Lesson 3

Climate Change in My City

Climate Change in My City

NYS Intermediate Level Science

Standard 1: Analysis, Inquiry and Design/Scientific Inquiry

S1.3   Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

S1.4   Seek to clarify, to assess critically, and to reconcile with their own thinking the ideas presented by others, including peers, teachers, authors, and scientists.

S2.3c   Collect quantitative and qualitative data.

S3.1a   Organize results, using appropriate graphs, charts, and data tables.

S3.2c   Evaluate the original hypothesis in light of the data.

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 Living Environment

7.2d   Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources.

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:

2. Developing and using models
4. Analyzing and interpreting data
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

ESS3-2.   Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

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).

CCSS.ELA-Literacy.RST.6-8.8

Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

CCSS.ELA-Literacy.RST.6-8.9

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.WHST.6-8.1a

Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

CCSS.ELA-Literacy.WHST.6-8.1b

Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

CCSS.ELA-Literacy.WHST.6-8.2b

Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.

CCSS.ELA-Literacy.WHST.6-8.2d

Use precise language and domain-specific vocabulary to inform about or explain the topic.

CCSS.ELA-Literacy.WHST.6-8.8

Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

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.

Climate Change in My City

Adapted from the World Wildlife Foundation Lesson on the WWF blogs
http://www.wwfblogs.org/climate/sites/default/files/WWFBinaryitem5966.pdf

Introduction
In this lesson, students will analyze short and long-term data and look for patterns and trends.

Background Information
Weather concerns the present and near-term future state of the atmosphere, whereas climate accounts for all past weather events as well as the future (in the form of climate model projections).

Scientists evaluate global warming by looking at trends in the global temperature, which is the average of the highs and lows measured at thousands of locations around the Earth. Observations collected over the last century suggest the average land-surface temperature has risen 0.45-0.6°C (0.8-1.0°F). The surface of the ocean has also warmed at a similar rate. Studies that combine land and sea measurements have generally estimated that global temperatures have warmed 0.3-0.6°C (0.5-1.0°F) in the last century.

Regional and local temperature trends will be different from the global average—over the last century some areas have warmed while others have cooled.

Objectives
Students will be able to
- Analyze temperature and precipitation data.
- Compare recent temperature and precipitation data with long-term averages.
- Describe how local temperatures have changed in the last ~75 years.
- Explain the importance of comparing short-term data with long-term averages.

Materials Required
- Smartboard or computer and projector
- Laptops or tablets for pairs of students to work on (alternatively, you can do the activities as a whole class)

Advanced Preparation
- Photocopy student worksheets
- If possible, bookmark the following website on computers or tablets on which students will be working:
  - http://www.ncdc.noaa.gov/sotc/national

Engage

As a "Do Now," ask students to think about the weather in their area over the last year. Ask them what stands out in their minds, e.g., warm winter, rainy spring, heavy snowfall, more snow days than usual, etc.
Then ask them to make a judgment, based on their own observations, as to whether the previous season was warmer or colder than normal, and whether it was drier or wetter than normal. Ask them to consider what factors influence their responses, e.g., how much time they spend outside, how much their lifestyles depend on the weather, etc.
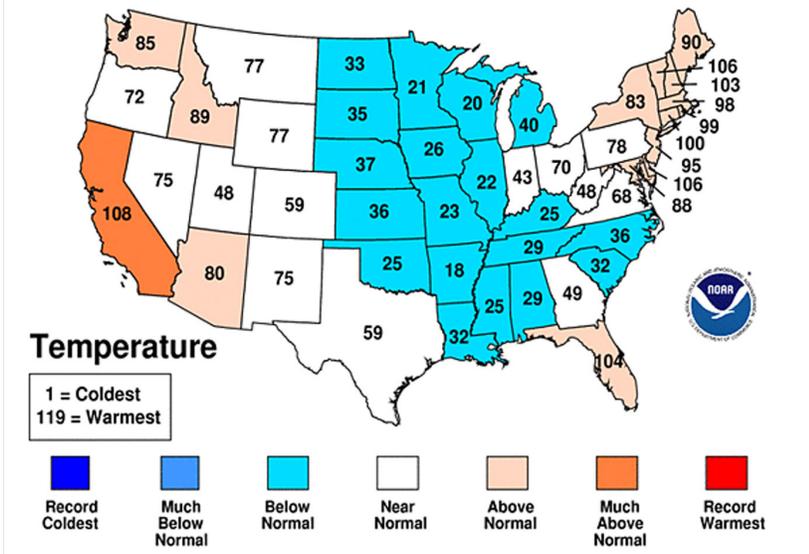
Have each student make a prediction about whether the previous year's temperature and precipitation were normal, above, or below normal (see student worksheet), for both New York and the nation. Tell them that they will be analyzing data to test their hypotheses.

Explore

- Show students the page: NOAA National Climatic Data Center: www.ncdc.noaa.gov/sotc/national
- Discuss the national overview for the previous year, which indicates noteworthy climate events on an annual basis.
- Next, scroll to select Temp, Precip, and Drought from the menu. Open that page, scroll down and select National Temperature and Precipitation Maps. Under Products, select Statewide Average Temperature Ranks. Discuss the color scale so that students understand how to read it. A year's data are compared to either the 20th century average or 119 year average. For the purposes of this lesson, you can refer to it as a 100 year average. Be sure students understand what is meant by this term.
- Also discuss the ranking system. The ranks indicate years from coldest to warmest, with low numbers indicating much colder than normal years, and highest numbers indicating much warmer than normal years. For instance, in the image below from 2013, Minnesota experienced its 21st coldest year on record, whereas California experienced its 12th warmest year on record.

- Have students work in pairs to further analyze the maps as directed on the student worksheets.

Explain
- As a class, discuss students' findings and whether their predictions were supported by the data or not. Ask:
  - Why might your predictions be different from what the data show?
  - Why is analyzing data important?
  - Why is looking at precipitation, in addition to temperature, important?
- Bring up the temperature and precipitation maps that students analyzed and discuss any patterns you can observe in the maps.
- Why are the rankings important? Why do scientists look at long-term averages?

Elaborate
- Explain to students that the NASA Goddard Institute for Space Studies, located in Manhattan, maintains a database of temperatures in many cities throughout the United States. Bring up the stations website http://data.giss.nasa.gov/csci/stations/ and click on New York. Then click on your city, or one close to you.
- Discuss:
  - What are some observations you can make based on this graph?
  - What is the overall trend—are temperatures increasing or decreasing?
  - Why does it go up and down? Why are there blank spaces in the graph?
- Next show students the following page: http://data.giss.nasa.gov/csci/bargraphs/, which shows continental United States and global temperatures as compared to the mean for the past ~180 years.
- Use questioning to be sure students understand that this image is very similar to the maps they analyzed earlier.
  - What does it mean when bars are above zero? Below?
  - What are some observations you can make based on this graph?
  - What is the overall trend—are temperatures increasing or decreasing?
  - Why are these data important?
  - How do our local data (on the previous graph) compare to these data?
  - How do last year's data (on the maps they analyzed) compare to these long term data?
  - Why might they be different? (Remind students that they are comparing different types of data, but they can look at the overall trends).

Evaluate
Using weather.com or another weather site, show students the past month's high and low temperatures for your city. (Put in your zip code, then click on "Monthly." You can also click to the previous month.)

Discuss, or ask students to respond in writing to, the following questions:
- How do these data compare to the data we have been looking at in this lesson? Are they above average, below average, or near normal?
- Why are both short-term and long-term data important?

Student Worksheet **Climate Change in My City**

Engage

Think about the last calendar year. Think about what you remember about the weather, both near home and in the news from other locations. Then, make a prediction about how the temperature and precipitation of last year compares with long-term averages. Circle your prediction:

· In New York State, temperature was warmer than/the same as/cooler than normal last year.
· In New York State, precipitation was more than/the same as/less than normal last year
· In the continental United States, temperature was warmer than/the same as/cooler than normal last year.

Explore

1. Go to: http://www.ncdc.noaa.gov/sotc/national

2. Scroll to select Temp, Precip, and Drought from the menu. Open that page, scroll down and select National Temperature and Precipitation Maps. Under Products, select Statewide Average Temperature Ranks.
3. What year's data are you analyzing? _____
4. To view and analyze the January-December Average Ranks for Temperature Map, select December as the month and 12 months in the Time span drop down menu.
   a. Was the yearly average for New York warmer or colder than normal, or near normal?

   b. How does this finding compare with your prediction?

c.   In the data table below, write the number of states that fall into the following temperature categories for the year you are analyzing:

Temperature Category	Number of States
Record Temperature	
Much Above Normal	
Above Normal	
Near Normal	
Below Normal	
Much Below Normal	
Record Coldest	

d.   For the year you analyzed, was the continental United States warmer or colder than the 100 year average? Use data from the table to support your answer.

e.   How does this finding compare with your prediction?

5.   Next, analyze the January-December Statewide Ranks for Precipitation Map.
a.   Was the yearly average for New York drier or wetter than normal, or near normal?

b.   How does this finding compare with your prediction?

c. In the data table below, write the number of states that fall into the following precipitation categories for the year you are analyzing:

Precipitation Category	Number of States
Record Wettest	
Much Above Normal	
Above Normal	
Near Normal	
Below Normal	
Much Below Normal	
Record Driest	

d. For the year you analyzed, was the continental United States drier or wetter than the 100 year average? Use data from the table to support your answer.

e. How does this finding compare with your prediction?

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