

THE PHENOLOGY RELAY RACE

REINFORCING STUDENTS' OBSERVATIONAL SKILLS FOR PHENOLOGICAL MONITORING WITH THE USA NATIONAL PHENOLOGY NETWORK



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In this 60-minute activity, students first observe and record the phenological status of native plants in their phenology garden using protocols and data sheets from the USA National Phenology Network (USA-NPN). Students then get some exercise and reinforce their knowledge about plant phenology and monitoring protocols through a fun educational game wherein they work collaboratively in small groups to problem solve and shuttle answers to a posterboard across the schoolyard.

Activity leaders and docents help students to make connections between the phenological status of plants and local and regional climate patterns. It is possible, and simple, to link these activities with other classroom activities and lessons in STEM, Humanities, and Fine Arts subjects. Students later contribute their phenological observations to the USA National Phenology Network (USA-NPN), which is a biological monitoring program that brings together citizen scientists, government agencies, non-profit groups, educators, and students of all ages to monitor the impacts of climate variability and climate change on plants and animals in the United States. The network harnesses the power of people and the Internet to collect and share information, providing researchers with far more data than they could collect alone.

Objectives

1. Students use their knowledge of vegetative and reproductive structures of plants (knowledge gained from previous lesson plans and activities in the phenology garden) to classify the phenological status of native plants and record their observations on USA-NPN data sheets.
2. Students gain an understanding of how the phenological status of plants change over the seasons.
3. Students work in groups and use their knowledge of plant identification, plant phenophases, and plant life forms (e.g., grass, herb, deciduous shrub/tree, evergreen broadleaf) to participate in an educational phenology relay race.
4. Students exercise and have fun by participating in an educational phenology relay race.

Photos by Brian Haggerty and UCSB's *Kids In Nature* environmental education program

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Background for educators: The Phenology Stewardship Program at UC Santa Barbara, in collaboration with the UCSB *Kids In Nature* (KIN) environmental education program, established native plant gardens in 2008 at two elementary schools in Santa Barbara, California. We since have been developing and implementing phenology education activities in these gardens for several 5th grade classes, though we also have adapted these activities for a variety of other audiences including: after-school programs at Boys & Girls Club in Santa Barbara and Oxnard-Port Hueneme; university classes at UCSB; adult education courses and instructional workshops for teachers; and interpretation programs at several National Parks in California. For the *Kids In Nature* phenology garden activities, UCSB undergraduate students (“Docents” in this activity) who are enrolled in an UCSB Education Practicum course help test educational activities in the phenology garden, in addition to other activities they run for the KIN program. Phenology garden activities are designed for student participation with the USA National Phenology Network. We also integrate activities on species identification, morphology & anatomy, plant-animal interactions, plant-climate interactions, soil ecology, ethnobotany, photography, and other ecology-related themes. Garden activities have been complemented by docent-led in-class herbarium activities designed to teach students collection, preservation, and labeling skills. As a result of these combined activities, students begin to integrate several subjects through a single phenology framework, including math, writing, biology, climatology, geography, computer science, fine arts, and social/cultural history.

More phenology activities and lesson plans are available online, including guides to establishing phenology gardens and activities that can be run in phenology gardens, school yards, back yards, or National Parks. To learn more and to download materials, visit the Education section of the California Phenology Project website (www.usanpn.org/cpp/education) or the USA National Phenology Network (www.usanpn.org/education).

PROCEDURE:

Materials:

- Writing utensil and writing surface (clipboard or notepad)
 - Data sheets, phenophase definitions, and life form definitions from the USA National Phenology Network (for the *Kids In Nature* program, these sheets were adapted and printed into each student’s *Kids In Nature Journal* that they used year-long for phenology garden and other environmental education activities and field trips).
 - Phenology Relay Race station (replicated 3 times) – see image and list of materials at the end of this lesson plan
 - Suggested: plant identification guide or homemade plant identification flashcards, coloring pencils, magnifying glass, metric ruler, digital camera
1. **5 minutes.** Fifth grade students are escorted from the classroom to the Phenology Garden by their undergraduate docents. Activity leader (Brian) reviews vegetative and reproductive structures, and delivers an introduction about the activities, making connections with: previous garden activities; recent weather patterns and plant requirements of water, sunlight, and temperature; soil properties; and the overall status of plants and animals in and around the phenology garden. Students split into groups of 4 and work with their docents on the following activities.
 2. **20 minutes.** Students use their knowledge of vegetative and reproductive structures to observe the phenological status of their two adopted plants and record their observations on USA-NPN data sheets.
 - a. Working in groups of 4, and with 1-2 docents per group, students locate their adopted plants. Docents help students recall the life form of their plant (following USA-NPN categories of herb, grass, deciduous shrub/tree, broadleaf evergreen, etc.). Docents discuss definitions of these terms with the students and ask them to explain differences among life forms, pointing to examples of these different life forms in the phenology garden and around the schoolyard.

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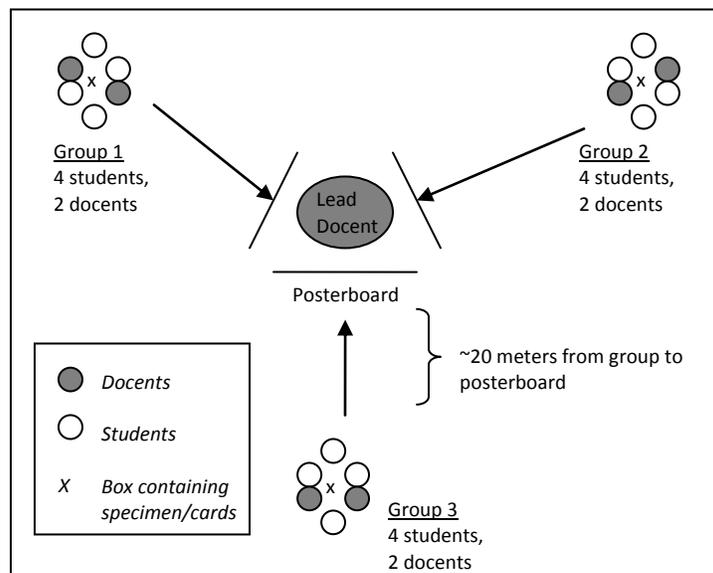
- b. Docents help students find and complete the appropriate phenology data sheet from the USA National Phenology Network (for the *Kids In Nature* program, USA-NPN data sheets were printed in each student's *KIN Journal* phenology garden chapter p19-36). Specifically:
 - i. Locate the correct data sheet in the *KIN Journal* (p32-36) – herb, grass, deciduous shrub/tree, evergreen shrub/tree.
 - ii. Check the plant name (including scientific name), student name, location.
 - iii. Insert date in appropriate cell in the table, then answer “Do you see...” questions about phenological status of each vegetative and reproductive structure. Students will need to look up each phenophase definition before circling one of the “Y/N/?” options (definitions on the associated page in the *KIN Journal* for herb, grass, deciduous shrub/tree, evergreen shrub/tree). Be sure that students take a *close* look both at the plant and the exact definition.

Throughout this phenological monitoring activity...

- Docents pose standards-focused questions to students about the functions and components of the vegetative and reproductive structures on the plants; the size and recent growth of their adopted plants and how recent weather patterns might affect that growth; and how the phenology of their adopted plants might affect interactions with animals (other plants, pollinators, herbivores, etc.).
- Students are in groups of 4 with 1-2 docents per group, or if possible in groups of 2 with 1 docent per group.
- Each group has a digital camera to document observations, methods, and interesting things. Magnifying glasses can and should be used to observe fine detail of plants.
- Brian will visit each group throughout the session to encourage students and docents to share their observations; to introduce specific knowledge about plants and year-long goals for monitoring the phenology garden; to pose questions to students that are connected to California Science Content Standards; and to engage the students in “pop-quiz” activities.

3. 30 minutes. Students participate in The Phenology Relay Race.

- a. **Setup I.** Students remain in their groups (4 students per group with 1-2 docents) and assemble on the school lawn. Each group sits in a circle; the three groups spread apart from each other in a large triangle. Each student in each group is appointed a number by the docent; numbers range 1-4 (or more for larger groups). Students eventually will take turns (by numerical order) running from the group to their respective posterboard in order to post answers. Diagram of spatial layout:



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- b. **Setup II.** Within each group, there is a small box in the middle of the circle (closed/covered so students can't see inside). The box contents are the same across all groups – each box contains a plant stem cutting from the garden, and 4 color-coded envelopes. The envelopes contain similarly-colored laminated cards of the following:
- "#1 Plant Species ID"** envelope contains several garden species names (including the name of the live plant stem).
 - "#2 Plant Life Form"** envelope contains "Grass", "Herb", "Deciduous shrub/tree", "Evergreen Broadleaf"
 - "#3 Vegetative Phenophases"** envelope contains "Emerging leaves", "Unfolded leaves", "≥75% of full leaf size", "≥50% Leaves colored", and "≥50% of leaves fallen"
 - "#4 Reproductive Phenophases"** envelope contains "Open flowers", "Full flowering", "Ripe fruits"

Each laminated card has a velcro tab on the back so that it will stick to similarly-colored felt on the posterboard.

- c. **Setup III.** Each group has a corresponding posterboard approximately 20 meters away. The three posterboards are arranged such that each group cannot see other posterboards, and so that a "Lead Docent" (referee, umpire, etc.) is positioned in the middle.
- d. **The Relay Race**
- Round I.** When the Lead Docent says start, each group opens their box, removes the live plant specimen to observe it, and opens envelope I (**Plant Species ID**). The group of students work together to identify the plant specimen and choose the correct answer from among the laminated cards. The docents may help students by opening plant identification guides, but cannot give away the answer. Once identified, Student #1 takes the card, runs to their posterboard, and attaches it to the appropriate color-coded felt square (marked "**#1 Plant Species**"). The Lead Docent may help the student navigate the posterboard. The student runs back to the circle – after giving the docent a high five, the docent opens Envelope II (**Plant life form**).
 - Round II.** The group works together to identify the life form of the plant specimen and choose the correct answer from among the laminated cards. Student #2 takes the card, runs to their posterboard, and attaches it to the color-coded felt square (marked "**#2 Plant Species**"). The student runs back to the circle – after giving the docent a high five, the docent immediately opens Envelope III (**Vegetative phenophases**).
 - Round III.** The group works together to identify all of the vegetative phenophases visible on the plant specimen and choose the correct answer(s) from among the laminated cards.
 - If there is one correct answer, Student #3 takes the card, runs to the posterboard, and attaches it to the color-coded felt square (marked "**#3 Vegetative Phenophases**").
 - If there are multiple correct answers, Student #3 takes one of the cards, runs to the posterboard and attaches it, returns to the group and then another student runs the next card, and so on until all cards are posted.Once all vegetative phenophase cards are posted to the posterboard, the docent opens Envelope IV (**Reproductive phenophases**).
 - Round IV.** The group works together to identify all of the reproductive phenophases visible on the plant specimen and choose the correct answer(s) from among the laminated cards. Student #4 takes the card, runs to the posterboard, and attaches it to the color-coded felt square (marked "**#4 Reproductive Phenophases**"). There may be several cards to post on the posterboard; students take turns running/posting them as before.

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- v. Once the group posts all cards, they have completed the Phenology Relay Race. Each group remains seated (and as calm as possible!) until all groups are finished. The docents are careful to encourage positive reinforcement for other groups, and to discourage competitive/negative behavior among groups – being the fastest is not the goal!
 - e. **End of race check.** Once all groups have completed their race, the Lead Docent calls all groups to gather near the posterboards (everyone faces the Lead Docent). The docent inspects each posterboard with the entire group for accuracy and asks questions of the students (e.g., “Can any of you find incorrect or missing answers on any of the posterboards?”). If any incorrect answers are discovered, or if answers are missing, then the Lead Docent asks questions of the students in order to lead them to the correct answers. *Remember: The plant specimens that each group identify are exactly the same among groups, including the vegetative and reproductive phenophases, so all posterboard answers should be the same.*
 - f. In this game, there is no prize for finishing the race first or for correctly identifying each component. Docents encourage positive reinforcement within and among groups. Once the end of race check is completed, the Phenology Relay Race is completed and may be run again with different plant species (which might be a different life form from the first relay race, or have different vegetative phenophases or different reproductive phenophases).
4. **5 minutes. Wrap-up.**

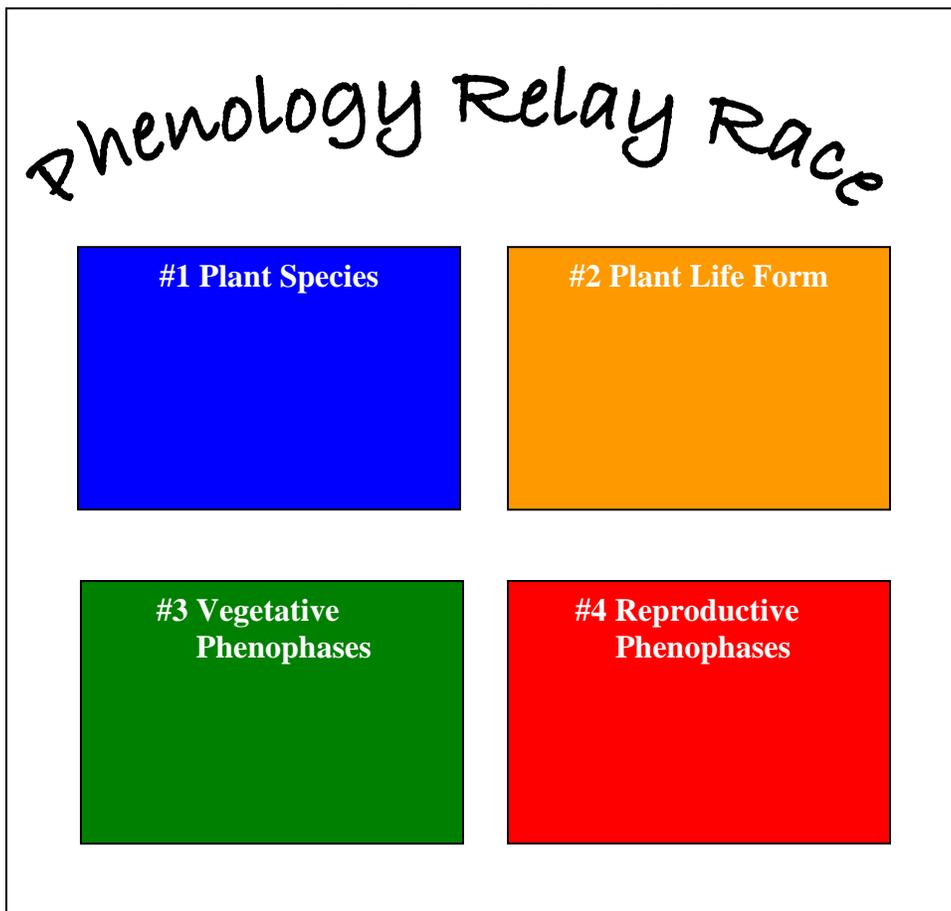
All groups gather into one large group. Brian calls on students to share experiences and observations. Brian wraps up the session by pointing out phenology of surrounding trees (especially Liquidambar trees in fall/winter or spring phases) and discusses the weather forecast. Brian revisits the guesses students made during previous garden visit about when the Liquidambar trees will be at USA-NPN’s “all leaves colored” and “all leaves fallen” stages. Students can revise their guesses for future visits. Brian takes a photograph to be used in a time-lapse sequence developed over subsequent visits.

Preview of the next phenology garden activity

During all future garden visits for the school year, phenological monitoring (activity 2 above) will take place the first 10-20 minutes followed by an activity designed to reinforce knowledge gained during that activity. Other activities to reinforce phenological literacy include *Flight of the Pollinator*, *Ethnophenology*, and various drawing/labeling and photographing activities. Students will continue to use USA-NPN protocols and data sheets to observe and record the phenology of native plants, and docents will continue to engage students in thinking about the importance of plant phenology in different ways. Option: At the end of the year, students help upload their data to the USA-NPN online database and receive a “Junior Phenologist” certificate.



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This is a simplified drawing of what the posterboards look like for the Phenology Relay Race. Colored panels are felt squares (ok to modify colors, but make sure they correspond to the color-coded laminated cards in each group's envelope). Students work in groups to identify and classify the four components of a plant that are required to participate in the USA National Phenology Network's plant phenology monitoring program. Each component (1-4) is color-coded with an envelope that contains similar color-coded laminated cards (with velcro tabs on the back). When an answer is determined by a group, a student runs across the schoolyard to stick the answer on its corresponding felt square. After all four components have been completed, docents review the answers with the students and pose questions about the accuracy of their answers. The relay race can be repeated several times with different plant species from the phenology garden.