

TOOLS

OF THE TRADE

A FOREST EDUCATION KIT

Developed by

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WELCOME TO THE TOOLS OF THE TRADE FOREST EDUCATION KIT!

Albertans have a strong connection to the forest and for many it is their livelihood. From wildlife biologists to machine operators; careers in the forest industry are as diverse as the forest itself.

This resource kit was developed to support teachers in bringing forest careers to life in the classroom and is suitable for any unit that explores forestry, careers and technology. You don't have to be a forest expert to use the equipment, just follow the step-by-step information. Take the kit and guide outside and discover the hands-on, outdoor work that is part of everyday life in the forest industry!

For each item there is a 1-page quick reference sheet which includes a description of the tool, who uses it, why the tool is important for the industry and an activity to guide your students through its exploration. Each forest tool and activity can be teacher-directed or student-directed; the activities can be used independently, in small groups, set up as stations or large group demonstrations.

Key terms are highlighted in bold and defined in the glossary.

Curriculum Connections

This toolbox has been put together to supplement units of study related to forestry and natural resource careers.

Alberta Program of Studies

Grade 6 Science: Trees and Forest

Grade 7 Science: Plants for Food and Fiber

Grade 9 Health and Life Skills

Grade 9 Social Studies

Biology 20 - Ecosystems and Population Change

CALM 20

CTS - Forestry

CTS - Stewardship



INCLUDED IN THIS RESOURCE?

This kit contains the following 20 forest tools and activities

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GLOSSARY

Breast height - a height of 1.3 meters up from the base of the tree commonly used in the forest industry as the accepted height on a tree trunk to perform the most common tree measurements.

Canopy/Crown- the multiple layers of branches and foliage at the top (crown) of a forest.

Coniferous - cone-bearing woody plants that have needle leaves. Majority of coniferous plants are trees but some shrubs are considered coniferous as well.

Crown Fire - forest fires that spread in the top layer or canopy of the forest.

Deciduous - trees and shrubs that lose their leaves seasonally.

Forest regeneration - the process of forests growth after the forest has been disturbed (cut, burned, killed by insects or disease, etc.)

Grading Lumber - the process of inspecting wood products for defects to ensure compatibility to company specifications and to classify products according to industry standards.

Merchantable timber - trees that have commercial value.

Pith - a plant tissue that stores and transports nutrients throughout the tree.

Springwood - the young soft wood that develops directly underneath the bark during the first part of the growing season. Spring growth rings are typically lighter and larger than summer growth rings.

Serotinous cone - a cone with a waxy seal that prevents it from opening until stimulated by heat (intense sun or fire)

Stand of trees - a group of trees that has been outlined for management purposes. Tree stands are typically comprised of similar tree species and age class.

Summerwood - a dense wood that is produced in the latter half of the growing season. Summerwood is harder and less porous than springwood therefore annual rings are typically darker and smaller than spring growth rings.

Resin - is a secretion from plants that has important chemical properties that help plants heal wounds, attract or repel insects and protect from disease. Note: resin is different than sap that carries nutrients and water through the plant.



CABLE CHAIN



What

A measuring device that will not tangle or break. This 50-meter nylon chain is marked with 1-meter distance intervals and includes topographic corrections that enable measurements on a slope or uneven surface.

Who

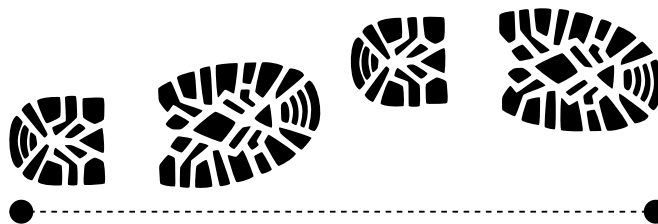
Hydrologist, Forest technician, Ecologists, Timber Cruiser, Biologist, Urban foresters, Harvesting Operator, Road Construction, Tree Faller, Planning Forester

Why

- It is important to know the distance from A to B.
- Measuring distances in the field is not always easy because straight lines are hard to find and the ground is not always level - the chain measure helps forestry professionals work around nature's obstacles.

Activity: Know Your Pace

1. One of the easiest ways to estimate measurements is knowing your own pace
2. In a large open area with straight and level ground, spread the cable measure out 50 meters
3. Walk the entire distance 3 times recording the number of paces you take in the 50 meter distance (Note: One pace is defined as two footsteps)
4. Calculate the average number of paces by adding up all the paces and dividing by 3 (the number of times you walked the 50 meters)
5. Determine the average distance of each pace by dividing the total distance (50 m) by the average number of paces it takes you to walk the 50 meters



1 Pace = 2 Footsteps

CLINOMETER



What

- Device similar to a compass used to measure the angle of a slope
- This kit contains a manual clinometer but other digital models are available

Who

Planning forester, Forest technician, Timber cruisers, Biologists, Urban foresters, Surveyors, Engineers

Why

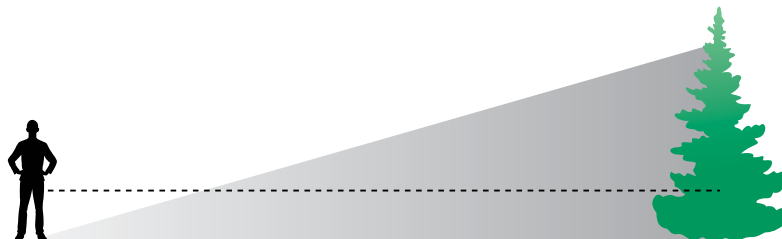
- Determine a tree's height
- Determine percentage grade on a slope

Activity: Determining tree height

*Materials: measuring tape or cable chain and calculator

The formula: $(\text{top \%} - \text{bottom \%}) / 100 \times \text{distance from the tree}$

1. Measure 20 metres back from the base of the tree
2. Hold the clinometer by the small ring with the red dot pointing away from you
3. Keep both eyes open looking through the glass hole with one eye and at the tree with the other
4. Level the clinometer so that the scale inside reads 0 on both sides
5. Point the clinometer to the top of the tree, record the number on the right-hand side of the scale (ie. 85)
6. Point the clinometer to the base of the tree, record the number on the right-hand side of the scale (ie. -10)
7. Add the 2 numbers together $(85 + (-10) = 75)$
8. Account for the distance from the tree (in this case 20 metres) by multiplying the distance by the % height $(75/100 \times 20\text{m} = 15\text{m})$





COMPASS

What

A compass is used to orient oneself relative to north and to find or travel in a direction.

Who

Planning forester, Forest Technician, Pilot, GIS Specialist/ Analyst, Biologist, Ecologist

Why

- A compass is an important tool to orient oneself in a forest
- Often used in conjunction with a map to locate specific features in a forest

Activity: Hide and Seek

1. One student will hide an object, which will represent the finishing point.
2. Use the compass to provide directions to hidden object for your partner from a set starting point. For example: Walk 5 paces to the north, stop. Walk 10 paces to the west, stop etc
3. Give directions and compass to other student to find hidden object from a defined starting location.
4. Switch and repeat.

How to use a compass

- i) Hold the compass flat.
- ii) Locate the N, S, E, W markings on the outer dial.
- iii) Spin the dial so that the red North arrow lies in the red arrow outline on the base - this inclines true North.
- IV) Determine the direction you wish to travel and turn the dial to indicate the direction of travel.
- V) Turn your body to ensure the red North arrow is back in the red outline, now walk in that direction.

CRUISE VEST



What

A component of forestry personal protective equipment (PPE). The yellow striping is high visibility and there are numerous pockets to hold all the essential forestry equipment.

Who

Hydrologist, Forest technician, Ecologists, Timber Cruiser, Biologist, Silviculture forester/technician
Urban foresters, Soil Scientist, Mill worker, Harvesting Operator, Grader Operator, Road Construction
Tree Faller, Planning Forester

Why

- Safety is a top priority in all areas of forestry whether you're working in the mill or in the field.

Activity: Dress a Timber Cruiser

1. Fill the cruise vest with as many forestry tools from this kit as possible.
2. Choose one student (or your teacher) and have them put on the cruise vest.
3. Pull out the items one at a time and see if your class can guess (or remember) the name of that piece of equipment, what it is used for and any related forest careers.

DENSIOMETER



What

A device used to estimate the % **canopy** cover in a forest. A mirror (convex or concave) is used to show the reflection of a large overhead area.

Who

Forest technician, Wildland Firefighter, Timber Cruiser, Harvesting Operator, Tree Faller, Planning Forester

Why

- Estimate the spacing of trees and determine if thinning or other practices are required to maintain the health of a forest
- Determine light requirements for the regeneration of specific species or light sensitive ground species
- Canopy density is an important factor to determine how a crown fire may spread in a forest

Activity: Determine % Canopy Cover

The formula: % canopy cover = $100\% - (\text{uncovered dots} \times 1.04)\%$

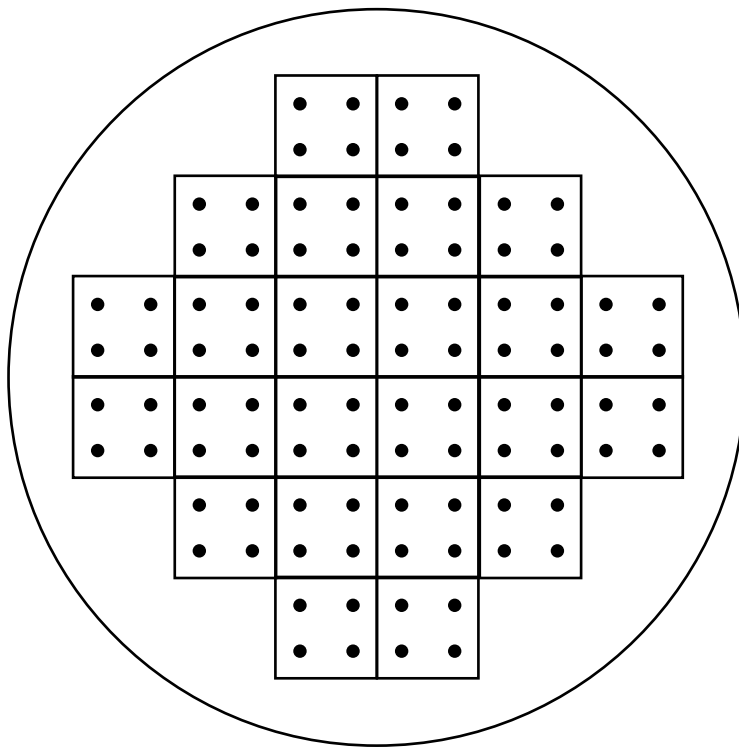
Average canopy cover = $(\% \text{ canopy north} + \% \text{ canopy cover east} + \% \text{ canopy cover south} + \% \text{ canopy cover west}) / 4$

1. Choose a reference tree.
2. Stand with your back to the tree - this is your reference tree. The crown of the reference tree should be outside of the canopy cover being measured.
3. Hold densiometer so that it is level. Use the bubble in the lower right hand corner to guide you.
4. Hold densiometer far enough away from your body so that your head and the reference tree are just outside of the grid.
5. The grid has a total of 24 squares. Each square represents an area of forest which will be covered by forest canopy or open (where you see sky).

continued on next page

6. Assume that there are 4 equi-spaced dots in each square for a total of 96 dots.
7. Close one eye. Count number of dots not covered by canopy (where you see sky) up to a total of 96.
8. Multiply the number of uncovered dots by 1.04 to calculate % uncovered canopy.
9. The difference between this number and 100% is the % canopy cover. (100% - % uncovered canopy)
10. Repeat to average the canopy cover from 4 different sides of the tree. (% canopy north + % canopy cover east + % canopy cover south + % canopy cover west) / 4

Note: If you are in an area where there is mostly open canopy you can reverse the counting process and count the smaller dots which are covered by canopy. Multiply by 1.04 to get the % canopy cover.



DIAMETER TAPE (D-TAPE)



What

- A tape measure that has the mathematical calculation for converting circumference to diameter (diameter = circumference / Pi) *Note: Pi= 3.14159
- The diameter tape in this kit has 2 sides. The numbers written in black are diameter measurements and the numbers written in red are a standard metric ruler measured in centimeters.

Who

Planning foresters, Forest technician, Timber cruisers, Ecologists, Conservation Officers, Biologists, Urban foresters

Why

- Determine the diameter of a tree
- The diameter of a tree along with other tree measurements such as species, height and age help determine the amount of **merchantable timber**.

Activity: Measuring tree diameter

1. Measure 1.3 meters up from the base of the tree (this is known as **breast height**).
2. Hook the sharp end of the diameter tape into the tree (careful this is sharp!).
3. Wrap the tape around the tree, keeping it as level as possible.
4. Ensure you are reading the numbers in black and that it is wrapped all the way around back to the '0' mark on the tape.
5. Record the diameter at breast height (dbh).



FOREST CAREER GUIDE

What

- A list of careers related to the forest industry
- Includes a description along with educational requirements, and salary ranges

Who

Everyone! From engineering to the trades, operators to the office, find a forest career that's right for you.

Where

- Work Wild - www.workwild.ca
- Woodlands Operations Learning Foundation - www.W-O-L-F.ca
- Northern Lakes College - www.northernlakescollege.ca
- Olds College - www.oldscollege.ca
- Northern Alberta Institute of Technology (NAIT) www.nait.ca

Activities: Who am I

- Read the description of a career and have students guess the job title or vice versa.

FOREST PRODUCTS

PULP, ORIENTED STRAND BOARD (OSB) & LUMBER



What

A forest product is any material derived from a forest for commercial use.

Who

Truck Driver, Sales and Marketing, Crane Operator, IT and Computer Systems, Mechanic, Grader

Why

Look around you! There are lots of products that come from the forest that you use everyday. From providing us with shelter, furniture to paper and much more!

Activity: Produce the definition

1. Match the definition to the following products:

Oriented Strand Board (OSB)
Lumber
Pulp

- a) Engineered wood product formed from layering wood fibres bonded by wax and resin adhesives.
- b) This wood product ranges from freshly felled trees to logs, boards, planks and other structural materials ready for use.
- c) Different processes such as mechanical, semi-chemical and fully chemical, are used to separate wood fibers into a material to make paper.

2. Brainstorm a list of forest products that you use everyday.

FOREST FIELD TRIP VIDEOS



*Voices
of the Boreal*

What

- **Forest Field Trip** - a series of online video clips that take you to the field. Learn how trees are harvested, what happens in a sawmill and pulpmill and all about reforestation. The video is divided into 8 short segments
 - Tree Harvesting*
 - Sawmills*
 - Pulp mills*
 - Reforestation*
 - Fire in the Forest*
 - Understanding the Forest*
 - Wood Products*
 - Changes in the Forest*
- **Voices of the Boreal** - a video series that explores careers in Alberta's north.

Who

Chemical engineer, Mechanical engineer, Electrical engineer, IT and Computer systems, Mill manager, Grader, Environmental coordinator, Harvesting operator, Soil scientist, Community relations, Tree Faller

Activity: Guiding discussion questions

1. How has technology changed the way the industry operates?
2. Brainstorm a list of trades people that may be employed in a mill?
3. Discuss how careers in different areas such as science, environmental management, public relations are connected (ie. Chemist, community relations and mill operator).
4. Regeneration of a harvested area back to mature forest can take over one hundred years. What challenges would this pose to the people that work in this industry?



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FORESTRY NOTEBOOK

WATERPROOF
PAPER

What

A waterproof notebook available in various sizes for recording data and information from the field.

Who

Planning forester, Forest Technician, Pilot, GIS Specialist/Analyst, Biologist, Ecologist

Why

To ensure your data stays legible during adverse weather conditions in the field.

Activity: Leave your mark

1. Record some interesting facts about the forest near you in the notebook provided.
For example:

| | |
|---|--|
| Date | |
| School Name | |
| Community | |
| Common Tree Species in your area | |
| What is unique about the forest in/around your community? | |
| Choose one forest animal to represent the personality of your class and briefly describe why. | |

** this notebook and tool kit will travel the province other classes can learn about your community.*



INCREMENT BORER

What

- 3 parts: the handle, the steel shaft and the extractor
- Available in various shapes and sizes for different sizes and species of trees
- The increment bore in your kit can be used for large softwood trees (like the spruce or pine trees) *Please note that this increment borer model should not be used on a deciduous tree.

Who

Timber cruisers, Scaler, Planning forester, Urban foresters, Forest technician

Why

- Determine the age of a single tree
- Estimate the average age of a **stand of trees**
- Project growth of a stand of trees
- Study distance between rings to look back on growth cycles
- Age along with height measurements are used to determine harvest plans

Activity: Collecting a tree core

1. Find a medium to large sized pine or spruce tree *to identify these trees please use the *Alberta Guide to Common Trees and Shrubs* included in this resource.
2. Assemble the tool by removing the shaft from the handle and locking it into the hole in the centre of the handle, as seen in the photo above.
3. Remove the extractor from the shaft.
4. Measure 1.3 meters up from the base of the tree (this is known as **breast height**).
5. Drill into the tree by turning it clockwise. Ensure the shaft is inserted past the pith (centre of the tree).
6. Insert the extractor fully through the shaft, turn the increment bore counterclockwise one-half turn to loosen the core.
7. Remove the extractor with the core.
8. Examine your tree core -
 - you may need to moisten the core with a dab of water to make the rings more visible
 - count the rings from the pith to the bark *note: one year includes both spring wood (light coloured rings) and summer wood (dark coloured rings)
9. Return the increment bore by turning it clockwise.
10. Protect the tree from insects and disease by pushing the core or a similar sized stick into the hole.



LOGEPOLE PINE CONES

What

- Sample of **serotinous** cones from lodgepole pine tree
- **Serotinous** cones are sealed with resin and require heat, such as that from a forest fire, to open. This is why lodgepole pine are one of the first trees to regenerate after a forest fire

Who

Planning foresters, Silviculture contractor - tree planter, cone harvester, Wildland firefighter, Forest Technicians, Conservation officers, Silviculture forester, Biologist, Chemist

Why

- Analyze the forest to maximize production and minimize negative impact
- Cones and seedlings are used for forest regeneration
- Plant resins have important chemical properties that make them useful in the production of varnishes, adhesives, and perfumes

Activity: Seed collection and dispersal distance

- Collect serotinous cones from your area (please do not use the cones in this kit) and place them in a 150 degree oven for 10 minutes.
- The cones should open up and release the seeds.
- To extract the seeds: pinch and twist each of the open scales on the cone. After all the scales have been twisted, tap the cone on the table until the seeds pop out.
- To calculate average seed dispersal take the seeds to an open area and place a fan on a large white piece of paper (for example 5m²).
- Hold the seeds from a defined height above a standard table fan set at a consistent speed.
- Drop the seeds a few at a time allowing them to disperse.
- Measure the dispersal distance and graph your results on a scatter plot.

LUMBER CRAYON

& VOLUME TABLES



What

A water-proof , fade-proof, smear-proof crayon used to mark dry or wet rough surfaces such as tree trunks and lumber

Who

Planning forester, Scaler, Grader, Timber cruisers, Harvesting Operator, Surveyors

Why

- Used for marking length of logs and **grading** lumber so stackers in the mill can easily sort the lumber
- Can be read by an optical scanner used in machinery so that a computer can track the grade of the lumber.

Activity: Tree volume

* Materials: clinometer, diameter tape, dichotomous key and volume tables

1. Your objective is to identify the volume of wood for a species of tree.
2. Find out the tree species, height and diameter of a tree. Record your results.

| | |
|--------------|--|
| Tree Species | |
| Height | |
| Diameter | |

3. Use the volume tables provided for your tree species to determine volume of wood using height and diameter.
4. Write the volume of the tree on the trunk with the lumber crayon.

MOUNTAIN PINE BEETLE

(*DENDROCTONUS PONDEROSAE*) (MPB) SAMPLES



What

- Small bark beetle native to western North America
- Approximately the size of a grain of rice (4.5 - 7mm)
- Carry blue stain fungus that prevents tree from producing **resin** that repels insects and impacts ability to carry water and nutrients eventually leading to tree mortality

Who

Planning foresters, Ecologists, Conservation Officers, Community relations, Woodlands managers, Biologists, Entomologists

Where

- Spends most of its life cycle in pine trees such as Alberta's provincial tree the lodgepole pine
- Spreading across Western Canada.
- 15% of Alberta's forested area is at risk (<http://mpb.alberta.ca>)
- For more information and images check out www.insideeducation/Mountain_Pine_Beetle_Mania

Why

- Hot, dry summers and mild winters in central B.C. and Alberta are leading to outbreaks.
- Fire suppression activities increase the number of mature pine trees, mature trees are less resistant to MPB attack
- As MPB populations grow, attacks may spread to smaller, younger and healthy trees, some times other tree species.

How MPB affects the forest industry

- Decreases the amount of merchantable timber
- Decreases the merchantability of harvested trees
- Standing dead trees lead to increase risk of forest fires
- Impacts to ecosystem health including habitat, clean air and water
- Forestry contributes \$10 billion/year to Alberta's economy and employs ~38,000 people, Alberta's pine stands make up a significant portion of the forest industry.

continued on next page

Activity: Take a Stand - Forest Fire Management

1. Discuss the advantages and disadvantages of a forest fire. You can discuss in terms of letting a forest fire burn or putting it out. Use the tables below to help guide the discussion, placing check marks if you think that the outcome is an advantage or disadvantage to the forest and surrounding community.

| If fire is left to burn..... | Advantage | Disadvantage |
|--|------------------|---------------------|
| Trees that are affected by insects and disease will be removed. | | |
| Nutrients will be returned to the soil, and new trees and shrubs may grow. | | |
| Pine cones will be opened by the heat, allowing seeds to disperse. | | |
| Human communities (homes and safety) may be threatened. | | |
| Species that rely on old growth forests, like owls and moose, will lose their homes. | | |

| If fire is put out..... | Advantage | Disadvantage |
|--|------------------|---------------------|
| Recreation areas will not be burned. | | |
| More trees will be available to harvest. | | |
| Less smoke and greenhouse gases will enter the atmosphere. | | |
| It may cost millions of dollars to fight the fire. | | |
| The natural fire cycle will be changed. | | |



SOIL AUGER & TEXTURING CHART

What

A hand drill that removes a soil core sample

Who

Hydrologist, Forest technician, Ecologists, Chemists, Silviculture forester/technician, Urban foresters, Soil Scientist

Why

- Forest soils can be highly variable and it is important to understand what is happening below ground surface, the locations of tree roots which provide both water and minerals to the tree.
- Ideal soil depth for sampling forest soils is approximately 15 cm - this is where there is the highest percentage of roots, biological activity and greatest nutrient levels.

Activity: Soil Sampling

1. Choose an area where the soil is workable (avoid rocky or muddy ground)
2. Obtain a soil core sample by using the soil auger to drill down until the bore of the auger is fully emerged in the soil
3. Sketch your sample indicating visible soil layers and the depth of each layer
4. Use the soil texturing chart to determine the layers and composition of your soil

SOIL PH & MOISTURE METER



What

- A digital device that measures the pH of soils, which indicates whether soils are acidic (low pH <7), neutral (pH =7) or basic (pH >7)
- A digital moisture meter that indicates the water availability in soil

Who

Hydrologist, Forest technician, Ecologists, Chemists, Planning Foresters, Silviculture forester/ technician, Urban foresters, Soil Scientist

Why

- The pH value of the soil affects the minerals and nutrients (such as phosphorus, nitrogen and iron) that can be stored in the soil and made available to plants. Most plants thrive at pH levels between 6-7 where soil nutrients are most readily available.
- Soil moisture is closely linked to soil type, loose sandy soils do not retain water in the same way as peat lands.
- Changes in soil pH and moisture may be the result of fertilizer, precipitation, decomposition of organic matter, groundwater aquifers etc...

Activity: Testing soil pH and moisture

1. Use the soil texturing chart to determine the type of soil in your soil sample
2. Record the ph and moisture of each soil layer using the meter provided. Please refer to the directions indicated on the meter.

| Soil Layer Depth (from soil auger activity) | pH value | Soil moisture level |
|---|----------|---------------------|
| | | |

STEREOSCOPE

AERIAL PHOTOGRAPHS

What

An instrument that transforms a 2-D image into 3-D. It works by creating an offset between the left and right eyes so that there is an illusion of depth.

Who

GIS specialist/analyst, Forest Technicians, Woodlands manager, Planning forester, Ecologist

Why

- A device used to see relief in drawing and photographs
- Calculate distances between objects or landmarks
- Helps identify stand types (species and age)

Activity: The forest in 3-D

- Place 2 aerial photos on the table with their edges overlapping (ensure the photos have the same orientation with the white dots to the left)
- Place the stereoscope over the centre of the photos
- Look through the stereoscope and make minor adjustments to one of the photos until the 2 images are together and visible in 3-D.

Helpful hints:

- Keep your eyes relaxed
- Find a common point on both photographs such as a lake or a road and use this as a starting point

TREE COOKIES

What

- A cross section of a tree
- Your kit contains both a **coniferous** (lodgepole pine, *pinus contorta*) and a **deciduous** tree (trembling aspen, *populus tremuloides*)

Who

Foresters, Timber cruisers, Environmental Manager, Climatologist, Conservation Officers, Biologists, Dendrochronologists

Where

- Typically tree cookies are taken from as close to the base of the tree as possible

Why

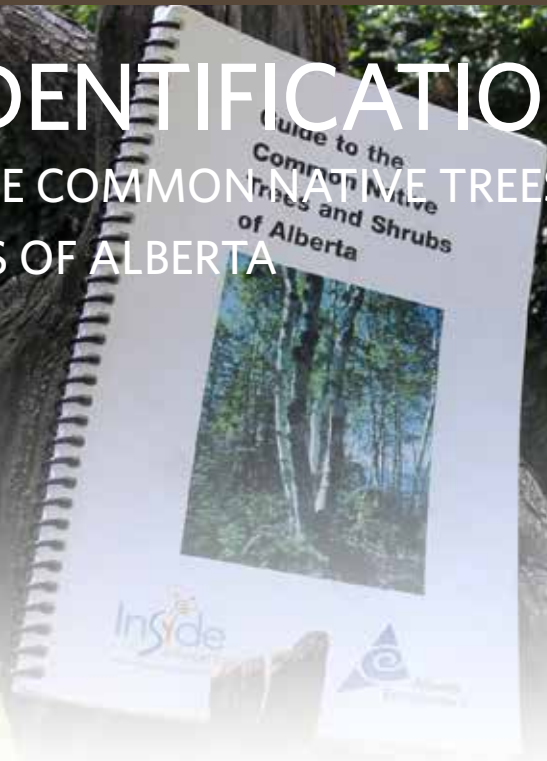
- Determine the age of a tree
- Study the growth patterns, look for evidence of fire, and/or disease, also determine when these events took place

Activity: Analyzing tree cookies

- Count the rings to identify the age of the tree *note: there are 2 parts of an annual ring, the lighter coloured **springwood** and the darker coloured **summerwood**
- Infer how the tree was affected by amount of rainfall, light, length of growing season and other environmental factors in any given year
- Can you find evidence of branches or fire scarring on your sample?

TREE IDENTIFICATION GUIDE:

GUIDE TO THE COMMON NATIVE TREES AND SHRUBS OF ALBERTA



What

A guide to the common trees and shrubs found in Alberta

Who

Planning foresters, Timber cruisers, Forest Technicians, Conservation officers, Ecologist, Biologist, Pest control officers

Why

- Identify tree and shrub species
- Determine species composition and biodiversity of an area

Activity: Tree Identification

- Refer to pages 8-9 of the Guide to the Common Native Trees and Shrubs of Alberta
- Identify the native trees and shrubs in your school yard or nearby forest



WILDLIFE TRACKING COLLAR

What

- A radio collar that is attached to wild animals. It transmits a radio signal to identify the animals whereabouts.
- The collar in this kit was used to monitor the movements of a woodland caribou

Who

Biologist, Conservation officer

Why

- Study population dynamics and animal behavior
- Infer habitat requirements
- Assess impacts of forest disturbance
- Use the information gathered to create management plans and long-term conservation strategies.

Activity: Land use and wildlife

- Use Google earth to find an area of forest in Alberta that has been changed due to human activities (for example the Alberta foothills region near Rocky Mountain House)
- Examine the image and discuss how wildlife might be affected by changes in habitat



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