

Harvard LTER Schoolyard Program

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



- Lesson Title: Woolly Bully LTER Planning Guide
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- School: Amherst Regional High School-South East Campus
- Level: High School -10th Grade
- Date: April 3, 2014

Name

Date

Plot Study – A Comparison of the Ecology of Hemlock and Deciduous Forests

Overview:

Eastern hemlock trees are considered a foundation species of northeastern U.S. forests because they strongly influence the environmental conditions of our forest ecosystems and provide food and habitat for many animal species. The invasive species, the hemlock woolly adelgid, is destroying the eastern hemlock. This could

significantly impact our eastern forest ecosystems. As hemlock forests disappear, they are replaced by deciduous forests, which do not provide the same habitat, food sources, or environmental conditions.

Purpose: The purpose of this plot study is to collect and analyze data on the biotic and abiotic differences between eastern hemlock and deciduous forests. Following the death of a hemlock forest, deciduous forests become established. Based on this pattern of forest succession, predict how the New England forest ecosystem could change if hemlock forests are lost to the hemlock woolly adelgid. Increase awareness of this issue by sharing your findings with the school community.

Objectives:

1. Gain experience collecting chemical and biological data in the field.
2. Use Excel to graph data.
3. Analyze data to compare and contrast the ecology of hemlock and deciduous forests.
4. Use data and research from journal articles to state the unique ecological value of the hemlock forest.
5. Predict how the New England forest ecosystem could change if hemlock forests are lost to the hemlock woolly adelgid.
6. Summarize your findings in a written report.

Materials:

Readings: *Hemlock: Irreplaceable Habitat* (Orwig, D.) *Loss of Foundation Species: Consequences for the Structure and Dynamics of Forested Ecosystems* (Ellison, et. al), soil thermometer, soil-testing kit (N,P,K, pH), hand lens, trowel, two jars, plant and insect identification guides, graphing program such as Excel, poster board

Assignments:

1. Read provided articles in order to research the importance of hemlock forests and the impact of the woolly adelgid on our forests.
2. Make a prediction about how three biotic and three abiotic factors will differ between the hemlock and deciduous forest plots.
3. Collect data on soil pH, nitrogen and phosphorus levels, soil temperature, and abundance of organisms by type.

4. Use Excel to create bar graphs to display your data. Create a series of graphs that compares pH, nutrient levels, temperature, and organism abundance by type in the hemlock and deciduous forests. Include titles and axis labels.
5. Analysis: Compare and contrast the characteristics of each plot. Present your graph and a verbal summary of your analysis to the class.
6. Lab Report: Write a lab report based upon your plot study. Write your report in the format described in the lab report guide.
7. Poster: Create a poster that includes a summary for each part of your lab report.

Lab Report Guide

Introduction (20 pts.): This section should be at least three paragraphs in length. Provide the following information:

Explain the purpose of this study. Describe the two forest plots in terms of location and tree species in the forest community (common and Latin names). Describe the biotic and abiotic data collected.

Describe the eastern hemlock tree in one sentence. Why is the eastern hemlock considered a foundation species (include a definition of a foundation species)? What role (niche) does the eastern hemlock play in New England forest ecosystems? Include both biotic and abiotic factors.

Describe the woolly adelgid by including the following information. When and how was it introduced to the United States? What does it feed upon and how does it feed? What is the life cycle of the woolly adelgid? How long does it take for the woolly adelgid to kill a hemlock tree? Describe the effect of the woolly adelgid on hemlock forests. Cite your sources.

Predict how three biotic and three abiotic factors will differ between the hemlock and deciduous forest plots. Biotic factors could include insects by type, animals, and understory plants. Include at least one animal species by looking for signs at the plot or from class readings. Abiotic factors could include soil temperature, soil pH, or soil nutrients.

Methods (10 pts.): List the steps you followed to collect data about the ecology of the hemlock and deciduous forests. Number each step in a clear, concise manner that could be followed by a scientist who wants to repeat your experiment.

Data (15 pts.): Report your data in table format. Then, use Excel to create bar graphs to display your data. Create a series of graphs that compares pH, nutrient levels, temperature, and organism abundance by type in the hemlock and deciduous forests. Include titles and axis labels.

Results (15 pts.): Summarize your data. Report your findings about the biotic and abiotic factors that you studied.

Analysis (20 pts.): Compare and contrast the characteristics of each plot. Make sure that your analysis answers the questions listed below. Write this in paragraph form.

Analysis Questions

1. How does the ecology of a 1 x 1 meter area differ in a hemlock vs. deciduous forest (plants by type/species, fungi, invertebrates by type, pH, nutrients, temperature, other observations).
2. How is a hemlock forest floor unique? What is the ecological value of a hemlock forest? Reference this with information from a journal article.
3. How do you predict the landscape and the New England forest ecosystems will change if we lose our hemlock forest due to the invasive insect, the woolly adelgid?

Conclusion (20 pts.): Summarize what you learned from this study in 1-3 paragraphs. In this section, discuss the similarities and differences between the two plots. Include a statement about the ecological value of the hemlock forests. Use what you learned from your data and the readings to predict how the New England forest ecosystem could change if hemlock forests are lost to the hemlock woolly adelgid.

Citing References in your Text

When you cite a reference in your text you should use one of the following two formats:

(1) Give the author's last name in the sentence and then give the year of the publication in parenthesis:

According to Rodgers (1983), the Appalachian Mountains were formed in three events.

or

(2) Quote the author exactly--be sure to put the quoted phrase between quotation marks--and then list the author's name, the date, and the page number in parenthesis:

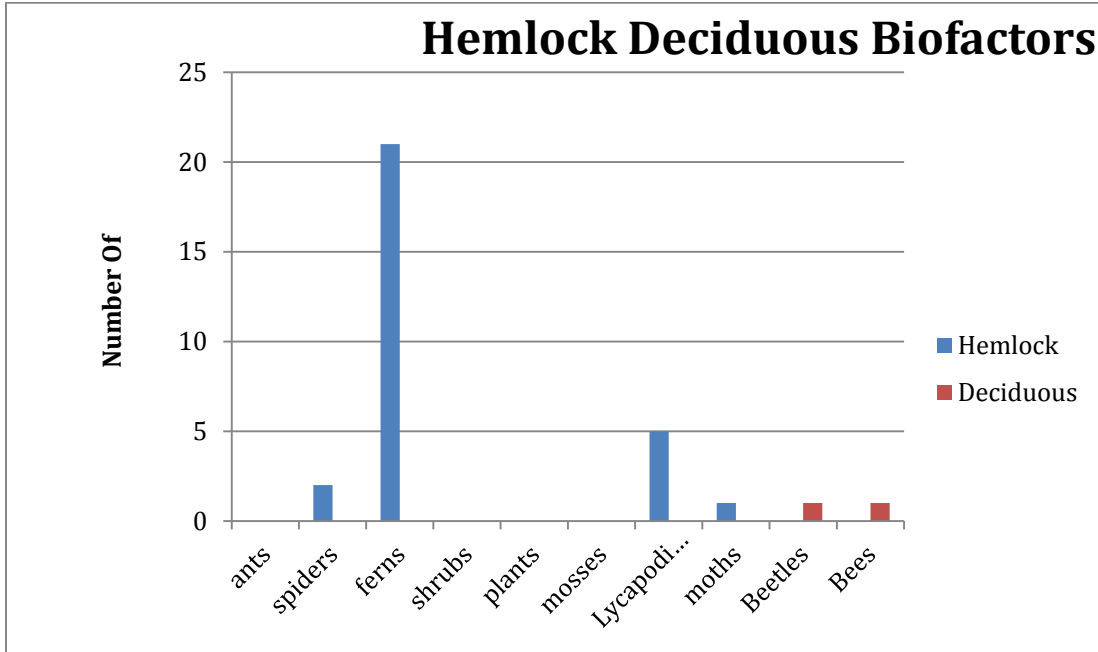
"All the climaxes produced mountainous islands or highlands that shed vast amounts of debris westward to form clastic wedges or delta complexes on the continental margin."
(Rodgers, 1983, p. 229).

*<http://tim.thorpeallen.net/Courses/Reference/Citations.html#when>

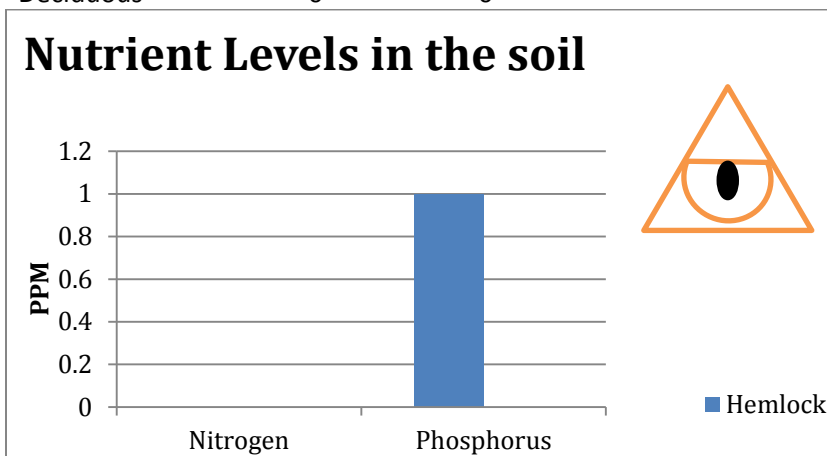
See Sample Student-made Graphs below:

Student -created Graphs

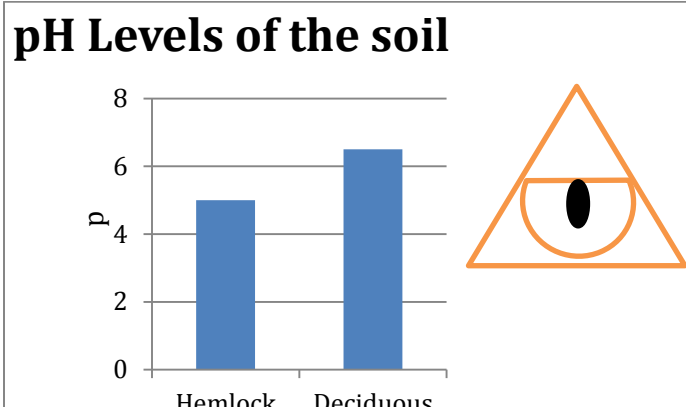
Forest	ants	spiders	ferns	shrubs	plants	mosses	Lycopodium	moths	Beetles	Bees
Hemlock	0	2	21	0	0	0	5	1	0	0
Deciduous	0	0	0	0	0	0	0	0	1	1



Nutrient Level	Nitrogen	Phosphorus
Hemlock	0	1
Deciduous	0	0



Forest	pH
Hemlock	5
Deciduous	6.5



Forest	Temperature in °C
Hemlock	12
Deciduous	13

