Lesson 2

Observing Changes at Mohonk Preserve

Hudson River Estuary
Sea Grant New York
New York State Water Resources Institute
Cornell University

Observing Changes at Mohonk Preserve

NYS Intermediate Level Science

Standard 1: Analysis, Inquiry and Design/Scientific Inquiry

S1.2c Differentiate among observations, inferences, predictions, and explanations.
S2.1d Use appropriate tools and conventional techniques to solve problems about the natural world, including: measuring, observing, describing, classifying, sequencing.
S3.1a Organize results, using appropriate graphs, charts, and data tables.
S3.2d Formulate and defend explanations and conclusions as they relate to scientific phenomena.
S3.2h Use and interpret graphs and data tables.

Standard 6: Interconnectedness

5.2 Observe patterns of change in trends or cycles and make predictions on what might happen in the future.

Standard 4: The Physical Setting

2.2i Weather describes the conditions of the atmosphere at a given location for a short period of time.
2.2j Climate is the characteristic weather that prevails from season to season and year to year.
2.2q Hazardous weather conditions include thunderstorms, tornadoes, hurricanes, ice storms, and blizzards. Humans can prepare for and respond to these conditions if given sufficient warning.
2.2r Substances enter the atmosphere naturally and from human activity. Some of these are carbon dioxide, methane, and water vapor. These substances can affect weather, climate, and living things.

Next Generation Science Standards

Science and Engineering Practices:

4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Grade 6

ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Grade 7

LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Common Core State Standards

ELA in the Content Areas - Grades 6-8

CCSS.ELA-Literacy.RST.6-8.7

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Common Core State Standards - Mathematics

Standards for Mathematical Practice

CCSS.Math.Practice.MP2

Reason abstractly and quantitatively.

CCSS.Math.Practice.MP4

Model with mathematics.

Grade 6

CCSS.Math.Content.6.NS.C.8

Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Observing Changes at Mohonk Preserve

New York Sea Grant developed this lesson plan using information from the Mohonk Preserve website www.mohonkpreserve.org

Introduction

Students will plot recent data and long-term averages of temperature and precipitation to discover the importance of long-term data sets. Using a presentation developed by scientists at Mohonk Preserve, they will learn more about the data sets and relate the weather data with phenological data. Phenology is the study of how living things respond to cyclical phenomena, in particular, how plants and animals respond to seasonal changes.

Background Information *(from the Mohonk Preserve website)*

A preliminary analysis of the Preserve's weather data shows that the average temperature has risen about two degrees over the past 113 years.

Composed of more than 40,000 days of weather observations, these records are part of the collection of the Preserve's Mohonk Lake Cooperative Weather Station, established in 1896 by the U.S. Weather Bureau (now the National Weather Service).

Weather readings at Mohonk began in the mid-1880s, taken by the Smiley family, founders of the neighboring Mohonk Mountain House, and are now continued by Preserve research staff. Beginning in the late 1970s, data collection expanded to include regular monitoring of the pH of precipitation, lakes, and streams.

Why are these data important?

To identify the extent of global climate change, researchers need access to reliable data covering the longest period possible. The Preserve's weather data is dependable because the station has been in the same, comparatively stable location for over a century and the same protocol has been followed by the relatively few people involved in collecting the data.

Objectives

Students will be able to

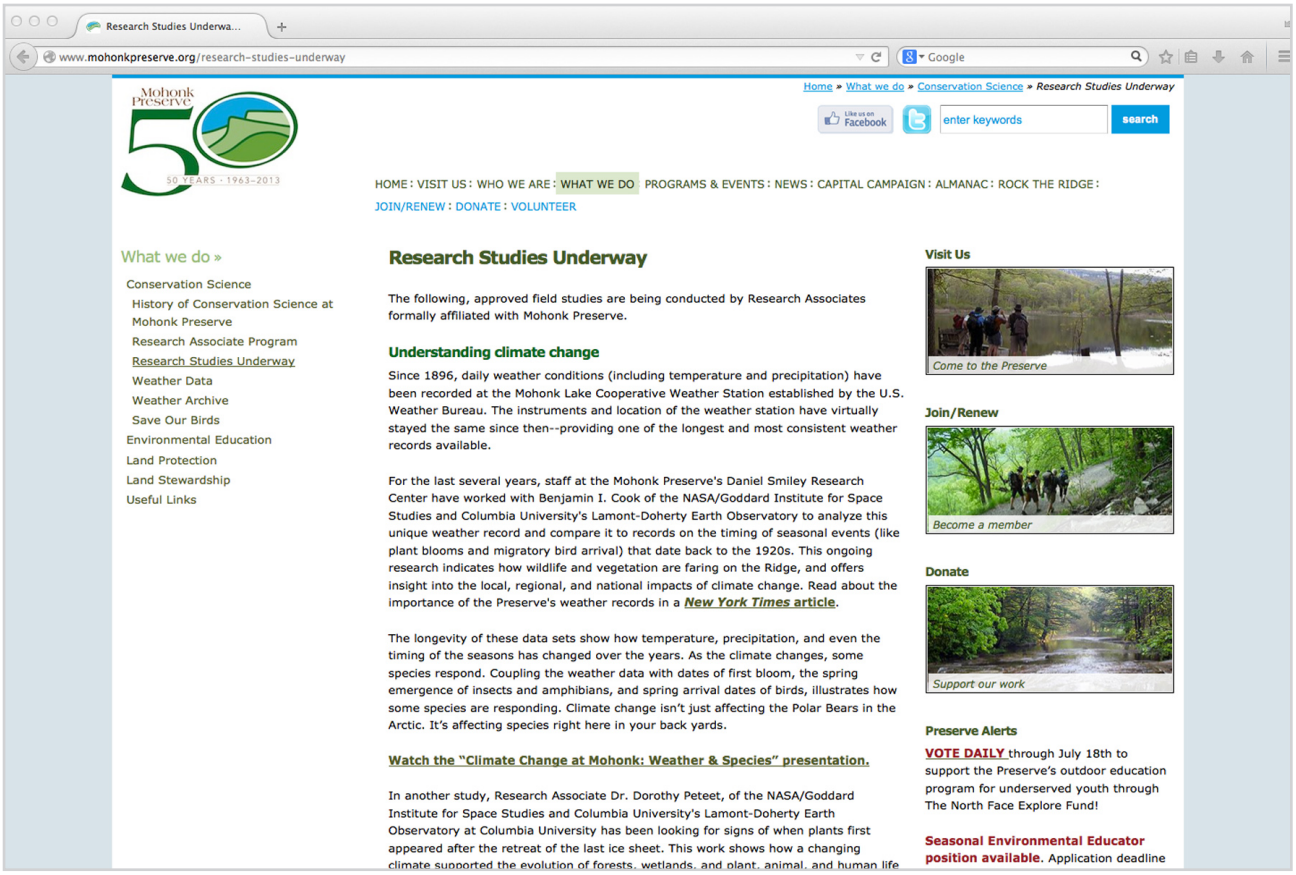
- Discuss the importance of long-term data sets.
- Analyze temperature and precipitation data.
- Compare recent data to long-term averages.
- Relate observed changes in weather and climate patterns to phenological changes.

Materials Required

- Presentation: "Climate Change at Mohonk: Weather & Species 1896-2012" (see advanced preparation). This lesson plan recommends starting and stopping points if you do not wish to show students the entire presentation at once.
- Computers or tablets with Internet access for pairs of students.
- Graph paper.

Advanced Preparation

- Download the presentation above from www.mohonkpreserve.org/research-studies-underway
- If possible, bookmark the site: www.mohonkpreserve.org/weatherarchive, from which students will get data in the Explore section.
- Photocopy the student worksheet.



The website is shown above.

Engage

- Discuss with students:
- How do we know what weather and climate were like 100 years ago?

Explain that there is a place in the Hudson Valley where the same measurements have been taken daily for well over 100 years. Show students the first 4 minutes and 35 seconds (or a little more) of the presentation (see Materials Required).

The presentation will give students some background on the area in which the data have been collected.

Explore

Explain to students that they are going to analyze some of the data that have been collected at Mohonk. The data used to be kept in log books but more recently is available digitally.

Divide students into pairs or groups of three. Each group should be assigned a different month. The groups will be using the weather archive (www.mohonkpreserve.org/weather-archive) to look at changes in their month over the amount of time captured on the page (<10 years). They will compare the observed data to the long-term averages and note any special data mentioned in the data sheet.

Bring up an example, e.g., January 2014 and model with students how to identify the month's actual data and to transfer the data from the data sheets to their student worksheets. You may want to show them how to do this with a document camera or on your SmartBoard.

Also model to students how to create their graph. Their years should go on the x-axis (independent variable) and temperature and precipitation on the y-axis (dependent variable). They will probably need a reminder about how to create an appropriate scale. Also note that they will graph the average readings as a straight line across the graph, which may cause some confusion.

If students are advanced, have them graph all three variables on the same graph. Most middle schoolers will probably need to graph temperature, rainfall, and snowfall on separate graphs.

Explain

Once all student groups have graphed their data, line up the data in the order of months across a long wall in your classroom. If your students did three different graphs, be sure that they align the rows so that precipitation graphs are lined up next to one another and so on.

While the graphs will not perfectly align because students have selected their own scales, students should be able to see the trend in how the data compare with the long-term averages, no matter the month. Discuss these findings as a class.

Also ask students to share any "interesting notes" they recorded.

Begin the recording again at 6:31. Stop the recording several times to discuss the findings and compare them to students' findings using discussion questions such as the ones below:

Discuss

- Why do your graphs look different from the ones in the presentation?
- What can you learn from some of the different sets of data, e.g., top 10 warmest years?

At 7:53, the narrator begins explaining the idea of lake ice cover. She notes that ice duration, the number of days that Mohonk Lake is completely frozen over, is now 27 days shorter than it was in the 1930s. Stop the presentation at 8:55.

Discuss how lake ice can affect living things, and also why lake ice is important. How does this data set relate to the temperature data?

Continue the presentation. The narrator begins to discuss precipitation data. Ask students to relate their data to the data she presents. Stop at 10:18.

Elaborate

Have students discuss the following with a partner:

- How do you think living things are affected by the changes in temperature that have been observed?
- Consider:
  - Plants
  - Birds
  - Frogs and other ampibians
  - Insects

Direct pairs of students to then share their ideas with the class.

- Begin the presentation again at 11:05, when the narrator begins discussing phenological data. Stop at 14:12.

The narrator discusses many examples of early emergence or arrival of plant, amphibian, insect, and bird species.

Discuss with students

- What do you take away from this clip? Why is this information important?
- Do you think this is evidence that the plants and animals are adapting to changes in climate? Why or why not?
- How do you think living things are affected in summer and fall?

Have students write a prediction about how they think bird species are responding to climate changes during the fall season.

Begin the presentation again at 17:43, when the narrator begins discussing the growing season, and play to the end (~23 minutes). She then discusses changes in peak fall foliage and changes in migration of species. Have students take notes that relate to their hypotheses. Pause the video occasionally to facilitate student note taking.

Discuss

- Were your hypotheses supported? What evidence to you have?

Evaluate

Wrap up the lesson with a discussion of why long-term data sets are so important. Ask students to think about what we would know if we only had the data sets they graphed versus what we know based on the long-term data. Why is this important? How can this knowledge be used?

Observing Changes at Mohonk Preserve Student Worksheet

Explore

You will be analyzing the temperature and precipitation data for one month over the course of several years. Mohonk scientists have done this for over 100 years! Repeat the following directions for your assigned month for each year.

Directions

1. Go to www.mohonkpreserve.org/weather-archive
2. Choose the most recent year for which there are data for your month.
3. See the column that says "Actual This Year," which is the middle column. Record the temperature, precipitation (rain) and snow, in the data table below.
4. Also record any interesting notes in the last column.

Month Assigned:_____

Year	*Temperature (°F)*	*Precipitation (rain) (inches)*	*Precipitation (snow) (inches)*	*Interesting notes*

Next, record the average since 1896 (1st column):

Long Term Average (Years)	*Temperature (°F)*	*Precipitation (rain) (inches)*	*Precipitation (snow) (inches)*

5. The next step is to create your graphs.
   a. First, graph your temperatures.
      i. Evenly space out the years observed on your x-axis, and
      ii. Determine the best scale for your y-axis based on the range of temperatures you recorded
      iii. Plot your observed temperatures on your y-axis. Then, graph your long term average as a straight line across your graph.
   b. Next, graph your rainfall data. Follow the same procedure.
   c. Finally, graph your snowfall data.

6. Use your data tables and graphs to answer the questions below:
   a. How do the temperature readings you recorded compare to the long-term averages?

   b. How do the precipitation readings you recorded (rain and snow) compare to the long-term averages?

   c. In your own words, explain what these observations mean.

   d. How do your "interesting notes" support your explanation?

Elaborate

Scientific Question: How are bird species responding to changes in the fall season at Mohonk Preserve?

Hypothesis:

Hudson River Estuary Climate Change Lesson Project

www.nyseagrant.org
http://www.dec.ny.gov/lands/

Hudson River Estuary
Sea Grant New York
New York State Water Resources Institute
Cornell University