Grand Blanc High School Nature Center Forestry Unit

By: Stephen Applebee

Target Grade/Subject: 10th Grade; High School Biology

Overview:
The main objective of this 5 to 6 day forest unit is to allow students to develop an overall appreciation of what a relatively untouched forest area looks like and how the ecosystem as a whole functions. We are very lucky here at Grand Blanc high school to have a parcel of land that is about 5 acres that has been maintained as a nature center since the school was built back in the 1970’s. The objective of this unit is to incorporate the terminology used in the Ecology unit of our book as well as allow students to actually see how these terms are applied in the field. When the unit is done I would like for the students to design a management plan that will allow the nature center to survive at optimal “health” for decades. While completing the unit the students will be asked to ID species of trees in the nature center, create their own 1/10th of an acre plot, use DBH and tree scale sticks, graph heights and diameters, use a cover board for the possibility of reptile and amphibians, analyze their plot for invasive species (plants and insects), determine what type of soil is most likely associate with what specific stand of trees, determine how much carbon is stored in one tree, and also come up with an overall assessment of the health of the nature center. I will also use lectures on the history of forestry and also use video evidence to show the ramifications of forest mismanagement.

Michigan Content Standards Addressed

SCIENCE:
Strand I. Constructing New Scientific Knowledge
   Standard 1.1 Constructing New Scientific Knowledge

Strand III. Using Scientific Knowledge in Life Science
   Standard III. 1 Cells
   Standard III. 2 The organization of Living Things
   Standard III. 5 Ecosystems

Strand V. Using Scientific Knowledge in Earth science
   Standard V.1 The Geosphere
   Standard V.2 The Hydrosphere
   Standard V.3 The Atmosphere and Weather

MATH:
Strand III. Data Analysis and Stats
   Standard III.1 Collection, Organization, and Presentation of data
   Standard III.2 Description and interpretation

SOCIAL STUDIES:
Strand II. Geographic Perspective
   Standard II.2 Human/Environment Interaction
   Standard II.4 Regions, Patterns, and Processes

Strand IV. ECONOMIC PERSPECTIVE:
   Standard IV.1 Individual and Household Choice
   Standard IV. 3 Role of Government

Strand V. Inquiry
   Standard V.1 Information Processing
   Standard V. 2 Conducting Investigation
Lesson one:

Objective: Today I will introduce the concept of Forest Ecology. A basic outline will include terminology necessary for the students to engage in activities that will be completed over the next week. A basic outline of this lecture will include the introduction of the following: ecosystem (ecosystem types), biodiversity, succession, renewable vs. nonrenewable, conservation, managed vs. unmanaged, and stand.

Activity:
1. Pre forest unit quiz
2. Correct quiz and discuss
3. Lecture on basic terminology associated with forest ecology

Review and Reinforcement:
1. Use Prentice Hall Biology book to complete the following:
   a. Page 62 Inquiry activity. How do organisms affect one another’s survival?
   b. Read 63-65 and answer questions 1-5 on page 65

Resources: Dr. Chris Webster, MTU School of Forest Resources & Environmental Science 2011

Introduction to Forest Ecology – Part I

I. Great Lakes Forest History
   A. 10,000 years ago the glacier that covered the Great Lakes receded.
   B. Primary succession begins. Look at page 94 and define primary succession
   C. After the pioneer species had fully established themselves and the soil became fertile then trees began to grow. The following trees began to grow:
      1. Black Spruce – 14,000 to 12,000 BP
      2. Jack Pine, Red Pine and Balsam Fir 11,000 to 10,000 BP
      3. White Pine 10,000 BP
      4. Oaks -11,000 to 10,000 BP
      5. Sugar Maples 7,000 to 6,000 BP
      6. Eastern Hemlock 4,000 BP
   D. Pines grew first due to the sandy soil.

II. History of Logging in the Great Lakes States
   A. White Pines logging began in Michigan in 1836
   B. White Pines were logged for there use to build houses and other structures
   C. Management practices were not used. The stands were clear cut as fast as they could cut them down.
   D. The pines were easier to move because pine trees float therefore the loggers would place them in rivers and lakes and direct them to mills along the water.
   E. Hardwood trees like Oaks and Maples were not cut down until the railroad system was functional. Why?

III. Impacts of Logging
   A. Because the forests were looked at as a renewable resource no management practices were used.
B. A lot of the areas that were logged were sold to farmers.  
C. Farming was hard on these lands because the soil was not great  
D. During the Great Depression most farmers could not pay their taxes and the land went back to the state  
E. Michigan has the largest state forest system in the US with about 4 million acres  
F. Some fields became stump fields and still are.  
G. If some trees had been left then the forest might have regenerated itself.  

*** Discussion point: Have any of you noticed forests throughout the state that look like all the trees are in perfect rows and are all the same species of tree? Does anyone know how this happened?  

**Introduction to Forest Ecology - Part 2**  

IV. Define Ecosystem (look at page 64) –  

A. An ecosystem can be any size. The following areas of the nature center can be ecosystems:  
   1. Log  
   2. Pond  
   3. River  
   4. Field  
   5. Forest  

B. Ecosystems are defined by their abiotic and biotic factors  
   1. Abiotic – nonliving factors of an ecosystem. List 5 that you might find in the nature center  
      a.  
      b.  
      c.  
      d.  
      e.  
   2. Biotic – living factors of an ecosystem. List 5 that you might find  
      a.  
      b.  
      c.  
      d.  
      e.  

V. We will focus on the ecosystems that have formed due to the growth of trees called a stand  
   1. Stand of trees are similar in age, species, and quality  
   2. Within the zone of your stand you will find biodiversity.  
   3. Biodiversity is the diversity of life in that particular ecosystem  
   4. Your stand will be an example of secondary succession. Define secondary succession (page 95)  
      5. What is the most common disturbance that causes forests to go through secondary succession?  

**** Discussion point: Are all wildfires bad for the overall health of a forest?
1. How much of Michigan is covered by forest?
   A. About 50%
   B. About 75%
   C. About 90%
   D. About 10%

2. Who has the most state owned land?
   A. Wisconsin
   B. Michigan
   C. California
   D. Alaska

3. How old do you think the majority of the forests in Michigan are?
   A. Between 0 and 50 yrs
   B. Between 50 and 100 yrs
   C. Between 100 to 1000 yrs
   D. 1000 yrs and older

4. Pine trees are conifers.
   A. True
   B. False

5. Oak and Maple trees are deciduous trees.
   A. True
   B. False

6. The most common tree in Michigan is:
   A. White pine
   B. Sugar Maple
   C. Paper Birch
   D. Ash

7. Hardwood stands like oaks and maples are sometimes called asbestos stands because they will not burn during a wildfire.
   A. True
   B. False

8. The logging industry helped jump start the U.S. economy throughout the 1800 and 1900’s.
   A. True
   B. False

9. What is the Emerald Ash Borer?
   A. Reptile
   B. Bird
   C. Insect
   D. Mammal

10. What does it mean to clearcut a forest?

11. Describe what you think a healthy forest looks like and what you would find in that forest?
Lesson 2: First field day

Objective: Students will be placed in groups of three and will be sent around the path of the nature center. They will be given a dichotomous key for trees in the Lower Peninsula. I will have a ribbon on each tree that they are to identify.

Activity: Tree ID in Grand Blanc Nature Center
   Materials: 1. Tree dichotomous key
              2. Spread sheet
              3. Pencil

Each group will follow the path that runs on the outside of the nature center. As they follow the path they will notice trees that have been marked by myself with a colored ribbon. Once they have found a tree with a ribbon they will have to use the dichotomous key that they were given to identify the tree. They will have to record this tree species on the spread sheet that I have provided them. If they run out of time they will be given time later in the week to complete the assignment.

Time: 60 minutes

Resources: Tree Identification Terms and Dichotomous Key, Wisconsin’s K-12 Forestry Education Program
TREE IDENTIFICATION TERMS

BRANCHING
ALTERNATE BRANCHING: A branching pattern where side branches, leaves, and leaf scars do not grow directly across from each other.

OPPOSITE BRANCHING: A branching pattern where side branches, leaves, and leaf scars grow directly across the stem from each other.

CONIFERS
BUNDLES: Groups of needles held together at the base by a small papery wrap called a fascicle.

CONIFEROUS: A tree that bears cones and has needles. Also called evergreen.

EVERGREEN: A tree that bears cones and has needles. Also called coniferous.

SCALY: Conifer needles that are flat and overlapping like fan scales.

SIMPLE LEAF: A type of leaf that has one blade attached to a twig by a petiole.

VEINS: Distinct lines of tissue that form the framework of a leaf. Used for food and water transport.

DECIDUOUS
BROAD-LEAFED: A tree that sheds all of its leaves annually. They have leaves as opposed to needles. These trees are also called deciduous.

DECIDUOUS: A tree that sheds all of its leaves annually. These trees are also called broad-leaved.

LEAFETS: Smaller parts of leaves that often resemble leaves themselves. They join together along the petiole. The leaf petiole attaches to the twig.

PETIOLE: The stalk that supports a leaf and attaches the leaf to the twig. They can be round, flat, or square.

LEAF MARGINS
ENTIRE: A type of leaf edge that is smooth and has no wavy or rough edges.

TOOTHED: A type of leaf edge that has small points or bumps along it (teeth). Single-toothed means that all the teeth are about the same size. Double-toothed means that on each tooth there is a smaller tooth.

LOBED: A type of leaf edge that has large rounded parts.

MARGIN: The outer edge of the leaf.

SINUSES: The spaces in between lobes on a leaf.

PETIOLE AND NEEDLE SHAPE CROSS-SECTIONS
FLAT
SQUARE
ROUND

LEAF GUIDE • 7-8 UNIT Wisconsin's K-12 Forestry Education Program www.uwsp.edu/forexleaf

6
TREE IDENTIFICATION KEY

BEGIN HERE:
Tree has needles use .................................................. use CONIFEROUS TREE KEY
Tree has broad leaves ................................................. use DECIDUOUS TREE KEY

CONIFEROUS TREE KEY

1. Needles in bundles or groups (2)
   1. Needles single or flattened and scaly (3)
   2. Needles in clusters of more than 5 needles, Tamarack* (Larix laricina)
   2. Needles 2 to 5 per bundle, Pine species (see a-c below)
      a. Five needles per bundle, White Pine (Pinus strobus)
      b. Needles in pairs, 3 to 4 inches long, Red Pine (Pinus resinosa)
      c. Needles in pairs, under 2 inches long, Jack Pine (Pinus banksiana)

3. Needles scaly and flattened (4)
3. Needles single (5)
4. Has cones, scales flat, branches fan-like, Northern White Cedar (Thuja occidentalis)
4. Has bines, may have scaly and prickly needles on same tree, scales rounded, Eastern Red Cedar (Juniperus virginiana)
5. Needles flat (6)
5. Needles square, 4-sided, stiff, sharp, Spruce species (see a-b below)
     a. Needles 1/3 to 3/4 inch long, twigs hairy, White Spruce (Picea glauca)
     b. Needles 1/3 to 3/4 inch long, twigs have hair, Black Spruce (Picea mariana)
6. Needles 1/2 inch long with short petiole, Eastern Hemlock (Tsuga canadensis)
6. Needles 3/4 inch to 1 1/4 inches long, no petiole, Balsam Fir (Abies balsamea)

*Note: A tamarack is a deciduous conifer.
**TREE IDENTIFICATION KEY**

**DECIDUOUS TREE KEY**

1. Opposite branching (2)
2. Alternate branching (4)
3. Compound leaves (3)
4. Simple leaves: Maple species (see a-c below)
   a. Leaf margins smooth, 5 lobes. **Sugar Maple (Acer saccharum)**
   b. Leaf margins double-toothed, 3 to 5 lobes. **Red Maple (Acer rubrum)**
   c. Leaf margins single-toothed, 3 to 5 lobes, lobes separated by deep, angular openings. **Silver Maple (Acer saccharinum)**

3. 3 (rarely 5) leaflets. **Box Elder (Acer negundo)**

5. 5 to 11 leaflets: Ash species (see a-c below)
   a. 9 to 11 leaflets, leaflets do not have petiole. **Black Ash (Fraxinus nigra)**
   b. 5 to 9 leaflets, leaflets have petiole, smile-shaped leaf scar extending up sides of new bud. **White Ash (Fraxinus americana)**
   c. 7 to 9 leaflets, leaflets have petiole, leaf scar ends at base of new bud. **Green Ash (Fraxinus pennsylvanica)**

2. Simple leaves (8)

4. Compound leaves (5)

5. 7 or fewer (usually 5) leaflets, egg-shaped nut. **Shagbark Hickory (Carya ovata)**

6. Leaflets rounded. **Black Locust (Robinia pseudoacacia)**

7. Leaf 6 to 8 inches long. **Mountain Ash (Sorbus americana)**

8. Leaf 8 to 24 inches long. **Black Walnut (Juglans nigra)**

9. Leaves not lobed (9)

10. Leaves lobed: Oak species (see a-f below)

   a. Rounded lobes, 5 to 9 deep even lobes and sinuses, leaves hairless. **White Oak (Quercus alba)**
   b. Rounded lobes, pair of deep sinuses near middle of leaf, hairy underside of leaves. **Bur Oak (Quercus macrocarpa)**
   c. Rounded lobes, leaf narrow at base and broad near middle, hairy underside of leaves. **Swamp White Oak (Quercus bicolor)**
   d. Pointed lobes, sinuses extend halfway to mid-vein, leaves hairless, dull green. **Red Oak (Quercus rubra)**
   e. Pointed lobes, deep sinuses extend 3/4 of the way to mid-vein, leaves hairless, bright green and shiny. **Northern Pin Oak (Quercus ellipsoidalis)**
   f. Pointed lobes, deep sinuses, young leaves hairy underneath, dark green and shiny, leathery. **Black Oak (Quercus velutina)**
TREE IDENTIFICATION KEY

DECIDUOUS TREE KEY

9. Bark not papery (10)
9. Bark papery: Birch species (see a-c below)
   a. Leaves single-toothed, white peeling bark...White Birch (Betula papyrifera)
   b. Leaves double-toothed, dull green leaves, yellow or bronzed bark...Yellow Birch (Betula alleghaniensis)
   c. Leaves double-toothed, shiny green leaves, reddish-brown to silvery-gray bark...River Birch (Betula nigra)

10. Leaf petioles flat (11)
10. Leaf petiole round (12)
11. Leaf triangular-shaped with coarse teeth...Eastern Cottonwood (Populus deltoides)
11. Leaf oval: Aspen species (see a-b below)
   a. Leaves have small, fine teeth less than 1/15 inch...Trembling Aspen (Populus tremuloides)
   b. Leaves have large teeth...Big-toothed Aspen (Populus grandidentata)

12. Leaves nearly as wide as long (13)
12. Leaves longer than wide (14)
13. Leaves finely toothed...Balsam Poplar (Populus balsamifera)
13. Leaves coarsely toothed...Basswood (Tilia americana)
14. Leaf less than 3 times as long as wide (15)
14. Leaf at least 3 times as long as wide...Willow species (Common species include Weeping Willow and Black Willow)
15. Leaf veins thin and branch often (16)
15. Leaf veins thick and run from center to edge of leaf without branching (17)
16. Fine blunt teeth, leaves 2 to 6 inches long, bark dark...Black Cherry (Prunus serotina)
16. Sharp pointed teeth, leaves 2 to 4 inches long and hairy...Hackberry (Celtis occidentalis)
17. Leaf shiny and leathery (thick), coarse sharp teeth...Beech (Fagus grandifolia)
17. Leaf dull and rough (18)
18. Most leaf bases even, seed in elongated clusters...Ironwood (Ostrya virginiana)
18. Leaf base uneven, seeds flat and papery...Elm species (Common species include American Elm, Rock Elm, and Slippery Elm)
Lesson three: Plot, DBH and Health Indicator

Objective: In the same groups of three the students will measure out a plot that is 1/20th of acre (26.33 ft radius). They will use marking tape to define the perimeter of their plot. They will ID all trees that are 4 - 9 inches in diameter and record. They will use a DBH to determine if they are at least 4 inches. They will need to do all diameters for the trees that are 4 inches and bigger. They also need to record these numbers. The last item to be completed is to place their cover board on the floor.

Activity: Forest Health Indicator: Forest Diversity
Project learning tree page 39 and 40
Students should complete activity as directed. Students must mark each tree that is measured with chalk with a number and record it on a separate spread sheet. We will use these numbers and the spread sheet the next day to record tree height.

Materials
1. DBH
2. Tree ID sheet or Dichotomous key
3. Cover board
4. Pencils
5. Activity sheet
6. Tape measure
7. Marking tape
8. Chalk

Resources: Project learning tree exploring environmental issues: Focus on Forests
Forest Health Indicator: Forest Diversity pages 39 and 40.

Time: 60 minutes
Forest Health Indicator: Forest Diversity

A healthy forest includes a variety of different plants and animals. One way to assess this diversity is to determine whether there is a mix of plant species of different sizes and ages, thus creating forest "layers" that provide habitat for many species.

Materials
Pencil, paper, tape measure, chalk, tree identification guide (optional)

Method
Look at the leaves, bark, seed pods, or flowers of the trees in your forest plot to determine whether they are the same or different species. Use the Tree Species Diversity chart below to catalog this information. Tree identification guides are helpful with this step, but not necessary. If a tree identification guide is not available, use your observation skills to describe the differences in tree types and include this information in the Tree Species Diversity chart below.

Measure (or estimate) the diameter at breast height (DBH) for all trees in the sample plot. Count (or estimate) the number of trees of different size classes using the corresponding DBH size classifications found in the Size Diversity chart below and record your findings. To help you, consider using chalk to mark the trees you have already counted.

Assess the presence or absence of different forest layers, using the descriptions found in the Forest Layer Diversity chart and record your findings.

Results

<table>
<thead>
<tr>
<th>Tree Species Diversity</th>
<th>Name or Description</th>
<th>Number found in sample plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species 1</td>
<td></td>
<td></td>
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<tr>
<td>Species 2</td>
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<td></td>
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<tr>
<td>Species 3</td>
<td></td>
<td></td>
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<tr>
<td>Species 4</td>
<td></td>
<td></td>
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<tr>
<td>Species 5</td>
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<td></td>
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</tbody>
</table>

Note: Please continue listing to account for all species present in sample plot.

<table>
<thead>
<tr>
<th>Size Diversity</th>
<th>DBH</th>
<th>Number found in sample plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saplings or Poles</td>
<td>4-8 inches (10-24 cm)</td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>10-14 inches (25-37 cm)</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>15-19 inches (39-49 cm)</td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td>20-29 inches (50-75 cm)</td>
<td></td>
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<tr>
<td>Giant</td>
<td>30 inches or greater (&gt; 75 cm)</td>
<td></td>
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</tbody>
</table>
Forest Health Indicator: Forest Diversity (cont.)

<table>
<thead>
<tr>
<th>Tree Layer</th>
<th>Description</th>
<th>Present in sample plot? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overstory</td>
<td>Trees whose canopies are fully exposed to the sun</td>
<td></td>
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<tr>
<td>Understory</td>
<td>Trees growing in the shade of other trees</td>
<td></td>
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<tr>
<td>Tall shrub</td>
<td>Shrubs (woody plants with several stems arising from the base) greater than 6 feet (1.8 meters) in height</td>
<td></td>
</tr>
<tr>
<td>Short shrub</td>
<td>Shrubs less than 6 feet (1.8 meters) in height</td>
<td></td>
</tr>
<tr>
<td>Forb</td>
<td>herbaceous (non-woody) plants such as ferns, wildflowers, and grasses</td>
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<tr>
<td>Leaf litter</td>
<td>Dead and decaying leaves and other matter on the forest floor</td>
<td></td>
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</tbody>
</table>

**Rating**

**Tree Species Diversity**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Three or more tree species present</td>
<td>3</td>
</tr>
<tr>
<td>Fair</td>
<td>Two tree species present</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>One tree species present</td>
<td>1</td>
</tr>
</tbody>
</table>

*Tree Species Diversity rating for sample plot: \( \text{Value A} \)*

**Size Diversity**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Three or more size classes present</td>
<td>3</td>
</tr>
<tr>
<td>Fair</td>
<td>Two or more size classes present</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>One size class present</td>
<td>1</td>
</tr>
</tbody>
</table>

*Size Diversity rating for sample plot: \( \text{Value B} \)*

**Forest Layer Diversity**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Five or six layers present</td>
<td>3</td>
</tr>
<tr>
<td>Fair</td>
<td>Three or four layers present</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>One or two layers present</td>
<td>1</td>
</tr>
</tbody>
</table>

*Forest Layer Diversity rating for sample plot: \( \text{Value C} \)*

**Overall Rating**

Determine the overall rating by adding up the points shown for the tree species, size, and forest layer diversity ratings, then dividing the total by 3. Round the total to the nearest whole number.

\[
\text{Value A} + \text{Value B} + \text{Value C} + 3 = \text{Average point value}
\]

Overall rating for Forest Diversity:

- Good: Average point value of 3
- Fair: Average point value of 2
- Poor: Average point value of 1

*Overall Forest Diversity rating for sample plot: \( \text{Value D} \)*

**Sources**

Lesson 4: Learn to use the Tree Scale Stick

Objective: Groups will go back to their plots and determine the overall heights of the trees that they numbered and measured their DBH from yesterday.

Demonstration: I will demonstrate how to use a tree scale stick.

Activity: Instructions will be handed out that contain the following information:
1. You must first measure 66 feet away from the tree.
2. You must hold the stick 25 inches away from your body.
3. You must also hold the narrow side labeled 1-5 at eye level.
4. Each number represents 15 feet.
5. The group must measure the height of all trees they did a DBH for.
6. They must record these heights on the spread sheet they were given yesterday.
7. The group must also check their cover boards for any activity.

Materials:
1. Tree scale stick
2. Spread sheet
3. 100 foot measuring tape
4. Pencils

Time: 60 minutes

Resources: Tree measurements, Jim Rivard, MTU 2011
Names of observers: ________________________________
Group/Hour: ___

<table>
<thead>
<tr>
<th>TREE #</th>
<th>Tree Species</th>
<th>DBH (inches)</th>
<th>Lichens Present</th>
<th>Tree Height</th>
<th>Overall Health of tree</th>
</tr>
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<tbody>
<tr>
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Lesson 5: Lichen Abundance

Objective: Use the presence of Lichens as an indicator of good health in the Grand Blanc Nature Center.

Activity: Forest Health Indicator: Lichen Abundance
   1. The student should use the spreadsheets from the previous day that contains the DBH and height of the measured trees.
   2. They are to look at each tree and determine if there is growth on any of the trees that they measured.
   3. They will use the activity sheet from Project Learning Tree to see if Lichens can be used in our nature center as a variable for health.

Resources: Project Learning Tree, Forest Health Indicator: Lichen Abundance pages 41-42

Time: 20 minutes
Forest Health Indicator: Lichen Abundance

Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution—particularly to sulfur dioxide, fluoride, and ammonia—their presence or absence is an indicator of forest health. The acidity of a tree's bark can also affect lichen abundance.

A lichen is actually two different organisms—either a fungus and an alga, or a fungus and a cyanobacterium—living in a symbiotic relationship. The fungus provides protection and moisture, while the alga or cyanobacterium provides food through photosynthesis.

Materials
String, tape measure, compass, chalk, 100-circle grid transparency.

Method
Select 10 trees on your study plot to sample. For each tree, measure the diameter at breast height (DBH), and tie a string around the tree trunk at that height. Use a compass to determine north, south, east, and west; then mark the directions with chalk on the tree at the string line.

At each of the 4 directions, place the 100-Circle Grid Transparency against the tree, and count the number of circles in which lichens are showing. That number represents the percentage of lichen coverage. For each tree, find the average lichen coverage by totaling the lichens found within the circles and then dividing the total by 4. Find the total average lichen coverage of the plot.

Results
For each tree and direction, record the number of circles that show lichens. This number represents the percentage of lichen coverage.
Forest Health Indicator:  
Lichen Abundance (cont.)

<table>
<thead>
<tr>
<th>Lichen Abundance</th>
<th>North</th>
<th>East</th>
<th>South</th>
<th>West</th>
<th>Total</th>
<th>Tree Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree 1:</td>
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<td>Tree 2:</td>
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<td>Tree 3:</td>
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<td>Tree 5:</td>
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<td>Tree 6:</td>
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<td>Tree 7:</td>
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<td>Tree 8:</td>
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<td>Tree 9:</td>
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<td>Tree 10:</td>
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<tr>
<td>Totals:</td>
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<tr>
<td>Average:</td>
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</tbody>
</table>

Add up the tree averages, which will be recorded in the final column in the chart above. Divide this total by the number of trees sampled to get the average lichen coverage for the entire sample plot.

Average Lichen Coverage for sample plot: _________ percent

Rating

<table>
<thead>
<tr>
<th>Rating</th>
<th>Lichen Abundance</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Greater than 5 percent lichen coverage</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>3-5 percent lichen coverage</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>0-2 percent lichen coverage</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Overall Lichen Abundance rating for sample plot:

Sources

Lesson 6: The carbon in trees

Objective: Measure tree diameter, calculate biomass, and carbon mass

Activity: “Tree Carbon Activity” also check cover boards for activity and record

Resources: Tree Carbon Activity, Maria Janowiak, MTU 2011

Time: 20 minutes
Activity: The Carbon in Trees

Description: Recent interest in the use of forests for carbon sequestration and bioenergy require knowledge about the amount of carbon stored in a tree or forest. For this activity, you will estimate the amount of carbon stored in a nearby or favorite tree.

Objectives: Measure tree diameter; calculate biomass and carbon mass

Materials Needed:
Tree(s); Diameter tape and/or tape measure; Calculator and/or spreadsheet software; Pencil; Allometric equation for tree species

Instructions:

Step 1: Measure Diameter
If using a tape measure or Biltmore Stick, measure the circumference of the tree at breast height (4.5 feet off the ground, see figure). If necessary, convert this value to cm. Then, using the tree circumference, calculate the diameter.

Circumference: ______ cm Diameter: ______ cm

OR: If using a diameter tape, the tree is measured the same way but it is not necessary to calculate diameter since the tape already does that for you. If necessary, convert this value to cm.

Diameter: ______ cm

Step 2: Calculate biomass for whole tree.
To calculate tree biomass, we use a standard allometric equation of the form $M = aD^b$ where $M$ is aboveground tree biomass (dry weight, kg), $D$ is the diameter at breast height (cm), and “a” and “b” are species specific coefficients. Locate the coefficients for the species of tree that you have in the table and calculate tree biomass (M).

Tree species: ______
Biomass (M): ______ kg

Step 3: Determine carbon content
Since carbon is the major building block for life, a tree contains a large portion of carbon (about half of its biomass). To determine how much carbon is in your tree:

Multiply biomass (M) by 0.521 for hardwood trees.
Multiply biomass (M) by 0.498 for softwood trees.

Carbon content: ______ kg C Multiply by 2.2 to convert to lbs. Carbon content: ______ lb C

Bonus Question: One lb of C is equal to 3.67 lbs of CO₂. Also, a car emits 19.6 lbs of CO₂ for each gallon of gas. If a person uses 400 gallons of gas a year, then their CO₂ emissions from driving would equal the amount of carbon sequestered in ______ of these trees.

Lesson 7: Show segments of For the Greatest Good: A History of Forest Mgt and USFS
Also show segments from Planet in Peril
Forestry Unit Post Assessment
And Clean up

I. Students will be asked to do the following as a way to demonstrate their overall comprehension of the forest ecology unit:
   A. The students will do a lab practical on identifying trees. They will use leaves for trees that they previously have identified. They will have to use a dichotomous during this assessment.
   B. The students will also have to design a management plan for the nature center based on the following criteria:
      If you were in charge of managing the nature center, how would manage the nature center? You will need to include what your goal is for the nature center, how you are going to accomplish this goal, and what problems do you see that might interfere with you accomplishing these goals.
   C. The students will also be asked to come up with their own definition of what a “healthy” forest is.

II. Students will be asked to hand in all completed worksheets, charts/graphs, and equipment.

III. Students will also be required to remove all unnatural items that have been placed in the nature center.