HARVARD FOREST
HARVARD UNIVERSITY
Established 1907 Long Term Ecological Research Site since 1988

Harvard LTER Schoolyard Program

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

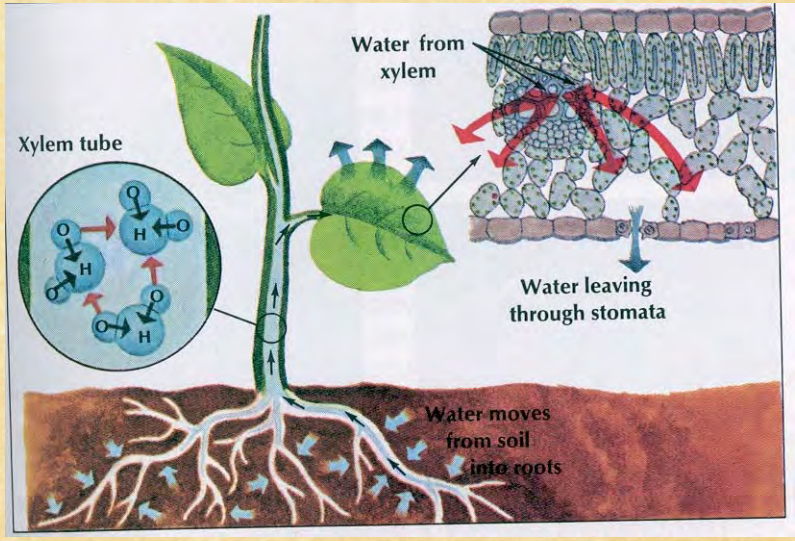
- Lesson Title: **Buds and Leaves**
- Teacher/Author: Lise LeTellier
- School: Holyoke Catholic High School
- Level: Freshmen Environmental Science
- Date: April, 2013

HARVARD FOREST

Established 1907
Harvard University's 3500 acre laboratory & classroom
Long Term Ecological Research Site since 1988

Schoolyard LTER Program

Real Science - Real Scientists - Real Issues



http://www.edline.net/pages/HolyokeCatholic/Classes/1213_10030001

Freshmen Environmental Science Harvard (LTER) Schoolyard Program: Buds and Leaves

Students will be able to:

- 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 and record data
  - Make and record field observations
  - Organize large quantities of data into proper data tables
- Analyze data and draw conclusions
  - Make graphs from data
  - Interpret graphs

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Harvard Forest Long Term Ecological Research

Working with Harvard Scientists

Research and Education in Ecology

Conservation and Forest Biology

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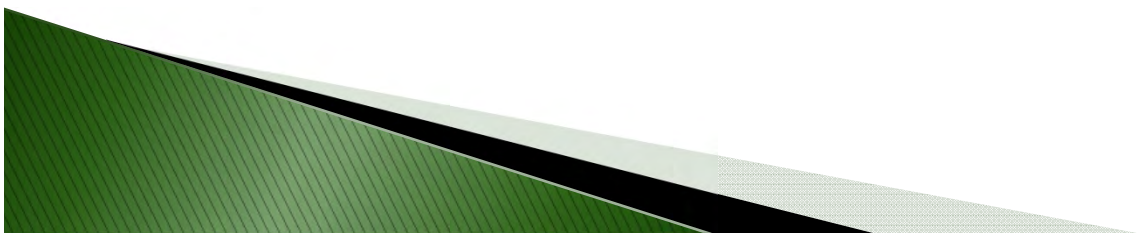
Harvard LTER Schoolyard Program

Real Science – Real Scientists – Real Issues

Phenology

- Definition:
  - The study of an organism's response to seasonal changes in their environment.
- Seasonal changes include variations in:
  - sunlight
  - precipitation
  - temperature
  - and other life-controlling factors
- Examples of a phenological event: List:



John O'keefe's Big Question

- How might our New England growing season be affected by climate change?

Leaf-out (Budburst) & Senescence (leaf death)

- In temperate regions, changes in leaves influence meteorological events-
  - Evapotransfer from leaves cause cumulus clouds in summer
    - Which lead to changes in river and stream flow
- Causes of Fall leaf drop
  - Cells in petiole burst based on lower temps & frost
  - Day length shortens, trigger change in hormones
  - During drought, cells wither
- Causes of Leaf- Out (Budburst) later!

Our Big Question:

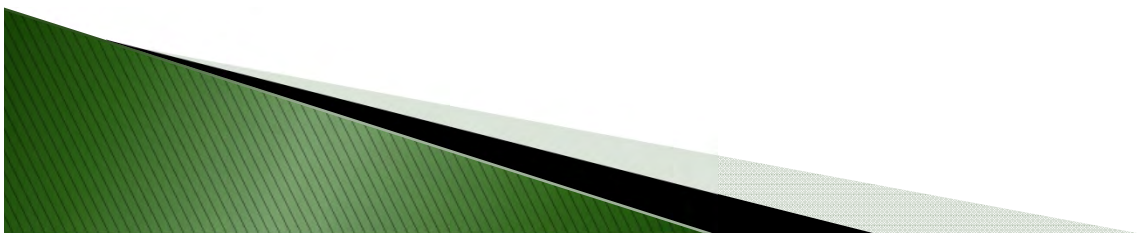
- How long is a tree's growing season for our campus?

Questions for here and now:

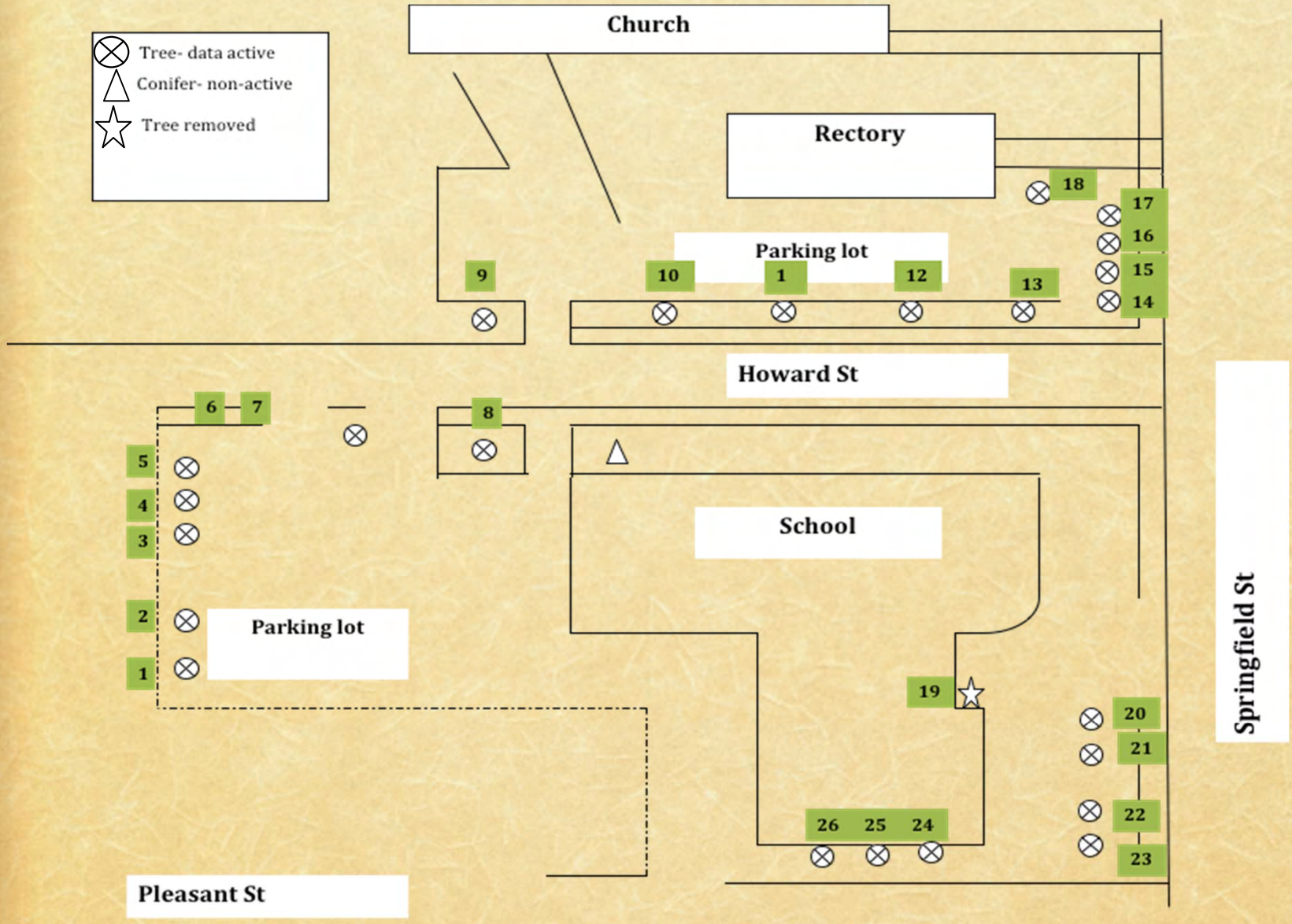
- When does the growing season end for trees on our campus?
- When does the new growing season begin in the spring?

Question for future classes:

- Is the growing season changing year to year?
- If it is, could it be related to climate change?



First Field Visit



First Field Visit

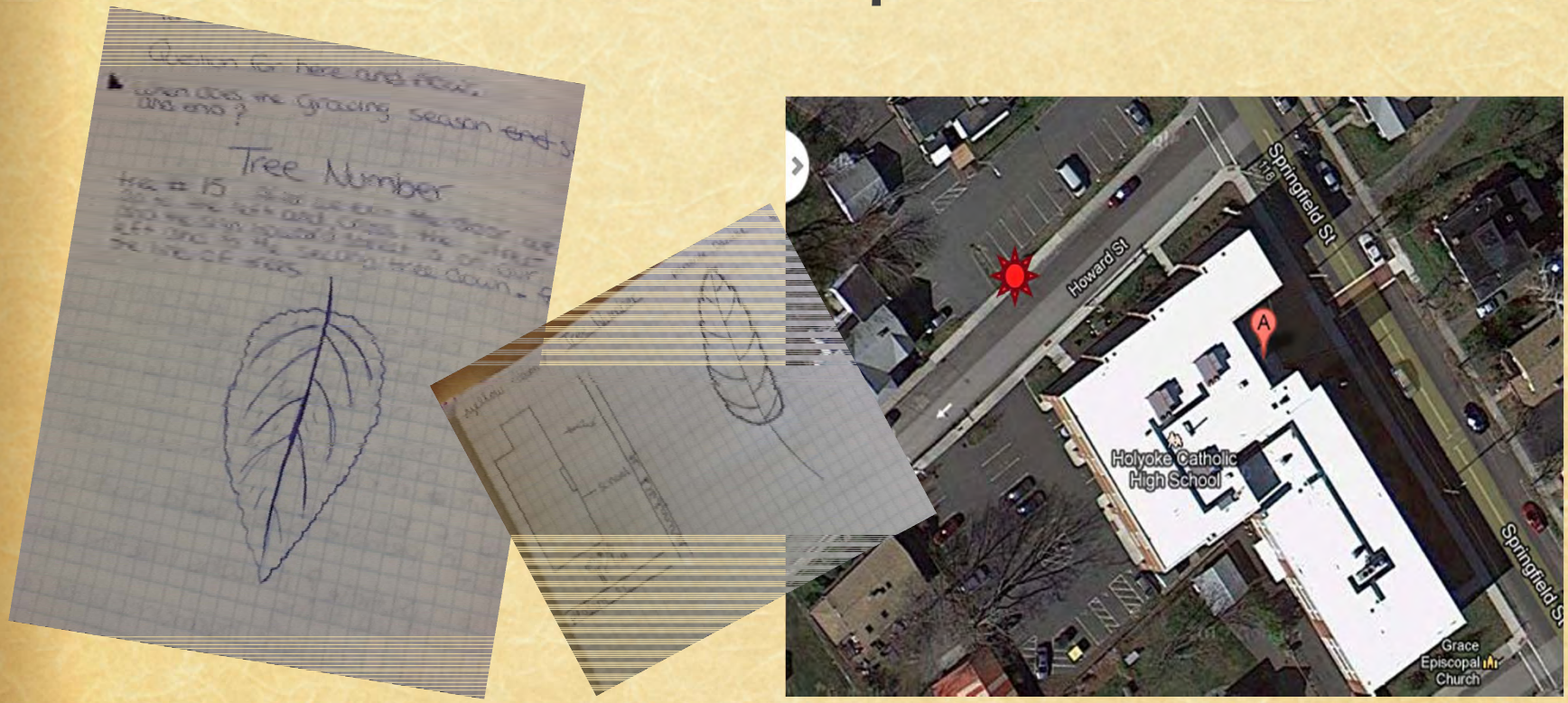
- First Field Visit
  - Locate tree
  - Check number of tree- Record tree number in your lab journal
    - Re-label if needed
  - Draw one leaf in your journal
  - Indicate if there is a yellow ribbon from past years on 2 branches or not.


Tree number 17
Tree number 201
Buds and leaves
Tree number 25

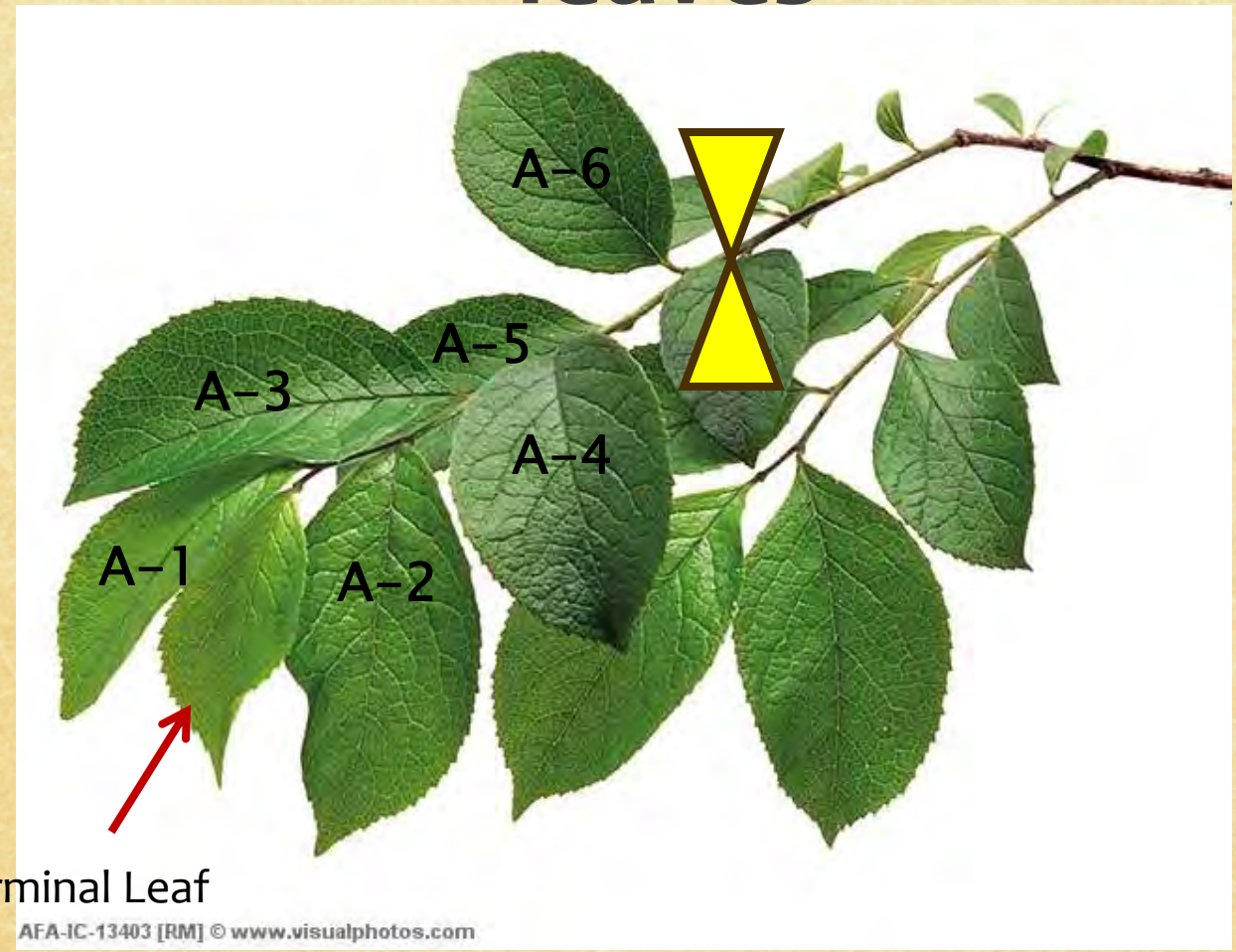
Harvard Assignment # 1

Sketch or use Google maps to indicate where your tree is located in relation to school and road.

See examples

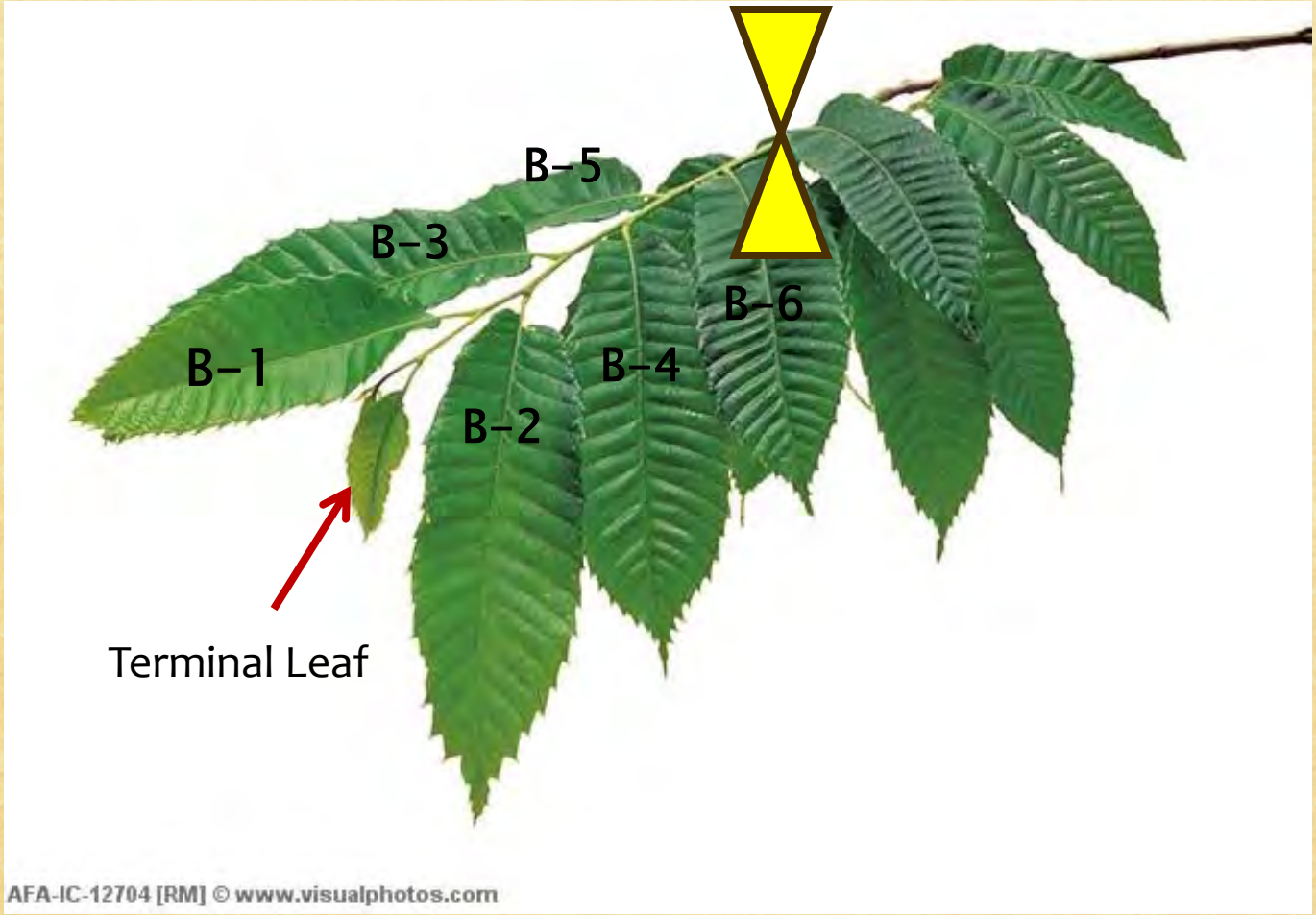


Placing the label and counting leaves



Practice # 2

Practice # 2


B–5
B–3
B–6
B–1
B–4
B–2
Terminal Leaf
AFA-IC-12704 [RM] © www.visualphotos.com

Harvard Assignment #2-

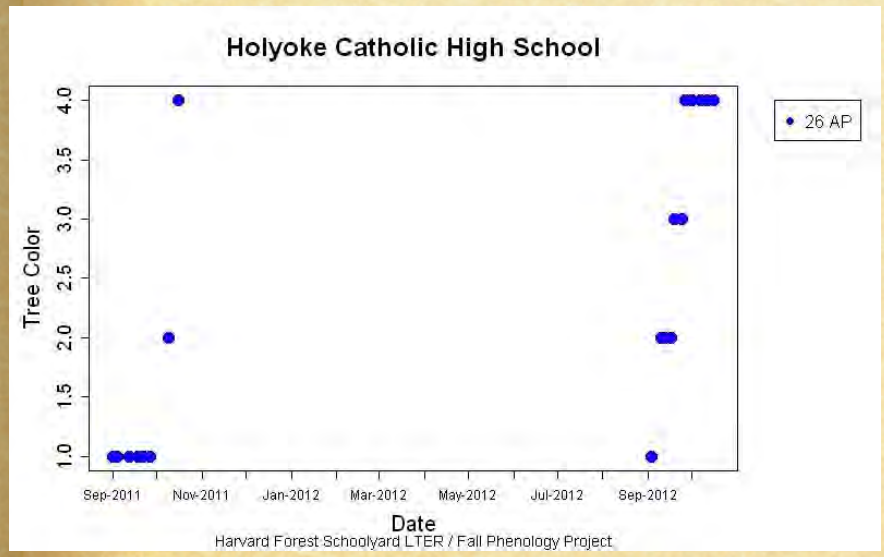
Choose a tree at home, draw a branch with its leaves, indicating on the diagram where you would place the yellow ribbon, and what each leaf is numbered as.

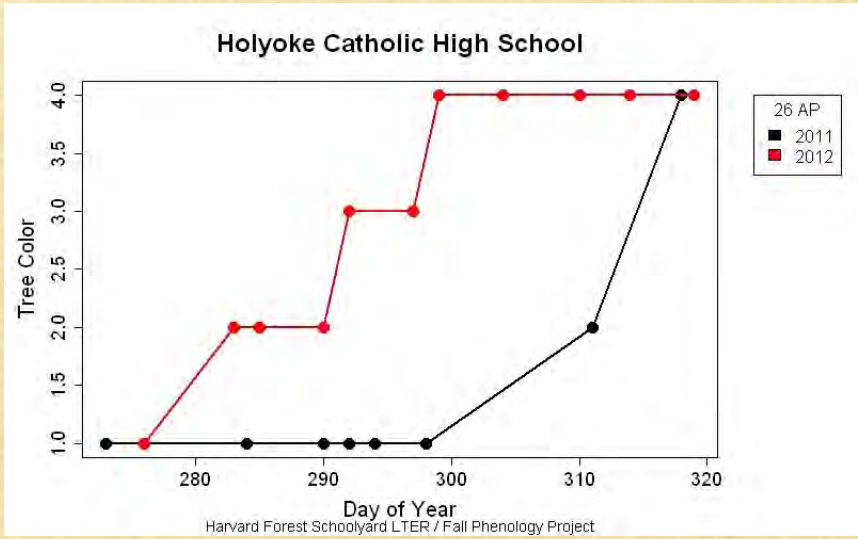
Harvard Assignment # 3
Make data tables in Field Journals

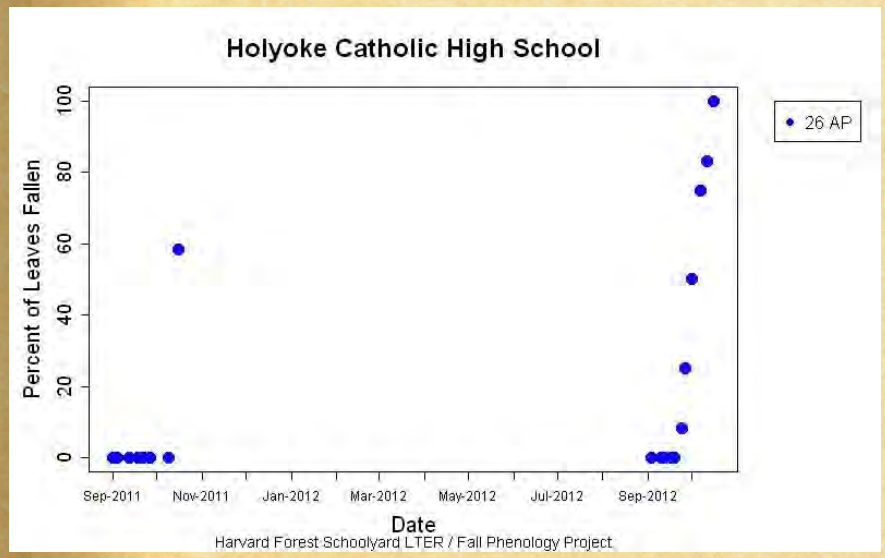
Tree #	Specie			Branch		
	Size Leaf # 1 cm	Size Leaf # 2 cm	Size Leaf # 3 cm	Size Leaf # 4 cm	Size Leaf # 5 cm	Size Leaf # 6 cm
	W-	W-	W-	W-	W-	W-
	L-	L-	L-	L-	L-	L-

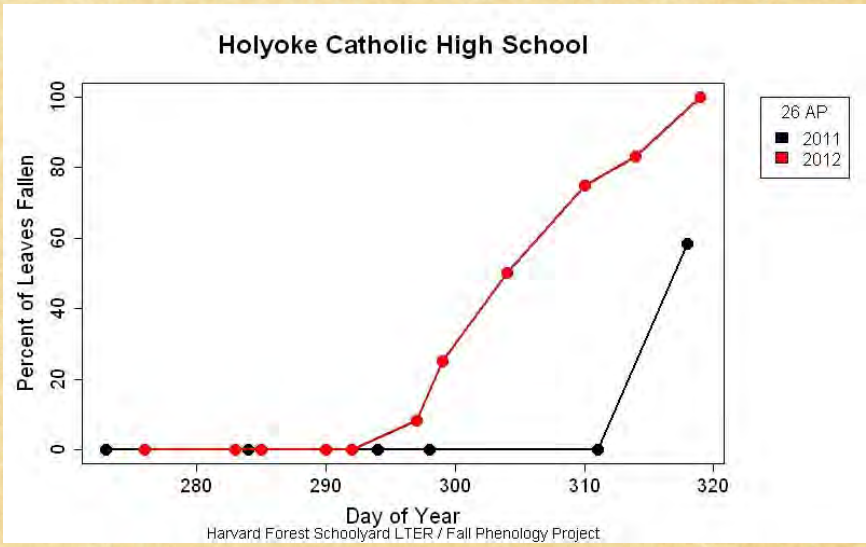
Tree #	Tree Species % not Green Fallen-1 Not fallen-0		Branch _____				
Date:Time: weather Time °C	Leaf #1	Leaf # 2	Leaf # 3	Leaf # 4	Leaf # 5	Leaf # 6	Whole Tree
9/20/2012	10%	15 %	15 %	15 %	20 %	20 %	20 %
Sunny-18	0	0	0	0	0	0	
9/25/2012	20%	25 %	25 %	50 %	25 %	50 %	50 %
cloud-20	0	0	0	0	0	0	

Harvard Assignment # 5- Learning to Analyze Data









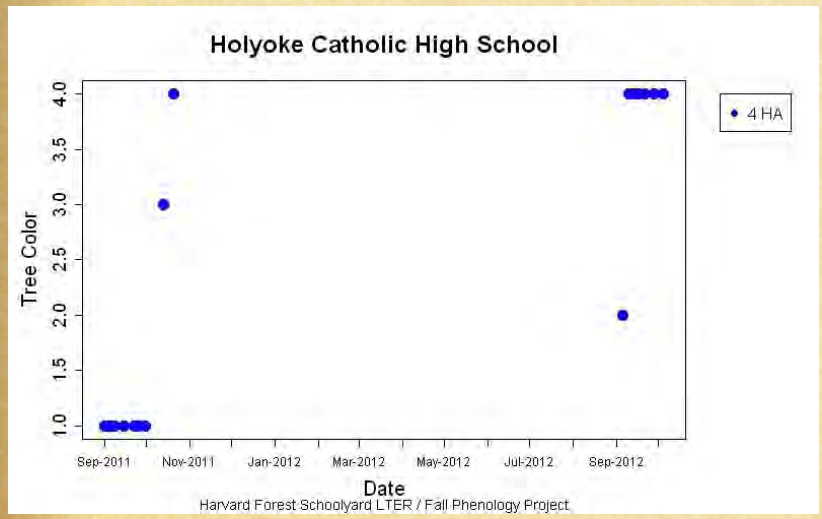
Harvard Assignment # 5- Above Average Student

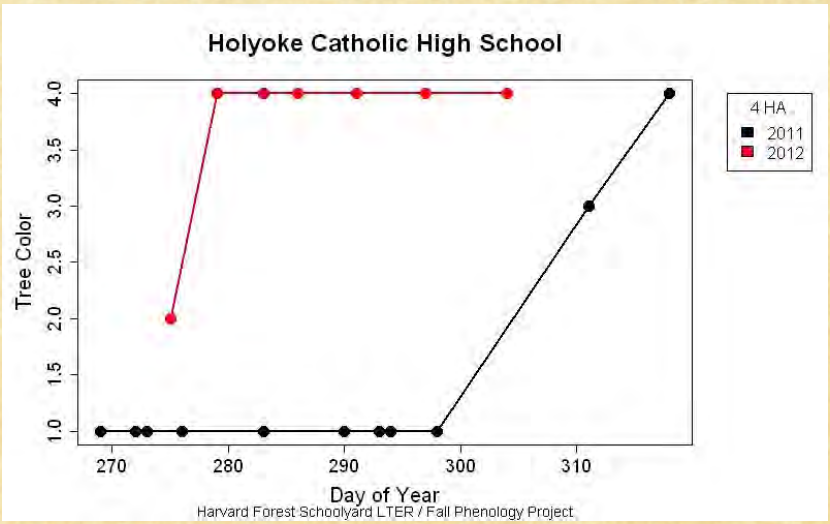
Samantha
Environmental Science
E Period
1/29/13

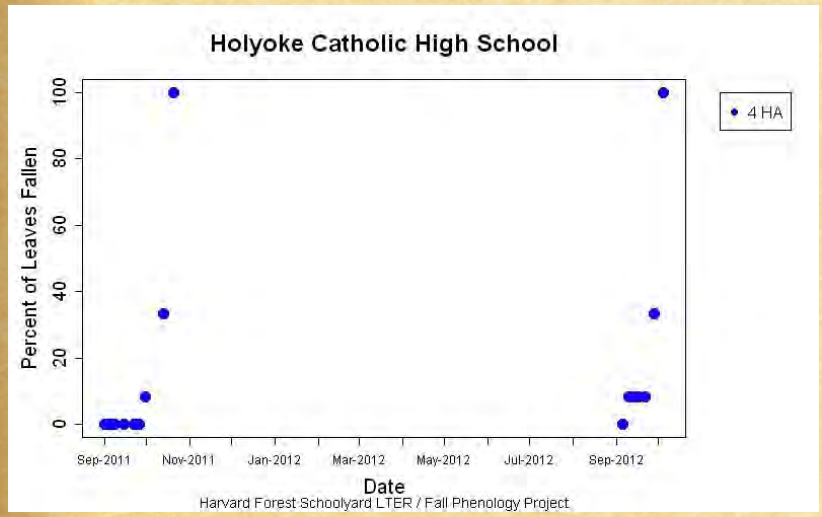
Harvard Leaf Study Assignment #4

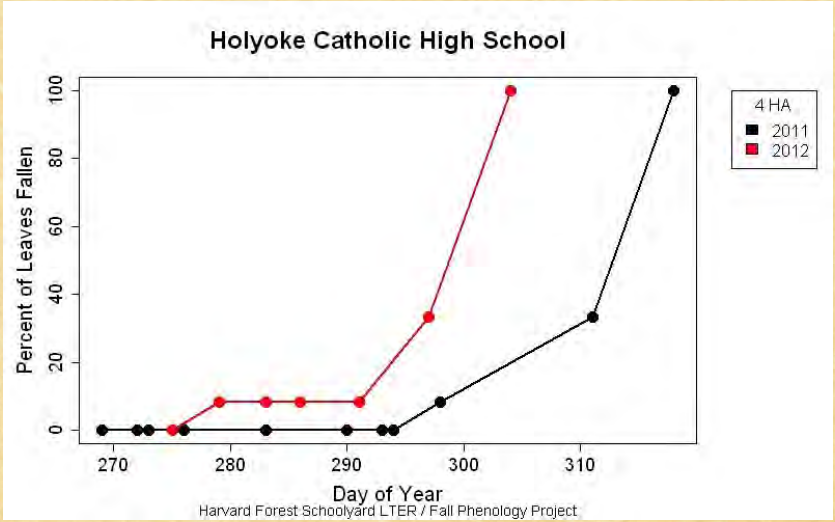
The purpose of this observation was to study when trees changed color and lost their leaves in the fall of 2011 and the fall of 2012. The major findings were that as the days went by, the tree changed color at a faster rate in 2012 than in 2011. In the fall of 2011, the tree stayed green until day 298 and it fully changed by day 318. In the fall of 2012, the tree remained green until day 275 and the tree was fully changed by day 319. Also, as the days went by, the leaves fell at a faster rate in 2012 than in 2011. In the fall of 2011, the percent of leaves fallen remained at 0% until day 311, and it reached 60% fallen on day 318. In the fall of 2012, the percent of leaves fallen until day 292. The percent of leaves fallen reached 100% on day 319. In comparison, Danielle and Mary's group had the same results when it came to the percent of tree color and leaves lost being faster in the fall of 2012 than in the fall of 2011. To improve this experiment, I recommend using extreme caution with the leaves later in the experiment because in the later weeks of the experiments, one of the leaves was accidentally caused to fall since it was only barely connected to the branch. For further study, I recommend to continue gathering data in future falls so there are more years to compare.

Harvard Assignment # 5- Learning to Analyze Data









Harvard Assignment # 5- IEP Language weakness

Ashley
Period F
1/29/13

The purpose of The Harvard Forest Tree study was to find out if the leaves falling in 2012 were earlier or later then the leaves in 2011 and also the same thing with the leaves changing color. The major findings were that in 2012 the leaves fell earlier then the leaves in 2011. The leaves in 2011 started falling around day 295 and 2012 started falling around day 275. The major findings for the color of the trees were that in 2011 the tree color lasted later then in 2012 because 2011 started changing at day 300 and 2012 started changing in day 275. In comparison to the other classmates graphs their leaves fell and also changed color later in 2011. I did not expect tree number 4 to be different from everyone else's, but I am now thinking that I only checked with the classmates who had their tree on the opposite side then mine. In conclusion, the reason for the different ways all the trees have fallen or changed faster or slower could've been because of where your tree was or also because of the weather or also the leap year that happened in 2012.

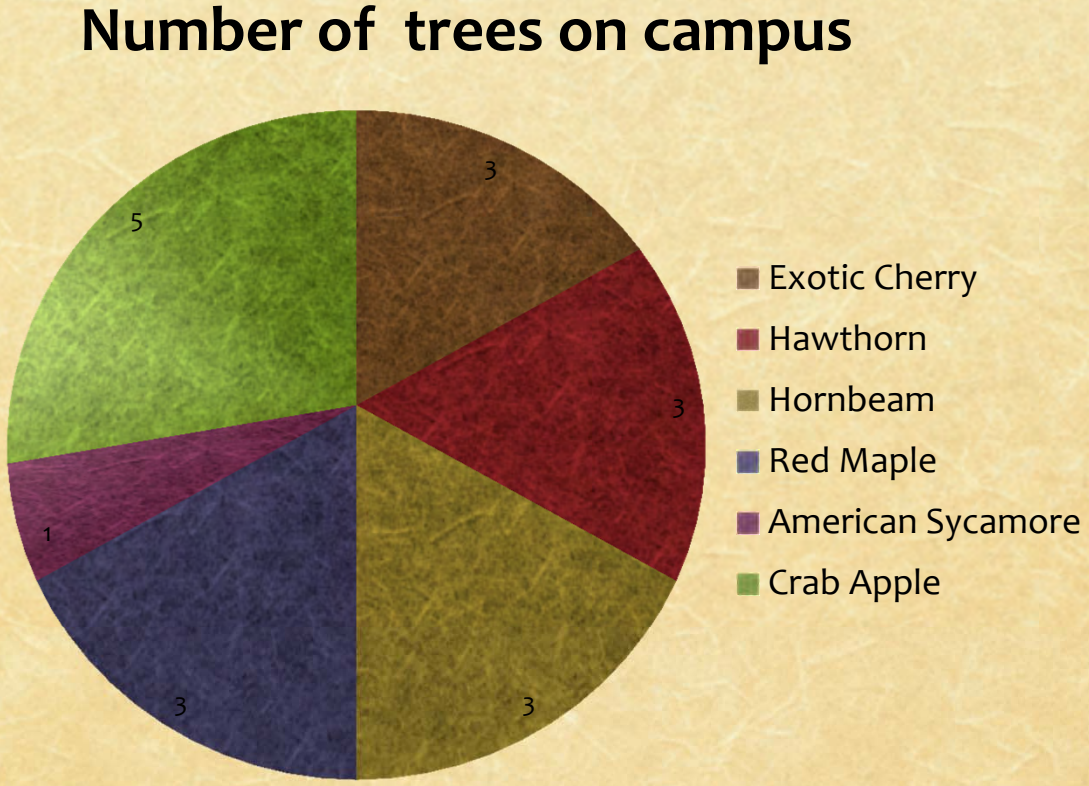
Harvard Fall Leaf Study Assignment #6
Comparing trees-
Researchable questions.

- Brainstorming
- Using the data from Harvard Forest, make a list of 5 + questions that you could ask about your tree and how it might compare with another tree, either here at our school or another school
- For now, this was a thinking process only.

Harvard Fall Leaf Study Assignment # 7 Trees on Campus- Learning to use Excel

Species Code	Specie Name		Tree Species	Number of the trees
EC	Exotic Cherry		Exotic Cherry	3
EC			Hawthorn	3
EC			Hornbeam	3
HA	Hawthorn		Red Maple	3
HA			American Sycamore	1
HA			Crab Apple	5
HO	Hornbeam			
HO				
HO				
RM	Red Maple			
RM				
RM				
AP	Crab Apple			
AP				
AP				
AP				
AP				
AS	American Sycamore			

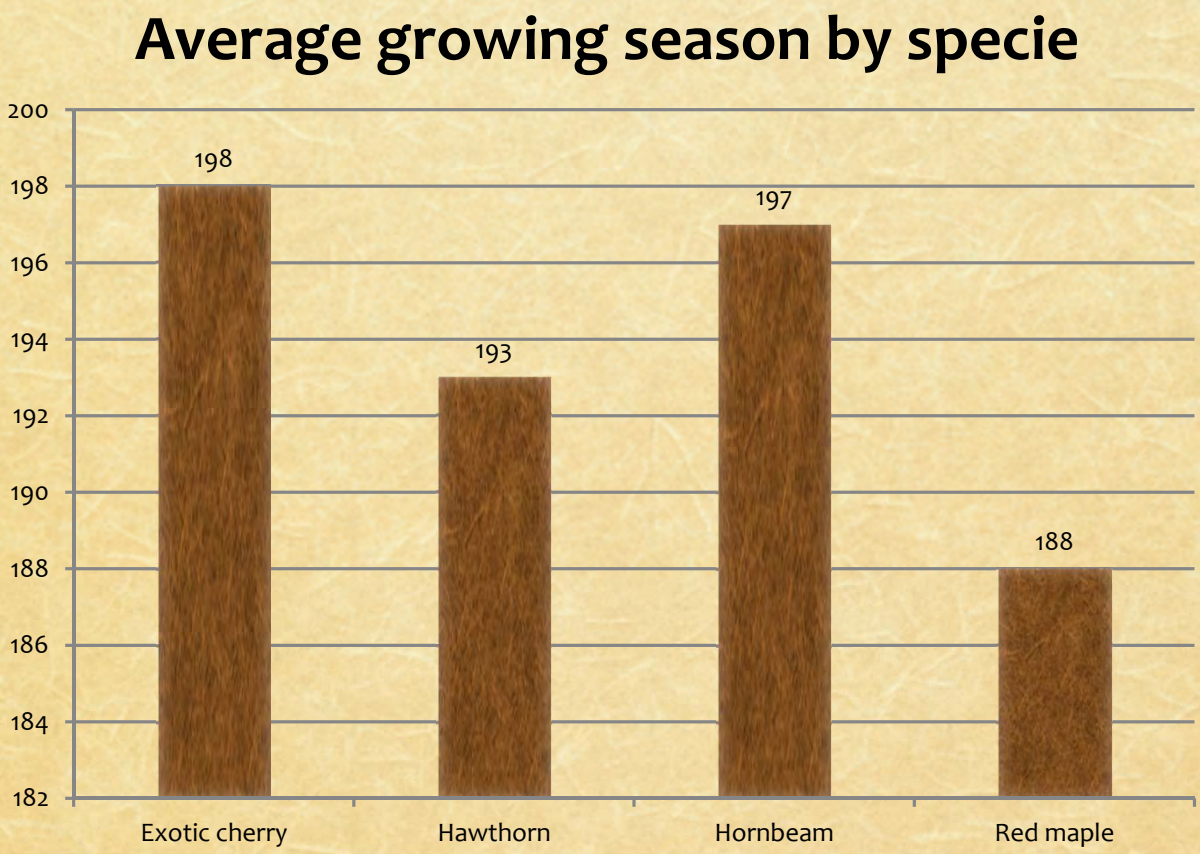
Harvard Fall Leaf Study Assignment #7 Trees on Campus



Harvard Fall Leaf Study
Assignment #8
Comparing trees growing season.

Trees we have full 2012 data									
School Code	**Teacher**	**Tree ID**	**Species Code**	**date of 50%budsburst**	**date of 50% fall**	**Calculate growing length by tree (Day of 50% fall - Day of 50% Bud burst)**	**Calculate Average growing season by species (Total of growing length /number of trees of specie)**		**Copy Data from Column H to this column**
HCH	LeTellier	10	EC	94	307	213	EC		
HCH	LeTellier	12	EC	97	294	197	198		Avg growing season by specie
HCH	LeTellier	13	EC	100	283	183		EC	198
HCH	LeTellier	3	HA	110	299		HA	HA	
HCH	LeTellier	4	HA	106	299			HO	
HCH	LeTellier	5	HA	101	299			RM	
HCH	LeTellier	1	HO	110	310		HO		
HCH	LeTellier	7	HO	146	321				
HCH	LeTellier	8	HO	109	326				
HCH	LeTellier	9	RM	109	301		RM		
HCH	LeTellier	20	RM	114	299				
HCH	LeTellier	21	RM	110	298				

Harvard Fall Leaf Study
Assignment #8
Comparing trees growing season

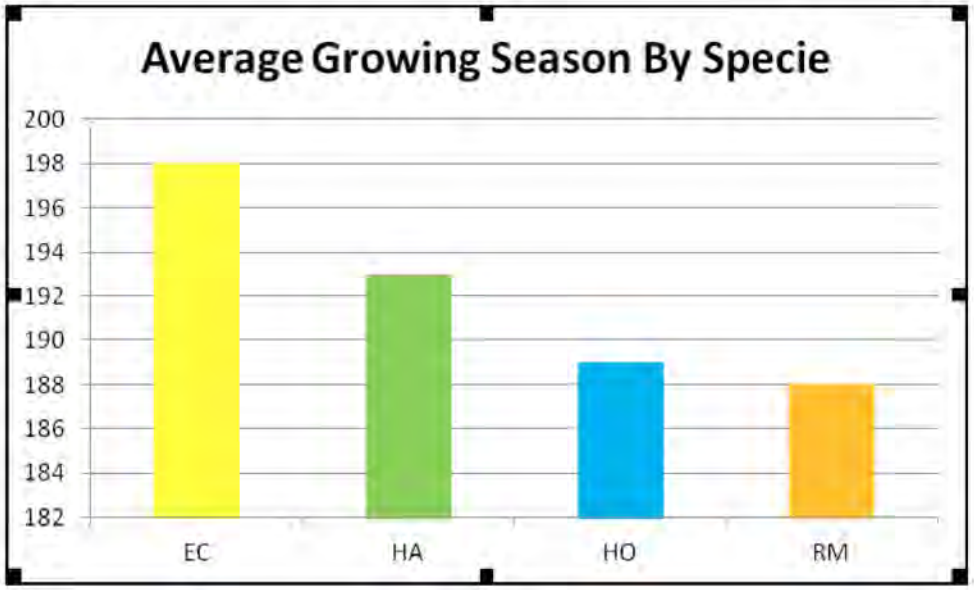


Kacie

2-2-13

Period F

Mrs. LeTellier



Result Statement: The tree species that has the longest growing season is the Exotic Cherry. The Hawthorn has the second longest growing season and the Hornbeam has the third longest growing season. The tree species with the shortest growing season is the Red Maple.

Harvard Fall Leaf Study Assignment #9 Putting it all together- Lab Report

The Growth Chart

A study on the length of the growing season of trees on the Holyoke Catholic High School campus

Introduction:

In doing this observational study, two questions were being asked. The smaller question exclusive to the students at Holyoke Catholic High School was, "How long is a tree's growing season for our campus?" Then there was the much larger question which was asked by John O'Keefe. His question was, "How might our New England growing season be affected by climate change?" Mr. O'Keefe works for the Harvard Forest which is conducting a long term ecological study and is helping students to learn about ecology, conservation, and forest biology. It also teaches about the study of phenology. To study phenology is to study how seasonal changes affect organisms, such as when trees lose their leaves, called senescence. This is due to hormonal changes in leave cells due to the shortening of days and the bursting of cells in the petiole due to frost.