



The Phenology Trail Guide:
An experiential education tool for
site-based community engagement

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TABLE OF CONTENTS

INTRODUCTION	4
PHENOLOGY TRAILS	5
PLANNING YOUR PHENOLOGY WALK	6
DESIGNING YOUR PHENOLOGY WALK	8
CREATE YOUR SITE IN THE <i>NATURE'S NOTEBOOK</i> DATABASE	10
CREATE INTERPRETIVE SIGNS AND MARKERS	11
COLLECTING DATA AND CREATING DATASHEETS	12
TEST YOUR PHENOLOGY TRAIL	13
START COLLECTING OBSERVATIONS	13
SHARE YOUR PHENOLOGY WALK	14
STAY CONNECTED WITH THE USA NATIONAL PHENOLOGY NETWORK	14
CONTRIBUTIONS AND ACKNOWLEDGEMENTS	15
REFERENCES	15

INTRODUCTION

Phenology refers to the study of recurring plant and animal life cycle stages, such as leafing and flowering, the maturation of agricultural plants, the emergence of insects, and the migration of birds. It also involves the understanding of the relationship of these life cycle stages to weather and climate. Learning how to make phenology observations is a great way to introduce people, young and old, to outdoor field studies and the basics of data collection. Making repeated observations on a daily or weekly basis will help students, amateur naturalists, and natural area visitors notice the subtle changes happening in the natural world. In addition, each observer has the opportunity to participate in scientific research, related to climate science, now being conducted at a global scale.



The USA National Phenology Network (USA-NPN) is a consortium of individuals and organizations that collect, share, and use phenology data, models, and related information. USA-NPN serves science and society by promoting a broad understanding of plant and animal phenology and its relationship with environmental change. USA-NPN encourages people of all ages and backgrounds to observe and record the activity of organisms to discover and explore the nature and pace of our dynamic world. Using this information, USA-NPN makes phenology data models and related information freely available to empower scientists, resource managers, and the public in areas of decision-making and adapting to variable and changing climates and environments.

The data collected and shared by the USA-NPN is intended to be used by resource managers to inform decisions, by educators to teach about phenology and climate change, by scientists to study changes in species phenology and to increase the public awareness of both phenology and climate change. Also important, a long-term data set will help scientists better determine how the changing climate may be affecting our planet's species and ecosystems.

The USA-NPN has an online integrated animal and plant-monitoring program called *Nature's Notebook* which provides standardized protocols for phenological status monitoring and data management for over 800 animal and plant species nationwide. The program facilitates a collection of sampling intensity, absence data, and descriptive information about sites, plants and observations. It also includes functionality for recording estimates of animal abundance and plant canopy development, real-time raw data for plants (from 2009 to present) and animals (from 2010 to present), including FGDC-compliant metadata and documented methodology. The program also features a data exploration tool, allowing sophisticated graphical visualization of phenological data alongside meteorological data. The network seeks to develop partnerships with other organizations interested in (1) implementing vetted, standardized protocols for phenological or ecological monitoring, and (2) using phenology data and information for a variety of modeling applications.

The USA-NPN engages citizen scientists in data collection through the *Nature's Notebook* phenology observation program, which provides a user-friendly interface for recording observational data. *Nature's Notebook* houses definitions and descriptions outlining plant and animal species protocols for use in observation and recording. It was developed to capture phenophase information by walking observers through a step-by-step recording process. The USA-NPN would like to ensure that the data collected are accurate and valuable, to ensure scientific confidence about the quality of the overall data set. By enhancing observer education through program design and evaluation, data being collected will be more accurate and therefore enhance the existing Quality Assurance/Quality Control (QA/QC) measures.

There is a recognized need for collaboration among groups monitoring phenology with an interest in building a strong data set. The USA-NPN has established a number of agency and organization partners ready collaborate and work toward this goal. Moreover, many current observers are looking for ways to further engage with *Nature's Notebook* as well as ways to analyze the data on their own. The USA-NPN developed a number of educational tools to facilitate phenology monitoring by citizen scientists on a large scale and encourage collaboration between organizations interested in phenology. One such tool developed for use at a site or on a regional scale is the *Phenology Trail*.

PHENOLOGY TRAILS

A **phenology trail** is a network of *Nature's Notebook* observation sites. Linked together, these sites provide the participant with places to visit, enjoy nature, collect data, and learn about supporting organizations and their efforts related to phenological research and beyond. Each site has at least two species, and numerous individuals, tagged for data collection and research purposes.



Why create a phenology trail? Phenology trails are:

- interesting ways to link local and regional phenology activities
- connections between organizations with similar missions
- tools for teaching about the scientific method and native species
- phenology and climate change education opportunities

Phenology trails can be big or small. They can be quite localized (at a school or in a town) or, conceptually, they can cover an entire state or even the whole country! The important thing is that they engage volunteers in a meaningful way, provide a venue for collecting phenology data independently or as a group of participants, and they *meet the goals of both the USA-NPN and the sponsoring organization(s)*. Phenology trails work best when there is a person, whether a staff person or volunteer, accessible to maintain it and answer questions for participants. However, having a staff

person facilitate the use of the trail is not necessary, especially if a plan for participation is well thought out in advance. For an example of an active phenology trail, visit our website to learn about the Tucson Phenology Trail at: www.usanpn.org/phenologytrails.

Often a phenology trail begins at one site with a phenology “walk”. The phenology walk may follow an existing pathway or hiking trail and should include tagged individuals as well as a list of common animals found in the area. The walk can then be linked or connected to other walks or trails in the area, concentrically growing as interest and momentum for monitoring is built.

This guide was designed to provide the steps and materials necessary for creating a phenology walk or trail. Phenology trails are meant to be creative and meet the needs of **your** community, however you define it (school, city, county, town, club, etc.), and also help the USA-NPN achieve its goal of collecting accurate phenological data to build our long-term database for scientific research. If you create a phenology walk or trail, be sure to register it with *Nature’s Notebook*. Contact our Education Coordinator (education@usanpn.org) and register it as a “geographic affiliate” (www.usanpn.org/geo_affiliates). Let us know about it so we can share what you’ve done with others interested in doing the same!

PLANNING YOUR PHENOLOGY WALK



For specific instructions on setting up a site in the *Nature’s Notebook* online interface, collecting phenology observations and entering them into the database, please view our online resources found at (www.usanpn.org/how-observe). There are a variety of materials available for individuals and groups of volunteers, including a “How to Observe Handbook” (USA-NPN 2010) and PowerPoint presentations for download and use in a classroom setting.

Once you have familiarized yourself with the online interface and resources available you’ll want to begin to conceptualize how you’ll establish a phenology walk or trail that meets your community’s needs.

Outlining goals for implementation, such as “Do I want to collect scientific data to answer local questions?” and “Do I want to utilize the trail as a volunteer engagement and teaching tool?”, “Is there a historical or ethno-botanical story that can be told by capturing information about the plant?” can be critical to the success of the project. Having a localized science question to answer more easily engages participants at your site or along your trail and gives them something in the shorter term to observe, examine change, and hypothesize about. It also gives people an opportunity to engage at the community scale. You may want to partner with other scientists within your organization or in your community to create some scientific questions to answer. *Nature’s Notebook* is an optimal tool for bridging the gap between the science and education/outreach communities. The experience of data collection may be of even greater value if a local team of resource managers can benefit from it. The number of groups participating is not as important as the quality of their participation.

Included at the end of this resource guide is a **planning worksheet** and **sample completed for the Tucson Phenology Trail** that will be helpful for implementation at your location. You will also find as an addendum a tip sheet including lessons learned from the field designed by one of our partners at Portland BudWatch (www.ecoplexity.org/node/920).

Starting on a smaller scale is sometimes easier than trying to establish a trail network over a large area or region. This allows for the implementation of available resources and engagement of visitors to the site, as well as builds momentum for participation.

For the purpose of this document, the following definitions will be used when referencing types of phenology trails, and their elements, from small to large scale:

- **Nature's Notebook site** – a designation in the *Nature's Notebook* application referring to a select area, less than 15 acres, and including at least one tagged individual plant or animal species.
- **Phenology walk** – a path or trail at one *Nature's Notebook* site, with any number of individuals tagged for observation, but usually ranging from two to ten species and at least three individuals of each.
- **Phenology trail** – a series of phenology walks or *Nature's Notebook* sites that may cover one location (depending on the size, if it is large, such as a National Park) or many locations. The key to this definition is that it includes a series of walks or *Nature's Notebook* sites, linked together, in total covering an area larger than 15 acres.

It is likely that your school or organization already has an area or path that is ideal for a phenology walk. All that is needed to get started, besides your established goals, are the plants and animals that already exist right outside. Depending on your location, you may consider adding interpretive signs, markers, and curriculum to your phenology walk or trail. If you are still not sure where a phenology walk might work, we suggest starting small with a few species of plants within a walk-able distance of your nature center building or school. There is always time to expand your trail to be longer and more diverse in the future!

What you will need:

- ✓ The USA-NPN *How to Observe Handbook* including instructions on delineating and registering a site in *Nature's Notebook*
- ✓ A plant and animal field guide specific to your local area or region
- ✓ Resources found on the USA-NPN website including species descriptions, educational resources and curriculum, and training materials
- ✓ A friend or local biologist familiar with local species of plants (recommended). Many agencies and organizations have staff available to assist citizens with natural resource questions.

Excellent resources include:

- Your local Cooperative Extension Office (www.csrees.usda.gov/Extension)
- Master Gardener Programs (blogs.extension.org/mastergardener)
- Your local State Native Plant Society

- US Fish and Wildlife National Wildlife Refuge System specialists (www.fws.gov/refuges)
- Your state Fish and Game Office
- ✓ A camera (optional)
- ✓ A GPS receiver (optional)

DESIGNING YOUR PHENOLOGY WALK



Start out by conducting a short survey along the path for your proposed phenology walk. It would be helpful to bring a list of available local *Nature's Notebook* species with you to reference as you walk along. Log on to www.usanpn.org/species_search, select your state, and generate the list. Plants already registered will have unique webpages including information about the species and the corresponding datasheet is provided. There are currently (as of July 2012) 871 total species available to choose from – 633 plants and 200 animals, insects, reptiles & amphibians, fish, and birds. If you wish to track a species that is not in Nature's Notebook, contact our education or partnership coordinator to discuss the possibility of adding the needed species.

Take notes on plants and animals of interest that are close to the trail edge and can easily be monitored by participants. Select individuals that are easy to see from the path so people will not need to or be tempted to venture off-trail to take a closer look at the occurring phenophase. Many locations do not encourage traveling off-path due to leave-no-trace principles, so be cautious when designing your walk to adhere to local guidelines. Also be sure to design your walk on a site that allows visitors to enter the property. Be aware of trespassing guidelines and stick to local rules and regulations by obtaining proper permissions ahead of time.

We suggest using some native species, with which folks may already be familiar and occur regularly in your region. Native species, because of their unique adaptation to local soils and climate, will have a better chance of surviving. Additionally, if multiple sites/walks are added to your trail, there is a good chance these plants will appear at more than one location. People can then begin to ask and answer scientific questions about the phenological changes, between sites, of those species and work with the data visualization tools

(www.usanpn.org/results/visualizations) to determine local similarities and differences in the phases. Above all, be sure to choose engaging species – those that will catch the attention of amateur observers. The more interactive and interesting the species, the more likely an observer will notice it and the more likely they will be interested in participating in this mode of scientific discovery.



We also suggest selecting about three to ten plant species to monitor at the site. Each should include one to three individuals of each species to account for any microclimates in the area. For example, if you choose common milkweed, eastern white pine, and yellow star-thistle for your three species, you should have 3 milkweed plants, 3 white pine trees, and 3 yellow star-thistle plants on your walk. This will help ensure that plants that thrive in your area are chosen and help validate the phenology observations that are made along the walk. To validate observations, you will compare the observations from one plant with another to understand if any local environmental variables are affecting the phenology of each plant. More information on how many plants to choose can be found at www.usanpn.org/participate/faq#how_many.

You may discover that there are not one to three individuals of any particular species along your proposed phenology walk. This is especially likely if your walk is in an urban area where the type of plants growing is dependent on what is planted there and what can survive. If you have difficulty designing your walk you may want to consider planting new plants either from seed or by transplanting individuals from a local nursery. Before choosing new plants be sure to get advice from someone with knowledge of native plants species for your area, and again, be cognizant of local guidelines. Certain natural areas prohibit the planting of species due to management regulations.

Keep a log or notebook of the plant species chosen and their specific location. As an added benefit, you can take pictures and collect GPS waypoints of each individual plant to make your project more interactive. Plotting the points using a mapping program, such as Google Maps ©, will provide a big picture snapshot of your space as well as be useful to participants collecting data for you in the field. These methods will also help you find those plants when you return to construct the walk. Additionally, the GPS coordinates can be used in a geocache activity. The USA-NPN Education Program is currently working on curriculum for geocache activities to use in conjunction with phenology walks.



You will also want to physically tag the plants along your walk so that others can easily find them and record data on the correct individual. Using inexpensive plant tags that can be written on with pencil or pen and affixed to the plant works well. Consider including a label with the *Nature's Notebook* logo (found at www.usanpn.org/resources/partner-resources) and on the other side the name of the plant corresponding to the nickname entered for that individual in the database. When attaching the tag to the tree, spiral the wire around a pencil so that as the tree or plant grows, the wire will expand with it. Depending upon how you use your walk or trail, you may decide to label the species differently.



Ideally your phenology walk should be no more than a mile long to allow a diversity of observers to participate. Of course, if potential observers are hiking enthusiasts or experienced in outdoor exploration, your walk may be significantly longer, or may be a combination of *Nature's Notebook* sites (a phenology trail). For schools and organizations introducing phenology for the first time, it is important

to create an experience that will be both accessible to new observers and create useful and interesting phenology data to explore and contribute. The exact parameters are up to you, the site manager, to decide. Ultimately you will want to create an activity that meets the needs of your organization as well as those of the USA-NPN.

CREATE YOUR SITE IN THE *NATURE'S NOTEBOOK* DATABASE

After selecting and tagging the species you'd like to include on your walk, you'll need to add them to your site in the *Nature's Notebook* database. After you create your site, or a group site, for a phenology trail, you can make the site "public" so others can find it when searching in *Nature's Notebook*. Information about how to create shared and group sites in the *Nature's Notebook* database can be found at www.usanpn.org/shared_sites. Again, be sure that you have permission from the landowner to make the site public and invite outside visitors to the location.

Shared sites are searchable by others in *Nature's Notebook*, and setting up your site this way will encourage people to participate in data collection on an ongoing basis. You can also view your data in the database after it has been entered, based on this shared site location, to see who has collected data. The Visualization Tool can be accessed at www.usanpn.org/results/visualizations; the snap shot (below) shows data at a specific site.

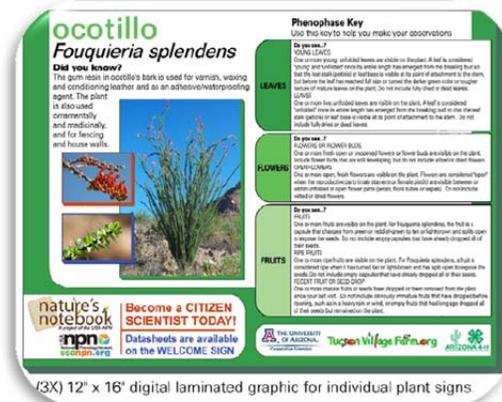


CREATE INTERPRETIVE SIGNS AND MARKERS

If your phenology walk or trail is going to become a permanent part of your interpretive program, you may want to consider including signs that are permanent. Create signs that include descriptions of the phenophases, as well as some photos, so that they are easily identifiable and located. All of the information needed to record data is there so participants just need a datasheet when they are on the trail (See the phenology trail page

[www.usanpn.org/phenologytrails] for example PDFs of such signs). All of the information on the sign, for each species, can be found via the species search page (www.usanpn.org/species_search).

If possible, it is best to include pictures of the primary phenophases that occur. It would be even better to include pictures of your *actual* plant or animal on the sign so people get a better sense of what the plant looks like in each phase in your location. If you choose to include animals on your list, you might want to include photos of each of their phenophases as well.



Some other content you may wish to use:

- ✓ **Common name and/or scientific name:** Online field guides (www.usanpn.org/participate/faq#how_id) can help you find this information for your plants and animals.
- ✓ **Did you know?:** Use this section to deliver a fun fact or information about the many uses of this species.
- ✓ **Why observe this species?:** There are many reasons to observe unique species of plants. The species you chose may be important ecologically or economically, or may impact human health, like allergens.
- ✓ **Image of species with attribution:** Most plant images can be found through USDA PLANTS (plants.usda.gov). A Google Image “Advanced Search” restricted to images labeled for reuse is a good supplement to PLANTS. Always give credit through attribution and note the photographer and source for the image.
- ✓ **Which phenophases should I observe?:** Find your species using the Species Search page (www.usanpn.org/species_search), and then use the “Which phenophases should I observe?” section.
- ✓ **Where is this species found?:** Each species profile has the states in which the species is found. For more detailed information, try NatureServe (www.natureserve.org).
- ✓ **QR codes:** Consider adding QR codes to your signs to direct people to Nature’s Notebook, USA-NPN and your website. Find more information on Wikipedia (en.wikipedia.org/wiki/QR_code)

COLLECTING DATA AND CREATING DATASHEETS

Nature's Notebook allows generation of datasheets for individuals species with multiple dates of observation OR single day data collection. The latter is most useful for visitors collecting information along your walk as a one-time event. For others making repeated observations on multiple days they may decide to print out individual species datasheets with multiple dates of observation.

Alternatively, you may decide to create an even more simplified version of a datasheet reflective of the type of visitors you anticipate. Other groups using *Nature's Notebook* have created and shared versions



Sample Datasheets for the Biosphere 2 Phenology Walk

of datasheets they've made, and these can be found on our Educator's page (www.usanpn.org/education) and below. For example, if you are working with school groups, each visiting one time, you may wish to create re-useable datasheets with a simplified number of phenophases. These sheets could include photos to help the students understand what they are looking for, and be laminated for reuse.

It is best for a single person to record data collected on one-time data sheets at your site. If the your organization has a ranger, environmental educator, or volunteer docent who leads groups, that person should collect the datasheets from each participant at the end of the session, review them for accuracy, and make ONE entry for the who group using their own *Nature's Notebook* login information. If visitors to the site are participating on their own, they may return the datasheets to a central location where an individual can be responsible for entering the data weekly, again, making only one entry per day for multiple datasheets.

If *Nature's Notebook* is part of a larger training program at the site, educators may wish to set up computer stations so participants can create their own data, enter their data after a workshop, and then return to the site again and again to make repeat observations. Again, implementation will depend upon the needs of your individual program. Contact the Education Coordinator (education@usanpn.org) for more information about how data collection and phenology trails have been implemented at sites around the United States.

TEST YOUR PHENOLOGY TRAIL

Before bringing students or the general public to your phenology walk, test it out with some friends or co-workers. These beta testers will help you determine if the phenology walk is ready for new observers. After collecting observations hold a discussion with the test observers. Ask them questions like the ones below:

- ✓ Are the plants on the phenology walk easy to find?
- ✓ Is the datasheet easy to understand?
- ✓ Was enough information provided on the datasheet for the phenology walk to be self-guided?
- ✓ What did you like about the phenology walk?
- ✓ Were there any challenges that you encountered while collecting your observations?

It is likely that the challenge of making observations will be greater if your plants are not flowering or dormant. It is important to communicate to observers the importance of **phenological data at all times of the year**, and at every stage of the life cycle, for these plants. Data throughout the year will provide a robust and complete dataset for investigation and analysis to understand the phenological trends of each species. The USA-NPN strongly encourages groups to collect data as often as possible, even if phenophases are not occurring. Activities designed around collecting this “negative data” may serve to encourage people to keep collecting data. Knowing when a phenophases is not occurring is as important as knowing when it is, in order for researchers to know when the phenophases began. It’s also relevant for species conservation – knowing that flowers are not blooming when they used to is key information for people interested in protecting hummingbirds.

Conduct several tests of your phenology walk with different groups of observers. If certain plants pose problems for many observers, a different species may need to be selected for the walk, or maybe more information needs to be available about what they are searching for. Similarly, if a plant has difficulty thriving along your phenology walk, you may want to replace it on the list of observed plants so that observers have a reliable plant to make observations on during their walk. Additionally, walking through it a few times will provide you with important background information that you might share with participants before they begin.

START COLLECTING OBSERVATIONS

Have datasheets available for observers near the start of the Phenology Walk. An outdoor, weather-proof box can hold clean datasheets and small pencils. At the end of the walk place a weather-proof deposit box for completed datasheets. As an alternative, datasheets can be picked up and dropped off at the front desk of your organization’s building. Your phenology walk may be designed to be self-guided, but a teacher or docent can lead observers through the walk for the first time. Additional materials for educators can be found on the Educator’s webpage (www.usanpn.org/education).

If conducting observations as a classroom group, try to encourage or schedule observations on a frequent and consistent basis. As explained above, the consistent collection of observations will yield a data set that is good for investigation and analysis.

SHARE YOUR PHENOLOGY WALK

Publicizing your phenology walk is the best way to engage people with your site and encourage regular phenology data collection. The USA-NPN has experienced success advertising locally via participating sites and though setting up a “Meet Up” group (www.meetup.com/tucson-phenology-trail) tied specifically to events and hikes along our trail. The network of sites that make up the Tucson Phenology Trail each have volunteer site contacts to maintain the project with each organization. Because the trail meets the needs, not only of the USA-NPN, but the sites themselves, there is interest in ensuring the program is sustainable. Although it is early in its implementation, the Tucson Phenology Trail is off to a great start and will serve as a model for other communities in implementation and evaluation.

Scheduling events with participating groups, at least monthly, is important to cultivate interest and community around the trail. Employ the use of docents who are interested in leading group walks to collect data. Partner with other groups who have an interest in the natural world, such as Master Naturalists or Master Gardeners, to gain momentum.

The Tucson Phenology Trail was mostly implemented without the benefit of funding, so it is possible to create and maintain such a project by engaging end users in a common goal as long as you have at least one person available to organize it with a vision and the ability to create the program. The key to a successful Phenology Trail will be consistent engagement and communication with the participants involved at each site. Scheduling community days and capitalizing upon local events happening at each site increases interest the reach of the group. Long-term engagement with volunteers and coordinators can be direct and meaningful. It is also important to evaluate your progress and provide feedback to the USA-NPN for future revisions and implementations.

STAY CONNECTED WITH THE USA NATIONAL PHENOLOGY NETWORK

Share your experiences with the USA-NPN Education Coordinator so other groups can benefit from your progress. Tell us what worked and didn't work!

Join us!



Facebook (www.facebook.com) Search for “USA National Phenology Network”



Twitter (www.twitter.com) @loriannebarnett

CONTRIBUTIONS AND ACKNOWLEDGEMENTS

Kristin D. Wisneski, USA-NPN and Biosphere 2 Science and Society Fellow, developed the concept and original draft of the Biosphere 2 Phenology Trail Guide. LoriAnne Barnett authored the Phenology Trail Guidebook, with input from K. Wisneski, S. Schaffer, and K. Fuccillo.

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