



## *Signs of the Seasons: A Maine Phenology Project*

<http://umaine.edu/signs-of-the-seasons/>

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### **Phenology Snapshots**

(can be paired with “Festival Dates” activity)

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**Grade level:** 6-12

**Themes:** Phenology, climate change

**Activity type:** Research, hands-on, field observation, evidence-based thinking, and supporting claims with evidence

**Setting:** Classroom, outdoors, meeting space

#### **QUESTIONS**

When do natural and human events happen in your community?

Is the timing of some events changing?

If you think so, how do you know? Can you find evidence to support your claim?

#### **OVERVIEW**

Students conduct an investigation using historical photographic records to determine whether the timing of plant phenophases has changed in their own communities. They search for old photos (indicating dates) in their family’s or town’s records that show sites where plants are in specific phenological stages (i.e., peak flower, 90% leaf out [or 90% lack of leaf cover], fruiting, seasonal festivals, etc.), and that show dates of record. They then visit those sites when plants are experiencing those same phenophases and take pictures to compare the past and present timing of seasonal events.

Students infer meaning from the comparisons (e.g., with respect to climate change), engage in speculation, and learn to articulate claims and conclusions. They also evaluate the

strength of those claims based on their investigation and the photographic evidence they've compiled. This can be used as a basis for classroom discussion, leading students to explore lines of reasoning and other potential avenues of investigation. Do they think scientists and resource managers could use this information to understand how climate change is affecting plants, animals, and humans, and how to best manage these changes?

## **EDUCATION STANDARDS**

### **Maine Learning Results (*Science and Technology*)**

#### ***A1 Unifying Themes – Systems***

**3-5.** Students explain interactions between parts that make up whole man-made and natural things.

**6-8.** Students describe and apply principles of systems in man-made things, natural things, and processes.

**9-Diploma.** Students apply an understanding of systems to explain and analyze man-made and natural phenomena.

#### ***A3 Unifying Themes – Constancy and Change***

**3-5 a.** Recognize patterns of change including steady, repetitive, irregular, or apparently unpredictable change.

**6-8.** Students describe how patterns of change vary in physical, biological, and technological systems.

#### ***B1 Skills and Traits of Scientific Inquiry***

**3-5 a.** Pose investigable questions and seek answers from reliable sources of scientific information and from their own investigations.

**6-8.** Students plan, conduct, analyze data from, and communicate results of investigations, including simple experiments.

#### ***C1 The Scientific and Technological Enterprise – Understandings of Inquiry***

**3-5 a.** Describe how scientists answer questions by developing explanations based on observations, evidence, and knowledge of the natural world.

**9-diploma.** Students describe key aspects of scientific investigations: that they are guided by *scientific principles* and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly.

#### ***E2 The Living Environment – Ecosystems***

**3-5.** Students describe ways organisms depend upon, interact within, and change the living and non-living environment as well as ways the environment affects organisms.

**6-8.** Students examine how the characteristics of the physical, non-living (abiotic) environment, the types and behaviors of living (biotic) organisms, and the flow of matter and energy affect organisms and the ecosystem of which they are part.

## **LEARNING OBJECTIVES**

- Participants understand that the timing of phenological events can change, particularly as a result of changes in climate
- Participants identify some of the actual or potential local impacts of changes in phenology

*Expectations and Misconceptions: It's important to mention to students that they probably will not find changes in the timing of all events. They may not find changes in the timing of any events. The goal is to know which have changed, which haven't, and why.*

*Guard against the notion that, "If I see changes in timing, that's climate change. If I don't see them, then the climate is not changing." Remind them that the climate is changing, that some things are impacted more than others, and that things are impacted differently.*

## **MATERIALS**

- Access to historical photographic record—either family, town, library or other
- Dated photos or photos where date can be inferred (holidays, graduation, festivals)
- Photocopier or digital scanner
- Digital Camera
- Optional: hand lenses, binoculars, materials needed to observe a particular phenophases

*Suggestions about types of photos to look for: variation can be easier to see in fall or spring scenes; or look for images taken around holidays (e.g., Labor Day, Columbus Day, Rosh Hashanah, Yom Kippur, Veterans Day, Thanksgiving, Easter, Passover, Patriots Day, Memorial Day) or at events that happen around the same time each year (e.g., sports tournaments, hunting or fishing trips, vacations, etc.).*

## **TIME NEEDED**

- 1.5-2 hours (or as needed for a field trip or classroom visit) for historical research
- 20 minutes (or as needed, depending on location) for photographing present-day phenological events
- One 30 to 40-minute class period (or as needed) to assemble evidence for any conclusions or claims
- 20 minutes for presentation and group discussion

## **ACTIVITY PROCEDURE**

1. Before announcing the activity, look at the calendar and think about upcoming seasonal or phenologically-relevant events on the horizon (e.g., fall foliage, leaf dropping or leaf out, alewife run, maple sugaring, or lupine festival, beginning [ $<10\%$ ] or peak [ $>90\%$ ] flowering time for lilacs, apple trees, or other flowering plants, berry seasons, etc). Choose one or more examples for students to focus on.
2. Announce and explain the overall activity to the participants/students. Ask the students to think about where they could look for dated photographs depicting those seasonal events in times past. Discuss, as a group, how to research the question and come up with a plan. Review the importance of evaluating the credibility of sources (and how to credit sources), especially if they want to search the Internet.
3. Establish a schedule for completing the project and expectations of students who aren't able to find any historic photos. The project may best be conducted in small

groups due to the limited number of phenological events to choose from. Also, this could help increase the likelihood of tracking down relevant family photos. Optionally, encourage students to conduct the investigation in other towns where other family members may live, so as to increase options for material and resources.

4. Depending on the students' experience using library resources, you may want to schedule a library visit for an orientation to help students get started. You also may want to establish milestones by which students must produce pieces of the project, and check-in points to encourage them to consult with you for advice.
5. As phenological events become imminent, make sure students are in the field making observations, taking pictures and notes, until their phenophases are observed and photographed.
6. Guide the students in reflecting on their body of evidence and what they think it means. Coach them on how to assemble the pieces to make a clear presentation of their findings (or lack of findings). Schedule a time for each group to give their presentation.
7. When the presentations occur, make sure there is ample time for questions, discussion, reflection and debate.

### **REFLECTION/ASSESSMENT IDEAS**

*Reflection:* Ask participants to describe their research process and reflect on what worked well and what they could do differently next time. Also ask them to reflect on how much can realistically be inferred from the material they have compiled and whether they can make strong conclusions and claims or not. Ask them to explain the difference between a strong claim and a weak one. Can they say that the overall timing of some events is changing, or not? If not, what more evidence/information would they need? How might we document these changes? What might cause changes in phenology? Are the changes likely to be uniform? What are some consequences (actual or potential) of changes in phenology for people, plants, and animals? Offer example(s) of changes in phenology of species, examples of how scientists (or others) have documented these changes, and any consequences that have been noted.

*Assessment:* Ask students to take their investigation one step further. If they need other information in order to strengthen a claim, ask them to pursue it (with your guidance and input) and then give an update to the group of their initial presentation. If they were unsuccessful with one investigation, ask them to try again with a different phenological event (in consultation with you). For students who are comfortable with this activity, can they lead their peers in a new or expanded investigation?

### **EXTENSION IDEAS**

See *Assessment* above. Also, if any group has developed a strong investigation, consider having their results presented publicly, at the local library, nature center, education and research center (i.e., associated with a national park), town meeting where a relevant discussion is on the agenda, relevant forum at an academic institution, and consider drawing media attention to the event. Can the students be enlisted to investigate, or

participate in an investigation of, a phenological question of strong interest/concern to the local community? For instance, a coastal community might be very interested in understanding how the timing of fish migrations is changing. Some participants in the group may know of records of past fish runs—e.g., town records, newspapers, journals of family members, etc.—that could be used to investigate the changes. Perhaps the students' skills in compiling photographic evidence could enhance the research effort.

## RESOURCES

Signs of the Seasons (<http://umaine.edu/signs-of-the-seasons>)

USA National Phenology Network (<http://www.usanpn.org>)

## Readings:

*Phylogenetic patterns of species loss in Thoreau's woods are driven by climate change.* (<http://www.pnas.org/content/early/2008/10/24/0806446105.abstract>).

*Photographs and Herbarium Specimens as Tools to Document Phenological Changes in Response to Global Warming* (<http://www.amjbot.org/content/93/11/1667.abstract>)

*Earth's Before and After Pics.* (Discover Magazine. Anne Casselman published online November 6, 2006: <http://discovermagazine.com/2006/nov/climate-change-vegetation/?searchterm=earth's%20before%20and%20after%20pics>)

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