Fall | 2012

Go Global Manual

ACER
ASSOCIATION FOR CANADIAN EDUCATIONAL RESOURCES

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CLIMATE'S SAKE

Go Global Manual
ACER 2012©

This publication is part of ACER's Publications, Manuals Series.

This revised version of the manual focuses on digitized mapping of a schoolyard using GPS coordinates and Quantum GIS open-source software. It includes student activities plus suggested research concepts for future investigation.

Please note this is an online version and does not include the final two sections of Tree Keys and Role cards. To obtain these sections please contact ACER.

Nancy Randall, Writer 1st version
Revised and formatted by Alice Casselman and Ana Maria Martinez, 2nd version

First Edition, 2005
Second Edition, 2012

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Go Global Manual

1. Introduction

RATIONALE FOR MONITORING PROJECTS

Biological diversity and climate change
Global warming and global economics need global ecology! Some of the warming effects due to the combination of global air masses, lake effects and urban heat islands are now being experienced in Canadian cities such as Toronto.

By measuring what is changing in our forests and calculating their rate of change, we can begin to understand more about global warming and the effects of human impact and climate change on biodiversity. This will allow us to make appropriate decisions for the future of our forests.

Biological diversity monitoring to assess the impacts of future atmospheric change on biodiversity has become a community effort across Canada at schools, conservation authorities, universities, biospheres, reserves, parks and other long term protected areas. Individuals are making a difference by getting involved in the excitement of measuring locally and reporting globally.

Don MacIver, Science Assessment
Excerpt from Environment Canada Poster, June 2002

ABOUT ACER

As a result of the Rio de Janeiro international conference, a biodiversity convention was signed and the Smithsonian Institution was commissioned to develop a protocol to inventory, then monitor, forests using one-hectare plots. Canada adopted the Biodiversity convention and has now 80 plots using Smithsonian protocol. ACER (Association for Canadian Educational Resources), with a variety of partners, established many of these plots across southern Ontario.

In 2002, ACER materials were part of Environment Canada's presentation on biodiversity at a world conference in Johannesburg that celebrated the tenth anniversary of Rio de Janeiro's achievements.

ACER currently has three different programs: Measure Up, The Gateway Project and The Youth Stewardship Project.

Measure Up has 3 projects tailored to different audiences. These projects are:

1. Planting for Change (P4C) allows a school to create a planting site on its schoolyard. The growing network of sites with mini-climate change outdoor classrooms enables teachers to complement their curriculum and to track climate change effects on new tree plantings.

2. Measuring Our Resources involves students measuring trees in their schoolyard as well as monitoring the local effects of a globally changing climate. ACER developed a set of field activities and assessments as a second cross curriculum

program in which teachers are helped to map their own school property using GPS coordinates to create QGIS digitized maps.

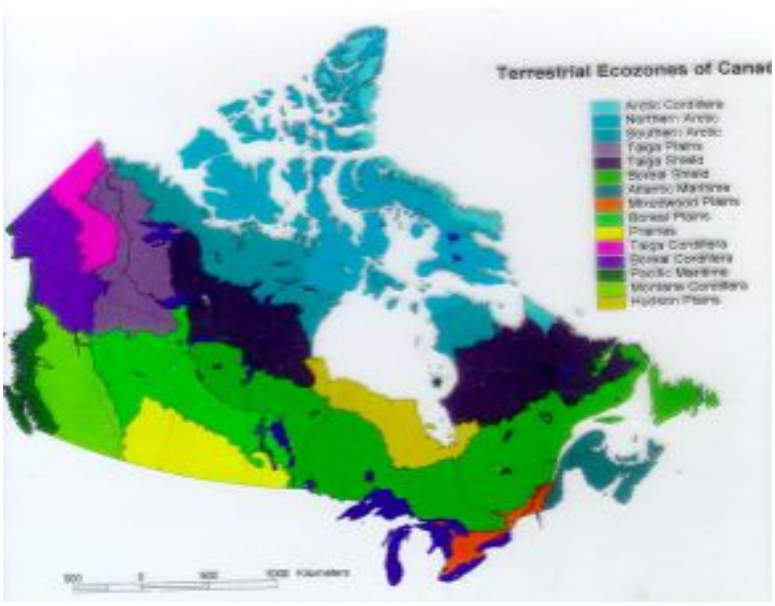
3. Go Global is a network of one-hectare plots, which demonstrate the effectiveness of local monitoring and reporting of environmental change in long-term forest biodiversity monitoring programs. ACER is currently establishing 2 hectares with the Niagara Parks Commission as part of the "Yes, We CAN" project.

The Gateway Project consists of the development of an access tool for decision-makers to implement adaptation measures and to assess risks related to climate change in watersheds. ACER expert scientists in climate change and water management are working with the Ministry of Natural Resources to provide the tools required to begin adaptation for water related issues within Conservation Authorities.

The Youth Stewardship Project is a project created to hire and train local youth under supervision to maintain and enhance natural areas by learning the protocols to remove invasive species, inventory the remaining native species and their regeneration followed by a fall event of community planting of native species to restore the area. Data collected tracks the growth and health of the trees.

ECOZONES AND ONE-HECTARE PLOTS

The Smithsonian Institution was commissioned to develop a protocol to inventory, then monitor, forests using one-hectare plots. This protocol tested in Costa Rica was to be used in 350 different countries – at least one per country – to gather data on the state of forest ecosystems around the world.



(MAP NEEDS REF)

Canada, a country with the second largest landmass in the world, has 15 Ecozones. Canada adopted the Biodiversity convention and established the first plot using Smithsonian protocols at Kejimakujik National Park in 1994. To date 80 plots have been established across Canada.

ACER has established 20 of these one-hectare plots in southern Ontario with a variety of partners including Humber Arboretum, Bluewater District School Board and Toronto Region Conservation Authority.

ABOUT THE TRAINING COURSE

Today, ACER is providing training for future leaders to organize and implement their own **Go Global** project in their own community.

The course provides training in:

- ✓ Plan, organize, and implement a **Measure UP! *Go Global*** project on surveyed plots.
- ✓ Set up cooperative learning.
- ✓ Train volunteers.
- ✓ Follow the procedures in the protocol.
- ✓ Use the specialized measuring equipment.
- ✓ Measure and record data according to the international protocol and analyze findings.

This manual has on-site fieldwork tasks and post-site activities provided.

An appendix of pre-site activities and teachers' pages is included. The activities have been referenced to the Elementary and Secondary School curricula in Ontario.

The fieldwork can be used towards the student community service graduation requirement.

Participants may become a certified ACER Trainer for **Measure UP! *Go Global*** projects.

The Train the Trainer **Measure UP! *Go Global*** Manual
Nancy Randall For ACER
First Version October 2005
Special thanks to Jim Wilson Athens District School Board and Rick Porto of Thames Valley School Board for their sage guidance and advice

REFLECTION 1

INTRODUCTION

1. Identify the expectations for the **Train the Trainers** course.

2. List the important points of information the video "Why Monitor?" offered about the project.

3. A clear understanding of the overall **Measure UP!** ***Go Global*** project is needed before the monitoring begins. Volunteers need to know what they are doing and why they are doing it a certain way.

   Write a short introduction to the **Measure UP!** ***Go Global*** project that you could give to your volunteers to give them this understanding.
   (Prompts: rationale for community based monitoring, ACER and hectare plots, standardized protocols)

2. Role of the Trainer

The trainer must consider the three aspects of a **Measure Up! Go Global** project in order to organize and implement one successfully in their own community. These are Organizational Decisions, Knowledge and Skills, and the Event Day seen below.

ORGANIZATIONAL DECISIONS
The trainer must have a solid understanding of the task (concepts and skills) and the elements of cooperative learning. The list of questions below is directed at the specifics of organizing the event and could be brainstormed. Responsibilities T =Trainer (leader responsible for organizing the event) or S = Supervisors (visiting teachers and parent volunteers). For example:

Detail	Who? (T o r S) Site
Where is the site to be?	T
What kinds of trees are involved?	T
What site preparation needs to be done ahead of time?	T
Is a permit needed? From whom? How much?	T
Are facilities needed? What kind? How much does it cost?	T
Logistics	
What is the date of the event?	T
How will the project be advertised?	T
What are the timelines?	T
Is there a first-aid kit? What is the emergency plan?	T
Is there a cell phone/method of communication?	T
What pre-instructions should be given re: meals, clothing, protection, etc.? How?	S
How many breaks should there be?	S
Is transportation needed? From where? How much?	T
Volunteers	
Who are the volunteers?	T
How many should there be/are there?	S
How many adult supervisors will be needed? Who?	S
What special skills/expertise do they have? How can they best help?	S
Are there any volunteers with special needs? How can they be accommodated?	S
How many on a team? Who will team them up?	S
What are the roles and responsibilities of each member of the team?	T
Tasks	
What are the tasks and goals?	T
What skills need to be demonstrated? By whom? How long?	T
What equipment is needed? How will it be accessed?	S
What pre-knowledge and skills should the volunteers have?	T
Who will provide the pre-knowledge and skills?	S
Who will develop the feedback sheet?	T
How/when should they give their feedback of the event?	S

REFLECTION 2

PLANNER

Complete one table for the trainer and one for the supervisor by making a chronological listing of plans for each role to hold a successful event from the first action up to the day of the event. Use the preceding questions as a guide.

Step#	Action List	Date to be completed by	Done ✔
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

KNOWLEDGE AND SKILLS: TASK AND TEAM

Social or teamwork skills, and, mapping and monitoring skills are both learning goals in this project. Teamwork involves cooperative learning, which incorporates two types of learning goals – knowledge of concepts and skills of the task and improvement of interactive social skills. Success is only reached if everyone on the team is successful.

Team

Volunteers are grouped into teams and work cooperatively to complete the task of measuring and recording data for the project. Success is defined as working together collaboratively to complete the measuring and recording of data accurately within the time limit.

The trainer must ensure that the basic elements of cooperative learning have been considered in the planning of the project. They are:

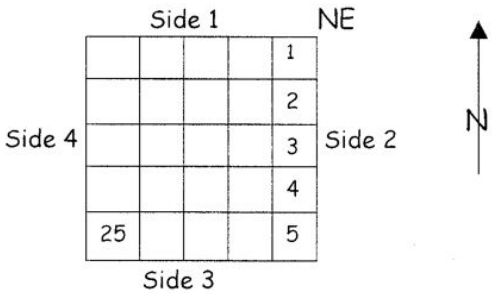
1. **Positive Interdependence** – team members connected to each other; shared leadership.
2. **Individual Accountability** – each is responsible for a specific job.
3. **Face-to-face Interaction** – team members work in close proximity and dialogue positively.
4. **Social Skills** – team members display positive interaction skills.
5. **Processing** – team members assess and target improvement.

Cooperative learning is discussed in much more detail in Appendix II – Teachers' Pages on our website www.acer-acre.org.

Establishing a Site

The MEASURE UP! Go Global projects are done on one hectare plots in forests that have vegetation typical for your area. Specific criteria are used to choose the site to establish an ACER plot.

The method for division into twenty-five 20m by 20m squares called quadrats is available in the ACER Site Manual Resource Guide for laying out the plot. The mapping of recorded data is done using the ACER on-line MYSQL data entry program that is available at www.acer-acre.ca



(1-hectare plot - 25 quadrats)

Numbering the Quadrats and Trees – The International Protocol

These 20m lines are numbered as shown in the above diagram creating 25 quadrats, each 20 metres square. Each quadrat has 4 sides numbered clockwise. Side 1 is always faces North. The trees are numbered by starting with the first tree which is >4 cm dbh at 1.3m.

Numbering begins at the northwest corner of the auadrat and moves along side 1 to the NE corner in a 2 metre swath moving clockwise around the 4 sides. Each completed quadrat swath then spirals, in 2 metre swaths, into the middle.

Hence the lowest tree number is at the NW quadrat corner while the highest tree number is in or near the middle of each quadrat.

** Measuring and Numbering the quadrats and trees are discussed in much detail in the On-site Procedures and Protocols section of the manual.*

The trainer must do a walk-about around the property, getting an idea of where the site quadrat lines will be and how they are numbered.

Monitoring

The procedures and protocols for measuring and recording are standardized so that the data collected is deemed scientifically sound. Special measuring equipment is used and the trainer must be familiar with using them in order to ensure accuracy and success with the volunteers.

The teams measure specific features of the trees and the data are recorded on the fieldwork data sheet. The data are then entered into the database on-line. The first set of data provides the benchmark; re-measuring and recording of new data can then be used to compare and analyze for changes in growth and biodiversity.

The Monitoring procedures and protocols are discussed in much detail in the On-site Procedures and Protocols section of the manual.

THE EVENT DAY

An agenda is a good tool for trainers to use when planning the day. The trainer should divide the day into 3 parts – the orientation session, the fieldwork, and the wrap-up. Answers to the questions relating to the events of the day of the field study listed in Organizational Decisions, are written in the appropriate place on the agenda.

The Orientation Session

The trainer should plan an orientation session for the volunteers when they first arrive. This session should be short but informative and include:

- ✓ Timelines of the day;
- ✓ Rationale for the project;
- ✓ Sequence of steps in the task;
- ✓ Cooperative teamwork (team roles & responsibilities);
- ✓ Demonstrations of the skills needed to measure and record accurately;
- ✓ The types of trees involved;
- ✓ The use and care of the various pieces of equipment;

Discussions of some key points will help to recap the information. Examples of questions are:

Teams
- ✓ Why are we working in teams?
- ✓ What problems can happen when working in teams?
- ✓ How can the members solve problems in a team?
- ✓ How can the members make others feel included?

Task
- ✓ How will you know the names of the trees?
- ✓ What will the trainer do while you are measuring?
- ✓ How will the trainer know what you've accomplished?

These discussions will serve as a final check for understanding of the task and strategies to use before beginning the task.

Fieldwork: Observing and Intervening

In the field, trainers and supervisors observe, monitor, offer information, and help in naming trees, using the equipment, and recording the data.

Wrap Up

During Wrap Up, the trainer should give feedback from their observations about the teams' successes, difficulties, solutions, and the fieldwork. The recording data sheets should be collected after making sure that all the volunteer information and date have been completed correctly.

Feedback sheets should contain questions that will allow the supervisor(s) and volunteers to offer their opinions and suggestions for improvement of the event. Examples of questions are:
- ✓ What was the purpose of the project?
- ✓ Was it worthwhile?
- ✓ Should it be offered again? Why/why not?
- ✓ How could it be improved?

The feedback sheet could use the rating system such as - on a scale of 1 – 10, (10 is excellent) rate the various aspects of the event i.e.

On a scale of 1 – 4, (4 being excellent) rate:

Importance of the event	1	2	3	4
Use of Role Cards	1	2	3	4
Working in teams	1	2	3	4
Other?_____	1	2	3	4

The trainers should compile the data from the completed feedback sheets and send a summary of the comments to ACER for consideration at acerinfo@rogers.com or Unit 44, 3665 Flamewood Dr., Mississauga, ON, L4Y3P5, Canada

REFLECTIONS 3

PRE-PLANNING

1. Design a flyer that could be distributed throughout the neighbourhood that would inform the community of the event and convince them to participate. (prompts: the project, how to volunteer, the site, the date, etc.)

GO GLOBAL

2. Create an agenda of the day for the trainer. List the important actions, points and/or questions the trainer should cover in each session. Use the prompts provided as a guide.

AGENDA

ORIENTATION: timeline
(project, overview, task, goals, knowledge, skills, teams)

FIELDWORK: timeline
(observing, monitoring, giving help, intervening)

WRAP UP: timeline
(success, trees, climate change, difficulties, solutions, teams, project, feedback)

3. Create a Volunteer Feedback sheet that is designed to get information from the supervisor(s) and volunteers about what things went well, what needs improving, and how to improve them.

VOLUNTEER FEEDBACK SHEET

COOPERATIVE LEARNING

Cooperative learning incorporates two types of learning goals – knowledge of concepts and skills and improvement of social skills. The use of teams causes learning to be maximized especially when it takes place in a context of support, encouragement, and assistance to be successful. What people can do together today they can do alone tomorrow.

Success is only reached if everyone on the team is successful. Cooperative learning ensures success of all the members on the team if all of them care about the success and effort of the team. It produces a greater care for one another in being successful and the success is criterion-based and every member understands the criteria.

The 5 basic elements of cooperative learning are:

1. **Positive Interdependence** – all the members of the team feel connected to each other in accomplishing the goal and leadership is equally shared. Giving them different and important roles to play using different equipment and resources satisfies this element. Asking each member to evaluate the teamwork of the others and the success of their team is also an excellent motivator.
2. **Individual Accountability** – each is responsible to demonstrate their learning. Informing them in the beginning that observations of their team work in the field will be noted, and at the end, a recap session of their learning will be conducted in which any team member might be asked about any part of the project. A project evaluation sheet will be completed by each member.
3. **Face-to-face Interaction** – all members of the teamwork in close proximity to each other and dialogue with each other in ways that promote continued success.
4. **Social skills** – all members of the team display positive interaction skills that enable the team to function effectively i.e. taking turns, sharing, encouraging, verifying, listening without interrupting, offering help, taking help, clarifying, checking, understanding, probing, complimenting, brainstorming, compromising, forming consensus, staying focused, welcoming. This enhances communication, trust, leadership, decision-making, and conflict management.
5. **Processing** – all members of the team assess – they can assess their own collaborative efforts and each other's and target improvements, they can assess the project and give positive feedback for changes.

To find out how students feel about team work, discuss the following questions:

- ✓ How does working in groups or teams work?
- ✓ How do you know what to do in your teams?
- ✓ What kinds of roles have you been given in teamwork before?
- ✓ Should there be a leader?

- ✓ What are the benefits of teamwork?
- ✓ What are the barriers in teamwork?
- ✓ How can the members help each other?
- ✓ Do people like working in teams?

- ✓ What do members like about working in teams?
- ✓ What don't members like about working in teams?
- ✓ How can the members solve problems in a team?
- ✓ How can the members make others feel included?

After the discussion, have students do the following activity alone and then in teams. This activity will show how working in teams is beneficial to completing a task more successfully and quickly.

COOPERATIVE LEARNING ACTIVITY

RIGHTS AND RESPONSIBILITIES
Part 1
Individual: 10 minutes
Get a Rights and Responsibilities sheet and cut up the two tables into strips.

Sort the strips in two piles – right and responsibilities.
(*** The rights are marked with a •.)

Take one of the rights and make a display by gluing the right onto your own large piece of paper.

Find a responsibility that goes together with the right and glue it beside the right.

Take another right and glue it to the paper - leave lots of room around the rights for other responsibilities strips to be glued around them.

Part 2
Team: 10 minutes
Get into teams of 4 and study each of the others displays.

Discuss: How many on average were completed?
Were any responsibilities matched differently than yours?
How many times did you match a responsibility to more than 1 right?

Part 3
Team: 10 minutes
Now, work together on one display.
Read each responsibility and agreeing which right it goes with. ***If there is more than one right it can match, draw a connecting line between them.

Part 4
Study your team display

Discuss: How many were completed?
Which way is more efficient?
How many times did the team match a responsibility to more than 1 right?

RIGHTS *We have the right…*	
✓ to be treated kindly	✓ to choose where to sit in the class
✓ to a clean and comfortable classroom	✓ to have enough paper and pencils
✓ to be able to work without being bothered	✓ to keep our things safe in our lockers
✓ to wear what we want	✓ to relax
✓ to get a drink when we are thirsty	✓ to come to school when its raining
✓ to have somewhere to hang our coats	✓ to ask for help when we need it
✓ to have some fun-time in the classroom	✓ to have some quiet time
✓ to tell the teacher what we think and feel	✓ to have our own space and privacy
✓ to be listened to	✓ to be safe

RESPONSIBILITIES *It is your responsibility…*	
✓ to wear clothing suitable for school	✓ to not enter the class with wet, muddy, or snowy shoes
✓ to not cause a disturbance during class	✓ to listen to what others have to say
✓ to be polite to others	✓ to not drop litter
✓ not to waste time	✓ to not waste materials
✓ to treat the furniture properly	✓ to not mess about in the classroom
✓ to treat people pleasantly	✓ to not bully
✓ to share materials	✓ to not offend others
✓ to do our homework	✓ to not play with our personal possessions during lessons
✓ to not fight	✓ to not destroy other people's property
✓ to return to the classroom promptly	✓ to respect the supply teacher
✓ to behave sensibly and safely	✓ to not interrupt others
✓ not to distract others	✓ to treat others with respect
✓ not to write on the walls or furniture	✓ to listen to the teachers' lessons and instructions
✓ to not hurt or harm other people	✓ to not take up too much attention so others their share
✓ to help each other	✓ to follow instructions
✓ to respect others' property	✓ to come to school
✓ to be kind to each other	✓ to arrive on time

METACOGNITION

Metacognition or self-thinking skills promote self-awareness, self-inquiry, self-dialogue, self-tutoring, and self-regulation in the student.

Metacognition embraces students having time for the sharing of their own thoughts and the listening to others articulate, and for providing them with "think aloud" opportunities to use to reflect on what they've done or are about to do, as well as how they did it, why they did it, and how they would improve it next time. Metacognitive activities can also provide opportunities to check for understanding of the concepts, procedures, and goals of the project.

Some examples of lead-ins to metacognitive opportunities are:

Thinking Skills	*Lead Ins*
Analysis	✓ compared to ✓ the best part ✓ on the positive side ✓ on the negative side ✓ similarly ✓ by contrast
Synthesis	✓ suppose ✓ imagine ✓ what if ✓ I predict ✓ how about ✓ I wonder
Evaluation	✓ how ✓ why ✓ the best ✓ the worst if _____ then… ✓ It's important to note

Metacognition develops commitment to continuous learning, improving, and up-leveling and leads to a higher commitment and involvement in the student's own thinking.

Metacognitive activities such as reflections, journals, group logs, tracking sheets, various types of evaluations, and time-out discussions provide students with opportunities to plan, monitor, and access their own actions and thinking.

REFLECTIONS

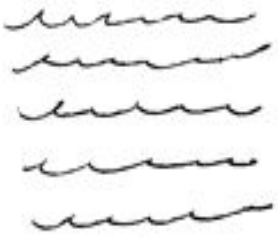
Reflections are personal notes that help students focus on their own successes and goals for continual improvement and up-leveling. They help students practice their own inward dialogue for learning, monitoring, and assessing. Different questions are used depending on the focus of the reflection. Some examples are:

Focus	Questions
Task:	*How did it go?*
	What needed to be done/accomplished?
	How was it accomplished?
	What was difficult to do?
	What could be done better next time?
	How successful was it?
	How could you use this in other places?
	Who does this in adult life?
Role:	*What was your role?*
	What were the responsibilities for it?
	How did you know what to do next?
	What did you do when you didn't know what to do?
	How did you work in a team? What could you do better next time?
	Where else could you use this?
	Who does this in adult life?
Learning:	*What did you learn?*
	How well did you learn it?
	How do you know you learned it?
	How can you use what you've learned?
	What do you need to learn next?

JOURNALS

Journals are personal records of connections being made in the framework of the student thinking, learning, and experiences. They provide a vehicle for students to develop in a manner that is uniquely their own. Journals can take on various looks depending on the expectations, student learning styles, and topics.

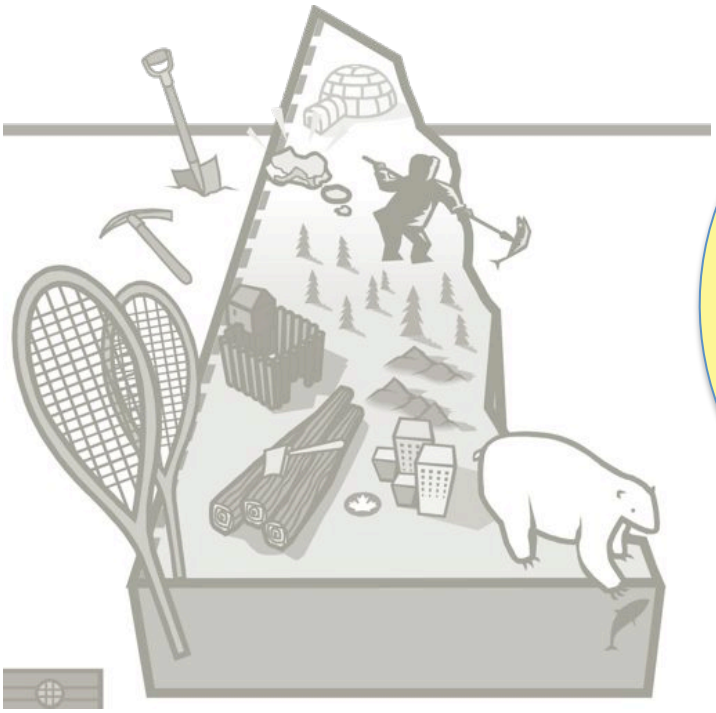
The Many Looks of a Journal

Verbal	Visual	Combination
		
✓ letters ✓ rebuttals ✓ snippets ✓ dialogues ✓ quotes ✓ jokes ✓ phrases ✓ paragraphs ✓ lyrics ✓ jottings ✓ opinions ✓ poems	✓ cartoons ✓ diagrams ✓ mind maps ✓ drawings ✓ webs ✓ souvenirs ✓ doodles ✓ flow charts ✓ clusters ✓ photos ✓ logos ✓ icons	

Entries may be reflective, evaluative, questioning, personal, introspective, revealing, humourous, communicative, thoughtful, philosophical, poetic, rambling, informative, or none of the above.

JOURNALS

(Template)



Entries are….

✓ philosophies
✓ feelings
✓ descriptions
✓ answers
✓ reactions
✓ values
✓ opinions
✓ insights
✓ memories
✓ reflections
✓ learnings
✓ goals

Uniquely You

Vary style, media, techniques, & their combinations

- ✓ Change colour for different feelings & emotions, insights
- ✓ Use visuals (graphics, webs, clusters, photos, charts, doodles, cartoons, collages, drawings, flow charts
- ✓ Capture verbals (quotes, lyrics, riddles, jokes, titles, "meaningful gems", profound ideas, phrases, dialogues)
- ✓ Write narratives (jottings, letters, poems, rebuttals)
- ✓ Glue in souvenirs (artifacts, clippings, labels, stickers, tags,cards)

GROUP LOG

Cooperative Learning

List the benefits and barriers of using cooperative Teams and other interactive strategies.

BENEFITS	BARRIERS
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

TRACKING SHEET

Date	Things I accomplished and/or learned today	Problems I had	Solutions I found	Things I need to do next

CUMULATIVE SELF-EVALUATION RECORD OF TEAMWORK

Evaluate your performance in your team according to the following scale:
ALWAYS = 2 SOMETIMES = 1 NEVER = 0

NAME	1	2	3	4	5	6	7	8	9	10	TOTAL
A. I got started immediately											
B. I contributed my ideas.											
C. I asked others for their ideas.											
D. I helped others in the group learn.											
E. I asked for help when I needed it.											
F. I checked to see that everyone on my team understood the work.											
G. I encouraged others to participate.											
H. I praised others for their ideas.											
I. I stayed on topic.											
J. I helped others stay on topic.											
DAILY SCORE											
Other Team Member's Initials											
										AVERAGE SCORE	

REFLECTION

a. My area of strength is

b. My area of weakness is

c. I plan to improve my areas of weakness by

TEAM OBSERVATION SHEET

Member's Name:

What did they do well?

What could they improve on next time?

Observer'(s) Name(s):

Member's Name:

What did they do well?

What could they improve on next time?

Observer'(s) Name(s):

Member's Name:

What did they do well?

What could they improve on next time?

Observer'(s) Name(s):

Member's Name:

What did they do well?

What could they improve on next time?

Observer'(s) Name(s):

PROJECT EVALUATION SHEET

Team Members:

_____
_____
_____
_____
_____

Answer these questions TOGETHER as a team:

1. What was the purpose of the project?

2. What was worthwhile about the project?

3. How can the project be made better for next time?

4. How can doing this project help?

5. Should this project be offered next year? Why/why not?

TIME-OUT DISCUSSIONS

Some examples of questions that are used in various metacognitive activities that will promote thinking and understanding of the concepts and skills required for task completion and for effective teamwork are:

Task:

What is the task?
Why are we doing this?
What are out goals?

How much time do we have to do it?
What do we have to do to be successful?
How could we do it better next time?
Where else could we do this task?

Teamwork:

Should there be a leader?
How can we help each other?

Do you like working in groups?
What do you like about working in groups?
What don't you like about working in groups?
How do you solve problems in a group?

What should teachers do to help?
What kind of debriefing would be helpful?
How will the teacher know what you've learned?
What was the hardest part? What was easiest?
Who would you like to compliment? Why?

INVESTIGATION REPORT (SAMPLE)

There are 8 stages involved in using statistics to analyze data & investigate relationships. The following is a sample of an Investigation Report containing the 8 stages.

Definitions:

Statistics:	Science of collecting, organizing, and interpreting data
Variable:	Characteristic that can be classified, counted, ordered or measured.
Population:	All the people eligible for a survey
Sampling:	Adequate amount to represent people within the population to predict outcome reliably
Multiple trials:	Repeating the data-gathering method several times

Investigation Report The best season for Grade 10 to volunteer for school environment project.

1. **Problem:** *(pose a problem or question that can be answered using statistics and identify the variable or variables)*. Which season is more popular for student to volunteer in a school-based environmental project?

2. **Hypothesis:** *(make a hypothesis or an educated guess which is a possible, statistical answer to the question)*. I think the fall is more popular for volunteers for a school-based environmental project.

3. **Data Collection:** *(identify the variables. Decide what type of data to collect, from whom you will collect it (population or probability or non probability sample that is large enough to give reliable results), and method of collecting and recording your data. Conduct the investigation using multiple trials. Select one from each:*

   i) Variables:

   ii) Collection methods:

   Primary data method: *survey* – interview, counting study, poll; *experiment* - scientific, mathematical *testing*

   or

   secondary data method *magazines, newspapers books, encyclopedia records, databases*

   iii) Population selection methods:

   Census

   or

   Representative Samples

   total

   probability sampling: *simple random* - complete random; *systematic random* - pre-selected intervals; *stratified random* - groups then random

   or

   non-probability sampling *convenience sampling* - passersby; *volunteers sampling* - volunteers call

   iv) Recording methods:

   The variables will be fall and spring and the years 19999 to 2003. The collection method will be school records of volunteers for the projects for the springs and falls from 1999 to 2003 from the total Grade 10 enrollment in semestered core subjects. I will use the total population of the school and I will design a frequency table to record the tallies on (table/tallies, spreadsheets, charts/checks, audiotape, videotape, photos, etc.)

Table 1: STUDENT VOLUNTEERS (percent) by school – Fall & Spring 1999-2003

Table/ Tallies

FREQUENCY DISTRIBUTION TABLE		
Years	Fall	Spring
1999	IIII	II
2000	IIII IIII	III I
2001	IIII III III	III IIII
2002	IIII III IIII	IIII III III III III
2003	IIII IIII III III III III	III III III III
Totals	101	75

4. Data Organization:

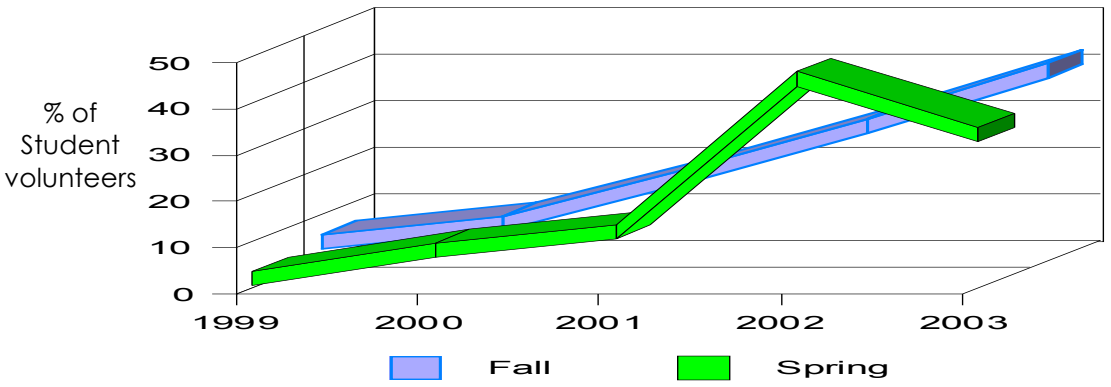
(organize and analyze the data using tables, graphs, and calculations)

a) Table of Values:

Table 2: STUDENT VOLUNTEERS (percent) – Fall & Spring 1999-2003

Years	Fall %	Spring %	Difference %
1999	4	2	- 2
2000	8	8	0
2001	18	12	- 6
2002	29	45	+ 16
2003	41	33	- 8

Graph 1: STUDENT VOLUNTEERS (percent) – Fall & Spring 1999-2003



5. **Data Analysis:** *(Graph Analysis Statements on patterns, relationships, and trends outlined on Pattern in Data Analysis template)*

   - ✓ **Patterns**: Fall – gradual rising from beginning, linear in shape, 2000 doubled from 1999, 2001 more than doubled from 2000, 2002 10% increase from 2001, 2003 12% increase. – pattern is steadily rising. Spring – rising gradually at first then a sharp increase then decrease, 2000 tripled from 1999, 2001 a third more than 2000, 2002 almost quadrupled from 2001, 2003 12% decrease from 2002. – pattern is intermittent gradual rising with spurts of sharp increase followed by a slightly less sharp decline.

   - ✓ **Relationships:** 1999 – Fall was double the amount of Spring, 2000 – Fall and Spring were equal, 2001 – Fall was 1/3 higher than Spring. 2002 – Spring is 1/3 higher than Fall, 2003 – Fall is 11% higher than Spring

   - ✓ **Trends:** Fall seems to gradually and steadily keep increasing while Spring seems to gradually increase for short periods followed by an extreme increase and a les sharp decrease.

6. **Inference:** *(use trends and relationships from the Graph Analysis Statements to make inferences or generalizations based that support the hypothesis; if they contradict, go back and find the reason and adjust, retest, or reform)*

   The trend for volunteers is that there will always be more volunteers in the fall projects than in the spring and that the fall will continue to increase their volunteers gradually while the spring will experience fluctuations – years of lower but steady increase in volunteers followed by abrupt increase and decreases in volunteers. This supports the hypothesis.

7. **Conclusions:** *(communicate the results of the investigation and justify your conclusions using the Analysis Statements and your own knowledge of local and world events as supportive details. Make future predictions and offer reasonable solutions)*

   The results of the investigation show that the fall semester is more favourable for student to volunteers to participate in environmental projects than the spring. The environmental projects are offered to core subject students (Math, English, Science and Social Science). More students tend to take the core subjects in the fall semester. Therefore, the enrollment was lower in the core subjects in the Spring term which means there were fewer students to volunteer in the spring.

   Vice versa, enrollment in the option and specialty courses was higher in the Spring. Option and specialty courses tend to be heavy courses some with much participation required. Therefore, there is less available time for the larger group of students to volunteer for the environmental projects. Further, the end of the spring semester is always busier for all students with planning, remediating, and finding a summer job.

   The fluctuation in the spring result could be traced to the increased media coverage of environmental problems or issues during these times.

To solve this imbalance, perhaps time should be provided for all students to volunteer in both Spring and Fall environmental projects and credit this time as part of their culmination evaluation or offer a selection of various environmental projects to participate in.

8. **Further Investigations:** *(pose further questions or related problems that are related to this investigation)*

   What kind of environmental projects would attract more student volunteers?

INVESTIGATION REPORT

(**TEMPLATE)** _____

title

1. **Problem:** *(question)*

2. **Hypothesis:** *(educated guess)*

3. **Data Collection:** *(collection, sampling, and recording methods)*
   i) variables
   ii) collection methods:
   iii) sampling methods:
   iv) recording methods:

Example		A	B	C	D	E	Totals
Survey	1.						
Tally	2.						

4. **Data Organization:** *(tables)*

	A	B	C	D	E	Totals
Value (example table of values) 1. %						
Value 2. %						

5. **Data Analysis:** *(on patterns, trends, & relationships)*
   i) Graph of Data:

   ii) Analysis
   Statements of Graph: (see Pattern in Data Analysis template)

6. **Inference:** *(generalization based on Graph Analysis Statements & decision if the Statements support or contradict the hypothesis – if contradict, go back and find the reason and adjust, retest, or reform)*

7. **Conclusions:** *(communicate the results & justify; make future predictions & offer solutions)*

8. **Further Investigations:** *((pose further questions or related problems to investigate that are related to this investigation)*

PATTERNS IN DATA ANALYSIS (TEMPLATE)

Statistics: science of collecting, organizing, and interpreting data

Variable: characteristic that can be classified, counted, ordered or measured.

Interpolate: analyze statistics or data - first in terms of the patterns it makes (or does not make) and second, in terms of the relationships and trends it indicates.

Extrapolate: analyze to predict trends and future scenarios.

DATA ANALYSIS

i) **Pattern Analysis** on the Graph: *Is there a pattern?*
the first thing you must do in your analysis is to decide *if* the data forms a pattern on the graph. A pattern is a design that has certain **attributes**. These attribute are called *Look Fors* (because these are the attributes you *look for* to determine if the data makes a pattern):

Look Fors	***Descriptors***
S**hape**	long, short, round, oval, like a.....
Size	big, small, thin, thick

General direction	rising, falling, wavering, tapering, traveling outward
Distribution	evenly spread, thinly spread, clumped, bulged "archipelego", ribboned
Comparison	highest, lowest, bigger than, less than, double, half, equal

ii) **Analysis Statements:** *Is there pattern? a relationship?* answer these questions in detail:
- ✓ Is there a pattern? How would you describe it using the descriptors above in at least 5 sentences? What has happened to the data or statistics, in general terms, since the beginning? Are there any major changes within the pattern?
- ✓ What are the variables? Does the pattern show a relationship between the variables?
- ✓ If you extended the pattern, what would it be like, where would it go?
- ✓ What trends do you see forming?

INFERENCE

W*hat does this mean?*
Answer the questions citing the relationships and trends described in the Analysis Statements to support your answers; if there is a contradiction, go back and find the reason (or not) and adjust, retest, or reform:
- ✓ What generalization can be made based on Graph Analysis Statements?
- ✓ Does the inference support or contradict the hypothesis?
- ✓ If it contradicts, why? *(Check original data, values, percentages, analysis statements, inferences)*
- ✓ If no errors have occurred, what should happen to the hypothesis? / How should it change?

CONCLUSIONS

Why does this pattern exist?
Explain the meaning of your inferences and justify them using the Analysis Statements as support:
- ✓ Why did the pattern happen (or not)?
- ✓ Why did it happen in the way it did? What does this indicate *(use your analysis and own knowledge of world events as supportive details)?*

What predictions or future scenarios may eventually happen if the trend(s) continues?

Curriculum Connections Grades 4-8 (Forest Biodiversity)

GR	GEOGRAPHY	GEOGRAPHIC INQUIRY SKILLS	MATHMATICS	MATH I INVESTIGATION SKILLS	SCIENCE AND TECHNOLOGY	SCIENTIFIC INQUIIRY
4	Natural resources forests Map symbols sketch maps	Use appropriate vocabulary Formulate questions to guide the gathering of information Locate Information From primary and secondary sources Sort and classify relevant information Construct and read a wide variety of graphs, maps, and models Communicate using media works, oral presentations, written notes and descriptions, drawings and charts, maps and graphs.	Measure in mm, cm, m to 2 decimal places Mental addition and subtraction of whole and decimal numbers Linear dimensions	Data collection Databases interpretation Data display – manual and computer generated tables, charts, graphs Symbols, titles, labels	Factors that affect plants Plant adaptations Human effect on environment Plants & loss of habitat Extinction	Formulate questions & possible answers Plan investigations for some of the answers, identifying constant variables & criteria for assessing solutions Use appropriate language Compile record, and present data using tally charts, tables, and labeled graphs produced by hand and by computer Communicate using media works, oral presentations, written notes and descriptions, drawings and charts
5	Past civilizations and the environment Grids Symbols Directions		Mathematical language Mental add & subtract Measure in linear units Geometric angles Grids Perimeter	Data pattern analysis	Weather and climate influences Energy Conservation	
6	Trade & Canada Canada-US. Interconnections Sketch map Symbol colours		Perimeter Mathematical language Geometric properties of square, rectangle	Spreadsheets, tables, Databases Patterns Types of graphs		
7	Natural resources Natural vegetation and climate patterns Environment Interconnections	Use appropriate vocabulary Formulate comparative & speculative questions Locate relevant info from primary sources; Analyze, synthesize, & evaluate data using a decision-making model Produce a wide variety of graphs, charts, diagrams and models for different purposes Communicate results stating opinions using media works, oral & written reports, drawings, tables, charts, and graphs.	Relevant units of measure Diameter	Prediction Central tendency – mean Trends Inferences Arguments Symbols	Ecosystems and population Impact of technology on environment Growth and reproductive conditions for plants Loss of habitat Extinction Greenhouse Gases Carbon Sequestering	Formulate questions & possible answers Plan investigations for some of the answers, identifying constant variables & criteria for assessing solutions Use appropriate language Compile, record, and present quantitative & qualitative data using diagrams, flow charts, frequency tables, & graphs produced by hand and by computer Communicate using media works, oral presentations, drawings, charts, written notes & descriptions,
8	Impact of human decisions on environment Maps		Angles Perpendicular Mathematical language	Spreadsheets Patterns and trends Variety of graphs Inferences Arguments		

Curriculum Connections Grades 9-12 (Mapping and Inventory)

GR	GEOGRAPHY	MATHMATICS	SCIENCE
9	✓Ecozones ✓International global concerns ✓Global/local natural systems ✓Natural resources ✓Natural/human systems ✓Ecological footprint ✓Urban/rural environments ✓Region & bioregion	✓Mental math ✓Integers ✓Inferences ✓Percentages and ratios ✓Sampling ✓Tables of values/graphs ✓Linear relations ✓Data collection/analysis/organizations	✓Resources Natural population & size ✓Sustainability ✓Carbon/oxygen cycles ✓Biotic/biotic ✓Canadian initiatives/ ecosystems ✓Ecosystem ✓Photosynthesis/cellular respiration
10		✓Ratio & proportion ✓Interpolation/extrapolation ✓Scale diagrams ✓Acute/tangent of angles ✓Trigonometric ratios ✓Measurement (sides/angles) ✓Tables ✓Height ✓Linear functions	✓Weather ✓Ecosystems
11	✓Earth spheres ✓Mechanisms of change ✓Location & local region ✓Field studies ✓Natural system & change ✓Ecosystems ✓Human actions/environment ✓Ecological footprints ✓Deforestation, fossil fuel burning, carbon cycle ✓Climate/soil/vegetation/population patterns	✓Problem solving ✓Symbols and visuals ✓Graphing technology ✓ Sampling techniques ✓Trigonometry (right angles) ✓Data collection ✓Tables and graphs ✓Spreadsheets	Biology 11: ✓Succession ✓Plant classification ✓Role of plants ✓Biodiversity/survival ✓Plant characteristics ✓Principles of taxonomy ✓Sampling procedures ✓Sustainability ✓Structure/physiology of leaf, stem, tissues, roots Chemistry 11: ✓Hydrocarbons as fuels
12	✓Canada/International cooperation ✓Ecosystems ✓Urbanization & growth ✓Global resource patterns ✓Climate change ✓Earth spheres ✓Role of plants ✓Natural habitats ✓Resources/sustainability ✓Place ✓Probable/desirable futures Alternative solutions ✓Human changes/natural systems ✓Biodiversity		Biology 12: ✓Population characteristics ✓Population growth ✓Human population growth and the environment ✓Ecosystems
Gr.	**INQUIRY/RESEARCH/COMMUNICATION SKILLS**	**MATHEMATICS INVESTIGATION SKILLS**	**SCIENTIFIC INVESTIGATION SKILLS**
9 to 12	✓Demo technologies used in geographic inquiries ✓Demo methods to collect, organize, manipulate, & interpret geographic data ✓Use geographic terms ✓Develop/use questions to define geographic issues ✓Locate & use primary sources ✓Use graphic organizers to interpret geographic info ✓Determine if questions were answered or addressed ✓Provide evidence to support conclusions & opinions ✓Select/use appropriate methods for data display ✓Collect/synthesize info ✓Select/use technology to represent geographic info ✓Create/use photos, charts, models, & diagrams ✓Use different maps to interpret info ✓Use cartographic conventions constructing maps. ✓Use statistical methods effectively when analyzing	✓Pose a problem and hypothesis ✓Demo principles of sampling & apply to investigations ✓Collect data, use appropriate equipment & technology ✓Organize/analyze/summarize data using appropriate techniques & technologies ✓Construct tables of values, graphs to represent linear relations from realistic situations ✓Describe trends & relationships observed in data, making inferences from the data ✓Draw appropriate conclusions about questions or issues on the basis of the interpretation of graphs ✓Solve/pose problems related to an experiment using findings of the investigation ✓Communicate & report the findings & solutions of investigations in a clear & concise manner, using appropriate mathematical language & forms	✓Select/use appropriate apparatus/instruments effectively & accurately in collecting data ✓Demonstrate plan/carry out investigations using lab equipment safely, effectively, & accurately ✓Select/use appropriate numeric, symbolic, graphical, & linguistic modes to communicate scientific ideas/results ✓Locate/select/analyze/integrate info, working in a team or independently using appropriate library & electronic research tools, including Internet ✓Compile/organize/interpret data, using appropriate tables, flow charts, graphs, & diagrams ✓Communicate procedures/results/research for specific purposes using data tables & laboratory reports ✓Express the results of any calculation involving experimental data to the appropriate number of decimal places or significant figures

4. Pre-Site Activities

VOCABULARY ACTIVITY Name _____ Class _____

Crown	noun: the top width of foliage of a deciduous tree, the part of the tree that is above the trunk
Deciduous	adjective: trees that loose their leaves annually
Coniferous	adjective: cone-bearing trees with needle-like leaves
Woodlot	noun: section of a forest
Top soil	noun: surface soil, 1st 10 – 15 cm down
Sub-soil	noun: next layer of soil, between 10-25 cm down
Quadrat	noun: a 20m x 20m piece of land, ⅕ of a hectare
Monitor	verb: to measure, record, re-measure, and record specific data in a specified frequency
Data	noun: information gathered from observing and measuring
Ecozones	noun: an area with unique, physiographic features, climate, soils, drainage, flora, fauna, and human systems
Hectare	noun: a hundred metre square
Clockwise	noun: a rotation or spinning to the right
Spiral	noun: a figure which coils inward to the centre verb: to spin or coil inward to the centre
Triangulate	verb: to calculate measures using 3 sides to make a triangle.

Activities:

1. Study the words and their meanings. Notice that some have two definitions.
2. Use the words or definitions to do one of the following:

   a) Play Jeopardy – students give answers in the form of a question to a definition;

   b) Play Win, Lose, or Draw – students are given a word and they have to draw it;

   c) Make a crossword or word jumble – students create their own crossword puzzles using the definitions, or word jumbles where a question is asked and to find the answer, selected words from the list are jumbled with certain letters circled.
   When the words are unscrambled and put in the letters selected and put in the correct order, spell out the answer to the question.

COMPASS DIRECTIONS ACTIVITY Name _____ Class _____

1. Draw a Compass rose and label the 8 basic compass directions.

2. On the map below, identify
   a) The most northerly place named on the map.

   b) The direction Hagersville is from Canfield.

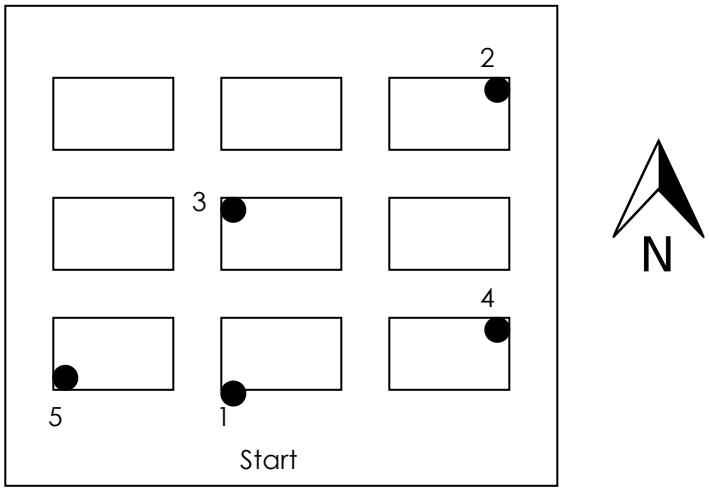
   c) The general direction of County Road 20.

   d) The general direction of Highway 6.

Compass Directions *(cont.)* Name _____ Class _____

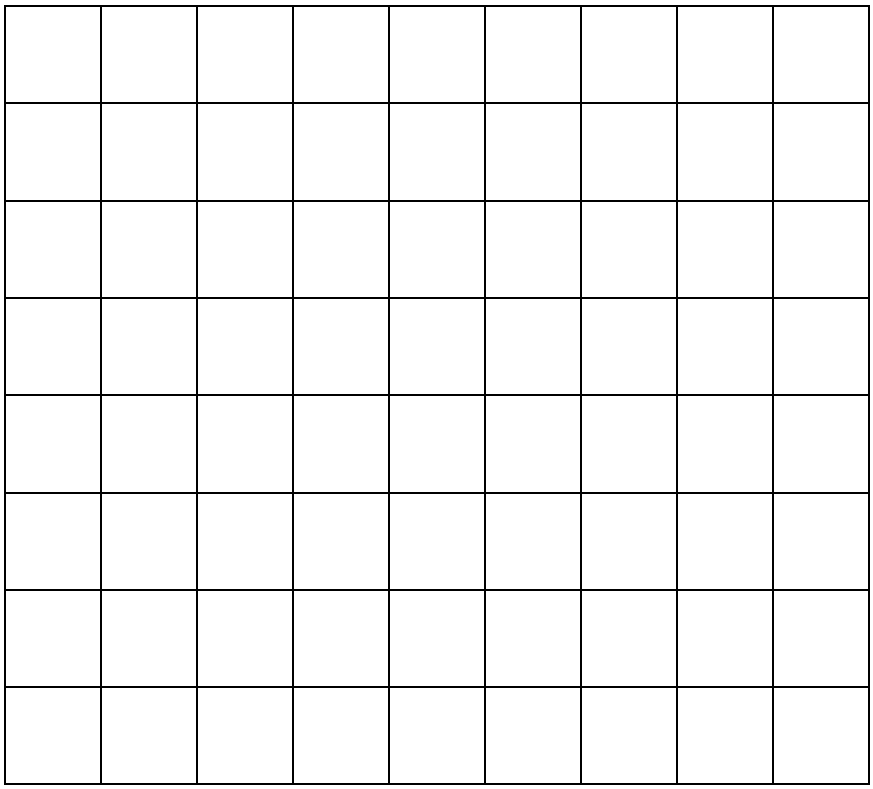
1. Write the directions using a compass on this map of a city community to get from one point to the other in the following:

i. From 1-2
ii. From 2-1
iii. From 3-4
iv. From 4-5
v. From 2-5

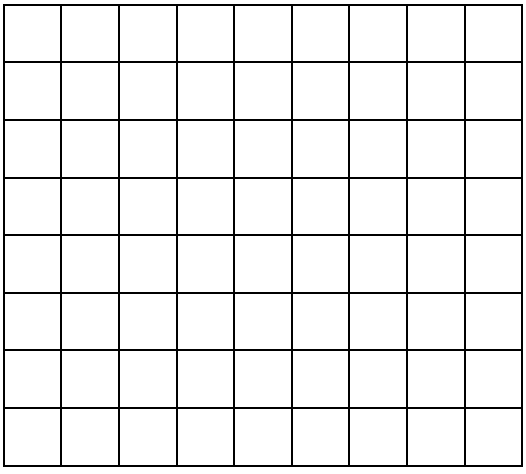


SCALE ACTIVITY Name _____ Class _____

1. Draw a simple object on Grid A and call it the original or actual object.



2. Reduce the actual object and redraw to scale on Grid.



3. *What are the different scales? How does it affect the image?*

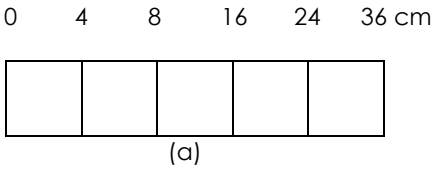
4. What is the relationship between the scale and the image?

5. On blank paper draw a map of a table to scale. When drawing a map to scale both dimensions must be changed. Follow these steps:
   i. Draw a frame around the edge of your paper.
   ii. Measure the width of the table.
   iii. Measure the width of the frame on your paper.
   iv. Measure the length of the table.
   v. Measure the length of the frame on your paper.

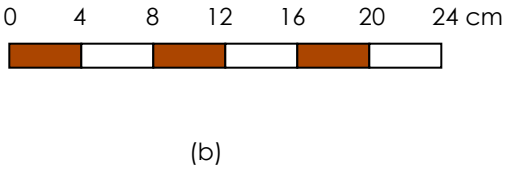
6. Calculate how many times you are going to reduce the measurements of the table so that it will fit in the frame. i.e. if the table is 60 cm and the frame is 10 cm then the frame is 6 Xs smaller than the paper, so 6 cm on the table is represented by 1 cm on paper.

7. Record the scale on your "Map of the Table" as a linear scale.

8. Measure each space of the boxes below.



(a)

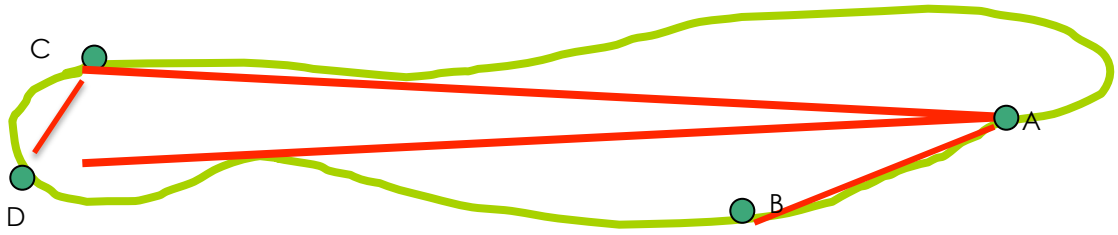


(b)

   i. How long are the boxes?
   ii. Are these scales the same as the verbal scale or statement 1 cm to 4 cm? Why?

9. Change the following verbal scales or statements to linear scales:
   i. 1 cm to 10 cm
   ii. 1 cm to 2 m
   iii. 1 cm to 15 m

10. Look at the map of Sandy Island



11. The actual distance from A to B is 10 km. What is the scale of the map?

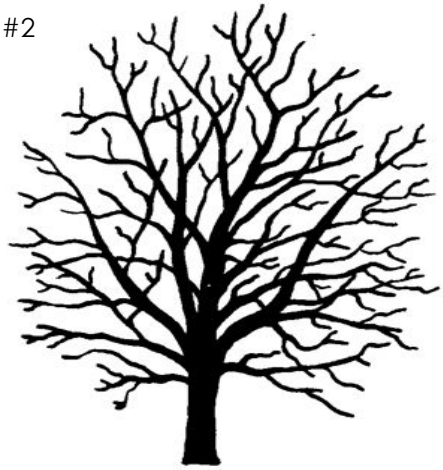
12. What are the actual distances from A to D? C to A? D to C?

Using the scale 1 cm represents 0.5m, calculate the heights of the following 5 trees:

#1

Red Oak

#2



Red Maple

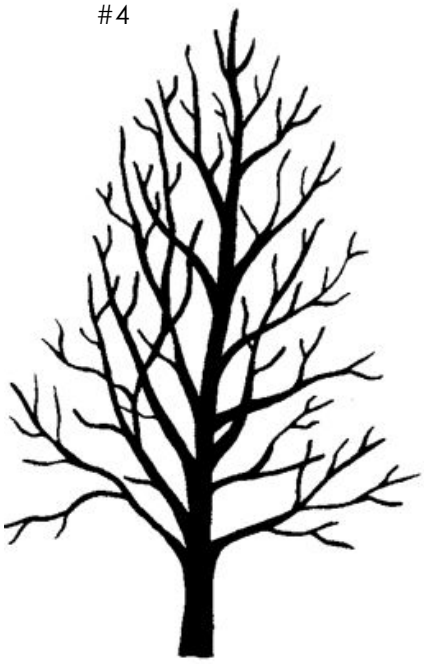
#3

Black Cherry

#5

White Birch

#4



White Ash

KINDS OF TREES ACTIVITY Name _____ Class _____

Canada's forests are made up of coniferous (90%), deciduous trees (1%), or a blend of both (9%). Most of her deciduous forests have been cleared for farming and urban development.

Coniferous trees are cone-bearing trees with specialized features that help them to adapt to the colder, drier climate they live in. These cones hang on the branches and protect seeds over the winter. Their leaves are long, slender, evergreen needles, shaped to limit the exposed surface area and thus reduce respiration and have a waxy coat to hold in moisture during winter. In spring, the needles immediately start manufacturing food for the shorter growing season. Conferous trees, such as spruce, pine, fir, and cedar, are softwoods and provide excellent wood for making pulp and paper, lumber and plywood products. Exceptions: Tamarack or Larch is a conifer which loses all its needles at once in the fall.

Deciduous trees are broadleaf trees with specialized features to help them survive over the winter months in the less severe climate they live in. They loose their leaves in autumn and remain dormant over the winter, then in the spring, new buds begin to grow and the trees bloom and manufacture food for the longer growing season. Deciduous trees, such as birch, ash, maple, cherry, and walnut are hardwoods and provide excellent wood for making furniture, flooring, and even sports equipment.

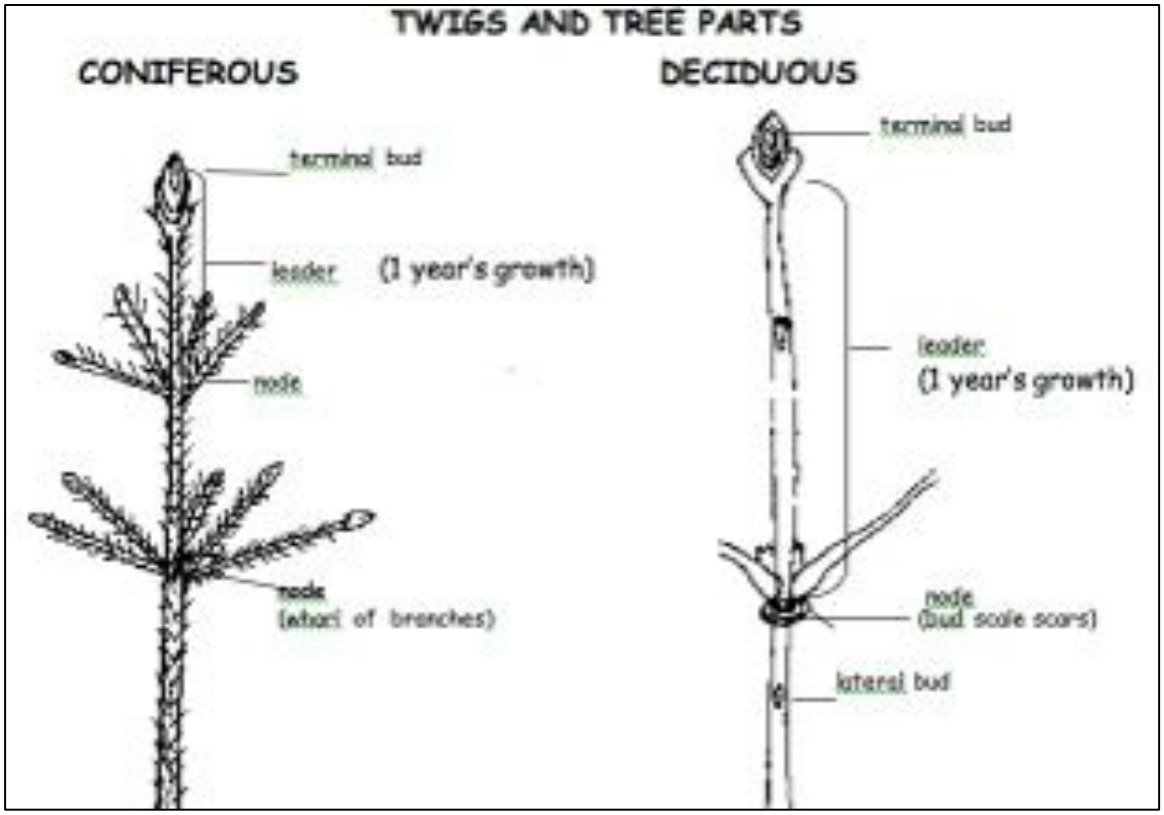
<u>Activities</u>

Visit some trees in your neighbourhood and…

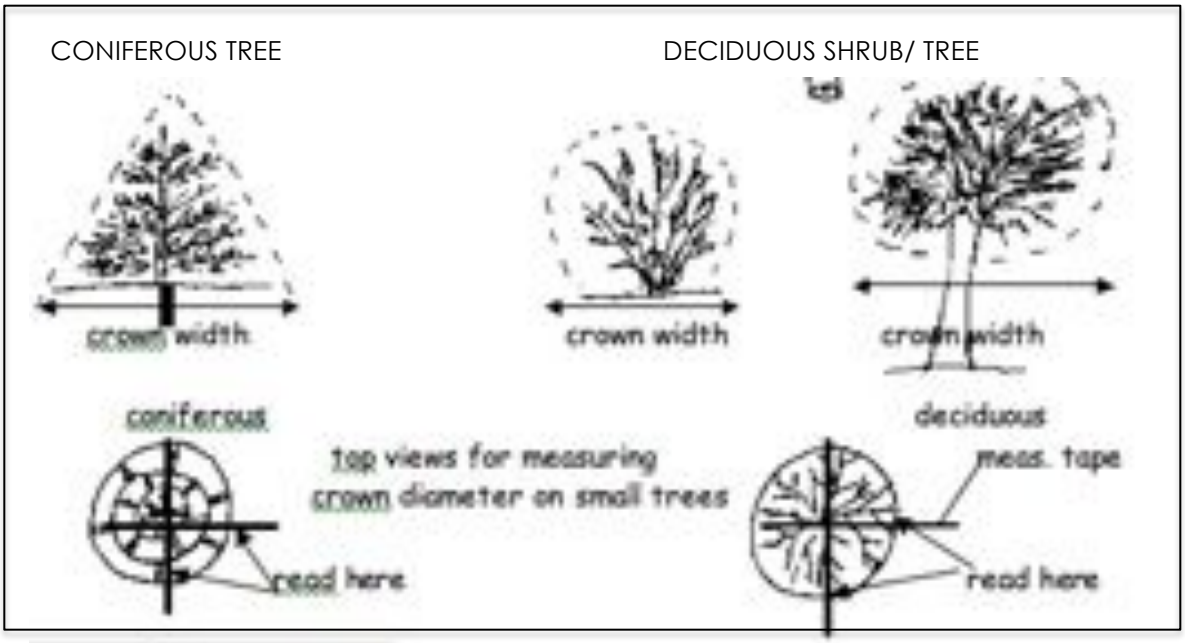
- ✓ Do bark rubbings using crayons or charcoal, and blank newsprint.
- ✓ Make a leaf print painting 1 side of the leaf and pressing it onto blank paper repeatedly.
- ✓ Make a photo journal of trees with a camera. Start a ID file with shape, leaves, bark, fruit.
- ✓ Do a sensory walk blindfolded and locate the various trees along the rope handrail. Listen, smell, and touch their leaves, bark, roots, and branches.
- ✓ Construct a tree including the major parts of a tree using various materials i.e. cardboard tubes, pencils, tape, glue, construction paper, crayons, paints, brushes, pipe cleaners, cloth, string, and natural plant parts.
- ✓ Visit some websites for more information on trees.
- ✓ Research Trees and Shrubs of Ontario by D. Hendry for a list of trees and shrubs in Ontario,

For a list of Toronto's native Tree species www.toronto.ca/trees: City Forester's Office; "Ravines"; scroll down to PDF "Forestry facts and Native Plant List"; Tree List & Shrub List.

GETTING TO KNOW YOUR TREES



CROWN MEASUREMENTS



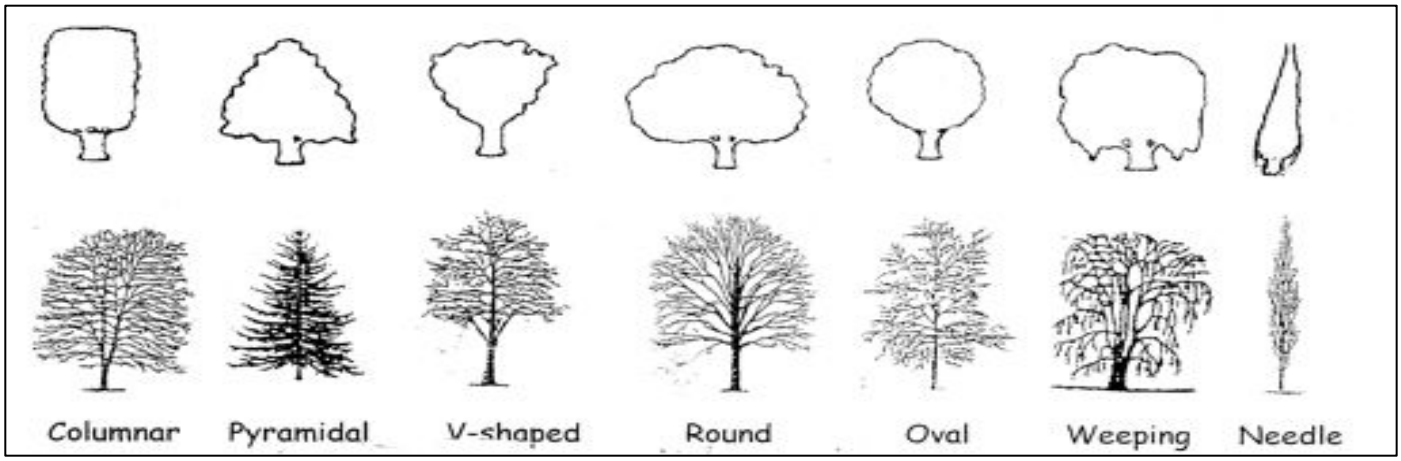
Crown width and length are measured at right angles from each other to find the largest area (W x L) that a tree occupies. "The drip line" found on the ground under a tree is at the outer edge (perimeter) of the crown. Tree health is often assessed by evaluating the health of the crown as well as the tree trunk etc.

WINTER TREE IDENTIFICATION

Identifying trees in the non-leaf seasons can be fun and often, easier. However, the differences between species are sometimes more subtle and we have to look at parts of the tree we don't usually pay much attention to. Key features are bark, twigs, and buds, but some other features, such as branching patterns, overall form, habitat, and taste are sometimes important also.

Form and Branching
Form refers to the overall growth pattern of a tree – the silhouette. Some trees grow very straight with narrow branching, while others may be short with very wide branching. Remember, the same tree species can have different forms depending on whether or not it is growing in the open (open grown) or in a crowded forest.

Key to Tree Shapes



Characteristic	Description
Columnar	Cylindrical; sides more or less parallel; much more broad than tall
Pyramidal	Conical, cone-shaped; broad at base, tapering to a narrow top
V-shaped	Vase-shaped; spreading upright
Round	Globule; about as broad as tall
Oval	Elliptical; more tall broad, widest branching at or near the middle
Weeping	Droopy, branches tend to droop downward
Needle	Spike-like; tall and narrow, thin at base, tapering to a very narrow top

Tree Size

Shrub	Up to 10m
Small tree	Up to 20m
Medium tree	20 – 30m
Large Tree	30 – 40m
Very Large Tree	0ver 40 m

Branching

Young rapid growing trees have cone-shaped crowns with a distinctive leading shoot which outgrows the branches below it. Older trees have a more founded or flat crown as the leadings shoot slows its growth.

Characteristic	Description
Angle off tree	Small angle vs wide angle
Direction	Ascending vs descending vs horizontal vs arched
Tips	Bending up vs bending down
Texture	Smoothes vs gnarly
Size	Stout vs slender
Shape	Straight vs zigzagged vs S-shaped

Bark

Bark is one of the most important features for tree identification because of its year-round accessibility. It is especially useful when the tree's leaves and twigs are inaccessible or unavailable during the fall and winter. The shape of the bark is characteristic of some species, for example, the small, rectangular plates on flowering dogwood. Bark on young trees differs from that on more mature trees. Experience is the best way to learn bark characteristics.

Characteristic	Description
Shape or general appearance	The shape of the bark is often characteristic of some species, for example, the small-rectangular plates on the flowering dogwood.
Texture	The feel of the bark, such as the smoothness of cherry trees is important.
Thickness	The thickness of bark can vary within a species as well as between species.
Color	Bark color varies with age, location, site, and light conditions.

Smooth

Furrowed

Scaly

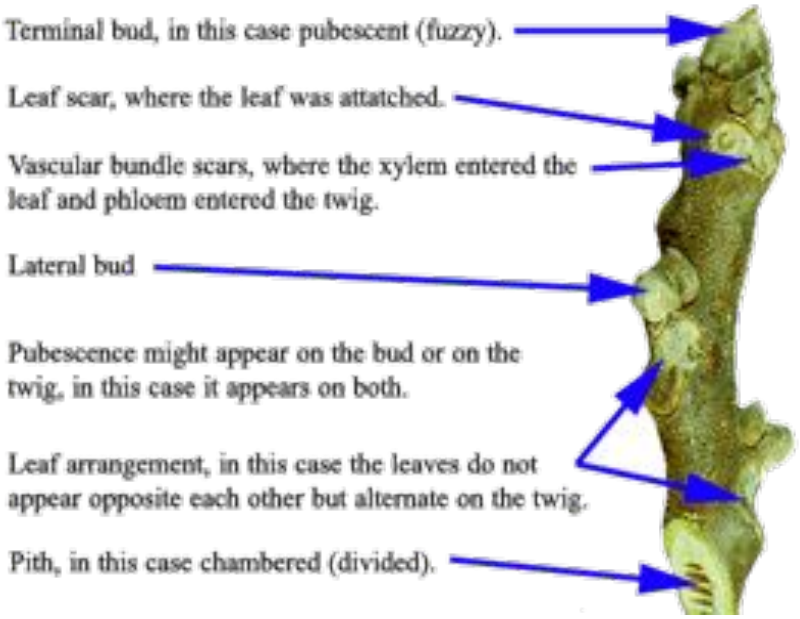
Warty

Shaggy

Twigs

Seed plants are divided into two classes - Angiosperms and Gymnosperms. Angiosperms are the flowering plants and they produce their seeds inside an ovary. Most northern Angiosperm trees are deciduous since they shed their leaves in the fall.

Gymnosperms produce their seeds in cones. Most of the Gymnosperms in northern latitudes are conifers. With one exception, conifers are evergreen since they retain their needles throughout the year.



Characteristic	Description
Buds	One location of growth tissue in a tree; usually visible on the twig; may be either on the side (lateral), or at the tip of the twig (terminal); may be scaly naked, smooth or fuzzy.
Leaf scars	Where a leaf falls from the twig; they vary in size and shape
Bud Scale Scars	Scars left when the scales protecting the bud fall off
Lenticels	Small, normally lens-shaped, openings on the stem that allow gas exchange often raised and looking like freckles on the young bark
Pith	Central portion of the twig seen only in cross-sections of cut twigs; usually lighter or darker than the wood that surrounds it; varies in color; in most cases is solid, spongy, or hollow
Thorns, spines and prickles	pointed structures project from sides of a twig; important features in some species

For photos of the various features go to www.fw.vt.edu/dendro/forsite/idform.htm

In winter, you can identify tree species by careful examination of their twigs, just as you can in summer using leaf characteristics.

It is best to use a mature tree, or one that is not a seedling or sapling. Deciding if a small tree is just a shrub or if it is a young tree can be difficult. The appearance of a tree sometimes changes quite a bit as a tree ages (kind of like people).

To examine the form of a tree, it is best to stand a short distance away. *Be careful to READ THE DESCRIPTIONS CLOSELY and CAREFULLY! Compare the descriptions with your sample and your memory of what the tree and habitat looked like. Remember that words such as "often" and "usually" do NOT mean "always". There is a lot of variety within most species so be careful.*

HOW TO USE TREE KEYS

DICHOTOMOUS KEYS (Di = two) are the tools that use 2 choices to lead to identification – of anything. For trees in winter, look closely at the bark. Use the key below to make choices following the lines to identify the tree in BOLD. You can design a Tree key for your space!
Check the three versions of dichotomous keys. They are all based on two choices eg. Yes or No, or number pairs or letters.

Excerpt from Native Carolinian Deciduous Trees Dichotomous Key *(bark, twigs, and buds)*

Created by William Cook. 1998. *Upper Peninsula Tree Identification Key*. Michigan State University Extension, Upper Peninsula Tree Improvement Center, Escanaba, Michigan.

1. *Opposite* branching. (2)
1. *Alternate* branching. (10)
   2. Twigs often *stout* but never reddish. Dark *terminal* buds, sometimes large. *Leaf Scars* are large. Ashes. (3)
   2. "Normal" or slender twigs. Maples & shrubs. (4)
3. Chocolate brown *terminal* bud. First set of side buds close to the terminal. *Leaf scar* has a distinct notch in the top. Bark is tight, furrowed in larger trees. *WHITE ASH*
3. First set of side buds usually set back 1/8 to 1/4 inch from *terminal* bud. *Leaf Scars* slightly notched. Bark flakes off easily when rubbed. Swampy habitat. *BLACK ASH*
3. Side buds tight against the *terminal* bud. *Leaf scar* top straight across. Twig ends tend to be somewhat flattened. Branching looks somewhat droopy. Bark often has many horizontal cracks. *GREEN ASH*
   4. Tree size, at least 4" diameter & 10 m tall. (5)
   4. Shrub size

*Customizing TREE ID using MATURE DECIDUOUS TREE **BARK** DICHOTOMOUS KEY*

ACER
Association for Canadian Educational Resources

Clues: check fallen leaves and fruit near tree
Reference: Trees in Canada, J.L.Farrar

Notes:
1. For definite identification of Norway **maple***, an import, **break the leaf stem** or petiole to check for **milky fluid**
2. Other **maples*** such as sugar, red, black, Manitoba and silver maples are all seen in the GTA.
3. Manitoba maple, the only maple with compound leaves, is sometimes called a "dirty Maple" as the leaflets make it look as if it is dropping many more leaves for people to rake up than the other maples.

Your school yard may need other trees added to the key – redesign may be needed to add other trees.
e.g. OAK – Check for leaves and acorns on the ground – Red Oaks buds and leaf lobes pointy; White Oaks leaf lobes and buds rounded.
e.g. HICKORY - Shagbark Hickory covered nut fruits, bark tight shallow grooves Check also for Bitternut Hickory**

Native Coniferous Trees Dichotomous Key *(needles)*

1a.Leaves **scale-like**, gen.less than 0.3cm long, in opposite pairs covering twig
- 2a. Leaf-covered twigs flattish; successive leaf pairs not alike in shape; cones **WHITE CEDAR**
- 2b. Leaf-covered twigs 4-sided, fine, cordlike, successive leaf pairs alike; berries **RED CEDAR**

1b. Leaves **needle-like** or linear, not scale-like.
- 3a. **Clustered** leaves present, needle-like.
  - 4a. All leaves clustered, not more than 5 in a cluster.
    - 5a. Clusters with 5 leaves in each.....**WHITE PINE**
    - 5b. Clusters with fewer than 5 leaves in each
      - 6a.Leaves in 3-leaved clusters.....**PITCH PINE**
      - 6b.Leaves in 2-leaved clusters
        - 7a. Leaves 15cm long.....**RED PINE**
        - 7b. Leaves about 3cm long.....**JACK PINE**
  - 4b. Leaves on short side of branchlets in cluster of more than 5; leaves on the end shoots singly placed (deciduous).....**TAMARCK**
- 3b. All leaves **singly placed**, linear.
  - 8a. Leaves **flat**.
    - 9a. Branchlets roughened by persistent woody bases of fallen leaves **HEMLOCK**
    - 9b. Branchlets smooth, leaf-scars circular (note bark blisters of resin) **BALSAM FIR**
  - 8b. Leaves **4-sided**, branchlets roughened.
    - 10a. Twigs **hairless**;closed cone cylindrical, blunt;open cone with thin, flexible, mostly entire scales.....**WHITE. SPRUCE**
    - 10b. Twigs densely short **hairy**, closed cone ovoid, pointed; open cone with stiff scales having more or less toothed margins.
      - 11a. Leaves **dark**-green, dull; cone 2cm long, persistent on the tree for many years.....**BLACK SPRUCE**
      - 11b. Leaves **yellow**-green, shiney; cone @5cm long, deciduous within a year after seed dispersal **RED SPRUCE**

NOTE: The silhouette of the entire tree can be used to identify these trees. The colour and texture of the bark can also be used for identification, but the differences between the bark of the younger branches and the bark of the trunk must be noted.
The new "Trees of Canada" includes seed details and non-native trees.

TREE ID FOR HUMBER ARBORETUM

Common Name	Latin Name	Picture of Bark (mature)	Picture of Bark (young)	Picture of leaf or leaflets	Special Features
Ash White	*Fraxinus Americana L.*				- Bark: regular A-pattern ridges - Leaflets: 5-9, usually 7 - Fruit wings enclose only the tip of seedcase
Basswood	*Tilia Americana L.*				- Bark: flat ridges
Beech American	*Fagus grandifolia Ehrh*				- Bark: has horizontal scar-like cuts, looks like "elephant leg" - Leaves: persistent through the winter

TREE ID FOR HUMBER ARBORETUM

Beech Blue Or American Hornbeam Or Musclewood	Carpinus caroliniana Walt.				- Bark: looks like "muscle"
Cherry Black	Prunus serotina Ehrh.				Bark: looks like burnt cornflakes
Hawthorn	Genus Crataegus				- Bark: flaky with sharp thorns - Leaves: have flowers and fruit

TREE ID FOR HUMBER ARBORETUM

Hickory Bitternut	*Carya cordiformis (Wangenh.)*				- Bark: flat ridged young; shallow narrow ridges when mature - Leaves: 7-11 leaflets
Ironwood Or Hop-Hornbeam	*Ostrya virginiana (Mill.)*				- Bark: square scales when mature; smooth when young - Leaves: finely toothed, each vein ends in a sharp tooth.
Maple Black	*Acer nigrum, Michx.*				Bark: flat ridges when young; more deeply ridged when mature Leaves: unlike Sugar Maple, Black Maple has blunt (not pointy) lower lateral lobes, in other words less pronounced lower lobes

Maple Manitoba	*Acer negundo L.*				- Bark: ridged to flaky when young; when mature develop into narrow firm ridges - Leaves: unlike other maples, Manitoba maple has leaflets 3-9 irregularly toothed or lobed
Maple Sugar	*Acer saccharum Marsh.*				- Bark: smooth to flat ridged when young; irregularly ridged to flaky when mature - Leaves: All leaf ends and lobes are pointy
Oak Bur	*Quercus macrocarpa Michx.*				- Bark: irregular A-shaped ridges; - Leaves: unlike white Oak, which is more rounded, Bur Oak is more irregularly and finely toothed

MORE TREE IDENTIFICATION ACTIVITIES Name_____ Class_____

IDENTIFY LOCAL DECIDUOUS TREES

Use the keys to identify 3 CONIFEROUS and 5 DECIDUOUS trees in your area.

USING A CONNECTED-PAGE KEY on the web.

Use a set of tree keys that is a series of connecting pages, with only one group of choices per page. They are easier for beginners who are just learning how to use a key. It makes sure that you stay on-track while finding your way to an answer.

1. Click 

2. Select the best description then click  to get to the next page and another group of choices.

3. Click  to get to an interactive glossary that can be used for terms and unfamiliar tree ID characteristics.

4. Go page by page and you will end up linked to a tree species described on a species description page.

5. For more information use the following websites:

Tree Identification www.urbanforestrysouth.org/pubs/ufmanual/dendro

Tree Identification http://forestry.msu.edu/uptreeid

USING THE DATA SHEETS ACTIVITY Name _____Class _____

Read these helpful hints and complete the activity before demonstrating how to use the data sheets to the volunteers.

The Data Tables
To know what to do next, read the headings on the data table in order left to right one at a time. The item to be measured, the unit of measure, and the equipment to use are all noted for each heading.

The Angle-Tangent-Height chart
To determine the height from an angle, locate the angle in the angle column on the Angle-Tangent-Height chart and slide across the row to the right to Height m column. Read the height for that angle.

The Health Status Codes
To determine the health of a tree, read the status criteria and codes, discuss the criteria and come to consensus. Decide on the code to use - each criteria has a code in bold.

Activity:
Record the following Mature Trees data correctly in the appropriate column of the Data Table. Use the Angle-Tangent-Height chart to calculate the total Height.

Mature Trees data

Description					
Quad #	23	7	12	25	1
#Tree	4	53	6	49	13
Common Names	Pin Cherry	Northern Hackberry	Peach Leaf Willow	Bur Oak	Trembling Aspen
Location					
side #s	3	4	2	3	1
line A (00.0m)	13,70	17.30	8.90	9.43	12.00
line B (00.0m)	12.03	3.20	13,04	10.69	12.89
Bearings °	45	4	97	126	300
Height					
Upper angle°/Ht (m)	27	9	20	13	10
Lower angle°/Ht (m)	5	36	3	43	17
DBH (0.00cm)	11.80	6.40	13.90	26.00	35.60
Status	A P	A L	A E	D \	A \

Mature Trees Data Table

Description			Location			Bearings		Height (clinometer & tangent table)			DBH	Status		
Quad #	Tree #	Common Name	Side #	A line B (0.00m)		Eye-tree Distance (30m tape)	° tree to measurer (compass)	Upper angle / Ht (0.00) m	Lower angle / Ht (0.00) m	Total Ht (0.00m)	Diameter tape (0.0 cm)	A /D E/L Dam		
4	*13*	*Oak*	*3*	*14.50*	*7.32*	*20m*	*95*	*24 / 8.90*	*17 / 6.12*	*15. 02*	*20.3*	*A*	*E*	*I*
						20m								
						20m								
						20m								
						20m								
						20m								
						20m								
						20m								
						20m								
						20m								
						20m								

HEALTH STATUS CODES:
Status: **A** *alive* or **D** dead;
Stance: **E** *erect* or **L** *leaning more than 30° off vertical* or **P** *prone*

ANGLE – TANGENT – HEIGHT TABLE AT A HORIZONTAL DISTANCE OF 20 METRES											
Angle°	**Tan**	***Height m***	***Angle°***	**Tan**	*Height m*	**Angle°**	**Tan**	***Height m***	***Angle°***	**Tan**	***Height m***
1	0.017	0.34	15	0.268	5.36	29	0.554	11.08	43	0.933	18.66
2	0.035	0.74	16	0.287	5.74	30	0.577	11.54	44	0.966	19.32
3	0.052	1.04	17	0.306	6.12	31	0.601	12.02	45	1.000	20.00
4	0.070	1.40	18	0.325	6.50	32	0.625	12.50	46	1.036	20.72
5	0.087	1.60	19	0.344	6.88	33	0.649	12.98	47	1.072	21.44
6	0.105	2.10	20	0.364	7.28	34	0.675	13.50	48	1.111	22.22
7	0.123	2.40	21	0.384	7.68	35	0.700	14.00	49	1.150	23.00
8	0.141	2.82	22	0.404	8.08	36	0.727	14.54	50	1.192	23.84
9	0.158	3.16	23	0.424	8.48	37	0.754	15.08	51	1.235	24.70
10	0.176	3.52	24	0.445	8.90	38	0.781	15.62	52	1.280	25.60
11	0.194	3.88	25	0.466	9.32	39	0.810	16.20	53	1.327	26.54
12	0.213	4.26	26	0.488	9.76	40	0.839	16.74	54	1.376	27.52
13	0.231	4.62	27	0.510	10.20	41	0.869	17.38	55	1.428	28.56
14	0.249	4.98	28	0.532	10.64	42	0.900	18.00	56	1.483	29.66

TIPS FOR USING THE EQUIPMENT – See the detail role cards for each!

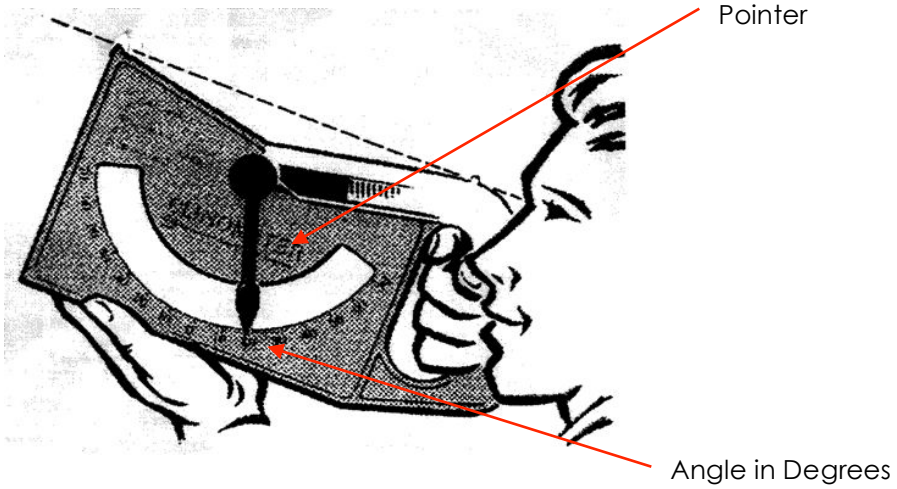
Read over these helpful hints before demonstrating how to use the equipment.

HEIGHT MEASUREMENTS

Clinometer

Stand & hold the clinometer at eye level. Line up the top of the tallest branch with the point of the front sight. Adjust until the peak of the front sight is in the valley of the site nearest your eye. ,Pull & hold the trigger until the pointer has come to rest. Then release the trigger & read the angle ° at the pointer tip. This is called the "upper angle"

Repeat this until two identical readings are obtained. From the same position, for the lower angle, sight the base of the tree where it enters the ground & follow the same procedure.

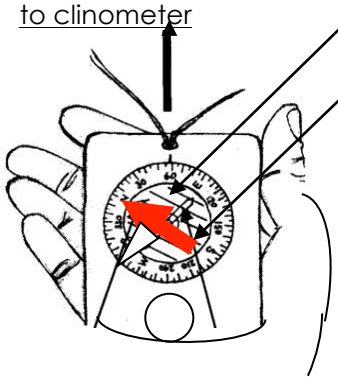


Compass

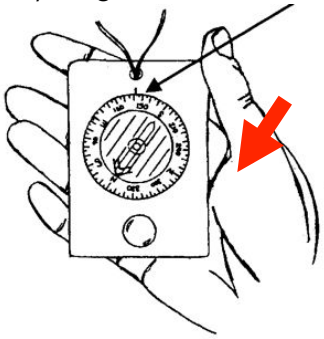
A) Hold the end of the compass level against you in front at waist height with the string pointing toward the clinometer person. B) Without moving the compass, turn the central housing around until the red magnetic compass needle is over top or inside the black hollow arrow ⇧ while you are pointing the string to the person holding the clinometer.

Read the Compass bearing at the mark below the string to the nearest degree. This is the "Compass Bearing" or the degrees from north.

A) to clinometer housing



B) degrees from north or "bearing"



FOR ALL MEASURING TAPES OR RULERS

Locate zero on the measuring tape. Start to measure at the zero mark. Measure the distance identified on the table heading of the data sheet. Use the correct unit of measure - meters to 2 decimal places (0.00 m), centimeters to 1 decimal place (0.0 cm) and millimeters to nearest whole (0 mm).

Diameter Tape

This is a special tape measure used to measure the **diameter** of trees.

Locate zero on the side of the tape which says diameter. Hook the tape into the bark and wrap the tape around the trunk at chest height (1.3m). You may need help with large trees. Make sure the tape is level around the tree.

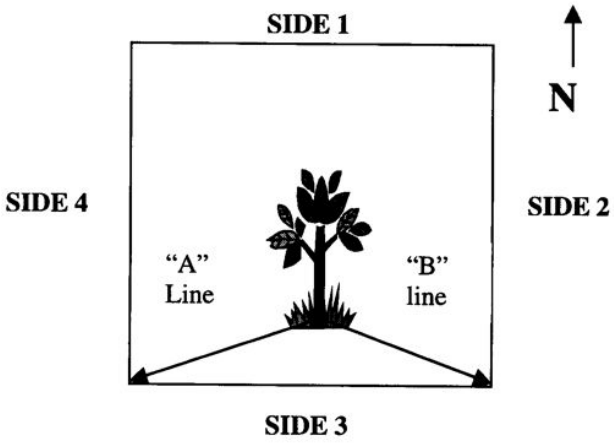
Read the measurement where the two ends of the tape overlap. Give the measurement in centimeters to 1 decimal place (0.0 cm). Note: The distance side of the tape may be used to measure up the tree trunk to the required 1.3m.

To Triangulate for Location with 30 metre tapes

One person stands in front of a tree facing the nearest side or line of the quadrat and holds the zeros of the two 30m tapes tightly at chest height (1.3m). Keep it level.

A second person measures the distance "A" from the tree to the right end of the quadrat in metres to 2 decimal places. A third person does the same for the left end "B". The two distances (A+B), added together, verify the accuracy.

The sum can't be less than 20m nor more than 27m.



5. On-Site Procedures and Protocols

Data Sheet – Forest Trees (>4 cm dbh) **PLOT# :** **DATE:**

Description			Location			Bearings		Height (clinometer & tangent table)			DBH	Status		
Quad #	Tree #	Common Name	Side #	A line B (0.00m)		Eye-tree Distance (30m tape)	° tree to measurer (compass)	Upper angle / Ht (0.00) m	Lower angle / Ht (0.00) m	Total Ht (0.00m)	Diameter tape (0.0 cm)	A /D E/L Dam		
4	*13*	*Oak*	*3*	*14.50*	*7.32*	*20m*	*95*	*24 / 8.90*	*17 / 6.12*	*15. 02*	*20.3*	*A*	*E*	*I*
						20m								
						20m								
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						20m								
						20m								
						20m								
						20m								

HEALTH STATUS CODES:
Status: **A** *alive* or **D** dead*;*
Stance: **E** *erect* or **L** *leaning more than 30° off vertical* or **P** *prone*

The "Tan" Table below is to be used to calculate the Height of a Tree from a distance of 20 metres

ANGLE – TANGENT – HEIGHT TABLE AT A HORIZONTAL DISTANCE OF 20 METRES											
Angle °	**Tan**	***Height m***	***Angle °***	**Tan**	*Height m*	**Angle°**	**Tan**	***Height m***	***Angle °***	**Tan**	***Height m***
1	0.017	0.34	15	0.268	5.36	29	0.554	11.08	43	0.933	18.66
2	0.035	0.74	16	0.287	5.74	30	0.577	11.54	44	0.966	19.32
3	0.052	1.04	17	0.306	6.12	31	0.601	12.02	45	1.000	20.00
4	0.070	1.40	18	0.325	6.50	32	0.625	12.50	46	1.036	20.72
5	0.087	1.60	19	0.344	6.88	33	0.649	12.98	47	1.072	21.44
6	0.105	2.10	20	0.364	7.28	34	0.675	13.50	48	1.111	22.22
7	0.123	2.40	21	0.384	7.68	35	0.700	14.00	49	1.150	23.00
8	0.141	2.82	22	0.404	8.08	36	0.727	14.54	50	1.192	23.84
9	0.158	3.16	23	0.424	8.48	37	0.754	15.08	51	1.235	24.70
10	0.176	3.52	24	0.445	8.90	38	0.781	15.62	52	1.280	25.60
11	0.194	3.88	25	0.466	9.32	39	0.810	16.20	53	1.327	26.54
12	0.213	4.26	26	0.488	9.76	40	0.839	16.74	54	1.376	27.52
13	0.231	4.62	27	0.510	10.20	41	0.869	17.38	55	1.428	28.56
14	0.249	4.98	28	0.532	10.64	42	0.900	18.00	56	1.483	29.66

PROTOCOLS FOR MONITORING THE TREES

Read Monitoring the Trees carefully and try to get a sense of what is expected during this phase of the project and how things should be organized effectively..

Teams of approximately* 12 experts in a group measure and record data for mature trees in various quadrats at the same time. This is called monitoring. The teams of experts are identified by different colours. The detailed tasks for each team are found in the appendix as role cards for duplication and putting in a plastic sleeve protector before going into the field.

These numbers represent the minimum numbers for each team. Some tasks may be combined, and others subdivided for greater numbers in a team (e.g. 10-15 needed).

Pink team (2-3)	Green team (1-2)	Yellow team (3)
Blue team (2-3)	Orange team (1-2)	Red team (1-2)

PROTOCOL FOR DESCRIPTION

1. Tree Numbering Team - PINK (3)

   SWATHER

   The swather starts in the NORTHWEST (NW) corner of the quadrat (where SIDE 1 meets SIDE 4) with **the hinged metre sticks** open to make a 2 m wide path. She/he rests the end of the stick on the SIDE 1 rope and walks along the rope towards the EAST corner (SIDE 2).

   TREE GAUGER

   The gauger, with the tree gauge string around their neck, follows swather from the NORTHWEST (NW) corner of the quadrat (where SIDE 1 meets SIDE 4) The tree gauge is used to check the diameter of any smaller trees that touch the metre sticks to determine whether the tree's dbh is large enough to be included in this inventory. If the tree gauge fits easily around the young tree at 1.3 metres, then it is too small. It may be included in following years. He/she indicates the trees with diameters over 4 cm to be numbered to the Flagger.

   FLAGGER

   The Flagger walks behind the tree gauger and writes the quadrat #, and tree # of each tree that is BIGGER than the tree gauge at DBH (1.3 m) on the roll of **PINK flagging tape** with a **black marker**, tears off it and ties it around the tree trunk to show the number of the tree for easy viewing.

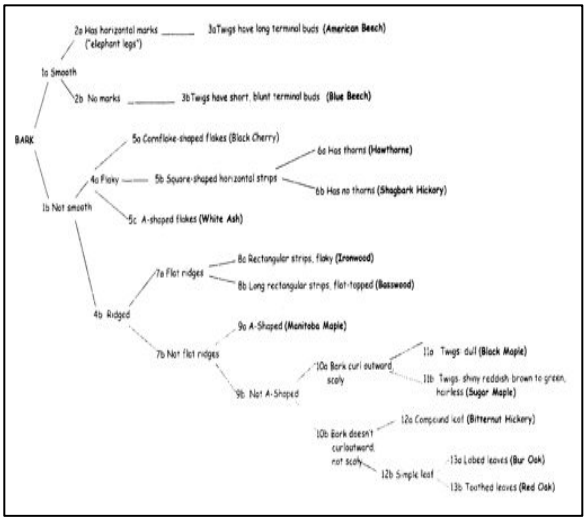
Both continue, following the swather, to number the trees in the quadrat while walking in a spiral from the outside edges into the middle. Each spiral is 2 m wide, measured with the hinged metre stick.

Be careful to not miss any trees and not miss any numbers! Do a double check often!

2. Tree Identification Team - GREEN (1-2)

NAMERS

The Namers have 2 tree classification keys – a CONIFEROUS tree key and a DECIDUOUS one. They find a tree that has been tagged and decide whether the tree is CONIFEROUS or DECIDUOUS. Then, using the correct TREE KEY, they figure out what the tree species is. (If the tree has needles or cones, use the **CONIFEROUS* tree key**; if the tree has broad leaves or no leaves at all, use the **DECIDUOUS tree key**).



They make choices until reaching the end of a line which has the name of the tree. If they are not sure, they can check the sheets on the inside of the tree key sleeve for more clues. They tell the recorder the species they have identified by calling out the tree number and the common name of the tree to the recorder.

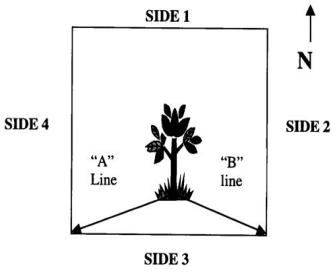
E.g. Call out "Tree #6, Bur Oak." * Remember that Tamarack is a deciduous conifer!

PROTOCOL FOR LOCATION

3. Tree Locating Team - YELLOW (3)

HOLDER

At the tree, the Holder puts her/his back to the tree and FACES the closest numbered side and holds the 2 zero ends of the 2 YELLOW distance tapes. The tapes will form two lines - line "A" will to the stake on the right of the Holder and line "B" to the stake on the left. The Holder helps to make the tapes as STRAIGHT and TIGHT and LEVEL as possible.



LOCATORS

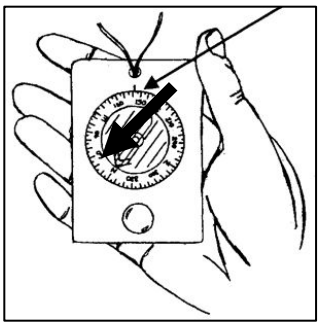
Each using a **YELLOW distance tapes**, the Locators walk from the Holder to one of the stakes at the quadrat corners. They ensure the tapes are pulled STRAIGHT, TIGHT and LEVEL from the tree to the MIDDLE of the quadrat stake. They take the measurement in meters to 2 DECIMAL PLACES (e.g. 5.23 m). They call the tree # and line "A" first, then line "B" to the recorder.

E.g. Call out "Tree #6, Line "A" is 16.07 m" and "Tree #6, Line "B" is 4.60 m!"

PROTOCOLS FOR MEASUREMENTS

4. Tree Height Team - BLUE (3)

COMPASS BEARER



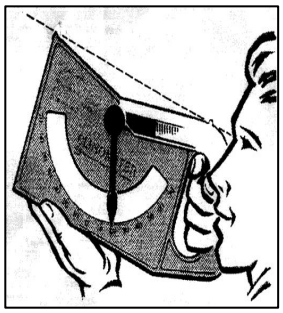
The Compass Bearer stays at the tree, holds the zero end of a 30 metre tape, and guides the others in a straight line away from the tree. Then he/she puts a marker (a light coloured shoe or jacket) at the tree base to give the Clinometer Reader a target. The Compass Bearer faces the others, calculates the tree bearings from North with the compass *(see pre-site activities in the Appendix),* and tells the recorder the tree # and bearings.

Eg. Call out "Tree #6, 27 degrees."

MEASURER

The Measurer gives the zero end of the 30 m Distance Tape to the Compass Bearer and walks 20 m in any direction, in a straight line with a clear line of sight, from the tree. Later he/she validates the clinometer reading. All height measurements are taken at 20 METERS DISTANCE from the TREE so EYE-TREE DISTANCE is always 20 METERS.

CLINOMETER READER



The Clinometer Reader finds the best line of sight (a good view of the top and bottom of the tree) 20 m away from the tree. This does NOT have to be inside the quadrat where the tree is. Standing at precisely 20 m from the tree, the Clinometer Reader holds the **Clinometer** with a straight arm, one hand open and FLAT underneath for support and the other on the trigger. The sights of the clinometer are lined up with the end of the top branch of the tree, putting the front sight "Mountain Peak" in the rear sight "Valley".

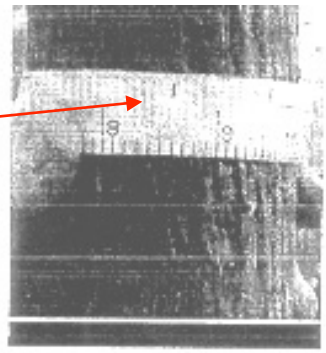
The Clinometer Reader squeezes and holds the trigger which causes the needle to swing. The Measurer indicates when the needle stops swaying and says "LOCK", The Clinometer Reader releases the trigger and locks the needle in place. The Clinometer Reader reads the angle the needle is pointing to. This is repeated until the same angle is achieved twice. This is the UPPER ANGLE. She/he tells the recorder and makes sure that the compass bearer has had the compass bearing recorded, then finds the lower angle from the same position. E.g. Call out "Tree #6, upper angle 47 degrees".

These steps are repeated for the LOWER ANGLE – pointing the clinometer at the base of the tree where the trunk meets the ground. E.g. Call out "Tree #6, lower angle 13 degrees" before moving away to do next tree.

5. Tree Diameter Team - Orange (1)

THE DIAMETER TAKER

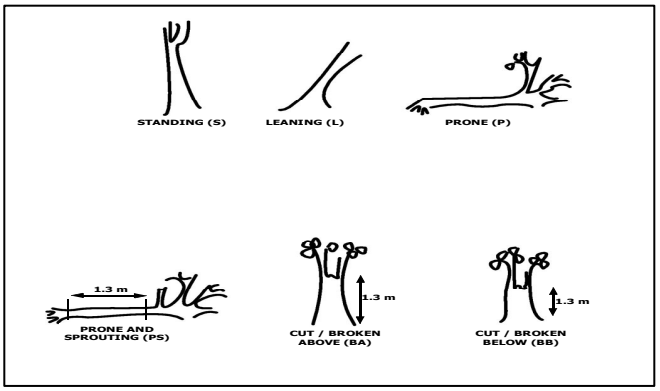
The Diameter Taker finds a tree that has been numbered and uses the **DBH tape distance side** to locate 1.3 m mark on the tree special stick on the SHORTEST side of the tree). Using the **diameter side** of the ORANGE diameter measuring tape (the side that has NO red numbers and says "DIAMETER" at zero), the Diameter Taker puts the hook into the tree at 1.3 m and wraps it around making sure it is level. He/she reads the diameter at the zero mark in centimetres to 2 decimal places (e.g. 4.56 cm) and tells the recorder the tree number and the DBH .



Eg. Call out "Tree #6, diameter is 6.54 cm".

PROTOCOLS FOR REPORTING AND RECORDING DATA

6. Tree DATA Team – Red (2)



TREE STATUS ANALYZER

The Status Analyzer uses the **Health Assessment Chart** to determine the Status of the tree: ALIVE (A) or DEAD (D), and its Stance: STANDING (S), LEANING (L) or PRONE (P). A tree is "leaning" when it is more than 30° off center. She/he tells the recorder the tree number and tree status.

Eg. Call out "Tree # 6, Alive, Leaning."

TREE DATA RECORDER

The Recorder records the answers called out by the expert teams in the groups on the sheet.

"Quad #, tree #"

Description			Location (0.00m) (2 30-metre measuring tapes)		
Quad #	Tree #	Common Name	Side #	A line	B
4	*13*	*Oak*	*3*	*14.50*	*7.32*
1	**1**				

"Name"

Description			Location (0.00m) (2 30-metre measuring tapes)		
Quad #	Tree #	Common Name	Side #	A line	B
4	*13*	*Oak*	*3*	*14.50*	*7.32*
1	1	Spruce			

"Location - side"

Description			Location (0.00m) (2 30-metre measuring tapes)		
Quad #	Tree #	Common Name	Side #	A line	B
4	*13*	*Oak*	*3*	*14.50*	*7.32*
1	1	Spruce	**2**		

"Location - A"

Description			Location (0.00m) (2 30-metre measuring tapes)		
Quad #	Tree #	Common Name	Side #	A line	B
4	*13*	*Oak*	*3*	*14.50*	*7.32*
1	1	Spruce	2	**18.30**	

"Location - B"

Description			Location (0.00m) (2 30-metre measuring tapes)		
Quad #	Tree #	Common Name	Side #	A line	B
4	*13*	*Oak*	*3*	*14.50*	*7.32*
1	1	Spruce	2	18.30	**4.32**

****LINE "A" + LINE "B'" must equal a minimum of 20 m and not be greater than 27 m.*
If it is outside this range the computer database will not map your data! Check the math to make sure your entry is correct before leaving the field.

"Bearings from 20 m"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	**27**				

"Height – upper angle"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	**21** /			

The Recorder uses the Angle-Tangent-Height Chart on the data sheet to calculate the height by finding the bearing and moving to the right to find its height.

ANGLE – TANGENT – HEIGHT TABLE AT A HORIZONTAL DISTANCE OF 20 METRES

Angle °	Tan	Ht m	Angle °	Tan	Ht m	Angle °	Tan	Ht m	Angle °	Tan	Ht m
1	0.017	0.34	15	0.268	5.36	29	0.554	11.08	43	0.933	18.66
2	0.035	0.74	16	0.287	5.74	30	0.577	11.54	44	0.966	19.32
3	0.052	1.04	17	0.306	6.12	31	0.601	12.02	45	1.000	20.00
4	0.070	1.40	18	0.325	6.50	32	0.625	12.50	46	1.036	20.72
5	0.087	1.60	19	0.344	6.88	33	0.649	12.98	47	1.072	21.44
6	0.105	2.10	20	0.364	7.28	34	0.675	13.50	48	1.111	22.22
7	0.123	2.40	21	0.384	7.68	35	0.700	14.00	49	1.150	23.00
8	0.141	2.82	22	0.404	8.08	36	0.727	14.54	50	1.192	23.84
9	0.158	3.16	23	0.424	8.48	37	0.754	15.08	51	1.235	24.70
10	0.176	3.52	24	0.445	8.90	38	0.781	15.62	52	1.280	25.60
11	0.194	3.88	25	0.466	9.32	39	0.810	16.20	53	1.327	26.54
12	0.213	4.26	26	0.488	9.76	40	0.839	16.74	54	1.376	27.52
13	0.231	4.62	27	0.510	10.20	41	0.869	17.38	55	1.428	28.56
14	0.249	4.98	28	0.532	10.64	42	0.900	18.00	56	1.483	29.66

"Upper Height"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diametertape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	21 / **7.68**			

"Height – lower angle at base"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	21 / 7.68	**7** /		

The Recorder uses the Angle-Tangent-Height Chart on the data sheet to calculate the height by finding the bearing and moving to the right to find its height.

ANGLE – TANGENT – HEIGHT TABLE AT A HORIZONTAL DISTANCE OF 20 METRES

Angle °	Tan	Ht m	Angle °	Tan	Ht m	Angle °	Tan	Ht m	Angle °	Tan	Ht m
1	0.017	0.34	15	0.268	5.36	29	0.554	11.08	43	0.933	18.66
2	0.035	0.74	16	0.287	5.74	30	0.577	11.54	44	0.966	19.32
3	0.052	1.04	17	0.306	6.12	31	0.601	12.02	45	1.000	20.00
4	0.070	1.40	18	0.325	6.50	32	0.625	12.50	46	1.036	20.72
5	0.087	1.60	19	0.344	6.88	33	0.649	12.98	47	1.072	21.44
6	0.105	2.10	20	0.364	7.28	34	0.675	13.50	48	1.111	22.22
7	0.123	2.40	21	0.384	7.68	35	0.700	14.00	49	1.150	23.00
8	0.141	2.82	22	0.404	8.08	36	0.727	14.54	50	1.192	23.84
9	0.158	3.16	23	0.424	8.48	37	0.754	15.08	51	1.235	24.70
10	0.176	3.52	24	0.445	8.90	38	0.781	15.62	52	1.280	25.60
11	0.194	3.88	25	0.466	9.32	39	0.810	16.20	53	1.327	26.54
12	0.213	4.26	26	0.488	9.76	40	0.839	16.74	54	1.376	27.52
13	0.231	4.62	27	0.510	10.20	41	0.869	17.38	55	1.428	28.56
14	0.249	4.98	28	0.532	10.64	42	0.900	18.00	56	1.483	29.66

"Lower Height"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	21 / 7.68	7 / **2.40**		

Then the Recorder calculates the Total Height by 1) adding the two heights together if the roots of the tree are at ground level, or 2) subtracting the lower height from the upper one if the roots are higher or on a slope.

"Total Height"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter (0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	21 / 7.68	7 / 2.40	**10.08**	

"DBH"

Bearings		Height			DBH
Eye-tree dist (30-m tape)	° tree to measurer (compass)	° Upper angle / Ht (clinometer) (0.00m)	° Lower angle / Ht (clinometer) (0.00m)	Total Ht (0.00m) (tangent tables)	Diameter(0.00 cm) (diameter tape)
20m	*95*	*24 / 8.90*	*15 / 5 .36*	*15.26*	*20.3*
20 m	27	21 / 7.68	7 / 2.40	10.08	**6.30**

"Status "

Status	
A /D E/L/P	
A	*E*
D	

"Stance"

Status	
A /D E/L/P	
A	*E*
D	**P**

The groups continue with this until all the trees in their quadrat have been measured and recorded.

Go out into your community with the equipment and test the protocols.

REFLECTIONS 4

FIELD TESTING

1. What went well with the task? With the team?

2. What problems were there? What needs to be changed? How would you solve/change them?

6. Post Site Lessons

DATA ENTRY FOR MATURE TREES ACTIVITY

Organize the students in teams of three – a Data Enterer, a Reporter, and a Checker.

Each team is given a completed Data Sheet from the Monitoring Activity.

Have the students double-check the location data to make sure that the sum of *LINE "A" + LINE "B" equals a minimum of 20 m and is not be greater than 27 m.* If it is outside this range, send the sheet back outside with the team for re-measuring!!!

Open the internet database program on the computer and begin the activity.

1. The Data Enterer requests, by heading, the data to be called for their quadrat.

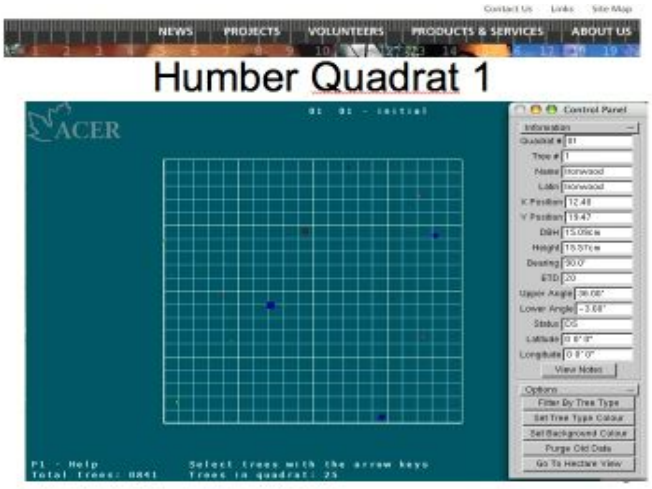
2. The Reporter calls out the data in the correct column for the correct tree.

3. The Data Enterer enters the data into the database following the instructions given in the one-line database. Mapping is done automatically.

4. The Checker makes sure that the data called is the same as the data that is entered.

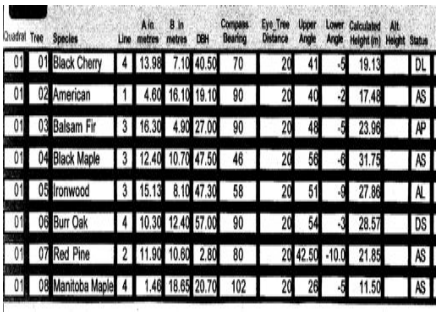
5. See the screen below which is the on-line data base for entry for tree #1 in quadrat #1 . Note that the program intergrates the data - mapping the entries by number, location, chosen species colour and proportional tree diameter.

6. Each teams' data is critical! Rotate the jobs for each set of 5 trees and map.

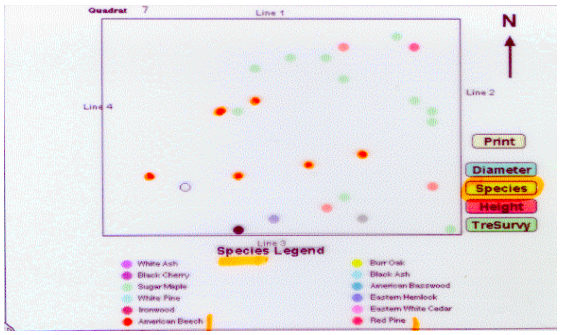


Note: If there is no internet access, then an excel spreadsheet can be created.

Some sites may have access to One Tree At A Time which uses File Maker Pro(FMP). FMP automatically saves entries as you go and calculates the height. Students should compare these heights with the ones calculated in the field. The figure below shows data in FMP on the left and mapped data on different screen on the right.



Quadrat	Tree	Species	Line	A in metres	B in metres	DBH	Compass Bearing	Eye_Tree Distance	Upper Angle	Lower Angle	Calculated Height (m)	Alt. Height	Status
01	01	Black Cherry	4	13.98	7.10	40.50	70	20	41	-5	19.13		DL
01	02	American	1	4.60	16.10	19.10	90	20	40	-2	17.48		AS
01	03	Balsam Fir	3	16.30	4.90	27.00	90	20	48	-5	23.96		AP
01	04	Black Maple	3	12.40	10.70	47.50	46	20	56	-6	31.75		AS
01	05	Ironwood	3	15.13	8.10	47.30	58	20	51	-9	27.86		AL
01	06	Burr Oak	4	10.30	12.40	57.00	90	20	54	-3	28.57		DS
01	07	Red Pine	2	11.90	10.60	2.80	80	20	42.50	-10.0	21.85		AS
01	08	Manitoba Maple	4	1.48	18.65	20.70	102	20	26	-5	11.50		AS



The Checker double-checks the data on the screen for accuracy and calls out "Okay" if it is correct.

After 5 trees have been entered, data enterer uses the menu bar and goes to:

- ✓ "find all"
- ✓ "build maps"
- ✓ "view the diameter/species/height maps"
- ✓ % analysis of diameter/species/height"

And checks to see that all the trees show on the map. E.g. The trees must be at least one metre apart to show up on the FMP map.

Remember to rotate the jobs for each set of 5 trees and map.

FURTHER DATA INVESTIGATIONS ACTIVITY

A minimum of 4 cm DBH of a tree is required to inventory temperate zone trees.

What trees would be reported if this data were collected in the tropical zone? In FMP use >10 cm DBH to re-sort the data for the new map.

In the northern Canada the minimum diameter to inventory a tree is 2.5cm.

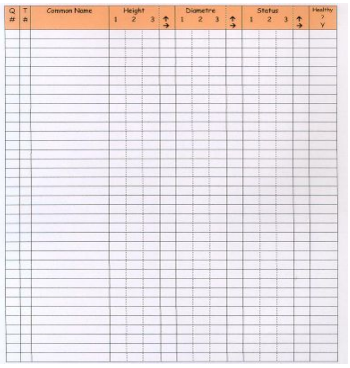
Questions:

1. What is the RELATIONSHIP between the diameter of the tree and the latitude where it is found?
2. How does this compare with the RELATIONSHIP between tree diameter and altitude? Find a textbook diagram / images that illustrates this relationship.
3. What is the common factor of tree growth that is involved in these relationships?
4. At what latitude is the "tree line" located in Canada in 2005?
5. How will global warming affect the tree line?
6. What some of the consequences of this change for Canada?

CUMULATIVE DATA ANALYSIS ACTIVITY

Cumulative Data Sheet

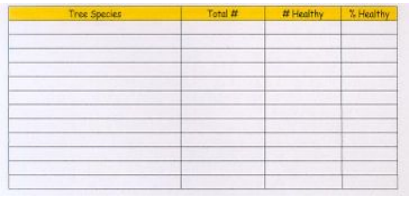
Native Trees Health



1. *Complete the NATIVE TREES HEALTH table (1,2,3 represents the data recording period) using the data from the cumulative data sheet.*

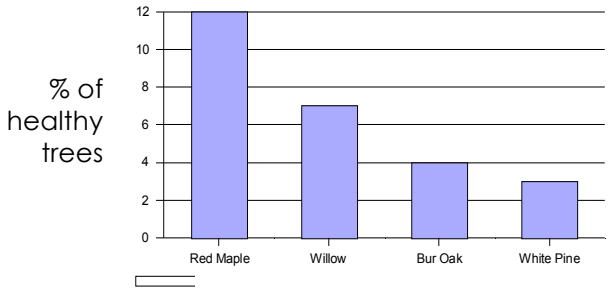
2. Analyze each set of data for changes.
   - ✓ Indicate growth with a ↑, or stability with a → in the column. Leave a decline unmarked;
   - ✓ Indicate the overall health of the tree with a Y (yes) if it is healthy.

Native Species Health



3. Then complete the NATIVE SPECIES HEALTH table.
   - ✓ List the trees by species; add their total numbers together and the total number that is healthy.
   - ✓ Calculate the percentage of healthy trees for each species and record.

3. *Create a multiple bar graph to compare the percentage of healthy trees of the various native species.*



4. *Interpret the graph and draw conclusions about the health of the various native species, and make predictions about the data. (Which are healthy? Which aren't healthy? Possible reasons why).*

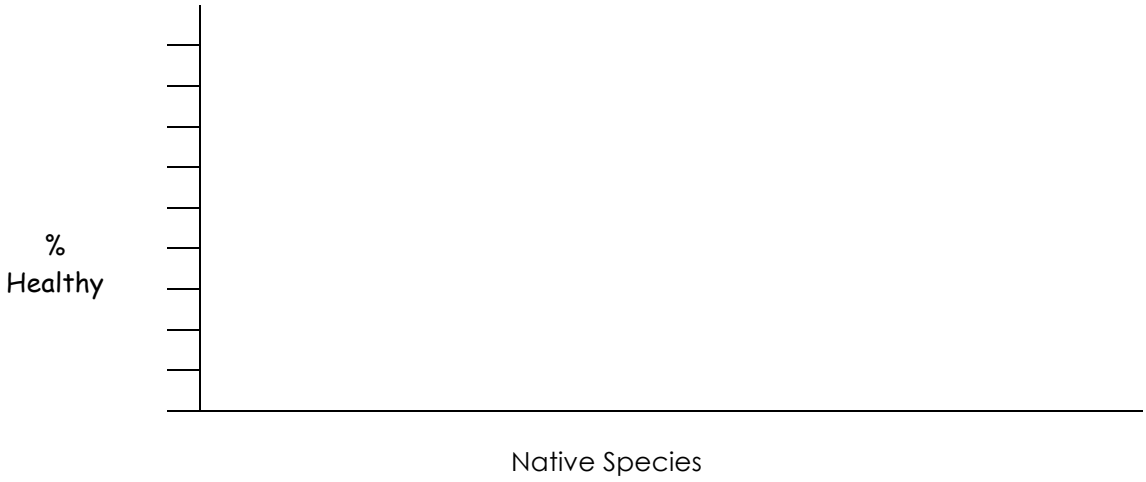
NATIVE TREES HEALTH SPREADSHEET

Q	T	Common Name	Height			↑	Diameter			↑	Status			↑	Healthy
#	#		1	2	3	→	1	2	3	→	1	2	3	→	Y

NATIVE SPECIES HEALTH table

Tree Species	Total #	# Healthy	% Healthy

NATIVE SPECIES HEALTH comparison bar graph



CONCLUSIONS:

FOREST HEALTH DATABASES AND DATA SETS ACTIVITY

Many people and organizations are involved with forest health.

Datasets resulting from research programs or monitoring studies are created in the National Forest Health and Biodiversity Database. Huge volumes of individual researcher's data are combined into a national repository by the Canadian Forestry Services. This database provides information to create a complete picture of the health and biodiversity of Canada's forests.

One such database, *The Forest Health Database,* is an automated repository of information concerning the health, biodiversity, and exotic pest threat in Canada's forests. It is the only national dataset that can provide geo-referenced distribution records for forest pests and diseases. The Forest Health database provides scientists with 15+ years of continuous forest health biomonitoring data collected under such programs as the Acid Rain National Early Warning System and the North American Maple Project. In some cases over 100 years of historical data is present that cannot be found anywhere else.

Forest Health Databases and Data Sets Activity

1. Check out what's in The Forest Health database:
   Pollution
   Insects
   Disease
   Climate
   Biodiversity
   Biomonitoring
   Current Projects
   Alien and Invasive Species
   Ice Storm Damage

2. Check out some of these web sites.
   http://www.atl.cfs.nrcan.ca:8080/cfsnet/index-e.html
   National Forest Health and Biodiversity Database
   http://www.naturewatch.ca/mixedwood
   http://www.nrcan.gc.ca/cfs-scf
   http://www.glfc.forestry.ca
   http://photoarc.glfc.cfs.nrcan.gc.ca
   http://www.nrcan.gc.ca/kids
   http://www.nrcan.gc.ca/statistics
   http://northernontarioflora.ca