

## Activity 3.1: Preparing for Project BudBurst

### Grades 10 – 12

**Description:** This activity serves as an introduction to phenology and Project BudBurst, and will prepare students to start collecting data. Complete these activities before you start BudBurst data collection.

**Part 1: Introducing Project BudBurst:** Students are introduced to the concept of phenology, or the study of the timing of periodic life-cycle events. Students discuss the life cycles of organisms and the environmental factors that can affect those cycles.

**Part 2: Mystery Plant Identification:** Students make observations of plants unfamiliar to them, create a field guide for their plants, and practice identifying other plants by using their classmates' field guides. This activity will exercise students' observation and scientific communication skills and provide students with practice identifying plants in preparation for the other activities. This is an outdoor activity, but can also be done inside on collected or purchased flowers/plants. If done outside, students can choose their BudBurst plant as part of the activity. Students do more plant identification and work with dichotomous keys in Activity 3.3.

**Part 3: BudBurst Data Collection:** Students will go through the process of identifying their plant, and then will collect data on that plant throughout the BudBurst project. Alternatively, you can assign student plant(s) to observe (if they have not done so in Part 2). Students begin data collection on the phenophases (the phenological stage) of their assigned plants. They continue to collect data on their chosen plant species throughout the growing season and enter it into the BudBurst website over a period of weeks or months. Students can write the data on the BudBurst data collection sheets. Plant identification sheets and phenophase guides are available on the BudBurst website.

**Time:** Three to four class periods (total for all three parts), ongoing data collection should be done periodically every two to three days, and should not take more than a few minutes per observation once students are familiar with the process.

#### Materials:

##### Part 1

- Pens/pencils
- Field journal or blank paper
- Cardboard or clipboard (one per student)

##### Part 2

- Colored pencils
- Rulers
- Digital camera (optional)
- Field guides to local wildflowers, grasses, shrubs, and trees
- Copies of the Mystery Field Guide and Official Field Guide

##### Part 3

- Computers with internet access
- Field journal or blank paper
- Cardboard or clipboard (one per student)
- Rulers
- Digital camera (optional)
- Field guides to local wildflowers, grasses, shrubs, and trees
- Pens and pencils

**National Science Education Standards:**

**A1.c** Use appropriate tools and techniques to gather, analyze, and interpret data.

**C3.c** Behavior is one kind of response an organism can make to an internal or environmental stimulus.

**AAAS Benchmarks:**

**5F/H6c** When an environment, including other organisms that inhabit it changes, the survival value of inherited characteristics may change.

**11C/M7** Cyclic patterns evident in past events can be used to make predictions about future events.

**12C/M3\*** Make accurate measurements of length, volume, weight, elapsed time, rates, and temperature by using appropriate devices.

**Guiding Questions:**

- What is phenology?
- How do we identify plant species?
- What are phenophases? What is the value of recording phenophase data?

**Pre-Activity Preparation:**

- Create a BudBurst site for your class. You will want to generate passwords for your students so that they are able to log into their class site. Complete directions for creating a classroom BudBurst site can be found in the “Creating a BudBurst Classroom Site” document.
- Familiarize yourself with the Project BudBurst website.
- Reserve time in the computer lab, or make arrangements to have at least one computer for every two students in your class.
- If you would like more intensive training on Project Budburst, or learn more about citizen science, visit the NEON Citizen Science Academy: <http://citizenscienceacademy.org/>

**Part 1: Introducing Phenology**

**Time:** 40 minutes

**Note:** If possible, have this discussion outdoors where students can look around and make casual observations about phenological stages and events.

**Periodic Life-Cycle Events—studying phenology****Procedure:**

1. Begin with some general questions to the group to get them thinking about things they observe and use as sources of information without really thinking about it.
  - What do you expect when the sky darkens from thick clouds?
  - What season is it when you are walking through a grove of maple trees and notice drips of liquid coming from a broken limb of one of the maples?
  - What are some things you observe that indicate that spring is coming?
  - If you see insects emerging, what season (or seasons) is it likely to be?

- If you want to plant a garden, would you do so when leaves are brown and falling or when they are just budding out?
- 2. Ask students how plants are grown. *What makes a plant start growing in the spring season?* (Plant growth may be triggered by daylight hours, precipitation, freeze/thaw cycles, in addition to warming temperatures). If they are having trouble, ask, *how do you know when it's spring? What do you notice?*
- 3. Point out to the students that we use many different signals to tell us about our world and to help us anticipate things like weather, temperature, and timing of things we need to do.
- 4. Ask students to work in small groups to list natural events they expect to happen or see over the course of a year. The list can include **biological** and **environmental** events. Divide them according to these two categories. Examples of things students might list include:

Biological	Environmental
<ul style="list-style-type: none"> <li>• First flower blooms</li> <li>• Leaves budding on trees</li> <li>• Hear locusts</li> <li>• See first butterfly</li> <li>• Leaves change color</li> <li>• Leaves fall</li> <li>• See birds flying north</li> <li>• Find tadpoles</li> <li>• See first honeybees</li> <li>• Pick apples from trees</li> <li>• Find seeds from trees on ground</li> </ul>	<ul style="list-style-type: none"> <li>• First snow</li> <li>• First ninety degree day</li> <li>• Able to ice skate outdoors</li> <li>• Hurricane season</li> <li>• Rainy season</li> <li>• First frost</li> <li>• Frequent thunderstorms</li> <li>• Windows frost over</li> <li>• Too cold to go barefoot</li> <li>• Too hot to wear a coat</li> <li>• Warm in the day, cool at night</li> </ul>

- 5. Explain to students that everything they listed in the biological category is part of the study of phenology.
- 6. Now ask students to imagine that these biological events did not happen at the right time one year. What might happen? Explain that the other part of phenology is understanding the relationship between biological events and seasonality or climate.
- 7. Based on what they have done so far, have students come up with their own definition of phenology? Take student ideas and write them on the board.
- 8. Define phenology as the study of the timing of periodic plant and animal life-cycle events and how these are influenced by seasonal and inter-annual variations in climate. Explain that they will be looking at the timing of events in the plant life cycle – like their first leaf and first flower. You may want to use this opportunity to review the plant life cycle with students.



CHICAGO BOTANIC GARDEN

9. If you are outdoors, you may give students a few moments to walk around and see if they can observe any of the phenological events on their list (or any others) before proceeding to the next discussion.
10. Have a general discussion about how changes in climate might affect phenology and how changes in phenology might impact ecosystem interactions. As an example, make connections between plant bloom times, pollinator life cycles, and food webs. In some cases a plant is cued by temperature, and often an animal is cued by day length. The English oak, for example, blooms two weeks earlier and moth larvae hatch two weeks earlier to feed on the leaves. The pied flycatcher used to arrive when the larvae hatched to feed on them. However the birds are migrating at the same time as they always have, so when they arrive, the larvae population is declining and the bird population is declining as a result. The following discussion questions can be used for homework or as a guide to the class discussion:
  - If you make phenological observations only one time, how will that be different from someone who makes observations once every year? Or once a month? Or weekly? Explain why the frequency of observations makes a difference in what conclusions you can draw from the observations.
  - Do you think all species respond the same way to changes in climate? In other words, do you think a warmer winter will cause all plants, all pollinators, all herbivores, and all carnivores to change their behaviors at the same time and in parallel ways? Explain your answer and why you think it might matter for ecosystems.
  - If you expect to see particular animal life-cycle events, but you don't see them, does that mean that the climate must have affected them? Explain some of the pros and cons of studying plants vs. studying animals.
11. Phenological events also shape our cultural practices. Ask students to think about the calendar and brainstorm traditional events that happen through the year that are linked in some way to phenological events (e.g., Thanksgiving is connected to harvest time).
12. Explain to students that people have always made phenological observations because of how they inform us about weather and climate. The project they will be studying for the next many weeks is designed very specifically to examine the relationship between climate and phenology.

## Part 2: Mystery Plant Identification

**Description:** Students make observations of plants unfamiliar to them, create a field guide for their plants, and practice identifying other plants by using their classmates' field guides. This activity will exercise students' observation and scientific communication skills, provide students with practice identifying plants in preparation for the other activities and remind them how to use a dichotomous key. This is an outdoor activity, but can also be done inside on collected or purchased flowers/plants.

**Time:** 1-2 class periods

### Background Information

Careful observation is a foundation of all science. When making observations, it is important to look closely in order to notice details, including information about size, shape, color, texture, and spatial relationships. It is also important to use many of the senses: sight, sound, smell, and touch. Quality observations are detailed, accurate, and often conjure up an image in the mind of the person hearing the observation for the first time. For example, describing something as "short" doesn't provide an accurate description, while saying, "it's taller than a two-liter bottle and shorter than this stool" is much more helpful. The details of the observation become extremely important and allow students to form valid observations based on a series of true statements.

**Source:** Adapted from Coskie, T., Hornof, M., and Trudel, H. 2007. A Natural Integration. *Science and Children* 44(8): 26-31. This teacher resource was made possible, in part, by support from the National Geographic Education Foundation.

### Pre-Activity Preparation:

- Identify the area you will use for Project BudBurst data collection where students can observe wildflowers, grasses, shrubs, and trees. Look at the plants ahead of time, and refer to the Project BudBurst field guides for ideas and information (available at <http://budburst.org/plantstoobserve>). Field guides are available on the website under individual plant species.

### Procedure:

#### Introduction

- Share some field guides of local plants and dichotomous keys with your students. Familiarize them with the types of information included in a field guide and key: photos/drawings, information on leaves, flowers, bark, and fruit. Discuss the observation skills needed to use when studying their "mystery" plant (looking at details, noticing size/shape/color, leaf structure and placement, etc).

#### Materials:

##### Part 2

- Field journal or blank paper
- Cardboard or clipboard (one per student)
- Colored pencils
- Rulers
- Graph paper (optional)
- Digital camera (optional)
- Field guides to local wildflowers, grasses, shrubs, and trees
- Copies of the *Mystery Field Guide*

2. Give each student, or pair of students a clipboard, magnifying glass, a few pieces of graph paper, and ruler. Take students outside and ask each group to select a plant they are unfamiliar with to observe. This can be a wildflower, grass, shrub, or tree. They don't need to identify the plants yet, so don't provide field guides for this part of the activity.
3. Have students observe their plant and record their observations in a journal or blank sheet of paper. This should include observable properties such as size, color, texture, odor, and markings. Have students measure leaves, indicate the number of petals and sepals, describe leaf placement, and quantify as many characteristics as possible.
4. In addition to writing about the plants, ask students to draw the plants on the graph paper, using the squares to estimate size as accurately as possible. As best they can, they should draw what they really see and add labels to identify the important parts of the plant and measurements.
5. Once students have completed their observations, instruct them to fill out a *Mystery Field Guide* page for their plants. These field guides can include photos if you have a digital camera and printer they can use. This *Mystery Field Guide* includes a description and illustration of the plant.
6. Have student groups exchange their field guides with each other, and try to identify the plant described by the other group.
7. Once students have identified the other group's plant using the *Mystery Field Guide*, have them to identify their plants using field guides you have provided for your local area.
8. Have students compare the descriptions in the actual field guides with the *Mystery Field Guide* they created.

**Discussion Questions:**

- What similarities were there between the plant descriptions on your *Mystery Field Guide* and your *Official Field Guide*?
- What differences were there between the plant descriptions on your *Mystery Field Guide* and your *Official Field Guide*?

**Extension Activity: Using a dichotomous key to identify plants**

This activity will also prepare students for activity 3.2 “Impacts of Climate on Forest Succession” in which students will learn how to use a dichotomous key to identify trees in their region.

- Go over how to use a dichotomous key with students. Inexpensive, easy-to-use dichotomous keys for a variety of plant types and regions can be purchased at [www.naturestudy.com/finders.html](http://www.naturestudy.com/finders.html).
- Set up stations around the classroom, each with a different flower or plant.
- Break students into their working groups and hand each a dichotomous key.

- Have students walk around to each flower “station” and apply the guide to try and identify the plant it refers to. See how many of the students are able to identify their plant using the guide.
- Go over student responses and work through the correct identification with students.

### Part 3: Project BudBurst

**Description:** Students review what they learned about phenology, research plant species and choose a plant to observe, and begin making observations they will contribute to Project BudBurst ([www.budburst.org](http://www.budburst.org)).

**Time:** One to two class periods (data collection to be repeated)

#### Materials:

##### Part 3

- Field journal or blank paper
- Cardboard or clipboard (one per student)
- Rulers
- Digital camera (optional)
- Field guides to local wildflowers, grasses, shrubs, and trees
- Pens and pencils

#### Pre-Activity:

- Locate a site near the school that can serve as the data collection site.
- Decide whether you will identify specific plants for students to collect data on ahead of time, or whether you want to have students identify the plants themselves.
  - If the former, you will need to set up a classroom BudBurst site and add the plants students will observe before beginning the activity.
  - If students will be choosing and identifying their own plants, make sure you budget at least one class period for students to spend outside locating and identifying the plant they are going to observe.
- You may want to label (or have students label) the plants students will be observing so that they are easy to locate when making subsequent observations.
- Once students have identified their plants, collect that information and enter it into the classroom BudBurst site (you will have to add the plants to the site because student accounts do not have administrative privileges). Once the plants have been added, students will be able to enter their data.

#### Procedure:

1. Tell students that they are now going to begin collecting data to contribute to scientists' understanding of how climate affects plant phenology.
2. Assign students plants, and take them outside to begin making their observations. Students will determine the phenophase (the phenological stage) of their assigned plants. Students can write the data on the BudBurst data collection sheets or in their journal. As noted in the Pre-Activity steps, it is useful to pre-identify the plants students will be observing, and note when they are expected to be in each phenophase. Plant ID sheets and phenophase guides for many species are available on the BudBurst website.

**Note:** BudBurst data collection sheets are available here:

<http://budburst.org/reportforms.jsessionid=ykvUdGmsc++AYN+NNKgYr5N5.dmz-portal-web-3>

*There are different data collection sheets for different types of plants (deciduous trees, wildflowers, grasses, conifers, and evergreens) because different types of plants have*



*different phenophases. These specialized data collections sheets are helpful for students because they focus students only on the phenophases they should be looking for for their specific plant.*

3. Depending on the time of year and plant species, students will look for the following phenophases:  
Note that images of phenophases can be found on the Project BudBurst website for most of the BudBurst species. Please see the reference guide included at the end of this activity for a general phenophase guide for different types of plants (e.g. woody, herbaceous, grasses etc.):
  - First leaf
  - All leaves unfolded
  - First flower
  - Full flower
  - End of flowering
  - First ripe fruit
  - 50 percent color
  - 50 percent leaf fall
4. When one of these stages is found, students should take a picture and record the phenophase and the date.
5. After the class is done collecting data, the students and/or teacher should enter the data on the project BudBurst website (report an observation). Photos can also be uploaded to the website. BudBurst data collection can be carried out during the entire growing season. In the fall students should look for ripe fruit, color, and leaf fall. Ideally, students will begin observing as the growing season begins and continue to observe as long as plants are still blooming.

**Extension:**

- Students can be given an assignment to monitor a plant near their house or on their way to school for a month. This way, they may see several different phenophases on one plant over time. Students should upload their data to the BudBurst website.



## Plant Phenophases

### Herbs



First Flower



Full Flower



End Flowering



End Flowering

### Woody/Perennial



Beginning Flowering



First Flower



Full Flower



End Flowering



First Fruits



First Ripe Fruit



Full Fruit



No Fruits



First Leaves Unfolding



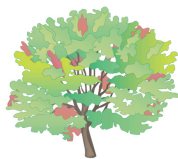
First Leaf



Early Leaves



Full Leaf



First Leaves Turning



50% Fall Colors



Full Fall Colors



Beginning Leaf Fall



50% Leaf Fall



End of Leaf Fall



No Leaves Branches Bare

### Grasses



First Leaves



Full Leaf



First Flowers



Full Flower



First Pollen



Full Pollen



First Fruits



Leaves Withered

### Gymnosperms



New Leaves



Leaves Mature



First Pollen



Full Pollen



Closed Cones



First Fruits



Cones Empty

<http://ian.umces.edu/discforum/index.php?topic=615.0>

## Mystery Field Guide

Plant name: \_\_\_\_\_

Plant description:

Plant illustration:

## Official Field Guide

Common name: \_\_\_\_\_

Scientific name: \_\_\_\_\_

Plant description:

Plant illustration:

Did you know?:

Close-up illustration:

## Creating a BudBurst Classroom Site

### Step 1: Create a Project BudBurst Account

(if you already have a BudBurst account, you can skip to step 2)

1. Go to:  
<http://budburst.org/register>
2. Fill out your information and create a password. Note that the address you put here does not have to be the location of your BudBurst data collection site. You will add that information later.
3. Make sure you select the “**I am an Educator**” checkbox. This will allow you to create multiple sites and manage student passwords.
4. Choose a unique login and a password you will remember. You will not have to share this with students – they will get their own password to the specific BudBurst site you create for their class.
5. Click “**submit**” to create an account and go to your BudBurst page.

(\* = required fields)

**Project BudBurst Registration**

**\*I am at least 13 years of age:** ☐

**\*First Name:**

**\*Last Name:**

**\*City:**


**\*State:**

**Zip Code:**

**\*Email:**

**I am an Educator:** ☒ (Educator accounts allow formal and informal educators to register classroom sites and create student reporter accounts.)

**\*Type the words that you see:**



Type the two words:

Your will use a login and password of your choosing to access your account.

**\*Login:**

(Please do not use your email address)

**\*Password:**

**\*Retype Password:**

### Step 2: Create a BudBurst Site

6. Click on “**Regular Reports**” to go to your BudBurst sites, and click “**Add a Site**” to create your first BudBurst classroom

**BudBurst > My BudBurst**

**CBGTeacher's MyBudBurst Page**

Welcome to your personal MyBudBurst Page!

Here you can submit observations and manage your account.

You can also review, search, and even download information about the reports you have submitted.

?  
 ?  
 ?

**BudBurst > My BudBurst > Submit Regular Reports**

**CBGTeacher's My Regular Reports Page**

Here you will be able to save information about your Regular Report sites and plants. This allows you to report the dates of each phenophase as they occur throughout the season.

Here are your registered site(s) and plant(s): ?

7. Name your site and add the site information, including the address latitude and longitude, and description of its features (irrigation, shade, and proximity to buildings). If you are not sure of the latitude and longitude, enter your address in the **Find Your Location** text box, and use the search function to find out.

[BudBurst](#) > [My BudBurst](#) > [Submit Regular Reports](#) > [Location](#)

## Enter Regular Reports - Register a Site

**MyBudBurst Site - Where are you monitoring your plant(s)?**


**Site Location**

### Map Tool

Find your latitude and longitude by:

- entering the address of your site location into the search box below (i.e. 1685 38th St, Boulder, CO, 80301 or City Park, Denver, Colorado)
- OR-**
- zooming in and clicking on the map to mark your location.

Search For:



### Describe Your Site

You can have more than one plant species at the same site.

**\*Site Name** (A unique name of your choosing)

Use the **map tool** to determine latitude and longitude (measured at the center of your site).

**\*Latitude** (decimal degrees, i.e. 40.01647)

**\*Longitude** (decimal degrees, i.e. -105.24557)

**\*City:**

**\*State:**

Select ▼

**Zip code:**

**Describe the irrigation at this site**

Select ▼

**Describe the shading at this site**

Select ▼

**Is the site within 100' of a building or concrete or asphalt?**

Select ▼

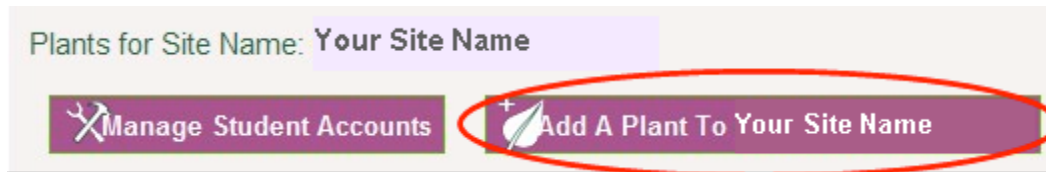
**How would you describe this site?**

Select ▼



### Step 3: Add Plants to Your Site

8. First select **Add A Plant To...**



9. Use the radio buttons to select the **plant group** for your first plant, and click **Submit**. You will add each plant separately. However, if there is a group of small plants together that students are observing, for example, a plot of mayapples, you may choose to list this as one plant and make one observation for the entire plot.



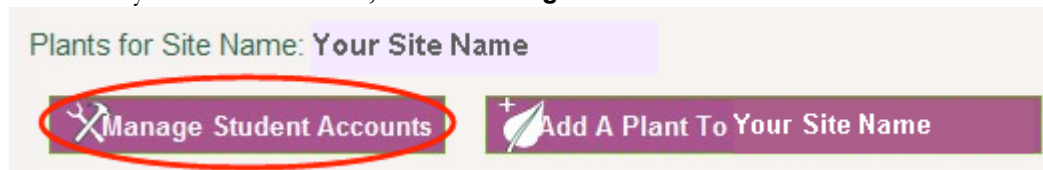
10. Use the drop-down menu to select your plant. If you plant is not listed, select "Other" to add your own. If you select "Other," you will be asked to add the common and the scientific names.



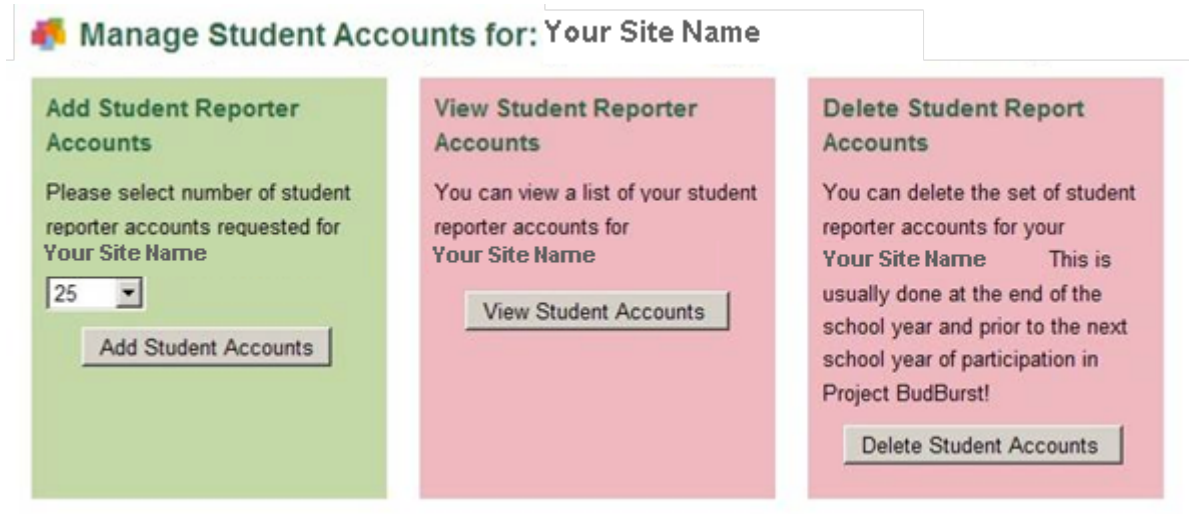
11. Repeat **Step 3: Add Plants to Your Site** until all the plants have been added.

#### Step 4: Create and Manage Student BudBurst Accounts

12. From your BudBurst Site, select “**Manage Student Accounts**”




13. Create student accounts by selecting the number of accounts from the drop-down menu, then click “**Add Student Accounts.**” You can create up to 40 student accounts per site.



14. The site will generate a list of student accounts and temporary passwords. **Make sure you print or save the page for your records.**

Once you leave the page, you will no longer be able to see the temporary passwords for your students, even under the view student accounts option. Students will be given the option to change their password the first time they log into the site.

 **My BudBurst - Student Reporter Accounts**

Please print this page for your records! You can now assign a student to each of the student reporter accounts below. Once logged in, the student reporter can change their password.

The following student reporter accounts have been created for:

My BudBurst Site: Your Site Name

Username	Password
CBGTeacher_CTL_Floral_Report_Card_reporter1	7axsx706
CBGTeacher_CTL_Floral_Report_Card_reporter2	oszuqzp3
CBGTeacher_CTL_Floral_Report_Card_reporter3	3hqv8m25
CBGTeacher_CTL_Floral_Report_Card_reporter4	dre55v56
CBGTeacher_CTL_Floral_Report_Card_reporter5	z72kdtxt
CBGTeacher_CTL_Floral_Report_Card_reporter6	tx6zvcwi

15. To delete student passwords, e-mail Project BudBurst at: [budburstweb@neoninc.org](mailto:budburstweb@neoninc.org)  
Make sure to include your site name.