Activity Guide

Program Description

Summary

Join citizens all over the U.S. in collecting plant lifecycle (phenology) data and contributing to an ongoing scientific research project that explores the effects of climate change on the plant lifecycle. Students will identify and observe and collect data on native U.S. plants at different stages in their lifecycle, budding, first bloom, full bloom, and die-off. Once data has been collected, students will return to the classroom, analyze their data, and enter the results on the BudBurst.org website to be included in the national data collection effort.

Grade level

BudBurst can be adapted for any grade level. The following activities include some grade level modifications for both older and younger students. For example, older students may identify species on their own using field guides, while younger students may be guided to observe a particular species identified by an adult.

Activities Suggested Time: 3-5 class periods

The following activities are related, but independent, lessons which can be used individually or as a group.

1. Connecting Plants and Climate
2. Plant Observation and Data collection
3. Plant Phenology and Climate Change

Student Outcomes

Activities have been aligned with both the Benchmarks for Science Literacy (AAAS, 2000) as well as the National Science Learning Standards (1997). By tracking the timing of leafing and floral bud emergence in their schoolyards and gardens, students will:

- Be able to identify several tree or flower species in their area, and observe the sequence of budding in those species relative to each other (e.g. spring ephemeral flowers on the forest floor bloom before the trees leaf out and block the sun) **(Benchmark: Systems)**
- Learn to observe budding phenology and understand how the budding stage fits into a plant's life cycle **(Benchmark: Constancy & Change)**
- Understand the relationship between weather and phenology **(Benchmark: The Interdependence of Life)**
- Learn to enter data into Web-based databases and compare their observations with those of students in other regions **(Benchmarks: The Nature of Science & The Diversity of Life)**
- Learn to interpret their data and convey results in graphics and/or in writing **(The Nature of Science).**

Tracy Warwick & Jennifer Schwarz Ballard, 2007

Background

Why Phenology is Important

Climate change has the largest effect on plants because, unlike many animals, they cannot move easily from one area to another. As a result, the growing season could start earlier or continue over a longer period of time. The timing of phases of the plant life cycle, known as ***phenophases***, are directly affected by temperature, rainfall and day length. Therefore, by monitoring changes in phenological events such as first bud, BudBurst, and flowering, scientists can detect climate change.

Phenology is important because…
…it affects whether plants and animals thrive, or survive, in their environment

…our food supply depends on the timing of phenological events

…changes in the timing of phenological events can be used as an indicator of climate change

1) Phenology affects whether plants and animals thrive, or survive, in their environment.

The success of an ecosystem or food chain depends on the timing of phenological events. Many animals rely on leaves, buds, flowers and fruit for their food. If the timing of the emergence of leafs, buds, and flowers is greatly changed, it can result in fewer seeds and insects which would impact the animals that depend on insects for their food.

Consider a mouse for example – some mice eat insects and seeds. If plants bloom early, they may be finished blooming by the time their pollinators (insects like bees or butterflies) are mature enough to pollinate their flowers. This reduces two of the mouse's food sources – if the flowers aren't pollinated, there are no seeds, and if the insects don't have food, there are no insects. If there is less food, fewer mice survive, so predators like snakes and hawks, which depend on mice as a food source, will also go hungry.

From the historical records and observations, we know that phenological events can vary from year to year. Ecosystems can recover from variation between years, but when these changes happen consistently over many years, the timing of events such as flowering, leafing, migration, and insect emergence can impact how plants and animals are able to thrive in their environments.

2) Phenological events affect our food supply

Changes in phenological events can also have a significant impact on how we live our lives and interact with our environment on a daily basis. For example, when plants flower and fruit can affect our health and food supply.

For many plants, the growing season is triggered by rising air temperatures. Fruit trees for example flower in response to rising temperatures. Take cherries for example. Cherry trees flower in response to warming temperatures, so if it is warmer earlier in the year, the flowers will bloom earlier as well. There is evidence that this is actually happening some places in

the country. For example, Washington DC has traditionally had a Cherry Blossom Festival during the first two weeks in April, culminating in mid April with a parade. Over the past few decades, the cherry trees have been blooming earlier and earlier, so that peak bloom is now at the beginning, rather than during the celebration at the end of the festival.

Cherry trees, as well as many other fruit trees like apples, peaches and pears, are pollinated by insects, which have a seasonal life cycle – they take time to develop from egg to larva to adult. If the trees flower earlier in the season, they may be out of synch with their pollinators. For example if an insect is still in the egg or larval stage, they will not be able to fly from tree to tree and transport pollen from one plant to another. Without pollination, the flowers are not fertilized, and will not produce fruit.

In addition to affecting our food supply, phenological events can also affect human health. Pollen allergies can be exacerbated by some changes in growing conditions. People are allergic to pollen from all kinds of plants, and when the flowering time changes, those reactions will change as well.

The effects?

- Changes in the timing of phenological events can have a significant impact on the variety and availability of many fruits and vegetables.
- Changes in the timing of phenological events can affect the severity and frequency of pollen allergies.

3) Indicator of climate change

Scientists can use changes in the timing of phenological events to determine how the climate changes over time. Scientists use phenological data in computer models that project future climate scenarios and the projected impacts of such changes on the environment. It is important for us to know how the climate is changing because the impacts of climate change are far-reaching.

Why Climate Change is Important

1) Species Distribution

Climate change affects individual plant species by changing the speed and duration of physiological (life) processes such as growth rate, the degree of evaporation of available water, and their interactions with birds and insects. Because plant species differ in their sensitivity to temperature and humidity, climate change also affects the kinds of plants and animals that can survive in an ecosystem.

2) Spread of disease

The spread of diseases carried by insects and other animals such as malaria, viral encephalitis, Chagas disease and African sleeping sickness is also a concern. These diseases are transmitted by what are called "biological vectors" – animals that carry a disease pathogen within their body. They are usually, though not exclusively, arthropods, such as mosquitoes, ticks, fleas and lice and transmitted by a bite. As climates warm, the animals that carry these diseases expand their range, surviving in areas that in the past have been too cold

for them to survive. Recently instances of malaria have been reported in both Texas and in Florida.

3) Extreme Weather
Heavier rainfall causes flooding in many regions as warmer temperatures speed up the water cycle. In the last ten years, floods have caused more damage than in the previous 30 years. Some researchers say that the number and strength of hurricanes, tornadoes, and other events has increased over the last 15–20 years. However, scientists are still looking into this.

4) Changing Ecosystems
As temperatures warm, species may migrate to cooler places or die. Species that are in particularly danger include endangered species, coral reefs, and polar animals such as penguins, polar bears and seals. There have been changes in where we can farm: As climates warm, some mid-latitude places, like Europe, are getting a longer growing season, while some tropical places are becoming too hot and dry to grow crops.

1. Connecting Plants and Climate

Objectives

Plants are composed of different parts with different functions. Plants go through a life cycle that includes seed to seedling to secondary plant growth to flowering to fruiting. Plant life cycles are dependent on climate, and we can use the study of when plants bud, leaf and flower to understand climactic conditions.

K-2nd Grade
Plant Life Cycle
Materials

- Colored pencils
- Paper

Procedure

- Begin by asking the students if they know the parts of a plant (seed, roots, stem, leaves, flowers, fruit). If they are older ask them if they know the life cycle of a plant. You might have to prompt them by asking where we get new plants.
- In this way you can talk them through the cycle of seed to seedling to plant growth to flowering to pollination to fruiting to seed dispersal. Draw this on the board.
- You might want to include in the discussion that anything with a seed is a fruit. Cucumbers, pumpkins, apples, green beans, pears, and tomatoes are all fruits (to name a few).
- Have students draw the plant life cycle, illustrating each stage. This can be as elaborate or as simple as you like depending on the age of the students. Stages you might include are: seed, rooting, sprouting, leafing, budding, flowering, die-off, fruiting. Have students label each stage.
- Ask them when plants start growing outside (spring) and why they start when they do (increased warmth and/or daylight hours). Ask them whether plants everywhere start growing at the same time. You might need to draw a comparison between Hawaii or Florida and Chicago.
- Tell students that tomorrow (or right then depending on your time) they are going to help scientists understand climate change by collecting data about when plants grow in the spring and giving it to scientists through a website. Students all over the country are collecting this data to contribute to a real scientific investigation.

3rd – 6th Grade
Plant Life Cycle

- Colored pencils
- Paper

Procedure

- Ask the students how we grow new plants or how do we propagate plants? Seeds are one way to produce more plants. Ask them to talk through the life cycle of a plant as you draw it on the board.
- Once they have established the life cycle, ask them why plants are important to us. Plants are important because they provide us with food, medicine, and natural beauty. They help to control loss of land due to erosion, provide habitats for other animals, and provide us with oxygen to breathe.
- Tell students that there is a whole area of science that studies the timing of the plant life cycle and when specific events like budding, leafing, blooming, die-off, happen for different kinds of plants. This science is called **Phenology**. Ask students whether it matters when plants bloom? Why would scientists want to study something like that? What would happen if apple trees bloomed in the fall? Would we get apples? Why not. (pollinators, climate)
- Ask students why plants start growing in the spring (rather than winter) and why the start when they do (increased warmth and/or daylight hours). Ask them whether plants everywhere start growing at the same time. You might need to draw a comparison between Florida and Chicago or ask if it is spring everywhere when its spring in Chicago.
- Tell students that because plants are sensitive to climate, scientists can use the timing of life-cycle (phonological) events to understand how the climate is changing.
- Tell students that they are going to help scientists understand climate change by collecting data about plant phenology that they will give to scientists to use by entering it into a website. Students all over the country are collecting this data to contribute to a real scientific investigation.

Extension 7th-12th Grade
Dichotomous Keys

http://inquiry.uiuc.edu/bin/update_unit.cgi?command=select&xmlfile=u13617.xml

Objective

Once students have completed this activity, they will be able to use a dichotomous key to identify some of their local plant species included the BudBurst project.

Materials

- Botanical dichotomous keys

Background

One way of identifying unknown plants is by using a dichotomous key. According to Merriam-Webster a dichotomous keys is "a key for the identification of organisms based on a series of choices between alternative characters." Characters are recognizable features about the organism. The key is a series of decisions about characters. Each decision leads either to a final identification of an organism or another decision to be made. Many curricula include units on the use and development of dichotomous keys.

There are several difficulties with the use of dichotomous keys as anyone who has used or developed keys can attest. One problem is with the decision process itself. All decisions must be made in the order that the characteristics are presented in the key. If it is difficult to make one of the decisions, either because the person using the key does not have the training to make the decision or because the plant in question simply does not have the characteristic then the key will be impossible to use. A good example is the use of flower characteristics in keys. These characteristics such as flower petal color are usually easily observed. However, what happens if the plant is not in bloom at the time someone is doing an identification using the key?

Definitions for descriptive characteristics of Midwestern plants may be found at
Illinois Plant Information Network: ILPIN http://www.fs.fed.us/ne/delaware/ilpin/ilpin.html

Procedure

- Tell the students that they will create a classroom dichotomous key. As a whole group, ask students how they would divide themselves into two groups using their physical characteristics. For example they might decide divide the class into two groups based on gender or hair or eye color.
- Students should try and choose the most efficient characteristics that divide their group. For example, if you choose as a category hair/no hair, the probability is that it won't do much to narrow the selection. Most, if not all, students will fall into the "has hair" category.
- Each half of the class work separately to create a dichotomous key that will allow them to identify each person individually based on their shoes. Depending on students' age, you may want to give them a sample key for some other item as an example or let them give it a try on their own.
- Often two groups will come up with different categorization schemes, which illustrate the specificity of a dichotomous key.
- Have the students chart a classroom dichotomous key. Each branch of the chart should eventually lead to the name of the student in the class. Then throw the shoes in a pile and have each student grab a shoe that is not his or her own. See if students can correctly identify the owner of the shoe using the dichotomous key.
- Tell students that like each of them, plants also have unique qualities. Botanical dichotomous keys use characteristics like leaf and stem type to distinguish between plants.
- Take students for a walk with botanical dichotomous keys to identify the plants around the school.

2. Plant Observation and Data Collection

Data on plant life cycle events can be collected once or multiple times for an individual plant. Ideally students will return to the same plant a number of times to mark the dates and weather conditions on which the plant shows first leaf, first bud, first flower, full bloom, and die-off. Any data you and your students collect is useful to our researchers, however, multiple collection dates provides richer base for data analysis activities for both students and scientists.

Objectives

Students will identify plants native to the United States and will collect and record data on their phenological stage.

Materials

- Plant ID sheets
- BudBurst student data sheets
- Pencils
- Thermometer (for measuring outside temperature)
- (optional Graph paper) rulers

Before you begin

- Decide on your data collection schedule. While this activity works best when you can make multiple observations, any data your students collect is valuable to the project.
- Download the plant species list from the BudBurst website.
- Locate the species that grow nearby the school, and note their location, **including the nearest street address, including number, city, and zip code**. You will need this information to enter the data on the BudBurst web site in **Activity 3**. The Multimap website is one easy way to convert your data. **(http://www.multimap.com).**
- Download the Plant Identification sheets for your chosen plants from the BudBurst website, make sure there are enough copies for each group (or individual student if they are working individually)
- Check the weather for the day – Data collection can take place in any weather, but it's easier when students are properly dressed for the weather.

K –2nd Grade
Plant Observation and Data Collection

Procedure

- Distribute plant ID cards to each student, or student group.
- Assign student groups to each location you have identified. You may either have students identify the plant using the plant ID sheets, or for younger students you may want to point out the plant to them.
- Ask students to search the area and find the plant(s) they have been assigned to track for BudBurst. Have students complete the data sheet noting the life cycle stage and illustrate their specimen.
- After they have finished making observations return to the classroom.
- In the classroom discuss what students have found. Are all the plants in the same stage of development? What stages are they in?
- The results should be entered into the online database, as described in **Activity 3.**
- If you have very young students, you may want to graph the results as a class, then use one computer and project it onto a wall or whiteboard and do the entry as a demo.

3rd-6th Grade
Plant Observation and Data Collection

Procedure

- Distribute plant ID cards to each student, or student group.
- Assign student groups to each location you have identified. You may either have students identify the plant using the plant ID sheets, or for younger students you may want to point out the plant to them.
- Ask students to search the area and find the plant(s) they have been assigned to track for BudBurst. Have students complete the data sheet noting the life cycle stage and illustrate their specimen.
- After they have finished making observations, return to the classroom.
- In the classroom discuss what students have found for each plant species. Are all the species in the same stage of development? What stages are they in? What are some of the ways that changes in budding, blooming, etc. might affect the rest of the ecosystem?
- The results should be entered into the online database **Activity 3**.

Extension 7th-12th Grade
Plant Observation and Data Collection

Procedure

- Distribute plant ID cards to each student, or student group.
- Ask students to search the area and find the plant(s) they have been assigned to track for BudBurst.
- Assign student groups to a general location and have them use the ID cards to identify one or all of the species you have selected for observation. Each student group will be responsible for making observations of all the plants that are found in their location.
- Have students complete the data sheet noting the life cycle stage and illustrate their specimen.
- After they have finished making observations return to the classroom.
- In the classroom discuss what students have found for each plant species. Are all the species in the same stage of development? What stages are they in? What are some of the ways that changes in budding, blooming, etc. might affect the rest of the ecosystem?
- The results should be entered into the online database as described in **Activity 3**. Depending on the amount of time you have, you can either enter the data upon returning to the classroom, or choose to do it in another class period.

3. Plant Phenology and Climate Change

Objectives

Students will understand how climate affects plant life cycle events, and in turn how changes in plant life cycle events can affect natural ecosystems and human life activities.

Students will become familiar with computers and the Internet.

Before you begin

You will need computers with Internet connection for this activity (If your school has a computer lab, you may want to talk with the computer teacher to integrate the BudBurst project into that class as well.)

- Check to make sure your computers are up and running, and their internet connection is functioning properly
- Practice using the BudBurst website, the location data converter (http://www.multimap.com) and elevation finder (http://seamless.usgs.gov/website/seamless/viewer.php) **Detailed instructions are provided at the end of this guide.**

NOTE: *You can enter data for multiple observations and phenological events at the SAME TIME. If you choose to have students collect data over time, you may want to wait until they have completed ALL their data collection before entering it into their database.*

K-2nd Grade
Plants and the Food Web

Materials

- Ball of yarn or string
- Pictures (or cards with written words) of plants and animals in different places in the food chain (one for each class member, you should have a good selection, though they don't all have to be different)
- Computer with internet connection and LCD projector (optional)

Procedure

- Begin by reminding students that they were outside looking at how plants are growing. Discussing some of the other natural and manmade things they may have seen – buildings, trees, grass, birds, cars etc. Say all these things put together are what we call our Habitat.
- Ask everyone to recount the things they saw. You may need to prompt students by asking: What was in the woods? Were there animals? Plants? What kind? What do they eat? They will say that there were birds, squirrels, shrubs, soil, maybe a water source, etc. Make a list of these parts on the board. And let them know they are all part of a habitat. You will use this information in the Ecosystem Web game explained below.

- Get them to discuss how natural areas provide a habitat for various animals (and plants). All of the plants and animals (the living components) and the soil and water (the nonliving components) form an ecosystem.
- Pass out one card or photograph to each student.
- Gather the students into a circle. Using a ball of yarn, hold one end and pass the ball across the circle to a component that you interact with. For example, if you are a tree you could pass the yarn to a person with a bird tag saying, "provides shelter for". The bird holds on to a section of yarn and passes the yarn on to another ecosystem component saying how the two components are connected (i.e. provides shelter for, eats, is eaten by, provides space etc).
- Once everyone is connected, tell the students to hold onto their part of the yarn web. Tell them that this web represents the ecosystem. Now, tell them that if they feel a tug on the string they should tug back (gently). The web should vibrate. This shows how one part of the ecosystem influences another part of that ecosystem.
- Now, while still maintaining the web, ask who has the flowers in the ecosystem. (This includes flowers, seeds) Ask everyone who has a flower to drop his or her portion of the yarn. How does this affect the ecosystem web? So, even if one part of an ecosystem changes, the timing of flowers blooming, it affects the whole ecosystem.
- Tell students this is a problem, but there are things that they can do right now that will help, recycle, walk or bike. And give the scientists the data they have collected.

Entering the Data

Depending on the age of your students, their familiarity with computers, and how many computers you can have younger students create a collective data table, and input the data as a demonstration. For older students, you may divide students into groups of 2-4, have them make a table displaying their data, then enter the date following the instructions on the BudBurst website.

- Go to the BudBurst website http://www.BudBurst.org and click on REPORT
- Look at your plant – is it tree/shrub a flower, or an ornamental plant – click on the picture representing your plant. You will see a form with prompts for data entry.
- Enter in the latitude and longitude of the location where you made your observations
- Enter in the elevation at the location where you made your observations
- Enter the city, state, and country where you collected your data. If there is anything unique about your data collection site, type any comments in the "Comments on Location" field.
- Using the drop-down menus, enter the month, day and year of your observation for each phenological event. Provide information for as many of the phenological stages as you can.

3rd–6th Grade
Plants and the Food Chain

Materials

- Milkweed plant or photo of the Milkweed plant
- Monarch Butterfly or photo of the Monarch Butterfly
- Large bucket of dried beans or tokens
- Two cups for each student
- Location Converter and Elevation Finder instructions (one for each group)
- Computers with Internet connection

Background

The female Monarch Butterfly lays her eggs on the leaves of the Milkweed plant. The larvae will hatch about four days after being laid. Once the egg hatches the larvae (caterpillar) begins eating the leaves of the Milkweed plant. The Milkweed plant contains poisons. When the larvae eat Milkweed they become poisonous to vertebrates, species with backbones. Some vertebrates can tolerate the poison; others have learned to avoid eating the most poisonous parts of the Monarch. But the colors of the Monarch serve as a warning and most predators stay away. The skin of the Monarch larvae does not expand with its eating habits; it must molt, or shed its skin. The larvae molts five times before entering the next stage in the life cycle, pupae. The larvae will attach itself to a twig, head down. They start to shed their outer skin and begin to transform into a pupa (chrysalis). The pupa is a green/jade color and becomes transparent as the larvae transforms into an adult butterfly. The adult butterfly will emerge from the covering and hangs until all the fluid reaches the wings.

Procedure

- Review the life cycle of plants with students.
- Explain that all living things have a life cycle.
- Show the students the Monarch Butterfly or photo of the monarch. Through inquiry have the students take you through the life cycle of a butterfly (egg, larvae, pupae, adult butterfly).
- Some plants and animals depend on one another to live. Discuss the relationship between Milkweed and the Monarch Butterfly. Pose the question do all living things depend on plants to live?
- Have students help you draw a food chain, beginning with Milkweed. Make sure to have at least four levels in the food chain, beginning with the sun.
  Ex: Sun - Milkweed (producer) - Monarch caterpillar (primary consumer) - Robin (secondary consumer)

- Play the Food Chain game.
  - Divide the students into pairs. The pairs should be grouped into the four levels of the food chain. Six pairs will be plants, three pairs will be the primary consumers, one pair will be secondary consumers, and one pair will be the sun.

  - Have the students sit in a descending line from the beginning of the food chain to the end.
  - Pass each student two cups, one is growth, the other is natural waste (i.e. plants-respiration, photosynthesis, reproduction; consumers-digestion, movement, respiration, reproduction).
  - The sun should have access to all of the dried beans or tokens. The sun gives energy for plants grow, so they will pass a handful of dried beans to each plant.
  - The plants will count out ten dried beans. Nine of the beans go into the waste cup and one into the growth cup.
  - Once the plants have ten dried beans in their growth cup they can pass all ten on to the next part of the food chain.
  - The primary consumer will put one dried bean in its growth cup for every ten dried bean it gets. The primary consumer will pass ten dried beans to the secondary consumer once it has ten dried beans in its growth cup.
  - The secondary consumer will live if it gets ten dried beans in its growth cup. The first secondary consumer to get all ten dried beans lives, the rest do not get enough food to live.
- Explain that if the Monarch caterpillar did not have the Milkweed to eat, it would die. Not only would this affect Monarchs, but also it would affect all aspect of the food chain. Every part of the food chain needs plants to grow to allow the components of the food chain to keep living. Plants need the heat from the sun to grow. With climate change it maybe to hot or too cold for plants to grow. This is why scientists are collecting data to see if the climate change has affected plant growth.
- Hand out BudBurst Data Entry Instructions to each group.
- Enter data collected into the BudBurst website. How you approach data entry will depend on your students' ages and school resources. You may want to have younger students create a collective data table, and input the data as a demonstration. For older students, if you have multiple computers, divide students into groups of 2-4, have them make a table displaying their data, then enter the date following the instructions on the BudBurst website.

Entering the Data

Depending on the age of your students, their familiarity with computers, and how many computers you can have younger students create a collective data table, and input the data as a demonstration. For older students, you may divide students into groups of 2-4, have them make a table displaying their data, then enter the date following the instructions on the BudBurst website.

- Go to the BudBurst website http://www.BudBurst.org and click on REPORT
- Look at your plant – is it tree/shrub a flower, or an ornamental plant – click on the picture representing your plant. You will see a form with prompts for data entry.
- Enter in the latitude and longitude of the location where you made your observations
- Enter in the elevation at the location where you made your observations

- Enter the city, state, and country where you collected your data. If there is anything unique about your data collection site, type any comments in the "Comments on Location" field.
- Using the drop-down menus, enter the month, day and year of your observation for each phenological event. Provide information for as many of the phenological stages as you can.

Math Extension:
You may have students graph their data in a variety of ways. When graphing consider the following variables: plant type, plant location, phenophase, temperature, precipitation observation date, # of observations (over time), # of observations (by different students)

Extension 7th-12th Grade
Plant and Animal Interdependence

Materials
- Computer with Internet connection or resource center (If your school has a computer lab, you may want to talk with the computer teacher to integrate the BudBurst project into that class as well.)
- Make copies of conversion instructions for students

Background
Climate change affects individual plant species by changing the speed and duration of physiological (life) processes such as growth rate, the degree of evaporation of available water, and their interactions with birds and insects. Because plant species differ in their sensitivity to temperature and humidity, climate change also affects the kinds of plants and animals that can survive in an ecosystem. While the number of wild plant species can increase because of climate change, most newcomers are species that perform well in human made environments such as roadsides, agricultural lands and urban areas. Species with more specific habitat requirements, on the contrary, disappear. Although there are many factors that affect species survival, climate change is considered a significant cause of decreased native plant populations.
The decrease in native plant populations also has an affect on animals. Many animals rely on these native plants for survival. Plant material can be a source of food, water, or shelter for animals.

Procedure
Remind students of the data they collected in their previous activity, and tell them they are now going to enter the data into the BudBurst website.
- Hand out BudBurst Data Entry Instructions to each group.
- Have students follow the instruction to enter the data on the BudBurst website. For older students, if you have multiple computers, divide students into groups of 2-4, have them make a table displaying their data, then enter the date following the instructions on the BudBurst website.
- **Enter the Data**
    - Go to the BudBurst website http://www.BudBurst.org and click on REPORT

  - Look at your plant – is it tree/shrub a flower, or an ornamental plant – click on the picture representing your plant. You will see a form with prompts for data entry.
  - Enter in the latitude and longitude of the location where you made your observations
  - Enter in the elevation at the location where you made your observations
  - Enter the city, state, and country where you collected your data. If there is anything unique about your data collection site, type any comments in the "Comments on Location" field.
  - Using the drop-down menus, enter the month, day and year of your observation for each phenological event. Provide information for as many of the phenological stages as you can.
- When students have finished entering their data, have a group discussion about how what they have been doing relates to climate change
- Discuss climate change.
  - What causes climate change?
  - How would the change in climate affect plants? Animals?
  - How would the change in climate affect our everyday lives?
- Have the students take you through the basic plant life cycle, draw this on the board. Next to the plant life cycle draw the life cycle of a butterfly. Refer students back to the discussion about the affects of climate change on plants. Due to the change in climate plants may begin their life cycle earlier than in years past or there may be a delay. Ask students if they think these changes would have an affect on the life cycle of butterflies.
- To give the students a better understanding, use the example of the Monarch Butterfly and the Milkweed plant. Monarch larvae depend on Milkweed for a food source. With out Milkweed the Monarch may not be able to survive.
- Have students use the Internet or resource center to research the dependency between a species of plant and animal. They should chose a plant species and research to find out if there is an animal that relies on the plant for food, shelter, or there may be an insect that only pollinates that species of plant.
- Depending on the level of your class you may wish to have your students research the dependency between a species of plant and animal individually, in pairs, or as a class.
- Once students have identified a plant and animal species that rely on one another to live, students should research the life cycle of each species. They should draw the life cycle and identify the time of year these stages occur.
- Pose these questions to students:
  - Are the lifecycles happening at the same time?
  - What would happen if spring came earlier? Later?
  - Would this have an affect on the plant or animal population?
- Have students report their findings to the class.
- Summarize the activity: by suggesting that though we don't usually talk about the seasons and plant growth in terms of phenology (the study of the timing of life cycle events in plants and animals), it has an enormous impact on the natural environment and how we interact with it in our everyday lives. Because plants are at the base of the food chain, anything that affects plants ripples out to affect the rest of the ecosystem.

Convert your location to latitude/longitude in decimal degrees

- To begin entering data, you first need to find out the latitude and longitude of your location. You can do this using the MULTIMAP website (http://www.multimap.com)

- Find the full address of the location you need coordinates for including street address and zip code. If your collection site does not have an address, use the street address nearest to your collection site.

- Where it says country in the top left corner it should say United States. Type in the street address, town, state and zip code and click 'find' it will then display a map of that location.

- The red circle is over address you entered into the search engine. You will also notice it has zoomed in on the location.

- If the location is not exactly where you want, you can use the arrows on the sides of the map to navigate to the specific location.

- Double click on it to center the map around that point. Notice that the red circle stays in the same place. To re-center the red circle, scroll down and under the map, you will see Map Information, including X and Y coordinates, latitude/longitude, and a URL address.

- Click on the link and the red circle will move to your selected location.

- Now look back under the map and you will see the new Map Information, including X and Y coordinates, latitude/longitude, and a URL address.

- Copy the latitude/longitude coordinates displayed within the parenthesis. These are the decimal degree coordinates needed to enter your BudBurst data online at www.BudBurst.org!

Find your Elevation

- Go to: http://seamless.usgs.gov/website/seamless/viewer.php (This is an electronic version of the U.S. Geological Survey).

- You will see a map of the U.S. in the middle of your screen, a toolbar along the left hand side, and a list of display features on the left.

NOTE: Be patient, the site takes a while to load

- To zoom in on your location, use the hatch-mark cursor to select the area on the map. Zoom in on your location until you are close enough to see your exact location. (it will look something like a roadmap)

- In the toolbar, in the second section titled **QUERY**, the top right-hand button is the **ELEVATION QUERY** button.

- Click on the **ELEVATION QUERY** button, you will see a prompt under the map, "**Click on the map to show the elevation at that point"**

- Use the hatch marks to click on the map on the location you collected data (you will probably have to **ZOOM** in to locate the exact place

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OR if you already know the lat/long in degrees

- In the toolbar, in the top section titled, **ZOOM,** you will see an **XY** button.

- Click the **XY** button to open another window which prompts you to enter the latitude and longitude of your data collection site and click **OK**

- You will now see the point you have entered on the map to the right.

- Underneath the map you will find the elevation in feet and the latitude and longitude in degrees, minuets, seconds.

Enter your data

- Go to the BudBurst website http://www.BudBurst.org and click on **REPORT**
- Look at your plant – is it tree/shrub a flower, or an ornamental plant – click on the picture representing your plant. You will see a form with prompts for data entry.
- Enter in the latitude and longitude in degrees of the location where you made your observations (See "Find your location in degrees" instructions)
- Enter in the elevation at the location where you made your observations (see the "Find your Elevation" instructions)
- Scroll down. You will see a list of phenological phases with fields for month, date, and year next to each.
- Using the dropdown menus, enter the month, date, and time that you observed each phase. Click "**report my observation**" to submit your data.
- Click "**clear form**" if you have other observations to report. You may report as many observations as you have.

Summary Data Collection Worksheet

WHAT PLANT DID YOU OBSERVE? (plant list, www.budburst.org/plantlist, or identify another plant)

*Common Name:_____

Scientific Name (if known):_____

WHERE DID YOU OBSERVE?

*Latitude: _____ decimal degrees (i.e. 39.9847)

*Longitude: _____ decimal degrees (i.e.-105.2682)

*Elevation: _____ meters

*City: _____

*State: _____

*Country: __United States_

Comments on Location: _____

_____

WHEN DID YOU OBSERVE? Report dates only for the phenophase(s) that apply to your plant.

	MONTH / DAY / 2007
Budburst/First Leaf:	_____ / _____ / 2007
Full Leaf:	_____ / _____ / 2007
First Flower:	_____ / _____ / 2007
Full Flower:	_____ / _____ / 2007
End Flower:	_____ / _____ / 2007
Seed or Fruit Dispersal:	_____ / _____ / 2007

Additional Comments: _____

_____

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