"Woolly Bully" – Hemlock Trees and the Invasive Pest, the Woolly Adelgid

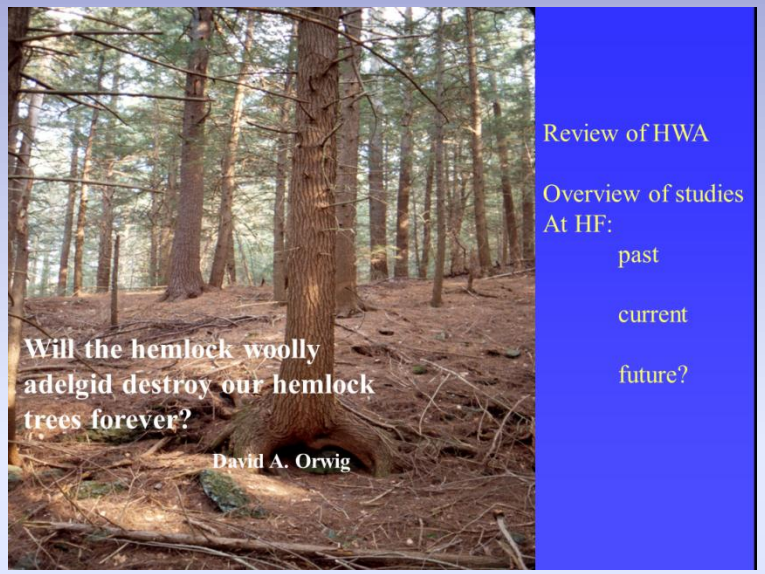
Tips for Successful Field Experiences

- Send a letter home explaining your study and include tentative dates for field work
- Prepare your field site- check for any hazards.
- Make sure all students visit the restroom before leaving
- Practice data taking and other skills inside first
- Check all supplies before going out.
- All students should be responsible for completing a data sheet.
- Remind students that going outside for science is a privilege. Review the basic rules each time.
- Have your active students carry the heavy equipment!

Safety First +

- √ All students should have appropriate footwear and clothing.
- √ Check with students or the school nurse for possible allergies.
- √ If it is sunny, hats and sunscreen should be worn.
- √ Thoroughly check your field site for hazards such as bees' nests and hanging branches.
- √ A little rain is ok, but stay out of the woods during storms and on very windy days.
- √ Take a radio or cell phone with you.
- √ Review safety rules often.

Get Started in the Classroom-



Show Some Pictures-
Pictures of students participating in the study are helpful.

Show Dave's PowerPoint.

Pest Alert

United States Department of Agriculture
Forest Service
Northeastern Area State and Private Forestry
NA–PR–09–05
August 2005

Hemlock Woolly Adelgid

Native to Asia, the hemlock woolly adelgid (*Adelges tsugae*) is a small, aphidlike insect that threatens the health and sustainability of eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*) in the Eastern United States. Hemlock woolly adelgid was first reported in the Eastern United States in 1951 near Richmond, Virginia. By 2005, it was established in portions of 16 States from Maine to Georgia, where infestations covered about half of the range of hemlock. Areas of extensive tree mortality and decline are found throughout the infested region, but the impact has been most severe in some areas of Virginia, New Jersey, Pennsylvania, and Connecticut.

Hemlock decline and mortality typically occur within 4 to 10 years of infestation in the insect's northern range, but can occur in as little as 3 to 6 years in its southern range. Other hemlock stressors, including drought, poor site conditions, and insect and disease pests such as elongate hemlock scale (*Fiorinia externa*), hemlock looper (*Lambdina fiscellaria fiscellaria*), spruce spider mite (*Oligonychus ununguis*), hemlock borer (*Melanophila fulvoguttata*), root rot disease (*Armillaria mellea*), and needlerust (*Melampsora parlowii*), accelerate the rate and extent of hemlock mortality.

FIGURE 1.—Hemlock woolly adelgid aviseces.

Hosts

The hemlock woolly adelgid develops and reproduces

observed from late fall to early summer on the underside of the outermost branch tips of hemlock trees (figure 1).

Life History

The hemlock woolly adelgid is parthenogenetic (all individuals are female with asexual reproduction) and has six stages of development: the egg, four nymphal instars, and the adult. The adelgid completes two generations a year on hemlock. The winter generation, the sistens, develops from early summer to midspring of the following year (June–March). The spring generation, the progrediens, develops from spring to early summer (March–June). The

Do some research - there's a lot on line too.

Practice measuring new growth in the classroom first- this is key!

Preview the data sheet in the classroom. Have the students fill in the top portion. Remind them how important it is to include the date!

Harvard Forest Schoolyard Ecology
Woolly Bully: Hemlock Trees and the Invasive Pest, the Woolly Adelgid

Student Data Sheet

Name(s):_____
School:_____
Date:___/___/_____
Site Name/location:
Tree ID Number:

Tree Crown health (0-3):_____

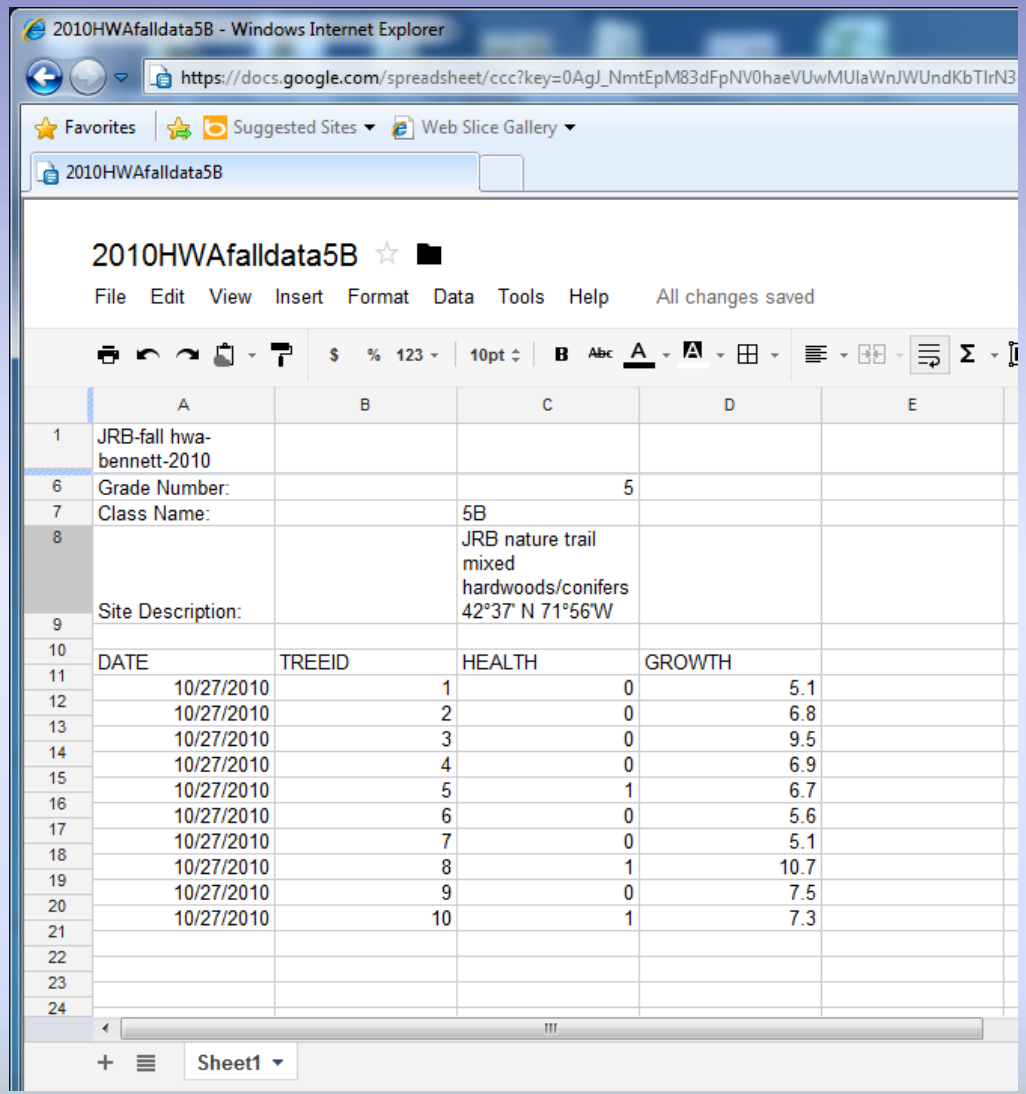
0 - Healthy-all green
1 – Some bare branches
2 –Unhealthy- half or more bare branches
3 –Dead- no green needles
4 - dead – killed by HWA
5 - cut down due to HWA
6 - cut down due to reasons other than HWA

ID Tree/Branch number/letter	**White wool** present(1) Absent(0)	**Number of Egg Sacs** Per 10cm segment	**New Growth at Branch Tip (cm)**
Summary data for Tree Number:	**White wool** Present(1) Absent (0)	**Average Number of Egg Sacs**	**Average New Growth** (cm)

ld notes/comments: Please write field observations re: field conditions such as
nate, wildlife, presence of other insects, and other plants on the reverse of this form.
te what other types of trees are nearby and may replace hemlock if it dies.

Where is the crown of the tree?

Talk about field notes.



	A	B	C	D	E
1	JRB-fall hwa-bennett-2010				
6	Grade Number:		5		
7	Class Name:		5B		
8	Site Description:		JRB nature trail mixed hardwoods/conifers 42°37' N 71°56'W		
9					
10	DATE	TREEID	HEALTH	GROWTH	
11	10/27/2010	1	0	5.1	
12	10/27/2010	2	0	6.8	
13	10/27/2010	3	0	9.5	
14	10/27/2010	4	0	6.9	
15	10/27/2010	5	1	6.7	
16	10/27/2010	6	0	5.6	
17	10/27/2010	7	0	5.1	
18	10/27/2010	8	1	10.7	
19	10/27/2010	9	0	7.5	
20	10/27/2010	10	1	7.3	
21					
22					
23					
24					

I like to have the students enter their own data on the data entry sheet. If you use a Google Doc they can all enter it at the same time in the computer lab!

Assessment

Name _____ Date_____

HWA Data Collection Assessment Rubric

	3 Detailed, accurate, neat, and complete!	2 Legible; most information included Some detail	1 Difficult to read; Incomplete, No detail
Heading – group names (yours first), school, tree id, date			
Field Notes			
Data • **tree crown health** • **presence/ absence of HWA** • **new growth measurements**			

Total points 9 **My score _____**

Teacher Comments

_____

_____

_____

Name_____ Group #_____ Date_____

Field Work Assessment Rubric

	Always 3	Sometimes 2	Needs Improvement 1	Points
I showed respect for **all** living things in and around the area of fieldwork				
I stayed with my group at all times, displayed good teamwork, and settled disagreements peacefully				
I completed my assignment and my data sheet is neat, complete, and accurate				
I used materials and the field site safely and responsibly.				

Total Points_____

Student Comments

_____

_____

_____

Teacher Comments

_____

_____

Open ended science questions

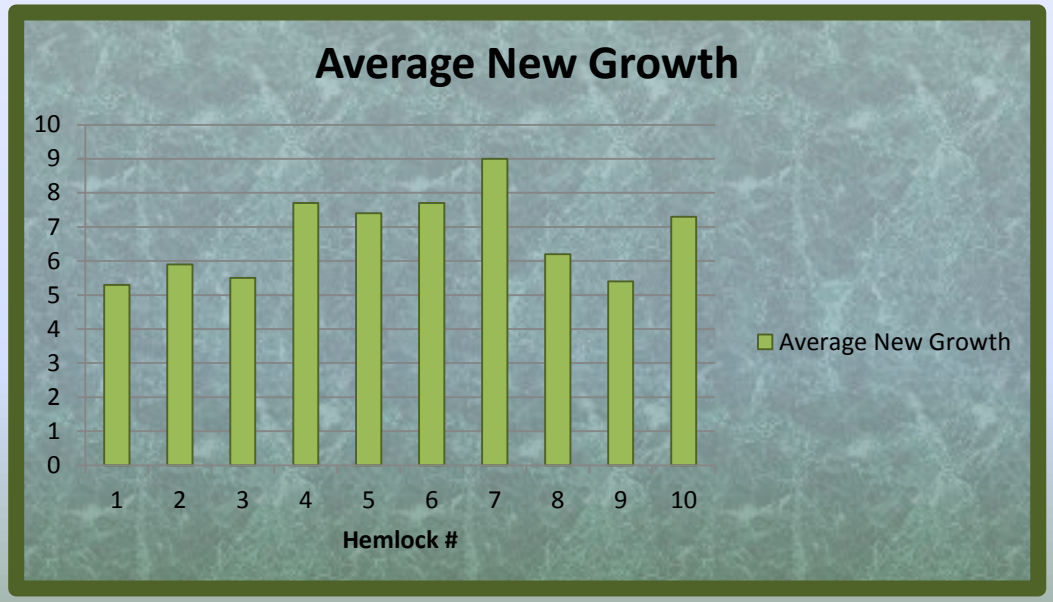
- **What changes will we see in our forest if the hemlock trees disappear?**
- ***Ecology* is the study of the relations and interactions between organisms and their environment. Why is our HWA study an *ecology* study?**

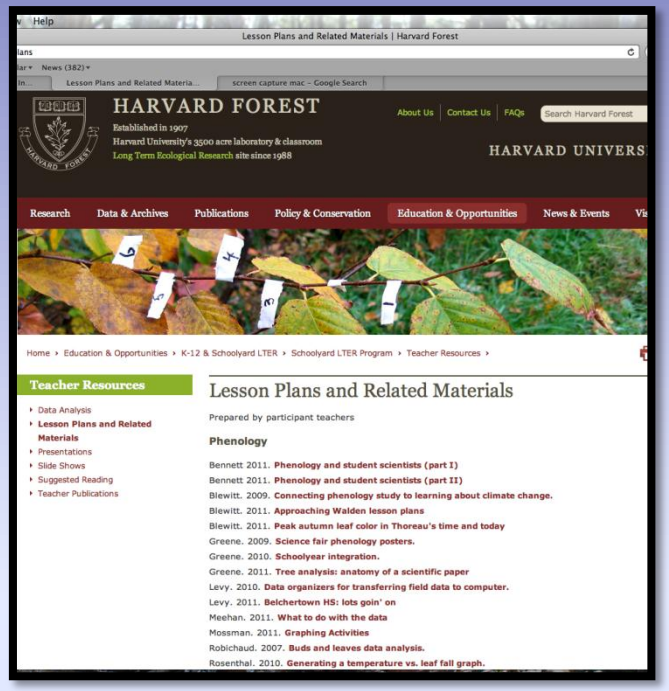
Student Name_____ **Assignment**_____ **Date**_____

Assessment Rubric for Open Ended Science Questions **Total # of points 16** **Student Score** _____

Points	**4**	**3**	**2**	**1**
Ideas	Several (4-5) thoughtful ideas included. Ideas are clear and supported with details.	Some (3-4) thoughtful ideas included. Ideas are clear and supported with at least one detail.	Two ideas included. Ideas are clear but not supported with detail.	One idea included. Idea is unclear and not supported with detail.
Organization	Topic sentence restates the question. Ideas are well organized. Concluding sentence gives a summary of ideas.	Topic sentence restates the question. Ideas are somewhat organized. Includes a concluding sentence.	Topic sentence restates the question. Ideas are somewhat organized. No concluding sentence.	No topic sentence. Ideas are not organized. No concluding sentence.
Word Choice	Includes at least four science vocabulary words that are used appropriately.	Includes at least three science vocabulary words that are used appropriately.	Includes at least two science vocabulary words that are used appropriately.	Includes one science vocabulary words that is used appropriately.
Conventions	All sentences include proper punctuation and capitalization. Correct grammar is used- subject and verb agreement; no fragments or run on sentences. 0-1 spelling errors.	Sentences include most proper punctuation and capitalization. Most correct grammar is used- subject and verb agreement; no fragments or run on sentences. A few spelling errors.	Sentences include some proper punctuation and capitalization. Some correct grammar is used- subject and verb agreement; contains fragments or run on sentences. Spelling errors.	Sentences include little proper punctuation and capitalization. Many grammatical errors in subject and verb agreement; contains fragments or run on sentences. Many spelling errors.

hemlock#	Average New Growth cm
1	5.3
2	5.9
3	5.5
4	7.7
5	7.4
6	7.7
7	9
8	6.2
9	5.4
10	7.3
average	6.74





Latitude ˚ N	Elevation (meters)	Adelgid*
42.74 Ashburnham	311 Ashburnham	0
42.54 Athol	220 Athol	1
42.42 Barre	316 Barre	1
42.11 Monson	189 Monson	3
42.37 N. Brookfield	223 N. Brookfield	0
42.61 Orange	236 Orange	0
42.04 Southbridge	290 Southbridge	4
42.08 Springfield	051 Springfield	4
42.15 Warren	247 Warren	1
42. 63 Winchendon	311 Winchendon	0

3. Save as Name (yours!) HWA data 2004

*Key to the Average Abundance of HWA Per Stand: This is a stand-level rating of how abundant HWA was throughout the area.
0 = HWA absent; 1 = light; 2 = light to moderate; 3 = moderate; 4 = moderate to heavy; 5 = heavy (sacs found at the base of most needles on most if not all branches examined.

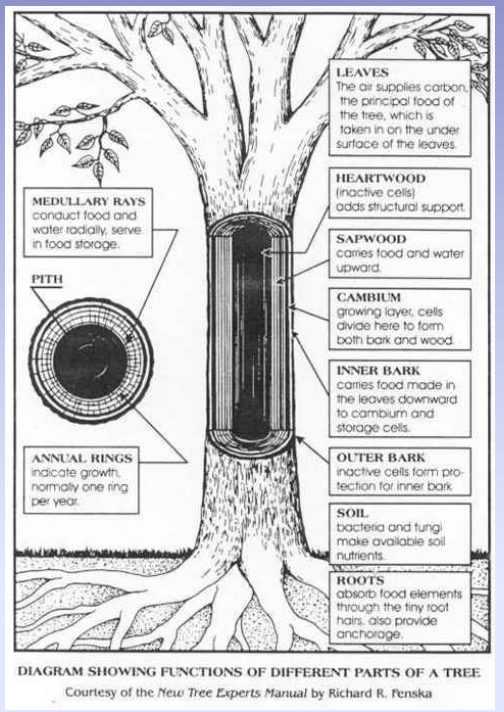
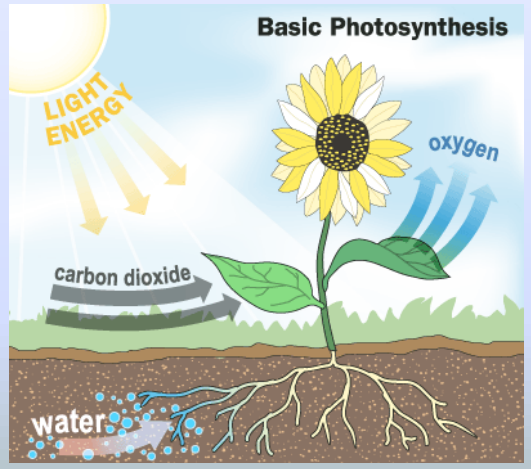


DIAGRAM SHOWING FUNCTIONS OF DIFFERENT PARTS OF A TREE
Courtesy of the *New Tree Experts Manual* by Richard R. Penska



Integrate lots of science- basic plant physiology, processes and forest ecology in general

Plot Studies With Students

Under the Hemlocks

Under the Hardwoods

Group names _____ **Date** _____

Hemlock Plot ~ plants (small plants, grasses, moss, ferns)

How Many?	Name of plant	Description
	moss cover	**0** none **3** 50-75% **1** 1-25% **4** 75-100% **2** 25-50%

Total # _____ **# of Species**_____

Hemlock Plot ~ shrubs (with woody stems)

How Many?	Name of shrub	Description

Total # _____ **# of Species**_____

Hemlock Plot~ Fungi (mushrooms and other fungi)

How Many?	Name of fungus	Description

Total # _____ **# of Species**_____

Hemlock Plot ~ Seedlings and Saplings

How Many?	Name	Description

Total # _____ **# of Species**_____

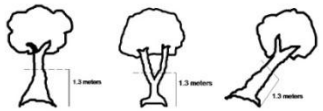
Create a class graph. What does the data tell us?

Are there differences between the hemlock and the hardwood plots? What do you think causes these differences?

Extending your study across the disciplines

Name_____ Date_____

Measuring Tree DBH (Diameter at Breast Height)
Scientists measure the diameter of trees at **1.3 meters** – the breast height of the average person. They use this to monitor the growth of the tree. Here are some rules for finding the **DBH** of your tree.



- First you have to find the circumference – the distance around the trunk.
- Make sure you keep your measuring tape level as you go around the tree!
- If your tree splits under 1.3 meters measure each side seperately.
- If your tree is leaning measure your 1.3 meters against the tree.

Now you are ready to measure!

Use your tape to measure the circumference of your tree. Remember scientists use centimeters!

Now use the circumference to find the diameter –

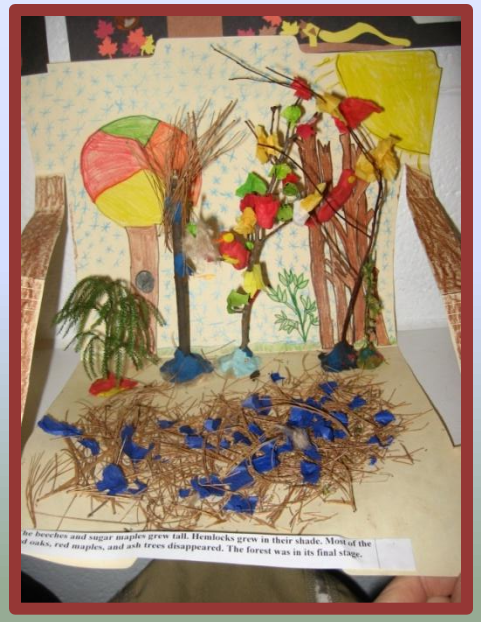
Diameter = Circumference ÷ 3.14 (pi)

The DBH of my tree is _____ centimeters.

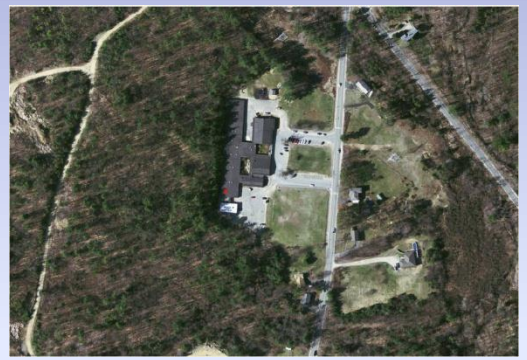
A Hemlock Tree Canopy

The hemlock tree's canopy
Is like a roof above my head
You can hide from your enemy
I can use the branches as my bed
All you have to do is rest your head
And then you see
A Hemlock tree canopy

Katherine Lemieux

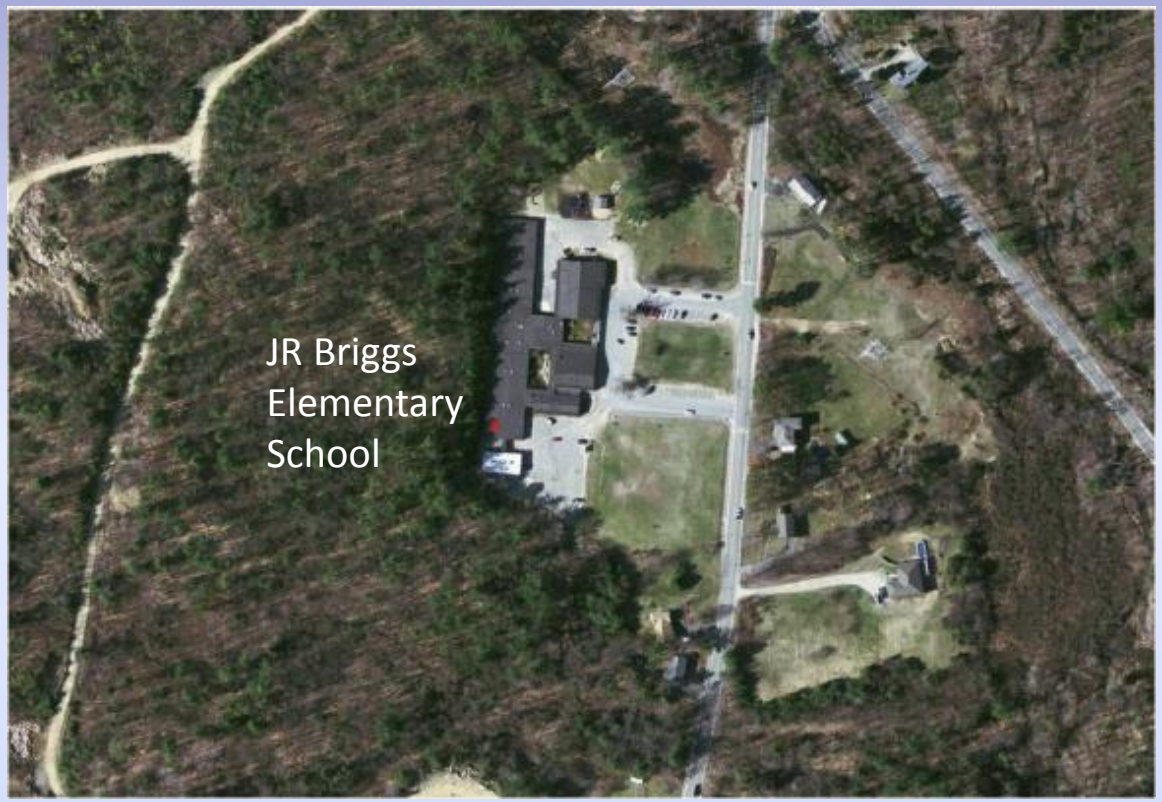


Enrichment




Now Playing
Library
Rip
Burn
Sync
Media Guide
Welcome
Dr. Orwig

Using Google Earth to Survey the Hemlocks in your Town



Step 1 **Students print out maps (black and white are fine) of their house and yard from the computer. *Make sure they have the latitude and longitude in decimals (under tools).**

Using Google Earth to Survey the Hemlocks in your Town

Step 2 **Students take this map home. With a parent they color in any areas that have hemlock trees with a green crayon.**

Using Google Earth to Survey the Hemlocks in your Town

Step 3 **Students check each hemlock carefully for adelgid. If they see adelgid on a tree, mark that tree with an x on their map. Then take a sample, a small piece of the infested branch and seal it in a ziplock bag. Have the students bring it in to school to do a positive identification under the microscope.**

2012 Ash HWA survey					
Name	address	latitude	longitude	Hemlocks	HWA + -
Josslyn Bourque	40 Winding Cove Rd	42 40 23.20	71 58 18 53	no	-
Ean Roy	22 Liberty Ln	42 37 45.36	71 54 16.52	yes	-
Connor Fagan	43 Juniper Rd	42 37 41.73	71 55 32.58	yes	-
Nicole Snow	56 Lincoln Ave	42 38 57.66	71 57 04.42	no	-
Michelle Lim	28 Main St.	42 38 10.06	71 54 27.77	no	-
Kahlan Jones	7 Cross St.	42 36 41.40	71 56 15.63	no	-
Megan Brown	14 Holden St.	42 38 27.56	71 54 25.40	no	-
Henry Rittberg	13 South School St.	42 36 33.18	71 55 56.84	yes	-
Tyler Money	50 Gardner Rd.	42 36 23.33	71 56 53.04	no	-
David Rousso	228 East Rindge Rd.	42 41 49.85	71 57 14.10	yes	-
Mackenzie Nims	402 Ashby Rd.	42 40 51.40	71 53 02 49w	no	-
Gabby Thomas	24 Juniper Rd.	42 37 47.65	71 55 40 38	yes	-
Mike Sullivan	70 Cushing St.	42 38 35.83	71 54 58 33" W	no	-
Rachael Law	58 Corey Hill Rd.	42 37 49.25	71 55 30 61	yes	-
Chloe Jess	222 Chesnut St.	42 34 27.08	71 59 05 52	yes	-
Ethan Hindle	46 Central St.	42 37 52.14	71 54 38 96 W	no	-
Liv Kuehl	51 Young Rd.	42 41 08.93	71 57 34 19 W	yes	-
Tyler Antley	53 Winchendon Rd	42 38 11.83	71 55 32. 91 W	yes	-
Jacob Fowler	15 South High St.	42 36 28.14	71 56 35 23 W	no	-
Jake Packard	3 Kelton Rd.	42 38 20.54	71 53 51 25W	yes	-
Finn Picone	49 Willard Rd.	42 37 40.20	71 54 35.38	yes	-
Olivia scarborough	32 south high st.	42 36 24.29	71 56 43 32	yes	-
Jenna Oulette	4 Mattakesett Cir	42 39 50.33	71 54 02.28	yes	-
Ben Gauthier	5 Winding Cove Rd.	42 40 19.98	71 58 10.38	yes	-

Step 4 **Students enter the latitude and longitude of their house from their map on to a spreadsheet. I like to use Google Docs so we can all do it together in the computer lab. Now you have a record of the hemlock trees and adelgid in town. You can add to the spreadsheet every year.**

Harvard Forest Schoolyard Ecology
Woolly Bully: Hemlock Trees and the Invasive Pest, the Woolly Adelgid

Student Data Sheet

Name(s):_____
School:_____
Date:___/___/_____
Site Name/location:
Tree ID Number:

Tree Crown health (0-3):_____

0 - Healthy-all green
1 – Some bare branches
2 –Unhealthy- half or more bare branches
3 –Dead- no green needles
4 - dead – killed by HWA
5 - cut down due to HWA
6 - cut down due to reasons other than HWA

ID Tree/Branch number/letter	**White wool** present(1) Absent(0)	**Number of Egg Sacs** Per 10cm segment	**New Growth at Branch Tip (cm)**
Summary data for Tree Number:	**White wool** Present(1) Absent (0)	**Average Number of Egg Sacs**	**Average New Growth** (cm)

Field notes/comments: Please write field observations re: field conditions such as climate, wildlife, presence of other insects, and other plants on the reverse of this form. Note what other types of trees are nearby and may replace hemlock if it dies.