



## Harvard LTER Schoolyard Program

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

- Lesson Title:

*Phenocam Lesson 1: Comparing The Percent of Color Change of Individual Trees to the Percent of Color Change on a Phenocam Canopy-wide Image.*

- Teacher/Author: Katherine Bennett
- School: J.R. Briggs Elementary School, Ashburnham
- Level: Grade 5
- Date: August, 2012

## **Using the Phenocam images with the Harvard Forest Schoolyard Ecology Program protocol- *Buds, Leaves, and Global Warming***

**Lesson Students can compare their own tree data to the images on the phenocam network.**

### **Lesson preparation**

**Download images from the Phenocam website – this is a valuable first step as the set of images you select can be used for a variety of lessons.**

**You must first register by creating a user name and password.**

**Click on the data tab and choose your location.**

**<http://phenocam.unh.edu/webcam/network/download/>**

### Common Core Standards

5.E.1.1 Students know that in different latitudes and hemispheres there are different (and sometimes opposite) seasonal weather patterns.

6.L.1.1 Summarize the basic structures and functions of flowering plants required for survival, reproduction and defense.

6.L.2.2 Explain how plants respond to external stimuli (including dormancy and forms of tropism) to enhance survival in an environment.

6.L.2.3 Summarize how the abiotic factors (such as temperature, water, sunlight, and soil quality) of biomes (freshwater, marine, forest, grasslands, desert, Tundra) affect the ability of organisms to grow, survive and/or create their own food through photosynthesis.

RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6–8 texts and topics*.

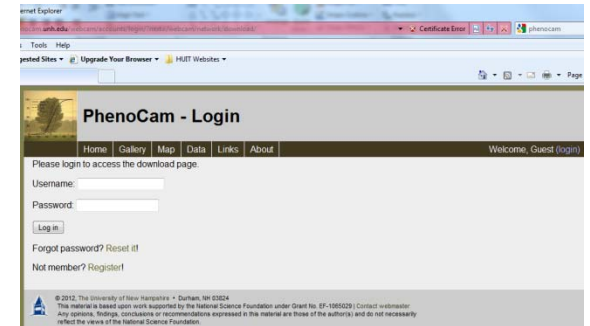
## Lesson preparation

### Download images from the PhenoCam website

This is a valuable first step as the set of images you select can be used for a variety of lessons.

You must first register by creating a user name and password.

<http://phenocam.unh.edu/webcam/>



- ★ Click on the data tab
- ★ Choose your site
- ★ Enter a start date and an end date-  
for example from beginning of  
color change to the end of leaf  
drop
- ★ Enter a start time of day and an  
end time of day to include one  
image from the middle of the day.
- ★ Submit- the program will  
download the images in a Gzip file.  
You can open them by using 7-Zip  
program that is free on the  
internet.
- ★ You will now have a set of the best  
picture of the day for each day.  
You should delete any images  
where the visibility is poor.

A screenshot of the PhenoCam - Data page. The page has a navigation bar with links for Home, Gallery, Map, Data, Links, and About. Below the navigation bar, there is a 'FAIR USE STATEMENT' section, an 'Input formatting' section with a bulleted list of requirements, and a 'Submit' form. The form includes a 'Site' dropdown menu (set to 'ashburnham'), 'Start Date' and 'End Date' text boxes (set to '2011-09-20' and '2012-06-10' respectively), 'Start Time of Day' and 'End Time of Day' text boxes (set to '12:00' and '13:00' respectively), and a 'Submit' button. The footer contains copyright information for The University of New Hampshire and the National Science Foundation.

**PhenoCam - Data**

Home Gallery Map **Data** Links About Welcome, kbennett42 (logout)

**FAIR USE STATEMENT:** Imagery from the PhenoCam archive is made publicly available to promote the continued development of algorithms for improved phenological monitoring using digital camera imagery. We encourage you to download imagery for use in your own research and publications. While considerable time and effort has gone into compiling and maintaining this data archive, we have no ownership over many of the images stored here, particularly those that were provided by cooperating federal agencies, e.g. the US National Park Service and USDA Forest Service. We do ask, however, that you send an email ( arichardson@oeb.harvard.edu) to inform us on how you intend to use the data, and any publication plans you might have, so that we can minimize overlapping efforts. We would certainly welcome invitations to participate as collaborators on your project. However, if we are already working on a topic similar to what you have in mind, we would ask that you give us a reasonable chance to finish our manuscript and submit it for publication first. Finally, please recognize the data source as a citation or in your acknowledgments, and cite the relevant papers we have already published on the topic (e.g., Richardson et al. 2007, 2009; Morissette et al. 2009; Jacobs et al. 2009).

Input formatting:

- Dates must be in the form YYYY-MM-DD
- Time of day must in the form HH:MM, where valid times are 00:00-23:59 (EST/GMT-5). (e.g. to select images between 10AM and 2PM use a start time of 10:00 and an end time of 14:00)
- All fields are required.

Assembling the download file may take as long as several minutes, please be patient. Downloads are limited to 1Gb at a time.

Site: ashburnham

Start Date: Enter a valid date. 2011-09-20

End Date: Enter a valid date. 2012-06-10

Start Time of Day: 12:00

End Time of Day: 13:00

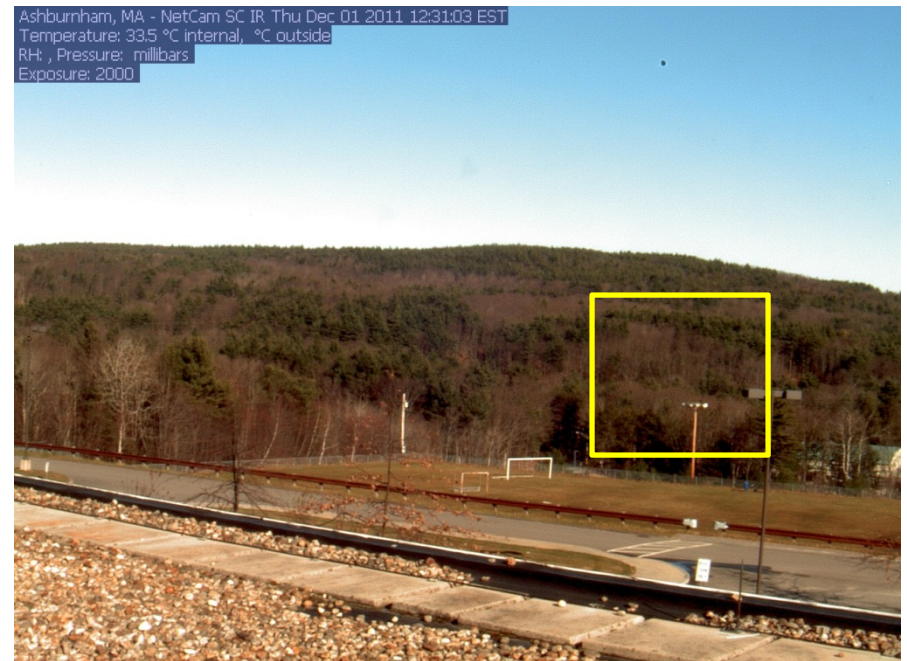
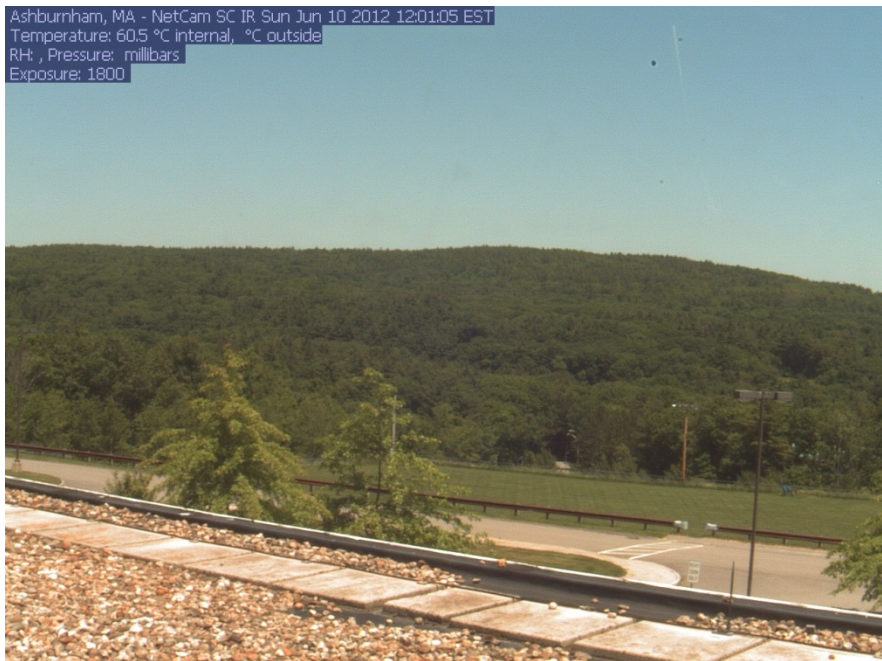
Submit

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This material is based upon work supported by the National Science Foundation under Grant No. EF-1065029 | Contact webmaster  
Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Copy the image from each date your students took data on their schoolyard trees on to PowerPoint slides.

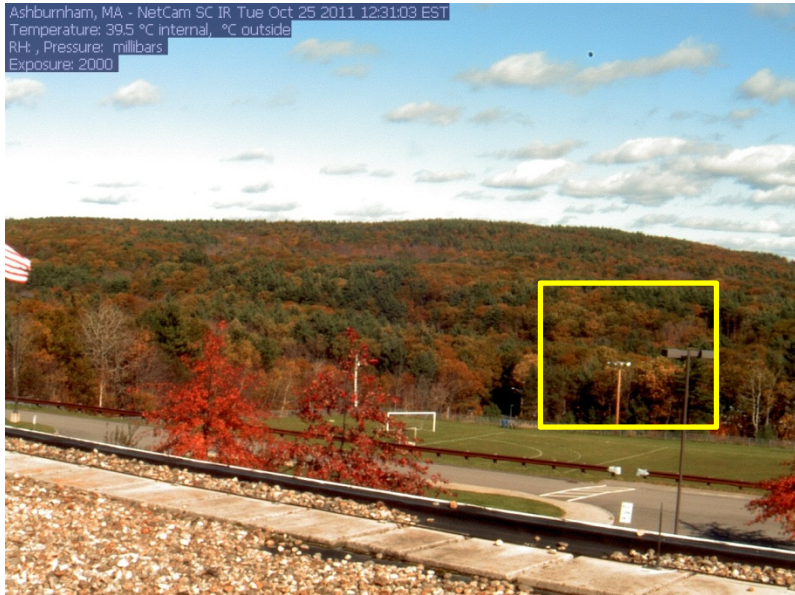
**Select a “region of interest”**

Your students want to focus in on an area of your image that contains mainly deciduous trees. You can identify and select an area for viewing either by choosing trees you know to be deciduous or by comparing a canopy image after leaf drop to an image after budburst. Select an area that is as close to 100% covered with deciduous trees as possible.



This selection is mostly deciduous trees. This will help you select a region of interest on the images you want the students to work with. Older students can determine this themselves.





Select the region of interest you chose on each of the images.



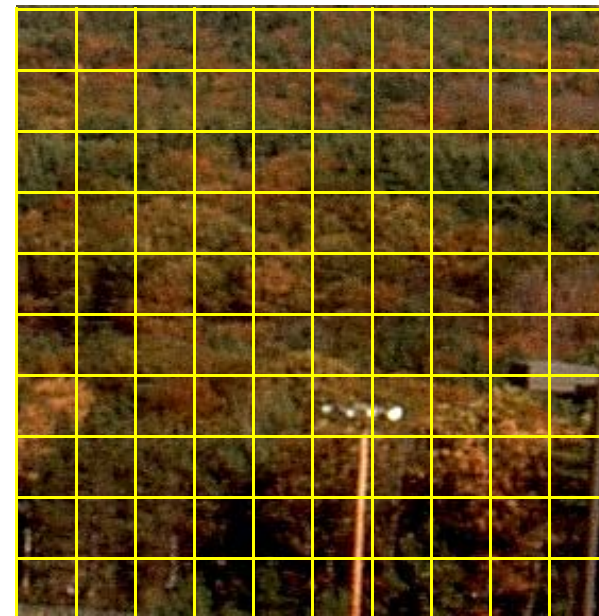
Crop the pictures to select that region.

Enlarge the pictures and use the picture tools to brighten and sharpen the image if necessary. Draw a 10 x 10 table and place it over each picture. Under table design, then layout, select no fill. Again, older students can do this themselves.

The students can now determine the percent of the canopy that has changed color!

The students count up the squares that are green. They may have to combine some halves and quarters. Remind them it is an estimate.

If the canopy is 25% green, what percent has changed color or already dropped leaves?

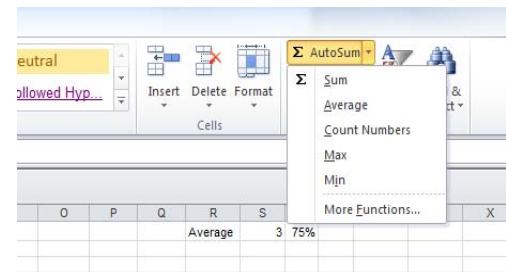


**JRB-fall phenology-  
bennett-2011** 2011

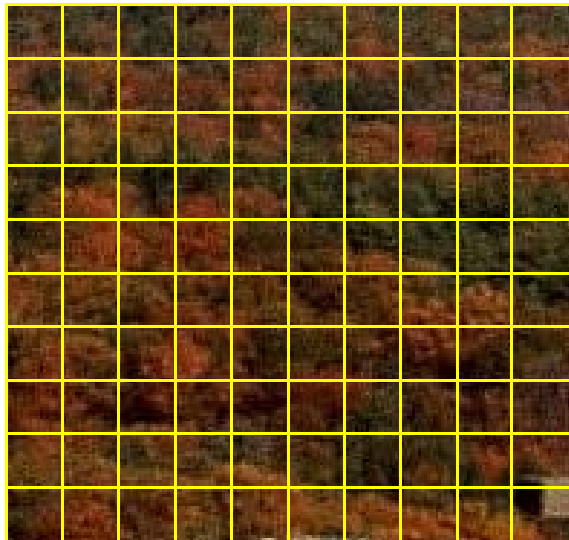
School Name: JRB  
 Teacher Name: Bennett  
 Grade Number: 5  
 Class Name: 5B  
 Site Description: JRB nature trail mixed hardwoods/conifers 42°37' N 71°56'W

Date	TreeID	Species	Ltotal	Lfallen	Tcolor	Tcolor
9/27/2011	31 rm		12	1	1	4
9/27/2011	32 be		12	0	1	4
9/27/2011	33 wh		12	0	1	4
9/27/2011	34 wo		12	0	1	1
9/27/2011	35 bc		12	0	1	2
9/27/2011	36 wo		12	0	1	3
10/3/2011	31 rm		12	2	2	
10/3/2011	32 be		12	0	1	
10/3/2011	33 wh		12	0	2	3 average
10/3/2011	34 wo		12	0	1	
10/3/2011	35 bc		12	2	2	
10/3/2011	36 wo		12	0	2	
10/11/2011	31 rm		12	4	2	
10/11/2011	32 be		12	0	1	
10/11/2011	33 wh		12	11	4	
10/11/2011	34 wo		12	0	1	
10/11/2011	35 bc		12	2	2	
10/11/2011	36 wo		12	3	2	
10/17/2011	31 rm		12	12	4	
10/17/2011	32 be		12	0	4	
10/17/2011	33 wh		12	12	4	
10/17/2011	34 wo		12	0	1	
10/17/2011	35 bc		12	2	2	
10/17/2011	36 wo		12	5	3	
10/24/2011	31 rm		12	12	4	
10/24/2011	32 be		12	0	4	
10/24/2011	33 wh		12	12	4	
10/24/2011	34 wo		12	0	1	
10/24/2011	35 bc		12	8	2	
10/24/2011	36 wo		12	11	3	
11/1/2011	31 rm		12	12	4	
11/1/2011	32 be		12	1	4	
11/1/2011	33 wh		12	12	4	
11/1/2011	34 wo		12	0	4	
11/1/2011	35 bc		12	12	4	
11/1/2011	36 wo		12	11	4	

Students can now use their class tree data to compare their trees to the canopy. Sort the data (under data tab) so the desired date is grouped together. Highlight and copy the tree color data for that day and find the average using the AutoSum tab .



Since a 3 represents tree color change 50-75% this is comparable to the color change we saw in the canopy!



**Region of interest selected from the  
Ashburnham Phenocam image 10-24-12**

10-24-2012

25% green

75% color change/leaf drop

**Harvard Forest Schoolyard Ecology Program  
protocol- *Buds, Leaves, and Global Warming*  
Student data file for 10-24-2011  
Average of individual tree color  
change 50%-75 %**

JRB-fall phenology-bennett-2011		2011			
School Name:	JRB				
Teacher Name:	Bennett				
Grade Number:	5				
Class Name:	5B				
Site Description:	JRB mixed hardwoods/conifers 42°37' N 71°56'W				
Date	TreeID	Species	Ltotal	Lfallen	Tcolor
10/25/2011	31	rm	12	12	4
10/25/2011	32	be	12	0	4
10/25/2011	33	wh	12	12	4
10/25/2011	34	wo	12	0	1
10/25/2011	35	bc	12	8	2
10/25/2011	36	wo	12	11	3
				Average	3 75%



Name \_\_\_\_\_

Date \_\_\_\_\_



Using the *Phenocam* images with the Harvard Forest Schoolyard Ecology Program protocol- *Buds, Leaves, and Global Warming*

Compare the percent of color change of your study trees to the percent of color change on the *Phenocam* image for the same date.

Using excel, find the average percent tree color change for each date of our study.

Then determine the percent color change of the canopy for each date by counting up the green squares on the images with the 10 x 10 grids. You may have to combine halves and quarters.

Date	Average % color – study trees	% color canopy

How do the percentages compare? Are they similar or very different? Explain.

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