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## Nature's Notebook and Extension: Engaging Citizen-Scientists and 4-H Youth to Observe a Changing Environment

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## Nature's Notebook and Extension: Engaging Citizen-Scientists and 4-H Youth to Observe a Changing Environment

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**Nature's Notebook and Extension: Engaging Citizen-Scientists and 4-H Youth to Observe a Changing Environment**

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**Abstract:** *Extension, with its access to long-term volunteers, has the unique ability to teach citizen scientists about the connection between climate variability and the resulting effects on plants, animals, and thus, humans. The USA National Phenology Network's Nature's Notebook on-*

*line program provides a science learning tool for Extension's Master Gardener, Master Naturalist, and Master Water Steward training programs, engaging volunteers to contribute to a scientifically rigorous data resource. We give examples of how Extension programs in Arizona, Florida, and Maine are currently incorporating Nature's Notebook, and encourage use of the program in other Extension locations.*

## Introduction

Increased temperatures and changes to the frequency, duration, and intensity of precipitation events are predicted for much of the globe in coming decades (IPCC, 2007) and will likely affect many dimensions of the environment, including agriculture (Fraisie, Breuer, Zierden, & Ingram, 2009). Phenology, the study of the timing of life cycle events of plants and animals, has emerged as an important tool for improving our understanding of plant and animal responses to climate change. Phenology has been used to clearly document changes in plants and animals such as range shifts, advance of spring events, and mismatches in timing (Walther et al., 2002; Parmesan & Yohe, 2003; Root et al., 2003; Both, Bouwhuis, Lessells, & Visser 2006), and patterns in shifts in phenology are increasingly being attributed to changes in climate (Bartomeus et al., 2011; Hurlbert & Liang, 2012).

To address the need for sustained, continental-scale phenology data, the USA National Phenology Network (USA-NPN; www.usanpn.org) was established in 2007. The two-part mission of the Network is to (1) Make phenology data, models, and related information available to scientists, resource managers, and the public, and (2) Encourage people of all ages and backgrounds to observe and record phenology. A key goal is to connect people with nature through formal and informal education and promote broad understanding of plant and animal phenology and its relationship with environmental change.

Extension, with its successful volunteer programs, has the unique ability to teach a wide audience of citizen scientists about the connection between trends in climate variability over time and the resulting effects on plants, animals, and humans. Phenology observation provides opportunities for participants to engage with personally interesting, research-critical topics. The USA-NPN provides teaching tools for involving adult volunteers in training programs and mentoring tools for adult volunteers and teachers to use with 4-H youth and other students.

## Nature's Notebook and Extension

Nature's Notebook is the USA-NPN's national plant and animal phenology observation program. It is an off-the-shelf program appropriate for participants in adult and youth volunteer programs, with a suite of training and support material available online (Table 1). The incorporation of Nature's Notebook into Extension programming provides great benefits to science and society by engaging volunteers in contributing to a scientifically rigorous data resource. Participants use scientifically vetted protocols to answer questions about the phenological status of plants and animals from a list of over 600 plant species and 200 animal species.

Participants then become part of a network of scientists and citizen scientists making valuable contributions to climate research. Moreover, by increasing their knowledge of phenology and effects of climate variability and change on plants and animals, program participants will engage in a meaningful activity that may foster support of environmental efforts (Thody, Held, Johnson, Marcus, & Bomberger, 2009). Phenology data are stored in the national database maintained by the USA-NPN and are made freely available for download and exploration through an online visualization tool.

Nature's Notebook is being effectively implemented in Extension programming as a science learning tool for Master Gardener (MG), Master Naturalist (MN), and Master Water Steward (MWS) training programs. Collecting data for Nature's Notebook has been identified as a "project of interest" by Extension Agents in MG and MN programs because it provides a platform for teaching many of the basic skills necessary for certification. It serves as a mentoring tool between adult volunteers and middle- and high-school aged 4-H youth, providing an activity for engaging with science through observation. Nature's Notebook can serve as a community engagement tool to facilitate collaboration between Extension programs and local organizations with science and natural resource missions.

**Table 1.**

Training and Support Materials for Nature's Notebook Offered on the USA-NPN Website

### Nature's Notebook Training and Support Materials

Current	Scripted training presentations for use by workshop leaders
Resources	A detailed "How to Observe" field handbook A "How to Observe" one-page tip sheet Recruitment posters and handouts Narrated training videos for use by individuals or groups USA-NPN Education Coordinator support
New resources	Consultation available on how to incorporate <i>Nature's Notebook</i> into Extension Programming

- for 2012
  - Call-in hours with USA-NPN National Coordinating Office staff to address questions and provide support
  - Live training webinars with USA-NPN National Coordinating Office staff (please contact our office to schedule)
  - Train-the-Trainer resources for use in Extension programs (e.g. Master Gardener and Master Naturalist), including 1-hour and 3-hour workshop materials and tips on how to get started
  - Templates for a "Phenology Trail": a series of collective and linked sites registered in the *Nature's Notebook* application and accessible by the public

### Outcomes from the USA-NPN Perspective

Since the launch of the Nature's Notebook program in 2009, the number of registered observers in the program has surpassed 4,000, and the national phenology database has amassed over 600,000 records from more than 5,000 observing locations. Participants include individuals with a range of backgrounds and levels of expertise, from citizen scientists observing phenology in their own backyards to personnel at Long-Term Ecological Research (LTER) field stations. Based on a survey of participants at the conclusion of the 2010 observing season, the primary motivation of observers has been a desire to contribute to a valuable national effort to understand the effects of climate change (USA-NPN 2010). Nearly all survey respondents indicated an interest in recommending the program to friends, and 86% planned to continue to participate in the program in 2011 (USA-NPN 2010).

Observer thoughts on the Nature's Notebook program (USA-NPN 2010):

- "Solid info easily understood, well presented."
- "I wish I had more time to give to this."
- "This would be a great program for teachers to implement with their students."
- "My kids and I have learned a lot."
- "This is a really neat program, and it makes me happy to participate. I might add some animal observations this year."

Observer responses to the question, "Why do you participate in the program?" (USA-NPN 2010):

- "It increases my observational skills."
- "I want to involve my students in real-world research projects."
- "I believe the data set will be of considerable long-term value to our station."
- "I'm a professional gardener: watching plants is what I do."

### Outcomes from the Extension Perspective

USA-NPN Education staff and Extension faculty are collaborating to offer workshops with curriculum suitable for MG, MN, 4-H, and other natural resource clientele enrolled in existing Extension training programs. Extension programs in Arizona, California, Connecticut, Florida, Maine, and New Mexico have already enlisted participants in data collection for Nature's Notebook through workshops and courses. Phenology activities undertaken by Extension groups range from a phenology trail in Arizona to a program in Maine specifically designed to collect data for Nature's Notebook (Table 2).

**Table 2.**

Phenology Activities Undertaken by Extension Programs in Arizona, Florida, and Maine from 2010 to the Present, and Results from These Activities

State Extension	Phenology Activities	Results
Arizona (Pima County Extension Program)	<ul style="list-style-type: none"> <li>• Master Gardener course on phenology (3 hours):                             <ul style="list-style-type: none"> <li>◦ Introduction to phenology</li> <li>◦ Tools for observation" hands-on activities</li> <li>◦ Dichotomous keys, nature journaling, data recording, introduction to map skills, site identification</li> <li>◦ Data analysis and problem solving</li> <li>◦ Understanding ecological systems</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Phenology trail sites:                             <ul style="list-style-type: none"> <li>◦ Instruct community members about the importance of phenology and its relation to a changing environment</li> <li>◦ Act as workshop facilities for citizens interested in learning about phenology and data collection for <i>Nature's Notebook</i></li> </ul> </li> </ul>

- Phenology Trail set up in collaboration with:
    - University of Arizona's Campus Arboretum
    - Santa Rita Experimental Range
    - Biosphere 2
  - 4-H groups collect data at the sites near club meeting locations
- Florida (Extension specialists, university faculty, NGOs, and scientists from federal, state, and local agencies)
- Since 2011, 16 workshops and presentations focused on educating potential citizen scientists and registering new observers (Kish, Sheftall, Reinman, and Farmer 2010)
  - Phenology concepts utilized in:
    - Extension programs (MG, MN, 4-H, Sustainable Floridians)
    - Botanical Gardens
    - Middle and High School science programs
  - Display gardens and nature trails designated as phenology observation areas.
  - Climate literacy and phenology taught at middle school level.
- Doubled number of registered observers in Florida to 114 trained participants.
- Network of trained agents who can offer phenology workshops.
  - Series of courses on phenology concepts (available May 2012)
- Maine (*Signs of the Seasons: A Maine Phenology Program*)
- *Signs of the Seasons: A Maine Phenology Program* (SOS, developed by UMaine Extension/ME Sea Grant in 2010):
    - Highly structured plan
    - Strong partners: Acadia National Park, Schoodic Education Research Center, US Fish and Wildlife, ME Audubon, ME Maritime Academy and scientists and educators from UMaine
    - 13 Trainings held around the state using expertise from SOS Advisory Committee and existing UMaine Extension and Sea Grant program faculty
    - 13 plant and animal species from terrestrial and coastal environments
  - Plans for 2012:
    - 10, 2 ½ hour trainings
    - 5 conference and teacher workshop presentations
    - Special campaign on the ecological interactions of monarchs and milkweeds
- Trained 225 individuals ages 10-86 from all 16 counties
- Developed SOS resources:
    - 54 page field guide adapted from *Nature's Notebook*
    - Training videos
    - Recruitment tools
    - Program and research posters
    - 10 lesson plan activities for educators
  - Resources placed on SOS website:
    - Information on the program, as well as interviews and articles regarding the science of phenology and its connection to climate change: [umaine.edu/signs-of-the-seasons/](http://umaine.edu/signs-of-the-seasons/)

## Conclusion

Following the successful models of incorporating Nature's Notebook into Extension programs as described above, the USA-NPN is enthusiastic to collaborate with educators, researchers, citizen science networks, and conservation groups to implement the Nature's Notebook program through Extension across the country. Please contact the USA-NPN National Coordinating Office for more information.

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