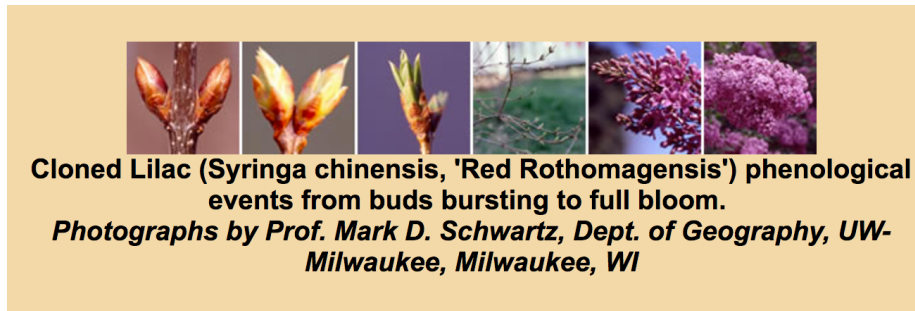


What is Nature's Notebook? The USA National Phenology Network serves science and society by promoting broad understanding of plant and animal phenology and its relationship with environmental change. The Network is a consortium of individuals and organizations that collect, share, and use phenology data, models and related information. The Network makes phenology data, models and related information freely available to empower scientists, resource managers, and the public in decision-making and adapting to variable and changing climates and environments. You can learn more about this Citizen Science Program by visiting their homepage: [Nature's Notebook](#)

What is Phenology? Literally, phenology refers to “the science of appearance.” In the simplest terms, phenology is the study of the timing of life cycle events in all living things. The life cycle of an organism is the period of time involving a single generation through reproduction. So, when we think of a life cycle in an organism, we are not necessarily referring to the life span, but rather, the period of time it takes to reproduce a generation. In plants, this includes first leaf, budburst, first flower, last flower, first ripe fruit, seed dispersal, and leaf color change, among others. In animals, this includes mating, offspring production, molting, hibernation, and migration, among others.

Scientists who study phenology – **phenologists** – are interested in the timing of specific biological events with relation to seasonal and climatic change, which are some of the *abiotic* components of the environment that impact the living or *biotic* components. Seasonal changes can include variations in day length, temperature, and rain or snowfall. Phenologists attempt to learn more about the abiotic factors that plants and animals respond to. In other words, how do plants and animals know it is time to migrate, hibernate, set flower, disperse seeds, or enter dormancy? What ‘calendar’ or ‘clock’ do they use to begin flowering, leafing, or mating? Many interactions in nature depend on timing. For example, many birds time their nesting so that eggs hatch when insects are available to feed nestlings. In turn, insect emergence is often synchronized with leafing out in their host plants. Farmers need to know when to plant to avoid frosts, and they need to know the schedule of plant and insect development to decide when to apply fertilizers and pesticides. Many interactions in nature depend on timing. In fact, phenology affects nearly all aspects of the environment, including the abundance, distribution, and diversity of organisms, ecosystem services, food webs, and the global cycles of water and carbon.



Why Study Phenology? Phenological observations have been used for centuries to maximize crop production, prepare for seasonal allergies, and anticipate optimal wildflower viewing conditions. Today, this well-established science is used to track the effect of global warming and climate change on organisms and to make predictions about the future health of the environment. From the historical records, we know that phenological events can vary from year to year. Ecosystems can recover from variation between years, but when these changes happen consistently over many years, the timing of events such as flowering, leafing, migration and insect emergence can impact how plants and animals are able to thrive in their environments. Changes in the timing of phenological events have important implications for scientific research. Scientists use phenological data in computer models that project future climate scenarios and the projected impacts of such changes on the environment. They are also interested in how phenology can inform the monitoring of drought conditions and the assessment of risk related to wildfires.

How will WE engage in phenological studies? To begin, we will set up a “group notebook”, which will permit all of us to make observations and record them on the Nature's Notebook website. We will then learn how to observe, which is trickier than it may sound! Finally, we will visit our target site and start observing. Here are some of the relevant details in preparation for the next two lab periods:

- Our site will be Foxcroft Farm, a 90-acre hay farm located in Amherst MA, about 4 miles from campus. This farm has been in existence for well over 150 years, and has served as a dairy farm, a horse ranch, and, more recently, a hay farm. The land boasts a diversity of ecosystems, including wetland, meadows, forest and fields.
- We will travel to the farm during lab period for two weeks to engage in collecting phenological observations. After we become familiar with the site, we will focus our efforts on a small number of “key” species of interest – which the class gets to choose! We may choose to focus on one or more of the numerous mammals found at the farm, such as bobcats, beavers, muskrats, mice or foxes. Some may be more interested in our winged friends, such as pileated woodpeckers, red winged blackbirds, or red-tailed hawks. Still others may prefer invertebrates, such as crayfish, damselflies, or bees. And of course, we have plenty of plants to choose from, such as milkweed, aspen, or wild grapes.
- An overview of what you will be doing:
 - Join Nature's Notebook – see instructions below
 - Join our group account at Nature's Notebook – **Foxcroft Farm**
 - Check out the animals and plants on the group account list
 - Pick at least one animal and one plant to serve as the focus of your first visit to the farm
 - Learn how to observe your plants and animals before lab
 - See instructions below on how to do this on the Nature's Notebook website
 - Spend time on the farm observing your organisms, discussing what you see with the class and revise how you observe
 - Spend time in class discussing our results and deciding how proceed during the second visit. The class may decide to focus on one ecosystem and its organisms, or they may want to create a competition of finding novel organisms, or something completely different!

Nature's Notebook Instructions

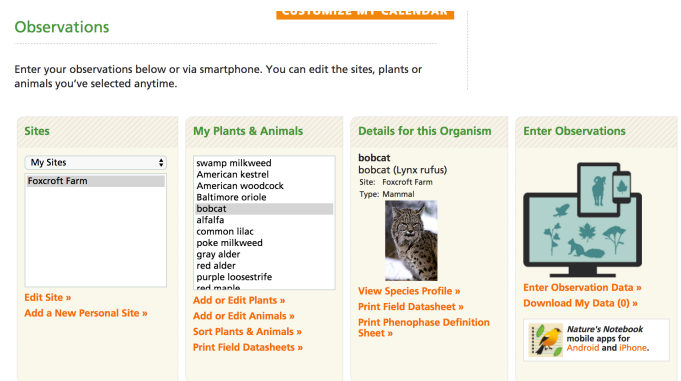
- **Join Nature's Notebook.** Your first step is to create a Nature's Notebook account. You will create a unique user name and password. Visit the main Nature's Notebook webpage to get started, www.nn.usanpn.org, click on the **BECOME AN OBSERVER** callout and follow the instructions on the screen – see first figure on the right.
- Join our group site: **FOXCROFT FARM**
- Now you need to **learn how to observe** some of our plants and animals. Let's use the bobcat for an example of how to proceed. Refer to the second below.
 - Click on bobcat in the “My Plants and Animals” section
 - Click on “View Species Profile”
 - Note that you learn where bobcats are found in the US
 - Note that you are directed to Activities: where you would record seeing one or more bobcats
 - Note that you are directed to development: where you would note if the individual where young or dead, etc.
 - Note that you are provided ITIS information: click on that to learn what that means.
 - If you were lucky enough to see a bobcat you would click on **Print Field Datasheet** to record your observations. Each datasheet is design for that particular organism. You can click on the **Print Phenophase Definition Sheet** if you are unclear about how to record the phenophase you observed.

The screenshot shows the 'User account' registration page on the Nature's Notebook website. At the top, there are navigation links for 'Nature's Notebook Home', 'USA-NPN Home', and 'Contact Us'. Below this, there are links for 'ABOUT US', 'OBSERVE', and 'MORE WAYS TO CONNECT'. A progress indicator shows three steps: '1 Join Nature's Notebook', '2 Set up your account', and '3 Start observing!'. The 'User account' section has three buttons: 'Join Nature's Notebook', 'Log in', and 'Request new password'. The registration form includes:

- USERNAME ***: A text input field with a note: 'Spaces are allowed; punctuation is not allowed except for periods, hyphens, apostrophes, and underscores.'
- E-MAIL ADDRESS ***: A text input field with a note: 'Your email address will not be publicly viewable or distributed outside USA-NPN.'
- CONFIRM E-MAIL ADDRESS ***: A text input field with a note: 'Please re-type your e-mail address to confirm it is accurate.'
- PASSWORD ***: A text input field with a 'Password strength:' indicator.
- CONFIRM PASSWORD ***: A text input field with a note: 'Password must be at least 8 characters.'
- NATURE'S NOTEBOOK QUARTERLY**: A checkbox for 'Subscribe to our quarterly newsletter for observers.'
- PARTNER GROUPS**: A dropdown menu currently set to '<none>' with an 'ADD' button.
- Terms of Use**: A checkbox for 'I AGREE WITH THE USA-NPN WEBSITE TERMS OF USE. *'
- Validation Question**: A text input field with a note: 'This question is for testing whether you are a human visitor and to prevent automated spam submissions.'
- MATH QUESTION ***: A text input field with a note: 'Solve this simple math problem and enter the result. E.g. for 1+3, enter 4.'

 At the bottom of the form is a 'CREATE NEW ACCOUNT' button. The footer contains links for 'FAQs' and 'Terms of Use'.

- You will spend time before lab **choosing at least one plant and one animal** to observe. We want people to observe different organisms so you will get to submit your organism requests and be assigned on first come first serve basis – no worries, there are many organisms to observe on the farm! Before lab you will explore your two organisms – learn what they are, where they are found, how to identify them, etc.
- Be sure to download Nature's Notebook** onto your phone for use in the field. Or partner with someone who can do this on their phone.
- Also, I urge you to download **Map of Life**, which is a super app for helping you identify plants and animals around you. Check it out before lab.



Lab 9. Learning how to observe nature

- Dressing for the lab.** You will be hiking in fields and through woods – please dress appropriately and bring a hat and perhaps something to sit on (piece of plastic or towel?). If you are going to observe aquatic insects – remember that they are aquatic and you may get wet! There may be mud, rain, sun, etc. So bring a hat, sunscreen, jacket. If you have binoculars bring those as well!
- Transportation.** The van will leave Lot 62 next to Morrill at 7:45 am. YES – it is early but we don't want to miss a moment of our limited time observing. For those who choose to drive their own cars, please join the van in lot 62 by 7:45 and follow the van to the farm.
- Hiking the farm.** Once you arrive at Foxcroft Farm – we will start by taking a hike around the property (about 30 min). During this hike you may see something you like and want to change your organisms – that is fine as long as no one else has already chosen it.
- First Observation period.** After our hike, you will head out in pairs to start observing. You will go to the locations where your chosen organisms are most likely to be found. You will have 45 min to find a place and observe for at least 20 min.
 - If you can't find your organisms– you will have to choose new ones! The list of organisms assigned will be available online so you can make sure you are not picking something already under observation.
 - Using Map of Life app will help you find organisms and identify them in the field.
 - We will also have animal and plant hand-outs for the most common species.
- Group discussion.** After 45 min we will reconvene on the east side of the hop brook bridge – where I will have refreshments and water. We will hear from each person about what they have observed so far – and if they were able to find their specific organisms.
- Second Observation period.** You will now return to your site – or choose a new one – and spend the rest of the period with your partner observing. You can move between sites, choose new organisms, get “into” nature and enjoy your time outside as field biologists!
- Return to campus.** At 10:45 we will all return to the van and you will be shuttled back to campus
- After lab.** You will document what you found on Nature's Notebook website before the next lab.
- You will visit the Nature's Notebook Discussion Forum on Moodle** and make comments about how we might want to use our second visit. I will post some ideas and the group will make a final decision the night before the second lab period.