

Temperature – Weather vs. Climate

MATERIALS

For the leader:

Projector

Whiteboard to project data graph onto

Thermometer

Graphing butcher paper or board for them to record data on

For the activity:

Copy each of the three graphs to give to each student

Pencils

Paper for each student

OVERVIEW

Scientists use a range of evidence to look at changes in weather and climate patterns over time. One of the main measurements used is temperature. In this activity students will collect their own temperature data from their schoolyards over a month. They will also look at surface temperatures from land stations near where they live to look at the changes in temperatures over time. The activity places a strong emphasis on teaching students how to plot data and read graphs. The students first need to gather the data, then plot it, and then interpret the data for conclusions. Through a series of activities that help students look at temperature data across different time scales students are lead in their exploration and investigation of the temperature data and what conclusions we can make from the data. Through gaining these data interpretation skills, students will also gain a better understanding of how scientists look at evidence when asking questions about changes in the Earth's weather and climate over time and observe an increase in annual surface temperature over the past century in central New Jersey.

Motivating Questions: [How do scientists study changes in temperature over time?](#) [What does that information tell us about the weather and climate?](#)

TAKE HOME MESSAGE

Scientists look at temperature data across a range of time scales to look for patterns in the weather and climate and to make predictions of what will happen in the future.

Engage: Lead the students in a discussion about what they know about the relationship between temperature, weather, and climate.	10 minutes
Explore: Students investigate data on the outside temperature in their school and surface temperature for New Jersey over the past century.	25 minutes
Make Sense: Students share their observations, ask questions, and discuss what they can learn from the temperature graphs.	10 minutes
Total:	45 minutes

AUDIENCE

Elementary and middle school students (K-8th grade).

NEW JERSEY CORE CURRICULUM CONTENT STANDARDS - SCIENCE

Grade	Content Statement	CPI#
2	Current weather conditions include air movement, clouds, and precipitation. Weather conditions affect our daily lives.	5.4.2.F.1
4	Weather changes that occur from day to day and across the seasons can be measured and documented using basic instruments such as a thermometer, wind vane, anemometer, and	5.4.4.F.1

	rain gauge.	
4	Tools and technology are used to gather, analyze, and communicate results.	5.1.4.B.2
4	Evidence is used to construct and defend arguments.	5.1.4.B.3
4	Reasoning is used to support scientific conclusions.	5.1.4.B.4
4	In order to determine which arguments and explanations are most persuasive, communities of learners work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories (e.g., scientific argumentation and representation).	5.1.4.D.2
6	Weather is the result of short-term variations in temperature, humidity, and air pressure.	5.4.6.F.1
6	Climate is the result of long-term patterns of temperature and precipitation.	5.4.6.F.2
8	Mathematics and technology are used to gather, analyze, and communicate results.	5.1.8.B.2
8	Carefully collected evidence is used to construct and defend arguments.	5.1.8.B.3
8	Scientific reasoning is used to support scientific conclusions.	5.1.8.B.4
8	Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	5.1.8.D.1

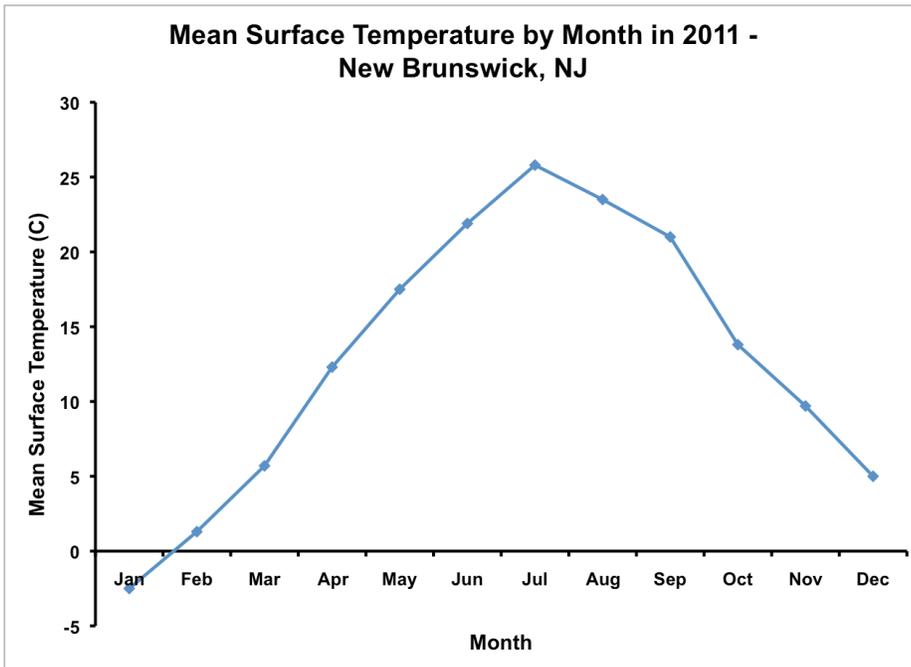
PREPARATION (20 MINUTES + ONE MONTH OF TEMPERATURE COLLECTION)

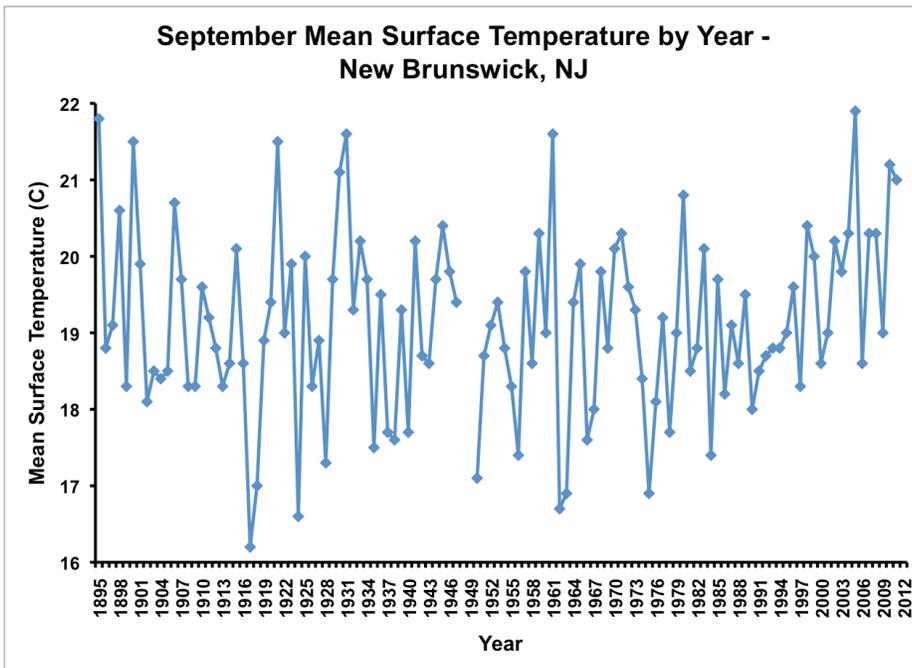
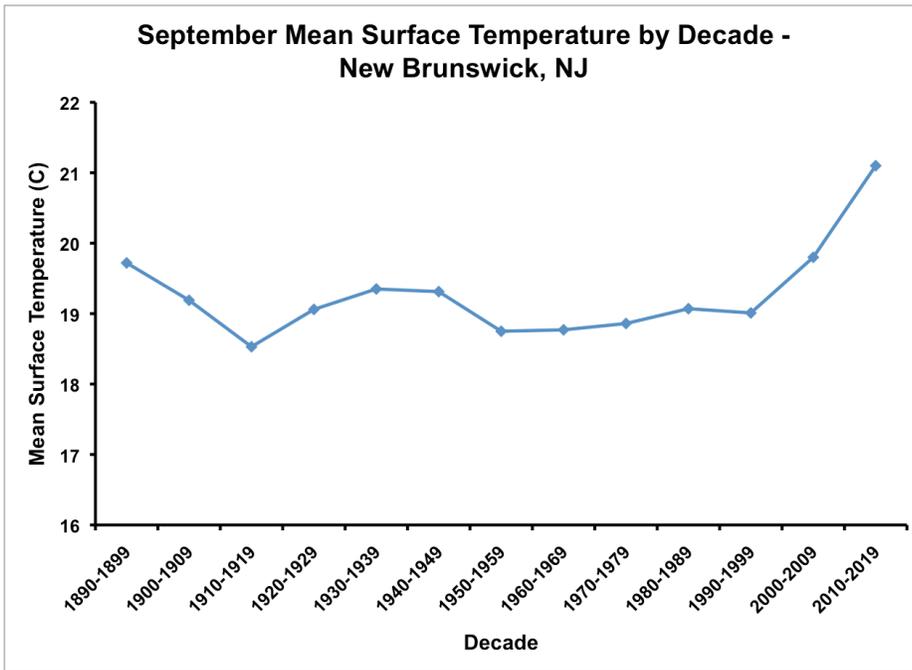
1. Place an outside thermometer in your schoolyard and have the students help you record the daily temperature (at the same time each day) for a month. Have the students enter the date and temperature onto a classroom data table.
2. Make a graph for the students to complete with the daily temperature data (they can add to the graph as they collect data or do it in the class period prior to running this activity).
3. Write the motivating questions on the board:

How do scientists study changes in temperature over time? What does that information tell us about the weather and climate?

4. Make class copies of student worksheets for each student (at the end of this write-up).
5. Determine which data station you are going to use for the activity (the activity is written for the New Brunswick 3 Se station). If you are using the New Brunswick 3 Se station data, you can use the NewBrunswickSurfaceTemperatureData.xls file. If not, then visit NASA Goddard Institute for Space Studies GISS Surface Temperature Analysis website at: http://data.giss.nasa.gov/gistemp/station_data/.
 - a. Under the "Download Station Data" section for "1) Select a specific data set from the pull-down menu below," choose "after GISS homogeneity adjustment."
 - b. For the "2) Click at desired location on the map below or enter here a station name to search for:" either click in the map where you would like to pull a dataset from OR type in the station name (e.g., New Brunswick 3 Se) into the box.
 - c. Click on the desired station name to access the data plot and downloadable data.
 - d. Under the "Downloads" section, click on the "plot in Postscript form" to download a copy of the data plot to your computer. This will download as a .ps file that you can open in Preview or other image viewing software programs.
 - e. Under the "Downloads" section, click on the "monthly data as text" to download the raw data. This will open as an html page.
 - i. Place your cursor on the page and go to Edit → Select All and then Edit → Copy; you can then Edit → Paste the data into a new Excel spreadsheet.

- ii. The data will paste all in the same column, so to separate it out across multiple columns go to Data → Text to Columns. This will open a “Convert Text to Columns Wizard” window, select Delimited and Next. On the next page in the Delimiters section, select Space (you should be able to see the columns separated accurately in the Data Preview section at the bottom of the window) and Next. On the next page select Finish.
 - iii. Save the excel file as you would like. When looking at the data the columns represent the year of record, months (January through December), seasons (Winter: D-J-F; Spring: M-A-M; Summer: J-J-A; and Fall: S-O-N), and the annual mean (metANN) for the dataset. Make any desired adjustments to the data table to make it easier for your students to complete the activity.
6. Make or project the graphs of the different data you will use with the students on the board, but make sure it is hidden from the students.





ENGAGE (10 MINUTES)

1. Lead the students in a discussion about the temperature plot they have created about the outside temperature in their schoolyard.

Q. What patterns do they see?

Q. Would the data or the patterns be the same if you repeated the investigation in a different month? In the same month but in a different year?

2. As the students think through their data, begin to ask the students questions about the relationship between temperature, weather, and climate.

- Q. What is the relationship between temperature and weather? What questions are scientists trying to answer when they collect information from temperatures?**
- Q. What is the difference between weather and climate?**
- Q. Why do scientists study the weather and climate?**
- Q. Why would scientists be interested in understanding the change in temperatures over time in different regions and throughout the world?**
3. After a few minutes and depending on what the students already know, share some information with them that you feel they need to know to understand the activity of the day.

EXPLORE (25 MINUTES)

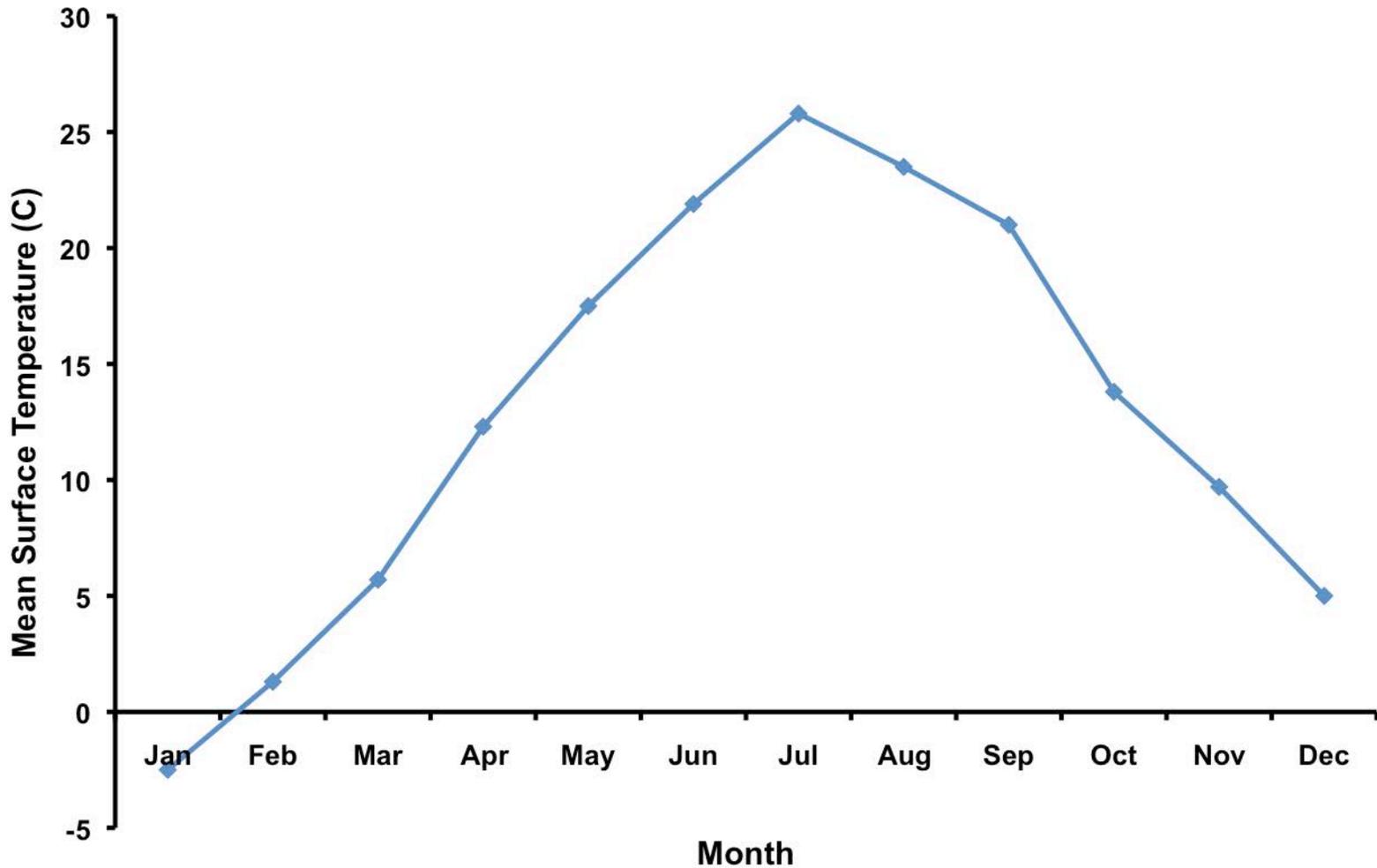
1. Explain to the students that they will be taking a closer look at surface temperatures in New Jersey over the past century to look for patterns in the dataset.
2. Seasonal changes in temperature:
 - a. Hand out copies of the “Mean Surface Temperature by Month in 2011 – New Brunswick, NJ” graph to the students. Explain to the students that using a thermometer at a weather station in New Brunswick, NJ scientists were able to collect daily temperature data just like they did and then calculate an average temperature for each month in 2011.
 - b. Have the students look at the graph and determine what patterns they see. The students should think through this graph together in small groups.
 - c. After a few minutes have the students report out what they observe in the graph (e.g., seasonal changes in the temperatures). Make sure the students support their statements about patterns in the data with what evidence they are using to make their conclusions.
 - d. Ask the students if they are looking at data that tells them about the weather or climate (weather). Be accepting of all responses.
3. Decadal changes in temperature within a month:
 - a. Hand out copies of the “September Mean Surface Temperature by Decade – New Brunswick, NJ” graph to the students. Explain to the students that they are now looking at the average temperature for September by decade for over the past 100 years.
 - b. Have the students look at the graph and determine what patterns they see. The students should think through this graph with a partner. After a few minutes have the students report out what they observe in the graph (e.g., temperatures in September are not the same each decade and over the past 100+ years the average September temperature has increased).
 - c. Ask the students to compare this graph with their temperature graph of schoolyard temperatures. Are there similarities or differences between the graphs?
 - d. Ask the students if they are looking at data that tells them about the weather or climate (weather). Be accepting of all responses.

4. Annual changes in temperature within a month throughout the century:
 - a. Hand out copies of the “September Mean Surface Temperature by Year – New Brunswick, NJ” graph to the students. Explain to the students that they are now looking at the average temperature for September for each year for over the past 100 years.
 - b. Have the students look at the graph and determine what patterns they see. The students should think through this graph by themselves. After a few minutes have the students report out what they observe in the graph (e.g., temperatures in September are not the same each year, there is more variation in the data by year than by decade, and over the past 100+ years the average September temperature has increased).
 - c. Ask the students to compare this graph with their temperature graph of schoolyard temperatures. Are there similarities or differences between the graphs?
 - d. Ask the students if they are looking at data that tells them about the weather or climate (climate). Be accepting of all responses.
5. As the conversation dies down, ask the to write a written response to:
 - Q. What did you learn about temperature by looking at these four graphs of temperature?**
 - Q. What were the patterns you observed in the different temperature graphs?**

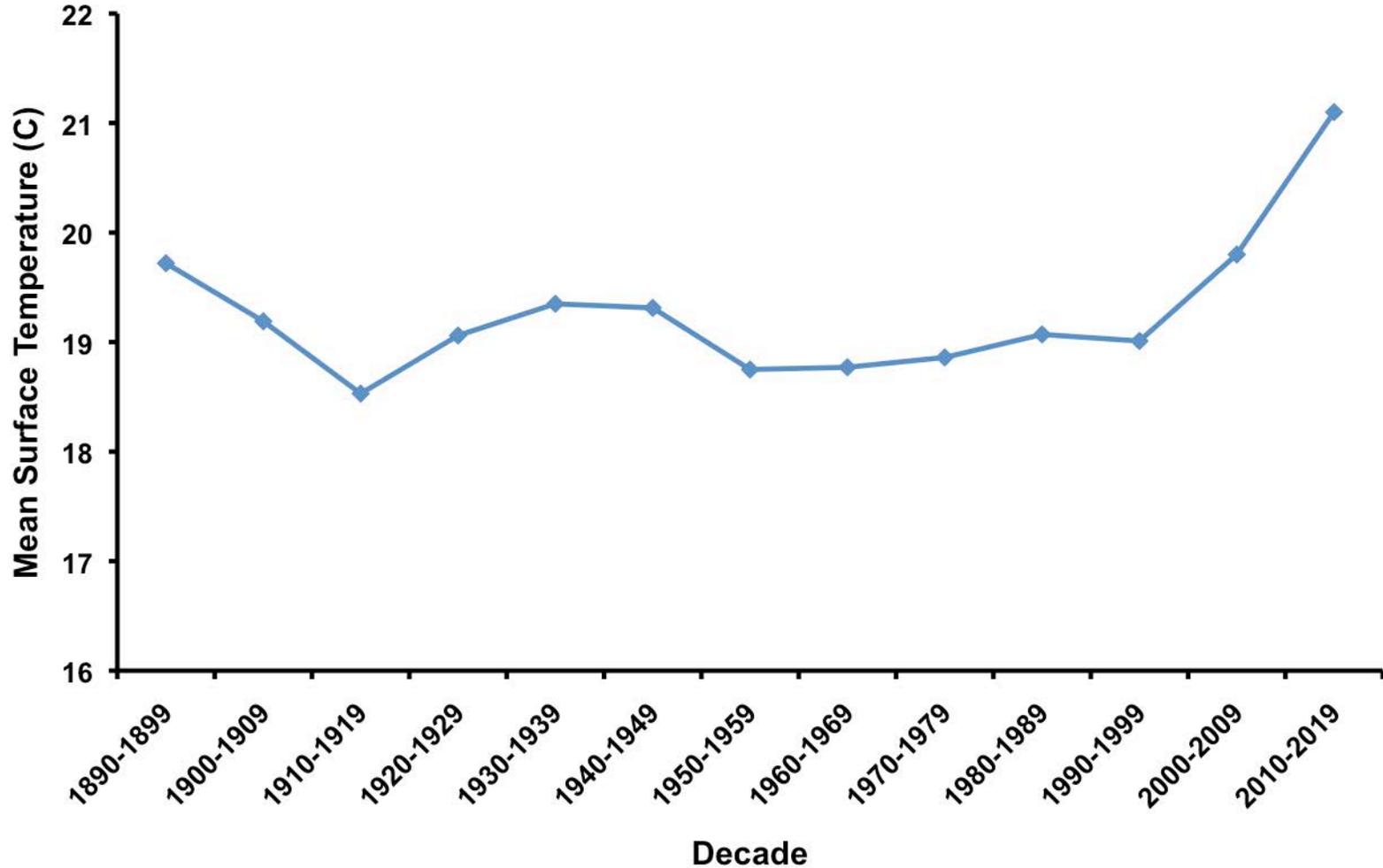
MAKE SENSE (10 MINUTES)

1. After a few minutes of writing their responses, tell the students that we are going to discuss their answers and the four different temperature graphs as a class.
2. Have the students report out what patterns they observed in the temperature data across the four graphs. Make sure to have the students support their statements of the patterns by stating what evidence they are using.
 - a. Help the students see that the pattern in mean surface temperature is variable over time, but that overall the surface temperature has increased over the course of the century.
 - b. Ask the students what conclusions they can make about the differences between weather and climate.
3. Once the discussion slows down, point to the motivating questions and ask:
 - Q. How do scientists study changes in temperature over time? What does that information tell us about the weather and climate?**
4. Ask students to share their ideas about the motivating questions with a partner. After a minute, ask volunteers to share the ideas they discussed with the entire class. Be accepting of all responses from the students. This is your opportunity to make sure the students understand the “take home message” that you identified.
5. Ask if the students have any final questions about the activity or the graphing.

Mean Surface Temperature by Month in 2011 - New Brunswick, NJ



September Mean Surface Temperature by Decade - New Brunswick, NJ



September Mean Surface Temperature by Year - New Brunswick, NJ

