CHICAGO BOTANIC GARDEN

Activity 3.4: Meet the Naturalists

Grades 5 – 6

Description: Students will read about the ways phenology has been used historically, including examining historic records where available. Students will then explore ways historic data sets can be used for modern purposes and learn the story behind more than 150 years of plant phenology data collected in Concord, Massachusetts. Students will be introduced to five individuals who collected data in this location.

Total Time: One 45-minute class period

Materials:
- Copies of the Meet the Naturalists background information on historical phenologists
- Copies of the Meet the Naturalists question sheets

National Science Education Standards

G1.a Women and men of various social and ethnic backgrounds engage in the activities of science.

G1.b Science requires different abilities, depending on such factors as the field of study and type of inquiry.

G3.a Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.

AAAS Benchmarks

1A/E2 Science is a process of trying to figure out how the world works by making careful observations and trying to make sense of those observations.

1A/M3 Some scientific knowledge is very old and yet is still applicable today.

1C/M1 Important contributions to the advancement of science, mathematics, and technology have been made by different kinds of people, in different cultures, at different times.

1C/H3b History often involves scientific and technological developments.

Guiding Questions

- What is phenology and why do people study it?
- How has the study of phenology been helpful to humans, and in what ways was it used?
- Who were the people who collected phenology data in Concord, Massachusetts, and why did they collect that information?

Assessments

- Students' Meet the Naturalists question sheets

Background

Henry David Thoreau began collecting plant phenology data in Concord, Massachusetts, in the 1850s. Recently, scientists at Boston University uncovered Thoreau's work and that of several other plant phenologists working in Concord, and began collecting modern data using the same methods as these phenologists. These scientists, Richard Primak and Abraham Miller-Rushing, found a relationship between first flowering date and temperature in many native and nonnative plants. Their work provides a basis for predicting how future climate change will affect species in Concord and throughout the world.

In this lesson, students will "meet" the phenologists involved in Primak and Miller-Rushing's study. Students brainstorm and discuss the motivation behind collecting plant phenology data. They make predictions about changes in first flowering date since 1851. Next, students graph and interpret first flowering data from five Concord plant species. Students will use their graphs to draw conclusions regarding how climate change (and other factors) affects plant phenology.

Procedure

1. Distribute the student handout "Meet the Naturalists: A History of Phenology." Explain to students that the data they are going to be looking at was collected from plants in Concord, Massachusetts. Have students read the descriptions of the five naturalists who contributed to the Concord data set. Students can read this information to themselves, in groups, or as a class.

   NOTE: *Pennie Logemann's data does not appear in the students' data set, however, it was used by Primak and Miller-Rushing to determine the effects of climate change on flowering dates.*

2. Have students answer the questions on the student work page themselves, then discuss their answers with a partner, then with the whole class. Questions 7 and 8 focus on problems and opportunities associated with using data collected by many people over a long time span. These are important experimental-design questions. On one hand, this is the only way to collect data over a long time span. On the other hand, individuals differ in their methods and naming conventions, or surroundings may change drastically, etc. In Question 8, students will brainstorm what changes may have occurred in Concord since 1851.

3. Discuss the students' participation in Project BudBurst. BudBurst data is collected all over the country by thousands of people. What challenges might this present in terms of designing a good experiment? What are the benefits of having so many people participate?

4. As an extension, students may research more information about the naturalists. Several sources of information can be found in the "For more information" section below.

5. Tell the students that they will now have a chance to analyze the data that's been collected since 1852!

Meet the Naturalists

History of Phenology
In the past, farmers knew when to plant or harvest certain crops based on the timing of natural events. They came up with sayings like these:

- Plant corn when oak leaves are the size of a squirrel's ear.
- Plant peas when forsythia blooms.
- Plant potatoes when the first dandelion blooms.
- Plant bean seeds when lilacs are in full bloom.

When the first dandelions bloom, we know that the environment is just right for planting potatoes. When the dandelion is blooming tells us that conditions are good for other things to grow too.

People have observed the timing of natural events for centuries. The study of the timing of natural events is called phenology. We still make these observations today. Being aware of the timing of plant and animal life-cycle events helps people manage the resources they need to live.

Climate affects when birds migrate. It also impacts when certain flowers bloom, and when fruits ripen. Native Americans, farmers, and gardeners have relied on these life-cycle events of different plants and animals to time their tasks.

Today, many people are interested in phenology. Now scientists compare records of natural event dates from the past to the present to learn about how the climate has changed. The science of phenology helps us be aware of how changes in Earth's climate affect us now. It also gives us a clue about how it may impact us in the future.

Below are some specific jobs, people, or cultures who collected and depended on phenological information.

1. Thomas Jefferson
   Some people, like Thomas Jefferson, kept records of the plants in their gardens. He kept records of his gardens at Monticello and Shadwell and collected information about the varieties of vegetables, fruits, flowers, and trees he planted, where they were planted, harvesting dates, and notations about weather conditions.
   - Thomas Jefferson's original records and documents can be found online: http://www.masshist.org/thomasjeffersonpapers/garden/

2. Japanese Cherry Blossom Festival
   Phenology also plays an important role in some cultures. In Japan, people have been celebrating the blooming of cherry trees in the spring since approximately 700 B.C.E. Families would celebrate spring by picnicking under blooming cherry trees. The brevity of the blossoms, the extreme beauty and quick death, has often been associated with mortality,

so cherry blossoms are used often in Japanese art, music, and film. Currently, every year the Japanese Meteorological Agency and the public track the *sakura zensen* (cherry blossom front) as it moves northward with the approach of spring and there are nightly forecasts following the weather on the news. The Cherry Blossom festival is also celebrated in the United States. Japan gave 3,020 cherry blossom trees as a gift to the United States in 1912 to celebrate the nations' then-growing friendship, replacing an earlier gift of 2000 trees that had to be destroyed due to disease in 1910. These trees were planted in Sakura Park in Manhattan and line the shore of the Tidal Basin in Washington, D.C. The gift was renewed with another 3,800 trees in 1965. In Washington, D.C., the cherry blossom trees continue to be a popular tourist attraction (and the subject of the annual National Cherry Blossom Festival) when they reach full bloom in early spring.

- History of the national cherry blossom festival in Washington, D.C. http://www.nationalcherryblossomfestival.org/about/history/

3. Fisherman

Phenology isn't only important for plants. It is also important for some animals, including fish, and the fishermen who supply fish to grocery stores. Remember, phenology is the timing of life-cycle events, for animals as well as plants. Salmon spend their early life in rivers, and then swim out to sea where they live their adult lives and gain most of their body mass. When they have matured, they return to the rivers to spawn. Usually they return with uncanny precision to the river where they were born, and even to the very place of their birth. It is thought that when they are in the ocean, they use the Earth's magnetic fields to locate the general position of their natal river, and once close to the river, that they use their sense of smell to hone in on the river entrance and even their natal spawning ground. Historically, large runs of salmon moved from the Pacific Ocean to breeding grounds in the Upper Columbia River in Washington state. The returning salmon provided a subsistence fishery for many local Native American tribes including the Spokane Tribe, the Colville Confederated Tribes (San Poil, Colville, Wenatchi, Sinkiuse, Peskwaus, Methow, and Nespelem tribes), the Kalispell Tribe, the Coeur d'Alene Tribe, and the Kootenai Tribe. Fish harvest times vary by species, since not all species breed at the same time. Species harvests vary by season, but the majority of the harvest included Chinook salmon (spring and summer), steelhead (fall, late winter, and spring), coho salmon (fall), and a silver salmon (either sockeye or whitefish) (Scholz et al. 1985).

- Information on historical fisheries at Lake Roosevelt, Washington state. http://www.lrf.org/Env/Env-History.html;
- Information on Atlantic Salmon from the Conte Anadromous Fish Research Center, Biological Resources Division, USGS http://www.bio.umass.edu/biology/conn.river/salmon.html

Who was Watching the Flowers?
The data that you are about to analyze is old. The first observations came from 1851!
The naturalists listed below would walk around a few times a week and observe flowers. They would write notes about the stages of the plant, for instance: emergence, first leaf, first flower, full flower, first fruit, etc. Read the information about these five naturalists and answer the questions below:

Who was watching the flowers?

Henry David Thoreau (1817 – 62) was an author, poet, naturalist, historian, and abolitionist, among other things. His most famous work is a book called *Walden,* which is about living in harmony with nature. Between 1852 and 1858 he noted the first flowering dates of more than 500 species of plants in Concord, Massachusetts. However, he did not publish his data.

Alfred Hosmer (1851 – 1903) was a photographer and owner of a dry goods store. He was a follower of Thoreau and helped make him famous. Hosmer observed the first flowering date of more than 700 species of plants in the years 1878 and 1888 – 1902. He also published articles about the plants of Concord.

Pennie Logemann (1918 – 2011) was head of a bacteriology lab. In 1966 she became a landscape designer. Logemann observed more than 250 species of plants near her home in Concord between the years of 1963 and 1993. Her work was used in a study by Miller-Rushing and Primack in 2008.

Richard B. Primack is a biology professor at Boston University. He teaches classes to college students on plant biology and conservation biology. He also researches the effects of climate change on plant flowering in Concord, Massachusetts, and in Japan and South Korea. Primack has studied plant flowering in Concord since 2003.

Abraham Miller-Rushing is a phenologist and the head of science at Acadia National Park in Maine. He studied with Primack at Boston University. Primack and Miller-Rushing put together data from Thoreau, Hosmer, and Logemann with data they collected from 2003 to 2008 to study how plant flowering in Concord has changed over time.

Name _____ Teacher/Class _____

Meet the Naturalists

History of Phenology

1. List some of the people who use phenology.

2. What type of phenology data do they use? Give two examples of the kind of data they collected.

3. In your two examples, explain what the purpose was for collecting the data and how it helped people with their work or interests.

Who was Watching the Flowers?

4. What do the five naturalists have in common? How do they differ?

5. Why do you think they were all interested in studying plants?

6. Why do you think these individuals all kept records of the first flowering dates of plants?

7. Describe some of the problems associated with compiling data collected by different people over a long time span.

8. Describe some of the opportunities associated with compiling data collected by different individuals over a long time span.

9. Think about Project BudBurst. How might the issues raised in Questions 7 and 8 impact BudBurst data? What are the positives and negatives for BudBurst—a national project with thousands of participants?

10. In what ways do you think Concord, Massachusetts, changed from the time Thoreau was collecting data until the time Primack and Miller-Rushing were collecting data?

TEACHER ANSWER KEY:
Meet the Naturalists

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