Harvard LTER Schoolyard Program

Teacher Developed Lessons and Documents that integrate Harvard Forest Schoolyard Ecology Themes into curriculum.

- Lesson Title:
Introductory Unit-Fall Leaf Color and Drop
- Teacher/Author: Lise Letellier
- School: Holyoke Catholic School
- Level: High School
- Date: February, 2013

Students will be able to:
- Maintain a proper field journal
- Define phenology and senescence
- Recognize at least 4 phenological events, including Budburst and Leaf Fall.
- Explain why leaves change color and drop off in the fall.
- Accurately collect, record and organize data
  - Organize large quantities of data into proper data tables
- Analyze data
  - Make and interpret graphs from data

Background Information:

This entire unit is developed in partnership and with full support of the Harvard Forest Schoolyard Long Term Ecological Research Program, specifically using the fall protocol for the Buds, Leaves and Global Warming Research Project. The Harvard Forest is part of a **national network of sites** that supports K-12 teachers and students in hands-on ecological research.

In the Harvard Forest Schoolyard LTER program, teachers learn about and initiate ecology research in their classrooms and schoolyards. Students learn to collect data on important long-term ecological issues and processes. Student data is then shared on the Harvard Forest website. Students can access their data to graph and analyze, as well as accessing other school's data.

Freshmen Environmental Students at Holyoke Catholic High School in Massachusetts collected the data used in this series of activities. It took two school years to collect the proper data. In the first year, students collected fall and spring data. This data was exported to Harvard Forest's web site. The following fall, students again collected and exported data. The 2012 spring and fall data set is provided to determine the growing season length for 12 urban trees, then averaged and compared. The data will continue to be taken for subsequent years to determine long-term change.

The data is provided in an Excel-based Spreadsheet, which can be downloaded and used. It is strongly recommended to consider collecting your own data and working with Harvard Forest Schoolyard Long Term Ecological Research Program, who offer workshops and full support. The first couple of assignments are to be used if you wish to collect your own data. If you would like to use the data for analysis only proceed directly to **Harvard Assignment # 5**

Teacher notes:
At the beginning of the unit, students should be introduced to the Harvard Forest LTER program and specifically John O'Keefe's Study and the purpose of the Buds, Leaves and Global Warming protocol and connect it to their own work. Generally,

- ➢ What is Dr John O'Keefe's, from Harvard Forest, big question-
  - • "How might the New England's growing season be effected by climate change"
  - • Student's big question-
    - ○ "Is the season length at our school changing?"

Fall Leaf data collecting protocols- Weekly Data Collection done from September to November, based on Seasonal changes. See
http://harvardforest.fas.harvard.edu/buds-leaves-global-warming

Figure #1

Harvard Assignment # 1 – Identifying Trees and recording location

- ➢ **Teacher notes:** Student can work in pairs or groups of 4 per tree.

- ➢ **Length of time:** 20-40 minutes w/Homework assignment
- ➢ Assign number of tree- Record tree number in field journal
  - ◦Draw one leaf in your journal (See Figure 1)
  - ◦**Assessment**: Teacher will access drawing for accuracy. Leaf drawing should be accurate enough to properly identify the tree. (Drawing is of a Red Maple Tree)
  - ◦In your lab journal, Sketch the location of your tree in relation to school and road (See Figure 2)

Figure #2

- ➢ Homework, use Google maps to locate and print out and paste in field journal. (See Figure #)
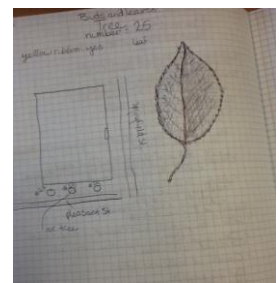 - ○ Assessment: Teacher will assess map for accuracy of tree location.

Figure #3

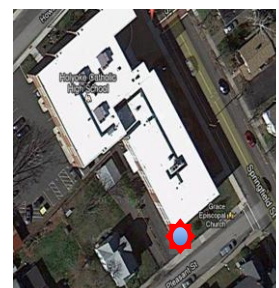**Harvard Assignment #2: Pre Tagging**
- ➢ **Teacher Notes**: Use PowerPoint to Introduce correct tagging protocol.
- ➢ **Time**: 20-30 minutes plus Homework

- ➢ Choose a tree at home, draw a branch with its leaves, indicating on the diagram the proper placement of the yellow ribbon, and the numbers of each leaf.
  - o **Assessment**: Teacher will check diagrams and be assured of proper understanding of the ribbon placement.
  - o Alternatively, teacher can bring branches into the class and students can practice placing the ribbon on the branches.

Harvard Assignment # 3- Tagging the Trees and measuring size of leaves
- ➢ Teacher Notes: Follow Harvard forest Buds, Leaves, and Global Warming Protocol.
  - ◦ http://harvardforest.fas.harvard.edu/buds-leaves-global-warming
- ➢ Summary of Protocol
  - ◦ Choose 2 branches, each from different parts of the trees, both in arms reach.
  - ◦ Place or reposition yellow ribbon and label (Tree# and branch letter: 1A, 13B, etc..) according to following protocol
  - ◦ Each tree has a number- 1,2,3…
  - ◦ Each branch has a letter, A or B
    - ▸ Only use 2 branches/tree
    - ▸ Count the first 6 leaves, DO NOT COUNT THE TERMINAL LEAF.
    - ▸ Carefully Draw the branch in lab book to be able to accurately identify leaves 1-6
- ➢ Measure the length (not including the leaf stem/petiole) and width in centimeters for each of the six leaves and record in a data table similar to the one below.

Tree #	Specie			Branch		
	Size Leaf # 1 cm	Size Leaf # 2 cm	Size Leaf # 3 cm	Size Leaf # 4 cm	Size Leaf # 5 cm	Size Leaf # 6 cm
	W–	W–	W–	W–	W–	W–
	L–	L–	L–	L–	L–	L–

- ➢ WARNING: Tell students not to pull down on branch by leaves or remove leaves accidently from the tree while measuring.

Harvard Assignment # 4 Fall Leaf data collecting protocols- Weekly Data Collection done from September to November,
- ➢ Teacher Notes: Follow Harvard forest Buds, Leaves, and Global Warming Protocol.
  - ◦ http://harvardforest.fas.harvard.edu/buds-leaves-global-warming
- ➢ Use data table similar to below to collect and record data.

   Leaf % green with sample data (do not copy sample data)

Tree #	Tree Species % not Green Fallen-1 Not fallen-0		Branch _____				
Date:Time: weather Time ºC	Leaf #1	Leaf # 2	Leaf # 3	Leaf # 4	Leaf # 5	Leaf # 6	Whole Tree
9/20/2012	10%	15 %	15 %	15 %	20 %	20 %	20 %
Sunny-18	0	0	0	0	0	0	
9/25/2012	20%	25 %	25 %	50 %	25 %	50 %	50 %
cloud-20	0	0	0	0	0	0	

Teacher Notes: Exporting the data into the Harvard Data base is not being discussed here, If you choose to collect and submit data, this will be explained.

This Unit is continued in another file on Harvard Forest Website for Lesson #5.