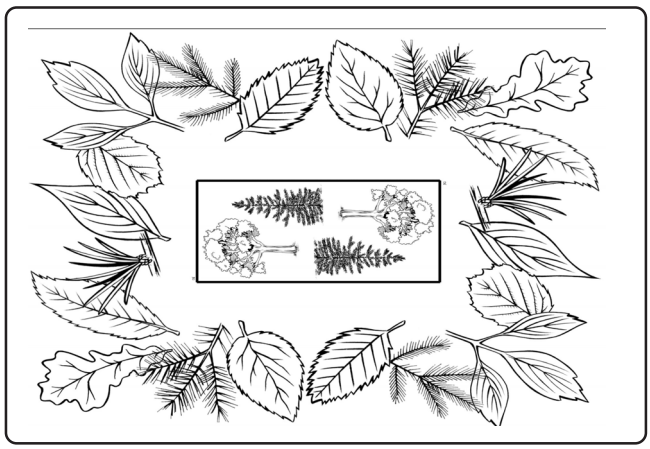
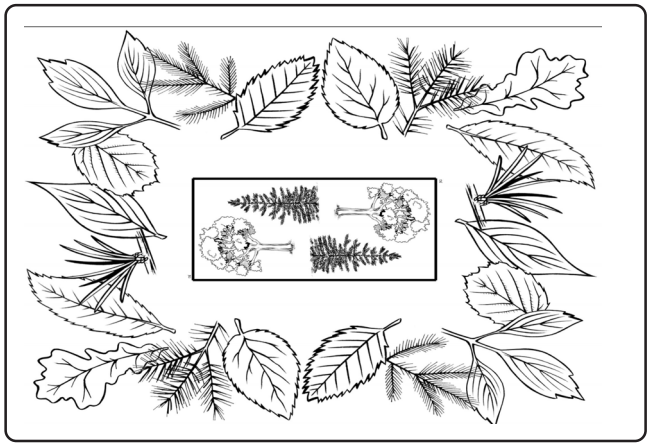
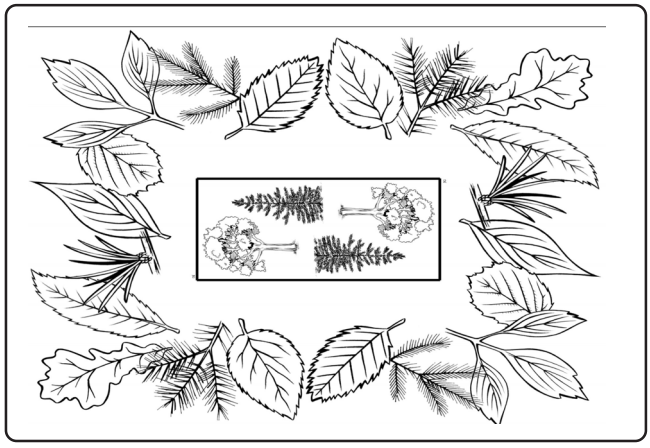
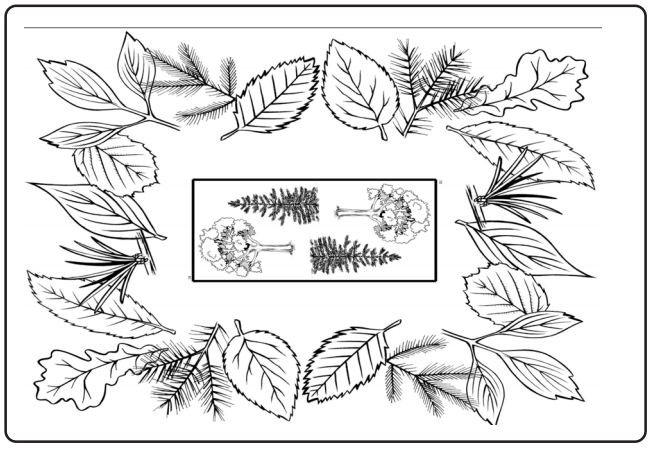
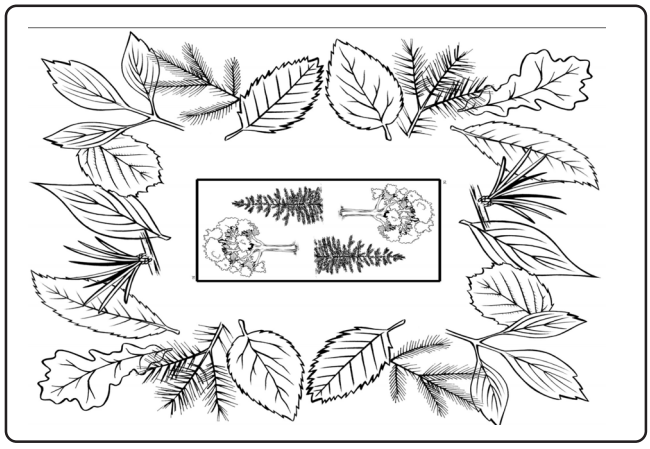
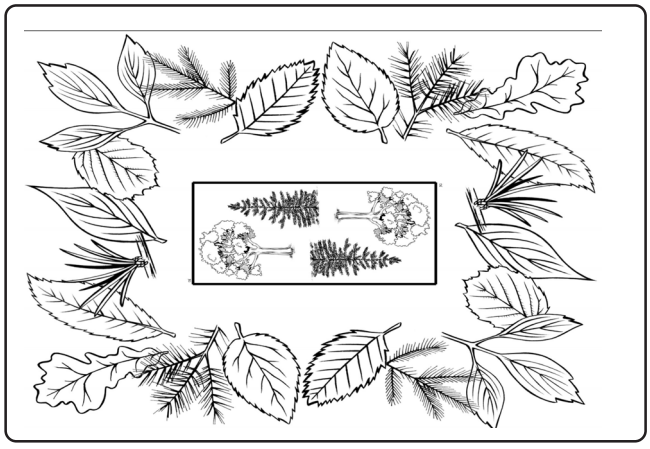
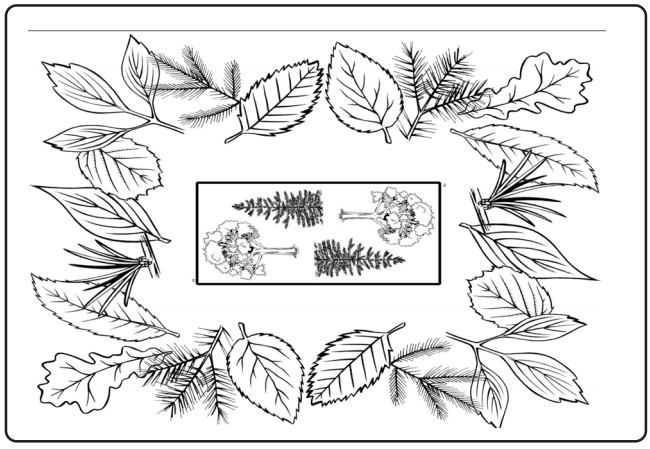
Balsam Poplar

Balsam Poplar

This tree is usually planted in rural areas for shelterbelts.

Balsam Poplar

Daring Decay

If a tree falls down in the forest, does anybody hear? And even if no one hears, does it have an impact on anything?

Forest decay is an essential part of the life and nutrient cycle of forests in the world. It consist of the breakdown of organic materials (remains of living organisms such as plants or animals), so nutrients can be transferred to the soil, then reused by other organisms. This process is also called decomposition and can happen at varying rates which depend on many environmental conditions.

In a tropical rainforest, for example, a tree can die, fall and decompose in about 20 years. In the Boreal forests of Saskatchewan a similar tree could take hundreds of years to completely decay. Saskatchewan forests are cold, which means that their growth and decay cycles are much slower than warmer, wetter environments. This is a very simple, but very important concept which in many ways define our forests and create an understanding of their ecology.

The decaying process in northern forests is slow but steady, and often starts even before a tree dies or falls. For many of the creatures in the boreal forest, like squirrels, martens, or woodpeckers, dying and dead standing trees (called snags) are great assets. Once they fall, trees became part of the forest floor litter (fallen leaves, twigs, pieces of bark, seed coverings), and they start to be decomposed by the lowest levels of the food chain. Fungus, bacteria, insects, worms and even small mammals will help in this process.

Even though, a busy ecological process is continuously underway on and under the forest floor, the cold climate and short growing season of the boreal forest leads to accumulation of organic material. Litter is produced by boreal plants at a faster rate than it decomposes, so it builds up on top of the soil.

There are many ways in which the forests have adapted to this steady accumulation of materials. One of them is fire. In Saskatchewan boreal forests and the transitional aspen parklands fire is definitely the single most dominant agent of disturbance or

Objectives:
Understanding the natural cycle of decay in the forest.
Understanding accumulation of organic material in northern forests and some of its results.

Subjects:
Science, Arts Education, Language Arts, Physical Education

Curriculum Links:
Grade 1 Science - Plants,
Grade 2 Science - Habitats, Plant Growth, Air and Water,
Grade 3 Science - Earth, Fire and Fuel,
Grade 4 Science-Plant Diversity

Duration:
One to two class periods

Setting:
Classroom, gym or outside

Materials:
"The Magic of Decay" Story
Decay Relay Sheets

change. They are thought to occur in the forest landscape in cycles of 50 to 250 years, rejuvenating, diversifying, and over time sustaining the forest landscape in irregular, unpredictable ways.

Another fascinating expression of slow decomposition in boreal forests are peat lands. These wetlands develop in areas with a high water table or with poor soil drainage. Summer rains and winter snow melt do not distill deep into the ground, so water tends to pool on the surface and stay there. An excess of stagnant water drives air out of the soil. Non-aerated soil, in turn, does not favor decomposition, since many forms of decay require oxygen. The result is that organic material accumulates much faster than it decomposes, creating peat. There are two very distinct types of peat- covered lands in northern forests, bogs and fens.

Bogs, definitely the most famous of peat lands, are created where the water is usually completely stagnant, nutrient poor and very acidic. In bogs sphagnum mosses are the main peat formers, since they thrive in these conditions. Fens, on the other hand, are not so nutrient poor and their slow moving waters create conditions for sedges and brown mosses (which are the main peat formers in fens) to grow. Shrubs and trees also grow more often in fens than in bogs.

ENGAGE

To introduce your students to the decay cycle in the northern forests you could read them the story The Magic of Decay.

EXPLORE

Dare to Decay

After discussing the story with the students and what happened in all the magic places that Gina stopped with her uncle, tell students that now it is time for them to be transformed into litter. This will be a game in which they will be two teams of organic material which will have to choose how to cycle.

Before the game you will have to prepare the cards for the groups. There is a sheet at the end of the lesson which should be photocopied in two different colours (ie. yellow and blue), which will be the colours of the teams. There are twelve cards in each sheet and they are clues that will tell students how they should cycle, for example: litter + lightening card, means they will choose fire. Each student will need a clue card. It may be necessary go over the graphics with the children to make sure they understand what they all mean.

Divide the class in two teams and name them in the colour of their cards. Explain to them that each of the teams are piles or dead organic material (dead trees or moss, fallen leaves, seeds, branches, etc) which have to decay.

In one side of the classroom (or the gym, or where you are playing the game), put three paper boxes or cans that say **forest decay**, **peat bogs** and **fire**. Close to each team put two other boxes with the coloured clue cards for each team. Blue team gets blue cards, and yellow gets yellow cards.
Explain to the students that this is a relay game and each person in the team has to run to the front, come back and touch the next student before he can move. They each have to get a card, look at it, decide how they will cycle, put the card in the right box in front of the class and come back so the next person can go. Tell them to try to remember their card.

Once they have all finished, ask students to sit down (or return to the classroom) and tell them that now
it is time to see which team won the game. Write the name of the two teams on the board, and check together with the class each of the decay boxes. For each correct card in the correct box,

Dare to Decay Relay Game Answer Key

Forest Decay
Woodpecker on a Dead Tree
Earthworms eating Debris
Bacteria eating Debris
Oxygen and Debris but no fire
Beetle in a Dead Log
Slow Decomposition

Peat Bog
Debris with No Oxygen
Water Logged Debris
Very Slow Decomposition
Acidic Debris

Fire
Debris lit by a Match
Fast Decomposition
Debris and Heat
Lightning struck Tree

give the team 5 points. Discuss as you go why certain clues would make them decide to cycle in a certain way and go over the incorrect one.
After you finish going through all the boxes, the team that gets the most points, wins. In the event of a tie the team that finished fastest is the winner.

EVALUATE

Ask students if they remember which card they had, if they do give each of them their card back. If they cannot remember, you can just distribute cards again. Tell students that they will have five minutes to find their new group according to the colour and the type of card they have. For example, All the Blue - Forest Decay clue cards should be together, etc. After they found each other, each group can sit together, colour their cards and prepare a poster explaining their cycle. After they are all done, each group can present their work to the rest of the class, explaining what it all means.

EXTEND

Terrarium:
Set up a terrarium in your classroom with a rotting log. Gather some soil, forest debris and a log from a forest area nearby. Set it up nicely in a glass container and monitor over time. Experiment adding more or less water and have children watch as fungus grows, spider webs get built, insects appear and eggs hatch.

Bag Decay:
Each student could do his own little decay experiment in a plastic freezer bag. They should label their bag with their name and date and then go outside to gather some forest debris. Have each student collect a handful of debris, plus some soil. Have them break up everything into small pieces and then put the pieces into the bag. All students should add some water to their bags, but some can add more than others. Some students can put their bags in a sunny window, and others in the shade, some maybe in a refrigerator. After a couple of days, compare the decomposition rates of the plant material and the growth of bacteria in everyone's bags.

Resources:

Dig In - Hands on Soil Investigations. National Science Teachers Association. Arlington,VA. 2001
Glob, P.V. *The Bog People*. Cornell University Press. Ithaca, N.Y. 1965
Pringle, L. *Fire in the Forest*. Atheneum Books for Young Readers. New York,NY 1995
Bastedo, J. *Shield Country: The life and times of the oldest piece of the planet*. Red Deer Press. Red Deer, AB. 1994
Treeducation - www.newforestsproject.com/teacher.html#top
The Canadian Intersite Decomposition Experiment - www.pfc.forestry.ca/climate/cidet/index_e.html
Compost Gin - The Compost Learning Game (Card Game) by Tall Oak Productions.

The Magic of Decay

Gina was watching her uncle dig through the leaves under some trees when she heard him say: "See, Gina, it's magic!". She had been waiting for that and crouched down quickly to look more closely at what he was pointing at. Going for magic walks with her uncle Tom was definitely her favourite part of coming to the lake. That day, it started inside the cabin, when she was listening to her parents talk about building a compost bin. She asked what that was and her mom explained that it was a box to throw natural garbage in, so it would decay and become fertilizer for their garden. She had a lot more questions but uncle Tom said that they should go for a magic walk! In a flash Gina was at the door.

Now they were kneeling on the ground looking at dead leaves. "It's the magic of decay", he said.

With uncle Tom everything was magic. Nothing was ever boring or ordinary. The smallest things were mysterious and interesting.

"What is decay?" She asked.

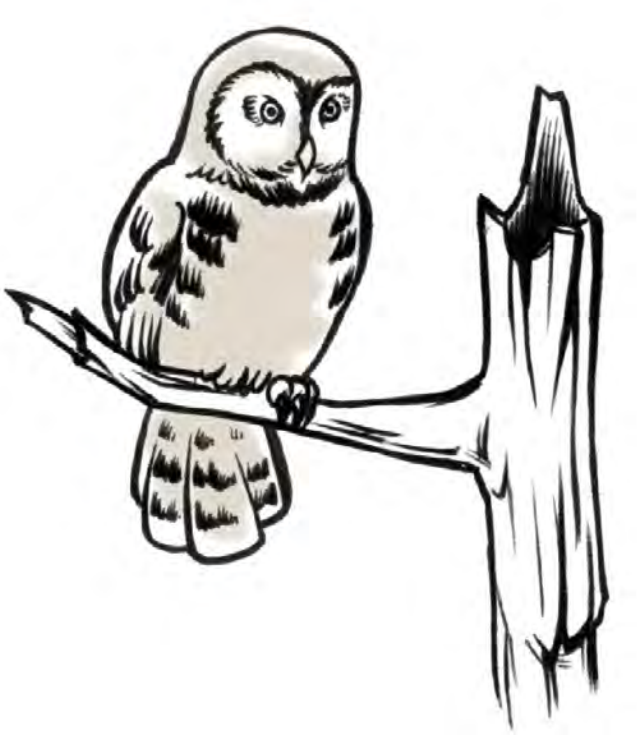
Uncle Tom started by explaining that the parts of plants like leaves, twigs, dead logs, and bark were known as debris or litter.

"When something dies in a forest, it means the beginning of life for other things. If you look closely at the leaves and twigs right here, you will see many mushrooms, insects, worms, spiders living off of it. There are also invisible things, like bacteria, that are busy working at it." These decomposers break it down into smaller parts. Once they break things down, they go back into the soil and the nutrients are used by growing plants.

"So all of this will turn into plant food?" asked Gina

"Yes! " replied Uncle Tom

Gina looked around and as quick as a whip, she asked her uncle: "So what about those dead standing trees? Shouldn't we cut them down so they will become plant food as well?"



Uncle Tom laughed, "You are on the right track, but dead standing trees will fall at their own pace. As they slowly decay where they stand,they help many animals survive by providing them food and shelter. Many insects live under the bark and owls, woodpeckers and squirrels have nests in them. "

Gina listened, then took a good look at the forest, then asked another question. "Now if this is all true, and if there are so many things eating and decomposing all the litter, why is there so much of it all over the forest?"

She got another laugh from uncle Tom, who stood up and said: "Well the answer is that where we live it is cold most of the year. Most decomposers are not very active when the soil is very cold, and our soils are often very cold...or even frozen! So debris builds up faster than it decomposes!"

Gina looked around again, thought for some time, then her faced became serious. "Uncle Tom, I always see Grandpa burning piles of leaves at the farm. If the forest is a big pile of leaves, would it not burn too easily?"

"Why you are a little genius!" He said throwing leaves up at her. "The forest often burns! Fires are part of the natural cycle of the forest. Fires clear debris in the forest. Trees like this pine in front of us, have adapted to fire and only relase new seed when the waxy layer on their cones is melted off. The ash left after the fire is full of nutrients that are used by the new forest. While most trees are burned up some die but become the dead standing trees which so many creatures live in. Areas are open and different plants and trees that need sun will grow there. It is all part of the magic!"

Uncle Tom then looked at Gina as if he had a great idea. "And it doesn't stop there!" He said, "Fire plays an important part of the decay cycle, but so can water. Come with me!"

"Where to?" Gina asked.

"To the BOG!"

Gina was not as impressed as her uncle. She knew the bog. It was a smelly place, full of mosquitoes and black flies.

"The Bog," he explained, "is a magic place where time stands still."

He stopped at the edge of it, stuck his hand inside the bog and pulled a bunch of smelly mud from it. "Remember I said decay was slow in the forest? In the bog, it is veeeeeeeeery slow. So things pile much, much faster than they decompose. That, my dear, results in Peat! Peat is this wonderful, cold, soggy, smelly and squishy stuff!"

Gina laughed feeling the peat and forgetting the bugs and the smell. Now she was curious again "Why does it do that?"

"Because of the cold and because of water. In bogs, water does not drain, usually because of frozen or rocky soil. Since most decomposers breath air they won't work in that environment. The debris just keeps dying and building up and decomposes at a very slow pace. In bogs like this one the water becomes very acidic (like vinegar) and a few special plants, like this sphagnum moss, grow on the wet organic soil and die over time.

"So the dead moss just stays there. It does not rot?" Asked Gina.

"Basically. It starts to rot, but it just takes a very long time. The same happens with things buried in bogs. In England they have found bodies in bogs that were thousands of years old and were very well preserved!"

"Yuck!" Said Gina cleaning her hands quickly.

"The most amazing things grow in bogs, though." Said uncle Tom. "Pretty orchids and insect eating plants, like this Northern Pitcher Plant!"

"Insect eating plants?" That excited Gina, looking closer.

"Yes! They get their nutrients from the insects because the soil is so nutrient poor."

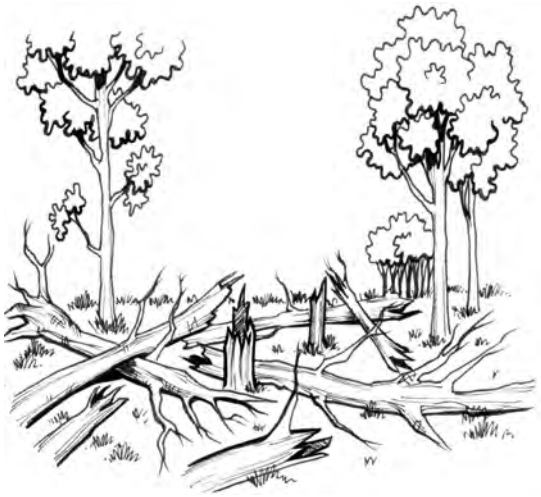
"Sweeeeeeeeet!" Now Gina was really impressed.

"Well, we should probably start heading back." said Uncle Tom swiping a mosquito from his face. "We have already given our share of blood to the mosquitoes!"

As they walked back, Gina was quiet, thinking about why the walk had started. Suddenly she said: "So now I get it! A compost box let's us do with our garbage what the forest does with its litter, so it can go back to the soil and feed the plants, right?"

"That is my girl!" said uncle Tom smiling," like magic."

Decomposition



Peat Bog

Fire

Woodpecker on a Dead Tree	Debris with No Oxygen
Water Logged Debris	Debris lit by a Match
Fast Decomposition	Earthworms eating Debris
Bacteria eating Debris	Very Slow Decomposition
Acidic Debris	Debris and Heat
Lightning struck Tree	Oxygen and Debris but no fire
Beetles in a Dead Log	Slow Decomposition

Urban Forest Fever

Objectives:
To give students an opportunity to discover the concept of urban forests and to learn about the benefits that this forest provides.

Subjects:
Science, Language Arts

Curriculum Links:
Grade 1 Science, Plants
Grade 2 Science, Plant Growth,
Grade 3 Science Plant Structures and Adaptations
Grade 4 Science. Plant Diversity

Duration:
1 hour

Setting:
Outdoors

Materials:
Oblique views of urban & natural forests
Sketch paper & pencils
Light meter (may be available from school dark room)
Wind speed indicators
Thermometers

Oddly enough, many of us live in communities with thousands of mature trees, yet we feel we live too far from a forest area to actually study such a thing. However, if one looks down from a tall building in some of the more mature areas of our communities at the height of summer, the only things you see are trees with the odd building rising above the canopy. It is very much like looking down on the canopy of a naturally wooded area.

What we have in our communities are "urban forests". This forest may be artificially created, but it is a forest none-the-less and we would find our communities a much less enjoyable place to live in if these trees weren't around. In fact, urban forests are known to provide many benefits such as:
-reducing heating costs in winter and cooling costs in summer
-providing shelter from wind
-reducing pollution levels
-providing food and shelter to birds and animals
-increasing real estate value
-providing beauty and softening of the landscape
-and even reducing crime rates

It is a very worthwhile exercise to study our urban forests so that we can better understand the advantages that they provide us with. In turn we can learn how to maintain that forest from insect, disease, and environmental threats. The following activities will help to connect students to their urban forest home.

ENGAGE

To introduce your class to the concept of urban forests, show them the oblique views of both urban and natural forests and see if they can tell which forest is which. Ask the students what clues they used to correctly determine which forest was the "urban forest". Were they surprised that the forests looked so much the same?

Once students realize that they do in fact live in a forest, ask them to brainstorm what they think might be the advantages of living in a treed environment like this. Are there also some negative things that could come from living with so many trees around? Explain that the upcoming activity will be based on determined both the advantages and disadvantages of an urban forest.

EXPLORE

To help students appreciate the impact that a mature urban forest has on our environment, have half of the class visit an open area like a school yard and the other group visit an area with mature trees to describe and document both locations. After the observations are complete, have both groups get together again to discuss their findings.

Have the students draw their location and, if they are able, include words in the margins of the drawing to describe the temperature, amount of wind, level of light and general impression of the location. Once the students have combined groups again, have them present their drawings, describing their impressions of the area they studied. Ask them which area they would rather live in and why they would feel more comfortable in that location.

EVALUATE

Ask students to prepare a "list" in pictures that compares the positive and negative aspects of living in a mature urban forest.

Resources

Hosie, R. C. Native Trees of Canda. Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. My Favourite Tree. Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. Woody Ornamentals for the Prairies. University of Alberta. Edmonton, Alberta. 1995.

EXTEND

1. Have students each chose an urban tree species to study in detail and present their findings to the class. Afterward, visit the urban forest in your community to try and identify these tree species. Note: the Focus on Forests activity called "Leaf Bingo" is a good introduction to identifying individual tree species by their leaf characteristics and would be very helpful in connecting students with the trees in your urban forests.
2. If your school yard is not well treed, consider designing and planting a "pocket park" in one corner of the yard that can grow up to be part of the urban forest. The forest could represent each of the student's favourite trees.
3. Learn more about potential insect and disease threats that could affect our urban forest such as Dutch elm disease.
4. If you are able, take the class to a high vantage point that will give them a perspective of their urban forest that is similar to the images used in the introductory activity. Ask students to do sketches or journal entries of the community from this perspective.
5. Visit your community parks department to learn more about how they keep the urban forest healthy and prospering. Find out what issues they are facing and how they are going about addressing these problems.

Shelter Me

Many animals depend on forests and trees to live. It provides them with places to live and food. The term we use for the combination of these things is "habitat". Many animals find habitat in human shaped environments. In some instances these animals are considered pests but in most cases they coexist with people quite well. In fact, many people will develop their yards to encourage certain animals, especially birds. In spring time especially the local area has many visitors but there are also year round residents as well.

ENGAGE

With your students, develop a list of animals that live in the natural environment around the school yard or community.

EXPLORE

1. Near the school, have the students observe, take pictures, or sketch the activity of earthworms after a rain shower; insects under rocks; ants around an ant hole; insects on tree trunks; birds nesting in trees or on ledges; rabbits burrowing; or squirrels in trees.

Objectives:
To give the students an opportunity to locate and observe animal homes within an urban community

Subjects:
Science, Language Arts, Math

Curriculum Links:
Grade 1 Science, Animals
Grade 2 Science, Habitats
Grade 3 Science, Animals

Duration:
One Hour

Setting:
Outdoors (schoolyard, community, or forest area)

Materials:
Camera (optional), pencil, sketch pad

Resources:

Fisher, Aileen. Animal Houses. Toronto: Thomas, Nelson and Sons, 1973

Hoberman, Mary Ann. A House is a House for Me. Richmond Hill: Scholastic-Tab Publications, 1978

2. Have them repeat their investigations in a park or wooded area. Students should search for signs of wildlife, including tracks, feathers, chewed cones, gnawed stumps, scratches or teeth marks on bark or twigs, pellets or droppings, nests, trails, runways, bedding spots, bits of hair, bones, antlers, holes, and dens.
3. Have your students compare discoveries made in the schoolyard with those made in the park or wooded area. Use the following questions as a guideline:
   - Who lives in this home?
   - Exactly where is the home located?
   - Why is the home located in this area?
   - What materials were used to construct the home?
4. Prepare a map of the school, and forested areas studied, and have the students note in what areas they observed the various types of animal homes.
5. Have the students do this activity during different seasons to see whether the homes move or are occupied throughout the year.

EXTEND

1. Graph the number and types of animals that make their homes in the school community and compare your graph to a similar one for the forest community.
2. Make a plaster cast of an animals track.
   a. Place a 5cm-high cardboard wall around the track.
   b. Pour plaster of Paris the consistency of pancake batter into the enclosed area to a depth of 2cm.
   c. When dry, gently remove the cast and clean off the surface.
   d. Cover the surface of the cast with petroleum jelly and put a new cardboard wall around the cast. Fill in the new wall to a depth of 5cm over the first cast.
   e. When dry, remove the second cast and paint it to resemble the soil in which it was found. Label it for further identification.

Forest Helpers

The forest is a dynamic environment where trees must compete for sunlight, water, and nutrients in order to survive. Fire, insects and disease play important roles in shaping this complex ecosystem.

Forest managers are responsible for harvesting, regenerating, tending and protecting the forest. Part of the job of a forest manager is to manage the forest for values other than fibre or timber. Fish and wildlife are two examples. To protect fish habitat, buffer strips of unharvested trees are left along the edges of lakes, rivers and streams. This prevents run-off from depositing silt and debris which can reduce the oxygen content of the water, and cover the bottom in silt, both of which would harm fish populations.

Trees left along a river are also important for shade, which controls water temperature and provides a food source of insects for fish.

To improve habitat for a species such as moose, the forest manager will often harvest mature trees which are too tall to be a food source. This allows new growth to be available as a food supply. The forest manager will also harvest trees in a manner that allows for a larger amount of 'edge' between the open harvested areas and the remaining trees. Wildlife managers have found that combining new growth of species like trembling aspen, with a good edge effect for cover, produces excellent habitat for moose.

Objective:
To give students an opportunity to role play events occurring in the life cycle of a forest and to understand the role of the forest manager.

Subjects:
Science, Arts Education, Physical Education

Curriculum Links:
Grade 1 Science, Plants
Grade 2 Science Plant Growth
Grade 4 Science Plant Diversity

Materials:
Newspapers; name tags for trees, insects and fire.

Duration:
30 minutes

Setting:
Indoors or outdoors

ENGAGE

1. Divide your class into five groups with approximately five students in each group.
2. Have the first group stand in a large circle with their feet apart and their arms extended to represent the boundaries of a forest area.
3. The next three groups represent three different species of trees competing to survive in this limited area. Give each student a newspaper and a tag depicting a tree species that might be found in the school area (e.g. white poplar, black poplar, white spruce, blue spruce, American elm, Manitoba maple, Russian olive, weeping birch, bur oak). Make at least one species a fast growing hardwood, like white poplar, and at least one species a slower growing softwood like white spruce.
4. The fifth group represents the forest managers, who are responsible for tending the forest.
5. Have the trees crouch down inside the forest boundary, making themselves as small as possible and hiding underneath their newspapers. Then have the fast growing trees "grow" by standing up and fully spreading their newspapers over their heads. This would represent the deciduous canopy that would shade the slower growing softwoods. The softwoods would remain crouching, (or could sit cross legged for comfort.)
6. Next, have the forest management team enter the dense forest. Under your leadership as the chief forest manager, decide which trees should remain and which trees should be cut to reduce crowding. Have one or two foresters cut the chosen trees and take them away.
7. Have the forest management team leave the room. Have the cut trees return as new seedlings on the forest floor. Have the softwoods that were crouching now grow to full height. Ask the forest management team return to the room and say what is different in the forest. Under your direction, have them thin some mature trees to make light for the seedlings. Say what use the mature trees will be put to, i.e. timber or pulp.
8. Appoint a new group as the forest management team. Have them leave the room. This time, have one of the boundary students act as "insects". Have him/her "infest" some of the adjacent "trees" by giving them "insect" tags.

9. Bring the forest management team back in. Ask them if they can see what is different. Once the infestation is identified, have them remove the infected trees.
10. Again appoint a new team and send them out. This time, have a student act as "fire" who sets fire to the nearest trees. Have the forest management team clear a "fire break" around the burning trees.
11. As a review, have the class discuss the various scenarios and the solutions used.

EXTEND

1. For older grades have the students acting as the forest managers come up with their own solutions to the challenges presented.

2. Lay a skipping rope in a meandering pattern through the forest. Ask the students what they think would happen to the water and the fish if trees were cut right up to the edge of the water. Ask what things we might be able to do to prevent this yet still allow some trees to be harvested (see diagram).

3. Discuss with the students elements that are important to moose populations (e.g. new growth – as in recently harvested areas – that can be reached for browsing, extensive forest edge so they can easily retreat into the forest.

My Plant Relations

Objectives:
Understand the importance of plants to the first people that inhabited Saskatchewan Forests.
Understand some of the traditional uses of plants by the Woods Cree.

Subjects:
Science, Social Studies, and Language Arts

Curriculum Links:
Grade 1 Science - Plants,
Grade 1 Social Studies - Heritage
Grade 2 Science Plant Growth & Foods
Grade 2 Social Studies - Heritage
Grade 3 Social Studies - Heritage
Grade 4 Science Plant Diversity
Grade 4 Social Studies - Heritage

Duration:
2 -3 class periods

Setting:
Classroom and outdoors in a forested area.

Canadian first-nations are diverse groups that speak different languages and are part of very different cultures. The Woods or Woodland Cree (Nihithawak) are Algonquian speaking and they were the main inhabitants of Saskatchewan's northern forests, but not the only ones. The forest's northern most points, close to the Northwest Territories, were inhabited by Chipewyan, which were an Athapaskan speaking group, also known by the collective name of Dene (people). Aspen Parkland areas further south often received seasonal inhabitants from the plains, who were very diverse as well.

For Saskatchewan aboriginal peoples, plants were very important, but not viewed as something separate from the rest of the environment in which they lived. In their beliefs, plants, animals and many other elements of their environment were not only connected, but also related (in the family sense of the word) to them, since they all needed each other in some level for survival.

Before Europeans arrived, Subartic groups like the Woods Cree and the Chipewyan lived in a very demanding environment. Their existence, like all other northern forest organisms, was heavily connected to the seasons and their limitations. Plants were used as part of a traditional lifestyle dependent on fishing, hunting and gathering, based on regular seasonal movements within a known landscape. As an example, we can follow the uses of plants in a year throughout different seasons.

Winter was definitely not the best season for plant gathering, so they relied on plants collected in summer and fall. Some plants, that kept their leaves in winter, were used for tea, which was sometimes important survival food. Berries that clung to their plants all winter long were also very important in times of need in winter, which happened often. Wood for fire was, of course, critical for winter survival and part of the everyday use of plants.

In spring, or the break up time, when open water was returning it was very dangerous time to travel on waterways. The ice was not safe to walk on and open water for canoe travelling was scarce. This was the time to be by a stand of birch trees. The bark of the trees could be used to fix canoes, which would be used in the near future. They could also collect sap from the birch and make syrup, which was an important source of nutrition in spring, or eat the under bark (cambium) of the trees. Some plant parts, like water parsnip roots, were collected before the plants started their spring growth while the roots were still full of winter reserves of starch. Other leafy plants were preferred in spring because of their tender young leaves.

In summer, the Woods Cree lived close to large water bodies, often travelling by water. Early in summer a lot of wood and bark were collected, since the bark separated from the wood more easily, because of running sap. Later in the season many water plants were collected either as a food source or for medicinal purposes. Forest plants, such as berries and moist area plants, such as wild mint were also collected. In summer, as a rule, most plants were collected for immediate use, but sometimes plant parts were refrigerated in bogs, or dried for winter use. Other summer collections included wood for building and stems, bark, roots and leaves for wide-ranging purposes.

During fall, some groups moved to different hunting grounds, but were still close to water. This was the season of the most intensive collection. Berries like blueberries and dryground cranberries were ripe and abundant. Roots used for medicinal purposes were also supposed to be at their best in fall and collected profusely. Other things like sphagnum mosses or and other bog plants were collected at that time and stored for assorted winter uses.

Materials:
- Copy of "Little Rainbow" story to read to students,
- Copy of plant description cards and plants pictures and English names,
- Recycled paper or cardboard.

ENGAGE

Oral Tradition was a very important aspect of traditional cultures. Like most northern aboriginal groups, the Woods Cree spent many hours telling and listening to stories during the long dark evenings in winter. Animals, plants and many other environmental elements played an important part in aboriginal culture, and this closeness is very clear in stories. People, animal, plants and supernatural beings relate to each other creating and transforming together their world. Most stories, even though often extraordinary, are embedded with some traditional knowledge. The story called "Little Rainbow" is a great example. In this very poetic story of how flowers came to the world, one can draw very important ecological connections. After all what is a rainbow? Sun shinning through water droplets, right? Isn't sun and water some of the very basic needs of plants? Isn't it with sun and water, through photosynthesis, that plants live and produce flowers?

Before reading the story to the class, you can talk about how plants were important to the Woods Cree. They lived in a world without hospitals, houses or supermarkets and plants provided many of their necessary needs. Stories often talked about the creation of the important things that were around them, including plants.

After reading the story, ask children why they think people were happy that Little Rainbow gave them flowers. Ask if they can think of important things that flowers and other plants provided to aboriginal people.

Little Rainbow

A long time ago, soon after the earth was made, a tiny Indian maiden was born. This happened during a rainstorm after which a beautiful rainbow appeared in the sky, so her parents named her "Little Rainbow."

As the maiden grew, she learned to love the rainbow. Her grandfather would take her up the hill to watch it in the sky till it disappeared. She asked many questions about it and her grandfather told her that there was once a flood on the earth. Afterwards the Great Spirit put a rainbow in the sky as a sign that there would never be a flood again. The story thrilled Little Rainbow and she wished she could see how the rainbow was made.

One day, when she was on the hill with her grandfather, Little rainbow closed her eyes. Suddenly there was thunder and a rustle of wings, and she felt herself being gently carried up into the air. She knew it was the thunderbirds taking her to the sky.

When she landed on the rainbow, she saw that it was made of all kinds of flowers. She was so delighted and dazzled by their beauty that the thunderbirds allowed her to throw some of them down to earth for her people.

So, Little Rainbow is still remembered by the Indian people as the one who brought the flowers to earth for them to enjoy.

From *Medicine Boy and Other Cree Tales* by Eleanor Brass
Story printed courtesy of the Glenbow-Alberta Institute

EXPLORE

In this activity students will try to identify some plants, shrubs and trees of Saskatchewan forest by their Cree names and their traditional uses. They can be divided in groups and together work in matching the nine descriptions and Cree names of plants with the name in English and the picture of the tree.
Once groups are finished, check answers together and discuss what they learned. Did they know that there was so much that could be done with many of the common plants around them?
Answers are 1.Athkapask – Fireweed; 2.Minahik – White Spruce; 3.Timaskik – Labrador Tea; 4. Okiniy – Prickly Rose; 5.Nipisiy – Willow; 6.Waskway – White birch; 7.Pidikomin – Bearberry; 8.Amiskowihkask – Wild mint; 9.Oskahtak – Jack Pine.

EVALUATE

Traditional Forest Walk

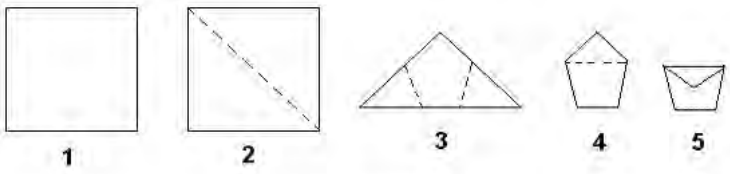
After learning about the plants and their uses, it is time to take your students to a hands-on test of what they learned. Together with you, your students can go on a forest walk to take a look at the plants and trees they have learned about. At the start, you can ask the students to pretend that they were out on a gathering walk, looking for things they could take home to eat. Check how many students recognise the trees and plants that they talked about earlier.

EXTEND

Paper 'Birch' Bark Cup

Since not everyone has access to fresh birch bark in early summer, nothing says we cannot pretend! Here is a way to learn how to make a traditional birch cup in five easy steps. Instead of bark, you can use recycled construction paper or cardboard.

1. Give each student an 8.5" x 8.5" square, and then tell him or her to decorate their paper as "birch bark". You can have a picture of some bark, or a real birch basket as an example.
2. Fold the paper in half, like the example shown in the picture.
3. Fold both sides of the triangle, one on top of the other, like shown in pic. 3
4. The cup should look like pic. 4 on the non-folded side. Fold the two triangular ends of the cup down, like shown in pic. 5
5. Your cup will look like the bottom picture!



Oskahtak
(Jack pine)

This is the main pine tree in Saskatchewan. People peeled pieces of the bark off and ate thin strips of the soft white layer under it. They also made tea from the bark as medicine for different things. The dry open pinecones were used to smoke tan hides, so they could make clothes and moccasins from it!

Pidikomin
(Bearberry)

This plant grows very low to the ground and has berries that cling to the plant all winter. They berries were fried, boiled or pounded and mixed with other things for food. People also dried the leaves for smoking.

Nipisiy
(Willow)

There are many different types of this shrub. They all like water and usually grow in clumps. They could be used for making baskets, bows and arrows and even fishnets! They were also used as medicine.

Timaskik
(Labradpr Tea)

This little shrub is very common in wet areas in forests. Its leaves are reddish-brown and fuzzy underneath. It was made into tea and used for many medicinal purposes!

Athkapask
(Fire weed)

These beautiful pink tall flowers often grow in areas that have been disturbed by fire. People used it as an important herbal remedy and sometimes ate the flowers in salads or the leaves boiled in stews.

Match these decriptions with the picture cards.

Amiskowihkask
(Wild mint)

This plant smells very nice, especially after a good rain. They like to grow near water and are quite common. People made tea from it, either fresh or dried. They also chewed the leaves to cure hiccups!

Waskway
(White birch)

This tree has a very famous black and white bark used for many things. People made canoes, baskets and shelter from it. From the tree wood they made toboggans, snowshoes, spoons and shelter poles. They also cooked the sap of the tree and made syrup with it!

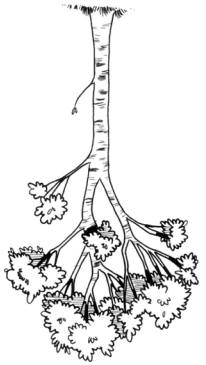
Okiniy
(Prickly rose)

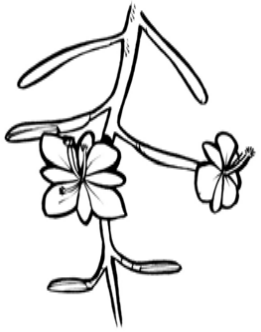
This beautiful pink flower turns into a little red fruit very rich in vitamin C. Since the fruit stays in the plant in winter, it was important winter food!

Minahik
(White spruce)

This common evergreen tree was very important for people. They used the tree roots to sew birch bark baskets, the wood for making canoe paddles and the pitch as chewing gum!

Match these picture cards with the description cards.





New Paper from Old

Objective
To give students an opportunity to make paper by hand.

Subject
Science, Visual Arts, Social Studies

Curriculum Links
Grade 3 Social Studies,Meeting Needs through Industry and Services
Grade 4 Social Studies, Resources and Industry

Duration
30 to 45 minutes
Group Size:
Small group, class

Setting
Indoors

Materials
Scrap paper, plant and vegetable scraps, non-toxic fabric dye, staples, tacks or waterproof glue, two wooden frames (approximately 20 cm x 15 cm), nylon screening, kitchen cloths (porous type), blender, sponge, iron, large plastic basin

Background Information

Paper can be made from almost anything that contains fibres: cotton, hemp, flax, or manufactured fibres. Rags were used when paper was first made in Canada during the early 1800s. Canada's first pulp and paper mill was built in Valleyfield, Quebec in 1866. Today, there are over 100 pulp and paper mills in Canada, with some located in every province except Prince Edward Island. These mills use about 60 per cent of the wood extracted from Canada's forests each year.

Two types of wood used for making paper: softwood (from pine, spruce, fir) produces strong paper; hardwood (from maple, poplar, birch) gives weaker but finer paper.

Writing paper is made up of millions of tiny fibres. These fibres originally formed the main substance of the wood. The first step in the papermaking process is to debark, grind, and /or chip logs. Next, chemicals are added and the whole mass is cooked under high steam pressure. This processing collapses the wood fibres into microscopic ribbons. The wood fibres are then dispersed in water. Fine screens lift the purified fibres, allowing the water to drain away. The purified fibres dry into sheets of paper.

ENGAGE

1. Staple nylon screening tightly to one wooden frame to make a paper "mould." The second frame without the screen is the "deckle," which will help make the edges of the paper more even.
2. Remove any plastic or staples from the scrap paper and tear it into small pieces (about 2 cm^2). Soak it in hot water for half an hour.
3. Put a handful of the soaked paper into a blender half full of warm water. Blend at moderate speed until you no longer have pieces of paper. (If you have problems, take out some of the paper.) Add small amounts of plant or vegetable scraps into this mixture (pulp) and blend again. If you want coloured paper, add fabric dye.

4. Pour the mixture into a large plastic basin half full of warm water.
5. Place the deckle on top of your screen. With both hands, dip the mould into the basin and scoop up some of the pulp. (The thickness of your paper will depend on the amount of pulp.) Gently shake the mould back and forth to get an even layer of fibres on the screen. When the water has drained through, place the mould to one side and carefully lift off the deckle, leaving the just-formed sheet on the screen
6. Lay a clean kitchen cloth on a flat table and lay the screen face down on the cloth. Soak up any extra water from the back of the screen with a sponge. Lift the screen very gently – the paper should remain on the cloth.
7. Cover the paper quickly with another cloth and iron at a medium dry setting. Once dry, pull gently on either side of the cloth to stretch it – this helps loosen the paper from the cloth. Gently peel the paper off.
8. Compare the strength, colour, and texture of homemade paper to that of the different types of paper used in the classroom. Have students point out similarities and differences.

EXTEND

1. Use the homemade paper to make personalized stationery or greeting cards with potato prints or poster paints.
2. Papermaking machines in modern factories can produce up to 48 km of paper per hour. Have your students investigate this process. Ask them to determine how it is similar to and different from making paper by hand.
3. Challenge students to create a list of all the ways they can reduce paper garbage at home and at school.

Teaching Notes

Be careful not to pour the leftover pulp down the drain. Collect it in a strainer and throw it out or freeze it in a plastic bag for the next time. This activity could be set up as an activity centre after you have done an initial demonstration. Emphasize paper recycling both at school and at home (e.g., reusing paper lunch bags and using both sides of a piece of paper.

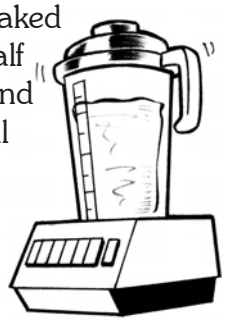
Resources

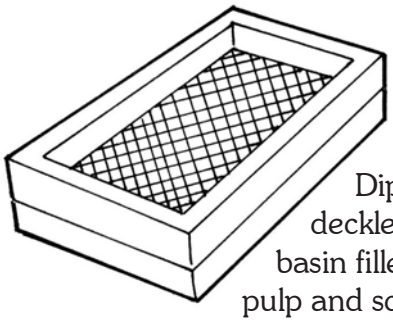
About Pulp and Paper. Canadian Pulp and Paper Association.
The Paper Chronical, LM Media Marketing,
State of Canada's Forest, The Canadian Forest Service.

How to Make Paper

Tear paper into small pieces (about 2 cm^2). Soak it in hot water for half an hour.

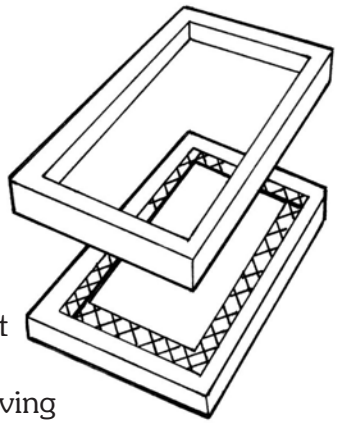
Put a handful of the soaked paper into a blender half full of warm water. Blend at moderate speed until you no longer have pieces of paper. Pour mixture in large flat bottomed basin half full of water.

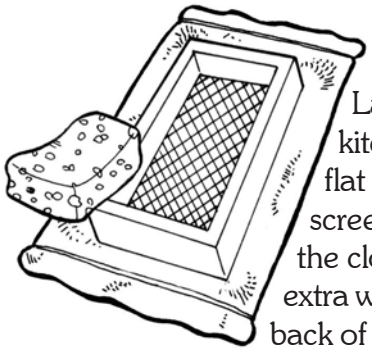




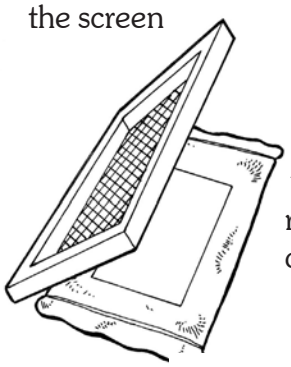
Dip the deckleinto the basin filled with pulp and scoop up some of the pulp.

When the water has drained through, place the mould to one side and carefully lift off the deckle, leaving the just-formed sheet on the screen



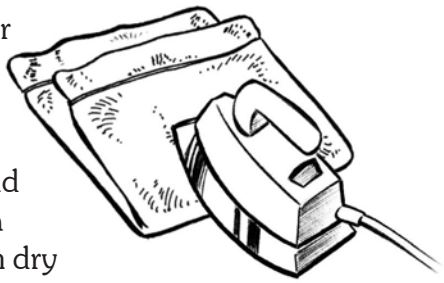


Lay a clean kitchen cloth on a flat table and lay the screen face down on the cloth. Soak up any extra water from the back of the screen with a sponge.

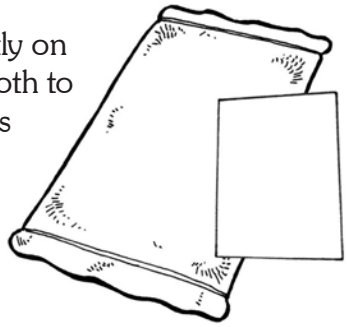


Lift the screen very gently – the paper should remain on the cloth.

Cover the paper quickly with another cloth and iron at a medium dry setting.



Once dry, pull gently on either side of the cloth to stretch it – this helps loosen the paper from the cloth. Gently peel the paper off.



FOCUS on FORESTS

Grade 5 - 8
Teacher's Guide

Terrific Tree Key

Tree keys are useful tools for identifying trees. A dichotomous key is an identification tool that presents a series of two (hence dichotomous) choices that are usually opposite traits. This type of key could be compared to a series of forks in a road that allow the user to make an accurate identification of a tree species.

We can identify trees by the features of their parts (e.g. leaves, bark, twigs, buds, flowers, and fruits) and by their shape or silhouette. For some species, a particular features stands out, e.g. the distinctive bark of a white birch. Leaves, however, are the most common feature considered when identifying a tree.

The shape of a leaf, the kind of leaf margin, the leaf type, and the arrangement of the leaves on the twig are important factors in tree identification.

Shape: Leaf blades can be long and narrow, oval, heart-shaped, spear-shaped, or circular. Poplar leaves, for example, are generally oval or circular in shape. Birch leaves are more triangular. Willow leaves are long and slender.
Leaf Margin: Leaf edges, or margins, also differ. They can be smooth, finely notched, coarsely notched or wavy. Oak leaves are lobed, while ash, poplar, and elm leaves have a toothed edge.
Leaf Type: Leaves can be simple (all one piece) or compound (divided into many separate leaflets). Birch and poplar have simple one-piece leaves. Manitoba maple and ash have compound leaves made of several leaflets.
Arrangement: On some trees, the leaves are attached alternately on the twig, Oak, poplar, and bark are three examples. On others, for example the Manitoba maple, the leaves are attached opposite each other.

Evergreen leaves can also be differentiated by shape. For example, the leaves of the jack pine are long and needle-like. Some needle-like leaves occur singly on the twig, while others occur in bunches. White spruce needles occur singly, while most pine trees have needles in clusters.

Objectives:
To observe differences in local tree species and to learn to identify these trees by these characteristics.
To produce and learn to use a dichotomous tree key.

Subjects:
Science, English

Curriculum Links:
Grade 5 Science, Plant Structure and Function
Grade 6 Science, Ecosystems
Grade 8 Science, Plant Growth

Duration:
Three to four class periods

Setting:
In natural area with mature trees (spring through fall) and in the classroom (winter).

ENGAGE

Many students may not realize that trees can be as distinct as each of their classmates. Take the class to a natural area where there are a variety of mature trees and ask the group to close their eyes and take turns describing various members of the classroom. Ask the students if there are any people in the class that look similar and if so, how can one still tell them apart? Inform them that they will be learning to tell trees apart from each other by using physical characteristics, in a similar way to how we identify our friends.

Divide the group into pairs and give each pair a blindfold. Have one student blindfold the other and then lead that person on a highly varied route (listening, smelling, and touching various things along the way) before arriving at a specific tree. Have the blindfolded student explore their tree noting how it feels, smells, and even sounds. The sighted student then leads the blindfolded student back to the starting area using another circuitous root, lets that person take off his or her blindfold, and then try to retrace the path back to their tree using the sensory clues experienced in the exercise.

When all the students have tried this out, gather at the starting point and ask students to share the clues they used to identify their tree. As the class highlights these clues mention the various names for the leaf types, leaf arrangements, leaf margins, and leaf shapes that they have observed.

Leaf Shapes


Circular

Triangular 


Oval

Leaf Margins

Toothed 


Smooth

Lobed 

Leaf Types


Simple

Compound

EXPLORE

Make a "Who is that Kid?" Key

Back in the classroom, expand on the concepts introduced in the introductory activity by explaining to the class that because trees types have differences that we can see, we can compare those differences to decide what type of tree we are looking at. As an example of doing this, prepare a dichotomous "Who is that Kid?" key on a blackboard or whiteboard to identify eight students based on what they are wearing or by their physical characteristics. Your key could look like the sample provided at the end of this lesson. There is also a blank version of the "Who is that Kid?" key to use as an overhead or hand-out.

Materials:
-blindfolds
-"Who is that Kid?" key" overhead or hand-out
-"Terrific Tree Key" overhead or hand-out
-Prepared tree keys appropriate to age group and location
-Various distinctive tree samples, e.g. bark, leaves, seeds, etc.

Make a "Terrific Tree Key"
Once students understand how a dichotomous key works, it is time to make one for the trees in your area. This can be done even if you and your students don't know the names of the species in your area. Starting in a natural area, make a "Terrific Tree Key" with your students by comparing characteristics of your tree. You may want to start with four to eight trees that are in close proximity to each other for easy comparison. As is done in the sample provided, you may want to start by looking at whether the tree has leaves (a deciduous tree) or needles (an evergreen tree) and then compare some of the following characteristics:

- if the bark peels or doesn't peel
- if the stem has thorns or not
- if the leaves are opposite or alternate
- what the leaf shape, type or margins are
- that the bark colour is
- etc.

Once you have finished inserting the contrasting activities for your key, fill in the names of the trees and shrubs you do know, try looking them up in one of the resource books listed at the end of this activity. When your "Terrific Tree Key" is complete, have the class try it out in other areas. Ask the students they think the key will work in other areas than the one it was prepared in. Can they suggest why it might not work too well in another district or region?

EVALUATE

To determine how thoroughly students have understood the concept behind the activity, provide them with sample leaves from both coniferous and deciduous (broadleaf) trees and help them work through a hands on classification.

Another way to determine how familiar the class has become with identifying tree species is to place a series of cones, leaves, or bark from distinctive trees around the classroom to see how many of these "Tree Clues" the class can identify.

EXTEND

Tree Buddies

Ask students to choose one of the trees that they looked at as part of the tree key activity and do some research on the life history of that tree. They can draw and or write a story about the tree as though it was one of their friends or "buddies" and then present the information to the class.

Shrub Key

For some added challenge, work with the class to develop a dichotomous shrub key for the area in which they live. As there are quite a number of woody shrubs in any given area, this could be an interesting and challenging venture.

Resources:

Guide to Forest Understory Vegetation in Saskatchewan – Technical Bulletin No 9. Saskatchewan Tourism and Renewable Resources. Regina, Saskatchewan. 1980.

Hosie, R.C. *Native Trees of Canada.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Johnson, D, L. Kershaw, A. MacKinnon, and J. Pojar. *Plants of the Western Boreal Forest & Aspen Parkland.* Lone Pine Publishing. Edmonton, Alberta. 1995.

Vance, F.R., J.R. Jowsey, and J.S. McLean. *Wildflowers Across the Prairies.* Western Producer Prairie Books. Saskatoon, Saskatchewan. 1984.

Who is that Kid Sample Key

Start Here

Is wearing jeans

- Wears glasses
  - Has blonde hair — Susan
  - Has brown hair — Paul
- Does not wear glasses
  - Has short hair — John
  - Has long hair — Martha

Is not wearing jeans

- Is wearing runners
  - Has blue eyes — Samantha
  - Has brown eyes — Raymond
- Is not wearing runners
  - Has Freckles — Kelly
  - Has no Freckles — Mark

Terrific Tree Sample Key

Start Here

Tree has Broadleaves

- Bark peels
  - Bark is white — Paper Birch
  - Bark is reddish — River Birch
- Smooth Bark
  - Bark has green tinge — Trembling Aspen
  - Bark is silvery — Balsam Poplar

Tree has Needleleaves

- Needles attached singly to branch
  - Needles pointed — White Spruce
  - Needles blunt — Black Spruce
- Needles attached to branch in clusters
  - Needles in pairs — Jack Pine
  - Needles in clusters — Tamarack

Who is that Kid Key

Start

Terrific Tree Key

Tree Home Habitats

Objectives:
To give students an opportunity to become familiar with the basic requirements for growth and survival of various tree species.

Subjects:
Science, Language Arts, Visual Arts, Phys Ed.

Curriculum Links:
Grade 5 Science, Plant Structures and Function
Grade 6 Science, Ecosystems

Duration:
One class period to several weeks with extensions

Setting:
Preferably in natural area with trees or in large open area like school-yard or gymnasium

Each tree species has its own particular requirements for light, water and soil type. For this reason we tend to see that tree species will grow and prosper in the areas that have the conditions best suited for that species, i.e. in the habitat that the tree prefers. A summary of preferred habitats for some common Saskatchewan tree species is as follows:

-**Trembling aspen** (***Populus tremuloides***): this tree species prefers well-drained soils and typically thrives in sunny areas. This tree reproduces from underground suckers and will therefore quickly grow back in aspen containing areas that that have been logged or burned. Aspen stands are often replaced by other shade tolerant species that start to grow under the canopy of an aspen stand.

-Balsam poplar (***Populus balsamifera***): this tree species tends to grow in moister areas with richer soils than trembling aspen. This species also grows well in full sun and can reproduce from underground suckers.

White spruce (*Picea glauca*): this tree species does well in well-drained soils, however as the tree is somewhat shade tolerant, it will tend to grow in under a stand of trembling aspen. This tree produces seed annually in cones that will open from fall through spring allowing the winged seed to spin down to the ground, perhaps traveling for some distance on windy days.

Black spruce (*Picea mariana*): this tree species is usually found in low, marshy or boggy areas that have poorly drained, moist soils. In these challenging conditions the trees are often very slow growing and because they are somewhat protected from fire, black spruce stands can be quite old. This tree can also reproduce by "layering" where a low hanging branch that comes in contact with the ground will sprout roots and grow into another tree.

Manitoba Maple (*Acer negundo*): This tree is usually found on lakeshores and along stream banks that are seasonally flooded. It will often colonize disturbed sites. It is shade intolerant and prefers lots of sunlight.

Jack pine (*Pinus banksiana*): this tree species tends to grow on very dry, sandy soils in full sun and for this reason often appears in pure stands as not many other trees species thrive in this type of habitat. Jack pine also tends to appear in pure stands of equal aged trees because the sealed cones that the tree produces tend to only open when exposed to the heat of a fire. When a fire passes through an area, many of the jack pine cones open starting a whole new stand of trees that will be the same age.

White birch (*Betula papyrifera*): this tree species tends to grow in sunny areas with well drained, sandy or silty soils. As this tree has high water requirements, it is often found in wet spring areas in the south part of the province. The tree does produce a lot of seed, however it will also sprout from its roots when the main trunk is damaged by fire.

Tamarack (*Larix laricina*): the tree species is usually found in very wet, marshy areas in the full sun. In these areas, tamaracks tend to be very small, however in more well-drained soils the tree can grow to be quite large. However, as this tree species does not tend to compete well with other species being intolerant of shade, it is often found in the less favourable open bog areas.

Materials:

-tree requirement pockets on strings (fold a sheet of card stock and staple to make a pocket, pasting the tree requirements to the front of the card – attach strings)
-element cards (reproduce the number you require from the samples attached)
-tree threat cards (reproduce from the samples attached)

ENGAGE

Begin the activity by describing the "habitat" of one of the students in the classroom, e.g. the type of area they live in, their favourite food and drink, etc. Ask the students to guess who is being described. When they guess correctly explain that these characteristics describe the habitat or preferred living conditions of this student. Trees in the forest also live in habitats with specific characteristics that students can learn about in the next activity.

EXPLORE

Place students randomly in a natural area or other large open space to represent various trees in the forest (the number of trees you use will depend on the number of students in your class). Hang the prepared "tree pockets" around the necks of each of the "trees" indicating which tree they represent. Explain that each tree prefers a certain combination of soil (explain the various soil types), sunlight, and moisture in order to grow and prosper as listed on the pockets. Hand out element cards to the remaining students and explain that the cards represent elements that the trees need to survive. Explain that the objective of the game is for the students with element cards to find a tree that needs their card by matching the symbols or words. When they find a tree that needs them they should put their card in the envelope and join hands with the tree or other elements. If one tree has all of its requirements the elements must look elsewhere for a home. The trees meanwhile try to attract the elements they need until all of the trees have found their requirements.

At the end of the activity review the requirements of each type of tree and see which trees have similar needs and which ones have different needs. Add any additional information you might have about each of the tree species. . If you did not have enough students to include all of the tree species, play the game again using a different combination of trees. For a variation, play the game again with a drought (take away some of the water cards) and see which trees survive and which ones don't because of a lack of water.

Once the students have a grasp of the game add to the complexity by removing some of the elements required and replacing them with "Tree Threats" that can be an issue in the forest using the cards provided. Explain that the "threats" must be a problem for the tree they attack (e.g. spruce budworm) unless it is a general problem, e.g. forest fire. Speculate on which trees will survive and which trees will die depending on the impact of these changes. Are there some changes that might actually favour certain species, e.g. spruce budworm attacks will favour balsam fir while forest fires will encourage jack pine and white birch.

EVALUATE

Ask younger students to draw the symbols for the elements required beside each of the tree species they discovered while doing the activity above. Ask older students to match the tree species with its habitat type. This can also include the "tree threats" used in the grade four to six version. After their participating in the activity students should do quite well at this quiz.

EXTEND

1. Take a field trip to a natural area to see if the trees studied in the activity actually grow in the habitats presented in the activity.
2. Have younger students create a poster that shows their favourite tree species growing in the habitat that it is supposed to prefer. Older students can do further research on the characteristics of these tree species and write a short report on the tree species that they find the most interesting.
3. As a class, work out a planting plan for part of the schoolyard that currently has no trees. This plan should be based on the conditions in the part of the yard being planted and will likely involve some research on the requirements of some of the more horticultural varieties of trees that might be available for an urban environment.

Resources:

Hosie, R. C. *Native Trees of Canda.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. *My Favourite Tree.* Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. *Woody Ornamentals for the Prairies.* University of Alberta. Edmonton, Alberta. 1995.

Trembling Aspen

Well Drained Soil

Two Water

Three Sun

Balsam Poplar

Rich Soil

Three Water

Two Sun

White Spruce

Well Drained Soil

Two Water

Two Sun

Black Spruce

Poorly Drained Soil

Three Water

Three Sun

Manitoba Maple

Rich Soil

Two Water

Three Sun

Jack Pine

Sandy Soil

One Water

Three Sun

White Birch

Well Drained Soil

Two Water

Two Sun

Tamarack

Poorly Drained Soil

Three Water

Three Sun

Forest Fire
(helps Jack Pine and White Birch)

Spruce Budworm
(can kill White Spruce)

Forest Tent Caterpillar
(Can affect poplar and aspen)

Fungus
(mainly affects deciduous trees)

Dwarf Mistletoe
(Will stunt pine trees)

Larch Sawfly
(will damage Tamarack)

Beaver
(can affect poplar and aspen)

Gypsy Moth
(will damage all trees)

Well Drained Soil	Well Drained Soil
Well Drained Soil	Rich Soil
Rich Soil	Poorly Drained Soil
Poorly Drained Soil	Sandy Soil
Water	Water
Water	Water
Water	Water
Water	Water
Water	Water
Water	Water
Water	Water
Water	Water

Water	Water
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	Sun
Sun	

Growing Green

All green plants require sunlight in order to live. The sun provides the energy with which plants manufacture their own food (a type of sugar in the form of starch) from the carbon dioxide in the air and water. This process takes place in the chlorophyll of the plant and is called photosynthesis. Chlorophyll gives leaves their distinctive green colour.

Plants manufacture starch as a means of storing sugar. A starch molecule is composed of a long chain of sugar molecules. A simple test for starch consists of placing a few drops of diluted household iodine on some food with a medicine dropper. If starch is present, the iodine changes from a reddish-brown to a blue-black colour. Remember that iodine is poisonous and it should never be ingested.

Objectives:
To give students the opportunity to discover the elements that green plants require to produce food.

Subjects:
Science, Language Arts, Math

Curriculum Links:
Grade 5 Science, Plant Structure and Function
Grade 6 Science, Ecosystems
Grade 7 Science, The Basics of Life
Grade 8 Science, Plant Growth

Duration:
Several days to a month with extensions to lesson

Setting:
In classroom (providing a window with strong sunlight is available)

ENGAGE

In order to introduce students to the elements that green plants need in order to prosper present them with the "Dr. Black Thumb's Hall of Horticultural Horror" which consists of several potted plants that were grown under various obviously unhealthy conditions namely:

- a plant grown in the darkness
- a plant grown with very little water
- a plant grown in a sealed container with little or no fresh air

Ask students to guess what important element has been missed in the care of the plants presented above. Explain that it is the sun's energy, combined with water and carbon dioxide from the air that allows the chlorophyll of the plant to produce the food that it needs to live and prosper. Tell students that the upcoming experiment will prove that light is the "invisible ingredient" needed in this formula for food production in green plants.

EXPLORE

Have students perform the following experiment to show that green plants require light to manufacture food:

1. Take a broad-leafed green plant, such as a geranium, some aluminum foil, a saucer, ethyl alcohol, paper clips, diluted iodine and a medicine dropper.
2. Cut a strip of aluminum foil (1-2 cm wide) to fit across the upper surface of one of the plant's leaves. The foil should stretch across the leaf and be clipped at both ends with paper clips.
3. Place the plant in a very sunny location for a few days. Then remove the leaf that has been covered with foil. Take off the foil and place it in a saucer and cover it with ethyl alcohol for a few hours to remove some of the chlorophyll.
4. Place drops of iodine on food items that are sure to contain starch (e.g. a potato) and on food items that likely do not contain starch (e.g. cheese). Observe how the iodine reacts on each of these foods to determine what colour signifies the presence of starch.
5. Remove the leaf from the alcohol solution and place a few drops of iodine on the area previously covered by the foil strip and on the area not covered by the foil strip.
6. Note which areas lack starch and let students speculate on why there was no starch produced in the area that was covered by the foil.

Materials:

-potted plants that have been grown under various specific conditions
-a broad-leaved green plant
-aluminum foil strips (1-2 cm wide)
-saucer
-ethyl alcohol
-diluted iodine
-paper clips
-medicine dropper

EVALUATE

For younger students hand out recipe cards and ask students to write a recipe of "growing green". For older students, ask them to prepare an "equation" for the elements needed for plants to "grow green".

Resources:

Hickman, Pamela. The Kids Canadian Tree Book. Kids Can Press Ltd. Toronto, Ontario. 1995.

Suzuki, David. Looking at Plants. Stoddart Publishing Co. Ltd. Toronto, Ontario, 1985.

EXTEND

1. Ask students to evaluate the condition of the green plants in their own homes or in a friend's home, e.g. are they getting enough water and water or do the plants seem to be lacking something. If the plants they view are not prospering, ask students to recommend some options for better plant care. The one factor worth mentioning is the type of soil in which the plant is growing and how often the plant is fertilized.

2. Experiment by growing bean seedlings under various conditions to determine the optimum combination of light, water and soil required by the plant. To do this bean seedlings should be started and grown for a month under conditions that combine each of the following scenarios (you will be producing 27 individual plants). Make sure to label the containers:

1. full sunlight/moderate sunlight/limited sunlight
2. daily watering/biweekly watering/weekly watering
3. potting soil/school yard dirt/sand

Seedlings would be measured at the end of the experiment to determine the conditions under which the seedling grew the tallest and healthiest. Please note that the tallest seedling isn't necessarily the most healthy as plants will produce elongated, spindly growth under poor light conditions. Stalk diameter, colour and root production should also be considered when determining health. Students can graph the results for comparison.

Tree Rummy

The more we find out about trees, the more terrific they become. Included below is some terrific tree "true or false" trivia (from the book *Native Trees of Canada*) that showcases fascinating facts about our main Saskatchewan tree species.

White Spruce
- likes to grow where it is somewhat shady (true)
- has a shallow root system and can blow over quite easily (true)
- can be found growing almost everywhere in Canada (true)
- is a common tree on the prairies (false – it is more a tree of the Boreal forest region)
- is one of the most important sources of pulpwood and lumber in Canada (true)
- needles are round in cross-section (false – they are square)
- cones can open from fall through to spring (true)
- roots where used by aboriginal Canadians to lace birch bark on canoes (true)
- needles make a nice tea (false – other spruce needles do, but the needles of white spruce are too aromatic to make a tasty tea)
- is an important tree for producing lumber and pulp (true)

Black Spruce
- tend to have club-shaped top (true)
- can grow new trees from where its branches touch the ground (true)
- gets its name from its black needles (false – black spruce does look dark, but its needles are bluish-green)
- tends to grow in mossy bogs (true)
- tends to have up-turned branch tips (true)
- cones are long and pointy (false – they are actually quite small and egg-shaped)
- cones release seeds slowly throughout the whole winter (true)
- seed is nearly black (true)
- has long fibers in its wood that makes it ideal for the pulp industry (true)
- has thick, shaggy bark (false – mature trees have thin, scaly bark)

Objectives:
To give students an opportunity to review and reinforce the characteristics of the major tree species found in Saskatchewan.

Subjects:
Science, Language Arts, Math

Curriculum Links:
Grade 5 Science, Plant Structure and Function, Grade 6 Science, Ecosystems, Grade 7 Science, Renewable Resources in Saskatchewan, Grade 8 Science, Plant Growth

Duration:
15-30 Minutes for Introductory Lesson with the main activity as a learning station.

Setting:
Indoors

Jack Pine
- can grow to be tall and cone-shaped to short and twisted (true)
- can cross breed with Lodgepole Pine to form a hybrid pine (true)
- needles are in clusters of five (false – they are in clusters of two)
- cones are usually straight (false – they are usually curved inwards)
- cones are sealed with a resin that usually requires the heat of a forest fire to open (true)
- wood is used for general purpose lumber and for pulp (true)
- male flower clusters can be boiled to remove resin and be eaten (true)
- was considered a lucky tree by early settlers (false – it was actually considered an evil tree, likely because crops tended to fail on the poor soil that these trees tend to grow in)

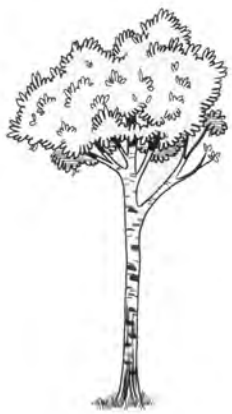
Trembling Aspen
- will grow from the wide spreading root system of a parent tree especially if an area is disturbed by fire or logging (true)
- likes growing in the shade (false – it actually is very intolerant of shade and grows best in full sun)
- is often called a "nurse" tree because other trees will grow in under the shade of an aspen stand (true)
- produces lots of fluffy, white seed that can float in the air or water for great distances (true)
- leaves are round with a short, sharp tip (true)
- leaves have round stems (false – their stems are flat, which is the reason the leaves "tremble" in the wind)
- bark is pale green to almost white when the tree is younger (true)
- is not used in the forest industry because the wood is too soft (false – aspen is mainly used for pulpwood and occasionally for lumber)
- inner bark was used for pain killer by early settlers (true)

White Birch
- grows best in well-drained sandy or silty soils (true)
- grows best in full sun and therefore thrives in burned-over or cut-over areas (true)
- is easily killed by fire, but will sprout from the base of the trunk (true)

White Spruce

Black Spruce

Jack Pine



Trembling Aspen

White Birch

Tamarack

- has round, smooth edged leaves (false – it has triangular or egg-shaped leaves with teeth along the edges)
- produces long worm-like bunches of seeds (true)
- twigs are a pale white colour (false – they are reddish-brown in colour)
- bark is reddish- brown on young trees, becoming white and peeling on older trees (true)
- produces a very soft wood (false – it produces a very hard wood that is often used in the furniture industry)

Balsam Fir

- tends to look like a church steeple in shape (true)
- tends to grow up under a canopy of aspen trees (false – balsam fir is very shade tolerant and tends to grow up under canopies of spruce)
- seedings are the only trees that can grow under the dense shade of a balsam fir canopy (true)
- tends to grow into pure stands where spruce budworm has killed the spruce (true)
- needles are flat and feel soft to the touch (true)
- bark is very rough in young trees (false – the bark of young trees is relatively smooth with many sap containing bubbles)
- produces soft, weak wood (true)
- is commonly cut and sold as a Christmas tree (true)

Tamarack

- is a tree of cold, wet, poorly drained soils (true)
- needs full sun to grow well (true)
- needles are light green and turn golden-yellow in fall (true)
- needles grow in clusters of 10 – 20 on dwarf twigs (true)
- needles are shed every fall (true)
- twigs are slender and brownish-orange in colour (true)
- tends to grow with a very straight grain (false – it actually grows with a spiral grain)
- wood is very strong and is used for everything from railway ties to fence posts (true)
- roots were once used to join ship ribs to the deck timbers (true)

Balsam Poplar
- does best on well-drained soils (true)
- Compund leaves with leaf arrangement opposite (true)
- roots form new trees by 'suckering' (false)
- drought tolerant and winter hardy (true)
- balsam poplars grow in the farthest north of any of North America's hardwoods (true)
- each banch usually curves upward(true)
- fast growing trees often used as wind breaks on the prairies (true)
- male and female flowers are found on the same tree (false)
- leaves are dark shiny green above and whitish green below(true)

Balsam Poplar

Balsam Fir

ENGAGE

As a means of reviewing characteristics of the various tree species found in Saskatchewan present the Terrific Tree "True or False" Trivia included in the background information section. This trivia highlights interesting information about these trees and as some of the trivia is incorrect ask students if they think the trivia is "true or false" as you read each statement. For younger classrooms you may wish to use only a few of the trivia facts, however you may wish to review them all with older grades. Older students can also be divided into smaller groups and then given the trivia from each species on separate cards that they take turns quizzing each other with. The information presented in the trivia forms the basis for playing the "terrific tree rummy" card game outlined in the next section.

Materials:
- Terrific Tree "True or False" Trivia
- Terrific Tree Rummy cards copied onto heavy card and cut out

EXPLORE

Have two to four students work in a small group using the "Terrific Tree Rummy" cards as a learning station based on the following rules:

1. Players each start with seven cards drawn at random from the overturned deck of cards.
2. The remaining cards are gathered into a pile and players then take turns drawing a card from the overturned pile aiming to assemble a run of three or more of a certain tree species (similar to how standard rummy is played).
3. A player draws a card and reads the clue for the player next to him. If the tree species is correctly identified the player who answered gets to keep the card and discard another.

Resources:

Hickman, Pamela. *The Kids Canadian Tree Book.* Kids Can Press Ltd., Toronto, Ontario. 1995.

Hole, Lois. *Favorite Trees & Shrubs.* Lone Pine Publishing. Edmonton, Alberta. 1997.

Hosie, R. C. *Native Trees of Canda.* Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. *My Favourite Tree.* Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. *Woody Ornamentals for the Prairies.* University of Alberta. Edmonton, Alberta. 1995.

4. Before discarding, the player can also lay down any run of three or more cards of a given species.
5. When no more drawing cards are left the player with the most runs layed down wins.
6. Once a run of cards has been laid down, other players can add to the run with one or more or that same species when it is their turn to play.
7. The first player to lay down all of his/her cards (including discarding a final card) wins the game.
8. Should all the cards in the overturned pile be drawn, the discard pile can be turned over to continue the game.

EVALUATE

Use the Terrific Tree Rummy cards as a quiz, taking turns asking students the questions on the cards to see how many of the facts they can remember. The stories written under the extension section could also be assigned as an evaluative exercise to see what students remember about a specific tree species.

EXTEND

1. Ask students to write a "Terrific Tree Tale" based on the tree species that they found the most interesting. They might also want to do some further research about this tree species to add further detail to their story. Make sure the stories are either presented to the class or provided as a binder for further reading so that all students can take advantage of the information compiled.
2. Have students write and illustrate a comic strip that includes a "Terrific Tree" as a super hero in the story. These stories could even be developed into a great play for performance to the rest of the school.
3. Research the "Terrific Trees" of our urban forests, by looking at some of the tree species found in our urban parks, yards and streets.

White Spruce

- likes to grow where it is somewhat shady (true)
- has a shallow root system and can blow over quite easily (true)
- can be found growing almost everywhere in Canada (true)
- is a common tree on the prairies (false – it is more a tree of the Boreal forest region)
- is one of the most important sources of pulpwood and lumber in Canada (true)
- needles are round in cross-section (false – they are square)
- cones can open from fall through to spring (true)
- roots where used by aboriginal Canadians to lace birch bark on canoes (true)
- needles make a nice tea (false – other spruce needles do, but the needles of white spruce are too aromatic to make a tasty tea)
- is an important tree for producing lumber and pulp (true)

Black Spruce

- tend to have club-shaped top (true)
- can grow new trees from where its branches touch the ground (true)
- gets its name from its black needles (false – black spruce does look dark, but its needles are bluish-green)
- tends to grow in mossy bogs (true)
- tends to have up-turned branch tips (true)
- cones are long and pointy (false – they are actually quite small and egg-shaped)
- cones release seeds slowly throughout the whole winter (true)
- seed is nearly black (true)
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- has thick, shaggy bark (false – mature trees have thin, scaly bark)

Jack Pine

- can grow to be tall and cone-shaped to short and twisted (true)
- can cross breed with Lodgepole Pine to form a hybrid pine (true)
- needles are in clusters of five (false – they are in clusters of two)
- cones are usually straight (false – they are usually curved inwards)
- cones are sealed with a resin that usually requires the heat of a forest fire to open (true)
- wood is used for general purpose lumber and for pulp (true)
- male flower clusters can be boiled to remove resin and be eaten (true)
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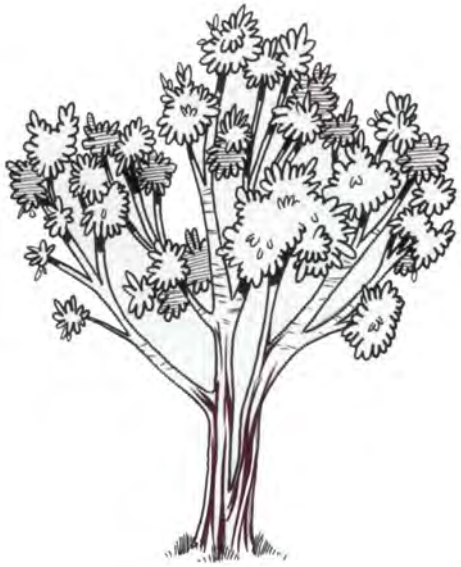
Balsam Fir

- tends to look like a church steeple in shape (true)
- tends to grow up under a canopy of aspen trees (false – balsam fir is very shade tolerant and tends to grow up under canopies of spruce)
- seedings are the only trees that can grow under the dense shade of a balsam fir canopy (true)
- tends to grow into pure stands where spruce budworm has killed the spruce (true)
- needles are flat and feel soft to the touch (true)
- bark is very rough in young trees (false – the bark of young trees is relatively smooth with many sap containing bubbles)
- produces soft, weak wood (true)
- is commonly cut and sold as a Christmas tree (true)

Black Spruce

White



Balsam poplar

Jack pine

White Birch

- grows best in well-drained sandy or silty soils (true)
- grows best in full sun and therefore thrives in burned-over or cut-over areas (true)
- is easily killed by fire, but will sprout from the base of the trunk (true)
- has round, smooth edged leaves (false – it has triangular or egg-shaped leaves with teeth along the edges)
- produces long worm-like bunches of seeds (true)
- twigs are a pale white colour (false – they are reddish-brown in colour)
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Tamarack

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- needs full sun to grow well (true)
- needles are light green and turn golden-yellow in fall (true)
- needles grow in clusters of 10 – 20 on dwarf twigs (true)
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- wood is very strong and is used for everything from railway ties to fence posts (true)
- roots were once used to join ship ribs to the deck timbers (true)

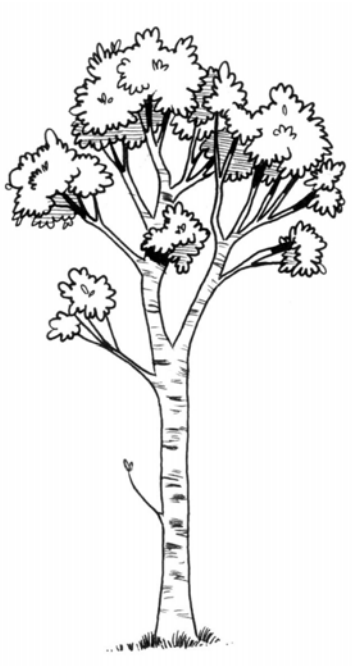
Trembling Aspen

- will grow from the wide spreading root system of a parent tree especially if an area is disturbed by fire or logging (true)
- likes growing in the shade (false – it actually is very intolerant of shade and grows best in full sun)
- is often called a "nurse" tree because other trees will grow in under the shade of an aspen stand (true)
- produces lots of fluffy, white seed that can float in the air or water for great distances (true)
- leaves are round with a short, sharp tip (true)
- leaves have round stems (false – their stems are flat, which is the reason the leaves "tremble" in the wind)
- bark is pale green to almost white when the tree is younger (true)
- is not used in the forest industry because the wood is too soft (false – aspen is mainly used for pulpwood and occasionally for lumber)
- inner bark was used for pain killer by early settlers (true)

Balsam Poplar

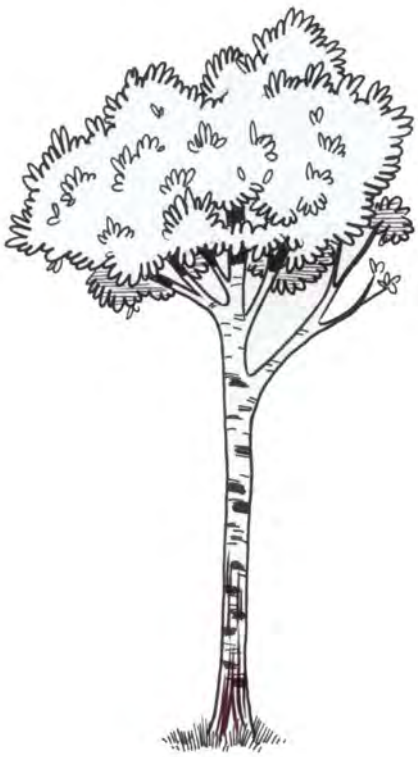
- does best on well-drained soils (true)
- compound leaves with leaf arrangement opposite (true)
- roots form new trees by 'suckering' (false)
- drought tolerant and witer hardy (true)
- balsam poplars grow the farthest north of any of North America's hardwoods (true)
- each branch usually curves upward (true)
- fast growing trees often used as wind breaks on the prairies (true)
- male and female flowers are found on the same tree (false)
- leaves are dark shiny green above and whitish green below (true)

Tamarack



White birch

Balsam fir



Trembling Aspen (white poplar)

White Spruce

The cones usually drop during winter after opening and losing their seeds in fall.

White Spruce

White Spruce

This tree has needles that are square in cross-section.

White Spruce

White Spruce

This tree can be found growing almost everywhere in Canada.

White Spruce

White Spruce

This tree likes to grow where it is somewhat shady.

White Spruce

Black Spruce

This tree tends to have club-shaped top.

Black Spruce

White Spruce

This tree has roots that where used by aboriginal Canadians to lace birch bark on canoes.

White Spruce

White Spruce

This tree is one of the most important pulpwood and lumber trees in Canada.

White Spruce

White Spruce

This tree has a shallow root system and can blow over quite easily.

White Spruce

Trembling Aspen

This tree has leaves with flat stems that tremble in wind.

Trembling Aspen

Black Spruce

This tree tends to have up-turned branch tips.

Black Spruce

Black Spruce

This tree tends to grow in mossy bogs.

Black Spruce

Black Spruce

This tree can grow new trees from where its branches touch the ground.

Black Spruce

Trembling Aspen

This tree produces lots of fluffy, white seeds.

Trembling Aspen

Black Spruce

This tree has long fibers in its wood that makes it ideal for the pulp industry.

Black Spruce

Black Spruce

This tree has small, egg-shaped cones.

Black Spruce

Black Spruce

This tree has seed that is nearly black.

Black Spruce

Jack Pine

This tree can cross breed with Lodepole Pine to form a hybrid pine.

Jack Pine

Trembling Aspen

This tree is often called a “nurse” tree because other trees will grow under its shade.

Trembling Aspen

Trembling Aspen

This tree has inner bark that was used for pain killer by early settlers.

Trembling Aspen

Trembling Aspen

This tree has bark that is pale green to almost white when the tree is younger.

Trembling Aspen

Jack Pine

This tree can grow to be tall and cone-shaped or short and twisted.

Jack Pine

Jack Pine

This tree has needles in clusters of two.

Jack Pine

Trembling Aspen

This tree will grow from the wide spreading root system of a parent tree.

Trembling Aspen

Trembling Aspen

This tree has leaves that are round with a short sharp tip.

Trembling Aspen

Tamarack

This tree has needles that grow in clusters of 10 – 20 on dwarf twigs.

Tamarack

Tamarack

This tree grows in cold, wet, poorly drained soils.

Tamarack

Jack Pine

This tree was considered an evil tree by early settlers.

Jack Pine

Jack Pine

This tree generally has curved cones.

Jack Pine

Tamarack

This tree sheds its needles every fall.

Tamarack

Tamarack

This tree has light green needles that turn golden-yellow in fall.

Tamarack

Jack Pine

This tree has male flowers that can be boiled to remove their resin and then eaten .

Jack Pine

Jack Pine

This tree has cones that are sealed with a resin.

Jack Pine

White Birch

This tree produces long worm-like bunches of seeds.

White Birch

White Birch

This tree is easily killed by fire, but will sprout from the base of the trunk.

White Birch

Tamarack

This tree has strong roots that ship-builders used to join ship ribs to deck timbers.

Tamarack

Tamarack

This tree has slender, brownish-orange twigs.

Tamarack

White Birch

This tree has reddish-brown twigs.

White Birch

White Birch

This tree has triangular or egg-shaped leaves with teeth along the edges.

White Birch

White Birch

This tree grows best in full sun and thrives in burned-over or cut-over areas.

White Birch

Tamarack

This tree tends to grow with a very spiral grain.

Tamarack

Balsam Fir

This tree has smooth bark when young with many sap containing bubbles.

Balsam Fir

Balsam Fir

This tree tends to grow into pure stands where spruce budworm has killed the spruce.

Balsam Fir

Balsam Fir

This tree tends to grow up under a canopy of spruce.

Balsam Fir

White Birch

This tree has reddish- brown bark on young trees and white, peeling bark on older trees.

White Birch

Balsam Fir

This tree produces soft, weak wood.

Balsam Fir

Balsam Fir

This tree has flat, soft needles.

Balsam Fir

Balsam Fir

This tree has the only seedings that can grow under the dense shade of a balsam fir stand.

Balsam Fir

White Birch

This tree produces a hard wood that is used for making furniture.

White Birch

Balsam Poplar

This tree does best on well-drained soils.

Balsam Poplar

Balsam Poplar

This tree has compound leaves with leaf arrangement opposite.

Balsam Poplar

Balsam Poplar

This trees bark is greenish-brown when young, becoming grey as it ages.

Balsam Poplar

Balsam Fir

This tree is commonly cut and sold as a Christmas tree.

Balsam Fir

Balsam Poplar

This tree is drought tolerant and winter hardy.

Balsam Poplar

Balsam Poplar

This tree is a hardwood that grows the furthest north of any hardwoods in North America.

Balsam Poplar

Balsam Poplar

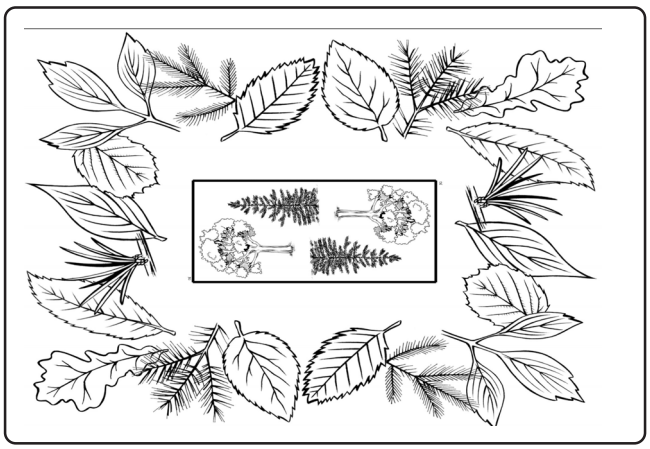
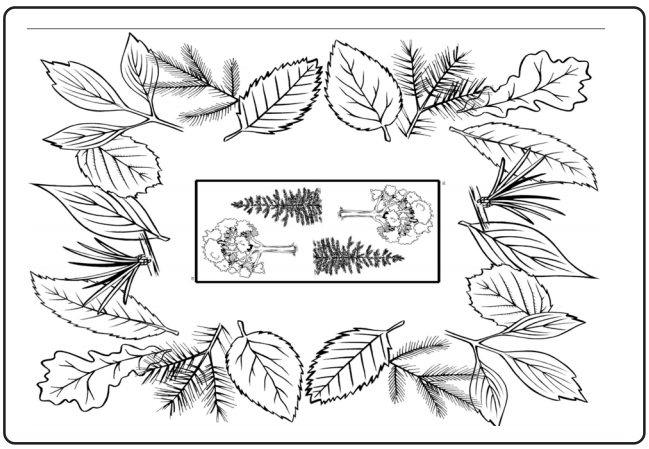
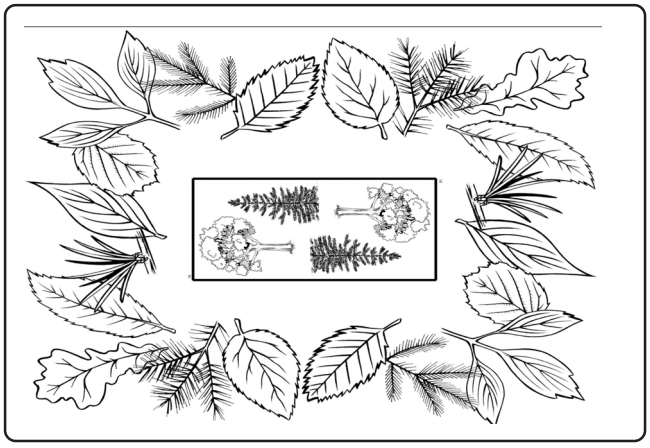
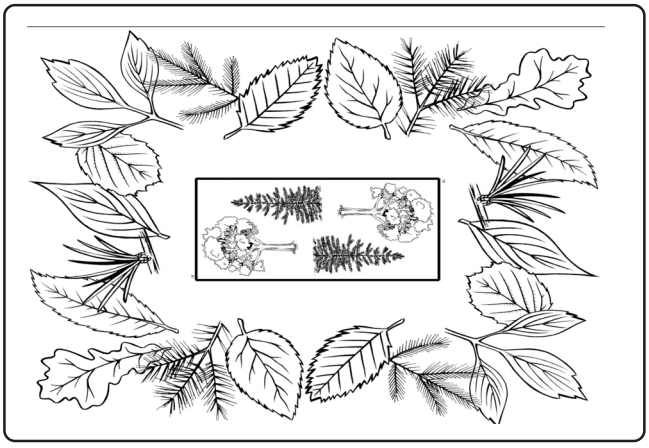
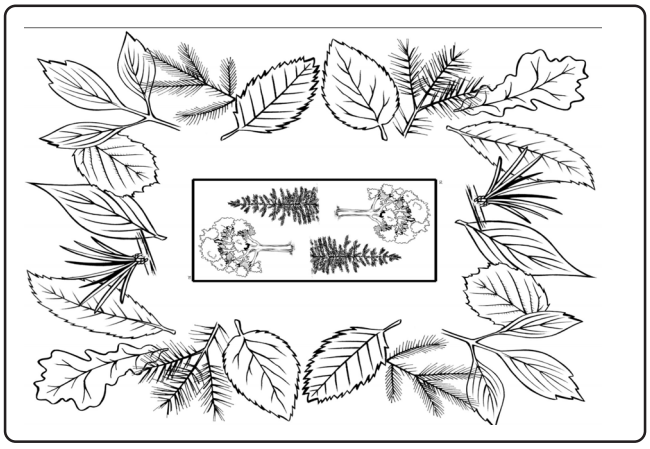
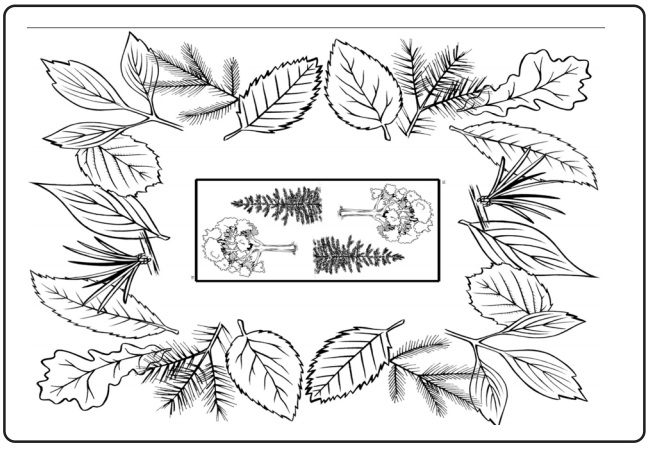
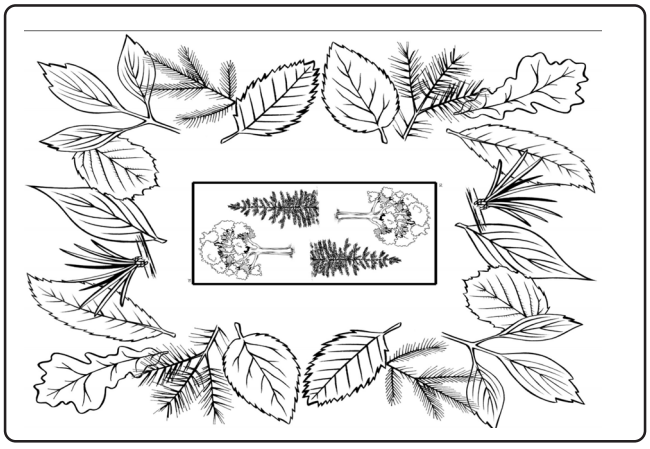
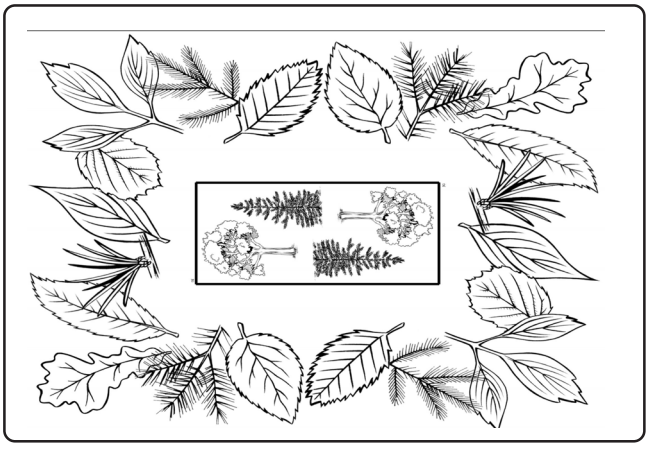
This trees branches usually curve upwards.

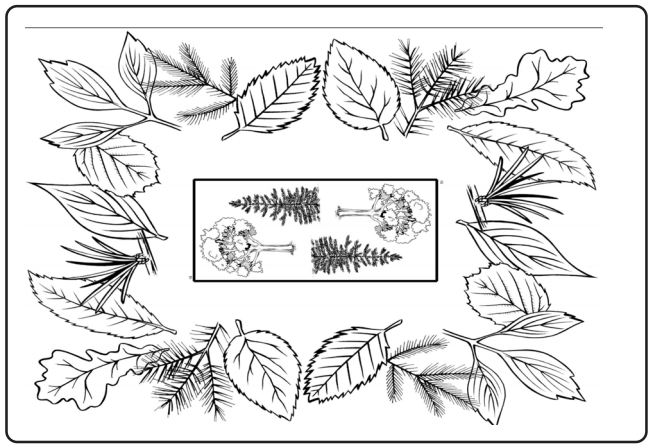
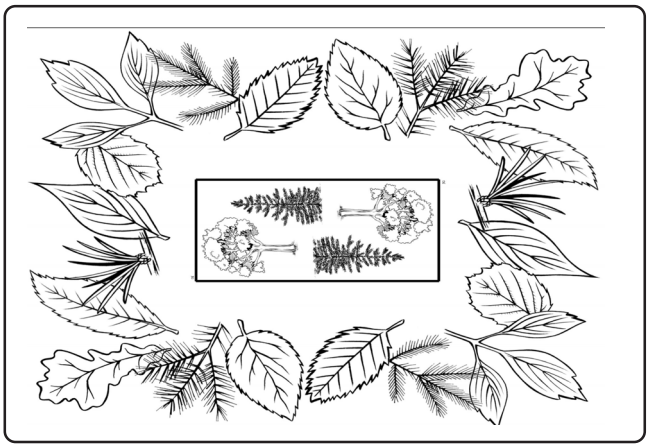
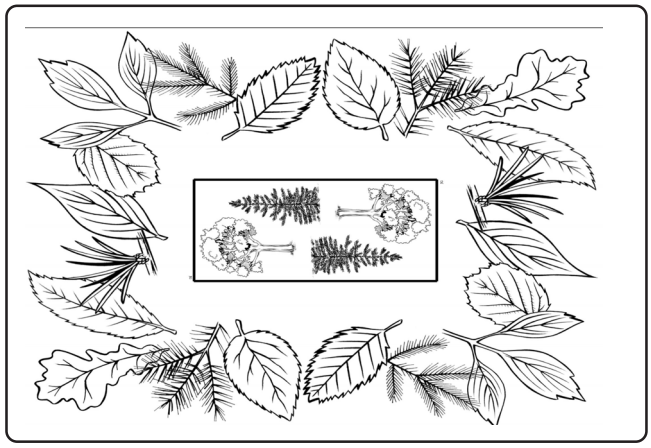
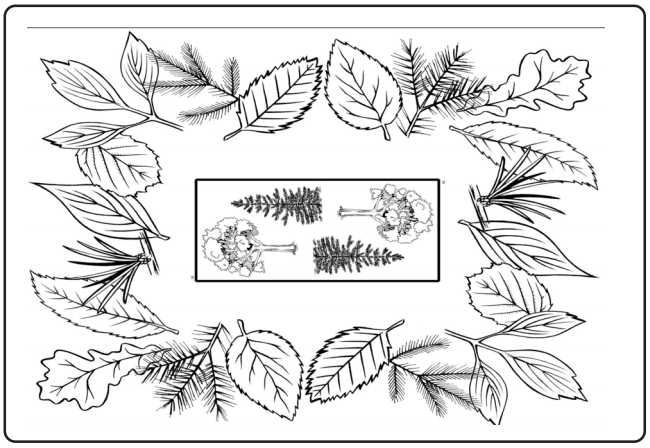
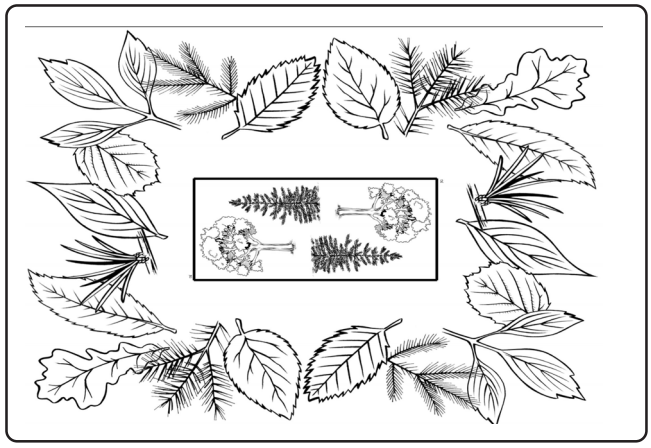
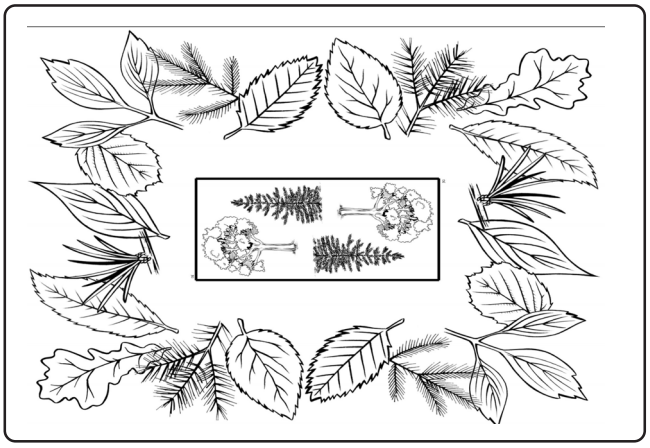
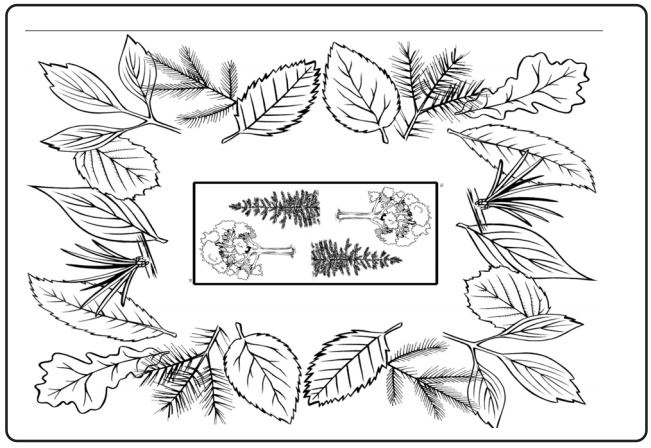
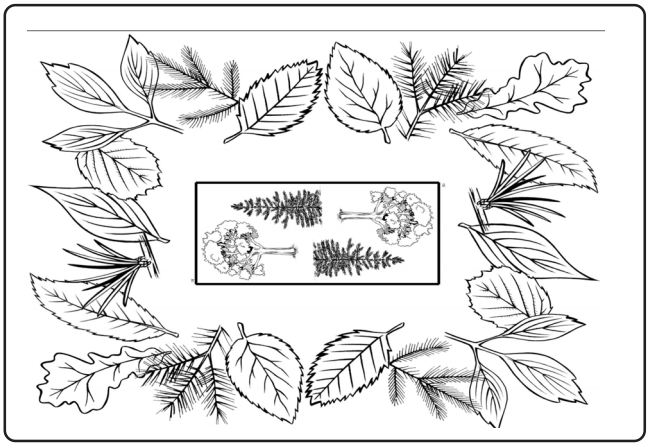
Balsam Poplar

Balsam Poplar

This tree is usually planted in rural areas for shelterbelts.

Balsam Poplar

Change in the Forest

Objective:
To give students an opportunity to investigate leaf pigments.

Subject:
Science

Curriculum Links:
Grade 5: Science (Plant structure and function)
Grade 6: Science (Ecosystems),
Grade 6: Science (Plant and Animal Adaptations)
Grade 8: Science (Plant Growth)

Duration:
2 hours

Groups Size:
Small group or whole class (demonstration)

Setting:
Indoors

Materials:
(per group) Nine green leaves, rubbing alcohol, three small glass jars, coffee filter paper, three pencils, tape, scissors, metal spoon, metric ruler

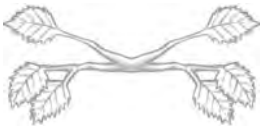
The fall provides us with a wonderful opportunity to explore the changes that occur in the natural world. Animal migrations, plant dormancy and changes in aquatic ecosysems are all very dramatice at this time of the year. One of the most dramatic signs of the season is the change that occures to trees. Autumn is the season we witness the leaves changing colour.

What is happening?

All green plants produce food through the process of **photosynthesis**. Simply put, photosynthesis occurs when light from the sun and carbon dioxide interacts with the pigment **chlorophyll** in the leaves of a tree. None of the photosynthetic pigments absorb green light; as a result, green wave lengths are reflected. This is why plant appear green. In the fall, once the tree has completed its growth for the year, a layer of cells forms the abscission tissue at the base of the stalk. The flow of sap is halted and leaves stop working. The chlorophyll disintegrates and the remaining pigments are displayed. The leaves seem to change colour. The tree is preparing for the long cold Saskatchewan winter. Trees become dormant in the fall and stay that way till spring. Buds form at the tips of the branches and the tree begins **hardening** off. Moisture in the branches and trunk are pulled down into the well insulated root system. This way the tree is less likely to be damaged when the temperature drops below freezing and water molecules expand into their solid state.

Seasonal change in trees is most dramatic in **deciduous** (broad-leafed) species like the trembling aspen and white birch.

Coniferous (needle-leafed) trees like jack pine and white spruce also become dorment in the fall but the change is less dramatic since most do not lose all their needles seasonally. However, some like the tamarac do. Its needles turn a brillant yellow before they fall off every fall and regrow in the spring.



ENGAGE

Ask your students: What makes leaves change colour in the autumn? How can we find out? Use their answers to help with the design of your experiment.

EXPLORE

The following experiment provides students with a relatively straight forward method to observe the various pigments present in a leaf. These procedures may vary from the experiements developed by the class. You may wish to attempt both experiments and compare the results of each.

1. Tear three of the leaves into small pieces. Put them into one of the jars. Repeat for the other two jars.
2. Add enough rubbing alcohol to each jar to cover the leaves. Mash the leaves into a soupy consistency with the spoon. Allow mixture to stand for 5 minutes.
3. Tape each filter strip to a pencil. Lay the pencil across the top of the jar. Adjust the strip so that the end just touches the liquid. Observe the strip absorbing the liquid.
4. When the liquid has moved half-way up the filter strip remove them and place them on piece of clean white paper to dry.
5. Have students record the different colours they observe on the filter.
6. Based on their observations what do they hypothesize the colour of the leaf will be once the green pigment has dissappeared?

EXTEND

Try the experiment with leaves that have already turned colour. What is the difference in your observations? How might this be explained?

Did you know?

Fall is the best time to discover trembling aspen clones? All leaves of the trees that are genetically identical will begin to change colour at the same time.

Most trembling aspen trees, within a grove, are clones of each other. Trembling aspen (Populus tremuloides Michx.) can regenerate by the process of ***suckering****. Root suckers emerge from bud-like organs called primordia. These organs are located beneath the bark of the roots. Suckering occurs when soil temperatures increase and the tree stops producing a growth inhibiting compound called* ***auxin****. Saplings will sprout that are genetically identical to the original tree. Large scale disturbance (harvesting, fire, wind, etc...) and natural mortality will create these conditions.*

Teaching Note

This activity could be set up as an activity centre. Post simplified instructions for student use.

Spotlight on Seedlings

Objective:
To give students an opportunity to demonstrate that green plants need light to grow after germination.

Subject:
Science

Curriculum Links:
Grade 5 Science, Plant Structure and Function

Duration:
30 minutes to prepare, 3 to 4 weeks to observe

Group Size:
Any

Setting:
Indoors

Materials:
Clear containers without lids or small plant pots, potting soil, fresh lima bean seeds or mung bean seeds, water

ENGAGE

1. Ask your students: Do plants need light to grow? Challenge them to create their own experiments to help find the answer. Begin by asking questions such as:
   - What would happen to green plants if they didn't have light?
   - How could we find out?
   - How could we test our ideas?
   - How could we ensure that our test is fair?

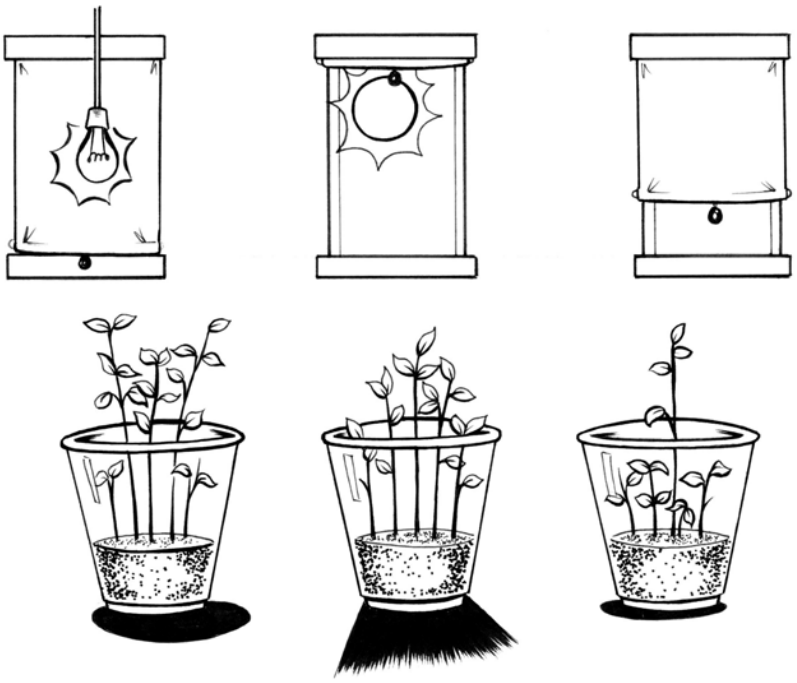
   Help them think through each step of their experiments and encourage them to predict what might happen. Assist them in conducting their experiments and in reaching conclusions. Alternatively, have them try the following experiment or use it as a model.

2. Plant four or five lima bean seeds in potting soil approximately 2.5 cm from the bottom of three containers. Add enough water to soak the soil. The seeds should germinate within a week or so.
3. After the seeds have germinated, let the class decide what type and amount of light each plant will receive (e.g., direct sunlight, indirect sunlight, artificial light, no light). Keep all other variables (e.g., temperature, water) constant.
4. Label each container (date planted, type of light), place them in the chosen locations, and add water when needed.
5. Observe each plant daily with your class and record observations.
6. At the end of three to four weeks, discuss which plant grew the best. Did this have anything to do with the light conditions? What conclusions can be drawn about light conditions necessary for the growth of the bean seedlings? Do these conclusions apply to all green plants (e.g., trees)? Why or why not?

EXTEND

Take the class on a forest walk. Observe which trees grow in full sunlight and which grow in full or partial shade. Using a tree identification book, make a list of these trees according to their differing light requirements.

Teaching Note:
Make sure the beans are fresh or they may not germinate. Mung bean seeds germinate in 24-48 hours.



Birds without borders

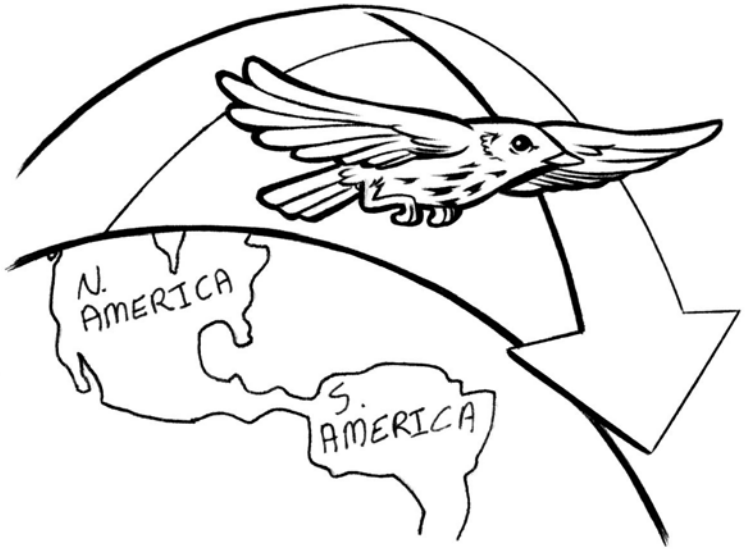
Objectives:
To introduce neotropical migratory birds, including why they migrate and where they go.
To develop an understanding the habitat requirements and threats of Saskatchewan neotropical migratory birds.

Subjects:
Science, Social Studies, Language Arts

Curriculum Links:
Grade 5 Science - Communities and Ecosystems,
Grade 5 Social Studies - Interdepence,
Grade 6 Science - Ecosystems,
Grade 6 Social Sciences - Location and Interdepence,
Grade 7 Science -The Basics of Life,
Grade 7 Social Studies - Location and Resources,
Grade 8 Science - Adaptation and Succession

Setting:
Outside and/or in classroom

Birds migration have charged the imagination of people since the beginning of times. In all corners of the world, birds come and go, always leaving people wondering why they leave, where they go and how. In Canada and the United States more than half of all the bird species that live and breed around us during our summer months, winter south of the Tropic of Cancer. These birds are called neotropical migratory birds, since they spend their winter in "new world tropical countries".



In Saskatchewan, the majority of our neo-tropical migrants are songbirds, but there are also many shorebirds, some raptors and some types of waterfowl that migrate to the tropics. All these birds choose our northern climate for their breeding grounds because being here increases their chances of breeding survival. During our warmer months, food is abundant and competition is less than in tropical areas. Predation is also limited compared to lush tropical habitats in Latin America.

In winter things change. Even though birds can survive at very cold temperatures if they have to, the harshness of the coming winter instigate them to move south. Birds need more energy to survive in winter and much of the foods that neotropical birds need, such as flying insects, caterpillars, fruits, nectar, fish and water critters are not sufficiently available through our winters. Days are also shorter, reducing the time most of these birds can look for food.

Neotropical birds' journeys, like most journeys of migrating birds, are quite serious endeavors. Some birds cross amazing distances, from the north of Canada to the tip of South America. They expend enormous energy migrating. Some birds that weigh no more than an ounce can cross the Gulf of Mexico in one flight The perils of their migration are many, such as predators and weather disturbances, from rain and fog to severe storms and headwinds. There are also man-made obstacles which, more and more, are taking a far greater toll than the natural hazards: Radio and television tower collisions and electrocutions; collisions with lit windows of office buildings; global warming and eradication of wetlands. In addition, the birds breeding and wintering habitats are under siege. At the same time that logging of forests and destruction of wetlands in Canada affect breeding of neotropicals, people in the tropics are cutting forests for timber and converting forests to grazing land. Coffee, once grown as a shade crop under a canopy of trees, is now grown in the bright sun. Pesticides, which are banned in Canada, are still being used in many countries.

Conservation of neotropical migrants is an involved issue. It has to take into account the environmental problems in our own backyards, as well as problems faced across the continent in different countries. It reminds us of how connected we all truly are to the rest of the world, and that cooperation is necessary for our natural resources to be sustainable.

There are some international agreements pertaining to the conservation of neotropical migratory birds across the Americas, but overall the international cooperation is limited. A list of conventions that refer to Canada are available at the Environment

Materials:

- an exercise ball, a frisbee, paper or styrofoam birds, badminton shuttles or anything (preferably very light) that can safely be thrown from a student to the other.
- a copy of "The Journey South"
- a map of the Americas

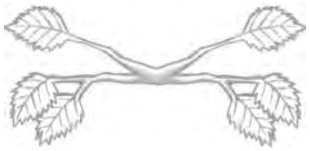
Saskatchewan forests neotropical migratory birds:

Pied-billed Grebe
Eared Grebe
Western Grebe
American White Pelican
Double-crested Cormorant
American Bittern
Great Blue Heron
Black-crowned Night-Heron
Turkey Vulture - Central America
Snow Goose
Greater white-fronted Goose
Gadwall
American Wigeon
Mallard
Blue-winged Teal
Northern Shoveler
Northern Pintail
Green-winged Teal
Canvasback
Redhead
Ring-necked Duck
Lesser Scaup
Red-breasted Merganser
Ruddy Duck
Osprey
Northern Harrier

Neotropicals cont.
Sharp-shinned Hawk
Broad-winged Hawk
Swainson's Hawk
Red-tailed Hawk
American Kestrel
Merlin
Peregrine Falcon
Virginia Rail
Sora
American Coot
Sandhill Crane
Whooping Crane
Semipalmated Plover
Killdeer
Greater Yellowlegs
Lesser Yellowlegs
Solitary Sandpiper
Willet
Spotted Sandpiper
Upland Sandpiper
Hudsonian Godwit
Semipalmated Sandpiper
Least Sandpiper
Baird's Sandpiper
Pectoral Sandpiper
Stilt Sandpiper
Buff-Breasted Sandpiper
Short-billed Dowitcher
Common Snipe
Wilson's Phalarope
Red-necked Phalarope
Franklin's Gull
Bonaparte's Gull
Ring-billed Gull
California Gull
Herring Gull
Caspian Tern
Common Tern
Forster's Tern
Black Tern
Mourning Dove
Black-billed Cuckoo
Short-eared Owl
Common Nighthawk
Ruby-throated Hummingbird
Belted Kingfisher
Yellow-bellied Sapsucker

Canada - Canadian Wildlife Service -Migratory Conservation Division website at www.cws_scf.ec.gc.ca/legislations/laws1_e.cfm. Unfortunately many of the legal conventions and regulations concerning migratory birds are limited to individual countries or very difficult to monitor in developing countries.

There are actually not many organizations or initiatives specifically embracing neotropical bird conservation in North America. Of course that many programs that encompass endangered forest habitats, waterfowl conservation or endangered bird protection, involve neotropical migrants, since so many of our birds are such. In Saskatchewan, the Trans America Migratory Bird Fund (TAMBF) was created by the Saskatchewan Wetland Conservation Corporation (SWCC). The idea of the fund was to aid in reversing the decline of neotropical migratory bird populations in the Americas with the collaboration of Mexican organizations.



ENGAGE

You can start by asking students if they know what a neotropical migratory bird is. You can explain to your students that although this is a big word, most of them probably have seen neotropical migratory birds even though they do not realize it. Many of our common spring and summer birds like robins, many songbirds, hawks and ducks migrate to the tropics. You can also introduce migration, by asking why the students think the birds go south, or why they come back north. Show them in a map how far some of those birds fly and how small some of them are.
After the introduction, tell them they will play a neotropic bird migration game.
(This activity can be done outside or inside, but the students will need room to spread out).

Divide your students into teams of five or six, and tell them to stand in lines such as in the graphic. They will have to be standing at least six feet away from each other in the lines (this distance may vary depending on the object that will be your bird). Explain to the students that they will represent four birds migrating. The example uses Ospreys, but any neotropical migratory bird can be used. There is a list of common names of Saskatchewan neotropical migrants in the right column. Each group will be the path of one of the birds, and each person, one of the places that the bird stops on the way to their wintering grounds and back.

Osprey Migration Game Example

Give each of the first students in line a "bird" (a ball, a badminton birdie, a cut styrofoam bird, a frisbee, a paper object, etc). If you are playing the game outside, the object should be light, so it can be caught by the wind, which will simulate environment obstacles for the birds. If you are playing it at the gym, any ball can be used. The groups have to throw the birds from hand to hand to their wintering grounds (Brazil) and back to Saskatchewan for the breeding season. The bird that gets back to Saskatchewan quicker wins, because he can pick his territory earlier than any other bird and start looking for a mate, which will give them and their chicks a head start. If the bird falls or hits the ground at any point, it dies.

Students play the first round with all the stops in place, then you can start to destroy some habitats to make it more challenging. For example, tell all the students who are the Mexico line to move out (there was a chemical spill in the area where the Osprey stopped in Mexico and all the fish there were poisoned). Now Colorado will have to throw the bird as far as Costa Rica, which is harder. You can play a few rounds removing stops or even the wintering and breeding grounds of the birds.

Afterwards, discuss with the students what happened during the game. Did they realize how much the bird survival depended on many habitats in different countries? If they were trying to

Neotropical cont.

Olive-sided Flycatcher
Western Wood-Pewee
Yellow-bellied Flycatcher
Alder Flycatcher
Willow Flycatcher
Least Flycatcher
Eastern Phoebe
Say's Phoebe
Eastern Kingbird
Loggerhead Shrike
Warbling Vireo
Philadelphia Vireo
Red-eyed Vireo
Purple Martin
Tree Swallow
Northern Rough-winged Swallow
Bank Swallow
Cliff Swallow
Barn Swallow
House Wren
Marsh Wren
Ruby-crowned Kinglet
Mountain Bluebird
Veery
Gray-cheeked Thrush
Swainson's Thrush
Hermit Thrush
American Robin
Gray Catbird
Sprague's Pipit
Cedar Waxwing
Tennessee Warbler
Orange-crowned Warbler
Yellow Warbler
Magnolia Warbler
Cape May Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Palm Warbler
Bay-breasted Warbler
Blackpoll Warbler

Neotropical cont.
Black-and-white Warbler
American Redstart
Ovenbird
Northern Waterthrush
Connecticut Warbler
Mourning Warbler
Wilson's Warbler
Canada Warbler
Yellow-breasted Chat
Western Tanager
Chipping Sparrow
Clay-colored Sparrow
Vesper Sparrow
Savannah Sparrow
Lincoln's Sparrow
Swamp Sparrow
White-crowned Sparrow
Rose-breasted Grosbeak
Bobolink
Red-winged Blackbird
Western Meadowlark
Yellow-headed Blackbird
Brewer's Blackbird
Brown-headed Cowbird
Northern Oriole
American Goldfinch

conserve birds in Saskatchewan, would it work if their wintering habitat in Brazil was destroyed? Why not? And what do they think would happen if the birds nesting grounds in Saskatchewan disappeared?

EXPLORE

To further explore the concepts introduced in the engaging game, students will follow the journey south of a migrating American robin. First show them a picture of a robin and tell them that robins are very common neotropical birds that breed in the United States and Canada and winter in South America. They are a small bird with a red breast. Ask how many students have seen a robin. Divide your classroom in pairs or small groups and give each of them a copy of the "Journey South" and a map of the Americas. Explain to the students that the robin's story is scrambled and the pieces need to be ordered from one to ten. Each part of the story takes place in a different country in the robin's path. To unscramble the story, they will have to follow the adventures of the robin as it goes through different countries, looking at the map. The first and last part of the story is already numbered, so they can know where the bird started and where it is going.

Once the groups have their stories organized, read the story aloud and discuss it with the class. Can they think of other things that would be threats to the lives of birds? What about in their breeding grounds in Saskatchewan?

EVALUATE

Ask students to create their own neotropical bird story. Based on "The Journey South", students can pick a neotropical bird that winters in forests in Saskatchewan and write about their journey north, or their adventures in their wintering or breeding grounds.

EXTEND

Birdathon

Have your students host a birdathon in your school. A birdathon is basically an annual bird count, usually done in spring migration, which works both as a fundraising for environmental projects or organizations and as an educational tool. One great article, rich with logistics, ideas and links for birdathons was published in the **Green Teacher** and it is called **Birdathons: Counting for Conservation** by Brete Griffin. It can be found at www.greenteacher.com/articles/birdathon.htm .

Trans American Connections

Create a partnership between your school in Canada and one school in the wintering grounds of a Saskatchewan neotropical migrant. Students could monitor the arrival and departure of a neotropical bird that summers in Saskatchewan forests, then be in contact with students in a Latin American school in the wintering grounds of the same bird. One great example of a program like that comes from schools in New Jersey and you could take a better look at it by going to: www.edc.org/GLG/EEPP/birds.html. One possibility for getting in contact with schools in Latin America would be through Bird Studies Canada, since they host international programs related to neotropical migratory birds in the area. Other ideas would be Bird Life International at www.geocities.com/RainForest/Wetlands/6203/ingles.html or Canada Nature Federation at www.cnf.ca/index.html.

Printed Resources:

Beyond Borders - Shorebirds of the Western Hemisphere - Transamerica Migration Bird Fund - Saskatchewan Wetland Conservation Corporation. Regina, SK.
Lerner, C. *On the Wing: American Birds in Migration.* Harper Collins Publishers. 2001.
Gans, R. *How Birds Find Their Way?* Harper Collins Publishers. New York, NY. 1996.
Birds Over Troubled Forests - Smithsonian Migratory Bird Center. Washington, DC
Feathered Travelers: Neotropical Migratory Birds of the Americas - Smithsonian Migratory Bird Center. Washington, DC

Web Resources:

Smithsonian Migratory Bird Centre - http://natzoo.si.edu/ConservationAndScience/MigratoryBirds/
North American Bird Conservation Initiative - http://www.dodpif.org/nabci/
Bird Studies Canada - http://www.bsc_eoc.org/bscmain.html
The institute for bird populations - www.birdpop.org
Partners In Flight - www.partnersinflight.org

The Journey South

1. I was born in northern Saskatchewan. My nest was in a alder tree around a boggy area where there were many insects and caterpillars to feed on. Life was easy where I was born. My nest was comfortable and my parents fed and protected me until I could fend for myself. After that, food was plentiful, days were very long and the sunsets stunning. It was hard to believe that at the end of the summer we would have to leave because it would get colder, days would get shorter and all the insects would disappear.

Late in that first summer, my body started giving me signs that something was going to change. I started to develop this urge to eat more than usual. I needed reserves of food to survive my long journey south. I was curious about what I would see down the mysterious south, but our journey scared me a little.

__ Most of the time in our trip, the wind was our helper, this was another reason to fly at night and use the currents going south. One night, though, we had a bad wind scare when we were flying from Texas into Mexico. The sky was dark and the day had been strangely still, but very humid. We thought the weather felt strange, but we didn't expect a tornado during the night. It really felt as if the whole world was falling on our head. Most of us managed to escape, but quite a few in our group were swept up by the tornado

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__We had just got to this beautiful freshwater swamp forest in Nicaragua, when the tropical storm hit us. The rain was warm, but very heavy, so we hid under large dark green leaves. We were huddling quietly when we heard familiar sounds. We responded and soon another small flock of robins joined us. It was a great joy! Our flock had got smaller during our difficult journey and it felt happier and safer to have more birds to fly with again.

__We kept flying during many nights, only resting during the day and I was getting very tired. I knew we were going to stop in a small wetland area in central Kansas, where birds had rested in past migrations. When we finally got there, though, the area had been drained for a new development and the trees and insects were all gone. It was hard to keep going until we could find a suitable place to rest.

__ Costa Rica was a long stop. We were just going to roost there for a few days close to a banana plantation, but our plans had to change. It was our second day there and most of us were busy trying new insects around the banana trees. Suddenly, we heard a loud noise and a white and smelly cloud completely surrounded us. Pesticides were being dumped on the bananas. Many of us were very sick and it took us some time to recover. Some of us did not make it.

__It was a crisp early fall night when we started flying. At first I thought it was strange to fly at night, but soon I learnt why older birds did it. Just at daybreak in South Dakota, I was almost a meal for a Ferruginous hawk. The big bird came out of nowhere and attacked our flock. I understood then, that our chances of survival are greater if we fly in the dark.

__The shade-grown coffee plantations in Colombia were a nice surprise. Plantations scared us a little, especially after the banana incident. In these plantations, though, they grew the coffee under other large tropical trees, so there were many fruits and insects for us to feed on. It was a wonderful place to rest and eat for a couple days.

__We were in Guatemala where I had my most serious scare in the trip. We were resting in the highlands, in a very different forest. There were many plants I had never seen before and pine trees that reminded me of home. It was early in the morning and very misty, when his beautiful big colourful bird, with a very long tail flew nearby. I had never seen anything so bright in my life! I was so amazed that I did not notice a spotted cat ready to pounce on me. If another robin had not alarmed me with a shriek, I would certainly have turned into Margay food.

__ I was trying hard to pay attention to the stars that night. I knew that during this migration I could just follow older birds, but this was a skill I needed to develop for future years. It became harder to see the sky when we flew into Oklahoma City. There were many lights on and it was all very confusing. Two robins in our flock hit a big skyscraper window. It was a very sad night.

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10. We finally stopped flying! It was about time. Most of us were getting pretty thin and worn out at this point. This will be our new home for a few months, the Peruvian Amazon Forest. It is an amazing place. There are giant trees everywhere, and everything is so deep green! It is very humid, but very warm all the time, even at night. There are different, colorful birds everywhere and many new insects and fruits. I never thought I would eat fruit, but here they taste good. There are new predators too, such as big colorful snakes, which I am learning to watch out for. It seems like I will have much to explore before I start preparing for my next adventure in the spring: my first journey north!

Wildlife Habitat at School

Objectives:
To be involved first hand in planning, planting, tending, and managing a wildlife habitat garden in order to develop an attitude of stewardship towards natural resources.
To develop an understanding of the steps required in managing a forest.

Subject:
Science, Social Studies

Curriculum Links:
Grade 7 Social Studies, Resources
Grade 8 Science, The Environment

Duration:
2 hours planning and ordering
1 hour or more planting

Group Size:
Class

Setting:
indoor planning, outdoor planting

A **wildlife habitat garden** (or woodland garden) is a small-scale community of compatible shrubs, trees, and other plants. Ideally, the plants chosen are native to the local area, and are planted in a way which captures the colour, texture, sounds, and scents of a natural wooded area. If carefully planned, these gardens may support a wide variety of insects and birds.

A wildlife habitat garden can be built in a relatively small area. The soil, light, and micro-climate of the site should be carefully evaluated and the species of plants chosen to match the existing conditions.
Wildlife habitat gardens can be created for a variety of purposes. For example, you may want to attract wildlife, establish a quiet rest or play area, grow wild flowers, berries, and herbs, break the wind blowing across the playground, provide shade, or cover open soil so it does not erode. Plant species that commonly associate with each other and are found locally should form the basis of the garden. Many plants will attract butterflies, birds, and small mammals.

A wildlife habitat garden must be maintained after it is created, using methods similar to those **silvilculture** practices required to manage forests. Silviculture is the art

and science of growing forests. The goals of silviculture are to regenerate valuable tree species, maximize growth rates and quality of trees, and assist in the establishment of new trees and forests. **Natural regeneration** (new forests grown from seed naturally dispersed on the site) is an important part of silviculture, but planting nursery-grown seedlings and direct seeding techniques are often required. To ensure the health and rapid growth of the trees, special care is taken to create a workable plan including preparing the site for planting and of tending the forest afterwards. Weeding, spacing, pruning, fertilizing, and protecting the forest from fire, insects, and disease are all essential to ensuring a healthy stand of trees.
By planning, planting, and tending a wilderness garden at your school, many of these silvicultural principles can be experienced first hand.

Materials:
Notebooks and pencils, drawing paper, model building materials, hoes, shovels, rakes, trowels, peat moss, water, plants, shrubs, seedlings, flowers, rocks, logs, bark chips.
See Page 57 & 58 Recommended Saskatchewan Shrubs and Trees, Site Requirements and Use of Wildlife.

Planning will involve two or three class periods. A garden can be planned as a problem solving exercise even if the planting will not really happen. Students should consider the purpose of their garden, location, kinds of wildlife to be encouraged, and the species of plants to be planted. With location chosen, plans for site preparation, planting, spacing, protection, and tending can be developed. These are the techniques used by foresters to grow and manage forests.

Make sure students are involved in all stages of planning. Much of the richness of the experience for the students can come in the early planning stages when factors such as the purpose and location of the garden are being considered.

Ordering of the trees and shrubs must be done well in advance. It is best to order as early as possible. The trees are available in the spring. Seedlings can be obtained from PFRA, Shand Greenhouse at no cost to the school. If you have not ordered trees soon enough, they might be purchased from a local nursery.

Purchase black plastic to use as mulch and have it ready for planting day. Cut the black plastic into squares approximately 2 feet by 2 feet. Put a slit in the centre by folding the plastic square into quarters and clipping the folded corner.

Teaching Notes:
This activity has several parts,; planning, ordering, planting, and tending. Advance planning is required.

Planting should be done in the spring after the soil thaws and before the buds open. If the group is well organized, has sufficient implements and water, it takes about 15 minutes per tree per student to plant the trees. For example, if 30 students (supervised in small groups by 2 teachers) plant 90 trees, it takes about 45 minutes to complete the planting.
To use the black plastic squares that have been prepared, gently work the roots of the seedling through the slit and fold the plastic up over the tree. One student will hold the seedling over the hole in this manner while another students fills the hole with soil and peat moss if it is available. Pack and shape the soil around the roots so that the plastic slopes toward the stem of the seedling. Secure the plastic by placing soil around the edges to prevent it from blowing up.

The roots of the seedlings must be kept moist at all times before planting. As soon as they are in the ground, the soil around them should be soaked down. If plastic mulch is being used, it will direct the water to the stem of the tree where it can move down into the soil in the area of the roots.

Tending the new tree is an ongoing process. Students should be assigned to check the trees throughout the year. They will be looking for growth, removing weeds and reporting problems with the trees. Soil moisture must be checked regularly and the trees watered if the soil dries out. Consider the moisture conditions required for each species as stated in the table Recommended Shrubs and Trees, Site Requirements and Uses in Wildlife. Some species thrive on dry soil conditions while others do better if the soil is kept moist. Weeding and watering will be reduced if black plastic mulch is used.

ENGAGE

1. To begin the **planning** stage, ask your class to describe some of their favorite wilderness scenes. Have your students imagine how they could recreate some of these scenes on the school grounds and brainstorm all the possibilities for recreating a wilderness area in a city or town. List all the possible purposes of such a garden and **decide on a purpose** for your garden.

2. Tour the school grounds to select a suitable site for the garden. Have students consider the following points:
   - Is the site already being used for other purposes? Are these uses compatible with the creation of a garden?
   - Could the area be converted easily or would it involve structural changes such as the removal of pavement?
   - Is the area sheltered from wind?
   - Is the soil dry, moist, or wet?
   - Does the site receive full sunlight? Is it shaded or partly shaded?
   - Are there already some trees and plants that could form part of the garden?
   - Would wildlife be attracted to this spot given the right sort of vegetation? What are their habitat needs?

3. Once the site is chosen, divide into small groups and have each group prepare a map of the area. Distribute copies of the table Recommended Saskatchewan Shrubs and Trees. Site Requirements and Uses by Wildlife. Students choose the shrubs and trees and draw them on the map. They should also indicate on the map; rocks, bird feeders, natural food sources, ground cover, available water, and brush piles.
4. Have the groups present their designs to each other. Discuss the reasons for their choices, problems encountered in designing the garden and information needed.
5. Have students reach a consensus about which model they would like to follow. They may decide to pick elements from more than one model. Have them jointly draw up a workable plan and write out the steps on a calendar.
6. Information may need to be collected on planning, site preparations, planting, tending, and protection. Students can use the library and other information resources to investigate techniques they would use under each of these headings. For example, tending the garden could include such activities as fertilizing, mulching the soil to prevent erosion and weed growth, pruning, thinning if there is overcrowding of some species, fencing the garden if necessary, controlling insect pests, loosening compacted soil, and protecting shrubs in winter by wrapping them in burlap.

Resources:

Planting Trees for Wildlife, PFRA Shelterbelt Centre. Indian Head, Saskatchewan S0G 2K0

Landscaping for Wildlife. Published by Minnesota's Bookstore. 117 University Avenue, St. Paul, Minnesota. 55155

Keep Canada Ever Green For Wildlife. Canadian Wildlife Federation, Ottawa, Habitat 2000 Kit, 1992.

7. Split the class into small groups and make each group responsible for planting a small section. It is best if the small groups plant only one species and are well informed ahead of time on the requirements for that species.
8. The garden must be monitored throughout the year. Rotate student groups through a schedule for tending purposes.

EXTEND

1. Observe the garden once it is established for signs of wildlife. Refer to table Recommended Saskatchewan Shrubs and Trees, Site Requirements and Uses by Wildlife to determine the animal species you might expect to find associated with the plants in your garden.
2. Have the students start a compost heap with weeds or cuttings from the garden. Use the decomposed compost to fertilize the shrubs and trees growing in the garden.

EVALUATE

1. Have students apply what they have learned to a real forestry situation. If they were responsible for growing new trees in a forest, how would they apply the techniques they have learned in this activity to planting and tending it?
2. Have students imagine they have the "perfect" setting for a wildlife garden. Have them design and draw a wildlife garden. Ask the students to identify the components they would require (biotic and abiotic) and explain why they are necessary.

Recommended Saskatchewan Shrub and Trees
Site Requirements and Use by Wildlife

	Soil	Moisture	Light	Growth Form	Use by Wildlife
Buffaloberry *Shepherdia argentea*	Medium coarse silt loam to sandy loam.	Moist, well drained. Moderately tolerant of drought and spring flood.	Sun	Medium shrub, irregular thorns. 4m	Berries are early winter food for upland game birds, songbirds, bear and deer. Browse for antelope. Excellent escape and nesting cover.
Chokecherry *Prunus virginiana*	Loamy sand.	Moist well-drained. Moderately drought tolerant.	Full sun best	Tall shrub. 6m	Flowers provide nectar for butterflies. Berries eaten by many birds and small mammals. Browsed by deer and elk. Bark and twigs eaten by rabbits and small mammals. Grouse eat buds. Cover for a variety of wildlife.
Dogwood *Cornus stonlonifera*	Broad range of soil.	Wet to moist, well drained. Low drought tolerance. Tolerant to spring flooding.	Sun. Tolerates light shade.	Low shrub Dense foliage. 2m	Butterfly nectar. Berries eaten by many birds. Browsed by deer, moose, rabitts. Bark and twigs eaten by deer, small mammals. Excellent dense cover.
Red Elder *Sambucus racemosa*	Medium texture.	Moist, well drained. Not drought tolerant. Spring flooding tolerant.	Full sun.	Medium shrub. Rapid growth. Dense branching. 2m	Butterfly nectar. Berries eaten by song birds and upland game birds, summer and fall. Leaves and twigs browsed by deer, rabbits and small mammals. Good cover.
Rose *Rosa rogues*	Wide range.	Moist, well drained.	Full sun best	Low-medium shrub. 1.5m	Butterfly nectar. Rose hips fall, winter and spring food. Deer browse young shoots. Rabbits and small mammals eat bark and twigs. Excellent escape and nesting cover.
Snowberry *Symphoricarpus occidentalis*	Slightly clay loam to sand loam to sodic soil.	Moist to dry, with moderate to poor drainage. Moderately drought tolerant.		Low shrub. 0.5 to 1m	Bee and butterfly nectar. Fruit food for song birds and upland game birds fall, winter and spring. Browsed by deer, rabbits and small mammals. Buds and leaves eaten by small birds. Excellent escape and nesting cover.
Sea-buckthorn *Hippophae rhamnoides*	Sandy steep slopes.	Dought tolerant.		Medium shrub. 5m	Berries eaten by upland game birds and songbirds in winter. Browsed by deer. Excellent escape and nesting cover.
Russian Olive *Eleagnus angustifolia*	Sand-loam.	Moist to dry, well drained. Drought resistant.	Full sun. Some shade.	Tall shrub-tree. Fast growing. 4-7m	Fruit eaten by upland game birds and song birds late fall, winter and spring. Browsed by some small mammals. Excellent early protection. Good nesting cover. Honey plant for bees.

	Soil	Moisture	Light	Growth Form	Use by Wildlife
Hawthorn *Crataegus species*	Broad range.	Broad range. Moist, well drained is best. Dought resistant.	Full sun	Tall shrub. Large thorns. 6m	Berries excellent winter bird food. Some browsing by deer and rabbits. Excellent escape and nesting cover. Bee nectar.
Bur oak *Quercus macrocarpa*	Broad. range.	Moist, well drained.	Full sun.	Tree on wet sites. Scrubby tree on dry sites.	Acorns fall and winter food for some birds, stored by squirrels and chipmunks, also eaten by deer. Browsed by deer. Nest cover. Butterfly and catepillar plant.
Acute Willow *Salix acutifolia*	Damp soil.	Wet sites.	Sun.	Spreading bush. 5m	Browsed by animals. Provides good cover.
Ussurian Pear *Pyrus ussuriensis*				Tree. 8m	Twigs and young leaves browsed by deer. Good cover for roosting, loafing and nesting. Shade.
Siberian Crabapple *Malus pyrus baccata*	Broad range loam.	Moist to dry. Well drained. Drought hardy.	Full sun.	Tall shrub, tree. 7-9m	Fruit winter and spring food for songbirds and upland game birds. Twigs and bark browsed by deer and small mammals. Shrub form good cover for roosting, loafing and nesting. Nectar used extensively.
Hybrid Poplar *Populus*	Light loam.	Tolerates a variety of moisture conditions.	Sun.	Tree. 15m	Young trees browsed. Good habit. Nesting sites. Provides shade and wind break.
Spruce *Picea*	Light loam.	Moist soil.	Partial sun.	Pyramidal shaped tree. 13m	Food for songbirds. Good nesting cover. Shade.
Scots Pine *Pinus sylvestris*	Sandy.	Dry site.	Sun.	Dense pyramidal tree. 13m	Summer food for sonbirds, upland game birds. Browse for mammals. Excellent winter cover. Excellent for nesting. Provides winter thermal cover for all wildlife.

A Roost with a View

Objectives:
To understand the importance of forest trees as shelter for animal habitat.
To identify the parts of a tree that provide suitable shelter for animals.

Subject:
Science, Language Arts, Visual Arts

Curriculum Links:
Grade 6 Science, Ecosystems
Grade 7 Science, The Land
Grade 7 Language Arts, Speaking, Writing
Grade 8 Science Adaptation and Succession

Duration:
2 to 3 hours

Group Size:
Individual, small groups, class

Setting:
Outdoors

Forests provide **habitat** for many different kinds of animals. This lesson will examine one aspect of forest habitat – the importance of forest cover in providing **shelter** for animals.

All parts of the tree provide shelter for some kind of creature. Chipmunks burrow under tree roots, Martens find den openings at the spreading base of trees. Red squirrels make winter nests in tree trunks and build leafy summer nests on branches. Birds, such as ruffed grouse, may nest at the base of the tree; downy woodpeckers may bore into the trunk; ruby-throated hummingbirds may build dainty nests in the **canopy** of leafy branches high above the ground.

Even dead standing trees (called **snags**), fallen trees, piles of dead leaves and undergrowth can provide shelter. Racoons, for instance, favour hollow trees, stumps, and logs, while chickadees look for hollows in the dead parts of living trees 9-12 m above the ground. In the damp, rotting leaf material on the forest floor (called **duff**), you can find sow bugs, centipedes, and millipedes. Some animals, such as beavers, use forest materials to build elaborate dams and houses for themselves. Others, such as skunks, will use any existing nooks and crannies they can find.

Fallen trees provide a particularly fascinating example of forest shelter, first because they are seen by most people as "waste material" and second because their use changes over time as they gradually decay. Studies have shown that logs on the forest floor are used as shelter by birds, mammals, reptiles, and amphibians.

After trees fall to the ground, they slowly decompose. The nutrients are returned to the forest soil. Ants, beetles, centipedes, and termites may be the log's first inhabitants. Insects help to weaken the wood as they tunnel through it.
Small mammals, such as squirrels, often find that logs make excellent escape routes from predators. The cover provided along the side of and under a log provides shelter for small reptiles and amphibians. As the inside of the log softens and rots away, it becomes hollow and may become the den of a raccoon or a snowshoe hare.

Logs are central to the existence of ruffed grouse. The protected areas beside or under the log may become the nesting site of a female grouse. Soil still clinging to the log is used by grouse for "dusting" to remove lice from their feathers. Male grouse have a unique use for logs: they use them for drumming. To attract a mate and establish his territory, a male grouse stands on a fallen log and snaps his wings to make a low-frequency drumming sound (similar to the starting noise if an outdoor motor).

Advance Preparation
Gather photographs or slides of different parts of a tree that provide animal habitat (e.g., dead leaves on the forest floor, a dead tree or stump, a canopy of leaves at the top of a large tree, a tree trunk with woodpeckers' holes) for use in discussions. Photos in *Nature* and other outdoor magazines and in *The Hidden Forest* by Siguard F. Olson and Les Blacklock (New York: Viking, 1969) are excellent for this purpose.

Materials
Photographs or slides of trees, drawing materials, arts and crafts supplies for model building, two or three logs from forest floor, several glass jars, bucket, newpapers, magnifying glass (10X), one small flashlight, one large jar (quantities determined by activities conducted)

ENGAGE

1. Begin this activity by asking students if they can imagine what it would be like to live in a tree. Can they imagine growing up in a nest, crowded with raucous siblings, out on a swaying tree branch? During a high wind, does the nest pitch and sway like a ship on a stormy sea? Introduce the topic of animal habitat by asking students to think about what they need to live (e.g., shelter from heat and cold, privacy, a quiet place to sleep, food, water). Point out animals need the same things from their habitat: shelter, food, water, and space. Elaborate on how trees provide them with shelter and food (both seeds and **browse**). Use the photos you have collected. Discuss the various parts of the tree and the kinds of animals that might live in each part. (Knowledge of specific animals and their homes is not necessary at this point; students can generalize that a large, slow-moving animal with strong claws might like to hollow out a den under a log rather than build a nest in a tree-top. Factors to consider include the size of the animal, its agility, what it eats, and what its enemies are.) Point out that, at any one time, a tree may be home to several types of animals. Over time, a growing tree, or a decaying log, may be as suitable home for may different animals.
2. Without disclosing their choices to each other, have each student choose a forest animal they like or are interested in and investigate its shelter using reference materials from the school library or public library. Saskatchewan animals with interesting shelters include beavers (lodges of branches and mud); black bears (dens may be located in large stumps or under overturned logs); chipmunks (elaborate underground tunnels and chambers); and ruby-throated hummingbirds (nests of catkins and cobwebs high in trees).
3. Have them prepare an illustrated report answering some of the following questions:
   Does the animal chosen use the existing shapes and hollows of a tree/stump/log, or does it build its own shelter:
   - Which body parts does the animal use to build its shelter?
   - How is the shelter used? (Year- round, only for

winter, only for raising young?)
- How many animals live in this shelter? (Just one or an entire animal family?)
- Does this shelter keep the animal warm and dry? How?
- Is there a food storage area in the shelter?
- Does the shelter protect the animal from predators? How?

EXPLORE

1. Locate two or three logs in various stages of decomposition. (A rotting log is an interesting example of the forest ecosystem – relatively small, but complete environment where students can discover many simple relationships between various members of the log community.)

   Ask your students how they could go about discovering what animals live in and on the log:
   - What signs would they look for?
   - Can any animals be seen?
   - Can they see what animal's home looks like?
   - What attracts them to the log?
   - Are they doing any damage to the log?
   - How do they move about?
   - Which are camouflaged to look like parts of the log?
   - Which are brightly coloured?
   - How might their colourings help them?
   - Are there any signs of larger animal life on the log (e.g., droppings, scratch marks, a nut cache)?

2. Have students observe the logs and devise a chart to compare the logs (e.g., by physical nature, such as colour and hardness; types of plants and animals; moisture content; and other features students find significant).
3. Have students observe insects and small animals, noting where they live on the log.
4. Students may also wish to observe the texture, smell, and feel of the log and the degree of rot. Try to determine the age of the log, if growth rings are present (one dark ring plus

Resources:

Hinterland Who's Who, from the Canadian Wildlife Service, Environment Canada.

Olson, Sigurd F. and Blacklock, Les. *The Hidden Forest*. New York: Viking, 1969.
Pringle, L.

Into the Woods: Exploring the Forest Ecosystem. New York: Macmillan, 1973.

Seeing through Trees (1977) and *A Forest in My Classroom* (1983) from the Western Education Development Group (Wedge). Vancouver; University of British Columbia.

one light ring equals one year of growth). Encourage observations about the plant life on the log and ask why some plants grow only in certain locations on the log.

5. Have students draw detailed illustrations of one of the logs. Have them exchange their illustrations and guess which log is illustrated.
6. Consider taking a log back to the classroom where it can be kept for a longer period of observation. Set it on a 10 cm layer of moist forest soil in a plastic-lined box with a lid. Keep it moist. Have students devise a way of recording changes over a period of about one month.

Have students design and draw an insect that could successfully live on a log. Include the insect's shape, size, and colouration and suggest reasons why the insect would be overlooked by insect-hunting birds.

EXTEND

To give students an idea of the number and variety of animals that find shelter in the forest soil, scoop up a small bucket or jar of dead leaves and soil from the base of a tree in a wooded area. Bring it back to the classroom and spread it out on sheets of newpaper on a table. Use a magnifying glass and sift through the plant material carefully. Have the students identify the animals found, using reference books.

2. Turn on a small flashlight and put it into a large jar. Make a large paper funnel and place it in the mouth of the jar. Put a few scoops of forest soil into the funnel and place the jar in a dark closet. After two hours or more, observe the jar (soil organisms will be moved down through the funnel towards the light source).
3. Have students research the differences in shelter and the animals found in a young forest as opposed to an old growth forest.

EVALUATION

Have each student select an animal and explain in a report or presentation the importance of habitat preservation.

Invent a Forest Creature

Objective:
To understand and appreciate the concept of an ecological niche within the forest community by identifying the needs and habits of a particular plant or animal.

Subject:
Science, Language Arts, Visual Arts

Curriculum Links:
Grade 7 Science, Life-keys to survival
Grade 7 Language arts, Speaking, Writing, Viewing

Duration:
2 ½ to 4 hours

Group Size:
Class, individual

Setting:
Indoors

Materials:
Art supplies, model building materials (e.g., paint, strings, nails, flat boards), tape recorder

Habitat is the arrangement of food, water, shelter or cover, and space suitable to animals' needs. The way a plant or animal behaves, or its role in the community, is called its **ecological niche** (e.g., a red squirrel spends much of its time searching for nuts and seeds; it builds its nest in trees; it is a food source for the great horned owl). What an animal feeds on, where it lives, what feeds on it, and its effect on the environment all describe its niche.

All living things have specific and individual habitat needs. For example, beaver require an abundant supply of trees, preferably poplar and birch, near a water supply. Plants need differing amounts and types of light, soil, water, and shelter and a certain amount of space in which to grow. For example, black spruce grow best in moist or wet soils. Pines are more commonly found in soils that are sandy or gravely.

There are numerous interactions between plants and animals in a forest community. One way of looking at these interactions is by examining **food chains** and **food webs**. The dependence of plants and animals on each other for food makes up a food chain. The sun transfers energy in the form of light to green plants. The energy stored in a plant is transferred to a plant-eating animal when it eats the plant, and so on.

In most natural situations, the flow of food material is more complicated than in a simple food chain. Many animals eat a number of different foods, depending on their abundance and availability. When many different species of plants and animals are interdependent, we speak of food webs rather than food chains. Nature works to keep a balance within the food web.

ENGAGE

1. In preparation for the following activity on inventing a forest creature, ask your class what plants and animals need to live and grow in a forest environment. Brainstorm a list of requirements or have students create their own methods for finding the answers (with partners or on their own). Encourage them to ask such questions as:
   - How do plants and animals depend on each other?
   - What are some of the webs or chains of relationships that exist in the forest?
   - How could we demonstrate some of these relationships (e.g., using word models comparing the relationships in a forest community or ecosystem to their own neighbourhood community; painting a food web on a flat board and connecting the elements in the web using nails and string; reports; drawings; computer-generated flow charts)?

2. Assist your students in conducting their chosen activity that demonstrates the interrelationships in a forest community.

Teaching Note:
Ideally your students will have had some prior ecosystem studies. However, if they haven't, Activity #1 may lead them to see the intricate web of relationships in the forest. They will use these relationships as they create and research the needs and roles of their hypothetical creature.

EXPLORE

1. Divide your class into small groups. Assign each group the task of inventing a new animal or plant that is able to live somewhere in a forest. To begin, suggest that they ask questions such as:
   - What does the animal or plant look like?
   - What are the climate and environmental conditions where it lives?
   - What does it eat and what are its enemies?

This imaginary creature is a large solitary creature with few natural predators except when it is young. It uses the big shovel-like horn to scrape the bark off of trees as its main food source. The two smaller chin protrusions help dig up roots. Its furry hide allows it to survive in cold climates.

2. Have the students record the specific features of their creature and its immediate environment. For example, they could describe:
   - The general forest environment (climate, animals, other plants);
   - The habitat and niche of their creature;
   - A description of physical characteristics that help it survive (e.g., beaks of birds and claws of tree dwellers);
   - A description of behaviour that helps it survive (e.g., hibernation, feeding habits);
   - How it reproduces and how it interacts with other species

Another way of describing their creature is according to its ecological niche. The ecological niche of an organism has to do with its function, or role, or way of life – e.g., as **predator** (an organism that hunts, kills and eats other animals) or **decomposer** (animals, plants, and bacteria that chemically break down dead organism, releasing important materials for use

by other living things) – and how it performs that function. Habitat is relatively static; **niche** is a dynamic condition referring to the relationship of a living thing to its environment. Have students describe their creatures according to the following elements that determine their ecological niche:

- The role played by organism in its biological community (e.g., predator, decomposer);
- Its food requirements;
- Its position in the food chain;
- Its requirements for shelter;
- Its behaviour;
- The timing of its activities (e.g., nocturnal or diurnal)

3. Have your students find creative ways of introducing their creatures to the rest of the class. They could use drawings, taped simulations of its sounds, simulated scientific reports on its environmental needs, or role-playing (e.g., interviews with naturalists familiar with the organism). They could even design and wear costume of their creature and have a classmate interview them.

4. Have students draw a diagram or cartoon strip or write a story that illustrates the interrelationships that exist between their creature and the rest of the forest community. If appropriate, make connections with the hypothetical creatures invented by the other groups.

EVALUATE

1. Ask your students to predict the impact of a particular change in their creature's environment (e.g., the effect of a drought on a water lily). Have them use any method they wish to express the change and its effect (e.g., role-playing, illustrations, interviews). How much change do they think their creature could adapt to?

2. Have the class develop a realistic food web for a local forest area or park.

Resources:

Andrews, W.A. *Investigating Terrestrial Ecosystems*. Toronto: Prentice-Hall, 1986.
Atlantic Science Curriculum Project. *3.*

Frosty Forest

Objectives:
To gain an understanding of how plants and animals adapt to and utilize their forest environment for survival.

Subjects:
Science, Language Arts

Curriculum Links:
Grade 5 Science Resources, Communities and Ecosystems,
Grade 5 Social Studies - Interdepence,
Grade 6 Science - Ecosystems,
Grade 6 Social Sciences - Location and Interdepence, Energy in our Lives, Earth's Climate
Grade 7 Science -The Basics of Life,
Saskatchewan - The Land,
Grade 7 Social Studies - Location and Resources,
Grade 8 Science - Adaptation and Succession.

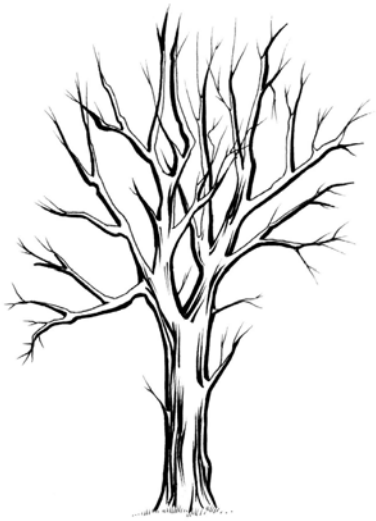
Duration:
Three to Four class periods

Setting:
Outdoors in a natural area with snow (partially sheltered by trees and partially open) and in the classroom.

Winter... The beautiful white, snowy season, that people in this province know so well. For many of us, winter is a time of beauty and fun, for others a time of hindrance and cold times. No matter how we feel about winter, we as humans can control our environment and mediate the effects of winter. We can live in heated houses, we can wear thick parkas and mitts or we can fly to Hawaii. Outside in forests, meadows, lakes and bogs, other creatures also have to deal with the cold season, and they do it in many different ways.

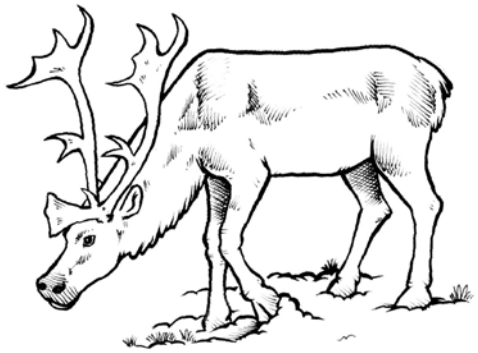
Northern plants, for example, have incredible adaptations that enable them to survive in these cold conditions. Most plants become dormant in winter, so they tend to be forgotten. Their strategies of survival, though, are very diverse and important for the survival of all other creatures in winter. Some plants stay slightly active all winter long under the snow, some survive only as dormant seeds, some send all their nutrients to their roots, some dry out in winter and sprout back in spring, and some stay above the snow bearing the brunt of winter. Trees are some "brunt of winter" survivors and they have incredible adaptations which help them to do so. Deciduous trees, for example, loose their leaves in fall by stopping the flow of nutrients to them. Without their leaves, they are less likely to suffer damage from snowfall or freezing. They

also became dormant, since they mostly cannot photosynthesize without their leaves. On the other hand, most coniferous trees (trees that have needles instead of leaves, and produce cones) do not loose their needles in fall. They also became dormant, not photosynthesising much in winter, unless a warm spell comes along. Once spring comes, though, they have an advantage over deciduous trees, since they don't have to spend energy to produce leaves and they can as soon as it is warm enough resume their nutrient and growth cycle.



Winter can be a difficult time for animals. During the cold months, it becomes more difficult for animals to get around, find food and water, and stay warm. Different animals deal with the trials of winter in different ways. Some migrate to different places where food is more abundant and weather conditions less harsh; others become dormant or hibernate, basically sleeping through the whole season; others meet the challenges of winter staying active and adapting.

Many of the animals that stay active year round, like big ungulates, the carnivores of the forest, hares, birds and many rodents like voles and mice, depend heavily on their environment for survival. Small rodents, some insects, fungus and even some plants need a good snow cover and its insulating blanket to protect them from the harshness of winter. Under the snow, what many winter ecologists call the subnivean (under-snow) environment, many creatures live in the dark in balmy temperatures close to 0° C all winter long. Without the snow, most of these creatures would not survive through the cold season.



Over the snow, in the supranivean environment, it is a different story. Temperatures dip very low, winds rob animals of warmth and snow hampers their movement. Forests and its trees become of great importance for many animals, providing food and shelter.

Large ungulates like deer and moose depend heavily on forest browsing for survival. Buds of trees and shrubs provide animals with essential nutrition throughout the winter. The same can be said about the snowshoe hare. These amazing animals, very adapted to walking on top of the snow, because of their large hind feet (thus the name), wait until the weight of the snow lowers the branches of many shrubs and trees, so they can nibble on the nutritious buds. Even the few hardy feathered creatures that stick around in winter, need the forest for sustenance. Chickadees and woodpeckers feed on insects under the bark of trees; waxwings and grosbeaks look for seeds and frozen berries in the frozen landscape. All the carnivores, on the other hand, rely on forests since these sustain the animals that they prey upon.

Shelter is almost as important as food for animal survival in winter. To survive the winter, all animals must find a balance between energy intake (food) and energy output (energy spent surviving) and shelter can help them save a lot of energy. Forests act as a thermal blanket for many forest creatures in winter. They trap escaping radiation beneath the forest canopy and protect against winds. Trees also restrict the amount of snow that falls on the ground, which really helps some animals to move around and survive. Even the highly adapted caribou will move from barren lands to wooded areas in winter. The shelter of the trees in the forest protect the snow from disturbance, keeping it softer and easier to dig through with their shovel like hooves, looking for lichen and mosses to graze on.

ENGAGE

Get all students to come with you outside on a cold winter day. Tell them not to get dressed to go out, just get their outside shoes on, if they have such. Get all the students outside the school door and stay there for one minute (or less, depending on how cold it is) then come back inside. Once back in the classroom, ask students how they felt. Ask them how long they think they would survive outside dressed the way they were and why. Talk about ways people deal with winter, then move on to animals and plants. Ask students how they think animals and plants live outside all year round. Ask them where they live and why. Divide your class into pairs and ask them to research about the winter coping strategies of a certain animal and plant and the environment they live in winter. This could be done either in class with resource materials or could be assigned for the next class. Students will have to present their findings to the class. Some examples of animals and plants to be researched would be:

Trembling Aspen, White Birch - Loose their leaves, Dormancy - Forests

Vole, Shrew, Mouse - Subnivean environment - Open areas or forests

Garter snake, Leopard Frog, Bat, Woodchuck, Bear - Hibernation - Forests, Lakes

Black Spruce, Jack Pine - Keep their needles, Dormancy - Forests

Snowshoe Hare, Lynx, Weasel - Active, Change colour - Forests

Fireweed, Yarrow - Perennials, Plant part above ground dies, Roots survive - Disturbed Forests

Deer, Caribou, Moose, Wolf, Fox - Active, Grow extra fur - Forests

Beaver, Ants - Active, Cache food, Hide in sheltered place - Forests, Lakes

Chickadee, Downy woodpecker - Active, Fluff up their down, Slow metabolism at night - Forests

Materials:
Thermometers (including a long stem thermometer), pencils, clipboards, copies of the winter data sheet

Teaching Note:
Winter conditions in Saskatchewan is serious business. At no time during these activities should the health and safety of your students be in jeapordy. Avoid having the students exposed to high windchills or conditions where frostbite and frozen skin will occur in seconds. Use your judgement, be sure to check school policy and ensure that the students are monitored properly and quick access to get back into the school is availible in case of emergency.

EXPLORE

After researching and learning about some of the adaptations of animals and where they choose to live, students will explore first hand some of the environmental conditions that animals and plants live under.

For this activity all students have to be prepared to spend some time outside. Make sure you tell them the day before to bring suitable winter clothing. It would be highly recommended that they had ski pants, good winter jackets, mitts and toques. Tell your students they will participate in a scientific experiment which will help them understand some of the environmental conditions that animals and plants adapt to in winter. Explain that this is just a simple experiment, the winter environmental conditions of animals and plants are very complex, but this will introduce you to some important aspects of it. You can divide the class into six groups. In each group, ask for a volunteer or pick one student to be the "data student". Equip each one of the data students with a thermometer (if possible, one of the students should have a long stem thermometer to measure snow), a clip board, a watch, a data sheet and a pencil.

Explain to students that each group is going to experiment a different winter environment and attitude in that environment and the data students will collect all the information they can give about it. Students will be outside for at least 15 minutes during the experiment.

1. The first group should be sitting in a sheltered area (under trees), they should not be too close to each other, but they do not have to be too far away. The data student should hang a thermometer in a sheltered place under the trees and register the temperature it shows after 5 minutes.
2. The second group should be in a sheltered area (under trees), but they should be walking around during the time of the experiment. The data student should hang a thermometer in a sheltered place under the trees and register the temperature it shows after 5 minutes.
3. The third group should find a snow bank, or a snow drift and try to shove themselves inside it, so the snow will be enveloping each of them - head always up and away from the snow. If the snow is not too deep and no drifts or banks can be found, the students could lie down,

trying to bury themselves (like making snow angels). (The students in this group **need** to be wearing waterproof clothes that will insulate them from the snow). The data student should try to measure the outside temperature, and the temperature inside the snow.

4. The fourth group should sit in the open, again not too close to each other. The data student should have the thermometer somewhere exposed to the elements and he should register the temperature after five minutes.
5. The fifth group should be in the open, but they should be walking around the whole time of the experiment. The data student should have the thermometer somewhere exposed to the elements and he should register the temperature after five minutes.
6. The sixth group should be in the open, but all huddled together. The data student should have the thermometer set in the middle of the group and record the temperature after the first five minutes.

Once all students are set in their positions and ready to go, the data students need to start interviewing and filling out the data sheets, provided at the end of the lesson. Each student interviewed has to pick only one answer for each question. The data student should gather information from the experiment students just at the start at the exercise, and just at the end of the exercise (15 minutes), they are also responsible for timing the experiment.

Once they are done, they can all go back to the classroom to warm up. Once they are well thawed, groups should get together to discuss the information that they gathered. Each group could present their findings to the rest of the class or you could ask some questions and discuss them with the students.

Some important questions to discuss with the students should be:

- What were the differences between being in a forest and out in the open? What caused those differences?
- How did the people sitting in snow feel? Why?
- Who was warmer, the people sitting down or the people moving?
- Who spent more energy and was more tired?
- Was it easier to move through the forest or out in the open?

- Where was there more snow? Why?
- Were the people huddle up warmer than the people sitting separate?
- If you were an animals where would you live?
- Can you think of different animals and plants adapting and relating to these different conditions?

EVALUATE

After researching adaptations and experiencing environmental affects, is time for your students to use what they learnt and their imagination becoming plants and animals!
During this activity, the class can be divided in groups again. Each group will get a winter story card, which tells them something about a winter creature. Each group will have some time to read their cards and prepare a small play about their animal for the rest of the class. Almost like charades, the group presenting is trying to get the rest of the class to guess what their animal or plant is. They cannot speak, but they can make different sounds and animal calls.

Vole: I live my winter under the snow. My daily routine is busy in a world without light. I sleep part of the day and run through a maze of tunnels in my underground world, eating from my food cache and digging holes to the surface once in a while. I also have to listen careful to coyotes and foxes which are walking on the surface of the snow, ready to pounce on me through the snow.

Spruce Tree: I never loose my leaves in winter. My leaves are green all winter and my branches slope out and downwards. After a heavy snowfall, when snow collects on my branches, the weight presses them down, and the snow slips down, like as if I was a slider.

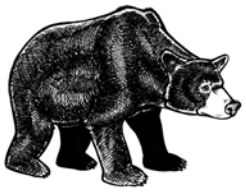
Caribou: I am the ultimate winter deer-family animal. My hooves are shaped like a shovel and with a few strokes of my feet, I can break through crusty snow and dig deep to find lichen and shrubs to feed on. I also have a keen sense of smell and I can sniff my favourite lichen buried in 70 cm of snow.

Fox: In winter I grow a thick layer of extra fur and I mind my business hunting and living as usual. I walk slowly and carefully over the snow, listening to the sound of voles and mice scurrying around in their under-snow world. If I can listen to one just below me, I quickly dig my face in the snow and see if I can catch a meal.

Chickadee: I fly around looking for the insects most of the day under the bark of trees. Many of them were collected and hid by me there in fall. When I stop I fluff up my downy feathers, and it is easy to keep warm. Sometimes when it is very cold, though, I huddled together with other chickadees to stay warmer. At nights I slow down everything to save energy, including my heart beat and breathing.

Snowshoe Hare: All my fur turns white in winter. If I crouch against a snowdrift, I am almost invisible. My large hind feet, covered in long stiff hairs that almost double their size, help me move around in the forest as if I was wearing snowshoes. Many predators sink in the soft, deep snow that I can walk over.
Walking on the snow also helps me eat, since it makes me reach fresh twigs and virgin bark that I wouldn't otherwise.

Black Bear: Early in winter, after fattening up on berries and anything else I could eat, I wait for the first heavy snowfall to go into my den. Most of my winter time is spent snuggled warm in the den, living off my stored fat. In a warm day in winter, during a warm spell, I might get up and walk around looking for some food. Soon I get back to my snooze though, hibernating the winter away.



Resources:

Halfpenny, J. and Ozanne, R. D. *Winter: An Ecological Handbook*. Johnson Books. Boulder, CO. 1989.

Berger, M. & G. *What Do Animals do in Winter?* Ideals Children's Books. Nashville, TN. 1995

Johnson, Kershaw, Mackinnon and Pojar. *Plants of the Western Boreal Forest & Aspen Parkland*. Lone Pine. Edmonton, AB. 1995.

Pruitt, William O. *Wild Harmony - The Cycle of Life in the Northern Forest.* Western Producer Prairie Books. Saskatoon, SK. 1983

Jones, J.B. *Who lives in the Snow?* Court Wayne Press. Boulder, CO. 2001.

Building a Quinzhee

Trample out a circle in the snow and all the snow within that circle. This will be the size of your quinzhee. The circle should be about two and a half metres in diameter for a small hut. Use shovels, pot lids or your hands to throw snow from the outside of your circle into the middle and create a mound. Try to pile up at least five to six feet of snow. Once you are satisfied with the pile of snow you have created, "Pin -cushion" the hut with sticks 20 to30 cm long in various areas around the dome. It should give the mound of snow a "porcupine look". Leave the snow resting for a day and come back the next day to hollow it out. This will settle the snow and strengthen your mound.

To begin hollowing out your quinzhee dig down and then in. As you form a tunnel entrance to your shelter, make sure someone on the outside to help shovel away the snow as it comes out.

Scoop out the ceiling. Use arcing strokes to create a dome shape inside. This will keep your snow structure strong. As you arch out the roof watch for the sticks to tell you when to stop digging. The more you shave snow away from the walls more light will come in. This is your key to know when to stop shovelling.

Use the interior snow to reinforce the sides of the hut or build up the entrance walls. Don't forget to carve in small air holes in the sides for ventilation.

Spruce Grouse: I live eating the buds of trees and sleeping in snow. When it is very cold, I jump from a branch to the deep snow and move in it until I get to a spot where I can make a snug snow cave for myself. There I can spend the night protected from predators and cold temperatures.

EXTEND

Build a Quinzhee:

Have your students truly experience life under the snow, by building a snow shelter. This is a two-day enterprise which is fun, but takes a lot of work. One very interesting activity to do once the quinzhee is built, is to measure the temperature outside in a very cold day, then go inside the quinzhee with the students and wait for about 10 minutes. After that, have all students guess what the temperature inside is, than look at the thermometer. The result will surprise everyone. Sometimes temperatures can vary more than 20°C! That is a great way to explore insulation qualities of snow and winter environments. All winter survival guides will have very in depth information on how to build a quinzhee, but one quick overview of how to make one is included in the sidebar on this page.

This activity should be supervised especially during the hollowing process. If too much snow is removed there is a risk of a cave in and even a few centimetres of snow can pin a person down. Once the activity is completed the quinzhees should be dismantled to ensure that no unsupervised use occurs.

Data Sheet

1. Sample Group Placement:_____
2. Temperature: _____

3. Group was: Active( ) Not Active ( )
4. Conditions were:Windy ( ) Calm ( )
Sunny ( )Shaded( )

Questions at the start:

1. Right now, you are feeling:	**Student 1**	**Student 2**	**Student 3**	**Student 4**
a. Freezing				
b. Chilly				
c. Cozy				
d. Toasty Warm				
d. Burning Hot				
2. Right now you are feeling:				
a. Rested				
b. Tired				

Questions at the end:

1. How are you feeling right now?:	**Student 1**	**Student 2**	**Student 3**	**Student 4**
a. Freezing				
b. Chilly				
c. Cozy				
d. Toasty Warm				
d. Burning Hot				
2. Would you say that now you are…:				
a. Rested				
b. Tired				
c. Completely Wiped Out				

Poetry Trail

Objective:
To give students an opportunity to write various types of poetry in a forest setting.

Subject:
Language Arts

Curriculum Links:
Grade 8 Language Arts – Poetry

Duration:
Half a day

Group Size:
Any

Setting:
Outdoors

Materials:
Clipboard, pencils, Poetry Trail activity sheet (p.80) (one per student), thesaurus (one per group)

ENGAGE

1. Take the class outdoors. Designate four different writing stations within the area. It could be four spots within an evergreen forest, in a grassy field, under the willows, in a woodlot, or in a city park.
2. Provide each student with a copy of the Poetry Trail activity sheet.
3. Divide students into four groups and send each to a different writing station
4. At each location, have students use one specific sense to explore the area and develop a list of descriptive words based on that sense. For example, if they choose the sense of touch, a student may write down words like "rough", "sharp", "warm", or "cool". Then have them write one of the types of poems listed on their Reference Sheet, using this vocabulary. (The poetry may be directly or indirectly associated with trees or forests.) Encourage students to use a different sense and a different poetry style at each station.
5. At set times, rotate the group so they have a chance to write at all the stations. Once all stations have been visited by all groups, share some of the poems as a class. Have your students pick at least five new words from a thesaurus and write a poem that summarizes the day's experiences.

EXTEND

Using slide film, take several pictures at each station. Have students prepare a forest slide show based on these pictures and their poetry.

Poetry Trail

Activity Sheet

Name: _____ ***Station #:*** _____

Which sense have you chosen? Check one.

Hearing _____
Sight _____
Touch _____
Smell _____

Some common descriptive words ***Synonyms from a thesaurus***

_____ _____
_____ _____
_____ _____
_____ _____

Poem

Which type is it? _____

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Poetry Trail

Reference Sheet

Poetry Styles

1. **Acrostic:** verses where the first letters of each line name someone or something or convey a special message. for example,

b usy	**n** atural
i nteresting	**a** always
r efined	**t** ruth
d azzling	**u** ntouched
s pirited	**r** aw
	e verlasing
= birds	= nature

2. **Alliteration:** verses where all the words begin with the same letter. *For example,*
   Two tall trees try to touch tenderly.
   Five freaky frogs fight fearlessly.

3. **Haiku:** a form of Japanese poetry that follows a structured pattern. *For example,*

Line 1: 5 syllables	Soft wings fluttering.
Line 2: 7 syllables	Bright colours flying through air.
Line 3: 5 syllables	Lovely butterfly.

4. **Windsparks:** versus with the following pattern:

Line 1:	"I dreamed"
Line 2:	"I was" (someone or something)
Line 3:	Where
Line 4:	Action
Line 5:	How

Example #1,

I dreamed
I was poison ivy
In the woods
Providing itches and rashes
Gleefully

Example #2,

I dreamed
I was a leaf
Growing in the forest
Providing food for catepillars
Unwillingly

5. **Cinquain:** versus with the following pattern:

Line 1:	one word title
Line 2:	two words describing title
Line 3:	three words showing action
Line 4:	four words showing feeling about the title
Line 5:	one word (simile or metaphor for title)

Example #1,

Water
Still, quiet
Reflects, listens, shimmers
Waiting for a splash
Silence

Example #2,

Trees
Monumental, majestic
Towering, soldiering, guarding
Whispering giants standing tall
Sentries

The Forest Sponge

Erosion is the gradual loss or wearing away of the earth's surface by the action of wind and water.
Forest cover, which includes trees and their soil-gripping root systems, shrubs and plants, mosses, and forest litter, acts like a giant sponge and helps to reduce erosion by absorbing rainwater and releasing it gradually.

EXPLORE

1. Have students brainstorm and design their own experiments that will demonstrate how forests help prevent soil erosion. Alternatively, use the experiment that follows:

a) Place two plastic flower pots with holes in the bottom into the mouths of two 1 L jars. Place filter material* (e.g., felt) on the bottom of one of the flower pots. Add one cup of potting soil to each flower pot. Measure and record the depth of the soil.

b) Ask your students to predict what will happen when water is poured into each of the pots?

c) Carefully pour 1 L of water into each flower pot. Allow the water to drain into the jar.

d) Have your students use the experiment sheet to record the amount of water that drained through the two pots, the clarity of that water, and the amount of soil left in each pot (either by measuring with a metric ruler or transferring the remaining soil back into the measuring cup). Share observations as a class. What are the differences in the colour and the amount of drainage water and the amount of soil remaining in the two pots? How does this compare with student predications? Have the students explain how this experiment illustrates the role of of forest cover in erosion prevention.

EXTEND

Try using a layer of leaf litter or moss in place of the felt layer to act as a filter paper.

Objective:
To give students an opportunity to demonstrate how forests can help prevent soil erosion.

Subject:
Science

Curriculum Links:
Grade 5 science, Resources
Grade 6 Science, Ecosystems
Grade 7 Sciience, Renewable Resources

Duration:
45 minutes to 1 hour

Group Size:
Small group

Setting:
Indoors

Materials:
Two plastic flower pots with holes in the bottom, small piece of filtering material* (felt or coffee filter paper) two 1 L jars, two cups of potting soil, measuring cup, water, paper towels, container for used wet soil, bucket (or large jar) to hold water, plastic table-cloths, experiment

The Forest Sponge

Experiment Sheet

Name: _____ Room: _____ Grade: _____

	Jar 1 **No Felt**	Jar 2 **With Felt**

Amount of drainage water:

1 L

1/2 to 1 L

Less than 1/2 L

_____

Clarity of drainage water:

Muddy

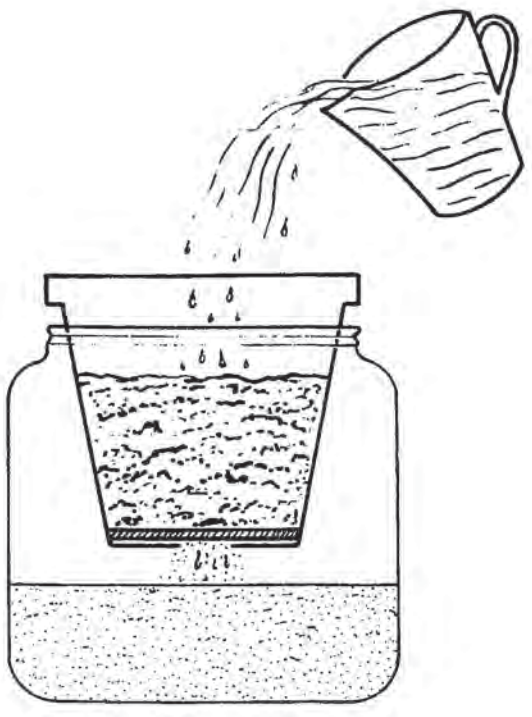
Murky

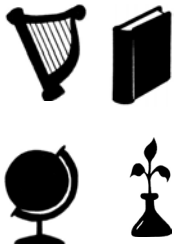
Almost clear

Clear

_____

Amount of soil remainig in the flower pot:
(in cm. or cups)





Rap-A-Tree

ENGAGE

To create interest, present the sample rap songs to the students.

EXPLORE

Students may choose a Forest Fact Card to obtain information about a tree species or alternatively do research in the learning resource centre. Accurate tree information is necessary and important. Research will also help the students find more adjectives and rhyming words. Students should choose a tree from Saskatchewan but may choose one from the rest of Canada or from another country.

Students may go outside in groups of two and visit a tree on their playground, making observations that can be used to create a rap song. Students can add as many observations as possible to the fact card provided, or they may want to research a tree of their own interest. Aesthetic value, biological or other interests concerning a tree may be used as the basis for a song.

Students should write their rap songs and then rehearse to insure a smooth flow. The use of rhythm instruments or background rap music may help the pace and add to creativity. Have the students present the rap song to the whole class. After each performance, the tree could be discussed and its ecology explained to the rest of the class.

Objective:
To give students an opportunity to create a "rap" song about a tree.

Subject:
Music, Language Arts, Science, Social Studies

Curriculum Links:
4 science, plant diversity
5 science, plant structure and function
3-5 social studies, interdependence
6,7 language arts, writing, educational drama

Duration:
1 or more periods

Group Size:
Class or small group

Setting:
Indoor or outdoors

Materials:
Forest Fact Cards, pencil and paper, rhythm instruments to keep the beat or taped instrumental rap music.

Teaching Notes:
Trees each possess their own unique and beautiful features. Refer to the Forest Fact Cards (p. 86) on Saskatchewan species for individual information or have the students research a tree species of their own choosing. This experience would be most inspirational if done out of doors.

EXTEND

Videotape the Rap-A-Tree performance to share with care partners or students' families.

Write out a collection of rap songs and compile in a songbook, complete with illustrations of the tree and/or pressed leaves of the feature tree.

Sample Rap Song:

Pine Tree
"Pine cones, pine cones, on top of the trees
Hear the branches swing'n in the breexe
Smell or touch that sticky sap
Smell or touch that sticky sap
Hey! This is the pine tree rap"

Collin Phillips (Age 8)

Send us your Raps!

If your class manages to produce a stellar Rap that you want the world to see then email us your submissions to info@whitebirch.ca. We'll post it on our website www.whitebirch.ca!

Forest Fact Cards

Students may choose a tree species from those below or research their own choice.

Jack Pine

- leaves are two flat needles in a sheath and slightly twisted
- cones are hard and curve slightly
- survives well on poor sites such as sandy and rocky soil
- root system is wide spreading and moderately deep
- wood is moderately hard and heavy, not partcularly strong
- normal height can reach 12 to 18 metres
- trees are used for general construction, pulp, railway ties and mine timbers

White Spruce

- quite a shade tolerant tree and able to maintain its branches low on the trunk, except in dense stands with little light penetration
- cones are 2-5 cm long, slender and cylindrical
- sharp, four-sided bluish-greem needles
- often found growing on moist, well drained silty soils and growing in a mixture of other trees
- an average height of 25 metres, but can attain a height of 36 meters
- the roots are pliable enought that Indian people could use them to lace together birch bark on canoes
- an important tree to the lumber and pulp industries

Tamarack

- called a larch
- deciduous soft green needles grown in clumps; turn orange-yellow in the autumn and fall off
- bark is brown and smooth on young trees, turning reddish-brown and flaky on mature trees
- cones are small, brown and oval
- found growing in cold, wet and poorly drained places such as muskegs
- shade intolerant and is rarely found in pure stands
- used for railway ties, poles, boat building and pulpwood

Manitoba Maple

- has an irregular shape where the truck divides near the ground into a few crooked limbs
- oftem found along lakeshores and banks of streams
- Only Canadian maple with leaves that are dividied into several parts or leaflets (ranging from 3 to 7 in number)
- reaches a normal height of 12 to 15 meters
- male and female flowers found on separate trees
- children like this tree because the branches make it easy to climb
- wood is used for box construction or as “rough lumber”
- the sap can also be used to make maple syryp

Black Spruce

- in stands, develops a straight trunk with very little taper from top to bottom
- cones are about 2.5 cm long, pointed and have an egg shape
- bark is thin and scaly with a dark greyish-brown colour
- often found growing near tamarack
- wood is soft, relatively strong and nearly white
- wood is of great importance in the pulp wood industry because its long fibres add strength to paper products

Trembling Aspen

- slender tree with a long cylindrical trunk and a short rounded crown
- tree is known as a “fire species” because it does so well in reproducing after a fire
- roots form new trees by “suckering”
- often grows in pure stands and is intolerant of shade
- leaves re round with a slight point at the tip and small teeth on the edges
- leaf stalk is flat which allows the leaf to flutter or “tremble” in the wind, creating a noise
- used mainly for pulpwood, although some select logs may be used for veneer and plywood

Forest Soils: Can You Dig It?

Objective:
To give students the opportunity to demonstrate how forest soil compaction is affected by a number of variables.

Subject:
Science

Curriculum Links:
Grade 5 Science, resources;
Grade 6 Science, ecosystems;
Grade 7 science, renewable resources;

Duration:
Two 45 minute to 1 hour sessions

Group Size:
Small group

Setting:
Indoors

There are many factors to ensuring forests are managed in a sustainable way and it goes without saying that responsible management starts from the ground up! One of the main concerns in forest operations is how the soil is preserved and maintained during forest operations. Besides the obvious risks of soil erosion and siltation of streams the amount that the soils are compacted during operations can have a dramatic effect on how well a forest grows back once harvesting occurs.

Soil compaction can affect the success of reforestation efforts in an area. If the soil is too compacted than the new seedlings may have difficulty spreading their roots and die due to lack of nutrients. Soil compaction can also have a negative effect on residual plant life left in a harvested area. Roots damaged by soil compaction are less likely to sustain a tree and cracks provide access to disease and insects. Therefore, trees left in an area to act as a seed source and habitat for animals may be blown down easier due to a weakened root system.

There are several techniques used to reduce soil compaction or its effects on reforestation. One way is to reduce the amount of area affected. Machines used to harvest cut blocks follow laid out trails to reduce the area affected. Once harvesting has completed the compacted areas are loosened up with machinery. Another approach is to use machines with wider tracks or tires. This spreads the weight of the machine over a larger area and reduces the amount of soil compaction overall.

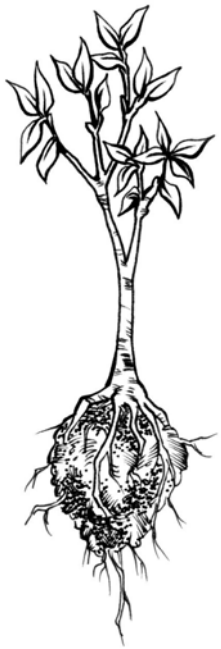
Some soils compact very easily. Soils with high clay content and moist forest soils with a lot of organic material tend to compact a lot. One solution in these instances is to hold off harvesting until the winter time when these soils are frozen. That way soil compaction is prevented altogether. This option also has the added benefit of reducing the effects of siltation and soil erosion on water bodies which soils in these areas are prone to.
Finally, reducing soil compaction can also be solved by not having the machines travel on the soil at all. Using the debris left in a cut block as a mat of vegetation the machines are able to float over top of the soil and reduce soil compaction. This has the side benefit of mulching residual vegetation and accelerating its absorption into the forest soils.
Preventing soil compaction is an important element to sustainable forest management.

Materials

1) Four large plastic flower pots or large plastic bowls
2) A weight with a flat surface. Preferably 4 to 6 cm in diameter and weighing approx. 1 Kg.
3) One hard, flat plastic disk (approximately 12cm in diameter)
4) Clay soil
5) Sandy soil (or just sand)
6) Potting soil
7) A Pail of Water
8) A bundle of twigs
9) A Ruler

EXPLORE

1. Put the different types of soil in the flower pots. Place clay soil in two pots.
2. Make sure to plug the holes on one of the flower pots with clay soil. Add water to all to make the soil moist but not soaking.
3. Allow the soil to settle overnight.
4. Place the plastic disk in one of the pots and set the weight on top of it. Allow it to sit there for 30 minutes.
5. Remove and measure the amount the soil has depressed.
6. Set the weight in the same pot without the disk and allow it to sit for 30 minutes.
7. Measure the depression made this time by the base the weight.
8. Continue using the plastic disk & weight with the other soil types.
9. Leave the pots undisturbed for 24 hours and measure the depressions again.
10. Compare how much each soil type depressed and how much they sprung up over 24 hours, if at all.



Questions to consider

1. Was there a difference in compaction among the different soils?
2. How did the water/clay mixture compare to the other soils?
3. If we added water to the other pots would it have the same effect as it did with the clay/soil mixture?
4. Why would plants find it difficult to grow in compacted soil?
5. What would have been the result if our weight had been narrower?
6. Besides spreading the weight over a broader area what other things could we do to reduce soil compaction?

EXTEND

Place the flower pots in the freezer over night and then do the same experiment. Measure the amount of compaction. Return the pots to the freezer for 24 hours once you have done the test. Remove them from the freezer and compare how much each soil type depressed and how much they sprung up over 24 hours, if at all. What effect did freezing the soil have on soil compaction?

Using unfrozen soil, place a pile of twigs on top of the soil before placing the glass. Remove the twigs to observe the depression left. Compare this to your original results. What effect did the twigs have on soil compaction?

Forest Management Model

Objectives:
To give students an opportunity to build a model that represents the changes and disturbances that can occur in a managed forest.

To convey to students that forest managers have the power to decide how a forest will look and what uses it will serve.

Subjects:
Science, Arts Education, Social Studies

Curriculum Links:
Grade 6 Science, Ecosystems

Duration:
2 – 2 1/2 hours

Setting:
Indoors

Group Size:
Full Class

Many of the forested areas in Saskatchewan are actively managed. This usually includes the extraction of resources including wood products, oil and natural gas. To ensure long term sustainability both practices and legislation are in place to promote responsible use of the forest resource. Primarily the incorporation of the management cycle will help to maintain long term sustainability of the forest resource.

Forest Management

The management cycle can be seen as having six steps: planning, harvesting, site preparation, regeneration, tending and protection. Of these, the planning is the most important as it determines what the forest will look like in the future and what uses the forest will have.

Planning

Managing a forest is a little like faming. Before doing anything, a farmer must first sit down and plan the farm. Decisions must be made about what to grow and where. In order to make these decisions, the farmer needs to know how much land is available for planting and also what crops will sell well at the market.

Once these decisions have been made, the farmer must set up a schedule to be followed, including all the steps necessary to grow and harvest a successful crop. These steps include preparing the soil for planting, planting the crop, and taking care of it as it grows by weeding, thinning, and protecting it from fire, insects, and disease. Finally the crop is ready to be harvested and sold at the market.

Like the farmer, the forest manager must follow steps to ensure a healthy, productive forest. Unlike the farmer, who may harvest a crop every year, the forester may wait for 50 to 100 years for trees to reach maturity. In addition, the amount of forest to be managed covers millions of hectares and includes a wide variety of users. In **planning** for forest management, managers must

also consider maintaining or enhancing the value of certain areas for other users. For example, cutting practices may be modified to create wildlife shelter and feeding areas. Managers also consider when it is best not to harvest an area. This is known as management based on ecosystem type.

Harvesting

Before harvest begins, forest managers must take **inventory**. This allows for calculations on how much wood there is and how much can be harvested on a sustainable basis. Just like the farmer, the forester must choose a suitable **harvesting** technique. Depending on tree species, size and location of the area being cut, and the type of regeneration planned, different techniques are used to harvest the trees.

Site Preparation

Once the wood is cut and hauled away, the regeneration plan is put into action. For artificial regeneration, **site preparation** is the first step. **Mechanical site preparation** using heavy machinery (such as bulldozers) does the same thing to the forest floor that farming equipment does to farmers' fields. However, the forest floor is less workable – there is logging debris (**slash**), which needs to be removed, crushed or aligned into rows, and the moss and needles, or **duff layer**, that cover the soil must be reduced. Often big skidders or tractors pull a piece of equipment that helps to expose fresh patches of mineral soil. The type of site preparation used is determined based on the characteristics of the area. While some areas require extensive site preparation to make sure a forest grows back others require very little. Species type, soil type, amount of residual materials left in the block as well as the water table are all factors that need to be considered when preparing a site.

Regeneration

Natural regeneration occurs in many instances after harvest. Allowing the forest to regenerate without human assistance is often an option for the forest manager. There are other methods to renew a **cutover** area. If there are no natural seed sources, seedlings grown in nurseries may be planted by hand or machine. By planting or seeding, foresters may choose the most appropriate species of trees to be grown on a site and speed up the forest renewal process.

The Cutting Edge: Harvesting Techniques in Saskatchewan

There are three main harvesting techniques used in Saskatchewan:

Clear cutting is most often used and involves the removal of all the trees in a stand at the same time. This technique is used where all trees are of similar age. The area is either replanted or left to regenerate naturally.

Strip cutting involves removing trees in strips or blocks.

Selection cutting involves the harvesting of selected mature trees, leaving the majority of trees standing.

There are two main methods used to harvest wood from the forest:

The **cut and skid** method uses chain-saws and skidders (tractor-like vehicles used to pull logs out of the forest).

Mechanical harvesting uses large mechanized equipment with cutting heads to cut and carry the wood to the roadside. Mechanical harvesting is by far the most popular method used today.

Tending

Tending the forest is somewhat like weeding a garden. After the new seedlings have been established, foresters tend the crop to promote good growth. This may involve periodic **thinning** or removal of some of the poorer, slow growing trees to make room for others to grow. Tending trees in this manner ensures a more vigorous forest, which is more resistant to pests and disease.

Protection

Once a forest is well established and on its way to maturity, the forest manager can sit back and relax, right? Wrong! Forest must be continually watched over and **protected** against **fire, insects,** and **disease.** Fire, often a natural phenomenon, can quickly sweep through a forest, killing the trees and damaging the soil. The Province of Saskatchewan has a complete fire detection system to prevent widespread fire damage. The system includes routine air craft checks and the use of lightning detectors to target areas where forest fires are most likely to occur. In Canada, lightning causes three out of every 10 forest fires; people start the rest. Once a fire has been spotted, it is put out using a variety of technologies, including everything from shovels to specialized aircraft that water-bomb the flames.

Did you Know...

Together, forest industry and government plant more than 15 million seedlings in Saskatchewan's forests each year.

Commercial forests also need protection from a variety of insects. In addition to insects that **defoliate** trees, there are borers, sucking insects and mites, gall-makers, and root feeders. The spruce and jack pine budworm and forest tent caterpillar all defoliate trees. Since tree leaves make the tree's food, few trees can withstand defoliation for several years in a row.

There are several ways to control these damaging pests. **Biological control** using natural **parasites** (bacteria or virus) is used, as well as **mechanical removal** of the infested tree. **Breeding** resistant tree species is an ongoing process for research scientists.

Once the trees have reached maturity, they are harvested and the cycle begins again. The art and science of planting and tending the forest to maturity is known as **siliviculture.**

Forests for All

Forest managers are increasingly aware that forests are utilized by many people and each has their own needs and desires for the resource. Increased public access to an area via all season roads promotes use by campers and hunters and also increases ease of access for fires crews. However, in many cases increased access is not desirable. Access can be restricted by bulldozing mounds of earth across the road entrance after harvesting is completed. Snowmobiles and all terrain vehicles might be able to gain entrance – or they might be excluded if it is decided that the area should be a wildlife sanctuary. There are many choices to make and no single 'perfect' plan.

We're All Responsible for Forest Management

Everyone can make important contributions to managing Saskatchewan's forests. We can care for the trees that grow around us, help prevent forest fires, clean up wooded areas. Repair vandalism, encourage others to respect the environment, and increase awareness among the general public of the need for conservation and responsible attitudes.

Did You Know...

Each year, about 25,000 hectares of forest are harvested. All of this area must be renewed - it's the law.

ENGAGE

1. Ask the students to name as many different types of forest uses as they can think of (some examples might be: pulp and paper, hunting, snowmobiling, picnicking, berry picking, hiking, trapping). List the students' suggestions on the board.

2. Outline with your students the basic steps involved in managing a forest. Explain that forest managers are responsible for all the steps outlined.

3. Divide the class into groups of six. Assign the task of managing a forest to each group. Explain that they must first decide what they want their forest to look like, how big it will be, what types of trees and animals will live there, whether there is a river or lake nearby, who owns it, and how it will be used (refer to their list of forest uses). Ask them to consider what sorts of management activities they might need to accommodate the different uses they have selected.
   The students should come up with a management plan for their forest which specifies:
   What uses are allowed
   Where these uses are allowed
   What limits there will be to development

4. Have each group appoint one of its members to record the key points of the plan.

5. Once they have made their decisions, have each group draw a sketch of its forest showing some of the management activities that might occur there (these will vary depending on the group's objective and may include harvesting, tree planting, forest fire fighting, clearing trails for hiking, etc.).

6. Next, have each group write a brief description of the activities depicted in its sketch. Have each group share its sketch and description with the class.

EXTEND

1. Based on their sketches, have your whole class, or in groups, paint a mural or build a model of the forest management cycle. Use some of the following ideas:
   a. Modeling clay on hardboard could serve as "soil" in which to plant trees. Alternatively, make salt and flour (play dough) relief map models.
   b. Toothpicks, Popsicle sticks, tissue paper, construction paper and real twigs or branches could be used to simulate trees of various ages.
   c. Cinnamon sticks make great logs (at the harvesting stage).
   d. Broken twigs can serve as stumps to help simulate a cutover area.
   e. Represent the forest protection stage with a model of a forest fire being fought by fire crews. Fire hoses could be made of narrow plastic tubing. Crumpled yellow and orange tissue could represent flames.
   f. Make people and animals out of clay or cardboard, or use commercially available models.
   g. Shake dried parsley or basil onto fresh glue for ground cover.

2. Have the students use the Internet or other resources to research their forest management decisions.

Materials:
Flat surface such as a table top or wooden board, modeling clay, construction paper, toothpicks, Popsicle sticks, twigs, cinnamon sticks, tissue paper, plastic tubing, dried parsley or basil, pencils, paper, paints.

Resources:
Examples of land use plans for the forested areas can be seen by going to: www.serm.gov.sk.ca/ecosystem/land%20use/default.asp.

Urban Forest Fever

Objectives:
To give students an opportunity to discover the concept of urban forests and to learn about the benefits that this forest provides.

Subjects:
Science, Language Arts

Curriculum Links:
Grade 5 Science, Plant Structure and Function,
Grade 6 Science, Ecosystems,
Grade 7 Science, Renewable Resources in Saskatchewan,
Grade 8 Science, Plant Growth

Duration:
1 hour

Setting:
Outdoors

Oddly enough, many of us live in communities with thousands of mature trees, yet we feel we live too far from a forest area to actually study such a thing. However, if one looks down from a tall building in some of the more mature areas of our communities at the height of summer, the only things you see are trees with the odd building rising above the canopy. It is very much like looking down on the canopy of a naturally wooded area.

What we have in our communities are "urban forests". This forest may be artificially created, but it is a forest none-the-less and we would find our communities a much less enjoyable place to live in if these trees weren't around. In fact, urban forests are known to provide many benefits such as:
-reducing heating costs in winter and cooling costs in summer
-providing shelter from wind
-reducing pollution levels
-providing food and shelter to birds and animals
-increasing real estate value
-providing beauty and softening of the landscape
-and even reducing crime rates

It is a very worthwhile exercise to study our urban forests so that we can better understand the advantages that they provide us with. In turn we can learn how to maintain that forest from insect, disease, and environmental threats. The following activities will help to connect students to their urban forest home.

ENGAGE

Materials:
Oblique views of urban & natural forests
Sketch paper & pencils
Light meter (may be available from school dark room)
Wind speed indicators
Thermometers

To introduce your class to the concept of urban forests, show them the oblique views of both urban and natural forests and see if they can tell which forest is which. Ask the students what clues they used to correctly determine which forest was the "urban forest". Were they surprised that the forests looked so much the same?

Once students realize that they do in fact live in a forest, ask them to brainstorm what they think might be the advantages of living in a treed environment like this. Are there also some negative things that could come from living with so many trees around? Explain that the upcoming activity will be based on determined both the advantages and disadvantages of an urban forest.

EXPLORE

To help students appreciate the impact that a mature urban forest has on our environment, have half of the class visit an open area like a school yard and the other group visit an area with mature trees to describe and document both locations. After the observations are complete, have both groups get together again to discuss their findings.

Have students review the tools they will need to take measurements of the two locations they are visiting: namely a thermometer, a wind speed indicator and a light meter (this is likely available through a school photography program). Ask students to take specific measurements of the temperature, wind speed, and light levels in each area along with recording their general impressions of each site.

Once students have completed their measurements have them reassemble and present their findings to the rest of the group. At this point you may ask students to hold a debate where one side takes the position that urban forests are a good thing to have, whereas the other side feels urban forests are more trouble than they're worth.

Resources:

Hosie, R. C. Native Trees of Canda. Fitzhenry & Whiteside Ltd. Don Mills, Ontario. 1979.

Iverson, Diane. My Favourite Tree. Dawn Publications. Nevada City, California. 1999.

Knowles, Hugh. Woody Ornamentals for the Prairies. University of Alberta. Edmonton, Alberta. 1995.

EXTEND

1. Have students each chose an urban tree species to study in detail and present their findings to the class. Afterward, visit the urban forest in your community to try and identify these tree species.
2. If your school yard is not well treed, consider designing and planting a "pocket park" in one corner of the yard that can grow up to be part of the urban forest. The forest could represent each of the student's favourite trees.
3. Learn more about potential insect and disease threats that could affect our urban forest such as Dutch elm disease.
4. If you are able, take the class to a high vantage point that will give them a perspective of their urban forest that is similar to the images used in the introductory activity. Ask students to do sketches or journal entries of the community from this perspective.
5. Visit your community parks department to learn more about how they keep the urban forest healthy and prospering. Find out what issues they are facing and how they are going about addressing these problems.

EVALUATE

Ask students to prepare a "list" of words that compares the positive and negative aspects of living in a mature urban forest.

Integrated Resource Management

Objectives:
To convey the idea of integrated resource management.

To demonstrate a recognition of the intricacy of dealing with a number of stake holders in addressing a development issue.

To demonstrate effective communication, either directly or through a spokesperson.

Subjects:
Social Studies, Science, Performing Arts

Curriculum Links:
Grade 7 Change, Grade 8 Interdependence

Duration:
1 hour

Setting:
Indoors

This is a fictional situation with aspects of real development conflicts brought together to illustrate the process involved in integrated resource management.

ENGAGE

Divide the class into the nine 'interest groups' listed on the Interest Group Information Cards. If possible, divide them so there are two or three people per interest group. Have each group pick one member to speak on their behalf in the town meeting.

You may want to provide each group with a full set of the Interest Group Information Cards, so that they can more fully understand what other groups are represented, or just the names of the other groups that will be at the meeting.

Based on the information supplied on the Community Situation sheet, Interest Group Card and the students' own backgrounds, and what constitutes a 'good quality life' for its members, each group should decide what position it represents in relation to the situation described.

Each group should develop an argument supporting its position. Allow 20 minutes for the groups to fully formulate their respective positions, or have them prepare prior to class time. Individuals of the Métis group may, after reading their position, split and join other interest groups.

With a member of the Government Agency group (or the teacher or a teacher assistant) chairing the meeting, have the groups present and argue the merits of their positions. The chair should ensure each group has an equal amount of time to speak and that the discussion does not stray to far from the objective.

There are two issues to be resolved. First, the class to reach a consensus about harvesting the trees. If harvesting is rejected as a solution, how does the class intend to deal with the dwarf mistletoe? (Point out that a decision to do nothing is also a decision to accept a particular outcome.) If a consensus cannot be reached after 40 minutes of discussion, they should agree to meet again after an environmental impact assessment is complete. This will not actually be done by the class, but gives an opportunity to wind up the discussion.

Point out to the students how complicated integrated resource management is in a summary of the activity.

Materials:
Pictures of jack pine branches that are infected with dwarf mistletoe.

Community Situation

An aging jack pine forest has been left standing near a town. Now it is discovered that the forest is badly infested with dwarf mistletoe (sometimes called "witch's broom"), a parasitic plant that attaches itself to the branches of trees, especially jack pine. Besides retarding the growth of its host, over time, the parasite can weaken the tree, leaving it vulnerable to other diseases and insects.

As the parasite spreads, more trees are becoming infected and some are dying. This increases the 'fuel loading of the forest' (build up of dead wood), which in turn increases the likelihood of fire and increases the likelihood that, when a fire does break out, it will be a big one. Fire is a part of the ecosystem. Jack pine cones are *serotinous*. This means they have a hard, waxy coating that melts in the heat of a fire, releasing the seeds and encouraging regeneration. However, regeneration can also be achieved by letting the cones fall onto bare mineral soil that's been exposed by mechanical scarification (one method of doing this is to drag heavy chains along the ground). When the soil is exposed in this way and heated by the sun, the resulting surface temperature is enough to melt the cone's coating. Sometimes a combination of this method and replanting is used to regenerate a pine forest.

The forest surrounds a lake that is good walleye habitat, and a river in which the fish spawn.

A local saw mill would like to clear cut the forest as a way of controlling the disease and as a way to earn income from trees that might otherwise be 'wasted'.

EXTEND

1. After completing the activity, students may be asked to write a short essay outlining the resolution to the development problem which might best satisfy all of the stakeholders.

2. Research dwarf mistletoe, other forest pests and methods used to control them. If possible, visit a forest for examples of forest management, and find out solutions, if any, being used, (e.g. the local debate in Waskesiu, Prince Albert National Park, over the best way to deal with spruce budworm).

3. Use the fact that the jack pine forest is connected to a larger, northern forest as a way to discuss the concept of wildlife corridors. Have the students research what sorts of animals might benefit from large, unbroken forests (woodland caribou, martin and cougar are three examples).
4. What are the consequences of doing nothing? If the group was unable to reach consensus than have them research the inevitable effects dwarf mistletoe has on a forest. What are the economic impacts? How are the concerns of the various interest groups served in the long run?

5. Find out what an Environmental Impact Assessment is comprised of. Investigate how they are conducted and how they are used in natural resource management.

EVALUATE

Evaluate students using anecdotal records or a checklist on their ability to use the information given here in formulating their positions. How well have they presented their own group's position? Have they been able to respond effectively to the concerns and needs of other groups? If students use information from other sources, additional marks should be given.

Resources

CD Rom for PCs and Macs: *A Forest For Everyone*, available from the Prince Albert Model Forest Association, P.O. box 2406, Prince Albert, SK S6V 7G3, Tel: (306) 922-1944, Fax: (306) 763-6456, e-mail: PAMF@PAmodelforest.sk.ca or visit their web site at http://www.PAmodelforest.sk.ca.

Examples of land use plans for forested areas can be seen by going to: www.serm.gov.sk.ca/ecosystem/land%20use/default.asp.

Interest Group Information Cards

First Nations Band

As First Nations people, you use the forest for food: big game, fish from the stream and lake, blueberries picked in August and medicinal herbs growing on the forest floor. The cultural traditions of your people have strong ties with the forest ecosystem.

Band members also make some income from the pine mushroom that grows in the forest, picking the fungus from July to September and selling it to a local buyer.

Your First Nations band wants to be consulted when decisions are being made that affect their area. The band has members who work in the local saw mill. As well, your band often does contract cutting and hauling work for the saw mill, bring much needed income into your community. However, many of your band members also feel the duty to honour their cultural and spiritual traditions. They would like to see a compromise solution achieved.

Fishermen

You are a group of fishermen who also support local tourism. You are concerned that siltation caused by logging will affect the fish species in the lake and reduce populations of the more desirable fish like walleye (pickerel). Walleye require a clean, clear stream with no silt deposits on the rocky bottom for their eggs to overwinter.

Fishing in the lake will be affected by rising siltation from runoff. Siltation reduces the amount of oxygen produced because less light gets through to plants in the water.

If cutting goes right to the water's edge along the river or lake, there could be loss of lake trout and walleye species. Loss of cover along the river will result in increased water temperatures which will also contribute to decreased dissolved oxygen levels.

Filamentous algae may develop with increased light and nutrients washed in from the surrounding watershed if the removal of trees and the building of roads increases soil erosion.

Fishing draws tourists who spend money in the community when they stay at local hotels and motels.

Government Agency

You are representatives of the provincial government called upon by the community. Although you may have your personal opinions, your role is to serve as technical advisors and mediators. As the discussion proceeds, you may offer the following ideas.

Dwarf Mistletoe is a host specific species that relies on a living host in order to propagate. Large scale clearing is the only way to permanently remove the infestation. Planting of an alternative species is not an option since provincial legislation requires that a forested public lands be regenerated back to their original state.

If there is a fire in the area it will end up costing the people of the province hundreds of thousands of dollars. The threat to the community is also considerable and providing for the safety of citizens, protection of property and preservation of provincial resources is one of your department's primary responsibilities.

Working with the local government, you would be interested in seeing the town become a FireSmart™ community but currently there is no money in the budget so funding this initiative will be an issue.

Inform them that under provincial legislation a 90 metre buffer must be left surrounding a stream that bears game fish.

A study of the lake and river could be conducted to identify critical habitat for spawning and perhaps increase the width of the buffer zone in those areas. Consider a possibility of longer closure for fishing in those areas critical to spawning. Catching fewer fish or encouraging catch and release by fishermen will ensure the long-term survival of the population.

Plant inventories could be done to determine the location of medicinal herbs and protect those areas for native people. Propose a study to see how pine mushrooms recover after an area has been harvested. A similar study might be done by harvesting two small areas, one a clear cut conducted with heavy equipment and the other a selective cut conducted with lighter equipment – and monitoring plant, animal, soil and water responses.

Inform them that the saw mill operators are required by law to ensure adequate regeneration of jack pine in the areas harvested.

Recommend to the saw mill that the logging roads are blocked off and reclaimed after the harvesting is complete. This is meant to reduce access by hunters and prevent depletion of big game species and disturbance of other wildlife.

If a consensus cannot be reached, the stakeholders should be reassured that their concerns will be addressed in an environmental impact assessment (EIA), to be done by the government, and further consultation and consensus building will take place after the assessment is complete.

Hunters

You are hunters who enjoy the recreation of big game hunting and who see the wild meat as a valuable addition to your families' diet. As hunters, you are in favour of the cut since it would open up access to the area for hunting. Moose and deer will be attracted to the edge of the cut where they may be spotted by hunters. Reduced deer and moose populations may result from the increased hunting access and potential for illegal poaching.
This may cause a split in the hunters' position, with some supporting and some opposing the tree harvest. In time, as regeneration progresses, the middle-aged pine stand will provide thermal cover for wintering game animals. If jack pine trees do not regenerate in the area, there is a good chance that some browse species of plants would grow, providing improved foliage for moose and deer.

You oppose any solution that would reduce game species or would completely eliminate local hunters' access to the area.

Mayor and Council

You are elected officials who recognize a need for economic development in the community. You know that many of the jobs in town are dependent on the viable operation of the saw mill. You are also concerned about the possibility of a future forest fire which could endanger the town itself and be a financial burden since municipalities usually pay a portion of the fire suppression costs when they are affected.

The council is also interested in the idea of turning the part of the forest area around the lake into a suburban development project as lakeshore houses and condominiums would expand the tax base of the community.

Métis Locals in the Community

Cutting the timber in this old pine stand will affect the lifestyle of your local Métis people. You pick blueberries in the forest every August and wonder if the blueberries will return after the pine trees have all been cut and heavy equipment has disturbed the area.

Métis trappers and fishermen in your community are concerned about the impact the development will have on fur bearing animals and fish stocks. Métis hunters, like their counterparts in the white community, see the cut as a means to encourage growth of species which would favour the production of moose. Some members of your community see the opportunity for employment with the forestry operations. As Métis people, you are diverse members of the community and may align yourselves with other interest groups.

Natural History Society

You are local naturalists who see a need to preserve the habitat of species like the pine mushroom (*Tricholoma Ponderosum*), a desirable, edible species that, in Saskatchewan, grows only in jack pine forests.

Woodland caribou, an indicator species representative of mature pine ecosystems, used this forest many years ago. The society hopes the caribou will return in the future since there are woodland caribou in the larger forest stretching north for about 150 km. The larger forest is near the north east corner of the old pine forest.

Natural history society members, along with others from the local community, pick blueberries in the forest. Ecotourists are drawn to the area to walk in the old forest. These visitors often stop at a local restaurant for a meal.

You also know that certain bird species use the 'witches broom' created by dwarf mistletoe as habitat and worry that removing it will endanger the breeding population of songbirds in the area.

Your members do not agree with clear-cutting the forest. You feel this form of logging is too intrusive and that the data on regeneration efforts following logging is inconclusive. You are not convinced that the forest could ever be regenerated after clear cutting to the extent it would naturally be after a fire.

Saw Mill Owners

As forest operations planners, you are searching for new sources of timber. This forest is quite close to the mill and would reduce timber hauling costs. The mill is facing possible layoffs and the proposed harvest would keep people employed. The big old trees have lots of wood product potential and would yield about 18,000 cubic meters of lumber.

You are concerned that if the pine stand isn't cut, the dwarf mistletoe could decrease the value of the trees that are left and eventually affect adjacent forests. Fire may be a problem if the forest is not cut, and this too could have consequences beyond the immediate forest area.

You are confident that the most economic and ecologically viable method of harvesting this area is through clear cutting.

You are also not convinced that a 90 metre buffer is necessary throughout the area surrounding the lake and that there are techniques you can employ to ensure that the lake is not disturbed when trees within the 90 metre buffer are utilized.

You have concerns that if all the infected stand is not removed that the new crop of trees will become infested and wood quality will suffer as a result. You would be interested in attempting to plant white spruce in the area if the provincial government will allow it.

Townspeople

You live in town and are concerned about drinking water quality in the community, since the drinking water comes from the river as it passes by the community. In other situation where there have been major disturbances of the soil – such as gravel excavation – there has been increased amounts of aluminum in the water; therefore contamination is a concern. Phosphorous and lead may also be introduced into the river since they are tightly bound to the particulate matter carried into the river by erosion.

Clear cut logging, new gravel roads, and the presence of heavy equipment and workers are all things which might contribute to increase erosion and alter the hydrology. The increase in runoff in the spring would be even greater as the snow would melt faster as it will now be exposed to direct sunlight. Until the trees regrow, they will not be there to take up the water and release it through evapo-transpiration. The changes in stream flow may result in flooding, and many homes in the community are along the river.

You are also concerned about how the area will look after all this change occurs. You moved out here to enjoy the natural scenic beauty the forest and the lake had to offer. You didn't move out to the woods to live on a moonscape and if they clear all the trees then you fear that is what will become of your 'paradise in the pines'. You are concerned for your safety but would rather find a solution that preserves the natural beauty while costing you nothing more.

Living in the Phoenix's Nest

The mythological bird known as the phoenix would burn itself in its nest at the end of its life cycle and a new Phoenix would emerge to take over. Forests in Northern Saskatchewan are like the Phoenix's nest because; through the destruction of the old forest a new one is created.

Fire plays an integral part in the rebirth of the boreal forest of Saskatchewan. Forests tend to accumulate a considerable amount of dead plant material over time. Trees fall down as a result of wind, insects or disease. The summers are too short for decomposing organisms to break down all the plant material that piles up so, over time, all this dead plant material builds up and locks away valuable nutrients from new plants. Fire is a very effective agent in transforming that dead material into fertilizer for new plant growth. The ash remaining after a fire is rich in nutrients and helps jumpstart the new forest.

Over thousands of years the forests of Saskatchewan have adapted to the presence of fire. Plants have adapted to the recurrence of fire. Pine cones, scorched by fire, drop seed which helps start a new forest. Like the phoenix, the new pine tree grows out of the ash made by the destruction of the old. Animals, too, have also adapted to fire. Since fire tends to leave a patchwork of old and young forest, animals that fled the destruction of the fire, return to fresh young plants that provide a plentiful food source. When predators appear these same animals find cover, either in the grasses found after fires (like the red backed vole) or the adjoining old stand of trees (for moose and other large ungulates).

Objective:
Students will understand positive and negative effects of wildfire fire and will begin to form their own opinions about it.

Subjects:
Science, Social Studies

Curriculum Correlations:
Science 7: The Land;
Social Studies 7: Resources;
Science 8: Adaptation and Succession;

Duration:
Two 45 minute to 1 hour sessions

Group Size:
Small Group/ Whole Class

Setting:
Indoors

Humans have historically been threatened by the existence of fire in the environment. As a result there is a long history of our attempt to control and prevent it from harming us. Fires can threaten personal property, natural resources that people depend on as a livelihood, and even, in some cases, human life. The 20th century has seen the attempt to eradicate fire from the landscape in western Canada.

History has taught us a number of lessons though. First of all we know that removing fire from the landscape is an impossible task. Thousands of years of adaptation cannot be changed in less than a century. We have also learned that, because many species have become dependant on large-scale change in the forest, removing fire from the landscape isn't completely desirable.

Did You Know??
Each year, forest fires affect about 300,000 hectares of forest land in Saskatchewan.

History has also shown us that, under proper conditions, fire can teach us how to better manage the landscape. Fire provides us with a tool to develop habitat for species that rely on new forests; allowing natural processes to work on the landscape provides their habitat needs. Natural disturbance modeling has also shaped the way forest harvesting occurs where the forest resource is valued for timber. Leaving small stands of trees in cut blocks and making cut areas with irregular edges are a couple of ways that forest companies have applied research in to forest fire into their forest management strategies.

Still, problems arise when people and fire come into contact. As communities expand into nearby forested areas there are more threats to property damage and threats to human safety due to wild fires. The aftermath of a fire is often dirty, ugly and poses real danger to people who need to work in it afterwards. Standing burned trees can be a safety hazard and the blackened forest will take time to grow back.

Many communities that exist in the forest are taking steps to reduce the danger from wildfires. Some of the ways that communities reduce the threat of wildfires on their residents is; develop fire breaks around their community, "thin" the existing forest by mechanically removing some of the trees, provide wildland fire training to local fire department staff, educate residents on ways to fire proof their homes and develop

emergency response plans in case a fire threatens the community. All of these are preventative measures that help reduce the threat to a community, not eliminate it.

Another method is the use of prescribed fire. Prescribed fire is the intentional, planned use of fire by a land agency under controlled settings. It is used to reduce the amount of flammable material in the forest (often called forest fuels). This reduces the threat of fire and reduces the intensity of a fire that burns through an area since there is less to burn. Rarely, but occasionally, prescribed burns "escape" and cause damage to human valued resources and properties. This is usually due to an unpredicted change in the weather. Prescribed fires also help in the promotion of wildlife habitat, forest pest control and wildfire personnel training.

The relationship between humans and fire is complex. Considering the changes that humans have done to the forest and the important values we derive from it, allowing fires to burn uncontrolled would pose challenges to everyone including communities and government. However, understanding the important role of fire, it is our destiny to co-exist with fire on the landscape in some form or another. We live in the nest of the phoenix and benefit from the complex interactions that have provided us with the forest we know today. Understanding those complexities and learning to live with the forest is a great challenge that will shape our view and use of the forest for the next millennia.

ENGAGE

Using the information provided in **Living in the Phoenix's Nest** as a starting point discuss how humans and fire coexist and how we also come into conflict with each other. Next, have the students discover more about fire through their own research.

Two years ago the community you live in was threatened by wildfire. The fire came very close to the townsite but fortunately, due to a combination of the weather changing and efforts of firefighters, the threat to the community was averted. Although there were no injuries several people who lived outside of the town were evacuated and the evacuation order for the town was no more than an hour or two away. Since then people have been very concerned about the ongoing risk of forest fires to their community. The town council has decided to have a public meeting to gather public input into the proposed fire management plan. This fire management plan will consist of the following parts:

- A firebreak that will leave a 100 m buffer between the town and the forest.

- A plan to prescribe burn several areas outside of the fire break to reduce the intensity of any wildfires that do come near the town in the future.

- A municipal tax hike to pay for these improvements, as well as cover the cost of sending the volunteer fire fighters on a training program where they will learn how to better prepare for wildfire threat to the community.

Suggested Roles

Park Manager: biodiversity, maintaining wildlife habitat, public safety in recreation areas.

Forest Manger: managing the forest resource, reducing fuel load, public safety.

Owner of a home adjacent to the forest: natural beauty of the area surrounding your home, safety for your family.

Forest products company: access to timber, profits, community goodwill.

Environmental/ conservation group: preservation of the environment, wilderness experience.

Town Council: creating fire breaks/ buffers around the town, costs associated with wildfires.

EXPLORE

Have the students participate in a roleplay activity. The scenario in the side bar on the previous page will provide you with a scenario that could very easily exist in several Saskatchewan communities today.

1. Divide the class into groups of four students. Each group will select a role to play. Some suggestions are listed in the side bar. You could also have students come up with other perspectives and research what their position on the issue might be. Discuss with the class some of the perspectives each group might have on fire in their community. Concerns each of the sample groups might have are listed for convenience.

2. The group that assumes the role of town council will be responsible for researching community wildfire management plans and presenting their plan to the rest of the groups. Any maps or diagrams they develop to explain their position would be helpful.

The other groups will each provide a short presentation along with a few prepared questions for the Town Council. The groups should answer the following questions to help guide their presentation and questions to Town Council:

a) How would you feel about fire in your area?
b) Would you feel different if it was lightning caused or human caused fire?
c) List your positive and negative views about fire.
d) What, if anything should be done to protect your community from fire.

3. Following the role play, in a large group, discuss the similarities and differences between the groups' perspectives. Address how education about fire management may influence some people's opinions about fire.

EXTEND

Have each student write a letter to another team explaining what new item they learned about fire and fire management from them. As well, the letter should reinforce the messages the group tried to convey in their own presentation.

New Paper from Old

Objective:
To give students an opportunity to make paper by hand.

Subjects:
Science, Visual Arts, Social Studies

Curriculum Links:
Grade 4 Social Studies, Resources and Industry
Grade 5 Science, Resources
Grade 7 Science, Renewable Resources

Duration:
30 to 45 minutes
Group Size:
Small group, class

Setting:
Indoors

Materials:
Scrap paper, plant and vegetable scraps, non-toxic fabric dye, staples, tacks or waterproof glue, two wooden frames (approximately 20 cm x 15 cm), nylon screening, kitchen cloths (porous type), blender, sponge, iron, large plastic basin

Background Information

Paper can be made from almost anything that contains fibres: cotton, hemp, flax, or manufactured fibres. Rags were used when paper was first made in Canada during the early 1800s. Canada's first pulp and paper mill was built in Valleyfield, Quebec in 1866. Today, there are over 100 pulp and paper mills in Canada, with some located in every province except Prince Edward Island. These mills use about 60 per cent of the wood extracted from Canada's forests each year.

Two types of wood used for making paper: softwood (from pine, spruce, fir) produces strong paper; hardwood (from maple, poplar, birch) gives weaker but finer paper.

Writing paper is made up of millions of tiny fibres. These fibres originally formed the main substance of the wood. The first step in the papermaking process is to debark, grind, and /or chip logs. Next, chemicals are added and the whole mass is cooked under high steam pressure. This processing collapses the wood fibres into microscopic ribbons. The wood fibres are then dispersed in water. Fine screens lift the purified fibres, allowing the water to drain away. The purified fibres dry into sheets of paper.

ENGAGE

1. Staple nylon screening tightly to one wooden frame to make a paper "mould." The second frame without the screen is the "deckle," which will help make the edges of the paper more even.
2. Remove any plastic or staples from the scrap paper and tear it into small pieces (about 2 cm^2). Soak it in hot water for half an hour.
3. Put a handful of the soaked paper into a blender half full of warm water. Blend at moderate speed until you no longer have pieces of paper. (If you have problems, take out some of the paper.) Add small amounts of plant or vegetable scraps into this mixture (pulp) and blend again. If you want coloured paper, add fabric dye.

4. Pour the mixture into a large plastic basin half full of warm water.
5. Place the deckle on top of your screen. With both hands, dip the mould into the basin and scoop up some of the pulp. (The thickness of your paper will depend on the amount of pulp.) Gently shake the mould back and forth to get an even layer of fibres on the screen. When the water has drained through, place the mould to one side and carefully lift off the deckle, leaving the just-formed sheet on the screen
6. Lay a clean kitchen cloth on a flat table and lay the screen face down on the cloth. Soak up any extra water from the back of the screen with a sponge. Lift the screen very gently – the paper should remain on the cloth.
7. Cover the paper quickly with another cloth and iron at a medium dry setting. Once dry, pull gently on either side of the cloth to stretch it – this helps loosen the paper from the cloth. Gently peel the paper off.
8. Compare the strength, colour, and texture of homemade paper to that of the different types of paper used in the classroom. Have students point out similarities and differences.

EXTEND

1. Use the homemade paper to make personalized stationery or greeting cards with potato prints or poster paints.
2. Papermaking machines in modern factories can produce up to 48 km of paper per hour. Have your students investigate this process. Ask them to determine how it is similar to and different from making paper by hand.
3. Challenge students to create a list of all the ways they can reduce paper garbage at home and at school.

Teaching Notes:

Be careful not to pour the leftover pulp down the drain. Collect it in a strainer and throw it out or freeze it in a plastic bag for the next time.

This activity could be set up as an activity centre after you have done an initial demonstration.

Emphasize paper recycling both at school and at home (e.g., reusing paper lunch bags and using both sides of a piece of paper.

Resources:

About Pulp and Paper. Canadian Pulp and Paper Association.

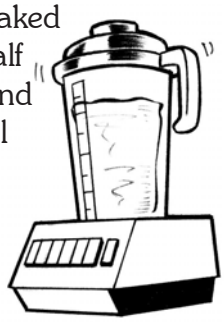
The Paper Chronical, LM Media Marketing,

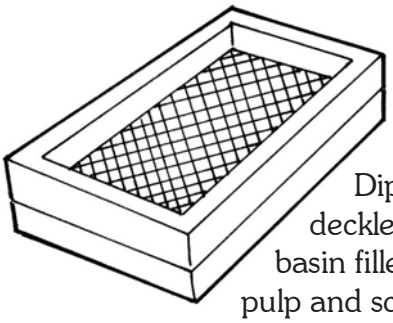
State of Canada's Forest, The Canadian Forest Service.

How to Make Paper

Tear paper into small pieces (about 2 cm^2). Soak it in hot water for half an hour.

Put a handful of the soaked paper into a blender half full of warm water. Blend at moderate speed until you no longer have pieces of paper. Pour mixture in large flat bottomed basin half full of water.





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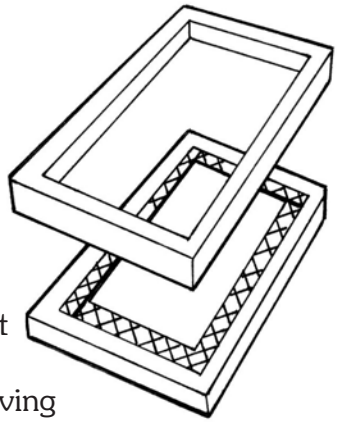

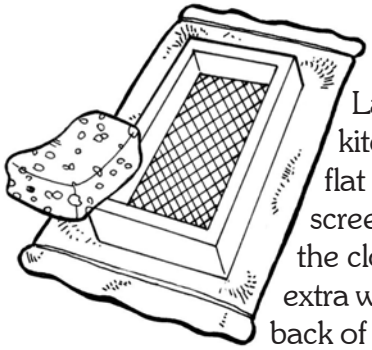

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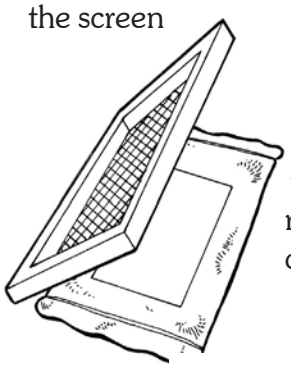

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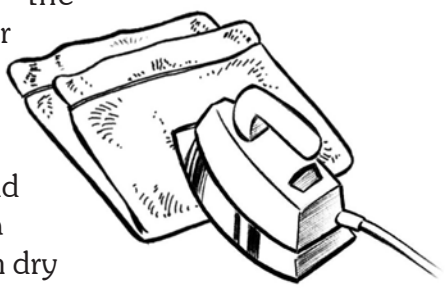

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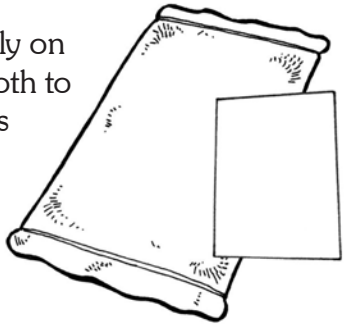


A Potpourri of Products

Objectives:
To give students an opportunity to practise research skills by investigating how a particular forest product is manufactured.

Subject:
Science, Language Arts, Visual Arts, Social Studies

Curriculum Links:
Grade 7 Social Studies, Resources
Grade 7 Language Arts, Media
Grade 7 Science, Renewable Resources

Duration:
2 hours

Group Size:
Class, small group

Setting:
Indoors

ENGAGE

1. Provide each student with a copy of Products from Canada's Trees or Canadian Forest Products – More than Meets the Eye.

2. Have groups of students choose and investigate products from this list and report their discoveries in one of the following ways:

Materials:
Art materials, copies of Products from Canada's Trees and the Potpourri of Products activity sheet (one per student)

a) Write a series of announcements to be read daily over the school PA system (e.g. briefly describe the manufacturing process for a different product each morning for one week).
b) Make a poster-size flow chart showing the production process used in making the wood product.
c) Cooperate with other groups to design and create a bulletin-board of Forest Product facts, including flow charts, product samples, and pictures.

EXTEND

1. Have students cooperate to write a play about life in a land with no forests and have them perform it for another class. Ask questions to stimulate ideas (e.g., What products would be missing from daily life? How would recreation and wildlife values be affected?

2. Have students create crosswords using A Potpourri of Products words?

3. Have students research how Aboriginal peoples of Saskatchewan have traditionally made use of forest products.

Teaching Note:
The sheets entitled Products from Canada's Trees and Forest Products – More than Meets the Eye list some of the many things made from or derived from the forest.

Resources
Thomas, M.G. and D.R. Shumann. 1992. *Seeing the Forest Instead of the Trees: Income Opportunities in Special Forest Products*. Midwest Research Institute, Kanas City, MO

A Potpourri of Products

Activity Sheet

Name: _____ Group Members: _____

_____

_____

Our product is: _____

Our product is used for / by: _____

Questions to Answer

What kinds of trees /plants does your product come from?

_____

_____

What parts of the tree / plant are used?

_____

_____

Does your product look like it comes from a tree / plan? Why or why not?

_____

_____

_____

_____

If there are no trees / plants, could this product be made from anything else? Give example.

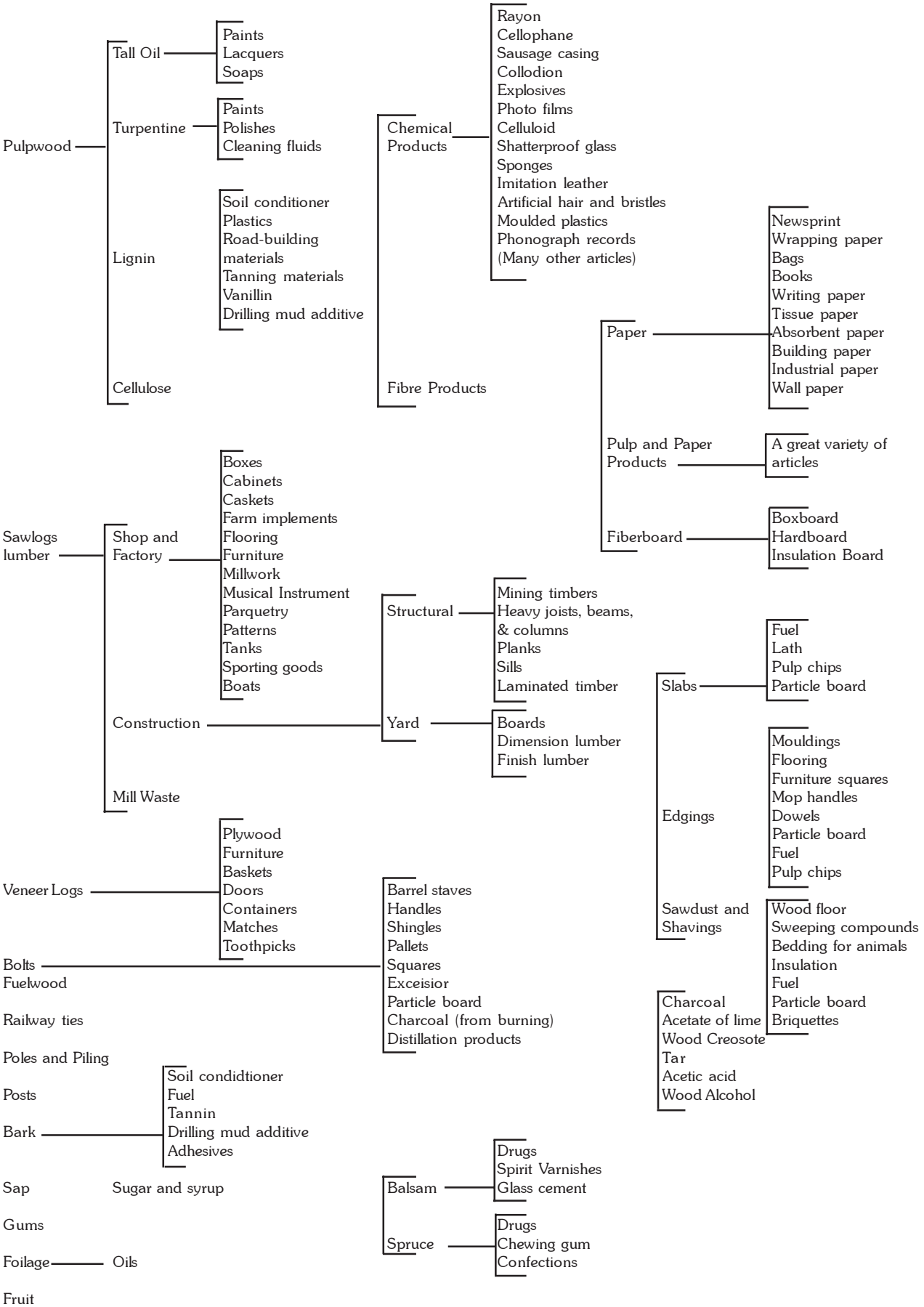
_____

_____

_____

Products from Canada's Trees

(Reprinted, with permission, from Morrison, G.R. *A Forestry Manual for Ontario Secondary School Teachers*. Willowdale: Ontario Forestry Association, 1983)



FOCUS on FORESTS

Grade 9-12
Teacher's Guide

Tree Growth

Trees are living creatures. Forests cover large amounts of the planet, and provide shelter, shade, food, resting places, and many other benefits to other living creatures.

Trees are collectively called forests, woods, copses, wood-lots and urban forests depending on the area they cover, and the use to which they are put.

There are fifteen major trees which are native to Saskatchewan. Eight of these are harvested from the commercial forests of the boreal zone, and the rest occur in the south in niche areas such as river valleys or the Cypress Hills.

White spruce	*Picea glauca* (Moench) Voss	Boreal
Black spruce	*Picea mariana* (Mill) BSP	Boreal
Jack Pine	*Pinus banksiana* (Lamb)	Boreal
Lodgepole pine	*Pinus contorta* Dougl. var *latifolia* Engelm	Cypress Hills
Balsam fir	*Abies balsamea* (L.) Mill	Boreal
Tamarack larch	*Larix laricina* (DuRoi) K. Koch	Boreal
Eastern cottonwood	*Populus deltoides* Marsh.	River valleys.
Western cottonwood	*Populus deltoides* Marsh var *occidentalis* Rydb.	River valleys.
Trembling aspen	*Populus tremuloides* Michx.	Boreal
Balsam poplar	*Populus balsamifera* L.	Boreal
White birch	*Betula papyrifera* Marsh.	Boreal
Green ash	*Fraxinus pennsylvannica* Marsh var *austinii* Fern.	River valleys.
Manitoba maple	*Acer negundo* L. var *interius* (Britton) Sarg.	River valleys.
White elm	*Ulmus americana* L.	River valleys.
Bur oak	*Quercus macrocarpa* Michx.	River valleys.

Objective:

To help students understand the rate of growth of trees using measurements and estimations.

Subject:
Science, Mathematics

CurriculumLinks:
Grade 9 Science - The Environment,
Grade 9 Mathematics - Problem Solving/Data Management
Grade 10 Science - Earth/ Environmental Science

Group Size:
Small groups/full class

Setting:
Outdoors and classroom

Materials:
Ruler, Tape Measure, Tree Cookies and Graph Paper

Parts of the Tree

The healthy tree consists of three major parts, the crown, the stem, and the roots. Each of these has a crucial role in supporting the growth and survival of the tree

Crown

The crown is the most visible portion, and consists of branches dividing into ever smaller portions ending with twigs and leaves. Leaves are the "lungs" of the tree; where an exchange of gases takes place, enabling the essential activities of photosynthesis and respiration. The leaves are the most delicate and easily damaged part too. Leaves are used by many insects who live, eat, grow and often pupate in them. The crown is also the location of reproduction - all trees have flowers, it is just that they are not as visible as in many plants.

Stem

The stem supports the crown, and transports nutrients and water between the roots and the crown, and it stores nutrients. In an older tree the stem is only partially living - the inner-most cells die and become storage organs, called the heartwood. The outer xylem cells are called the sapwood, where the transport takes place.

The stem develops a thick bark layer which protects it from mechanical and other damage. This layer is primarily the dead outer phloem cells. But instead of dropping off, they often have additional substances deposited in them which make the stem unpleasant and more difficult to eat. The bark layer provides protection from insects and disease and predation.

Roots

The roots provide support; it also is the location for intake of water and nutrients from the soil; and also store carbohydrates until the plant needs to use them.

Major Functions of a Tree

The major functions include transport of water and nutrients, photo-synthesis and respiration, growth, and reproduction.

Transport

Did you Know...

Photosynthesis is useful to the climate because it causes:
- carbon incorporation into wood for long periods of time,
-intake and break-down of carbon dioxide, which is a greenhouse gas,
- release of oxygen into the atmosphere

The tiny root hairs on a root take in water and nutrients from the soil. This is often assisted by special mycorrhizae which grow in association with the root hairs, and facilitates the uptake of water and nutrients from the soil into the root system. Upward transport of water is accomplished cell by cell through the cells which make up the xylem. Leaves manufacture sugars and starches which have to be distributed through the tree for storage and for later use. This transport is downwards, and takes place through the phloem cells, on the outer portion of the stem. This transport from cell to cell is done by water pressure, called **turgor**, which uses the processes of capillary action and evaporation and a system of special cell walls.

Photo-synthesis and respiration

Plants have the unique capability to turn simple substances into more complicated ones. In the leaves, carbon dioxide from the air, and water from the roots are turned into sugars. The green colour of leaves comes from small green structures called **chloroplasts**, which are able to use energy from the sun to build up sugars. As it requires light, photo-synthesis takes place in daylight only. Sugars are transported to a place of respiration or storage. Storage is most often as starch, which is larger carbohydrate molecules built up from sugars.

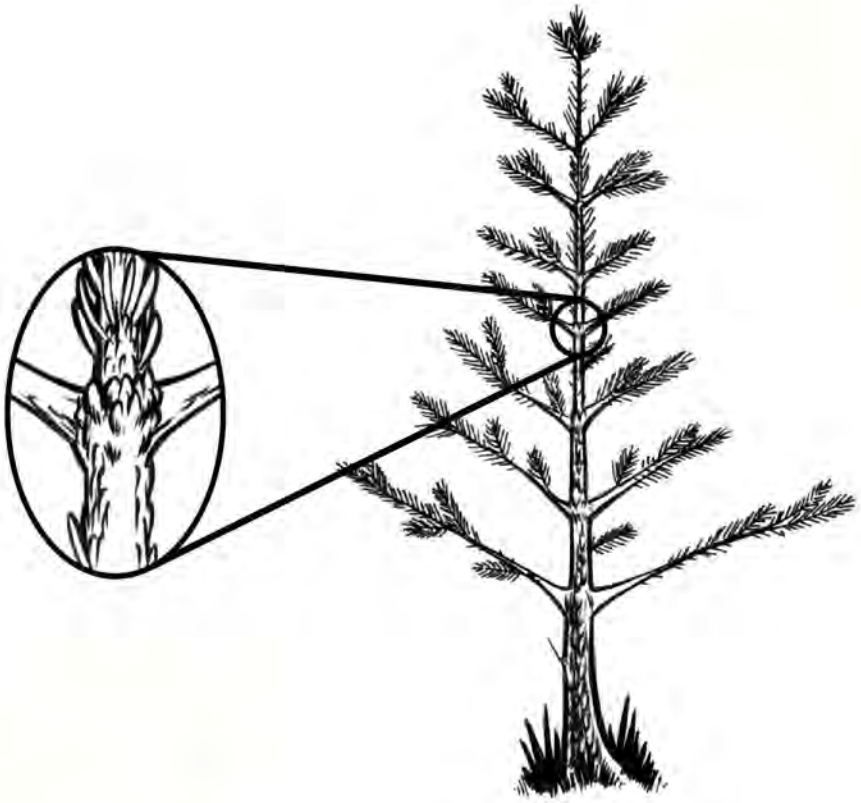
Respiration is the break-down in the cells of the starch (a complicated molecule) or simple sugars. This releases energy which the plant can use for its growth and other functions. The water formed by this process evaporates from the leaves, which cools the leaf.

Growth

The **meristems** are the two growth areas. The apical meristem is at the end of each branch and root, and enables height growth, (and depth in the roots). The lateral meristem is situated around the stems of the tree, and causes growth in thickness.

Between phloem and xylem is a very thin **cambium** layer. This is the meristematic material which divides on both sides. The results of the inner division are xylem cells, and the outer ones become phloem.

The **apical meristems** grow outwards, laying down the cell structures of the stem, including the lateral meristem.



Reproduction

The flower is the primary organ of sexual reproduction where the male spore is transferred to the female - a process called **pollination**. The major parts of a typical flower are the organs which produce female and male **spores**, organs which attract pollinators, and a **calyx** which protects the developing flower bud until it opens.

Did you Know...
In spring clones of poplar leaf out within a day or so of each other. In the fall the leaves of clones will change colour and fall off around the same time as well.

Some species have flowers which are male only (called **staminate** - no female component) and others female only (called **pistillate**). Some species produce both male and female flowers on the same tree, and for others they are on separate trees. Typical flowers are usually found on hardwood trees. Conifers have a different arrangement. They have pollen cones (male) and seed cones (female), which may be on the same or separate trees. Since they are pollinated by wind they do not rely on the attraction of petals but on copious amounts of very light pollen. In spring you will find yellow "stains" on the ground, particularly around the edges of puddles. This is accumulation of pollen.

Bur Oak Acorn

Sexual reproduction requires dispersal of the **fruit** or the seed, and this activity is facilitated by the use of different seeds and fruit, depending on the method of dispersal. For instance wind dispersed have "wings" which the wind catches to disperse it, and others have fruity surroundings which are eaten, and the seeds spread during defecation.

Some examples include the American Elm, whose seed has an attached flat structure, catches the wind which enables it to be carried further, the Cottonwood, aptly named for the attached fluffy material which catches the wind or the Mountain ash whose fruit attracts Bohemian waxwings in the winter where the seeds are not digested and are returned to the ground in the faeces.

American Elm Seed

There are very many methods of asexual reproduction, but they all use portions of the original plant, and encourage it to grow into its own separate plant. Thus the genetic make-up of the new plant is exactly the same as that of the originating plant - it is a clone of the parent material. Nature uses some of these methods, and humans have adapted and extended these general principles for our own reasons. Methods in nature may include root suckers which spread by having new trees grow up as part of the original tree's root system. Birch trees employ what are known as coppice shoots. Multiple new shoots grow up from the stump when the stem is cut. Black spruce and dogwood can employ a technique called layering. Adventitious roots grow from parts of the stem which contact the ground where they will eventually break with the parent plant.

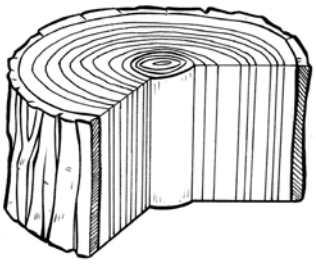
Resources:

Farrar (1995) **Trees in Canada** Her Majesty the Queen (502 pages).

Mader **An introduction to Biology,** 4th ed. Mader Wm. C. Brown Publishers 1993

The bud at the tip of this branch would form the new growth for the coming spring but a scar would be left exposing where one year's growth ended and the next began.

When looking at the cross-section of a tree trunk the dark lines are growth that occurs in the spring while the lighter line is the growth from the summer. The combination of both is considered one year's growth.



EXPLORE

Have the students determine the amount of annual growth of several different species of trees. This can best be done on a coniferous tree which has obvious whorls at the end of growing season. You may wish to choose a small tree growing on a boulevard or at the school, or depending on the season, a Christmas tree after it has been taken down. If the latter is the case, take care that the growth can be seen, as with a "pruned" tree, its growth may have been disguised by the pruning. On a hardwood the same can be done, but they will need to find the bud scars for each year.

Next, the students can determine the growth of a tree's width. This can best be done on a cross-section "cookie" of a tree. A conifer has more obvious growth rings at the end of growing season. It can be done on a recent stump on the ground or a cookie cut beforehand. Some hardwoods, like oak, show obvious growth rings but species such as poplar are less distinct and may be difficult to discern by the untrained eye.

Finally have the students make some assumptions about growth, and then measure the volume growth of the tree.

1. Divide the class into groups, each with a ruler or tape, have them measure the vertical growth for a number of years.
2. Have them chart the growth, with a graph.
3. Have them make some conclusions about this growth.
   - Did it start slowly and increase?
   - Was growth interrupted? (was the top broken off?)
   - If it slowed, why might that be? (A dry year, insect attack, etc).
   - What might the growth be next year? (a chance for follow-up).
4. Next measure the radial growth from the centre of a tree cookie or stimp for a number of years.
5. Have them chart the growth with a graph.

6. Have them make some conclusions about this growth.
   - Did it start slowly and increase?
   - Was growth interrupted? How?
   - If it slowed, why might that be? (a dry year, insect attack, neighbouring trees growing closer)
   - If it increased why might that be? (Neighbouring trees being taken away)
   - What might the growth be next year? (a chance for follow-up).
7. Lastly, determine the volume using the height and radial measurements of a particular tree over a number of years. The formula for the volume of a cone with base radius **r** and height h is $V_{Cone} = (\frac{1}{3})\pi r^2 h.$
8. Make some assumptions about the formula: i.e. the tree grows as a perfect cone; year 5 volume is the volume at that year, less year 4 volume.
9. Have them chart the growth, and graph it also.
10. Have them make some conclusions about this growth.
    - Did it start slowly and increase?
    - Was growth interrupted?
    - If it slowed, why might that be?
    - If it increased, why might that be?
    - What might the growth be next year?

Here are some follow-up questions for the class to consider.

1. If the tree reached 100 years old, how tall might it get to at current growth? How wide might it be at its current growth?
2. If the tree reaches 20 metres in 60 years, what does it need as annual growth from now to reach that?

3. If the tree reaches 45 cms in 60 years, what does it need as annual growth from now to reach that?

Extend

Develop a Growth and Yield chart.

Growth and Yield tables are used to calculate the volumes of trees at any particular age, for particular site conditions. For a commercial tree, the wood volume is the asset of most interest, but is time consuming to calculate for each tree. Therefore the forester develops a table by which he can convert an easy measurement to the volume without having to take all the individual measurements. Diameter is most often used in the commercial forest, and again for simplicity is converted from the D.B.H., or "diameter at breast height".

If your class has been using small trees, in their case the easy measurement may be height, which can again be converted to volume. The class can use their data from the previous exercise and chart the volume against the height. Then they can go out and measure a few more trees, and determine their volume in a few minutes.

Forested Lands

Objectives:
To locate and describe the ecoregions of Saskatchewan.
To understand the distribution of vegetation and animal species within Saskatchewan in relation to the climate and landscape.
To describe land use practices in the eco-regions of Saskatchewan.

Subject:
Science

Curriculum Links:
Grade 9 Science - The Environment

Group Size:
Small groups/full class

Setting:
Classroom

ENGAGE

Palm Tree Pondering

Present the students with the following scenario and questions:
Suppose you were picked up by an alien spacecraft, taken for a spin around the planet, then dropped back to earth in the middle of a forest somewhere in Saskatchewan. Could you tell where on earth you were? The continuous forest and absence of trembling aspen are good clues. The presence of birch, spruce and pine provide even more information. These three tree species dominate the forest north of the Churchill River in Saskatchewan. If, on the other hand, you are surrounded by bur oak, white elm, aspen and green ash, in a small forested area, it's a good guess that you are in southern Saskatchewan, where these trees are common. The fact is, not all forests are alike. Foresters can tell what part of the world they are in from the species of trees alone. Why do forests in different places have different species of trees? Why are you less likely to find bur oak or green ash near LaRonge? What trees would you expect to find if you landed in a forest in central Saskatchewan? Do you think it's possible to tell what the typical year-round weather is in a certain area by looking at the kinds of trees growing there? Why don't we see palm trees growing in northern Saskatchewan? What trees are common in Saskatchewan?

Ecoregion Visitors and Residents

Familiarize the students with the ecoregions of Saskatchewan by projecting the map of the ecoregions with an overlay of the geological highway map. Ask students to share which of the eleven ecoregions they have been to and plot it on the map. Ask those who have been to the most ecoregions what differences they noticed from region to region and why those differences exist. Ask students: Why is it that certain areas are more developed than others? What effect might monocultures have on the diversity in the ecoregion? Determine the % of land base that is preserved or have little human activity.

Putting the Pieces Together

Give 11 students a piece of poster board (each of a different color if possible or give them all white and have the student color it). Project the ecoregion map of Saskatchewan on the wall as big as you can. Designate an ecoregion to each student with the piece of poster board and have them trace the ecoregion onto their poster board and cut it out.

Give a description (printed off the web) of an ecoregion to a different 11 students so that each of these students has a different ecoregion. Give the rest of your students pictures of trees or tree cards/silhouettes of trees in Saskatchewan. Have students with the description of the ecoregions stand in front of the class and take turns reading their handout. Then have all students mingle to find a match between the poster board puzzle piece of an ecoregion, the description of the ecoregion and a common tree(s) for that ecoregion (some ecoregions will have the same tree listed in the description but make sure that each ecoregion is represented by at least one tree. This will divide the class into groups of three (if you have 33 students- if you have less students then some will work in pairs). This group will work together to do the research necessary for the next activity. But before the groups disperse have each group label their poster board with the appropriate ecoregion name and as a class put the poster board puzzle pieces together to create a huge wall map of the Sask. Ecoregions. Tape or staple the trees for each region on the wall map as well.

Materials:

Copies Saskatchewan's Eco-regions Map and a description of each ecoregion is available on the following website: (print off one per student from www.biodiversity.sk.ca/eco.htm).

Geological Highway Map of Saskatchewan (available from Tourism Sask. or Sask. Geological Society).

Overhead projector and transparency of the Sask. Eco-regions Map
Pictures or silhouettes of the trees of Saskatchewan
Pictures/photos of flora, fauna, and people using the land.

EXPLORE

Ecoregion Explorers

Have students, in groups of three, explore their ecoregion by visiting it if possible and gathering data and photos. If that isn't possible have them explore it virtually and visually via videos, internet, books, magazines, tourist packages, etc.. They should gather information and photos on the ecoregion's soil, climate, vegetation, wildlife, and land use practises. They will ultimately be responsible for delivering this information to the rest of the class in a creative way such as a PowerPoint presentation, a jeopardy game, songs, poems, etc.

Advance Preparation

Make a transparency of the map of Sask. Ecoregions and the geological map of Saskatchewan

Have magazines, travel brochures showing scenes and pictures of plants, animals and people for students to use.

Resources

www.biodiversity.sk.ca/eco.htm
Richards, J.H.

Atlas of Saskatchewan. University of Saskatchewan, Saskatoon, 1969.

Canada and the World – an Atlas Resource, Prentice-Hall Canada, Inc. Scarborough, Ontario, 1994.

Cypress Hills of Saskatchewan. Kelsey Institute. Media House #V6186. A 15 minute video of tree and plant life in the Cypress Hills, sponsored by Saskatchewan Education. Farmer John Laird

Ecoregion Creations

Have each ecoregion group create a collage that portrays the plants, animals, climate, land use and landscapes of the ecoregion on their ecoregion puzzle piece of Saskatchewan (from *Putting the Pieces Together* activity).

EXTEND

Ecoregion Experts

Have students choose an expert from their group of three to represent the group on an Ecoregion Panel. The eleven students on the panel will then be quizzed by the other students. Panel members will each have a buzzer (or a unique sound that they make). The first panel member to buzz in will have a chance to answer the question. The questions presented will be the reponsibility of the remaining two students in each ecoregion group. These students may choose to show photos of animals, plants, landscapes, and land use practices for the panel to guess which ecoregion the photo was taken. They could also create questions such as the following:

1. Do some species live in more than one ecoregion? How is this possible?
2. How might the greenhouse effect influence the distribution of tree species across Saskatchewan?
3. Is there any relationship between type of soil and type of forest?
4. Why do certain species tend to predominate in the different forest regions (e.g., moose vs. deer, ruffed grouse vs. sharp-tailed grouse)?
5. How does development and various land use practices affect the ecosystem of each ecoregions?
6. What species have been threatened or have become endangered in each ecoregion? Why has this happened?

EVALUATE

Ecotour Planner

Have the class use the Saskatchewan's Ecoregions map and the knowledge that they have gained from these activities/unit to plan an ecotour for a friend from another province. The tour must visit at least three ecoregions. Students could describe the route in a travel diary and suggest interesting forest-related activities to do along the way. Have students explain why the visitor will encounter particular species of plants or animals in each of the three areas. Have students compile all the information into a tourist package that includes a brochure, photos, travel diary, posters, etc..

Trees in Canada Fitzhenry and Whiteside 1995 (ISBN: 1-55041-199-3) A comprehensive tree identification guide that provides both keys and identification of most native and many introduced species for Canada and the Northern United States for both summer and winter.

The Southern Boreal: Eastern Regions. Kelsey Institute. Media House #V6190. A 15 minute video showing the eastern regions of the southern boreal forest of Saskatchewan.

The Southern Boreal Forest. Kelsey Institute. Media House #V5540. A 11 minute video showing the transition from grassland to forest vegetation north of the Saskatchewan River.
http://www.sierraclub.org/ecoregions/boreal.asp
http://collections.ic.gc.ca/abnature/shield/shield.htm
http://www.ec.gc.ca/soer-ree/English/vignettes/Terrestrial/bs/default.cfm

Dutch Elm Disease Dilemma

Objective:

To give students an understanding of the benefits of intensively managing Dutch elm disease (DED) versus the "cost" of doing nothing.

Subject:
Science, Mathematics

CurriculumLinks:
Grade 9 Science - The Environment,
Grade 9 Mathematics - Problem Solving/Data Management
Grade 10 Science - Earth/ Environmental Science

Group Size:
Small groups/full class

Setting:
Classroom

Materials:
Fact and Scenaro sheets (included), flip-chart paper

Engage

The purpose of this activity is to confirm that intensive management of DED will not only save American elms, but will also save a community money. An intensive program allows the controlled replacement of elm trees over time in a more financially manageable fashion. Review the facts about DED with the class based on Fact Sheet #1 & 2 which can be accessed at www.sdeda.ca. As a class, prepare a list of the activities recommended to manage DED.

Explore

1. Divide students into three work groups and provide each with a scenario sheet (see attached) that documents the situation in three fictitious towns where: one town had an intensive DED management program, one had only a winter sanitation program, and the other had no program at all. Ask students to review their assigned scenarios and answer the following questions:
   - What activities did your DED management program involve?
   - What was your average loss rate over the ten year period?
   - What was your total number of dead trees?
   - What was your total number of trees removed?
   - How many trees were left alive in your community at the end of the ten year period?
   - What was the total cost of your program?
   - What was the "value" of the living trees before and after the ten year period assuming each tree is worth $3,600?
   - What was the value of the trees that died in the same period?
2. After the student groups have answered these questions have them plan a presentation where one or two representatives from each group reviews their situation for the rest of the class to try and convince the class that their particular scenario is the best way to deal with DED. Summarize the report of each group on the blackboard or on flip chart paper as the presentations take place.

3. After the presentations have taken place, compare and contrast the three options with the class and ask each student to write a one page statement on which technique they would like to see used in the community that they actually live in and why they think it is the best option.

4. When all of the statements have been prepared, have students vote for the technique they prefer and see which scenario is the preferred choice of the classroom.

Extend

1. Have students assess the steps that their community has undertaken to manage or prepare for DED by either interviewing community parks personnel or by inviting a local parks official in as a guest speaker. If all the techniques for managing DED are not in place, have the class write to community officials encouraging implementation of missing options. Perhaps suggest that the students make a presentation to their community's town/city council.

2. Encourage the class to form a "Wilt Watchers" patrol to watch for elm leaves that are wilting, turning yellow, curling and turning brown. If they see these symptoms, they should report them to local park officials or call 1-800-SASKELM.

3. Do a door-to-door walk in the neighborhood to alert homeowners about the dangers of storing, using, or transporting elm firewood. Have them remind homeowners that it is illegal!

4. Make "No Elm Pruning" signs and put them up in your community during the annual elm pruning ban which runs from April 1st to August 31st.

5. Get everyone involved banding their trees against canker worms if they are a problem in your community. This won't prevent DED, but it will help keep your trees healthier.

Resources

The following resources are available from the Saskatchewan Dutch Elm Disease Association (306-933-5546) or by visiting their web site at: www.sdeda.ca.

Fact Sheet #1 - Dutch Elm Disease Overview
Fact Sheet #2 - Elm Bark Beetle Life Cycle
Tree Identification Series - American Elm/ Siberian Elm/Green Ash/ Manitoba Maple
"Dutch Elm Disease Kills Trees" poster
"There's a Fungus Among Us" poster and activity sheet
"There's a Fungus Among Us" kid's page

Elmwood: The town that did it all!

Elmwood is a community of 13,000 people with beautiful elm lined streets in the downtown core and the older neighbouring areas. When Dutch elm disease (DED) was first discovered in a boulevard tree in front of the courthouse the community decided to go with an intensive sanitation program to try and eradicate the disease before it spread. The community always had a surveillance program in place, but it wasn't as comprehensive as the one they now put in place. From March to June, four city tree inspectors drove through the streets to locate dead trees and elm woodpiles missed the previous year. From June through September, 12 inspectors surveyed each elm once every two weeks for new signs and symptoms of the disease. Four inspectors worked from October through December. City crews removed diseased trees and other elm bark beetle breeding wood within 20 working days. Every three years afterwards, each elm would be pruned as needed to remove dead limbs over 5 centimetres in diameter. The intensive scenario resulted in an annual elm tree loss rate of 5% in year two and 3% afterwards.

Table 1. Intensive sanitation tree losses, removals, remaining live trees, and costs, year 1-11

Year	Loss Rate	No. of Dead Trees	No. of Trees Removed	No. of Trees Alive	Total Cost
	%				*Dollars*
1	-	-	-	86,468	-
2	5	4,323	4,323	82,145	1,668,179
3	3	2,464	2,464	79,681	1,193,868
4	3	2,390	2,390	77,291	1,166,095
5	3	2,319	2,319	74,972	1,139,347
6	3	2,249	2,249	72,723	1,113,121
7	3	2,182	2,182	70,541	1,087,905
8	3	2,116	2,116	68,425	1,063,195
9	3	2,053	2,053	66,372	1,039,479
10	3	1,991	1,991	64,381	1,016,254
11	3	1,931	1,931	62,450	993,762

Source:
Economics of Dutch Elm Disease Control: A Model and Case Study
Melvin J. Baughman

Barkertown: The town that went half way!

Barkertown is a community of 14,700 people located in the beautiful Wood valley. Barkertown has the Stump River running through the centre of the community with native elms in the valley and planted elms in the downtown area and the older parks in the community. Many homeowners also have elms on their property especially in the older neighbourhoods. Dutch elm disease (DED) was first found in several of the native elms in the valley and the community decided to proceed with a winter sanitation program. Four city tree inspectors operated from September through November. Diseased trees and elm woodpiles were removed from October through the winter months. Only 90 percent of the diseased trees were actually detected and removed each year. The remaining 10 percent were removed the following year along with 90 percent of that year's losses. Delayed tree removal allowed a build-up in beetle populations and faster disease spread. The tree pruning budget was less than 80% of the amount required for an intensive DED management program. This scenario resulted in an elm tree loss rate of 7% in year two, 8% in year three, and 10% afterwards.

Table 2. Winter sanitation tree losses, removals, remaining live trees, and costs, year 1-11

Year	Loss Rate	No. of Dead Trees	No. of Trees Removed	No. of Trees Alive	Total Cost
	%				*Dollars*
1	-	-	-	86,468	-
2	7	6,053	5,488	80,415	1,724,338
3	8	6,433	6,395	73,982	1,944,397
4	10	7,398	7,301	66,584	2,163,203
5	10	6,658	6,732	59,926	2,014,029
6	10	5,993	6,060	53,933	1,839,796
7	10	5,393	5,453	48,540	1,682,438
8	10	4,854	4,908	43,686	1,541,139
9	10	4,369	4,417	39,317	1,413,846
10	10	3,932	3,976	35,385	1,299,506
11	10	3,539	3,578	31,846	1,196,326

Source:
Economics of Dutch Elm Disease Control: A Model and Case Study
Melvin J. Baughman

Beetleville: The town that didn't do much!

Beetleville is a community of 11, 800 people with elms planted in all schoolyards, parks and major thoroughfares. Elm was the tree of choice for planting when the town was growing and many homeowners throughout the community have at least one elm on their property. Dutch elm disease (DED) was first located in a row of elms at a schoolyard close to the downtown core and many other trees were showing symptoms. With a smaller tax base the community chose to use a minimum control program as they had fewer resources to do anything major. Two city tree inspectors operated from September through November. Only 80 percent of the diseased elms were detected and removed each year. The remaining 20 percent were taken out the following year together with 80 percent of that year's losses. Elm woodpiles were not destroyed. Tree removal was done from October through the winter. The pruning budget was reduced by 90 percent from the amount spent under intensive sanitation. This scenario resulted in a loss rate of 7% in year two, 12% in year three, 25 % in year four, and 40 % afterwards.

Table 3. Minimum control tree losses, removals, remaining live trees, and costs, year 1-11

Year	Loss Rate %	No. of Dead Trees	No. of Trees Removed	No. of Trees Alive	Total Cost *Dollars*
1	-	-	-	86,468	-
2	7	6,053	4,842	80,415	1,521,022
3	12	9,650	8,931	70,765	2,538,254
4	25	17,691	16,083	53,074	4,317,055
5	40	21,230	20,522	31,844	5,415,765
6	40	12,738	14,436	19,106	3,887,641
7	40	7,643	8,662	11,463	2,440,167
8	40	4,585	5,197	6,878	1,571,533
9	40	2,751	3,118	4,127	1,050,352
10	40	1,651	1,871	2,476	737,744
11	40	990	1,122	1,486	549,979

Source:
Economics of Dutch Elm Disease Control: A Model and Case Study
Melvin J. Baughman

Change in the Forest

Objective:
To help students understand the impacts various agents of change have on a forest.

Subject:
Science, Social Studies

Curriculum Links:
Grade 9 Science- The Environment
Grade 9 Social Studies- Change
Grade 10 Social Studies - Ideology and the Decision Making Process
Grade 10 Science - Earth/ Environmental Science

Group Size:
Small groups/full class

Setting:
Classroom

Materials:
Newspaper Articles (included), Benefit/ Drawback Worksheet

Saskatchewan's forests

While Saskatchewan is widely known for its wide open prairies, more than half of the province of Saskatchewan is actually covered by forests. There are 35.5 million hectares of forest land in the province, with roughly 12.2 million hectares under commercial development.

Forests provide numerous benefits for Saskatchewan people. Forests help regulate water cycling, help mitigate the greenhouse effect, produce oxygen and prevent soil erosion. In addition to these significant environmental benefits, forests provide a host of social, cultural and economic benefits. A variety of recreational activities may be enjoyed in the forest, ranging from bird watching to snowmobiling. People come to the forest to work, hunt, fish, trap or pick berries and mushrooms. Some enjoy the forest as a quiet location for contemplation; for others, including many Aboriginal people, the forest represents their spiritual connections.

In the 1990s and early 2000s, provincial government policy aims to balance the sometimes-conflicting interests of various groups of forest users, while protecting the long-term health of the forest ecosystem.

Forests and the process of change

Forests are more than a collection of trees. They are complex ecosystems that include a host of living organisms, including micro-fungi, lichens, plants, insects, birds and animals.

Forests are not static; instead, they are often viewed as a dynamic ecosystem that changes over time and in response to certain events or forces. In the short-term forests undergo various physiological changes in response to the changing seasons. Diseases, insect infestation, changes in the local animal population, drought or heavy snowfall are other forces of change in the forest ecosystem. Change can be experienced within a limited area or throughout the forest ecosystem .

Wildfire – fires started by lightning or through other natural means has been the predominant change agent in the boreal forest and prairie grasslands for thousands of years. However, wildfire can pose significant risks to people, property and natural resources. Since the 1950s, provincial government forest protection policies have worked to eliminate fire, at a cost of tens of millions of dollars annually.

Recently there has been a growing recognition of the potential benefits that fire may hold for the forest ecosystem. Wildfire triggers growth and renewal, converting mature forest areas back to an earlier successional stage. As part of current forest management practices, prescribed burns may be employed to achieve specific management objectives. These may include:

- reducing fire hazards by burning forest debris and other materials;
- preparing harvested forest areas for regeneration;
- creating and maintaining wildlife habitat;
- revitalizing forests and grasslands;
- sanitizing areas after insect and disease infestations;
- and improving grazing potential.

Human-caused change in the forest

Forestry is perhaps one of the most obvious examples of human-caused change to the forest ecosystem. The bulk of the province's timber harvest takes place in the Boreal Plain Ecozone. The predominant species in the area are trembling aspen, jack pine, white spruce and black spruce.

In the early 1900s, many of the province's forests were cleared for use as building materials and to allow for agricultural use. One hundred years later forestry is Saskatchewan's second-largest manufacturing industry, contributing more than $750 million to the provincial economy annually.

Environmental groups are concerned about the impact of forestry, mining and other industrial development in the forested areas. The conversion of forest fringe area to agricultural use and the expansion of logging activity into the northern Boreal Shield Ecozone are perceived as potential threats to the health and sustainability of the province's forest ecosystem.

In addition to the direct impact of forestry and other forms of development in the forest, a number of secondary changes may result. For example, when roads are built in forests, this opens up areas that had been previously inaccessible. Studies have shown that improper road construction can impact fish habitat and water quality in nearby water sources. Other potentially negative environmental impacts related to road construction in the forest include illegal hunting activity, vandalism, habitat degradation and soil compaction.

While change is a natural part of the forest, there is some change that is unnatural. It is important to manage this type of change.

Forest change caused by wildfire and by harvest

While wildfire and timber harvest are both agents of change, there are differences between the two in terms of their impact on the forest ecosystem. In areas that have been mechanically harvested, much of the stand canopy is removed, which allows the existing understory plants to proliferate. In turn, this luxuriant vegetation may encourage the migration of certain wildlife to the area.

In forest areas that have been burned, large numbers of snags (standing dead trees) are left. These snags are important for wildlife habitat and as a source of carbon. Fire often leaves patches and individual trees unburned. These are also important for wildlife habitat as well they provide a source of seed and carbon sequestration. Soon after the fire, various fire-dependent plants rapidly colonize the forest floor.

A number of studies have compared plant diversity patterns following disturbance by clearcutting and fire. In one study, carried out in the Prince Albert Model Forest, researchers found the main difference between burned and cut areas was the time required to reach maximum biodiversity. Cut areas reach maximum diversity earlier than in burned areas. Researchers concluded that clearcutting may speed up succession in comparison to natural stand development.

Timber harvest systems

Forestry companies now utilize a variety of harvest practices in order to more closely mimic natural forest disturbances such as wildfire. This is defined as "Variable Retention" and is the most commonly used technique in Saskatcewan. Other methods of harvest may include clearcutting, selective harvesting, patch retention, understory protection, seed-tree retention, commercial thinning and salvage thinning.

The shape of the harvest area can have a significant impact on the quality of the post-harvest forest habitat. Forestry companies are abandoning the standard block style of clearcutting in favour of irregularly shaped cuts that more closely emulate the impact of wildfire. Clumps of residual trees are left to provide a seed source, help provide cover for local wildlife and provide a more natural disturbance pattern to the forest.

Regeneration and replanting

After forest areas have been harvested or damaged by fire or insects, natural regeneration may occur. Natural regeneration refers to the new growth that occurs naturally from the seeds and roots left by the original trees. For some trees, including trembling aspen and Jack Pine, there is a high natural regeneration potential.

In order to support regeneration site preparation may be carried out to ensure seeds or seedlings have a suitable location to grow. For example scarification, which is a form of site preparation, involves specialized equipment which exposes mineral soil and, with the heat of the sun, opens jack pine cones allowing them to release their seeds.

For some species, such as black spruce and white spruce, replanting may be required. Although these species can regenerate on their own, it is a slower process which is enhanced by hand planting seedlings. Replanting may also be required where there is not sufficient seed present following timber harvest or fire.

In the past regeneration measures in the commercial forest were not closely enforced or monitored. Today legislation and monitoring programs are moving towards a system that all forests that are harvested are regenerated adequately to ensure sustainable forests.

Change is the only constant in the forest ecosystem

Forests are dynamic ecosystems that continue to change in response to a variety of seasonal, human-caused and natural forces. It is crucial that we manage rapid, unnatural change in order to protect the sustainability of the forest ecosystem.

Engage

Discuss the notion that "any human activity will have an impact on the forest ecosystem." What types of human activity do students believe have had the greatest impact on the forests of Saskatchewan? What are some examples of human activity that have most dramatically changed the forest ecosystem of Saskatchewan?

While change is a constant in the forest ecosystem, various groups and individuals have different perspectives on the most effective way to manage this change. Current management of the forest is an ecosystem based approach where the forest is managed for many differenct uses using ecosystem based science as a basis for decision making. Some believe the forest should be maintained in its present form, protected from any forces of change. Others believe change should only occur as a result of natural forces such as wildfire, insect infestation and changes in plant and wildlife communities. A third perspective is that change should be managed in order to benefit the community.

Discuss with students how the following human activities have changed the forest ecosystem in Saskatchewan:

- bison hunting (pre-European contact),
- the establishment of permanent human settlements,
- the cultivation of land for agricultural use,
- mechanized forestry practices,
- industrial development (oil & gas, mining, mineral).

Working in groups of four, set up a display that illustrates examples of human-caused change in Saskatchewan forests from pre-European contact to the present time. Students may wish to focus on one specific forest region (e.g., Duck Mountain, Cypress Hills, the northern Boreal forest) or the entire province. Display items should be labeled to indicate time frame and significance to the process of change in the forest.

Students can use their creativity in seeking potential content for this display. Local or provincial museums, archival photos, Web sites and library resources can provide a wealth of useful data. Aboriginal Elders, homesteaders (or their descendents) and retired forestry workers may be contacted to share their personal experiences relating to change in Saskatchewan's forest lands.

EXPLORE

In the summer of 2002 a debate raged in the small community of Waskesiu. This issue gained considerable attention throughout the province. The values challenged were whether human intervention in a natural process should occur. The following activity uses real-life information to help students decide which side of the debate they are on.

Introduce the idea that change is an ongoing process in the forest ecosystem. Brainstorm examples of the forces of change in the forest. Discuss the potential impact of seasonal, human-caused and natural change in the forest. Consider how change may result in short and long-term impacts to forest lands and wildlife. What type of development, if any, should be allowed to take place in Saskatchewan forests?

Internet Resources:
Saskatchewan Environment: http://www.serm.gov.sk.ca/
Parks Canada: http://www.parkscanada.gc.ca/index_e.asp
Saskatchewan Forestry Association: http://www.whitebirch.ca/about/about-us.shtml Save Our Spruce: http://www.save-waskesiu.com
Saskatchewan Environmental Society: http://www.lights.com/ses/current/budworm-pr.html
Saskatchewan Eco-Network: http://www.econet.sk.ca/pages/action.html Canadian Parks and Wilderness Society: http://www.cpaws-sask.org/index.html

Make photocopies of the newspaper articles and the benefits/drawbacks worksheet for each student.
Distribute copies of the following four newspaper articles to each student.

After the students have read the articles, discuss as a class how the proposed spraying would affect plant and animal life in the park. Ask students to consider how the proposed spraying would affect cabin owners and business owners in Waskesiu and visitors to the Prince Albert National Park.

Have each student summarize the benefits and drawbacks of the proposed spraying on the worksheet on the next page.

Have students use the Internet to conduct further research about spruce budworm and the potential impact of spruce budworm on the forest ecosystem in Prince Albert National Park. Consider the environmental impact of various management tools for the prevention, control and treatment of the disease. Add the results of this research to the benefits/drawbacks sheet students have already started.

EVALUATE

Have a students write a two-page letter to the editor of their local newspaper. In the letter, students should articulate their position on the Waskesiu spray/no spray controversy. Students should support their opinions with the information gathered in the course of their research.

BENEFITS/DRAWBACKS WORKSHEET

What will be impact on:	**Spray for spruce budworm**	**Don't spray for the spruce budworm**
Spruce trees in P.A. National Park		
Other trees in P.A. National Park		
Other wildlife in P.A. National Park		
Cabin owners in Waskesiu townsite		
Business owners in Waskesiu		
Visitors to Waskesiu and P.A. National Park		

Saskatoon Star Phoenix – Saturday, August 3, 2002

Waskesiu cottage owners campaign to save the spruce

Residents square off with park officials over dreaded budworm

By Jason Warick – Senior Reporter – Saskatchewan News Network

Waskesiu – The plentiful, towering white spruce trees of Prince Albert National Park are under attack, and longtime cabin owner Peter Kilburn can't believe park officials are willing to let the trees die.

Kilburn is not alone. More than 2,000 names have been collected on a petition demanding park officials spray a pesticide to kill the dreaded spruce budworm.

The budworm is sure to be one of the main topics this long weekend during the park's annual meeting Saturday and a cabin owners' meeting Sunday.

This issue is complex and emotional. Park officials don't want to interfere with the natural process of the aging forest, and say spraying won't accomplish much anyway.

Park users argue the spruce is central to the park's identity, and the park would be devastated if large numbers die off.

"I can't imagine why the Government of Canada is not interested is saving these trees. They can't just let this happen" Kilburn said during a tour of the Waskesiu townsite and golf course.

The tips on many of the evergreens are brown and shrivelled. Other trees are almost completely brown, and stand in stark contrast to the bright green leaves of the poplars and other trees.

"Can you imagine that tree not being there? Or that die?" asked Kilburn, who has frequented the park for almost all of his 63 years.

"I want my grandchildren to be able to enjoy this park."

On the fourth hole of the golf course, generally considered one of the most beautiful in the province, Kilburn surveys the 30 or so baby spruce that were planted several years earlier.

Only a couple of metres tall, most of the trees are sickly and brown.

"People think it's just ridiculous. They think the trees should be sprayed," said Regan Nelson, the course's assistant golf pro. Nelson displays more that 500 names collected at the golf course for the petition in the past week.

The budworm is a plant-eating insect that's native to the mixed boreal forest of the park. It is currently in the middle of its peak infestation cycle, which usually lasts a total of about 7 years.

Parks Canada officials estimate 30 to 70 percent of the spruce may eventually be killed by the budworm, which has spread to most areas of the park.

The worm feeds on the tree, but also causes damage by weakening the tree's immune system. The infested trees are more vulnerable to drought, insects and other factors.

Another cabin owner, Columbus Blue Jackets coach Dave King, has done research into the budworm problem. He can't understand why park officials won't even study the issue. He said the government policy is "overriding common sense."

King said he is angry the park superintendent and other staff dismissed concerns brought to them at a meeting two weeks ago.

King and others in the group Concerned Park Supporters presented briefs at the meeting, but were told on the spot that there would be no spraying.

He said park staff should at least bring in some scientists to study the issue, but they were refused.

"We're very frustrated. We'd like to develop a relationship with trust, (but) we just wasted our breath," King said.

"The process really bothers us. It's an insult."

Some concerned park residents are even considering legal action, although that's just one possible option, said cabin owner and lawyer Hugh Harredence.

The May to June window for spraying has now passed, but petitioners want a commitment from park staff to spray next year.

That's not going to happen, according to Prince Albert National Park chief of resource conservation Norm Stolle. "The park has made the decision there will not be spraying," he said.

Manipulation of natural process such as fire or insects in Canada's national parks can only occur if there is a threat to public safety, or if there is a threat to neighbouring land.

Park users have also raised the possibility of spraying just around the townsite of Waskesiu, which is only a small portion of the total park.

Stolle and Allyson Brady of the Saskatchewan Environment Society say spraying the townsite would be a "short-term fix."

Spraying one part of the park might help for a while, but the worms remaining in other parts can travel vast distances and would soon return.

Prince Albert Daily Herald – Tuesday August 6, 2002

Park stands ground on spraying

National policy prevents staff from blasting spruce budworms, annual general meeting hears

By Holly Wiberg – Saskatchewan News Network

Waskesiu Lake – Prince Albert National Park officials remain firm on their stance not to allow spraying for a pest threatening park trees.

Parks Canada policy doesn't allow for intervention to deal with an infestation of spruce budworm, even in just the Waskesiu townsite, said superintendent Anne Morin at the park's annual general meeting Saturday.

"We're at the point now that the decision has been made and people don't agree," she said.

And those not in agreement – many of whom call Waskesiu home for all or part of the summer – vow to keep fighting the decision.

Causing all this fuss is a caterpillar not much bigger than the spruce needles it eats. A species indigenous to the Saskatchewan boreal forest, the spruce budworm's feeding habits could lead to the death of as many as 70 percent of the white spruce, black spruce and balsam fir in the Waskesiu townsite, and 30 to 70 percent of those tree species in the rest of the park.

A close look at the spruce trees in the Waskesiu townsite reveals the spruce budworms' handiwork. Instead of finding green and tender new growth at the tips of the branches on the towering evergreens, that provide shade along the beach, in front of cabins, near parking lots and along roads, needles are more likely rust-coloured and brittle.

Spruce budworm feeding, however, doesn't kill trees but makes them more vulnerable to other stresses such as drought, root disturbance, soil compaction and erosions, a fact sheet produced by Parks Canada said.

With drought now plaguing much of Saskatchewan, the effect of the spruce budworm infestation, which began in the northern part of the park in 1996 and reached the townsite in 1998, has been particularly noticeable this summer.

To bring attention to the issue, members of a group calling itself the Save Our Spruce committee have tagged spruce trees in Waskesiu with orange ribbons.

"National Parks officials tell us that, untreated, seven out of 10 spruce trees in the townsite will die," a notice posted by SOS reads. "Take a look around. Most banded trees you see will be dead."

But SOS's actions don't sit well with everyone in Waskesiu. One man at Saturday's meeting likened the ribbon campaign to vandalism.

As well, ribbons put up Saturday morning were taken down by park staff the same day. But Morin, who wasn't aware of the ribbons until Saturday morning, said she hadn't ordered their removal and told SOS members if they put up the ribbons again park staff would leave them alone.

Cornelia Melville, a regular visitor to the national park who attended the annual general meeting supports the park's decision not to spray for spruce budworm.

While the townsite represents only one percent of the park's entire geographic area, she fears spraying would affect species of insects other than the spruce budworm.

Bacillus thuringiensis var Kurstaki, a pesticide derived from a naturally occurring bacteria and more commonly known as BtK, will kill spruce budworm and about 200 pest species of moths and butterflies as well as some species of leaf-eating beetles. Spraying with BtK is not 100 per cent effective but limits defoliation to less than 50 per cent of new growth.

Morin hopes if people come to the next community vegetation strategy meeting, set for Saturday at 10 a.m. at the Waskesiu recreation hall, they'll understand better the park's decision and the other options available.

A landscaping architect has been hired to develop visual images of both the best and worst case scenarios, and those will be presented at the meeting, as will a written response to questions asked at the July 13 vegetation meeting, Morin said.

Prince Albert Daily Herald – August 12, 2002

Angry group marches out of Waskesiu park meeting

By Heather Polischuk –
Saskatchewan News Network

Waskesiu – Members of the Save Our Spruce committee walked out of a vegetation management strategy meeting on the future of the Prince Albert National Park held in Waskesiu Saturday.

An SOS spokesperson said his group left the meeting to protest the fact the meeting was continuing even though the Waskesiu Community Council is in the midst of appealing a decision by Parks Canada not to spray for spruce budworm in the park.

"These consultations should be adjourned until the application is heard and finalized," said Herve Langlois before he and other members of SOS left the Waskesiu recreation hall. He called the continuation of the meeting "disrespectful of the community."

Community council chair Shelley Funk and other members of the council stayed to observe the meeting.

"We feel we have an obligation to hear and to understand all of the information," she said outside the meeting.

Although they stayed, Funk did express concern inside the meeting about the democratic process involved. The council sent a resolution to park superintendent Anne Morin, asking the national park to consider all options in battling spruce budworm – a caterpillar that feeds on new growth of white and black spruce and balsam fir – by spraying with the pesticide Bacillus thuringiensis var Kurstaki, or BtK.

That will not happen, Morin said previously, because spraying is against park policy.

The council, which has the right to appeal such decisions to higher park officials, is currently drafting a letter of appeal to the chief executive officer of Parks Canada.

Langlois said the Parks Canada strategy meeting should have been postponed until after the appeal was completed. More than half of the 60 people initially in attendance left following Langlois's address.

"This is a crisis for our community," said Langlois outside of the meeting. "We need to keep fighting as hard as we can on every front."

A Parks Canada fact sheet says as much as 70 per cent of Waskesiu's mature spruce could die over the next few years as a result of spruce budworm.

Addressing the remaining crowd, Morin expressed her own concerns about the infestation of spruce budworm but restated the national park policy is to not spray.

"We are doing our jobs," she said. "We are doing what we are paid to do."

"This is a very emotional issue. I think you can see that."

Throughout the meeting, mention was made of threats and intimidation by certain individuals in favour of spraying.

The issue will be the topic of a fall meeting in the national park. A date for the meeting has yet to be set.

In the meantime, the vegetation management strategy meetings will continue. A further meeting will be held Aug. 13 in Waskesiu.

Saskatoon Star Phoenix – Thursday, August 29, 2002

Parks Canada undecided on spraying budworm

By Shannon Boklaschuk - Star Phoenix

Parks Canada still has not made any decisions about whether to use an organic pesticide to control Prince Albert National Park's spruce budworm outbreak, which has raised the ire of some cabin owners in the area.

On Wednesday, a meeting that included representatives from Parks Canada, the Waskesiu community council and the Save Our Spruce (SOS) committee was held in Saskatoon, to examine the future of vegetation management in the park.

The use of the bacteriological BtK – believed to be capable of stopping the pest from contributing to the eventual destruction of mature spruce trees in the Waskesiu area – has won the support of SOS and hundreds of petition signatories from around the province.

However, Gaby Fortin, Parks Canada director general for western and northern Canada, said a decision about using BtK has not been made.

"We're gathering all the information. We're looking at all options right now. There's no decision that has been made," Fortin said in an interview following Wednesday's meeting.

"I don't have an exact date as to when the decision will be made, but it will be made before the next operating season, or the next spring.

"Hopefully it will be made somewhere in November, so if there are actions to be taken there'll be time to take those actions before next spring."

The budworm is a plant-eating insect that's native to the mixed boreal forest of the park. Parks Canada officials estimate 30 to 70 percent of the spruce may eventually be killed by the budworm, which has spread to most areas of the park.

The May-to-June window for spraying has now passed, but petitioners want a commitment to spray next year.

While Fortin said on Wednesday that no options have been ruled out, he also said, "there hasn't been much spraying done anywhere" over the last decade.

"Our policy is to allow natural processes to occur, and not to interfere with nature," he said.

"And certainly our overall policy is to minimize the use of pesticide, and in the long term even to try to eliminate them completely."

But those weren't the answers that Herve Langois the co-ordinator of the SOS committee and a Waskesiu cabin owner, was looking for.

In an interview, Langois said he wants the issue to be resolved as soon as possible.

"Time is not our friend here. We don't have a lot of time. The scientists made it clear (on Wednesday that if we don't address this by next spring that the jig may very well be over," he said.

"The message that we tried to get across all along and again (on Wednesday) is that the spruce trees are an integral and vital part of the cultural life of Waskesiu."

Al Ross, a Waskesiu community councillor, said he will make a decision as to whether or not spraying should occur based on the information he was given at the meeting.

He said the community council hasn't decided one way or the other about spraying.

Langlois, however, believes the community will eventually see it his way.

"In the absence of any other viable option – and nobody has presented us with any other viable option – then it seems that spraying is the only solution, and I suspect council will support that at the end of the day," he said.

But Dave Weider, a member of Prince Albert National Park Environmental Society, hopes that doesn't happen.

He said neither he nor his group supports spraying pesticides in any national park, and are concerned about the possible health and environmental side effects that could be associated with using BtK.

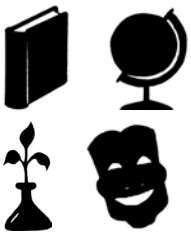
"We're concerned that there has never really been any long-term health studies on the effects of this pesticide, which is BtK, over a population," he said.

"I have two small girls that live with me and my wife here in the park, and I don't want to be wondering 30 to 40 years from now when they start getting some symptoms if this is something that I could have circumvented."

And as for the people involved with the SOS campaign, Weeder says, "they're in it for their own self interests."

Their concern is primarily for aesthetics of the trees sitting in front of their cabins," he said.

"And there are no provisions for that in either the National Parks Act or the policies, or in the Waskesiu community plan that states that this community will serve as a model environmental community.



Misi Sakaw

"The voles, the hares, the lynx, the moose, and the other animals lived successfully in the taiga through millennia because they had evolved as interdependent parts of a living community. The people of the moose had also evolved as members of this community. Thus they meshed into the complex interplay of energy exchanges and were also successful."

Wild Harmony - The Cycle of Life in the Northern Forest by William O. Pruitt

This quote, taken from a book originally published in 1960, beautifully summarizes some important forest ecology concepts. It was a book written about the boreal forest and it refers to its northern inhabitants, the Chipewyan, as the people of the Moose.

For quite some time, the "balance-of-nature" belief has played an important part in western environmental conservation thought. The belief involved the concept that before the advent of Europeans, Saskatchewan forests existed in some intact pristine and climax condition to which they would return if left alone. Also part of the belief is the perception that the inhabitants of this pristine environment were either poor primitive, starving people whose numbers were too low to have any impact on the landscape or that they were children of nature who magically lived in absolute harmony with their environment, not influencing it.

Even though this romantic idea sounds appealing, there are two important flaws in it. The first one is that a pristine, climax, intact forest is not a very objective reality. Forests, like other natural ecosystems, are and were constantly being disturbed and changing. Change is probably the only pristine characteristic of dynamic and healthy forests. The second one is that Saskatchewan forests were not wildernesses barely touched by man, but instead were home to many thousands of people, who formed different societies, spoke different languages, and had unique cultural and spiritual beliefs.

Objectives:
Investigate the nature of the historical interaction of Aboriginal peoples with Saskatchewan forests. Explore the idea of humans as part of the ecological cycle of the forest.

Subject:
Social Studies, Science, Arts Education, English Language Arts

Curriculum Links:
Grade 9 Science- The Environment
Grade 9 Science - Diversity of Life
Grade 9 Social Studies - Roots of Society
Native Studies 10
Drama 10/20/30,
Wildlife Management 10/20/30,
English Language Arts A10,
Biology 20/30,
Forestry Studies 20/30,
History 30,
Native Studies 30,
Social Studies 20,
Social Studies 30,
English language Arts A30

Duration:
Three or four class periods

Setting:
Classroom

Materials:
Copies of *The Wise Old Wolf*, copies of the life form questions, material for making masks(optional).

These different groups of people have been inhabiting, interacting, impacting and transforming their environment for thousands of years. Like William Pruitt points out, forest communities developed like any other natural communities, by the interplay of forces of many different organisms. People have been one of these forces for 10,000 years. They not only actively influenced the ecology of the forest, but they were keystone species which helped to shape their environment. The original inhabitants of North America determined the structure of entire plant and animal communities by firing the vegetation and by limiting ungulate numbers, for example.

Aboriginal people of the forest knew very well that their lives depended on the land and the animals. For hundreds of years they were able to hunt and gather what they needed. They believed that they should not destroy life needlessly. This position was commonly reiterated in their stories and in their spiritual beliefs. The need to repeat it and teach this to their own, implies that aboriginal people were aware of their abilities to manipulate and manage their environment. It also suggests they knew this should be done carefully.

Scholars believe that the aboriginal people learned from forest fires or from floods that all plant and animal life could disappear from an area very suddenly. In their view, this had also led them to understand that if a particular plant, or animal, or fish became scarce, other species that depended on it would also grow scarce.

There is also a simpler theory behind aboriginal people's understanding of ecological principles and their interdependence with other life forms. The following quote comes from the International Institute for Sustainable Development, in Indigenous *Perspective and Relationship with the Environment,* which was written by Indigenous people*: "… This understanding did not arise from a romanticized version of our relationship to the earth. It developed before contact with other societies and was based upon the basic law. This law was quite simply, life and death."*

Engage

Quote Discussion
Read or write the following quote to your students and ask them what they think of it and why.

"The acceleration of environmental transformations blinds us to their antiquity." David Lowenthal

Story
Stories have always played a very important role in first-nations cultures across Saskatchewan. Since these were mostly oral cultures, stories entertained, taught people about their past and sometimes had strong moral lessons. Stories also clearly demonstrated aboriginal people's closeness to the natural world. In their fantastic stories, it was sometimes difficult to tell people apart from animals. Animals were often seen as different kind of 'people' and as such talked and lived in their lodges, interacting like any people would do.

The Wise Old Wolf is a very interesting Cree story. Give a copy of it to your students and ask them to read it. Discuss what they thought of it afterwards. See if they can find anything in the story which would reflect ways in which aboriginal people interacted with their environment.

The Wise Old Wolf

Mahican, a wise old wolf, lived with his wife in the thick woods. One of his tricks was to try to get food away from Wesuketchuk[1].
One day he asked his wife to prepare something to eat. He knew they had very little food left but she managed to find a chicken. After they had finished Mahican trotted off to the bush, feeling quite content, even though they had no more food. He went straight to a patch of weeds where he knew many rabbits and deer lived.
On reaching his hunting ground, Mahican hid under a bush and waited for something to appear. Soon he saw some rabbits on the edge of a thicket. He waited a long time for them to come out, but instead they went deeper into the brush where he could not see them.
Any other wolf could have given up, but not old Mahican. He looked around until he found two stones and with these he started a fire by striking them together. He then lit some of the thicket and climbed on top of the matted bush until he was sitting over the centre of it. He knew that all the animals would stay inside there, for they were all afraid of fire. Then he sang his song:

"Mother Earth, Mother Earth,
Save Mahican, save Mahican.
The fire will cook his meat.
Mother Earth will save Mahican
And he will go home happy."

Just as the wolf finished singing, Mother Earth opened up for him and he disappeared from sight. In a short time all of the bush was burned and in it were many rabbits and three deer.
As soon as the fire was out, the wolf came out of the ground. He gathered up some of the cooked rabbits and started for home, saying to himself: "I'll get my wife to help me carry the rest home."
On his way he met another wolf who was hungry; as they were good friends, Mahican offered to divide the rabbits but on being told how they were captured, the other wolf said: "No, I'll try to get some for myself if you'll teach me the song."
"I shall be very glad to teach you." Said the wise wolf. So, he repeated the song over and over until the other wolf had learned it. Then he trotted off home with his rabbits.
The hungry wolf set off at a brisk gait, eager to try this new way of getting food. He soon found a thick patch of brush where he knew that many rabbits lived. He made a fire just as Mahican had showed him, setting the brush ablaze in ten places around the outside. Then he jumped into the centre of the parch as quickly so he would sink down into the ground where he would be away from the danger. But alas! He could not think of the first words of the song. Then he tried to get out of his trap, but there was a solid wall of flames all around him. The hungry wolf kept running round and round trying to escape until at last he was overcome with the smoke and heat and in the end he was burned with the other animals in the thicket.

From *Medicine Boy and Other Cree Tales* by Eleanor Brass
Story printed courtesy of the Glenbow-Alberta Institute

[1]Wesuketchuk, or Wisakedjak was a legendary Cree figure who possessed supernatural powers. He existed before the Creator made all the animals and the first people. He often played tricks on animals and plants, so stories talk about how he outwitted many of them.

Resources

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Canadian Museum of Civilization - http://www.civilisations.ca

EXPLORE

The Council of All Beings

The Council of All Beings was first introduced by deep ecologist John Seeds in his book *Thinking Like a Mountain: Towards a Council of All Beings.* Since then, the exercise of holding a council of all beings became an important environmental educational tool. During the activity students role-play different life forms and try to look at things through the perspective of the organisms they are role-playing. The idea is to build empathy and explore the idea that an ecosystem is formed by many different organisms, each having their own ecological values and needs.

Most North-American first nations, including the groups that inhabited Saskatchewan forests (Woodland Cree, Chipewyan and seasonally various Plains groups) believed that at one time (when the world was young) people and animals could talk to each other. They believed that all creatures could think and feel in very similar ways to people. As time went on, animals, plants, people and everything else in the environment got transformed into their actual form, but animals could still appear in human form in their own shelters. These beliefs indicated a strong closeness between aboriginal people and the other elements in the environment in which they were dependent.

Looking from this perspective, a Council of All Beings is a very appropriate activity to explore with students the role of aboriginal people in Saskatchewan forests in pre-Columbian times. People were important agents of change in the forests, but also part of their ecosystem and interconnected with all other elements of this system.

After reading and discussing *The Wise Old Wolf* story, tell your students they will have to prepare for a Council of All Beings, which will be held next class. This will be a historical council, in the time of Old Mahican. During the council, students will have to discuss from the perspective of animals, plants and people some important ecological roles in their time. Students will have to research in quite some depth the being that they are role-playing. It is important for students to be very aware of the ecological needs of their entities. Since this is a pre-European council, the person playing the human being should represent a Saskatchewan forest aboriginal culture, such as the Woodland Cree. This will also need serious and respectful research.

To help students focus on their beings, they should be able to answer the following questions about themselves in their research preparation :

1. What is your name - common name and scientific name? To what kingdom do you belong? (Plant, Animal. Fungi, etc.) What is your classification? (Mammal, Bird, Reptile, Amphibian, Fish, Arachnid, Deciduous, Coniferous, Moss, Bacteria, etc.)

2. Describe your physical appearance: size, shape, color, outstanding features. Make a picture. Make a mask. Describe and perform your movements, growth, and vocalization.

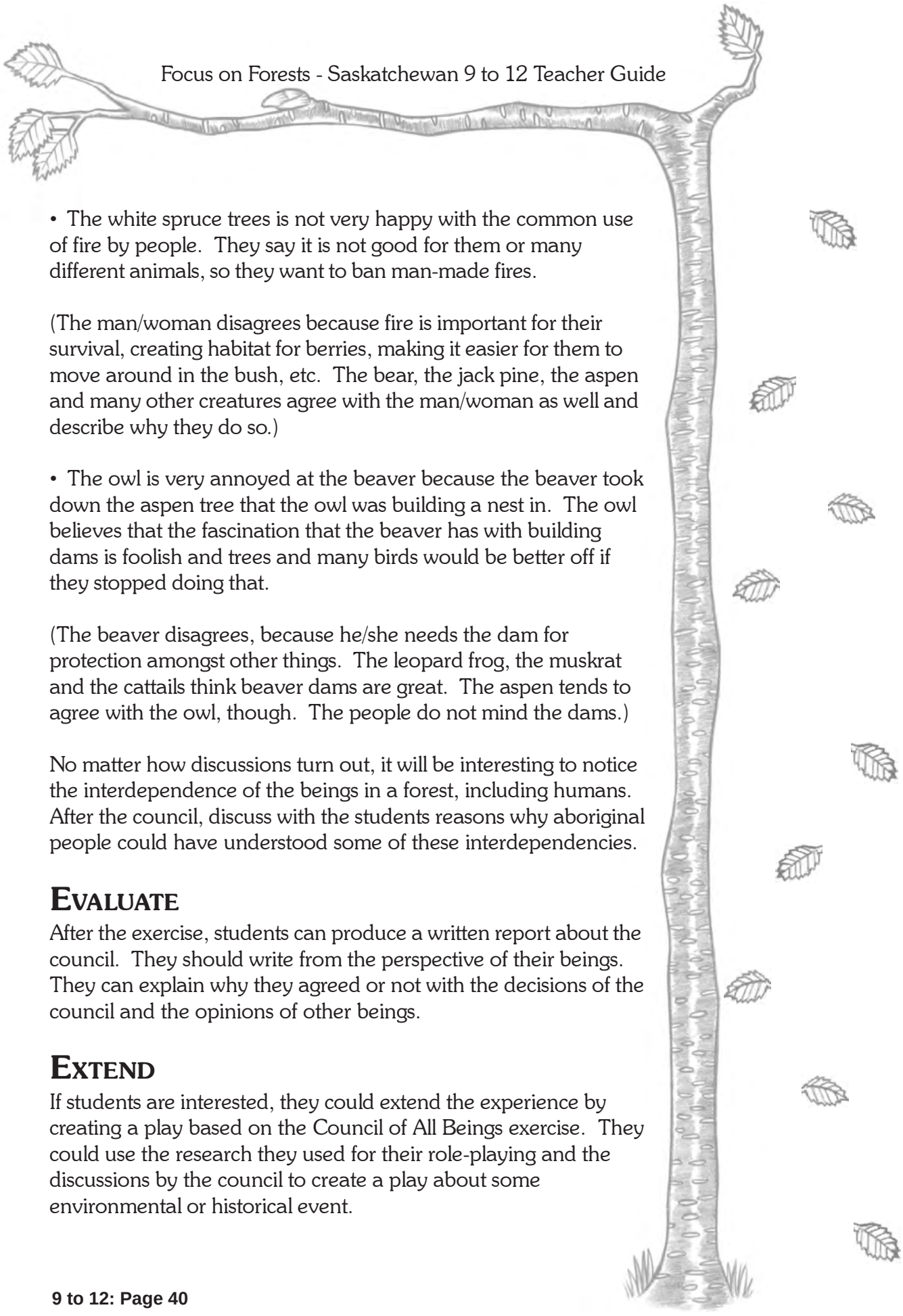
3. Identify your habitat. Describe the place or places where you live, the geographical location and characteristics.

4. Identify your place in the food web. What do you eat and what eats you? What adaptations or body features assist you in acquiring food? How do you protect yourself from predators?

5. Describe your activities as the seasons change. Describe your life cycle.

6. Tell your evolutionary story. How long have you lived on Earth, how long in this forest.

It may be helpful for your group to brainstorm some of the discussion topics of the council, before they start to research and prepare their positions. This may help them focus their research, so they know how their beings might argue their positions. Some examples of discussion topics could be:



• The white spruce trees is not very happy with the common use of fire by people. They say it is not good for them or many different animals, so they want to ban man-made fires.

(The man/woman disagrees because fire is important for their survival, creating habitat for berries, making it easier for them to move around in the bush, etc. The bear, the jack pine, the aspen and many other creatures agree with the man/woman as well and describe why they do so.)

• The owl is very annoyed at the beaver because the beaver took down the aspen tree that the owl was building a nest in. The owl believes that the fascination that the beaver has with building dams is foolish and trees and many birds would be better off if they stopped doing that.

(The beaver disagrees, because he/she needs the dam for protection amongst other things. The leopard frog, the muskrat and the cattails think beaver dams are great. The aspen tends to agree with the owl, though. The people do not mind the dams.)

No matter how discussions turn out, it will be interesting to notice the interdependence of the beings in a forest, including humans. After the council, discuss with the students reasons why aboriginal people could have understood some of these interdependencies.

Evaluate

After the exercise, students can produce a written report about the council. They should write from the perspective of their beings. They can explain why they agreed or not with the decisions of the council and the opinions of other beings.

Extend

If students are interested, they could extend the experience by creating a play based on the Council of All Beings exercise. They could use the research they used for their role-playing and the discussions by the council to create a play about some environmental or historical event.

Damage to Trees

Objective:
To show the wide range of damage agents, and to balance their similarities and differences.

Subjects:
Science, Visual Arts

Curriculum Links:
Grade 9 Science- The Environment
Grade 9 Science - Diversity of Life
Grade 9 Social Studies - Roots of Society
Biology 20/30, Social Studies 20,
Forestry Studies 20/30

Duration:
One to two classperiods

Setting:
Outdoors and Classroom

Materials:
Insect and disease damage reference, Tree Identification Guide, and Clipboard

Trees are food to many biological organisms. To some species, trees are also shelter. By rolling the leaves, or creating a cavity in the trunk, certain birds and mammals may find shelter and safety using trees. These uses are not always fatal to the tree, in fact in some cases this also benefits the tree.

So when we talk of damage to a tree, we have to keep in context that damage is natural. If species did not undergo some sort of stress, they likely would not have developed through time as they have, because the nature of life is that the more successful plants and animals are the most likely to survive. This includes those which adapt most successfully to its niche in the ecological system in which it lives.

That being said, however, there are times when damage becomes unacceptable to us humans, especially in the park or urban setting. This includes forest fires, which damage large portions of our commercial forest. Now fire is natural, and most of our tree species have developed in this milieu so that they are to a great extent reliant on fire for their health and reproduction - they have adapted to benefit from this activity.

For instance our jack-pine is susceptible to dwarf mistletoe (*Arceuthobium americanum*), which spreads slowly from tree to tree. Therefore it is at its worst in older stands in which it has had the time to spread. In addition, these stands are under age stress, and are more likely to be more susceptible. What happens when man prevents fire, nature's cleaner? The infestation of the dwarf mistletoe increases, and eventually leads to tree mortality and even greater risk from fire.

Man-caused damage is less acceptable to us; and pests which make life unpleasant for us are also unwelcome. This includes fall cankerworm (*Alsophila pometaria*) in our cities; in the spring, they descend from little web lines and dangle above the side-walks where they can get caught in a person's hair. It includes beaver which topple the trees in our river-side parks. It includes fire-blight (the bacterium *Erwinia*) which kills apple trees.

Human-caused

This is the damage that is preventable, often by taking a little care and attention. These include mechanical damage, such as breaking off branches, or swiping the trunk with the lawn-mower, or carving your initials in the tree. They can also include chemical damage from salt from the roads, or from agricultural spray of herbicides or other agents.

Environmental

Mother nature also has her own list of surprises to damage the tree, which can include late spring frosts which damage the tender young shoots, or hail which can damage stems (and in one particularly bad storm near Greenwater Lake Provincial Park actually killed many hectares of poplar). Floods can kill trees if they stand in water for any length of time, and also flooding and rivers can erode the soil around the tree, or topple it.

Mammals

Mammals use trees too, and the beaver is one extreme example. Also elk in rut can swipe the bark off trees; porcupine munch on the tender and tasty bark of spruce trees, rabbits strip young trees of their bark and their juicy buds, and squirrels impact the least as they only steal and nip off tips from mature trees.

Birds

Whilst most birds are beneficial, in that they eat the larvae of budworms or other pests, birds, such as sapsuckers (*Sphyrapicus*), drill holes in the trunk causing the tree to lose sap, and the bird returns periodically to eat some, as well as any insects.

Rabbits strip young trees of their bark and their juicy buds

Sapsuckers drill holes in the trunk causing the tree to lose sap

Spruce Budworm can cause considerable damage to conifers

Dwarf Mistletoe grows on living pine trees and extracts nutrients from the tree

The mycelial fan of a fungus spreads under the bark so it can go undetected in a tree.

Insects

There are many insects which cause damage to trees, and most are very specific about the type of tree they will go to, and also specific about what part of the tree they will use. Bark beetles tunnel inside the bark of trees and lay their eggs. The elm bark beetle (*Hylurgopinus rufipes*) will only go to elm trees. The ash trees have their own beetle. The forest tent caterpillar (*Malacosoma disstria*) invades our farmland, parks, and communities, and devours the aspen trees, but it leaves the black poplar.

Green plants

Plants damage trees too. The example we are familiar with is the dwarf mistletoe (*Arceuthobium*) which grows on living pine trees, and extracts nutrients from the tree, thus weakening it to attack from other pests.

Fungi

There are a great many fungi in the forest, but we seldom see them. Most of the time we only see them when they mature and we see the fruiting bodies. These appear as mushrooms, or conks. Fungi are major agents of rot in wood, and the appearance of them is very characteristic of the type of rot or fungus.

Multiple infections

There of course is never just one pest alone, and more often than not there is a series of pests which attack the same tree. For instance in a tree which a fungus has caused rot, the ants can now access it; fungi live or fruit in the spaces opened up by insects; pine weakened by mistletoe (*Areceuthobium*) is more susceptible to attack by insects; and in fact the Dutch Elm Disease (*Ceratocystis ulmi*) relies on the elm bark beetle (*Hylurgopinus*) to spread the disease. Stem damage by a lawnmower will allow entry of insects and fungi.

Engage

Using their understanding of plant physiology have the students brainstorm a system to determine classifications and severity of damage of various agents to a particular tree. For example, extensive damage to the stem or trunk of the tree will be more severe than to a leaf but a wide spread defoliation could have serious short term impacts on a particualr specimen.

Explore

Using the classification developed by the class have the students do a survey of a forested area (either urban or wilderness). Using guide books and other resources the students should be able to identify the damaging agent and depending on the location and prevalence they will be able to determine the severity.

Extend

The class could use photographs and a web page to develop a guide for the surveyed location. This may be extremely valuable for some communities and could be used to education people about the identification and prevalence of various damaging agents that exist within a community.

Integrated Pest Management

Objective:

To help students recognize that epidemic and pandemic levels of pest infestation may call for human intervention. Students will be exposed to a variety of insect and disease problems.

Subject:
Science, Mathematics

CurriculumLinks:
Grade 9 Science - The Environment,
Grade 9 Mathematics - Problem Solving/Data Management
Grade 10 Science - Earth/ Environmental Science

Group Size:
Small groups/full class

Setting:
Classroom

Materials:
Binoculars would be useful, but not necessary.
Tally sheets and pencils.
Ribbons for marking the boundaries of the plots.
Some way to mark the trees which have been examined already.

Integrated Pest Management (IPM) is a coordinated and inclusive approach to pests, which uses information and life histories about the pest and the victim, which are both considered in planning to avoid and counteract infestations. This approach includes emphasis on prevention and avoidance of problems, but when action is warranted, it must be socially acceptable and environmentally responsible. It is also carried out only after all aspects of the pest and hosts systems are understood.

The intention is not necessarily elimination, but should aim at bringing the populations below levels which cause significant injury. "Significant" can vary depending on the tree location, urban or rural, and safety issues. I.P.M. becomes a blend of biological indications and socially acceptable norms.

What is a pest?
A pest is similar to a weed, which is a "plant in the wrong place" A pest is an organism which interferes with a desired crop; and the range of pests is a lot wider than just insects, plants and fungi. It includes nematodes(round worms), bacteria, and arthropods other than insects.

The pests we see are usually endemic (always present at low levels) in the boreal forest community. The eco-system usually accommodates endemic levels in co-existence with agents which balance its growth.

Sometimes the balance is changed; one of the components in the eco-system becomes out of phase with the others. Then the one component takes advantage until the other portions of the eco-system compensate and catch up with it.
Exotic pests are more danger, as they are unknown in the local eco-system and may have no controlling agents. Asian long-horn beetles is one concern and may be brought over in pallets used to bring imports from Asia. Dutch Elm Disease is another.

What are infestation levels?

Endemic- Levels at which the pest is always there, but is in balance with other organisms and/or food, so that the levels remain constant.
Epidemic- This is an outbreak above the levels which the usual controlling influences are able to contain it. Action is usually warranted.
Pandemic- This is a widespread outbreak of a pest, so that the levels are high not only in one area, but over a widespread area. Action is usually warranted.

I.P.M. Strategies
Known by the acronym MUPEC, this strategy is used when developing an Integrated Pest Management program.

Monitor
The first requirement is to know what is happening. Even if nothing is happening it is important to know that. Or if you have taken action, it is very important to know how that is affecting the eco-system, so that future action can be adapted as a result of this information.

In the forest this monitoring takes place as surveys carried out to detect, monitor and forecast forest pest conditions. It is important to watch the historical relationships between various pest stages so that we know whether the insects are behaving normally or not, and if not there may be an epidemic impending.

Understand
In preparation to take an action, it is important to know how the various components behave individually and in concert. Know for instance the life history of the pest, how it affects the tree, what causes build up of populations. Know the effects of the actions available - (if a spray, its effects on other organisms); if "do nothing" how the infection may progress.

Prevention
Try to take those actions which will minimize the potential for any adverse effect. Consideration before you plant a certain species on a particular site.

Evaluation

The objective is likely to keep pest populations below specified thresholds that cause undesired levels of damage. Evaluate the controls which could do this - you may need preventative, suppressive, or regulatory. The suppressive phase may include the use of :

- mechanical (e.g. water spray, or manual picking),
- biological (e.g. usually increased populations of natural pests such as insects (often ladybirds), parasites, viruses, bacteria, fungi); or
- synthetic insecticides (e.g. chemical spray).

Using all information at hand, and with the social acceptance of the relevant public, options will become available. One may be the "do nothing" approach, while another may be to "eliminate the pest". More often it is usually something in between. These options must be evaluated, and an appropriate one chosen. This will balance the best available control options and ensure that they are biologically sound, and are effective in meeting the objective at a reasonable cost, as well as being socially acceptable.

Control

Elimination of an endemic pest in a mature forest is not desirable.

If action is called for, this may include several actions which act together to optimize the balance between cost and result, while minimizing adverse effects. When initiated it must be done completely, and in a timely fashion. There is no point going at less than full levels, as that will likely not save half the cost.

Re-MUPEC all over again

The last phase in the action is to return to the start, and monitor what happens as a result of the action taken. Any action must be monitored to record and evaluate the results, and to compare them to the forecast result. If the effects are not as had been thought, it is very important to know that and understand why, before it is repeated.

And if the action has an unexpected result, that in itself may require movement through the steps above, such as understanding and evaluation, to determine whether corrective action is warranted, and whether the action chosen was the appropriate one.

ENGAGE

Divide your students into three groups and have each group study one of the insect and disease handouts provided. They can use the internet or other resources to find pictures of the insect or disease they are studying. They will then present a summary of their insect or disease to the class. Next the class can devise a system for determining the degree of infestation. Have the students produce this in a format that will be useful for the field.

EXPLORE

The following uses Dwarf Mistletoe as the example but this activity could be used with any forest pest where observable phenomena exist.

1. Measure an area, or a number of trees for the sample, and inspect every tree within that sample.
2. Refer to the disease study handouts to help gain a better appreciation of the particular disease. Otherwise refer to the research the class has done on the various forest pests.
3. Using the system the students devised for determining your degrees of infestation monitor an area for the disease.
4. Then have them sample the infestation levels of each tree, and apply that to the stand
5. Summarize the findings.

EXTEND

Using the classes findings take the next steps in developing an integrated pest management program for the area you have developed. What are some of the tools and strategies that could be used to prevent spread of the pest or to control it in the case of an outbreak.

TEACHING NOTES:

You should look at the stand beforehand, so that you know the level of infection. If we are using brooms as an indicator of the disease, there should be some. The sample should be of a size which covers the time allotted, and the more brooms they have to count, the longer it will take.

The European mistletoe (Viscum album) is a completely different plant from the one found in N. America. It has larger leaves which are quite visible year round, and the berries are larger, and white, and do not explode. They have sticky insides and are spread by birds which either excrete the seeds on another tree, or which rub the berries off their beaks after eating the jelly surrounding it.

Disease Study # 1– *Armillaria*

BACKGROUND INFORMATION

What is Armillaria?

Saprophyte- is a plant which can live on dead (decaying) organic material.
Parasite- lives in or on another living organism without contributing in return.

Armillaria is a family which includes a wide range of similar fungi, which grow in wood. They are indigenous (ie they occur naturally) to forests. They can behave parasitically, when they infest a living tree, and can live saprophytically, once it has killed it. Other names for this include the honey mushroom, because of the colour of the mushrooms; and the bootlace fungus, named after the brown/black string-like rhizomorphs which spread the fungus through the ground. Armillaria causes wood decay, growth reduction, leading to mortality. It is known as a white rot, as the effects are to leave the rotting wood of the tree as a white stringy mass. It infects and kills trees that have been already weakened by competition, other pests, or climatic factors. The fungus also infects healthy trees, either killing them outright or predisposing them to attacks by other fungi or insects.

Structures
Rhizomorph - (From Greek: root; body.) An aggregation of hyphae resembling a root and having a well defined apical meristem capable of transporting nutrients and spreading infection over considerable distances.
Mycelium - A white thread-like mass of hyphae forming the body of the fungus
The mycelium grows through the end of the rhizomorph into the tree root, partly through physical pressure, and partly by enzymes. Once the tree detects the fungus, it will try to seal off the entry attempt by producing lignin callus tissues and producing resins to dissuade the entry. Thus they may remain at a "stand-off" until conditions change and favour one or the other.

Life history
In its fungal form, it lives in wood. It consists mostly of a mass of white hyphae, collectively called a mycelium. It expands through the soil by rhizomorphs, which consist of strings of hyphae in a thicker brownish leathery coating

Once it arrives in the tree it spreads through the root, and up between the bark and the stem. It breaks down the woody portions of the tree into nutrients it can use for growth. In the fall of the year, if conditions are satisfactory, it will grow mushrooms at the base of the ailing tree. These are in small groups, are honey-coloured, and produce spores. The spread is usually by rhizomorphs through the soil, infecting roots they contact.

How the tree is affected

The fungus breaks down the woody portions of the tree, turning the cell walls themselves (which consist of celluloses, hemi-celluloses and lignins) into nutrients which it can use for growth. If the mycelia dissolve the cells, this will slow water uptake and transport, further weakening the tree, and cause wilting. If the tree was already in stress, it will weaken quickly and die. A smaller tree is more easily overcome than a large and vigorous one.

How the stand is affected

Synapse is a junction between the roots of neighbouring trees, through which infection can travel. If one tree is affected, it is likely that the fungus will spread, because other trees are likely to be in the same condition of stress. If trees are close there are more likely to be root **synapses** to hasten the spread. Also, if some trees are taken out of the stand, the fungus can enter these with no opposition, thus forming centres of healthy fungus from which it will spread. Trees will tend to die in increasing circles as the fungus spreads from the disease centres. Eventually the whole stand may die, unless over time conditions become better for the trees and worse for the fungus.

Spread and infection

When a mycelium attempts to enter the root, a healthy tree will be able to mount a counteraction. In these cases the fungus is slowed or stopped until conditions change. However a pre-disposed tree which is under stress already will be less able to mount a defensive move. In these cases the fungus will likely quickly infest the tree, and will soon kill it. Once the tree is dead, the fungus has no opposition and can quickly expand over the whole root system. From this expanded diameter, it can then continue its progress towards other trees. It does this either through root synapses or by forming rhizomorphs back into the soil. A root synapse is a point where roots from different trees meet together, thus forming a potential spread point for diseases.

Detection

This is one of the pests which grow in the tree or in the ground, and is difficult to notice. In fall the mushroom might be noticed, especially in wet weather. The best way is to notice it is through the effects which the fungus is having on the tree. The tree will look unhealthy, the crown will thin, the needles will be small, growth almost ceases, and in later stages the needles will brown and drop off. In these cases, peel off the bark from the lower stem, and there will be white mycelial "fans" growing up the stem between the bark and the cambium. There may also be rhizomorphs. In hardwoods there are sometimes sunken cancers which may exude gums and saps.

Disease Study #2 – *Jack pine and Dwarf Mistletoe*

BACKGROUND INFORMATION.

What is mistletoe?

Parasite - lives in or on another living organism and harms the host.

Dwarf mistletoe is a parasitic plant which grows on coniferous trees in North America. These are so-called "new world" mistletoes, including pine dwarf mistletoe, and the spruce mistletoe. These are both from the family *Arceuthobium*, and are leafless.

The most frequent one we see is the pine mistletoe which can affect pine stands which are under stress. Mistletoe weakens the tree, which may eventually die, thus killing the mistletoe also.

Life History

The infection cycle starts when a seed lands on a pine branch late in the summer, and the seed lies dormant until spring. Then it forms a root-like structure which penetrates the host bark, and into the tissues underneath. These root-like structures grow in the stems for up to 4 years before they seed. Then greenish aerial shoots appear around the infection point and produce tiny yellow flowers in late spring. Later the female mistletoe produced green berries which ripen. In the sun they split, and the seed is expelled from the seed pod; it is covered by a mucilaginous substance and it adheres to the plant it lands on. The seeds can fly up to 18 metres.

How the tree is affected

Vascular system - the system of vessels which conduct liquids and sugars through the plant. The mistletoe obtains nutrients from the vascular system of the tree, which makes less available to the tree, thus weakening the tree. Beyond the point of infection, the branch becomes stunted, and causes repeated division of the stem which forms the "witches' brooms" we often see in jack pine trees.

Also, the invasion stimulates the tree to divide very enthusiastically. This diverts tree resources to these witches brooms which are of no positive use to the tree. In fact they often break off due to the weight of the witches' brooms, making wounds suitable for entry of insects and diseases.

If a seed falls on a jack pine branch, it germinated and its roots can grow into and infect the tree. However if the tree is healthy it can oppose this entry attempt.

Control in Nature

Mistletoe does not have any natural predator. Control in nature is by periodic natural fires.

Control

Suitable control is planned by reviewing the life history; the planning could look like this.

1. Mistletoe is a plant, but lives under the bark.
   Therefore spray does not work.
2. It is a parasite, and dies when the host dies.
   Killing the host will kill the mistletoe.
3. It can be shot for 18m.
   Keep young stands at least that far from infected stands.
4. It is host specific, and only infects jack pine.
   Barrier planting (another species between blocks) limits the spread.
5. It spreads slowly.
   Inspect for diseased trees and eliminate them.
6. It is able to infect stressed trees.
   Plant on areas which will not stress the trees.

Successful disease avoidance

1. Cut down badly infested stands.
2. Plant on good sites.
3. Keep the plantation at least 18m away, further downwind of the prevailing winds.
3. Harvest the trees when they mature.

Management which does not avoid disease

1. Allow pine to grow on very dry sites where it will be stressed.
2. Do not allow fires to renew the forest.
3. Do not allow harvest.

What is a vicious circle?

Some areas are very badly infested with dwarf mistletoe. This happens when man prevents natural forest renewal. On very dry areas pine is the only thing that will grow, but then it gets diseased and looks shabby and there is much dead material, which is even less tempting for harvest. So infection increases, mortality takes place, dead limbs and trees fall on the ground and hang from the trees, making a very dangerous fire situation. If a fire does come in, there is lots of dead and dry wood available to make a very bad fire.

Disease Study # 3 – *Spruce Budworm*

BACKGROUND INFORMATION

What is spruce Budworm?

Spruce budworm is an endemic insect in boreal forests; the larval stage (caterpillar) of this insect eats the new needles of balsam fir and spruce. ***Endemic*** means that the pest is always present, but is in balance with other organisms and/or food, so that the levels remain constant. Although it is named the spruce budworm, it prefers balsam fir; however when it reaches epidemic proportions it is quite happy on spruce.

Life History

The adult budworm is an inconspicuous moth with a wing-span about 2 cms.
In July they mate and the female lays up to 200 eggs on the undersides of needles. These hatch after 10-14 days, and the small larvae find a sheltered place where they spin silky shelters where they spend the winter in hibernation. Once it is warm enough in spring, they get themselves to a terminal bud or a new needle where they can nibble the tender new needles as they are forming. The larvae moult several times as they grow quickly, eventually reaching 2.5 cms long. Instar is the stage of a larva between moults. The spruce budworm moults 7 times. The larvae are wasteful feeders, and partial needles are left around, and often catch on the silky web the larva produces. In severe infestations the larvae can run out of food, then they lower themselves on their silky threads in the search for more. In severe infections this gives the top of the tree a misty brown appearance, which can have a multitude of silky threads over it. Larvae mature by the end of June. They have yellow-brown bodies and black heads, and are about 20 mm in size. They then pupate on the foliage; and the adults hatch about 10 days later, ready to start the cycle over again. These moths fly in the evenings where they are often carried large distances by the winds.

How the tree is affected

The new growth is eaten. In a heavy infestation this can severely reduce the amount of photo-synthesis, sugar production, and compromise the growth of the tree. Spruce needles live for 3 or 4 years, so if there are a few years of needle loss , the tree will die.

How the forest is affected?

In the past, epidemics have been small in area and short in duration. An epidemic is when there is an outbreak above the levels which the usual controlling influences are able to contain. In recent years the infections seem to be larger in extent, and longer in duration. Some equate this with the series of warm winters and dry springs experienced in Saskatchewan's forests.

In 1985 an estimated 4,000 hectares were infected; by 1997 120,000 ha, and by 1998 150,000ha. If all that area was to die, and if provincial harvest is 25,000 ha, harvest could not keep up with the spread of that one pest.

Control in Nature

In nature the insect is balanced and kept at low levels by insect parasites, insect predators, birds and by diseases such as bacteria which can infest their soft bodies. Although the second instar over-winters, late instars of the larvae are more affected by late spring frosts. At low levels this insect is not a major problem, and is kept at low levels by the balance with its predators.
Sometimes if the conditions are right for it, and the predators are at a low level, and the weather is suitable, populations can become epidemic. This happens particularly in mature to over-mature stands. Then all the new growth can be eliminated, and some of the older needles also. Thus only reduced levels of photosynthesis can take place; this puts the tree under severe stress and it can die in 3 or 4 years.

Predators are not as quick to react to an epidemic - to build up their own populations takes more time, but once they do in a few years time they will again reduce the insect populations. However in really intense infestations this may be too late; the tree may be almost dead, or have become so weakened that it is damaged by other pests and diseases.

Control

On small residential trees larvae can be picked off by hand, or knocked off with a water spray.

In the provincial forest they can be sprayed with a naturally occurring bacterial insecticide, which is mass produced for the purpose. This affects only the stomachs of larvae which ingest it. This spray contains Bacillus thuringiensis, or “B.t.”. Only certain larval stages are affected by the spray, and only when they are actively feeding. So the spray has to be done at very specific times in the development of the larvae, and exact timing is very critical.

Glossary of Terms

A

Abiotic: Referring to the absence of living organisms.

Adaptation: The occurrence of genetic changes in a population of species as the result of natural selection so that it adjusts to new or altered environmental conditions.

Afforestation: Establishing a forest on an area that has not previously had trees growing on it.

Age Class: Any interval into which the age range of forest stands is divided for classification and use.

Agro-forestry: The practice of raising trees and agriculture products such as forage and or livestock on the same area at the same time.

Allowable Annual Cut (AAC): The average volume of wood which may be harvested annually under sustained yield management. Roughly equal to the amount of new growth produced by the forest each year including a proportion of the mature volume less deductions for losses due to fire, insects and disease.

Annual Ring: A line appearing on tree cross-sections marking the end of a growing season and showing the volume of wood added during the year.

Artificial Regeneration: Establishing a new forest by planting seedlings or by direct seedling (as opposed to natural regeneration).

Azimuth: The horizontal angle or bearing of a point measured from the true (astronomic) north. Used to refer to a compass on which the movable dial (used to read direction) is numbered in 360°. (See also bearing)

B

***Backlog*:** A term applied to forest land areas where silviculture treatments such as planting and site preparation are overdue.

Bearing: A direction on the ground or on a map defined by the angle measured from some reference direction: this may be true (geographic) north, magnetic north, or grid north. Used also to refer to a compass on which the movable dial (used to read direction) is number as four 90° quadrants where N=0, S=0, E=90, W=90.

Biome: An ecological community of plants and animals extending over a large natural area.

Biosphere: The life zone of the earth, including the lower part of the atmosphere, the hydrosphere, soil, and the lithosphere to a depth of about 2 km.

Biotic: Of or pertaining to life and living organisms.

Boreal Forest Region: The largest forested area in Saskatchewan, dominated by conifer species including spruce, fir, pine and tamarack. The southern edge of the region contains a mixture of deciduous trees such as birch and poplar. This region forms a band extending diagonally across the northern half of the province.

Broadleaf: A tree with flat leaves and flowers that produce fruit when developed and fertilized. The group includes all deciduous trees and a very few evergreens, such as holly.

Buffer Strip: A strip of land where disturbance is not allowed or is closely monitored to preserve or enhance aesthetic and other qualities along or adjacent to roads, trails, watercourses and recreation sites.

C

Cambium: A single layer of cells between the woody part of the tree and the bark. Division of these cells results in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: The forest cover of branches and foliage formed by tree crowns.

Cellulose: A carbohydrate (CHO) that forms the walls of plant cells and makes up the bulk of the wood in trees.

Clearcutting: A method of harvesting trees where all standing trees are removed in one operation. Clearcutting is most often used with species like jack pine that require full sunlight to regenerate successfully. An even-aged forest results.

Climax ecosystem: The semi-permanent culminating stage of succession which continues to occupy an area unless there are significant changes in the environment.

Closed canopy: The description given to a stand of trees when the crowns of the main level of trees forming the canopy are touching and intermingle so that light cannot reach the forest floor.

Coniferous: Cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood know commercially as "softwoods".

Conk: A hard, spore-bearing structure of a wood-destroying fungus that projects beyond the bard of a tree.

Conservation: The wise management of renewable resources in such a way as to ensure their continuing quality and availability to current and future operations.

Crown: The upper part of a tree or other woody plant, carrying the main branch system and foliage.

D

DBH: The diameter of a tree at breast height (defined as 1.4 m above the ground).

Deciduous: Term applied to trees, commonly broadleaf, that usually shed their leaves annually, also known commercially as "hardwoods".

Decomposer: A heterotrophic organism (including bacteria and fungi) that breaks down the complex compounds of dead protoplasm, absorbs some decomposition products, and releases substances usable by consumers.

Dendrology: The study of the identification and classification of trees.

Dominant Crowns: The uppermost branches of trees that can reach above their neighbors to get the most sunlight.

Dominant Species: Most numerous and vigorous species in a mixed crop.

Duff: Mossy, organic matter that covers mineral soil.

Ecosystem: An interacting system of living organisms (plant and/or animal), soil, and climatic factors all linked by the flow of energy and nutrients.

Even-aged Forest: A forest in which all of the trees present are essentially the same age.

F

Feller-buncher: A harvesting machine that cuts a tree with shears or a saw then piles it.

Firebreak: Areas or strips of less flammable fuels that are either natural (standing time or landslides) or a made in advance (cat trails or roads) as precautionary measures, separating areas of greater fire hazard.

Fire guard: A man-made barrier (often an area cleared of fuels constructed at the time of a fire to control it and provide a point from which to carry out fire suppression.

Fire Weather Index (FWI): A numerical rating of fire intensity that combines the expected rate of spread and the total amount of available fuel for combustion. It is suitable as a general index of fire danger in the forested areas of Saskatchewan.

Forest: A plant community predominantly of trees and other woody vegetation growing more or less closely together.

Forest cover map: A map showing relatively homogeneous forest stands or cover types produced from the interpretation of aerial photos and information collected in the field. Commonly includes information on species, age class, height class, and stocking level.
Forest inventory: A survey of a forest area to collect such data as area condition, timber volume and species, for specific purposes such as planning, purchases, evaluation, management, or harvesting.
Forest Management License Agreement: A contractual agreement between the Provincial Government and a forest company to provide a wood supply to the processing plants of that company. It ensures that the forest on such lands are harvested and reforested to produce successive crops of timber on a sustainable-yield basis.
Fungus: An organism that obtains its nourishment through the organic matter of other plants, causing decays.

G
Galls: Ball-shaped growths on plants resulting from insects, fungi, bacteria or injury.
Girdling: To kill a tree by severing or damaging the cambium layer and interrupting the flow of food between the leaves and the rest of the tree.
Greenhouse Effect: The steady warming of the earth's atmosphere, caused by the accumulation of greenhouse gases, including carbon dioxide.

H
Habitat: The local environment in which a plant or animal lives; includes the food, water, and shelter necessary for its survival.
Hardwood: A term used to describe broadleaf, usually deciduous, trees such as oaks, maples, ashes, elms, etc.
Harvest: The removal of timber for use. Includes felling, extraction, and sometimes initial processing.
Heartwood: The inner core of a woody stem composed of nonliving cells and usually differentiated from the outer wood layer (sapwood) by its darker color. (see cambium)
Height class: Any interval into which the range of tree heights is divided for classification and use, commonly 3m, 5m, or 10m classes.
Height/diameter curve: A graphic representation of the relationship between individual tree heights and diameters used to determine tree volumes in localized areas.
Humus: A general term for the more or less decomposed plant and animal residues in the upper soil layer.

I
Increment borer: A hollow auger-like tool used to bore into the trunk of a tree to remove a cylinder of wood about the diameter of a straw containing a cross-section of the tree's growth rings.
Integrated resource management: The deliberate and carefully planned management of a forest area taking into account the values of all resources in the area.

L
Lateral Bud: Any bud that develops on the side of a stem.
Lignin: A complex organic molecule that acts as the binding substance that holds wood together.
Litter layer: The uppermost layer of organic debris on a forest floor; it is slightly decomposed and consists mainly bark, twigs, and leaves.

M

Mensuration: That phase of forestry that deals with the measurement or present and future volume, growth, and development of individual trees and stands and their products and values, such as timber and wildlife populations.

Merchantable timber: A tree or stand that has attained sufficient size, quality and /or volume to make it suitable for harvesting.

Microclimate: Generally the climate of small areas, especially insofar as this differs significantly from the general climate of the region. Stands often create microclimates.

Microsite: A small area which exhibits localized characteristics different from the surrounding area. For example, the microsite created by a rock outcrop with thin soils, or the shaded and cooled areas created on a site by the presence of slash.

Mycorrhizae: A group of fungi which grow associated with plant roots in a symbiotic relationship. They are "extensions" of the tree's own root system. and are very absorptive, and more efficient than the plant's roots themselves, they take up mineral nutrients from the soil and then pass some of these minerals to the plant. In return, the fungi receive sugars and other nutrients from the plant's photosynthetic processes.

N

Natural regeneration: The renewal of a forest by self-sown seed or vegetative means.

NSR (not satisfactorily restocked): Productive forest land that has been denuded and has failed partially or completely to regenerate naturally or to be artificially regenerated.

P

Pest: An organism capable of causing material damage. Forest pests include insects and disease.

pH: A measurement, indicating the alkalinity or acidity of a solution.

Phloem: A layer of complex, food-conducting vascular tissue in higher plants.

Photosynthesis: Synthesis of chemical compounds in light, especially the manufacture of organic compounds (primarily carbohydrates) from carbon dioxide and a hydrogen source (such as water), with simultaneous liberation of oxygen, by chlorophyll-containing plant cells.

Pioneer plants: A succession term for plants capable of invading bare sites, e.g. a newly exposed soil surface and persisting there, i.e. 'colonizing' until supplanted by invader or other succession species.

Pith: The central core of a stem and some roots, representing the first year of growth and consisting mainly of soft tissue.

Prescribed burning: The knowledgeable application of fire to a specified land area to accomplish designated land management objectives.

Provincial forest inventory: A description of the quantity and quality of forest trees, non-wood values, and many of the characteristics of the land base compiled from statistical data for the forest lands of the Province.

Pruning: The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood. Pruning is also practiced in urban areas for safety and sanitation purposes.

R

Reforestation: Re-establishing a forest on an area where trees have been removed.

Regeneration survey: Carried out to determine the initial restocking of a site. It is used to describe the number of trees on a site that have reached acceptable standards.

Relative Humidity: The amount of moisture in the air as compared with the maximum amount that the air could contain at the same temperature, expressed as a percentage.

Respiration: The processes by which tissues and organisms exchange gases with their environment.

Rotation age: The age at which a stand is considered mature and ready for harvesting.

S

Sanitation cutting: The removal of damaged or diseased stems to prevent the spread of insects or disease to the forest stand.

Sap: The liquid that rises from the roots of a tree. Sap consists of water and minerals. In the spring it also contains sugars to stimulate growth.

Sapling: A small tree, usually defined as being between 5 cm and 10 cm dbh.

Sapwood: The outer layers of wood in a tree that contains living cells and is responsible for nutrient transportation.

Scaling: The measuring of lengths and diameters of logs and calculating deductions for defect to determine volume.

Scarification: A method of seedbed preparation that consists of exposing patches of mineral soil through mechanical action.

Seedling: A tree, usually defined as less than 5 cm dbh, which has grown from a seed.

Seed orchard: An area of specially planted trees that have been selected for their superior characteristics (i.e. growth, volume, branching, pest resistance, etc.) to breed genetically improved seed.

Selection cutting: An uneven-aged silviculture system in which trees are harvested individually or in small groups continuously at relatively short intervals.

Shade-tolerant: The capacity of a tree or plant species to develop and grow in the shade of, and in competition with, other trees or plants.

Shearing: In Christmas tree culture, to prune the branches to make dense foliage and give the tree a conical shape.

Shrub: A low-growing perennial plant with a persistent woody stem and low branching habit.

Silvics: The study of the life cycle and characteristics of forest trees and stands with particular reference to local factors and environmental requirements.

Silviculture: The art, science and practice of cultivating continuous forest crops based on a knowledge of species silvics.

Site Class: The measure of the relative productive capacity of a site for a particular crop or stand based on volume or height at a given age.

Site preparation: Disturbance of an area's topsoil and ground vegetation to create conditions suitable for regeneration.

Skidder: A wheeled or tracked vehicle used for sliding/dragging logs from the stump to a landing.

Slash: The residue left on the ground after felling, including unused logs, uprooted stumps, broken tops, etc.

Snags: Either a standing tree that has begun to decay and has value as a wildlife habitat or a tree that has been felled but has been caught on the way down.

Springwood: The less dense, larger thin-walled cells of an annual growth ring. Also called early wood because it is formed early in the growing season.

Sprout: A shoot that has grown from the base, stump, or root of another tree.

Stand: A community of trees sufficiently uniform in species, age, arrangement or condition to be distinguishable as a group from the forest or other growth on the area.

Stand tending: Any operation carried out for the benefit of an established forest crop at any stage of its life (e.g., cleaning, thinning, fertilizing, spraying).

Stomata: Pores in plant leaves that control the respiration of a plant.

Stumpage: The price that must be paid to the provincial government for timber harvested from Crown land.

Succession: The replacement of one plant community by another until ecological stability is achieved.

Sucker: Sprouts growing from the root system as opposed to coppice shoots from the stump or root collar.

Summerwood: The denser, later-formed wood of annual growth ring. Also known as 'latewood'

referring to the time in the growing season that these cells are produced.
Suppressed Trees: Trees experiencing slowed growth resulting from being shaded by other trees.
Sustained Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Sustained Yield: The management of a resource for continuous production with the aim of achieving approximate balance between net growth and harvest.

T
Terminal Bud: A bud that develops at the apex of a stem. Also know as apical bud.
Terminal Bud Scar: A ring of thickened bark on a twig, indicating where the terminal bud grew the previous year.
Thinning: Cutting in an immature forest stand to reduce the tree density and concentrate the site productivity on remaining, often higher quality trees, results in accelerated growth and larger trees.
Timber cruising: The collection of field data on forests commonly by the measurement and recording of information in sample plots.
Tracheids: An elongate, spindle-shaped xylem cell, lacking protoplasm at maturity.
Transpiration: The passage of gas or liquid (in the form of vapour) through the skin, a membrane, or the other tissue.
Tree: A woody living plant having a well-defined stem and more or less definitely formed crown and usually attaining a height of at least 3 m.

U
Understorey: The portion of the trees or other vegetation in a forest stand below the main canopy level.
Uneven-aged Forest: A forest in which there are considerable differences in age of trees and which three or more age classes are present.

V
Veneer Log: A log of suitable size, species and quality for peeling on a lathe into thin sheets of wood for the manufacture of products such as plywood.
Vessel: A xylem tube formed from several modified tracheids oriented end to end.

W
Watershed: An area of land that collects and discharges water into a single main stream through a series of smaller tributaries.
Witches' broom: An abnormal tufted growth of small branches on a tree or shrub caused by fungi or viruses.
Wolf Tree or Bull Pine: Usually a tree which is older, larger, or more branchy than other trees in the stand. A tree with a short trunk and a spreading crown that interferes with young growth below.
Wood Pulp: Mechanically ground or chemically digested wood (composed primarily of wood fibers) which is used in the manufacture of paper, fiberboard etc.

X
Xylem: The principal water-conducting tissue and the chief supporting tissue of higher plants.