

ETHNOPHENOLOGY

A hands-on nature exploration activity designed to engage participants in observing plant phenology while investigating how traditional cultures remedied health ailments with seasonally-available wild plants



“Ethnobotany” – the study of cultural uses of plants

“Phenology” – the study of seasonal plant and animal activities

This activity is designed to help participants experience first-hand one practical application of plant phenology. After being assigned (imaginary) health ailments associated with historically-relevant events, participants learn how indigenous and traditional cultures used wild plants to treat the symptoms of these ailments or diseases. Then they explore plants growing nearby to find appropriate plants that are bearing seasonally-available structures such as leaves, stems, fruits, and seeds. The focus is on phenology throughout the activity; talking points for activity leaders are provided throughout this guide. In addition, participants can (unknowingly or knowingly) record phenological data while participating in this activity. These data can then be reported to the USA National Phenology Network (www.usanpn.org), 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.

Will the Ethnophenologists find what they need to treat their ailments? Only the seasons can tell...

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The *Ethnophenology* activity was designed to align with the goals of the USA National Phenology Network. Instructions are provided (page 9) so that phenological data can be collected during this activity and contributed to this important scientific effort.

All photos in this activity guide were taken by Brian Haggerty.

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).

BASIC KNOWLEDGE & SKILLS NEEDED TO LEAD THIS ACTIVITY

- Ability to lead a group with diverse science literacy backgrounds on an informative and engaging natural history interpretive walk.
- Ability to identify at least 4-5 plant species in your activity area (trail, garden, etc.), and be able to describe several ethnobotanical/historical uses of those plants.

If you don't have much experience with plants yet, that's ok! It doesn't preclude your ability to lead this activity. An effective way to learn (very quickly) about your region's plants is to get in touch with local botanists and ecologists at botanic gardens, colleges, nurseries, and gardening shops. If you're having trouble finding traditional *medicinal* uses of plants (or if the subject matter is not appropriate for your audience), try other traditional uses of the same plants! This could include textiles & building materials; games & musical instruments; spiritual ceremonies; and tools used for hunting, gathering, preparing, cooking, and eating food.

A brief word of caution – The goal of this activity is to learn about seasonal medicinal properties of wild plants – not to learn how to prepare and ingest them yourself. While there are references available to learn how to do so, any attempts to do so, whether by activity leaders or participants, are to be strongly discouraged. Even the most informed ethnobotanists agree that much of the cultural knowledge about the proper preparation and administration of treatments derived from wild plants

has been lost or mistranslated, and attempting to do this on your own could result in new life-threatening ailments requiring immediate medical attention.

AUDIENCE – The core concepts of this activity are appropriate (and fun!) for all ages and abilities, including amateur naturalists, students of all ages, educators at all levels, citizen scientists, and professional scientists. Some materials and terminology may need to be adjusted according to the specific audience or the activity leader’s goal.

This phenology activity was designed with “informal” science education programs in mind – places like botanic gardens, natural reserves, and National Parks where activities are developed and run by trained educators, docents, and rangers. This activity, however, could easily be adapted for a “formal” science education setting (K-12 classrooms and university courses), and could satisfy many different educational standards for STEM subjects, social sciences, and – with just a bit of planning – fine arts. Homeschoolers and families might also find this activity enriching and could adapt it for the community garden, neighborhood park, or backyard garden.

MATERIALS NEEDED TO COMPLETE THIS ACTIVITY

- List of health ailments and the plant species that traditionally have been used to treat those ailments (including specific plant structures such as leaves or fruits). Species and ailments should be chosen based on 1) the availability of ethnobotanically-important species at the activity site, and 2) the USA-NPN’s list of species targeted for phenological monitoring (<http://www.usanpn.org/participate/species>).
- An identification guide to local species, or a leader capable of pointing out species to participants
- Phenology monitoring data sheets, available from the USA-NPN (<http://www.usanpn.org/participate/observe>)
- Optional materials:
 - Hand lenses & magnifying glasses
 - Cameras
 - Journals or paper for journaling activity
 - Small paper or plastic bags for collecting plant parts

PREPARATION BY ACTIVITY LEADER(S):

1. Choose one to several species to be included in the activity.

- a. Ideally this activity will be run with species that already are being monitored nationwide through the USA National Phenology Network. This way, not only is an effective and fun activity conducted, but the resulting phenological data collected by citizen scientists can be contributed to a much larger effort to detect impacts of climate change on plants and animals (*tip: use this as leverage in funding proposals!*).

To align this activity with the USA-NPN’s targeted species, first become familiar with the phenology monitoring program (www.usanpn.org), being sure to click on the “Participate” tab. Then determine which of the USA-NPN’s targeted species occur in your region (www.usanpn.org/participate/species). If you are unfamiliar with the species at your site,

consult with colleagues, docents at nearby botanic gardens and natural reserves, and local sources of botanical expertise such as nurseries and colleges.

- b. If USA-NPN targeted species do not occur at your site, or you otherwise don't have the capacity to participate, that's ok! This activity can be run anywhere, by anyone with access to knowledge about ethnobotanical uses of plants.

2. **Consult local or regional ethnobotany references¹ and record ailments that can be treated with those plant species.** To do this in a place-based historically-relevant manner, cross-reference these records with ailments that commonly arose with important historical events (e.g., natural disasters, social conflicts, disease epidemics). Also record which plant structures are harvested (e.g., roots, leaves, fruits) for each ailment and how they are prepared (e.g., tea, salve, chew). Be sure to record which stage of those structures is used – for example, in some cases it may be the *young* fresh leaves, in others it may be the *old* leathery leaves.

Once a final list has been generated, and to enhance interactions among participants during the activity (see suggestions in procedure below), activity leaders may want to choose at least one plant species that can be used to alleviate several ailments (blue elderberry in the example below). Similarly, activity leaders may want to choose an ailment that can be remedied by more than one plant species (poison oak rash can be remedied with two plant species in the example below).

The table below could be divided into two or more tables and integrated into the activity to suit the activity leader's goal. For example, to encourage interaction among participants, the Ailment column could be split away and distributed to half of the participants, and then they meet and talk with other participants who hold the remaining information (a "treatment guide" of sorts).

Together, the participants determine which plant(s) and plant parts are needed.

POCKET PROCEDURE FOR ACTIVITY LEADERS

1. Activity leader introduces the activity.
2. Participants select an ailment
3. Activity leaders provide "treatment guides" to participants so they can learn which plants – and most importantly, which of their structures – can help alleviate their symptoms.
4. Participants explore the area for the appropriate targeted plant species.
5. Once a correct plant species is found, participants search the plant for the appropriate structures (e.g., stems, leaves, fruits, seeds) – *particular attention should be paid to whether the appropriate plant structure is at the correct seasonal status to treat the ailment.*
6. While the participants search for seasonally-available plant structures, it's a perfect opportunity to engage them in recording the phenology of their plants for the USA National Phenology Network.
7. Post-activity de-briefing

¹ For running this activity anywhere in North America, an excellent resource is Daniel Moerman's *Native American Ethnobotany* (Timber Press, 1998). This activity was developed with south-coast California plant species in mind – an excellent regional resource is Jan Timbrook's *Chumash Ethnobotany* (Santa Barbara Museum of Natural History, 2007).

ETHNOPHENOLOGY

This table may be one way to organize species information with the ethnobotany information. This type of guide could be printed and laminated, and then provided to activity participants while they participate in this ethnophenology activity.

Plant photo	Common name	Scientific name	Ailment	Plant structure & stage	Preparation	Other uses
	mugwort	<i>Artemisia douglasiana</i>	Dermatitis from contact with poison oak	Leaves (the more hairy the leaves the better)	Crumble leaves in hand, rub directly on skin	Sleep aid, important cauterizing agent (similar function as stitches)
	coyote brush*	<i>Baccharis pilularis</i>	Dermatitis from contact with poison oak	leaves	Boiled then applied to skin	Small branchlets used to brush away tiny spines from prickly-pear cactus
	hummingbird sage	<i>Salvia spathacea</i>	Pulmonary ailments & rheumatism	Fresh leaves	Decoction drunk or used as a bath	unknown
	blue elderberry*	<i>Sambucus nigra</i> (subspecies <i>cerulea</i>)	Cold & fever Aches	flowers Ripe fruits	decoction Mixed with egg white & mud	Induce sweating, musical instruments, bows, numerous tools

*The species in bold are being monitored by the California Phenology Project and the USA National Phenology Network. Ask your activity leader about it!

PROCEDURE

- 1. Activity leader introduces the activity.** The introduction is the activity leader's opportunity to focus the attention on phenology; specifically, the causes and consequences of phenological variation. There are many ways that people connect with the seasons, and the following questions may help activity leaders generate discussion focused on why phenology matters.

EXAMPLE QUESTIONS TO ASK PARTICIPANTS:

- General phenology awareness – What's happening with the plants in your neighborhood or schoolyard right now? Surrounding us? Are they actively producing new leaves, or are they turning colors and senescing? If plants aren't producing new leaves right now, when will they start to produce them in the annual cycle of the seasons? Are any plants in flower? If so, are they being visited by insects or birds that may ensure their pollination? What happens to flowers after they are pollinated? Can you see any developing fruits? Any ripe fruits with seeds inside? Any dispersing seeds?
- What foods are currently in season? What foods are you looking forward to in the coming season? Are the edible portions reproductive structures (flower buds, flowers, fruits, seeds) or vegetative structures (leaves, stems, roots)?
- When is the last time you steeped tea leaves (*Camellia sinensis*) in hot water, or dripped hot water through ground-up coffee beans (*Coffea arabica*)? Have you ever done this to treat ailments like headaches, scratchy throat, or allergies? Can you think of any other uses of these plants?
- Can anyone name any foods that are thought to have particularly good health benefits? From which botanical structures are those foods derived (e.g., antioxidants from blueberry fruits, coffee beans, and wine grape fruits)?
- Have you, your grandparents, or other elders used plants medicinally or otherwise? How?
- Does anyone know of any plant-derived medicines?
 - Digitalis and digoxin – a group of cardiac glycosides used to treat heart conditions – are derived from foxglove plants [*Digitalis purpurea*];
 - Salicylic acid – used to treat acne and to reduce fever – is derived from willow (*Salix* species)

The activity leader may also introduce some of the plant species and plant communities that will be encountered, and the general phenological status of those species and communities. In other words, participants will explore the current status of surrounding natural resources while learning about how that knowledge was (and could be) used to treat health ailments.

2. **Participants select an ailment** from a list determined in advance by activity leader (e.g., headache, nausea, or wounds; see above section *Preparation for activity leaders*). Put simply, activity leaders should ensure that assigned ailments are treatable by one or more plant species available in the activity area (even though the necessary structures such as leaves or fruits may not be seasonally-available).

Keep the ailment process interactive and fun by having participants draw the names of ailments (written on pieces of paper) blindly out of a sack; select ailments for each other; roll dice; spin a wheel; or answer trivia questions about the place they're visiting.

A recommended approach here is integrating place-based historical scenarios – participants spin a wheel to select one of several important historical events (e.g., natural disasters, wars, or disease outbreaks) that caused many people to develop particular ailments (e.g., cuts, sores, nausea, rash, headache). Activity leaders should use the opportunity to provide context for those important historical events – either by discussing each with the entire group, or by distributing a brief written summary to each participant who then can inform the group about the event and the ailment they'll be trying to remedy during the activity. This latter approach increases interactivity among participants and, with some planning by the activity leader, could lead to other group activities in the next step(s).

If an historical event isn't available to draw on, consider discussing ailments that are common to all communities, including: headaches, nausea, dizziness, pain, fever, infertility, stress, diabetes, diarrhea, stomach aches, insomnia, and liver and kidney ailments.

3. **Activity leaders provide “treatment guides” to participants so they can learn which plants – and most importantly, which of their structures – can help alleviate their symptoms.** These guides could have additional information about each plant species, including their expected phenologies; geographic distributions; known pollinators and fruit-eating or seed-eating animals; and other interesting uses and facts (*see examples below*).

KEEPING IT INTERACTIVE:

- Encourage participants to meet each other and find others who are looking for the same plant species to treat different ailments – *“Wow, isn't it amazing that the leaves of this plant could be used to treat something so different from what the fruits are used for?!”*
- Ask participants to create (and share with the group) an imaginary scenario for their historically-relevant ailment and treatment. Alternatively, this could be done as a collaborative story where each participant adds a component to one story that everyone is a part of.
- Ask participants to act out their ailment while the group guesses it (like a game of charades), then a second round where the “physician” acts out and describes preparing a tea or pounding stems into a powder.
- (For more advanced groups) Split the group into several small teams, where each team is given an ailment and one to several reference texts or online resources (rather than pre-made

treatment guides) with which to discover a treatment for their symptoms on their own (essentially, they make their own treatment guide).

- Yet another group activity: Hand out treatment guides to half of the participants (“doctors”); hand out ailments to the other half of participants (“patients”). Each patient then tells each doctor their symptoms and they determine whether the doctor’s treatment guide is appropriate for the patient’s ailment. Patients continue to request second opinions, third opinions, and so on, until each patient knows which structures on which species they need to find. Then groups are formed and the activity continues. The activity could be designed so that some doctors have a plant that more than one patient would need (e.g., different patients may need different structures from the same species of plant from the same doctor).

4. **Participants explore the area for the appropriate targeted plant species.** This is likely to be a guided hike by the activity leader, particularly well-suited to places such as National Parks and botanic gardens where rangers and docents already guide interpretive hikes.

Alternatively, a self-guided program could have its advantages. Activity leaders would need to provide plant identification guides and maps for participants to find the appropriate species on their own (or instead of maps, they could provide GPS coordinates and/or orienteering routes for a phenology-based geocache program!). Materials may need to be adjusted accordingly. A self-guided option may also be useful for places like National Parks and botanic gardens where 1) trails and paths generally are well marked, 2) plants in heavily-visited areas often have identification signs nearby, and 3) the supply of available docents and rangers can’t always meet the demand of interested visitors. The self-guided option can be particularly engaging for amateur naturalists and students still learning to navigate in natural settings, however care should be taken not to make it too challenging.

5. **Once a correct plant species is found, participants search the plant for the appropriate structures (e.g., stems, leaves, fruits, seeds). Particular attention should be paid to whether the appropriate plant structure is at the correct seasonal status to treat the ailment.** In other words, does the phenology of the plant align with what is needed to treat the ailment?

If the appropriate structures are available and at the right phenological status...

- A brief discussion or activity could be run on how these structures were traditionally harvested and prepared.
- Point out interesting botanical features and, generally, use the opportunity to explore other topics (see examples below)

If the appropriate structures are not available or at the right phenological status... (continued next page)

- Be sure to point out that the participant’s ailment won’t be treated unless they can find something that can help – either another individual of the same species, or perhaps a different species that can treat the same ailment (which might involved a different plant structure, such as fruits instead of leaves).
- Encourage participants to explore the rest of the area for other individuals of the species; if one individual isn’t producing fresh leaves, perhaps another one is. Perhaps participants are just seeing first-hand the consequences of phenological variation!

In both cases, activity leaders should be sure to point out (or ask participants about) other traditional uses of other parts of their plant, and whether those structures could be harvested now and preserved for use later in the year when those structures are out of season (for example – harvesting and drying leaves for wintertime headache-taming teas).

- 6. While the participants search for seasonally-available plant structures, it’s a perfect opportunity to engage them in recording the phenology of their plants for the USA National Phenology Network.** The activity leader need only ask participants the standardized questions on USA-NPN data sheets (“Do you see open flowers?”, “Do you see ripe fruits”, and so on). Download data sheets from the USA National Phenology Network website (www.usanpn.org/participate). Data sheets could be managed by the activity leader, by individual participants, or even by gregarious young naturalists and students.

Logistical note: At the end of the activity, the leader could retrieve all the data sheets and complete the simple data entry step on the USA-NPN website. It’s quick and easy. The activity leader could also invite participants to participate in entering the data – thereby “closing the loop” by training participants to be self-sufficient phenology observers (and data-recorders) upon completion of the activity!

7. Post-activity wrap-up

Just as modern merchants and companies keep track of stock and inventory, and just as Facebookers track the status updates of their friends and family, members of indigenous and folk cultures rigorously tracked the phenology of plants and animals around them and adjusted the timing of the cultivation, harvest, and preservation of their crops and medicines accordingly. The seasonal cycles leaf, fruits, and seed production have provided humans with important medicines, fibers, and tools for millennia. While plants such as blue elderberry have been incredibly useful to humans because we can eat many of its structures (flower buds, flowers, fruits, leaves, young stems), their value to wildlife is immense as well, providing food, shelter, and more.

Today, scientists are tracking the seasonal availability of these natural resources to learn more about the relationships among plants, animals, and our climate system. The seasonal cycle of plant and animal activities is critical for planning societal responses to natural hazards such as wildfires

and pest outbreaks; to cyclical challenges to human health such as allergens and the flu; and to opportunities for socioeconomic development that are offered by ecotourism activities, wildflower displays, autumn leaf color changes, and harvest festivals.

Many components of our livelihoods are so closely tied with the timing of the seasons that thousands of people across the U.S. are tracking the phenology of their local plants and animals and reporting their observations to the USA National Phenology Network. Participants include professional scientists, academic scientists, citizen scientists, and teachers and students. Tracking plant and animal phenology can take place in easily-accessible places like National Parks, wildlife refuges, neighborhood parks, schoolyards, and backyards. Together, we are tracking the pulse of our planet and learning more about how plants and animals respond to environmental variation and climate change. Learn more about the national effort at www.usanpn.org, and about the effort in California at www.usanpn.org/cpp.

TIPS FOR HELPING PARTICIPANTS GET THE MOST OUT OF THIS ACTIVITY

KEEPING IT INTERACTIVE

- Participants become leaders – Once a participant has become familiar with a plant species and its useful structures, leaders can encourage them to provide a peer-guided mini-lesson. With younger participants (ages 8-12 or older), ask them to pretend that they're passing down medicinal information from one generation to the next.
- Make the learning process mutual – If available, bring field reference guides or ethnobotanical publications or floras to your group and explore them *with* the participants.

FOCUSING ON PHENOLOGY

- Take a close-up viewpoint. Bring hand lenses to the activity and encourage participants to take a close-up look at plant structures. Alternatively, use the 'macro' mode on any cameras in the group (macro mode is usually designated by a flower symbol) to take close-up photos and then view them on the camera screen. Looking through the "wrong" end of a pair of binoculars will also provide a magnified view of an object. *Do you see any breaking leaf buds or emerging leaves? Are any flowers actively shedding pollen?*²
- Explore the concept of phenological variation in the plant population by encouraging participants to locate and observe other individuals of their targeted species. Pose a scenario: suppose a lot of

² These questions are the basis of phenological monitoring with the USA National Phenology Network. It's easy... and fun... to integrate phenological monitoring anywhere in this activity. Try to locate other points where it would provide added value to the ethnophenology activity!

people in their community have the same ailment so that they need to harvest lots of these plant structures. Pose questions such as:

- ✓ *What's the maximum number of structures you could harvest from this population at this time of year?*
- ✓ *What proportion of the individuals in the population is at the proper phenophase for collection?*
- ✓ *How would that proportion change if you were here three weeks ago, or if you were to return in three weeks?*

This discussion could even lead toward conservation-oriented topics such as using phenology to inform natural resource management and the sustainability of wild species for human use.

- Plant-animal interactions – plant phenology regulates resources for animals and food webs; animal phenology (partially) regulates plant reproductive success and persistence.

EMPHASIZING THE PHENOLOGY-CLIMATE CONNECTION

An important conceptual link to make with participants is between the phenological variation they're observing and weather and climate patterns. *How do 'microclimates' in the activity site (shaded vs. sunny, dry vs. wet, trailside locations vs. undisturbed sites, etc.) seem to influence the phenology of the plants, and what does this mean for being able to use these plants to treat ailments?*

How might the phenology be different in a population that is located in a warmer and drier site on an exposed hillside compared to a population located in a cooler and wetter site or near a stream? What plant structures are available for use in different kinds of locations?

Hint: It's likely that plants will be phenologically earlier or more advanced in warmer and drier sites than in cool and moist sites. This means that plant parts (such as buds, leaves, and flowers) that may be young, fresh, and rapidly growing on plants found in a moist environment may already have withered and died on plants found in hotter and drier sites).

How might the phenology of plants located in a high-elevation site differ from that of the same species found at low elevations? What about north-facing slopes compared to south-facing slopes?

Each of these questions provides an access point for discussing and inferring the relationship between phenology and local climate. Inferring the relationship between phenology and climate *change* is a short step farther. *We expect global and regional temperatures to continue warming in the coming decades, so perhaps the phenology we see now in the warm and sunny site will be what we see years in the future in the cooler shady sites. How would this affect our harvesting activities? Do you think this would affect the way other animals interact with the plants? In fact, scientists around the world have documented many examples where shifting plant phenology has directly affected the animals feeding on those plants or using them for shelter (for some of these examples, visit the USA-NPN's website and find the Publications list).*

OTHER REPEATABLE ACTIVITIES THAT MIGHT INTEGRATE WELL WITH THE ETHNOPHENOLOGY ACTIVITY AND EXISTING PROGRAMS OVER THE LONG-TERM

Any efforts that activity leaders and program directors can make towards maintaining a cumulative or on-going interpretive understanding of the phenology of their local plants would be valuable. For example, during the first step of this activity, leaders could discuss what was observed last week during the activity and how they perceive the progression of the seasons at that site. This could even be as specific or quantitative as showing cumulative graphs of phenology in the area, and pointing out that participants will contribute to this ongoing study. In general, participants on a given day are observing but a snapshot of the whole phenological sequence of the plants that they observe, and it's the role of the activity leaders to help them understand the "bigger picture" by connecting them with the observable changing phenology of the landscape. Some other methods to achieve these goals include:

- Photo documentation of the phenology of the targeted (and non-targeted) plants. Whether it's a high-quality camera or a cell phone, many people have cameras with them these days. Put them to use and create an ongoing photo collection program. Check out some possibilities of "crowdsourcing" the concept with something like PicturePost (<http://picturepost.unh.edu/>).
- Activity leaders could lead participants through the process of collecting different plant structures for preservation. This could be as formal as collecting specimens to be added and accessioned in an herbarium, or as informal as pressing and taping some leaves or flowers in their notebook to take home. Done well, this could even supply the foundation of a seasonal art gallery and educational installation in visitor centers of botanic gardens, National Parks, and schools.
- Journaling activities and botanical illustrations where participants describe the phenology of the site, as well as the sense of place they experience as a result.