Woodland Layer Assessment

Activity Overview
Students will investigate their school woodland using scientific data collection methods to determine the composition of their woodland.

Objectives
Students will:

- Design an inventory plan and set-up quadrats
- Identify plant species
- Collect and analyze data that will be used to determine the composition and status of their school woodland

Subjects Covered
Science, Math, and Language Arts

Grades
5 through 12

Activity Time
Depends on size of area; this may be a long-term project

Season
Tree Inventory – any; Shrub and Ground Layer – spring and /or fall

Materials
Measuring tapes, compasses transect lines, survey stakes, quadrat sticks, field guides, d.b.h. tapes, clipboards, and data collection and analysis sheets

State Standards
Science:

Use scientific sources & resources (B.4.1)

Select multiple information sources (C.4.3)

Use data to answer questions (C.4.5)

Identify data and sources to answer questions (C.8.2)

Evaluate data (C.12.3)

Choose & evaluate data collection methods (C.12.4)

Math:

Use reasoning abilities (A.4.1, A.8.1, A.12.1)

Background

When planning a woodland restoration, one of the first steps is assessing the current vegetation at the restoration site. This assessment is the starting point for the restoration and is the basis for the restoration plan. Since a woodland is comprised of layers and a wide range of specie types and sizes, the inventory is divided into two different methods of assessment—tree inventory and shrub/groundlayer assessment.

Tree inventory
An inventory of trees on the site will answer some of the following questions:

- How many different species of trees are on the site?
- Is the site dominated by native trees or by exotics?
- Are there trees that need to be removed from the site?
- Are there native trees missing from the site that need to be added?
- What size(s) of trees are on the site?
- Are important native species present as larger, older trees, and/or as small, younger trees?
- Given the species present, will the dominant species remain the same or change over time? Generally trees growing in the understory will become canopy trees in the future.
- Is the density of trees appropriate?

The inventory is done by recording the species name and d.b.h. (diameter at breast height) of every tree in a series of quadrats located along a transect (line) across the site. Standard size for each quadrat is 10 m x 10 m, but this size can be adjusted as needed to meet your situation.

Shrub/Ground Layer Inventory
The inventory of the shrub and herbaceous ground layer will answer some of the following questions:

- How many different species of shrubs and herbaceous plants are on the site?
- Are native or exotic species growing on the site?
- What is the cover of the individual ground layer species?
- Are native plants missing from the site?
- Are invasive species present that need to be removed and/or managed?
- Are there any patterns or associations, (i.e., because of sun/shade, change in soil or topography, specie to specie) evident in the understory?
- Has the ground layer been adversely affected by trampling?
- Are there areas with educational or aesthetic value.

Inventory the understory using one of four different sampling strategies.

Connect mathematical learning with other subjects (A.4.3)

Use vocabulary, symbols, notation (A.4.4)

Explain solutions to problems (A.4.5)

Communicate logical arguments (A.8.2)

Analyze non-routine problems (A.8.3)

Develop effective oral & written presentations (A.8.4)

Communicate logical arguments (A.12.2)

Analyze non-routine problems & arrive at solutions (A.12.3)

Develop effective oral & written presentations (A.12.4)

Organize work & present mathematical procedures & results (A.12.5)

Represent & explain whole numbers, decimals, & fractions (B.4.1)

Identify & represent equivalent fractions (B.4.4)

Select & use appropriate computational procedures (B.4.5)

Create & critically evaluate numerical arguments (B.12.5)

Routinely assess the acceptable limits of error (B.12.6)

Describe simple two-& three-dimensional figures (C.4.1)

Identify & use relationships among figures (C.4.3)

Identify & demonstrate an understanding of trigonometry (C.12.5)

Recognize & describe measurable attributes & units (D.4.1)

Demonstrate understanding of measurement (D.4.2)

Read & interpret measuring instruments (D.4.3)

Determine measurements by using standard tools (D.4.4)

Identify & describe attributes in situations not directly or easily measurable (D.8.1)

Choose the method that best meets your needs at the present time. Whatever method you choose, be aware that an inventory will need to be compiled once in the spring then later in the year. This is because some of the woodland plants are ephemerals. Ephemerals appear, blossom, and fruit before the trees leaf out, then disappear from sight.

The four shrub/ground layer sampling methods are:

1. A Species list: Compile a list of the understory plants that you observe during a walk-through of your site.
2. Transect sampling: Run transects through the site and record what species are growing at predetermined intervals on the transects. This method is useful for studying patterns along a gradient. The length of a transect varies. Ten meter line transects with one meter intervals is a reasonable length for students to work with.
3. Quadrat Sampling: List species present in a defined area. Quadrat sampling is similar to the tree inventory sampling method. This approach provides the means to measure frequency and the abundance of species.
4. Visual Estimation Quadrat Sampling: This method of sampling involves listing the species present and estimating the space they cover. The two choices for recording data are:

   - Map all species in a quadrat showing approximate cover of each species.
   - List species present and estimate the area covered in a quadrat.

   Cover may be recorded as fractions or percentages. Random individuals are only listed. Use the "Comparison Diagram for Visual Estimation of Percent Cover" field sheet to help with estimations.

Activity Description

Tree Inventory

1. Design a sampling plan; consider the size of your woodland, topography, and density of species when laying out a series of transect lines.
2. Begin laying out your transect lines using measuring tapes, compasses, and survey stakes. Locate the transects on a map, if feasible.
3. Use the following data sheets, field guides, and d.b.h. tapes to inventory, identify, and record the trees present. See Earth Partnership for Schools activity, "Measuring up Tree Size" for instructions on measuring d.b.h..
4. Calculate frequency, abundance, and total basal area using formulas described under section "definitions and instructions for calculating statistics" in this activity.
5. Describe the composition, identify patterns, and predict the growth and development of your woodland.
6. Detail your findings in a report. Use this information to determine a restoration management plan.

Woodland Layer Assessment (cont.)

Demonstrate understanding of measurement facts, principles, techniques (D.8.2)

Determine measurement directly by using standard units (D.8.3)

Determine measurement indirectly (D.8.4)

Determine measurement indirectly (D.12.3)

Describe a set of data (E.4.2)

Analyze information from organized & displayed data (E.8.3)

Use results of data analysis (E.8.4)

Language Arts:

Conduct then communicate research (F.8.1, 12.1)

Shrub and Groundlayer Inventory

7. Design a sampling plan, consider the size of your woodland, complexity of the ground layer, and how detailed an inventory you will need to begin a restoration.
8. Set-up quadrats.
9. Use the following data sheets and field guides; identify and record species present.
10. Calculate frequency and abundance of the species present using formulas described in following section.
11. Describe the composition of the groundlayer and identify patterns developing.
12. Detail your findings in a report. Use this information to determine a restoration management plan.

Definitions and instructions for calculating statistics

Percent Frequency = the percent of quadrats in which the species is found. Frequency shows how common or uncommon a plant species is in an ecosystem. This measure can be used to rank the species from common to rare.

Instructions for calculating frequency:
Calculate the percent frequency for each species by dividing the total number of quadrats where that species was found (# quadrats) by the total number of quadrats sampled, then multiply by 100.

For example, if red oak were present in 6 of 12 quadrats, the percent frequency for red oak would be:

$$\frac{6}{12} \text{ X } 100 = 50\%$$

Abundance = the number of individual trees of a species found in all quadrats combined.

Total basal area = the sum of all the basal areas of the individual trees of a species,
where the basal area of a tree is equal to

$$\pi \left(\frac{\text{diameter}}{2}\right)^2$$

Extensions

- Invite a natural resource professional to meet with the class to discuss the ecology, health, and structure of the woodland.
- Make visual diagrams, drawings or dioramas of the woodland.
- Make leaf rubbings or press leaves of the plants to create a herbarium of the woodland.
- Use reports to design a restoration management plan and present it to the class.

Additional Resources

- Curtis, J.T. (1959). *The vegetation of Wisconsin.* Madison, WI: University of Wisconsin Press.
- Daigle, J.M. & Havinga, D. (1996). *Restoring nature's place.* Ontario, Canada: Ontario Parks Dept.
- Egan, D. (Ed.). *Ecological restoration.* Madison, WI: University of Madison Press.
- Packard, S. & Mutel, C.F. (1997). *The tallgrass restoration handbook: For prairies, savannas and woodlands.* Washington D.C: Island Press.

Website

- Earth Partnership for Schools. Woodland restoration for Wiscconsin schools. http://uwarboretum.org/eps/woodland/welcome.htm

Assessments

- Data collection actually depicts species in sampled areas.
- Calculations are accurate.
- Conclusions are supported by the data collected.

Woodland Layer Assessment Field Sheet

Summary of Tree Inventory

Location: _____

Date: _____

Tree Species	1	2	3	4	5	6	# Quad	% Freq

Woodland Layer Assessment Field Sheet

Tree Data Sheet for Calculating Basal Area. Use one field sheet per tree species.

Location: _____

Date: _____

Quadrat Number	Tree Species	d.b.h.	Basal Area
Total Basal Area			