



Blooming Thermometers

Unit: Little Ice Age
Lesson: 6

Materials & Preparation

Time:

- Preparation: 20 minutes
- Teaching time: 45 minutes

Materials for the Teacher:

- Overhead projector
- Overhead of images of cherry blossoms (p.4)

Materials for Students:

- Student Page
- Pencil
- Ruler
- Eraser
- Paper

National Science Standards

- Science as Inquiry: Content Standard A
- Earth and Space Science: Content Standard D
- Science in Personal and Social Perspectives: Content Standard F

Colorado Science Standards

- Science: 1, 4.2b, 6c
- Geography: 6

Learning Goals

Students will

- Understand that many natural phenomena respond to seasonal weather changes.
- Understand that the timing of seasonal changes and reactions of these natural phenomena will change as climate changes over long periods of time.
- Natural and human records help us to recreate the history of climate based on records of seasonal change.
- Cool spring temperatures occurred in the 11th-14th and 16th centuries according to records of when plants bloomed each spring.

What Students Do in this Lesson

In this lesson students develop an understanding of the relationship between natural phenomena, weather, and climate change: the study known as “phenology.” In addition, they learn how cultural events are tied to the timing of seasonal events. First, students brainstorm a list of natural phenomena that occur annually in response to changes in seasonal weather changes. Next, they receive cultural and historical information regarding the Japanese springtime festival of Hanami, celebrating the appearance of cherry blossoms. Students plot and interpret average bloom date data from over the past 1100 years.

Key Concepts

- Biological phenomena respond rapidly to changes in weather as seasons change throughout the year.
- Gradual shifts in the timing of these seasonal biological responses occur as gradual changes in the climate occur over decades and centuries.
- Human records of events such as the blooming of cherry blossoms help to illustrate climate change over centuries.
- Spring temperatures were cool and blossoms appeared later than usual in April from 1100 to 1400 AD and in 1600 AD.



Blooming Thermometers

Advanced Preparation

- Make copies of the Student Page, one per student.
- Copy the *Cherry Blossom Overhead Images* (page 4) onto transparency.

Introducing the Lesson

- Ask students to brainstorm how they know that seasons are changing. What changes? Is it just the temperature? Do other phenomena react to the change in weather? How? (Examples: Leaves turning color, harvesting crops, flowers blooming, air conditioning turned on, heat turned on, etc.)
- Discuss the following:
 - Do the phenomena that the class brainstormed happen at exactly the same time each year?
 - What might cause the timing to be different?
 - If the climate were to cool or warm, how would these phenomena be affected?

Facilitating the Lesson

- Explain that in this lesson, the students will investigate data about one phenomenon that is affected by changing seasons: the blooming of cherry blossoms.
- Show images of the festival and blossoms (see overhead on page 4). Explain that each spring the Japanese celebrate the appearance of cherry blossoms (sakura) with the festival of Hanami.
- Explain that records have been kept of the first appearance of cherry blossoms and scientists have used these records to understand climate variations. In this lesson, the class will do the same.
- Discuss what students would expect to happen to bloom timing if the climate were cooler or warmer.
- Distribute the Student Page and explain the concept of “mean blossom date.” The data from each century is averaged. That is why there is a decimal place in the date (average day in the month) for each century. Because the data is averaged, small variations in bloom time are not present. Additionally, one year’s blossom date is also an average because not all trees bloom at exactly the same time.
- Have each student create a graph of blossom date versus time. (Their resulting graphs should resemble the graph on page 4 of this lesson plan.) Students are instructed to make a bar graph. If students are not familiar with bar graphs, show examples from outside this lesson. Point out that the graph on the student page has a y-axis with the largest number on the bottom and the smallest at the top.
- Once students have created graphs, ask them to answer the thought questions listed on the Student Page.
- Review student responses to the thought questions and discuss the nature of indirect evidence, and how survival has historically been tied to seasons and climate.

Extension

- Have students identify a local event that occurs regularly and in response to seasonal change and review historical records of that event if available. (Examples may include: melting ice from a pond, presence of migratory birds, blooming flowers, monarch butterfly migrations, etc.)
- Participate in the GLOBE Program, which involves students in collection of phenology data (globe.gov).
- Have students do background research about phenology.



Blooming Thermometers

Background Information

Biological Events and Climate Change

The study of climate change includes *phenology*. Phenology is the study of biological events that change in response to their environment. The word takes its meaning from “phenomenon.” For example, bird migration is a phenomenon associated with climate and season. Likewise, the appearance of flowers, such as cherry blossoms, is a response to the local weather and climate. On an annual basis, many biological events respond to weather, whereas over long periods of time the phenomena shift gradually, earlier or later in the year, in response to climate.

For hundreds of years, the Japanese have held a celebration each spring called Hanami in honor of the appearance of cherry blossoms (sakura). Originally a social event reserved for the nobility, it has evolved into one that most Japanese share. Ancient documents record the date of past festivals and scientists have been able to use this information to calculate the mean annual blossom date for cherry trees over the past 1100 years. The change in the bloom dates provides insight into past changes in climate.

The early appearance of blossoms indicates a mild winter and warmer climate whereas a late blossom date indicates longer, harsher winters and a cooler climate. The table and graph below indicate the mean blooming date each century for the years 900 to 1956 for cherry trees in the city of Kyoto, Japan.

Based on the bloom data (in table below), a relatively warm climate during the 10th and 11th centuries gave way to cooler conditions in the 12th-15th centuries. The climate warmed during the 16th century, cooled during the 17th century, and has been relatively warm since.

Additional Resources

- Japanese Festival, Hanami: <http://www.tjf.or.jp/eng/ge/ge11hana.htm>
- Annual Blossom Forecast: http://www.jma.go.jp/JMA_HP/jma/jma-eng/sakura/sakura.htm
- Images of Cherry Blossoms
 - http://www.ktv.co.jp/hanami/2003/index_english.html
 - <http://www3u.kagoya.net/~tanimoto/hanami/sakura.htm>

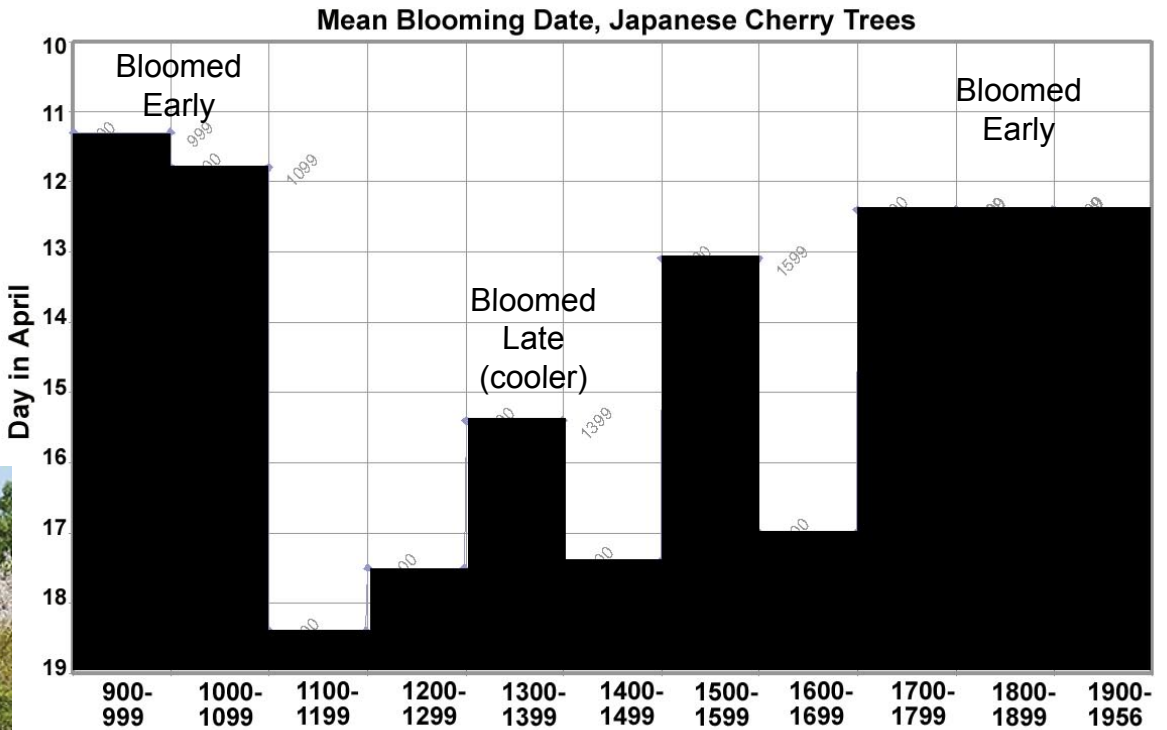


Blooming Thermometers

Cherry Blossom Overhead

Instructor: Copy onto transparency for use with an overhead projector.

Table 1. Mean Blooming Dates by century; from H. Arakawa, Journal of Meteorology, December 1956



Cherry blossoms



People attending the festival of Hanami

Century	Mean Blooming Date
900-999	April 11.3
1000-1099	April 11.8
1100-1199	April 18.4
1200-1299	April 17.5
1300-1399	April 15.4
1400-1499	April 17.4
1500-1599	April 13.1
1600-1699	April 17
1700-1799	April 12.4
1800-1899	April 12.4
1900-1956	April 12.4



Blooming Thermometers

Name _____

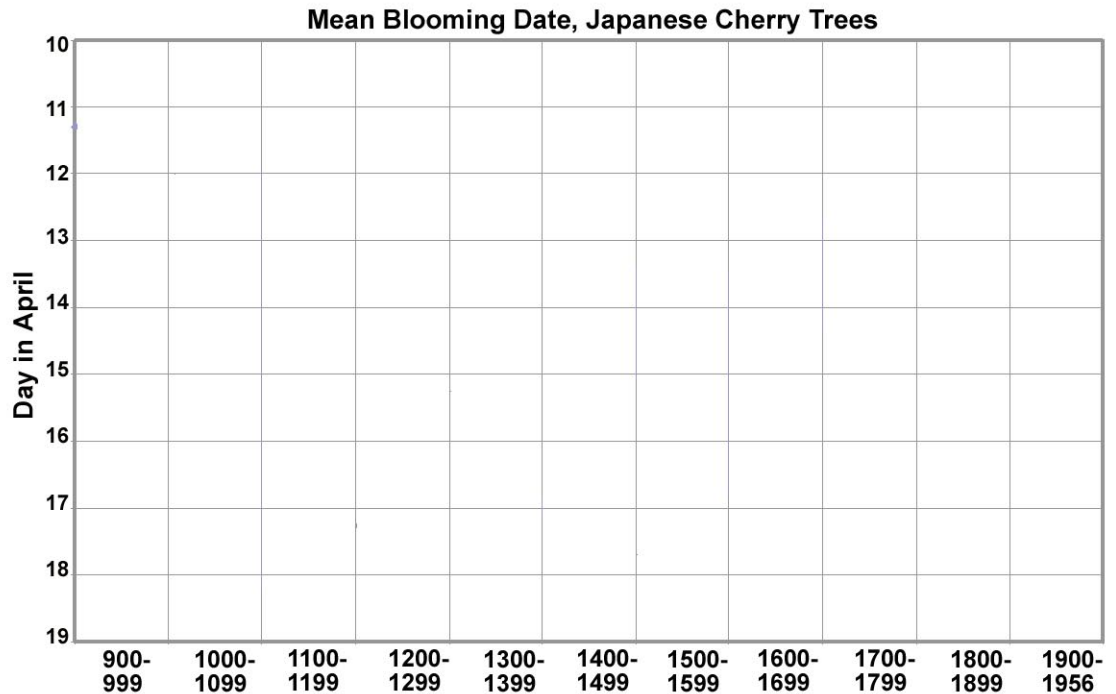
Date _____ Class _____

The data in the table below indicate the mean blooming dates of cherry trees in Kyoto, Japan during each century between 900 and 1956.

Make a bar graph:

- Use the data below to make a bar graph of Mean Blooming Date versus Century. A bar graph has a bar for each category (time period). The height of the bar depends on the bloom date.

Century	Mean Blooming Date
900-999	April 11.3
1000-1099	April 11.8
1100-1199	April 18.4
1200-1299	April 17.5
1300-1399	April 15.4
1400-1499	April 17.4
1500-1599	April 13.1
1600-1699	April 17
1700-1799	April 12.4
1800-1899	April 12.4
1900-1999	April 12.4



Answer the following questions based upon your graph.

- In what century did the cherry blossoms appear earliest in April? _____
- In what century did the cherry blossoms appear latest in April? _____
- What environmental conditions, weather and climate, might cause cherry blossoms to appear late or early? _____
- Do you think the date that a flower appears is a good indication of the regional climate? Explain your answer. _____
- The changes in bloom date may have been caused by global climate change. What additional data would you need to investigate this statement? _____