



THE GLOBE PROGRAM

Student Climate Research Campaign

Phenology and Climate Project



Teacher Participation Guide

Purpose

To involve students in short-term and long-term scientific studies focused on the relationship between climate and the biosphere by collecting plant phenology, atmosphere, and soil measurements near their school and in comparison with schools across the globe.

Overview

The Phenology and Climate Project is a research effort between GLOBE schools and climate scientists to improve our understanding of how climate relates to the cycles of living things (i.e. phenology). Using GLOBE phenology protocols, students make observations of the timing of budburst, green-up, and green-down of native plants near their school. Where possible, students will also use GLOBE atmosphere and soil protocols to collect climate data that can be used by students and scientists to answer key science questions about how the growing season is affected by climate.

Key Science Questions

The following are key science questions about phenology and climate that scientists are interested in answering. These big picture questions should be considered during participation in the Phenology and Climate Project and when conducting related research investigations of your own:

- What are the best indicators to define the onset and end of the growing season?
- How well do satellite-based measurements of ground-based plants (such as the Normalized Difference Vegetation Index or NDVI) compare with ground-based observations of green-up or green-down?
- How much do phenology measurements vary from year-to-year? (You can address this science question if you have been collecting GLOBE phenology on a regular basis for several years or by using data from a school or network with a long history of phenology data)
- What is the relationship between spring budburst and atmospheric/soil measurements among GLOBE schools within a biome or by latitude?

Phenology and Climate Intensive Observing Periods (IOPs)

Localized Intensive Observing Periods (IOPs) of budburst, green-up, and green-down should occur during September 2012-June 2013. Because the timing of budburst, green-up, and green-down vary geographically, each school will need to determine the time period appropriate for their local environment. (Note: some schools may start in August if Budburst or Green-down begins then).

What is needed

In order to participate in the Phenology and Climate Project, you will need the following materials:

- GPS
- Clipboard
- Student Field Guide for GPS Protocol
- Pencil or pen
- Local tree identification guide
- GPS Data Sheet

For Budburst and Green-up, you will also need:

- Budburst Data Sheet and Field Guide
- Green-up/Green-down Site Definition Sheet and Field Guide (For Tree/Shrubs or Grasses)
- Ruler with mm marks
- Camera
- Flagging tape, 1 label per student
- Green-up Data Sheet and Field Guide (for Trees/Shrubs or Grasses)
- Binoculars (optional)
- Compass

For Green-down, you will also need:

- Green-up/Green-down Site Definition Sheet and Field Guide (For Tree/Shrubs or Grasses)
- Flagging tape, 1 label per student
- Fine-tip permanent marker
- Compass
- Green-down Data Sheet and Field Guide (for Trees/Shrubs or Grasses)
- GLOBE Plant Color Guide
- Camera

Time needed to participate

- Identify and establish a new phenology site and report data: *1 – 2 class periods*
- Conduct repeat observations of an established phenology site and report data: *30 minutes twice per week during the local IOP*
- *(Optional, but highly encouraged)* Identify and establish a new atmosphere and/or soil site near your phenology site and report data: *1 – 2 class periods*
- *(Optional, but highly encouraged)* Conduct repeat observations of an established atmosphere/soil site and report data: *30 minutes*

What to do and how to do it

Determine your local Intensive Observing Period (“local IOP”)

1. Timing of phenological processes (budburst, green-up, and green-down) varies by location around the world. Plan your local IOP depending on your local climate and biome.
 - a. *Example for schools in the U.S. or Northern Hemisphere:* GLOBE schools would observe green-down during the beginning of the school year for a local IOP sometime during August-November. The exact timing is determined by the local biome. Schools would then observe the same trees (as studied for the green-down IOP) to observe budburst and green-up for a local IOP during January-May. The local IOP would be again determined by the local biome.
 - b. *Example for schools in the Southern Hemisphere:* GLOBE schools would observe budburst and green-up for a local IOP sometime during August-November. The exact timing is determined by the local biome. Schools would then observe the same trees (as studied for the green-up IOP) to observe green-down for a local IOP during January-May. The local IOP would be again determined by the local biome.

Collect and report data with phenology protocols

1. Schools measure budburst, green-up, and green-down of native plants using the GLOBE budburst, green-up, and green-down protocols during local IOPs.
2. Phenology measurements should be made at least twice per week during each local IOP.
3. Report data to the GLOBE database.

(Highly encouraged) Collect and report data with atmosphere & soil protocols

If possible, schools should measure climate variables, such as air temperature and precipitation, soil temperature and soil moisture, in addition to phenology protocols, during each local IOP. It would be ideal for the atmosphere/soil site to be as close as possible to the phenology site, provided it meets the site definition set up requirements for an atmosphere study site.

1. Identify and establish a representative atmospheric study site, if your school has not previously established a study site. Refer to the Site Selection and Set-up guide for information regarding identification and establishment of an atmosphere site.
2. Follow the Max/Min/Current Air Temperature protocol **or** Digital Multi-Day Max/Min/Current Air and Soil Temperature protocol **or** the Soil Temperature protocol directions for collecting atmospheric and soil temperature data, depending on your instrumentation, and record data on the Atmosphere Investigation Data Sheet.
3. Follow the Rainfall Protocol or Solid Precipitation Protocol directions for collecting atmospheric data and record data on the Atmosphere Investigation Data Sheet.
4. Follow the Soil Moisture Sensor protocol directions for collecting soil moisture data and record data on the Daily Soil Moisture Data Sheet.
5. Atmosphere and soil measurements should be made at least twice per week, on the same days as the phenology measurements (except for the Digital Multi-Day Max/Min/Current Air and Soil Temperature, which can be made every six days).
6. If possible, take soil temperature twice, in two different locations: once at the atmosphere study site and once close to the plant or tree being observed in the phenology protocols.
7. Report data to the GLOBE database.