FIELD ENHANCEMENT 2
Forest Mapping

OBJECTIVES
Upon completion of this lesson, students will be able to:

- Spatially represent a forest and its features on a map.
- Compare and contrast data collected from different forest plots.

SUBJECT AREAS
Arts, Mathematics, Science

LESSON/ACTIVITY TIME
- Total Lesson Time: 90 minutes
- Time Breakdown:

  Introduction...........15 minutes
  Activity 1 ....45 minutes
  Activity 2 ....20 minutes
  Conclusion............10 minutes

TEACHING SITE
A schoolyard, school forest, or park.

CLASSROOM LESSON CONNECTIONS
This lesson ties closely with Classroom Lesson 3, *How Forests Are Managed*.

NUTSHELL
In this lesson, students work in small groups to map features of a forest plot. Included in their data collection are the measurement, identification, and ageing of trees. As a large group, students compare their information and discuss unique features of the area.

BACKGROUND INFORMATION
MAPS
Maps spatially represent the three-dimensional world in two dimensions. Maps may contain a wide variety of information, though usually they are created to emphasize specific kinds of information. Some common examples are:

- Geopolitical Maps: Maps that show political boundaries of countries of the world, states, or counties.

- Road Maps: Maps that show all roads in an area such as a state, county, or city.

- Topographic Maps: Maps that shows the elevation and land features of an area.

Each of these maps often contains more information than just their major focus. This can include geographic information such as rivers, lakes, and mountains and features such as landmarks and points of interest. Maps are a convenient way to store large amounts of spatial information in a concise format (usually just one page). Maps use symbols to represent information.

MATERIALS LIST

FOR EACH GROUP (8 TOTAL)
- Copy of Student Page 🖊️**1**, *Forest Map*
- Copy of Student Pages 🖊️**2A-B**, *Forest Mapping Data Sheet*
- Clipboard or similar writing surface
- Colored pencils
- Sewing tape measure (preferred because of pliability) or metal tape measure. As an alternative, you can use a DBH tape.
- Tree ID book and/or dichotomous key
- Calculator

FOR THE CLASS
- Examples of maps (world map, road map, topographic map, school map, etc.)
- Copy of Teacher Page 🍎**1**, *Forest Map Example*
- Masking or Scotch tape

FOR THE TEACHER
- Copy of Teacher Page 🍎**1**, *Forest Map Example*
- Compass
- Plot markers (flagging, ribbon, stakes, etc.)
- Tape measure (preferably 50' or 100')
- Marker

TEACHER PREPARATION
- Create eight plots at your teaching site. If time permits, students can help prepare the plots as part of the lesson.
  - Each plot should be 33' by 33' (which is equivalent to 1/40th of an acre).
- One side of each plot should be aligned in a north/south direction.
- The plots should be adjoining so students can put their maps together at the end of the lesson.
- Mark the corners of the plots with flagging, cones, or stakes.
- Mark the center of the plots with a stake containing a number, letter, color, etc. The plots should look like this:

A	B	C	D
E	F	G	H

SAFETY PRECAUTIONS
Visit the teaching site ahead of time to locate any hazards such as holes, hanging branches, protruding tree roots, poison ivy, etc. Encourage students to walk at all times. Consider these:

- Are you in sight or earshot of students?
- Are boundaries for students marked?
- Have you set expectations for being out of the classroom?
- Do you have a whistle, first aid kit, insect repellent, and sunscreen?
- Is everyone dressed appropriately?

VOCABULARY

Coniferous Forest: Type of forest containing cone-bearing trees.

Deciduous Forest: Type of forest containing trees that shed their leaves annually.

Diameter at Breast Height (DBH): The diameter of a tree 4.5 feet above ground level.

Diameter Tape: A type of measuring tape specially graduated so that diameter can be read when the tape is wrapped around a tree (circumference) without extra calculations.

Geographic Information System (GIS): A computerized system that gives resource managers the ability to organize and access information (e.g., soil type, watershed, population density) about a specific area.

Global Positioning System (GPS): A handheld device that collects data from satellites to provide users with the coordinates of their location on the surface of the earth.

Plot: A measured parcel of land. Plots vary in size and shape.

Anyone can create a map. The more complicated the map, the more complicated the method. Today, satellite technology and **GPS (Global Positioning System)** are helping to make maps more accurate and more up-to-date than ever. With a GPS unit, users can determine a location on the earth, usually within meters of the exact coordinates. Foresters and resource managers often use data from GPS to create a **GIS (Geographic Information System)** map to overlay various types of information on the same map. This can include, forest types, waterways, soil type, roads, population, etc. A GIS allows large amounts of information to be stored in an interactive format. GIS technology is a powerful tool for professionals such as those who track forest health over time, monitor wildlife populations, or create new trails in forest a preserve.

Forest mapping is important for planning and making decisions about forest management. Part of planning is to determine what is on a site and to document features that are present. A map creates a visual representation of forest features on the ground. With a spatial representation like a map, one can see relationships that aren't otherwise evident. These may include boundaries between different habitats, the proximity of trees to one another, and other physical features. A map allows one to see a whole area at once rather than a small piece.
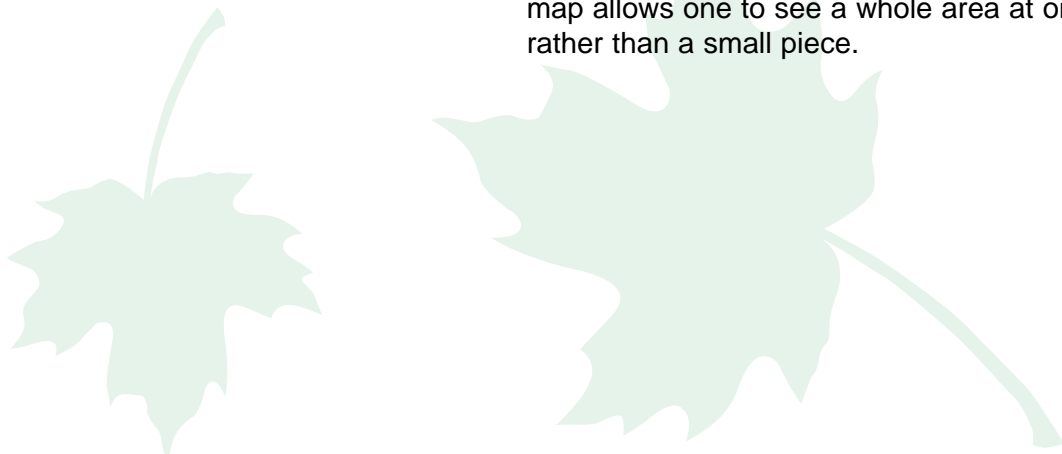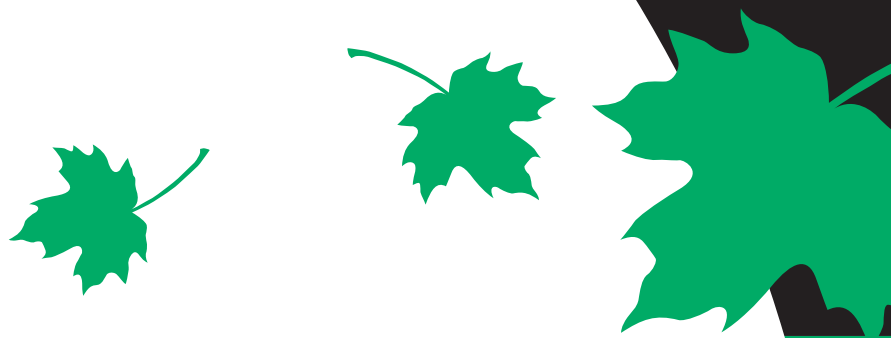
DBH (DIAMETER AT BREAST HEIGHT)

DBH is a measure of the diameter of a tree in inches 4.5 feet up from the ground. A measure of tree diameter is important to determine the overall size of a tree and its relative monetary worth. To measure DBH, foresters use a specially calibrated **diameter tape**. If one is not available, you can also use a sewing tape (preferred because it is easier to wrap around a tree) or metal tape to measure circumference and a simple calculation to determine diameter.

TO MEASURE DBH

1. Using a tape measure, have students determine where 4.5 feet is on themselves. This will help students easily locate 4.5 feet on the tree. All DBH measurements must be taken at 4.5 feet above ground level.

2. Have students wrap the diameter tape or measuring tape around the tree. Make sure the tape is tight against tree and not twisted. For larger trees, this may require two students.

3. Record the measurement. **NOTE:** On some measuring tapes 0 is not at the very end of the tape. Be sure to point this out to students when they are taking measurements.

4. If you are not using a diameter tape, divide the measured circumference by pi (3.14) to get the diameter.
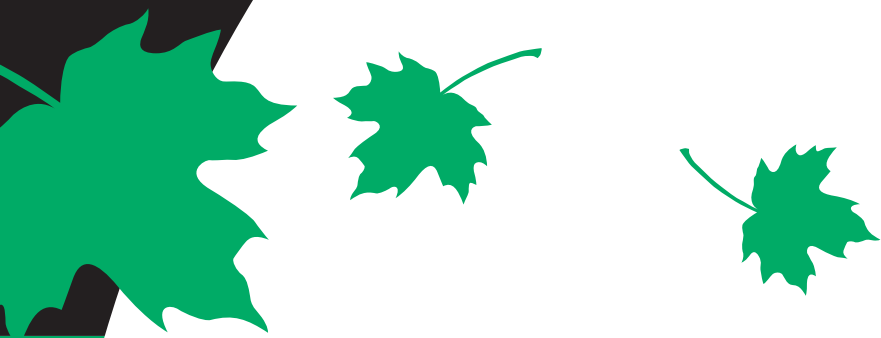

TREE AGE

One way the age of a tree can be determined is by counting annual rings. This can be done from the cross section of a log or a core sample. A core sample is taken with a tool called an increment borer, which is used to extract a thin cylinder of wood from the trunk of a tree so the rings can be counted.

Pine trees add one row, or whorl, of branches each year. By counting the whorls, an estimate of the age of a pine can be made. Other species of conifers do not necessarily grow in this manner.

Another way to estimate the age of tree is to use a growth factor calculation. This factor is species specific. Different tree species grow at different rates. Based on species characteristics, a growth factor has been assigned. When this number is multiplied by the tree diameter, an approximate age can be determined. This method provides a relative estimate and is not 100 percent accurate. The growth factor was determined for trees growing in a natural forest setting. In an urban or landscaped setting, trees receive extra care such as fertilizer, watering, pruning, etc., and they have less competition so they tend to grow faster and with wider growth rings.

PROCEDURE
INTRODUCTION

1. Begin in a large group by brainstorming a list of maps that students are familiar with. Examples might be a world map, road maps, a school map, a bus route map, mall maps, etc. Ask students what kinds of things are found on maps *(Roads, landscape features, towns, trails, etc.)*.

2. Hand out example maps that you have gathered. Encourage the students to pass the maps around and study what each map represents.

3. Have students choose one of the maps and share information about it. Key things to look at are: What is the main type information the map is trying to convey? What is the scale of the map? Is the map easy to read? What types of things are found on the map?

4. Explain to students that today they will be creating their own maps. They will be mapping as much as they can based on observations made in plots that are marked in the forest. Each plot is 33 feet by 33 feet, which is 1/40th of an acre. As a comparison, a standard outdoor football field is about 1.2 acres. Show Teacher Page 🍎1, *Forest Map Example* so students can get a sense of how the map might look.

ACTIVITY 1

1. Take students to your outdoor site. Plots should be clearly marked. Set your expectations, rules, safety considerations, and boundaries for the mapping exercise.

2. Divide students into eight groups and assign each group a plot.

3. Hand out one Student Page ✏1, *Forest Map* and one set of Student Pages ✏2A-B, *Forest Mapping Data Sheet* to each group.

4. Go over how to complete the activity. Tell students that they will be creating a map for one of the marked plots. Point out that Student Pages ✏2A-B, *Forest Mapping Data Sheet* will guide them through the steps they need to complete to create the map. Touch on the idea of scale and explain that when creating their maps, they should try to be as accurate as possible (e.g., larger trees should be represented by larger circles, smaller trees with smaller circles, etc.). Explain that Student Page ✏1, *Forest Map* is divided into a grid to help them spatially locate features in their plot. Have students imagine their plot is divided into smaller squares, just like on the mapping page.

5. Point out which direction is north and explain that students should orient their maps to north.

6. Explain to students that they will need to measure the DBH of some trees in their plot. Using an example tree, go over the steps to his. Remind students that there are also instructions on the bottom of their *Data Sheet* on how to do this. **NOTE:** Depending on the trees in your plots, you may want to adjust the diameter size listed on the *Forest Map* and *Forest Mapping Data Sheet* student pages. Eight inches may be too large or small and can be changed.

7. Students will also need to identify the species of some trees. They should use a tree identification book or dichotomous key to do this.

8. Ask if the students have any questions before you begin. Point out to students that all of the worksheet except the large group questions on the second page should be completed in order for the map to be created successfully. Also tell students that they will be sharing their maps with the rest of the class so it is important that their work is accurate and legible. Each student needs to participate in each group. In general, the three roles will be: mapmaker, worksheet recorder, and plot examiner.

9. Allow time for students to switch roles during the activity. Assist your students by checking in on the groups and making sure they are working together and on task. Check on each group to note their progress on the worksheet and map.
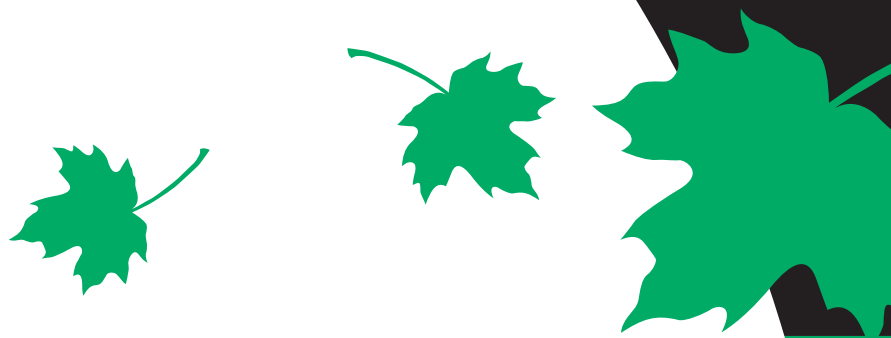
ACTIVITY 2

1. Gather students back together. At this point the groups should have collected the majority of the information on their worksheets and maps.

2. Tell students that they will be creating one large map of the area from all of their smaller maps. Students need to fold two or more edges of their maps under to hide the white areas. Once the maps are laid side-by-side as in the diagram below, the maps can be taped together, but it is not necessary.

GROUP A	GROUP B	GROUP C	GROUP D
GROUP E	GROUP F	GROUP G	GROUP H

3. Have students complete the large group questions on the Student Pages ✏**2A-B**, *Forest Mapping Data Sheet*.

CONCLUSION

1. Have groups share their answers for the large group questions. Are there any conflicts? Surprises?

2. Ask students how a map like this might be useful to a forester. *(Helping age trees, count how many trees of a certain size there are, identify trees, identify factors influencing the health of the forest.)*

EXTENSION

Acquire an aerial map of your area from the Internet, local DNR office, or city forester. Compare the students' map with the aerial photo. When was the aerial photo taken? Can students locate some of the same features on the aerial photo? How might an aerial photo be useful to foresters? *(Locating forest types and sizes, to observe a forest fire's size.)*

SUMMATIVE ASSESSMENT

Assign students to create a map of the (urban) forest around their home. Include the same type of features as on the map created in class. Have a discussion about how the trees, shrubs, and other mapped features affect students' homes and the surrounding area. *(Attraction of wildlife, shading, aesthetic values, recreational values, etc.)*

REFERENCES

Kupkowski, G., Et al. <u>Urban Forestry Laboratory Exercises for Elementary, Middle, and High School Students</u>. USDA Forest Service.

Project Learning Tree Secondary Environmental Education Program. <u>The Changing Forest: Forest Ecology</u>. (1998). Washington D.C.: American Forest Foundation.

<u>Project Wild K-12 Curriculum and Activity Guide</u>. (2000). Council for Environmental Education.

<u>Journey North</u>. World Wide Web: www.learner.org/jnorth/

RECOMMENDED RESOURCES

●●● WEBSITES ●●●

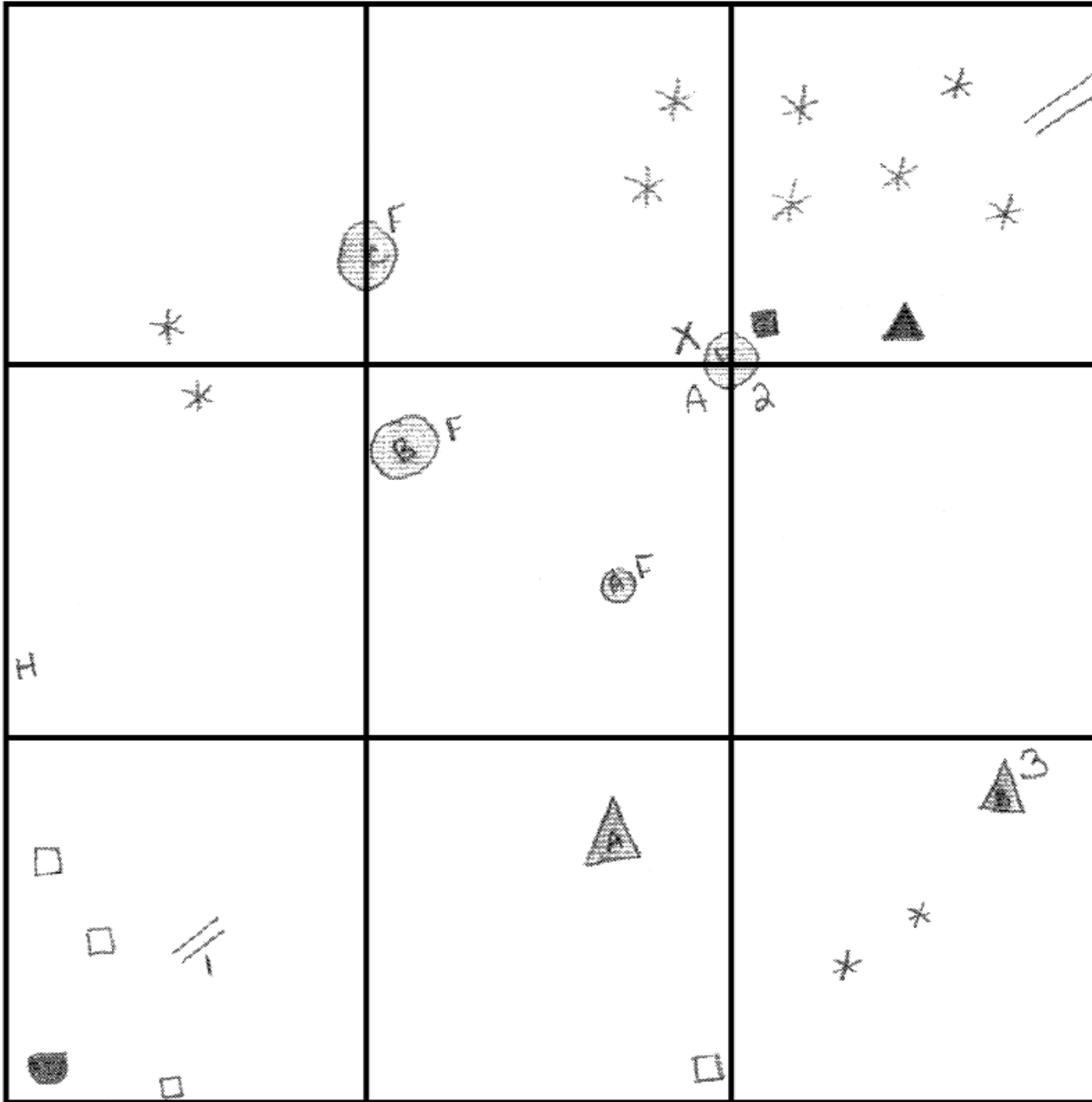**TerraServer**
http://terraserver.microsoft.com
Click on an area to obtain an aerial photograph that you can print.

Wisconsin State Cartographer's Office
http://feature.geography.wisc.edu/sco/sco.htm
Links to many kinds of Wisconsin maps.

FOREST MAP EXAMPLE

FOREST MAP LEGEND

☺ Deciduous Tree Over 8" Diameter
△ Coniferous Tree Over 8" Diameter
☐ Small Trees Under 8" Diameter
X Standing Dead Tree
● Large Rocks
✳ Shrubs Under 6' Tall
H Evidence of Human Activity
A Animal Home/Nest
= Fallen Log
▲ Highest Point

♥ Lowest Point
∼ Standing Water
1,2,3 Unique Features
■ Oldest Tree
F Trees That Produce Food

N

SCALE = 1:60

TREE SPECIES

Ash ....Dark Purple
Aspen ....Yellow
Basswood ....Black
Birch............................Dark Green
Cottonwood ....Light Blue
Elm ....Peach
Fir ....Dark Red
Maple ....Light Red
Oak ....Dark Blue
White Pine ....Orange
Red Pine ....Light Purple
Shagbark Hickory ....Pink
Spruce ....Light Green

FOREST MAP

FOREST MAP LEGEND

☺ Deciduous Tree Over 8" Diameter
△ Coniferous Tree Over 8" Diameter
☐ Small Trees Under 8" Diameter
X Standing Dead Tree
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H Evidence of Human Activity
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FOREST MAPPING DATA SHEET

1. Go to a tree in your plot.
   A. If it is under 8" in diameter, mark it with the appropriate symbol on your map.
   B. If it is over 8" in diameter, do the following:

   ☐ Mark deciduous trees with a circle on your map. Mark coniferous trees with a triangle on your map.
   ☐ Measure the DBH of the tree. Record the data below. Place the letter from your data set in the corresponding circle or triangle on the map.
   ☐ Identify the tree. Record species name. Color in the circle or triangle using the species key on the map.
   ☐ Estimate the age of the tree. Multiply the DBH by the growth factor for that species from the table on the right side of this page. Record the age.
   ☐ Continue this process for all the trees in your plot.

DATA: DECIDUOUS TREES 🌳

	DBH	Tree Species	Estimated Age
A.	_____	_____	_____
B.	_____	_____	_____
C.	_____	_____	_____
D.	_____	_____	_____
E.	_____	_____	_____
F.	_____	_____	_____

DATA: CONIFEROUS TREES 🌲

	DBH	Tree Species	Estimated Age
A.	_____	_____	_____
B.	_____	_____	_____
C.	_____	_____	_____
D.	_____	_____	_____
E.	_____	_____	_____
F.	_____	_____	_____

GROWTH FACTORS
American Elm 4
Aspen..........................2
Basswood 3
Black Cherry 5
Black Oak 4
Black Walnut.............4.5
Cottonwood.................2
Green Ash...................4
Ironwood 7
Red Maple 4.5
Red Oak 4
Red Pine..................5.5
River Birch 3.5
Shagbark Hickory 7.5
Silver Maple.................3
Sugar Maple 5
White Ash 5
White Birch 5
White Oak...................5
White Pine 5

NOTE: If a growth factor is not listed for a tree species in your plot, choose a similar tree from the list and use that growth factor.

TO MEASURE DBH
1. Using a tape measure, determine where 4.5 feet is on yourself. This will help you easily locate 4.5 feet on the tree. All DBH measurements must be taken at 4.5 feet above ground level.
2. Wrap the diameter tape or measuring tape around the tree. Make sure the tape is tight against tree and not twisted. For larger trees, this may require two people.
3. Record the measurement. **NOTE:** On some measuring tapes 0 is not at the very end of the tape. Be sure to take this into account when you are reading the tape.
4. If you are not using a diameter tape, divide the measured circumference by pi (3.14) to get the diameter.

FOREST MAPPING DATA SHEET

2. Locate the following and add them to your map with the appropriate symbol:

☐ Standing Dead Trees X
☐ Large Rocks ....●
☐ Shurbs Under 6' Tall .... *
☐ Evidence of Human Activity (Powerlines, Trails, Litter, etc.) .... H
☐ Animal Homes/Nests.. A
☐ Fallen Logs... =
☐ Highest Point ....▲
☐ Lowest Point..◖
☐ Standing Water... ~
☐ Three Unique Features (Unusual Tree, Strange Colored Rock, etc.)............1, 2, 3
☐ The Oldest Tree...■
☐ Trees that Produce Food (Nuts, Fruit, etc.) .... F

STOP   STOP   STOP
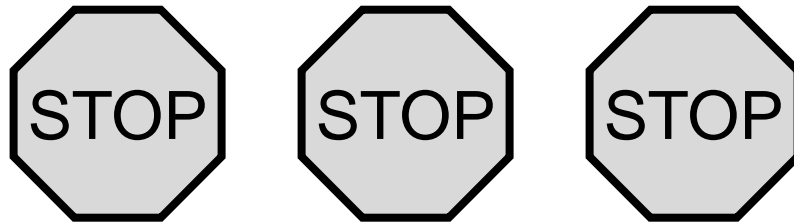
LARGE GROUP QUESTIONS

1. What is the most abundant tree species? Why might this be?_____
_____
_____

2. Which plot has the oldest tree?_____
_____

What is the most common tree age?_____
_____

What is the average age of all the trees in all the plots? (Add the ages of all the trees in all the plots together. Divide by the total number of trees.)_____
_____

3. What type of animals might live or feed in this area? How do you know this?_____
_____
_____

4. Share your three unique features with the rest of the group. Which plot has the most unique feature?
_____
_____