

## Scientists' Letters to Students

Hi,

I'm David Verbyla, a remote sensing scientist. I am excited about working with students and teachers all over the world on the plant phenology investigation. Plant phenology observations around the globe are very important. The seasonal cycle of atmospheric carbon dioxide, a greenhouse gas, follows the seasonal cycle of plant green-up, growth, and green-down. At high latitudes, the pattern of spring green-up is related to the distribution of calving caribou and other animals. In dry regions, the pattern of green-up and senescence or green-down is related to wildfire danger. Green-up and green-down can be estimated from satellite data, but these estimates need to be validated with observations throughout the globe.

Unfortunately, on-the-ground plant phenology observations are rare because they are typically too expensive and time consuming for scientists to take. There is no way that I can do all these ground observations at different places at the same time. However, with your help in the GLOBE schools, important plant stages such as budburst, leaf growth, and plant green-down can be observed and recorded. Such information is important for scientists modelling global carbon budgets, and for me and other remote sensing scientists validating our estimates of world-wide plant activity.

This spring we hope to use GLOBE data to compare an improved vegetation index that has been developed for the new MODIS sensor that was launched on the new TERRA satellite. In theory, the improved vegetation index is better at estimating plant green-up but we need GLOBE data to test this.

Welcome to our research team!

Dr. Dave Verbyla  
Phenology Investigation

# Phenology Pupils' guide



## Activity 1. Defining your phenology site.

### The task

To select and mark tree(s) for monitoring.  
To define the phenology site

### What you need

Lengths of bright plastic to tie on branches.  
Worksheet



### How to do it

You can use your school grounds or any other site where the trees are not watered or fertilised.

1. Identify the dominant native tree species
2. Identify your trees from the dominant species and find the family name (genus), its species name and its common name. For example: *Acer Pseudoplatanus* is actually known to us as the sycamore (that is its common name). *Acer* is its genus and *Pseudoplatanus* is its species.
3. Choose two of the larger, mature (overstory) trees. Do not use understory trees. Select trees with branches that are low enough to monitor. If this is not possible you will need to use binoculars to monitor the branches.
4. If a tree dies or is removed, choose another tree of the same species and label it. If a branch dies or breaks, choose a new branch, label this 'c'.
5. For each tree select two south facing branches for permanent monitoring. Use a compass for this.
6. Choose strong, healthy branches that are unlikely to break or die.
7. Mark the branches with flagging tape or some other long lasting means of identification. Label each branch '**a**' or '**b**'. You should now have four branches labelled '**tree 1 branch a**', '**tree 1 branch b**', '**tree 2 branch a**' and '**tree 2 branch b**'.
8. Enter this information onto 'Defining your phenology site' sheet

# Phenology Pupils' guide



## Defining you Phenology site

For Budburst, Green-Up and Green-Down (trees)



|                        |                              |                                |
|------------------------|------------------------------|--------------------------------|
| Name of site:          |                              |                                |
| Source of data: (tick) | GPS<br><input type="radio"/> | Other<br><input type="radio"/> |

| Latitude |         |       | Longitude |         |       | Elevation<br>ft / m<br>(del.) |
|----------|---------|-------|-----------|---------|-------|-------------------------------|
| Degrees  | Minutes | N / S | Degrees   | Minutes | E / W |                               |
|          |         |       |           |         |       |                               |

| <b>**Information in this section is optional</b>  |                    |
|---|--------------------|
| Name of your nearest weather station  |                    |
| Distance from the trees to your weather station   |                    |
| Compass direction from the trees to your weather station  |                    |
| When standing at your weather station, what is the difference in elevation to your trees? (can be positive or negative) |                    |
| Are the trees at your : (please tick)   | Biology study site |
|   | A land cover site  |
|   | Other              |

| <b>About your tree(s)</b> |   |
|---------------------------|---|
| Genus                     |   |
| Species                   |   |
| Common Name               |   |
| Tree 1:                   | Height:                      Circumference: |
| Tree 2:                   | Height:                      Circumference: |

# Phenology Pupils' guide



## Activity 2. Detecting budburst.

### The task

To record any signs of budburst

### What you need

Recording sheet

### How to do it

Make daily trips to your site.

- Have any of the buds burst open?
- Can you see signs of tiny leaves inside the bud?



If you answer yes to both of these questions, record the date of budburst for that branch. Continue with the observations until the buds have burst on all four branches.

You are trying to detect the first signs of budburst so don't worry if all the buds on a branch have not opened yet.



## Budburst Data Sheet

|        |          | Date budburst first observed | Date of last observation before budburst |
|--------|----------|------------------------------|--|
| Tree 1 | Branch : |                              |  |
|        | Branch:  |                              |  |
| Tree 2 | Branch : |                              |  |
|        | Branch:  |                              |  |

# Phenology Pupils' guide



## Activity 3. Green-Up.

### Your task

To record the time of budburst and monitor the growth of a leaf

### What you need

Green up Data Sheet  
Pen or pencil  
Fine permanent marker  
Ruler



### How to do it

1. Identify the bud at the end of one of your branches.  
Mark one dot on the branch next to the bud.
2. Locate the 3 buds closest to your end bud, mark them with 2,3 and 4 dots.
3. You will need to check the state of your buds at least twice a week and each time record what you see.
  - Record **dormant** if the bud is unchanged.
  - Record **swelling** if the bud is getting bigger.
  - Record **budburst** the first day you see the green tips of leaves.
  - Record **lost** if something happens to the bud and it disappears.
4. After budburst, use a ruler to measure the **length** of the leaf in mm. Do not include the stem. Record the measurement on your data collection sheet.
5. Keep measuring your leaf until it stops growing.



# Phenology Pupils' guide



## Activity 4. Green-Down.

### Your task

To record green down in trees

### What you need

Green down Data Sheet  
Pen or pencil  
GLOBE plant colour guide  
Compass  
Fine permanent marker  
Ruler



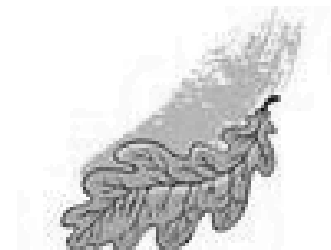
### How to do it

**If you did not do green up complete steps 1 and 2 first**

1. Identify the leaf at the end of one of your branches. Mark one dot on the branch next to the leaf.
2. Locate the 3 leaves closest to your end leaf, mark them with 2,3 and 4 dots.

**If you did the Green up activity try and use the same leaves**

3. Examine each of your 4 leaves. For each leaf estimate the dominant colour.
  4. Record your observations on the green down data sheet
- Record **snow covered** if the leaf is covered in snow
  - Record **fallen** if the leaf has dropped and stop recording





# Phenology Pupils' guide



## Glossary

### **Clinometer**

An instrument for measuring angles. It is used to measure slope and the height of objects.

### **Dominant**

The most numerous

### **Dormant**

Biological activity is suspended as: being in a state of suspended animation: not actively growing but protected (as by bud scales) from the environment

### **Elevation**

Height above sea level.

### **Fertilised**

To have had a substance added or introduced (e.g. manure or a chemical mixture) to make soil more fertile

### **Native tree**

Species that have not been introduced from elsewhere e.g. Oak, Silver birch, Ash etc

### **Overstory**

The upper layer of foliage in a forest canopy

### **Phenology**

A branch of science dealing with the relationship between climate and periodic biological phenomena

### **Understory**

An underlying layer of vegetation; *specifically* : the vegetative layer and especially the trees and shrubs between the forest canopy and the ground cover