

Name:

Date:

### Weather to Climate Investigation: Maximum Temperature

*\*\*These are example answers using the Durham, NH dataset. Answers from students using Boise and Little Rock datasets will differ.*

#### Guiding Questions:

- What are the historical and current weather patterns or events for a location in the United States?
- What are the long-term weather (i.e. climate) patterns for this location?

#### Definitions:

- **Weather** is the mix of events (precipitation, humidity, temperature, etc.) that happen over a short period of time (minutes to months) in a specific location.
- **Climate** is the long-term pattern of weather in a particular area. This is often measured as the average weather over a period of time.
- **Maximum Temperature** is the highest temperature recorded on a particular day.

#### Conduct the Investigation:

- 1) Open the Excel Spreadsheet on your computer.
- 2) In the table below, record your location name, latitude, and longitude from the INTRODUCTION tab on the spreadsheet.

Location	Latitude	Longitude
<i>Durham, NH</i>	<i>43.13</i>	<i>-70.93</i>

- 3) Click on the **DAILY** tab at the bottom of the spreadsheet. The columns contain data for the Date, Maximum Temperature, Minimum Temperature, Snow Water Equivalent, and Precipitation (*\*Use the INTRO tab to understand what these variables mean*). Begin by making a graph of one year of temperature data:
  - a. Highlight one year of the DATE column, A1 to A366, by clicking on A1 and dragging the mouse down.
  - b. While holding down the Ctrl (PC) or command (Mac) button, highlight one year of the TMAX column, B1 to B366.
  - c. Click on the CHARTS tab at the top of the spreadsheet, and click the X Y (Scatter) button.
  - d. Choose a chart that connects the points with lines. The chart will now appear on the spreadsheet.
  - e. In the Formatting Palette, under Chart Options, add in an appropriate Chart Title.
  - f. Click on the dropdown menu to change 'Chart Title' to 'Horizontal Axis' and add an appropriate title for the x-axis.
  - g. Repeat the same steps for the y-axis.



- 4) In your location, in 1980, which month had the highest maximum daily temperature? How hot was it? Make an estimate of the highest temperature in 1980.

*July had the hottest temperature in 1980. I would estimate that the temperature got up to 34°C.*

- 5) Which month had the lowest maximum daily temperature? How cold was it? Make an estimate of the lowest temperature in 1980.

*December had the coldest temperature in 1980. I would estimate that the lowest temperature was -8°C.*

- 6) How would you describe the overall temperature pattern for 1980?

*The overall pattern is a curve that increases and then decreases. The temperature starts around 4°C in January, dips a little in February, rises steadily to the highest point in July, and then falls to the lowest point in December.*

- 7) Make a prediction: do you think the overall temperature pattern is similar or different from year to year? (i.e. will the temperature in 1981 look the same as the temperature in 1980?).

*I think that each year, the temperature will follow the same pattern, but the temperature values for the highest point and lowest point might be different.*

- 8) Find out by making a graph of 3 years of temperature data, following the same steps as above, but highlighting more data.
- Highlight three years of the DATE column, A1 to A1096, by clicking on A1 and dragging the mouse down.
  - While holding down the Ctrl (PC) or command (Mac) button, highlight three years of the TMAX column, B1 to B1096.
  - Click on the CHARTS tab at the top of the spreadsheet, and click the X Y (Scatter) button.
  - Choose a chart that connects the points with lines. The chart will now appear on the spreadsheet.
  - In the Formatting Palette, under Chart Options, add in an appropriate Chart Title.

- f. Click on the dropdown menu to change 'Chart Title' to 'Horizontal Axis' and add an appropriate title for the x-axis.
- g. Repeat the same steps for the y-axis.

9) Do the data support your prediction? Explain using data from the graph.

*The data did support my prediction. Each year the temperature follows the same curve. However, the highs and lows each year are different. The highs are all fairly similar, around 34°C. But the lows in 1981 and 1982 are around -14°C, whereas in 1980 it was -8°C.*

- 10) Will these weather patterns remain the same over time? One way to find out is to display the yearly averages (the daily weather data averaged over each year), which illustrates how the climate in an area may be changing over time. By averaging the daily weather data, an entire year's worth of daily weather data is summarized with a single number. Click on the **YEARLY\_AVERAGES** tab at the bottom of the spreadsheet.
- 11) To make it easier to see the trend, make a graph of average yearly temperature from 1980 to 2013, following the same steps as before, but highlighting the **entire DATE** and **AVE\_TMAX** columns.
- 12) What is the range of yearly average temperature from 1980 to 2013?

*The average temperature ranges from about 14°C to 16°C.*

- 13) Add a trend line to the graph to see the overall pattern.
  - a. Right click on the data points of the graph.
  - b. Choose 'Add Trendline..' (A **trendline** is a line showing the general direction of the data).
  - c. Under options, click 'Display equation on chart' and 'Display R-squared value on chart.' (The **R-squared** value describes the goodness of fit of the line to the individual data points).
  - d. Click Okay.

- 14) Using the trendline to help you, do you observe a trend in temperature over time? Is the temperature increasing, decreasing or remaining the same? Support your response with specific evidence displayed in the graph.

*The temperature is relatively stable. I can tell because the slope of the line is close to zero, with a value of 0.001 ( $R^2 = 0$ ).*

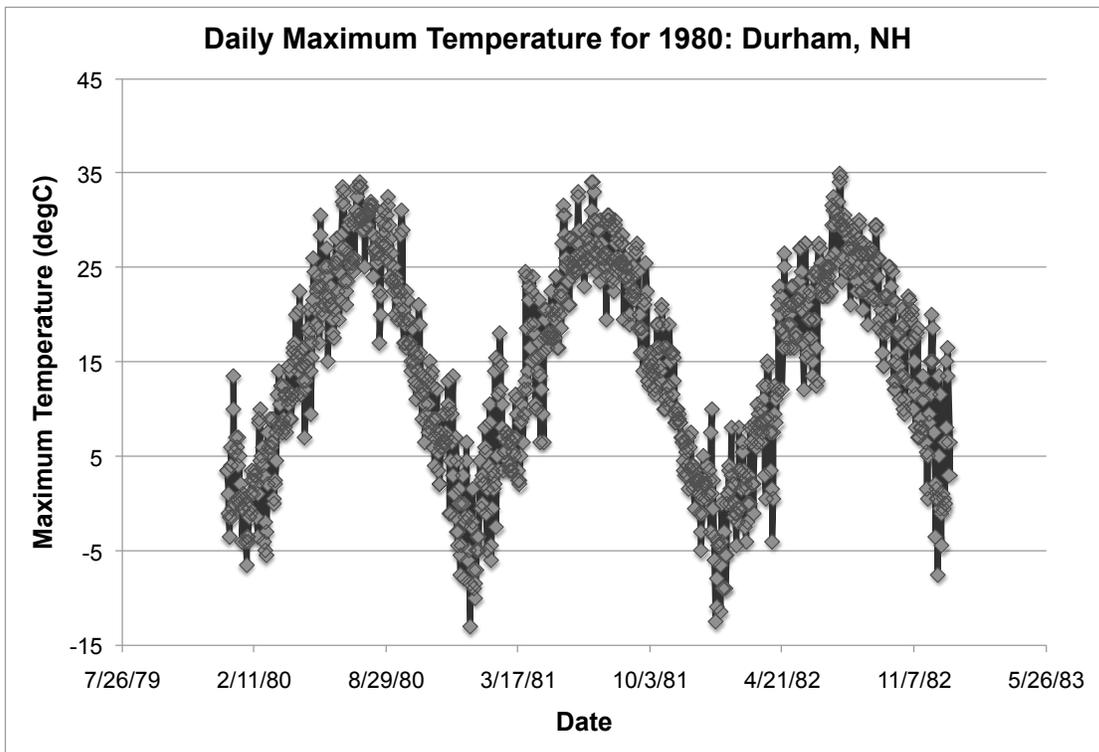
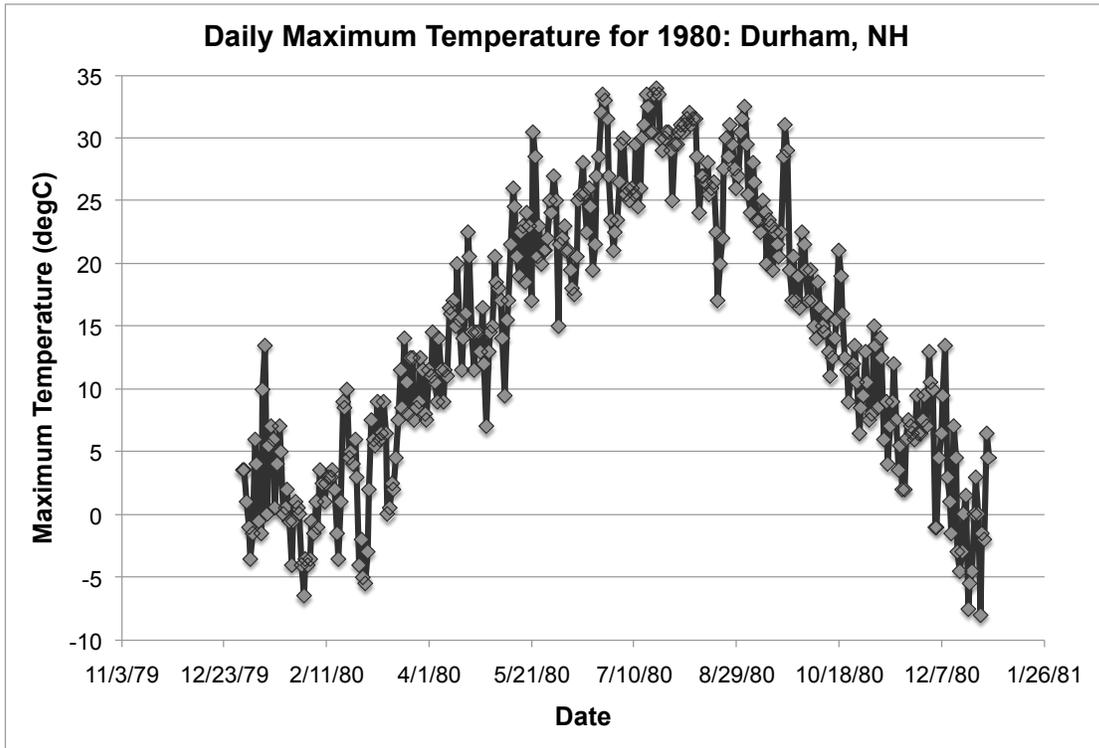
- 15) Make a prediction: Do you expect this trend to continue over time? How might the climate change in this area in 100 years? Provide some evidence that supports your prediction.

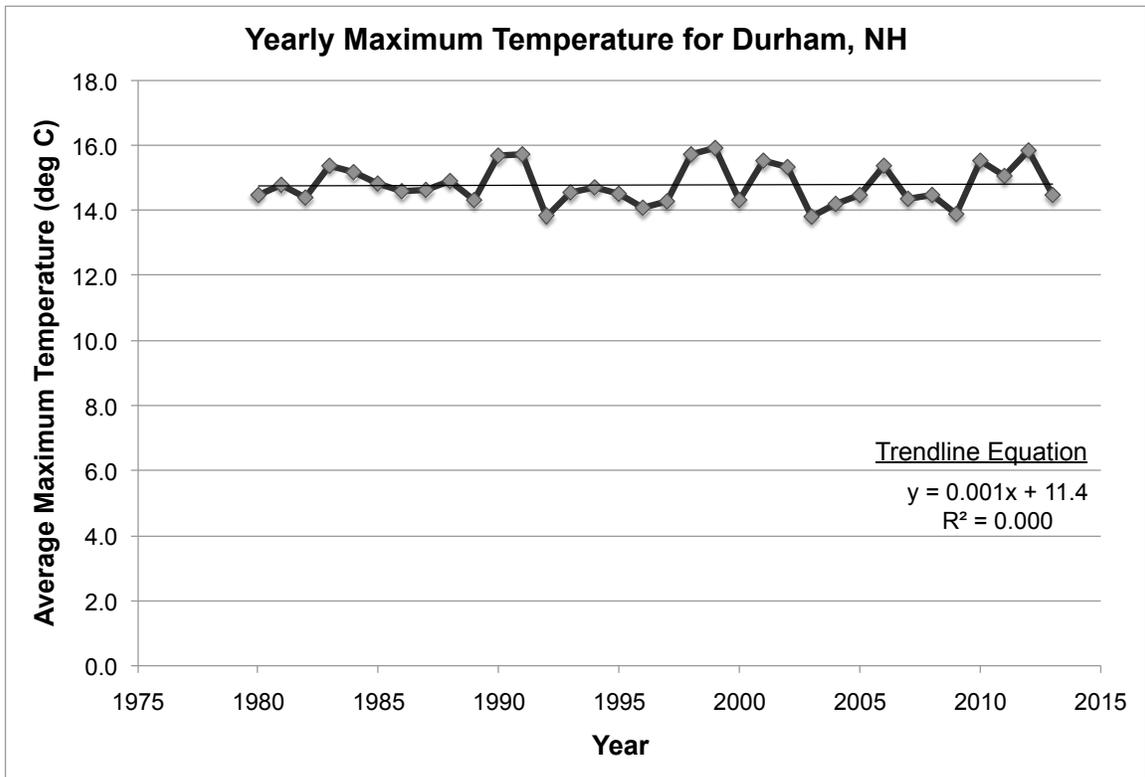
*I think that the trend will change over time and the slope will increase. I expect that the temperature will begin increasing more because of increasing greenhouse gas levels in the atmosphere.*

- 16) Ask a question: What questions do you have about weather and/or climate following an initial exploration of one site?

*Will the temperature increase more in the future with climate change?*

Examples of the three graphs students will produce:





*(As an extension, have students look at Minimum Temperature changes, a much more dramatic trend).*

