
Climate Change in Your Schoolyard

Activity Overview

Students will learn about climate change and phenology.

Objectives

Students will:

- Define and give examples of phenology
- Understand how changes in climate affect plant phenology
- Formulate ideas and questions about how changes in phenology may affect relationships among species

Subjects Covered

Science, Language Arts

Grades

Targeted for grades 5 through 8

Modifiable for grades 3 through 12

Activity Time

50 minutes

Season

Any

Materials

A Sand County Almanac, journals for recording phenological observations, internet access to phenology-related websites

Source

Sarah Wright from Center for Biology Education

Modified from Earth Partnership for Schools K-12 Curriculum Guide, University of Wisconsin Board of Regents.

Background

You may have heard of Aldo Leopold, a Wisconsin hero in restoration who is celebrated around the world for his work as an ecologist and his beautiful book, *A Sand County Almanac*. Aldo was an enthusiastic phenologist (someone who studies the timing of life cycles), always carrying a journal for recording events like the first bloom of flowers and return of migrating birds. If you read *A Sand County Almanac* with phenology in mind, it is almost like a beautifully written phenology notebook! The book contains observations Aldo made from 1935-1945 near the “Shack” in the Baraboo Hills. The whole Leopold family practiced phenology for fun during their trips to the Shack. In fact, when Aldo’s daughter, Nina Leopold Bradley, moved back to Baraboo in 1976, she started right where Aldo left off, recording over 300 phenological events! Today, she still has a clipboard hanging in her kitchen for making observations.

While the Leopolds had a lot of fun doing phenology on the land they loved, it also turned out to be very useful for a reason no one would have imagined back in the 1930s - documenting climate change. That is because many plants and animals pay attention to temperature to decide their life schedules. When it comes to phenology, there are a few main reasons why plants do things when they do. One is having enough light, so that plants grow and bloom only when the days are long enough. We would expect these plants to pretty much keep the same schedule from one year to the next. But plants also need water and nutrients and how much of those things are available depends a lot on temperature. For example, spring plants need warm enough days to melt snow, and summer plants might be in a hurry to get things done before it becomes too dry. Most plants take their cues for when to do things like grow, bloom, and set seed based on the temperature.

Activity Description

Comparing plant phenology in Aldo’s time with ten years of Nina’s data (from 1997-2007) shows us how things are changing. The table below shows the phenology of most of the plants looked at in Earth Partnership for Schools “A Prairie Year” activity (excluding little bluestem and purple coneflower). For each species listed, this table includes:

1. The average date when Aldo saw it bloom between 1935 and 1945. The only exceptions being big bluestem, which is a grass and thus its ‘bloom’ is really first pollen.
2. The Julian date, or the day of the year, of that date (i.e. January 1 would be 1, January 2 would be 2, etc).

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3. The same information is listed from Nina’s observations. The day of year makes it easier to compare Aldo’s and Nina’s observations with each other.

Plant Species	Aldo 1st bloom	Aldo day of year	Nina 1st bloom	Nina day of year
Pasque flower	April 19	110	April 7	98
Lupine	May 20	141	May 13	134
Shooting star	May 22	143	May 10	131
Spiderwort	June 2	153	May 25	146
Black-eyed Susan	June 22	174	June 13	165
Butterfly weed	July 5	187	June 21	173
Bergamot	July 12	194	July 3	185
Yellow coneflower	July 14	196	June 30	182
Compass plant	July 15	197	June 25	177
Prairie dock	July 19	201	July 15	197
Big bluestem	July 30	212	July 24	206
New England Aster	August 21	234	August 27	240
Stiff goldenrod	August 27	240	August 9	222

Discussion



How many species bloom earlier now than when Aldo saw them? How many are later? Which ones have changed their schedules the most? Can you think of reasons for these differences? What would this mean for planning your prairie?

You may notice that nearly all the plants bloom earlier now than they did when Aldo observed them. This is probably largely due to the warmer average temperature that plants experience. Even though the blooming date changes a lot from one year to the next, and is different for different species, the overall change we see across years and across species gives us a pretty strong picture that summer is coming earlier and staying later. You may also notice that New England Aster actually blooms later now than it did in Aldo’s time... this could be because this is an ‘early fall’ species, and since fall arrives later, so does the onset of flowering for this species. Some of these species are on such a different schedule that Aldo would need to write a new *Sand County Almanac*! For example, the compass plant appears in the ‘July’ chapter, but would now need to be in the ‘June’ chapter!

Extensions

- There is still an awful lot we do not know about how climate change is affecting plant phenology! These data focus on the first bloom of plants. You may wish to also pay attention to things like how long blooming lasts for these species in your prairie (i.e., the time between the first individual blooming to the last setting seed) or the peak bloom (i.e. when about half of the plants of that species are in bloom).
- What about phenology of the organisms with whom these plants have relationships, like pollinators (bees, butterflies), or even diseases (like fungus or galls)? You may wish to observe these events, too.

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-  Create an electronic database and use data to make digital graphs.
- Students create a set of research questions they would like to explore about changes in phenology and create a plan for answering their questions.
- Students keep a phenology journal about a question that interests them.
-  Students do library or internet research to get more information about a phenological event not included in the Leopold set, such as ski resort seasons, ice fishing, or insects. Use computer software to present their findings.
- Students interview an older family member, tribal elder, community member, farmer, or scientist about how phenology has changed over time and present their findings.
- Write a phenological 'personal ad' for species whose relationships may be disrupted. Here is an example:

NO LONGER WAITING 4 U. All summer long I anticipated your vibrations. I bloomed showier than ever, with the most alluring UV stripes and sweetest nectar, just for you. So many lonely days in waiting... afraid I'd go unpollinated and finally gave my reward to another. Where were you?

Additional Resources

Books

- Bauer, C. and M. Smith Fry. 2000. *My nature journal: Explorations of the natural world using phenology*. Printed by the Arboretum Bookstore: Madison, Wisconsin. <http://uwarboretum.org/bookstore/>
- Leopold, A. 1949. *A Sand County almanac*. New York: Oxford University Press.
- Walther, Gian-Reto. 2002. *Ecological responses to recent climate change*. Nature, Volume 416.
- Weber, Larry. 1996. *Backyard almanac*. Duluth: Pfeifer-Hamilton Publishers.
- Weber, Larry. 1998. *Teaching with the seasons*. Green Teacher, No. 54.

Websites

- Climate Change and Indiana: [www.yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BUQ6Z/\\$File/in_impct.pdf](http://www.yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BUQ6Z/$File/in_impct.pdf)
- The National Phenology Network: <http://www.usanpn.org/>
- Project BudBurst, National Phenology Network: www.budburst.org
- Journey North: www.journeynorth.org
- Cool Kids for a Cool Climate: www.coolkidsforacoolclimate.com
- National Sustainable Agriculture Information Service: <http://attra.ncat.org/attra-pub/phenology.html>
- Phenology and Climate Change: www.windows.ucar.edu/tour/link=/life/phenology_climate_change.html
- Encyclopedia of Earth: <http://www.eoearth.org/by/topic>

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- Environmental Protection Agency Climate Change for Kids: www.epa.gov/climatechange/kids/index.html
- Teaching Climate Change: www.teachingclimatechange.com.au/
- Climate Change North: Lesson Plans: www.climatechangenorth.ca/section-1p/C1_Lesson_plans.html

Assessments

- Students create graphs, charts, or pictures which convey how phenology has changed between Aldo's and Nina's period of observation.
- Students look at Indiana weather records to discern relationships between weather and phenology from one year to the next (i.e. interannual variability).
- Students present research on their phenological event of interest (based on data they collect in the schoolyard) at the EPS symposium or other student event.
- Students create writing or art based on their findings and hold a 'phenological art opening'.