



NSDL/NSTA Web Seminar:

**Project BudBurst: Getting Students
Involved in Climate Change Research**



Tuesday, March 9, 2010



Today's NSDL Experts



Dr. Sandra Henderson

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Co-Manager of Project BudBurst
Chicago, IL



<http://nsdl.org>



Lowell Cemetery, Massachusetts

5/30/1868



5/30/2005



What similarities & differences can you find in these two photographs? Write your responses in the chat.



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Understanding Nature's Calendar



Phenology is the science that measures the timing of life cycle events in all organisms



Not to be confused with Phrenology, the study of bumps on heads!



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Brief History of Phenology



The Japanese have been recording the timing of Cherry Blossoms since 900AD



Grape harvest dates in Switzerland have been recorded by wine makers since 1480 AD



Thomas Jefferson referred to the progression of blooms in his garden as “acts in a play”

Henry David Thoreau and Aldo Leopold kept extensive phenological records that are being used today



There are also numerous ‘shoebox’ naturalists whose data may prove extremely valuable



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Phenology Today



- There is a recent resurgence of interest in phenology due to global climate change
- Remote sensing using satellites is a new way to provide “green-up” data with global coverage, as are automated webcams.

Which of the following could be problems with remote sensing via satellites?



- A. Short history of the data set
- B. Cloud cover interference
- C. The need for ground truthing
- D. All of the above

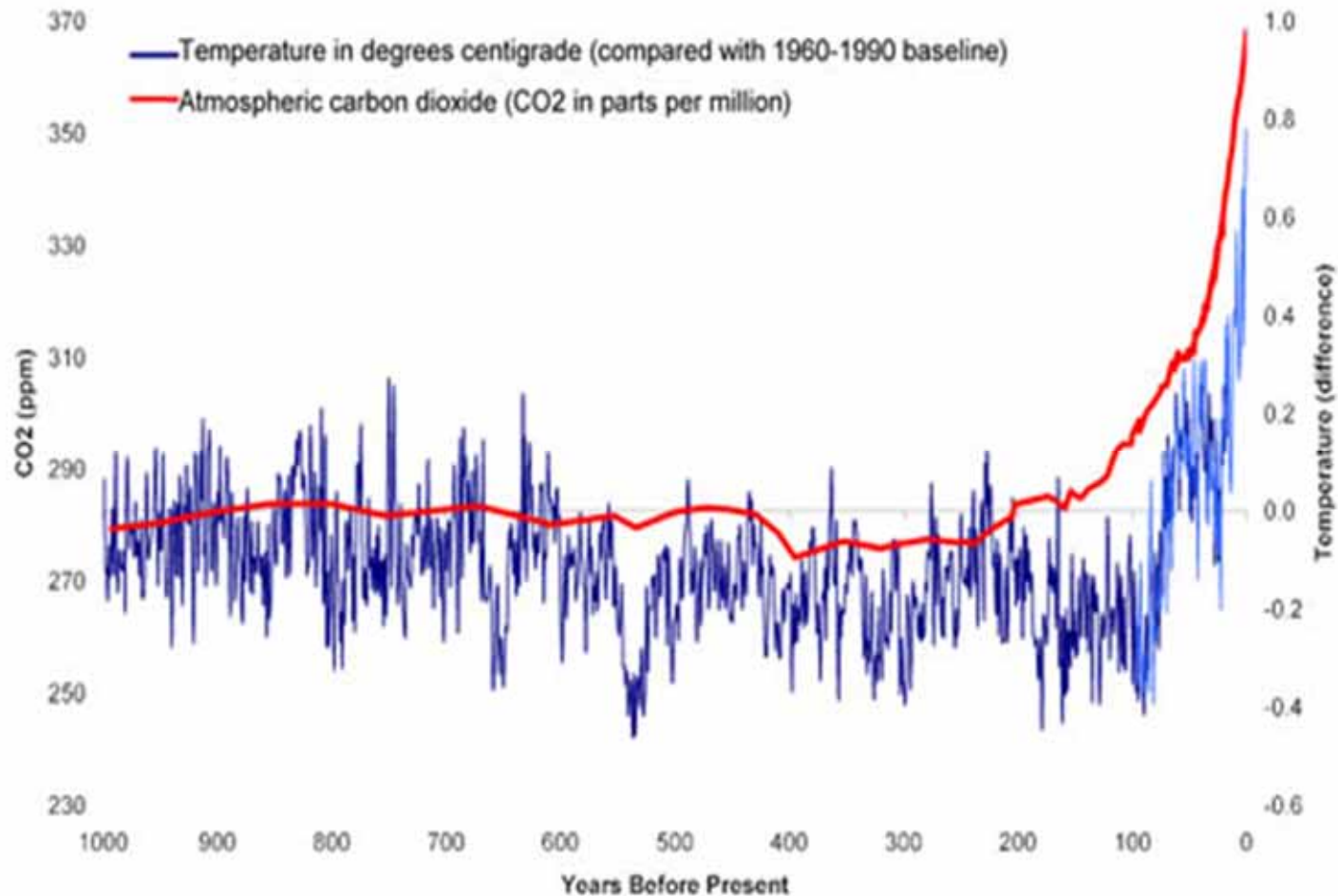
Plants provide an excellent context to understand changes in the environment



They are extremely sensitive to:

- temperature change
- precipitation change
- growing degree days





The planet is warming faster than any time in the last 10,000 years
CO2 and other greenhouse gases are at their highest level in 400,000 years



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During the 20th century, Earth's average temperature rose 0.6°C.

Some effects:

- Arctic warming twice as fast
- Melting snow and ice
- Changing extreme weather events (droughts, heat waves, hurricanes)
- Sea level rise
- Longer growing season
- Changes in timing of phenological events



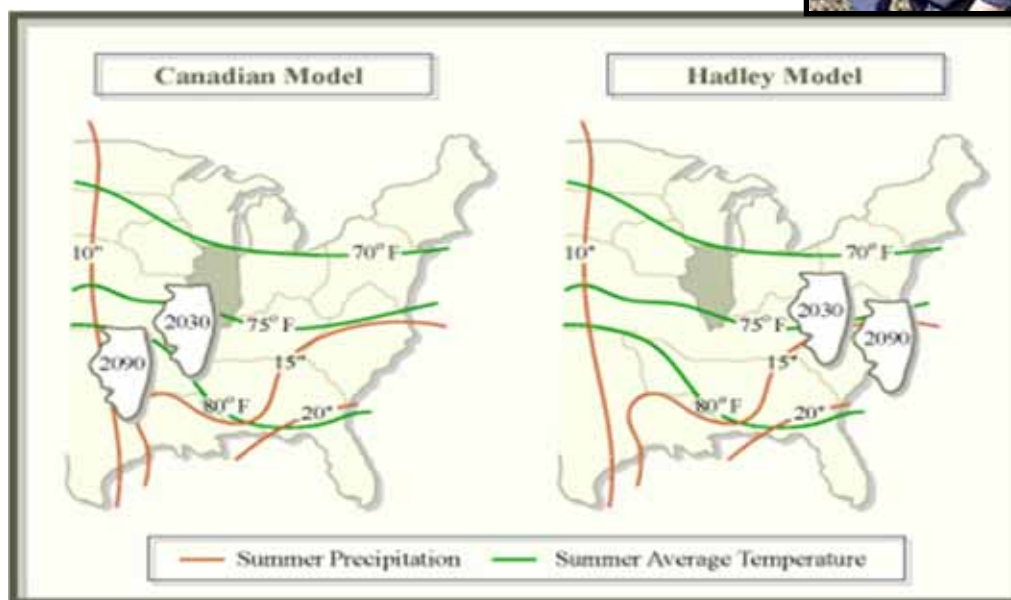
During the 21st century, models predict Earth's average temperature will rise between 1.8 and 4.0° C.

IPCC (2007)

Plant Responses to Climate Change



- Adaptation
 - Plants will cope, adapt, migrate, or go extinct (locally or globally)
 - People can conserve habitats, conduct *ex situ* work, assist migration, or accept extinction

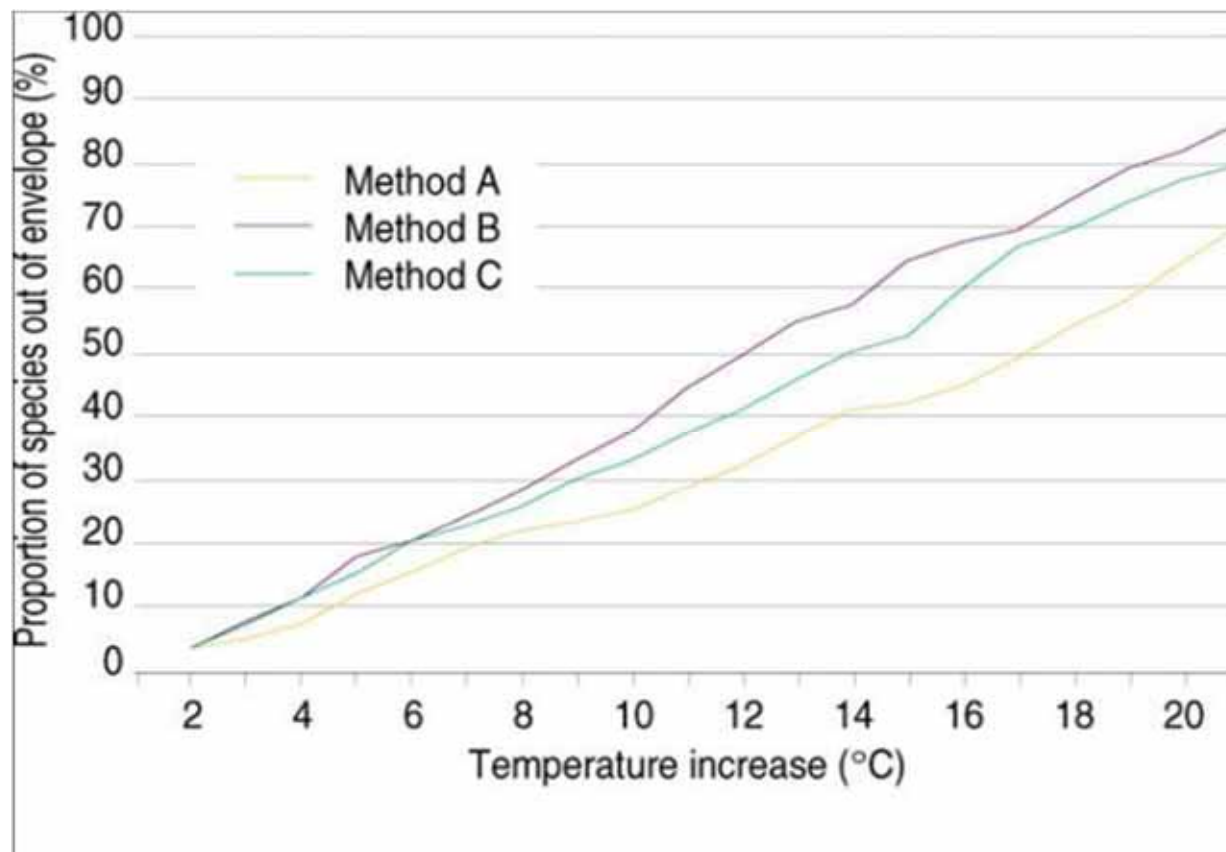


“It is not the strongest of the species that survive, nor the most intelligent, but the ones most responsive to change!” Charles Darwin

Even with modest change many plants are in trouble



The proportion of native US species that were entirely out of their climate envelopes as a function of the increase in temperature above mean annual temperature. Three methods were used to determine climate envelopes (A, B, C). From Morse, Kutner and Kartesz, 1995.



Phenological mismatches



Phenological changes are particularly troubling when mutualistic relationships are disrupted, such as when a plant is cued by temperature and an animal by daylength.

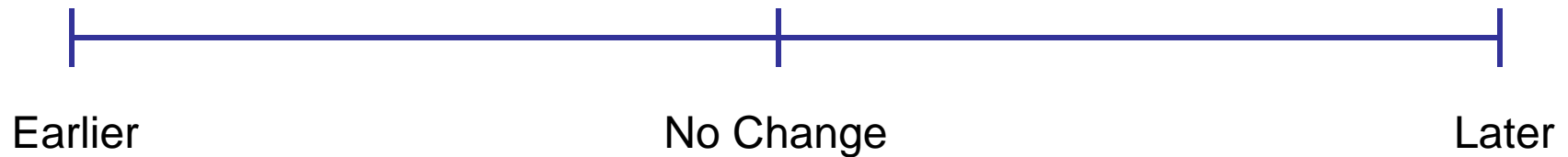
For example, the English oak blooms two weeks earlier and moth larvae hatch two weeks earlier to feed on the leaves. The pied flycatcher used to arrive when the larvae hatched to feed on them. Now the larvae population is dwindling when the birds arrive and the bird population is declining as a result.



How has flowering changed where you live?



Stamp on the graph:



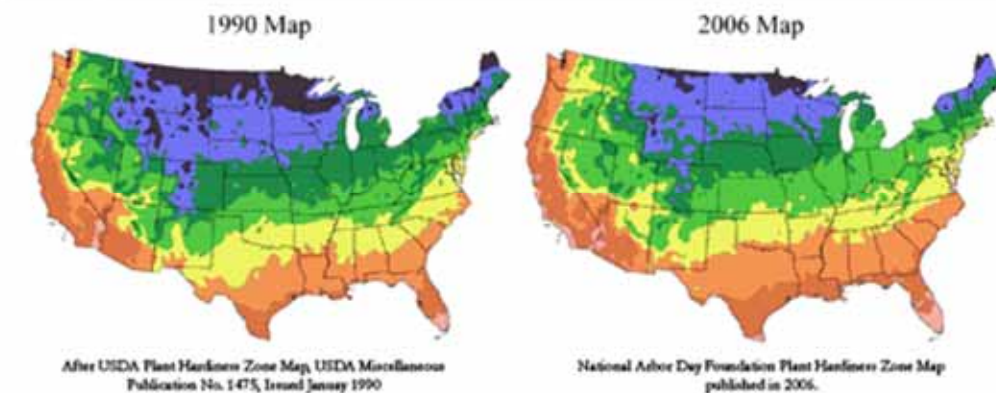
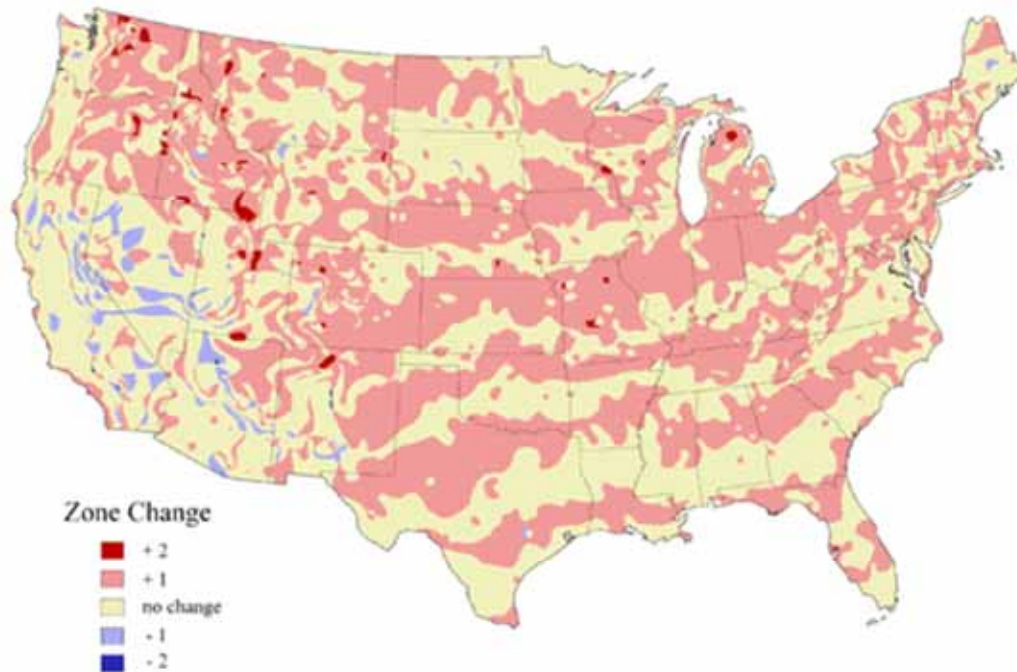
<http://nsdl.org>



Differences between 1990 USDA hardiness zones and 2006 arborday.org hardiness zones reflect warmer climate



About half of the US has warmed one hardiness zone based on the last 15 years of weather data



Seasonal Changes in Plants



Volunteers— How do plants signal seasonal change for you?

1

2

3

4



Phenology Today



National networks like NEON, USA-NPN, and, of course, **Project BudBurst** are actively collecting and analyzing phenological data. Your data can help!



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Let's pause for
questions from
the audience....



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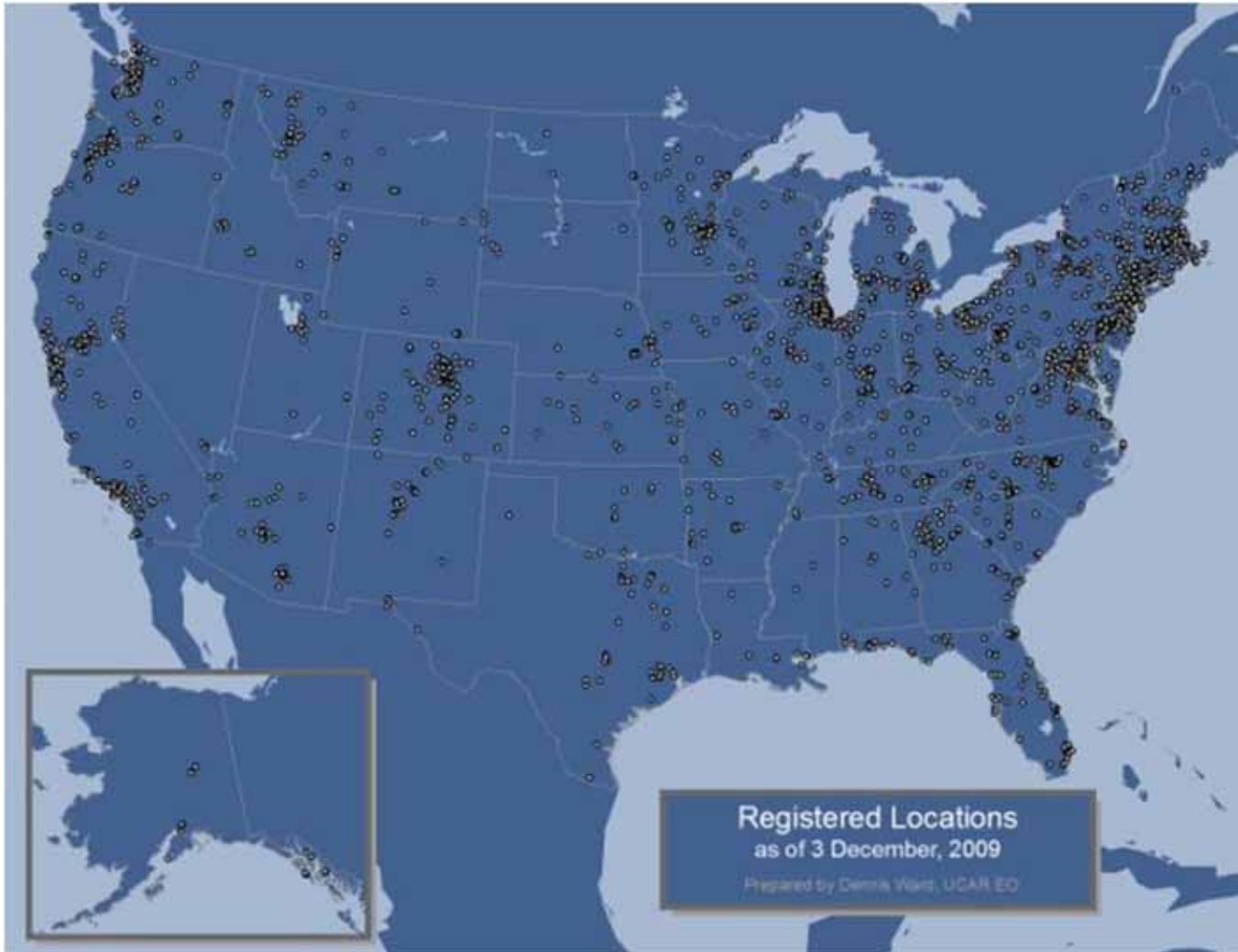
Project BudBurst

A National Phenology Network Field Campaign for Citizen Scientists

Join us in collecting important climate change data on the timing of leafing and flowering of trees and flowers in your area through Project BudBurst! This national citizen science field campaign targets native tree and flower species across the country.

www.budburst.org

Participant locations across the country



Almost 5000
registered
locations

Over 10,000
observations

50 states



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Educational Goals of Project BudBurst



Increase awareness of **phenology** as an area of scientific study

Increase awareness of the **impacts of changing climates** on plants and the environment, and

Increase **science understanding and appreciation** by engaging participants in the scientific process.



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Steps to participate in Project BudBurst



1) Select and identify your plant using the **plant list** or by **geographic area**. (For help use our **Identification Guides**.)



2) Describe the site where your plant is located. This includes finding the **latitude and longitude** of your site.



3) Determine the **phenophases** (phenological stage) you are looking for (i.e. First Leaf, First Flower, First Fruit Ripe). For help use our **Phenophase Field Guides**.



4) Begin observations (before expected time of leafing or flowering)!



5) **Report** your observations online.

Step 1: Pick A Plant



The screenshot shows the Project BudBurst website. At the top, there's a navigation bar with links: "For Students", "For Educators", "Special Projects", "Participate!", "Resources", "Report Observations", "Phenology", "Climate Change", and "Results". Below this, on the left, is a sidebar with "Resources" and a list of plant categories: "Wildflowers and Herbs", "Grasses", "Deciduous Trees and Shrubs", "Evergreen Trees and Shrubs", "Conifers", and "Media Center". The main content area features a "Project BudBurst" logo, a "Steps to Getting Started" booklet, and a "reporting form". It also includes "UPDATED" and "NEW" sections with links to "Identification Guides" and "Phenophase Field Guides". At the bottom, there are five small images representing different plant groups: "Wildflowers and Herbs", "Grasses", "Deciduous Trees and Shrubs", "Evergreen Trees and Shrubs", and "Conifers". A footer section lists "Other Project BudBurst resources from our early years" including "K-6 Facilitation Guide*", "K-12 Teacher Guide*", and "Student Data Collection Sheet*". A note at the bottom states: "*All downloadable materials require the free Adobe Reader." The top right corner of the website has links for "Become a Member", "Join!", "Login", and a Facebook icon.



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Step 2: Get Your Plant's Lat & Long



Project BudBurst
www.budburst.org

Determine your Latitude & Longitude

In addition to street addresses, you can also now find named places such as schools, parks, gardens, and nature preserves!

Enter your location into the box below:

Chicago Botanic Garden

Geocode Clear Map Results

Once you have found your city or town, you can zoom in/out and pan around until you find your location. Double-clicking anywhere on the map will center that location, and its coordinates will be shown below.

Location of map's center:
Latitude: 42.14833
Longitude: -87.79

Example Locations

- 1850 Table Mesa Drive, Boulder, CO
- Truman High School, Taylor, MI
- Chicago Botanic Garden
- The Dallas Arboretum
- Balboa Park
- Morton Avenue Elementary School
- Natchez National Historical Park
- Tallgrass Prairie National Preserve
- Crater Lake National Park

Found 1 result(s)
1: Chicago Botanic Garden, Northfield, IL 60062, USA(42.1483333, -87.79)

Map Hybrid Terrain

Highland Park
Green Bay Rd
Clayton Rd
Green Acres Country Club
Northbrook
Sunset Ridge Country Club

Map data ©2010 Google - Terms of Use



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Step 3: Determine the Phenophases

Don't let our name fool you! We are interested in phenophases throughout the year – Project BudBurst is not just for springtime



14 phenophases of interest

- Flower (first, full, end)
- Leaf (first, full, color change, withered, drop)
- Pollen (first, full, end)
- Fruit (first ripe)



Photo courtesy Mark Schwartz

Step 4: Begin Observations

Identification Guides and Phenophase Field Guides

Project BudBurst
Identification Guide
www.budburst.org

Ponderosa pine (*Pinus ponderosa*)
Also Known As: Yellow pine, Western yellow pine, Bull pine
Plant Family: Pine (Pinaceae)



Identification Hint: Ponderosa pine is the iconic pine of the interior west, with its thick colorful bark which can be bright orange or yellow in color in open sunny spots. It is the only 3-needle pine in the Rockies, in California, and near its borders in Oregon and Nevada and in the Southwest there are other 3-needle pines and ornamental pines that can be confused with ponderosa. Jeffrey pine is very similar but usually has larger cones up to 38 cm (15 in), and purplish felts (the felts are orange to red in ponderosa). Jeffrey pine felts have a pineapple-like odor. In Arizona and New Mexico Apache pine is found which has longer needles up to 38 cm (15 in).

Did You Know? Ponderosa pine got its name because of its ponderous, or heavy, wood. It is one of the most widely distributed pines in western North America. Ponderosa pine is a major source of timber, which is especially suited for window frames and panel doors. Ponderosa pine forests are also important as wildlife habitat. Quail, nutcrackers, squirrels, and many other kinds of wildlife consume the seeds. Dispersal is aided by chipmunks that store the seeds in their caches.

Phenological observations of interest: First Needles, First Pollen, Full Pollen, First Ripe Fruit

General: Ponderosa pine is a large, long-lived native evergreen conifer that grows between 18 to 30.5 m (60 to 100 ft) and frequently lives for over two hundred years. It is common throughout the western U.S. Young trees are narrow and pyramid shaped. As they mature, the crown becomes irregular in shape.

Leaves: The curved, rigid needles are clustered in bundles of 3. They can be dark green to yellow green. The needles remain attached and continue growing for approximately 5 years.

Bark: When the tree is young, the bark is dark brown to nearly black. As the tree matures, the bark turns from cinnamon brown to orange-yellow at about 90 years of age. The bark of older trees is split into broad plates covered with small concave scales. The bark has a fragrance of vanilla or butterscotch.

Cones: Male and female cones are separate but found on the same tree. Female cones are pineapple-shaped, 7.6 to 15 cm (3 to 6 inches) long, and take 2 years to mature. They are borne singly or in clusters of 3 to 5. They are light reddish brown. The male cones are small, yellowish, and in clusters. The tips of the cone scales are armed with short, sharp, prickles that curve out.

Fruit: The small seeds are about 0.6 cm (.25 in) long, with a broad terminal wing about 2.5 cm (1 in) long.

Habitat: Ponderosa pine is found in rocky hills and low elevations in mountains. It is well adapted to grow on bare rock with its roots following crevices or cracks in the rocks. It needs sun and prefers deep moist well-drained soil, but will grow in a wide range of conditions. Ponderosa pine is drought and salt tolerant.

Bloom time: First pollen is correlated closely with the passing of freezing weather and generally occurs in mid-Spring.

Distribution Area



Compiled by Brooke McBride and Sara Mukler
Source: USDA Plant Database; USA-NPN; Lady Bird Johnson Wildflower Center; Preston, North American Trees; ECOG guide to the Ecology of the Northern Rockies; Utah State Extension
Photograph by: Sally and Andy Waskowiak, Lady Bird Johnson Wildflower Center

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Project BudBurst
Ponderosa pine (*Pinus ponderosa*) Phenophase Field Guide



First Pollen



Full Pollen



First Needles



First Fruits Ripe

First Pollen: Report the date when the plant starts releasing the powdery, yellow pollen from their cones on three or more branches. If there is pollen you should see the pollen dust in the air or on your fingers when you gently touch the cones. Male cones are generally reddish in color and when pollen starts to disperse first needles start to appear.

Full Pollen: Report the date when 50% of the branches with cones have pollen.

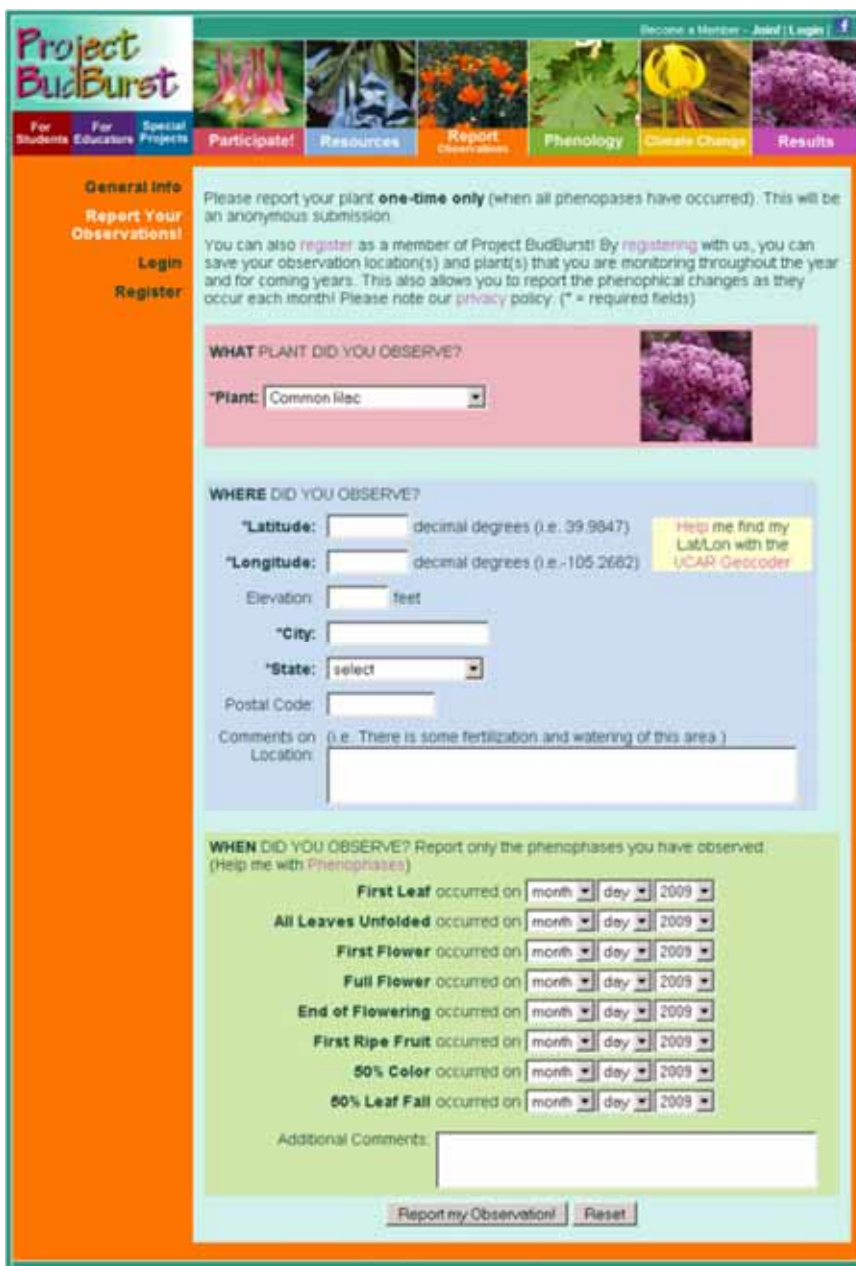
First Needles: Report when new needles emerge from tips of buds, or are visible from the side of the buds. First needles generally show green tips which grow out of brownish scales for each cluster of needles.

First Fruits Ripe: Report the date when you notice the first fruits becoming fully ripe or seeds dropping naturally from the plant. Record when the cones turn brown and the scales expand on 3 or more branches (seeds should start dispersing shortly thereafter).

Photographs courtesy of Paul Alaback, University of Montana

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Step 5: Report Observations Online



The screenshot shows the Project BudBurst website interface. At the top, there is a navigation bar with the Project BudBurst logo and links for 'Participate!', 'Resources', 'Report Observations', 'Phenology', 'Climate Change', and 'Results'. Below this, there is a section for 'General Info' with links for 'Report Your Observations!', 'Login', and 'Register'. The main content area is titled 'Please report your plant one-time only (when all phenophases have occurred). This will be an anonymous submission.' It includes instructions on how to register and a link to the privacy policy. The form is divided into three main sections: 'WHAT PLANT DID YOU OBSERVE?', 'WHERE DID YOU OBSERVE?', and 'WHEN DID YOU OBSERVE?'. The 'WHAT PLANT DID YOU OBSERVE?' section has a dropdown menu for 'Plant' with 'Common lilac' selected and a small image of a purple flower. The 'WHERE DID YOU OBSERVE?' section has fields for 'Latitude', 'Longitude', 'Elevation', 'City', 'State', and 'Postal Code', along with a 'Comments on Location' text area. The 'WHEN DID YOU OBSERVE?' section has a series of dropdown menus for various phenophases: 'First Leaf', 'All Leaves Unfolded', 'First Flower', 'Full Flower', 'End of Flowering', 'First Ripe Fruit', '50% Color', and '50% Leaf Fall', each with 'month', 'day', and 'year' (2009) options. There is also an 'Additional Comments' text area and 'Report my Observation!' and 'Reset' buttons at the bottom.

Project BudBurst

For Students For Educators Special Projects


Participate! **Resources** **Report Observations** **Phenology** **Climate Change** **Results**

General Info
Report Your Observations!
Login
Register

Please report your plant **one-time only** (when all phenophases have occurred). This will be an anonymous submission.

You can also **register** as a member of Project BudBurst! By **registering** with us, you can save your observation location(s) and plant(s) that you are monitoring throughout the year and for coming years. This also allows you to report the phenological changes as they occur each month! Please note our [privacy policy](#). (* = required fields)

WHAT PLANT DID YOU OBSERVE?

*Plant: 

WHERE DID YOU OBSERVE?

*Latitude: decimal degrees (i.e.: 39.9847) [Help me find my Lat/Lon with the UCAR Geocoder](#)

*Longitude: decimal degrees (i.e.: -105.2662)

Elevation: feet

*City:

*State:

Postal Code:

Comments on Location:

WHEN DID YOU OBSERVE? Report only the phenophases you have observed. (Help me with [Phenophases](#))

First Leaf occurred on

All Leaves Unfolded occurred on

First Flower occurred on

Full Flower occurred on

End of Flowering occurred on

First Ripe Fruit occurred on

50% Color occurred on

50% Leaf Fall occurred on

Additional Comments:

How can Project BudBurst Data be used to better understand climate change?



- Comparison with existing and historical phenological data sets
- Comparisons with existing climate data
- “My BudBurst” allows personal archived data over time
- Our data is available to educators, students, and scientists



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Project BudBurst in the Classroom



K-12 Formal and Informal educators and their students are a key audience for Project BudBurst

- Provides students with opportunity to contribute to a better understanding of climate change
- No special equipment or instruments needed to participate
- Open to everyone



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Selected classroom activities overviews



Project BudBurst

For Students | For Educators | Special Projects

Participate! | Resources | Report Observations | Phenology | Climate Change | Results

BudBurst in the Classroom

Download and use these teaching materials and classroom activities designed for each grade level to effectively implement Project BudBurst in the K-12 classroom setting. General descriptions of selected classroom activities are provided below.

Click on the checkmarks below to see the standards met by each activity

Classroom Activities	Grades K-4 Implementation Guide	Grades 5-8 Implementation Guide	Grades 9-12 Implementation Guide
Plant Parts/Physiology	<ul style="list-style-type: none"> ✓ Root Roundup ✓ Pulling the Water Chain ✓ Breathing Plants ✓ Operation Flower Dissection ✓ How Seeds Travel 	<ul style="list-style-type: none"> ✓ Cold Consequences ✓ Plant Part Adaptation Charades 	<ul style="list-style-type: none"> ✓ Investigating Invasives
Plant Observation	<ul style="list-style-type: none"> ✓ Colors in Nature ✓ Leafy Combo 	<ul style="list-style-type: none"> ✓ Mystery Plant Identification ✓ Botanical Scavenger Hunt 	<ul style="list-style-type: none"> ✓ Using a Key to Classify Plants ✓ Botanical Scavenger Hunt
Why We Care About Plants	<ul style="list-style-type: none"> ✓ Making a Joyful Noise ✓ The Wander of Pollen 	<ul style="list-style-type: none"> ✓ Pea Patch Pollination Game ✓ Plant and Pollinator Adaptations 	<ul style="list-style-type: none"> ✓ A Plethora of Pollinators
Ecosystems and Biomes	<ul style="list-style-type: none"> ✓ Ecosystem Exploration 	<ul style="list-style-type: none"> ✓ Habitat World 	<ul style="list-style-type: none"> ✓ Studying Eco-Climate Domains
Plants and Climate	<ul style="list-style-type: none"> ✓ Pick-a-Plant ✓ In the Neighborhood 	<ul style="list-style-type: none"> ✓ The Climate Connection 	<ul style="list-style-type: none"> ✓ How Might Elevated CO₂ Affect Plants?



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Project BudBurst in the Classroom

Which of our educational resources are you interested in? Stamp your answers:



	Standards aligned Classroom Activities at 3 grade bands
	Teacher Implementation Guide
	Live mapping
	Scientist's Blog



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Coming Soon: Mobile phone technology for citizen science



Conceptual image for illustrative purposes only

UCLA Center for Embedded Network Sensing is developing software for mobile-to-web portal system using Project BudBurst database

Features

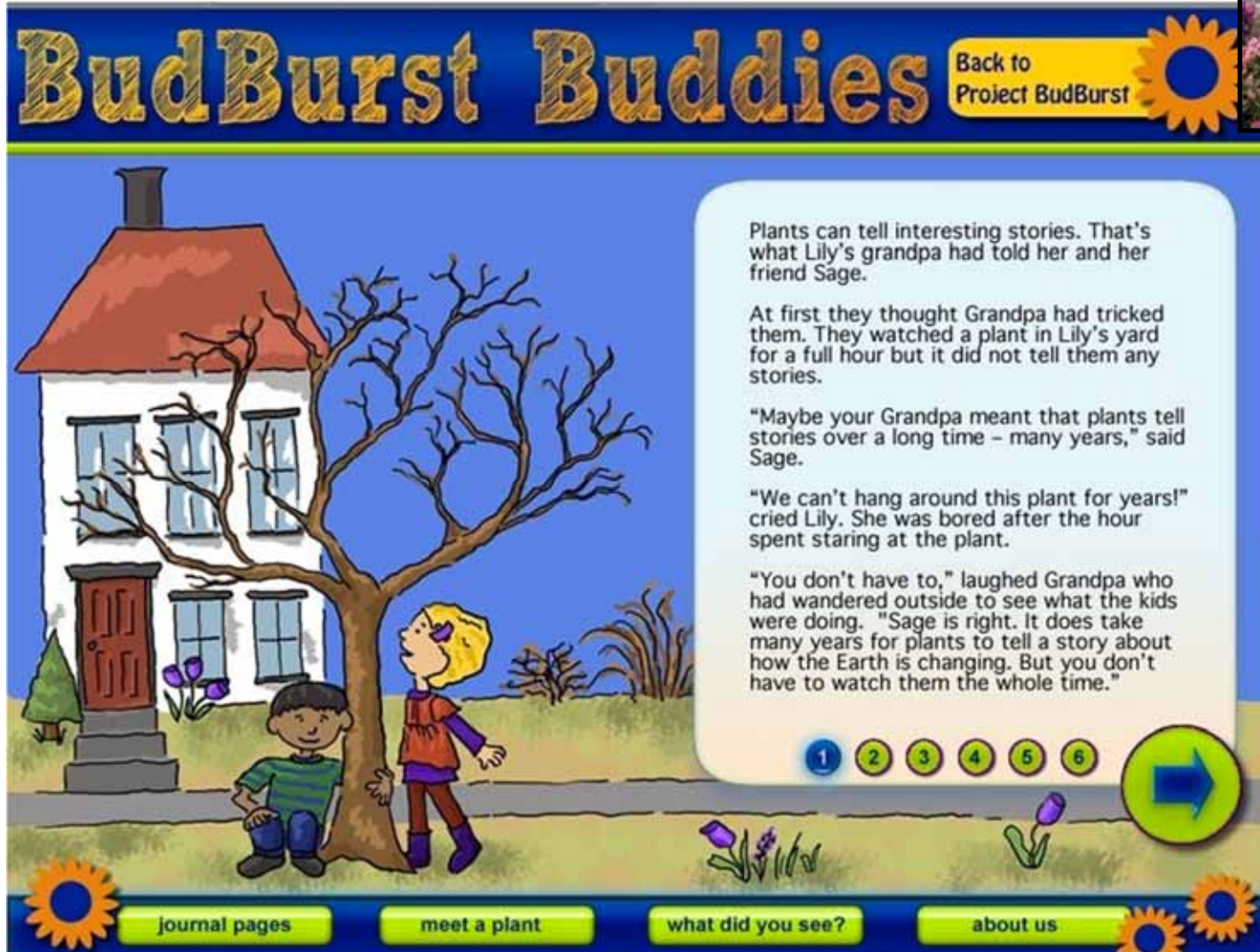
- mobile phones used to capture and upload data in the field
- data automatically geotagged
- photo uploads will help with quality control of data being reported
- real time feedback
- Web 2.0 social networking



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Coming Soon: BudBurst Buddies



BudBurst Buddies

Back to Project BudBurst

Plants can tell interesting stories. That's what Lily's grandpa had told her and her friend Sage.

At first they thought Grandpa had tricked them. They watched a plant in Lily's yard for a full hour but it did not tell them any stories.

"Maybe your Grandpa meant that plants tell stories over a long time – many years," said Sage.

"We can't hang around this plant for years!" cried Lily. She was bored after the hour spent staring at the plant.

"You don't have to," laughed Grandpa who had wandered outside to see what the kids were doing. "Sage is right. It does take many years for plants to tell a story about how the Earth is changing. But you don't have to watch them the whole time."

1 2 3 4 5 6

journal pages meet a plant what did you see? about us

Project BudBurst exists due to the support from funders, partners, and collaborators



UCAR EDUCATION AND OUTREACH



CHICAGO BOTANIC GARDEN

Managed by

- University Corporation for Atmospheric Research
- Chicago Botanic Garden






With Funding from

- US BLM
- NEON
- USGS
- USDA Forest Service
- US Fish and Wildlife
- National Geographic Society
- NASA
- NSF



In Collaboration and Partnership

- National Phenology Network
- National Ecological Observatory Network
- Windows to the Universe
- UC LA – Center for Embedded Network Sensors
- Oak Ridge National Laboratory
- Windows to the Universe





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**THANK
YOU!**



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<http://nsdl.org>



Resources from this web seminar are listed at:

<http://www.diigo.com/list/nsdlworkshops/web-seminar-budburst>

Learn about new tools and resources, discuss issues related to science education, find out about ways to enhance your teaching at:

<http://expertvoices.nsdl.org/learningdigitalK12>



<http://nsdl.org>



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The Learning Center is NSTA's e-professional development portal to help you address your classroom needs and busy schedule. You can gain access to more than 3,300 different resources that cater to your preference for learning. Over 925 resources, such as journal articles, science objects and web seminars are available [for free](#). A suite of practical tools such as My Library, My Transcript, and My Professional Development Plan and Portfolio tool help you organize, personalize, and document your growth over time. If desired, you may review an [archived Web Seminar](#) overview of the NSTA Learning Center, or download the ["How to Guide"](#) PDF (2.7 MB).



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3. Energy: Thermal Energy, Heat, and Temperature
4. Universe: The Sun as a Star

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By Subject	By Grade Level	By State Standards
<ul style="list-style-type: none"> Earth & Space Science Life Science Physical Science 	<ul style="list-style-type: none"> Elementary Middle School High School College 	<p>Select your state to begin:</p> <p>Choose a state <input type="text"/></p>


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 Learn at your own pace online with these 1-2 or 6-10 hour interactive activities.


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Multimedia Overview

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