Section 4

Data Representation and Change

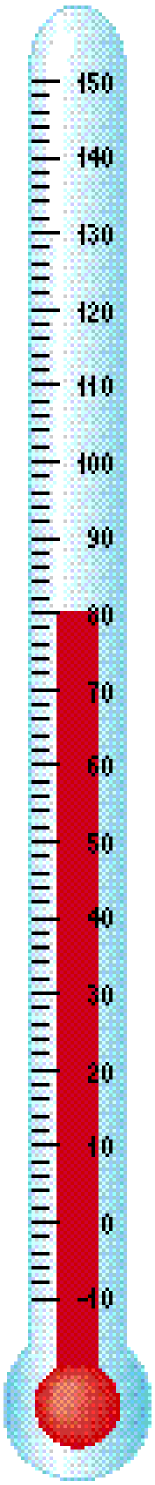
The big idea in this section centers on how to represent and analyze changes in temperature over time.

In the first activity, students make a graph of local high and low temperatures. They identify other locations in the United States where the temperatures are most similar to and most different from their own. By hand, students construct line graphs to compare patterns of highs and lows across three geographic locations.

Next, students analyze temperature data collected by the StowAway™ data logger that was launched at the start of this unit. They use the computer to explore line graphs of the temperature changes outside their classroom, calculate the amount and rate of change between each high and low temperature, and answer questions such as "Is the rate of change faster from the coldest temperature to the hottest, or from the hottest to the coldest?" and "What is the relationship between the slope of the graph and the rate of change?"

Finally, students write a narrative description of the temperature over the last several weeks, drawing upon the data they have collected with the StowAway™, their weather logs, and the analytical techniques they have learned in this unit. After communicating via e-mail with their partner class, students compare the temperature changes outside their own classroom with those outside the classroom of their partner class.

10 Line Graphs



How can the temperature fluctuations in students' location best be represented graphically? Here students first interpret information presented in line graphs. They then construct line graphs of the high and low temperatures they have been collecting.

math goals

- Students read and interpret line graphs; they discuss scales, axes, and labels.
- Students construct line graphs to show changes in temperature over time.
- Students use line graphs to informally compare rates of change.
- Students use line graphs to informally discuss slope.

ongoing assessment

This activity will enable you to assess students' ability to construct and interpret line graphs. Use Reproducible Master 16 as an assessment of individual students' ability to read and reason about data shown in a line graph.

advance preparation

Students will need five days' worth of temperature data from other cities in the United States. You can provide five days of the *USA Today* weather page or get data from Blue Skies daily for five days.

materials

1 copy of Reproducible Master 16 (Learning About Line Graphs) for each student

1 copy of Reproducible Master 17 (Make Your Own Line Graph Story) for each student

high/low temperature data from students' weather logs

graph paper (1/4 inch)

rulers or straight edge

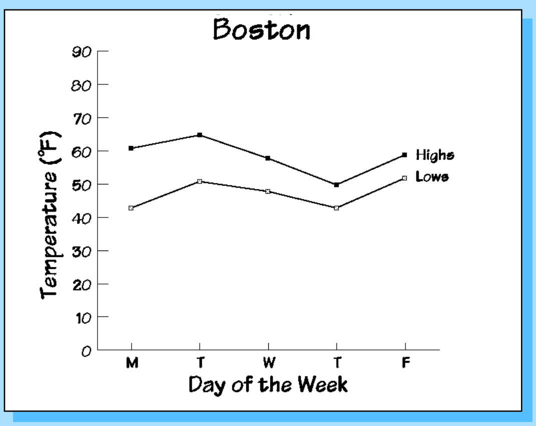
what students do

1. Using Reproducible Master 16 (Learning About Line Graphs), students match events from a story with points on a corresponding line graph.

   This is an opportunity for students to become more comfortable reading line graphs and more familiar with the parts of a line graph.

2. Students construct a line graph of the local high temperatures over the last week.

   Also have students use the same grid to construct a line graph of the local low temperatures.



3. Students compare and discuss the construction and meaning of their line graphs.

   Ask students:

   - What range did you use on your scale?
   - How many degrees are represented by each grid mark on the graph paper?
   - Did the high temperatures follow the same pattern as the low temperatures?

Teachers'

Teacher A

My students worked in groups of three. Each group constructed a line graph of minimum and maximum temperatures for the previous week (Monday through Friday). When we were looking at all of the graphs, one group mentioned that we didn't really know exactly what all of the temperatures were between the high for Monday and the high for Tuesday.

We talked about how we didn't know whether the temperature fluctuated a lot between days or whether it changed smoothly. In other words, a lot of data were missing. Most of the students felt this was OK because we just wanted to show a trend in the data. A few students felt uncomfortable with so much data missing.

I couldn't have planned this better! This debate was the perfect setup for the next lesson, using the data collected by the StowAway™ data logger.

Stories

Teacher B

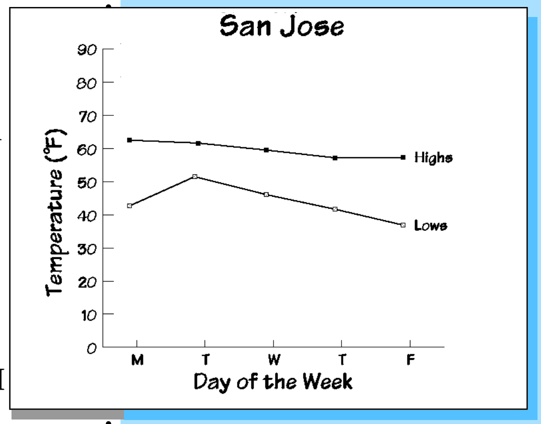
I gave my students one week to find examples of line graphs in the media. At the end of the week, they gave mini–oral reports about the graphs they brought to class. They described what each graph was about and detailed the trends being represented in each. The sources that seemed to be most fruitful were business magazines and the business section of the newspaper.

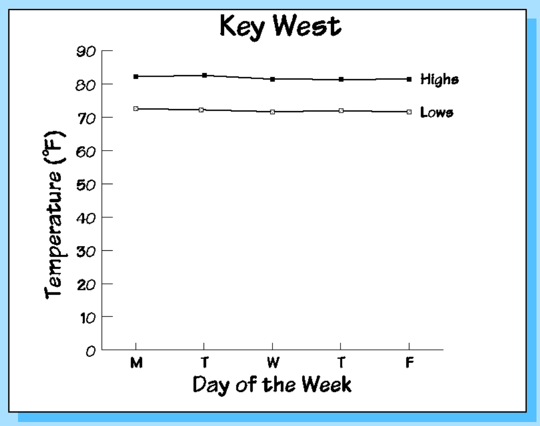
After students had plenty of experience constructing line graphs, I had them go back to the graphs they collected from newspapers and magazines and focus on the scales used in the line graphs. How would the data look if larger increments were used on the scale? What if the increments were smaller?

Each student chose one graph and constructed two new graphs of the same data—one with a scale using larger increments and the other with a scale using smaller increments. The students were surprised that you can change the look of the data (and therefore the message to the reader) by changing the scale. Students then had fun finding misleading graphs in the media. [See Background Information for more on line graphs and scales.]

4. Students find two other locations in the United States that have temperatures similar to and different from their own.

   Have students construct line graphs of the high and low temperatures for the two locations they chose. Tell students to use the same scale they used on the local graph. For example:





5. Students compare patterns in the three sets of line graphs.

   Ask students to identify what similarities and what differences they notice.

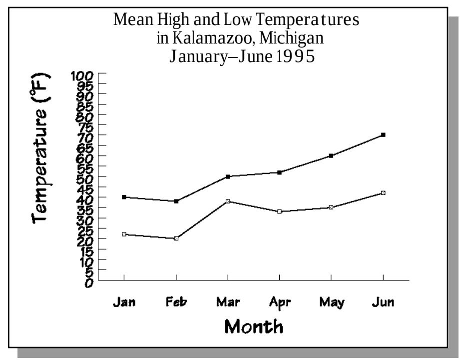
6. Using Reproducible Master 17 (Make Your Own Line Graph Story) , students create their own line graphs stories.

background information

Constructing Line Graphs

To construct a line graph, first draw the horizontal and vertical axes. The horizontal axis typically shows the time period covered by the data. In the graph below, the time period is six months—January through June—with one data point for each month.

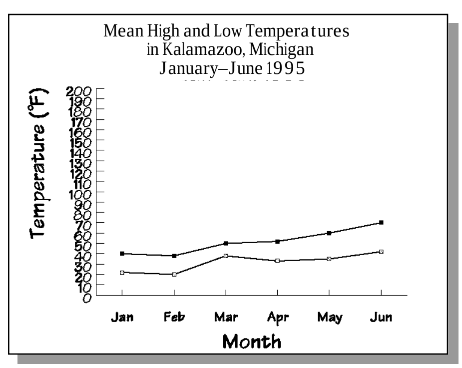
The scale on the vertical axis indicates degrees Fahrenheit. The range is 0 to 100 degrees, and the scale is marked in 5-degree intervals. It is also important to label each axis and to title the graph.



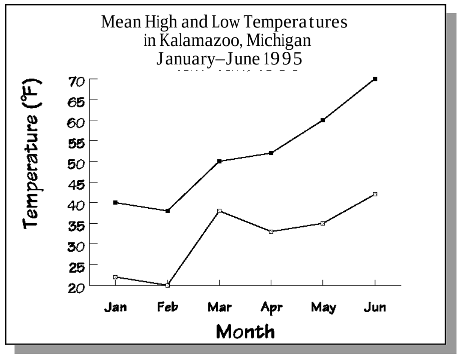
Scales on Line Graphs

It is useful to look at the scale on a line graph before you interpret the data. On the three line graphs shown on these pages, the scale on the vertical axis indicates degrees Fahrenheit. The range of the scale is 0 to 100 degrees. The scale on the horizontal axis indicates time. In these graphs, the time period is six months, January through June.

If you wanted to change the look of the data, you could change the scale on the vertical axis. For example, to make differences in the data appear smaller, use a larger range:



To make differences in the data appear larger, use a smaller range:



Any of these scales is appropriate, but as a reader one should consider the scale being used and how it may change the appearance of the data.

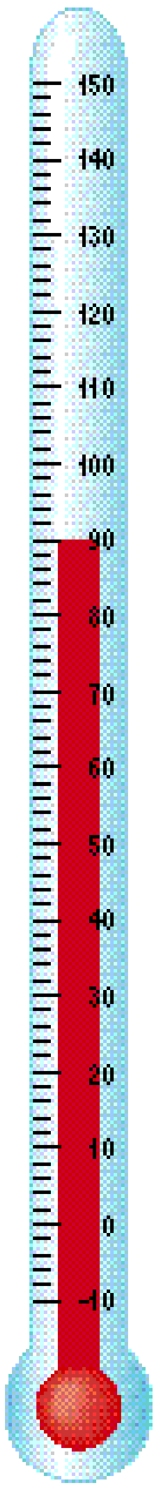
Interpreting Line Graphs

When interpreting a line graph, the reader is usually looking for a trend over time. In the Kalamazoo graph, it could be noted that the trend is for the temperatures to go up from January through June at a fairly consistent rate. Another trend is for the differences between the high temperatures and the low temperatures to become greater during spring and into summer.

Another thing to look for in a line graph is the size of the changes between data points. When did the greatest change occur?

In the Kalamazoo graph, the greatest change in high temperatures occurred between May and June. The smallest change occurred between January and February. Similar patterns can be seen in the low-temperature data.

11 Exploring the StowAway™ Data



How do the data recorded by the StowAway™ compare with the data kept by students? In this activity, students analyze temperature data collected electronically outside their classroom over 18 days. They examine a line graph of the data and mark the high temperature, low temperature, and amount of change between maximum highs and minimum lows.

math goals

- Students interpret line graphs and discuss patterns in the data.
- Students use the LogBook® software to construct a line graph and import data into a spreadsheet.
- Students use the data from the StowAway™ to create a table of temperature highs, lows, and range.
- Students identify patterns and trends in line graphs and tables.
- Students compare weather log data with StowAway™ data.

ongoing assessment

Observations during this activity and students' work will enable you to assess students' ability to organize and analyze temperature data.

advance preparation

The StowAway™ data logger was set to collect temperature data at the beginning of the unit for an 18-day period. Download the temperature data and print a line graph of the data. (See Background Information for directions.) Export the data to your spreadsheet and format and print the data.

Copy the Reproducible Master 18 (LogBook® Graph Overlay) onto an overhead. Put the overhead over a printout of the StowAway™ graph and make one copy of the graph and the spreadsheet data for each student.

materials

overhead from Reproducible Master 18 (LogBook® Graph Overlay)

calculators

students' weather logs

StowAway™ data logger / LogBook® software

what students do

1. Students read and interpret the StowAway™ line graph.

   Referring to the line graph, ask students questions like the following:
   - Was the temperature fairly consistent during this period?
   - What patterns do you notice?
   - Did any unusual weather days occur during this period? If so, can you spot them on the graph? How?
   - When did the greatest change in temperature occur?

   Suggest that students refer to their weather logs as they look over the graph.

2. Students practice reading the StowAway™ data from the LogBook® software.

   Ask students:
   - What was the highest temperature for a given date? The lowest?
   - At what time did the high temperature occur?

3. Students mark on the line graph the times the high temperatures and low temperatures occurred each day.

   Tell students they can find this information in the spreadsheet.

4. Students make observations about the graph and the temperature data.

   Encourage students to make observations such as these:
   - On most days, the temperature changed about 40 degrees through the day.
   - The highest temperature occurred on September 1 at about 2:00 PM.; it was 105 degrees.
   - The lowest temperature occurred on

Teachers'

Teacher A

My students worked in groups of three in the computer lab. Each group downloaded the data from the StowAway™ logger into LogBook® and then into ClarisWorks. This took almost the whole class period, but I felt my students needed that experience.

Students had various difficulties attaching the StowAway™ to the computer. Some groups attached the gray cable to the printer port instead of the phone port. Other students didn't make sure the connections were tight by pressing the cable firmly into the computer and the StowAway™.

Students all found the LogBook® software pretty easy to use. They were fascinated when they ran the cursor around the graph and saw the values displayed. They were also amazed at the variability of the temperature over the 18 days.

After exporting the data (some groups had trouble remembering to change the format to Excel), students imported the data into our spreadsheet application. They were confused by the long number shown in the date column, but we changed the format of the number to "Date & Time" and the table made much more sense.

Stories
Teacher B

Several students noticed an odd pattern in the StowAway™ graph. On Tuesday mornings, the temperature would climb until 10:30. Then it would drop 10 or 15 degrees, and quickly shoot back up 20 minutes later. We speculated that clouds covered the sun or a cold wind always blew at that time, but nobody thought those were likely explanations. Finally, Jennifer suggested that the cafeteria might get a delivery then and the truck could be blocking the StowAway™ probe from the sun. The following Tuesday at 10:30, we checked—there was the truck!

September 10 at about 5:00 AM; it was 45 degrees.

- During the first week of September the highest temperatures were all in the 90s or low 100s, but during the second week the highs were in the 80s or low 90s.

5. Students mark their graphs with data they recorded in their weather logs.

If students notice discrepancies between the StowAway™ data and the temperatures they recorded in their weather logs, ask them to think about why the discrepancies might have occurred.

6. Students create a data table to record the high temperature, low temperature, and range for each day.

Also have students record the time the high and low temperatures occurred. For example:

Date	9/1	9/2	9/3	9/4	9/5	9/6	9/7
Low	70° 4:34AM	64° 5:01 AM	52° 5:12 AM	51° 4:38 AM	59° 5:06 AM	64° 5:22 AM	60° 5:10 AM
High	105° 3:33 PM	93° 3:48 PM	96° 3:30 PM	100° 2:39 PM	97° 3:41 PM	100° 3:09 PM	97° 2:35 PM
Range	35	29	44	49	38	36	37

7. Students look for patterns in the data.

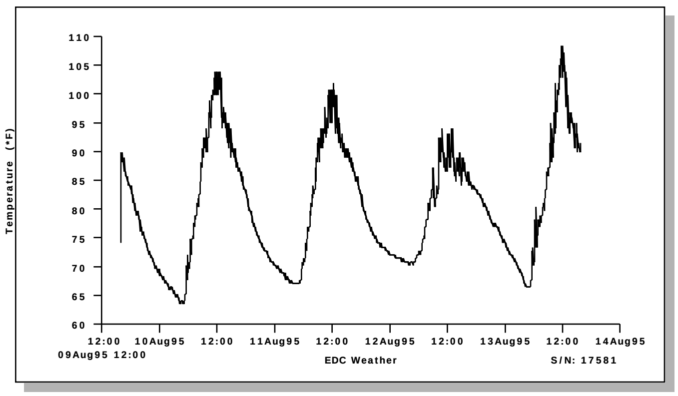
You may find that students make observations such as the following:

- The high temperatures occur around 3:00 to 3:30 each afternoon.
- The low temperatures occur around 4:00 or 5:00 in the morning.
- The range between the high and low temperatures was almost 50 degrees on September 4.

background information

Downloading Data from the StowAway™

To download the data from the StowAway™ data logger, plug the data logger into the gray cable and then plug the other end of the gray cable into the modem port of your Macintosh or the DB-9 serial port of your IBM-compatible. Start up the LogBook® software. The menu will show **File Edit Logger Views Windows**. Pull down the Logger menu and select the Readout option. After 10 or 15 seconds, a graph of your data will be displayed and a dialog box allowing it to be saved will appear over it. Name your data and save the file. A graph like the one shown here will appear.

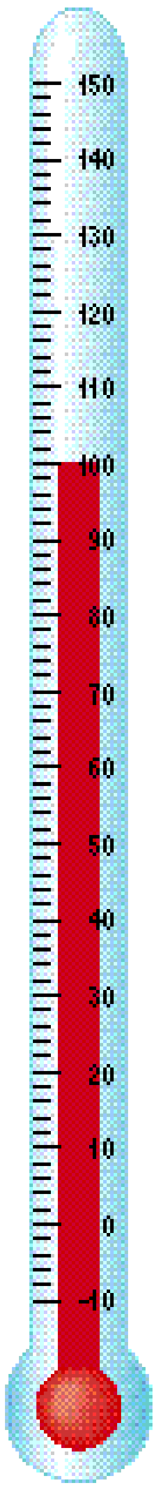


Students can zoom in on the plot to get a closer look at the data by drawing a selection box around the section they'd like and clicking in the box or selecting **Zoom In** on the **View** menu. To zoom out, select **Zoom Out** from the **View** menu.

On the Macintosh, students can use the **Show Plot Info** command under the **Windows** menu in LogBook® to closely examine their graphs. This command brings up the Plot Info Window, which shows start time, stop time, minimum recorded temperature, and maximum recorded temperature. It also shows the plot information (time and temperature) pertaining to the mouse location. Students can place the cursor anywhere on the graph to obtain numerical readings.

To download the StowAway™ data for use in other data manipulation packages (like Microsoft Excel or ClarisWorks), pull down the **File** menu and select **Export Setup**. Click on the desired export format button and click on OK. Then pull down the **File** menu again and select **Export Plot Data**. Type in the name you want to give your data set and click on OK. The data set is now saved in a file that can be used in another software package.

12 What's Been Happening?



How fast did the temperature change each day from coldest to hottest over the last two weeks? From hottest to coldest? In this activity, students calculate the rate of change from the low temperature to the high temperature for each day and compare the rates. They also examine the temperature changes using the data recorded in their weather logs. Finally, they explore what events caused the rate of change to increase, decrease, or remain constant.

math goals

- Students calculate the rate of change between high and low temperatures.
- Students explore the meaning of a positive (or negative) rate of change.
- Students relate rate of change to the slope of a line in a line graph.
- Students compare rates of change.
- Students write about data collected outside the classroom using the StowAway ™, noting patterns in the data.

ongoing assessment

Your observation of students' group work will inform you about their ability to calculate rates of change. Students' written narratives will help you evaluate their understanding of the relationship between their own observational data and data represented in a StowAway™ line graph.

advance preparation

materials

calculators

copies of the StowAway™ graph, spreadsheet data, and students' graphs from Activity 11

what students do

1. Students calculate the rate of change from coldest temperature to hottest temperature for a day.

   Choose one day from the StowAway™ data. Ask students to calculate the rate of change from the coldest temperature to the hottest temperature (see Background Information).

2. Students calculate the average rate of change from the hottest temperature to the coldest temperature for the day.

3. Students compare the rates of change.

   Ask students:

   - Does it take longer to warm up (go from coldest to hottest) or to cool down (go from hottest to coldest)?
   - Do you think this is true for every day?

4. Students calculate the rates of change for each day logged by the StowAway™.

   You may want students to work in groups, with each group responsible for several days of data.

5. Students compare the rates of change with the slopes of the graph for each day.

   Ask students:

   - What is the relationship between the rate of change and the slope of the graph?
   - When the slope is steeper, is the rate of change faster or slower?
   - Can you predict the rate of change by looking at the slope? If so, how?

Teachers'

Teacher A

Before we even got to do rates of change, my students made two interesting discoveries from the StowAway™ temperature data. First, they seemed surprised that the coldest point of the day was usually 5:00 AM; they thought it would be closer to midnight. Second, they noticed that it took less time to warm up (go from coldest to hottest) than it did to cool down. At this point, we decided to e-mail our partner class to see if this was true there too.

When our partner class replied to our message, we learned that its data showed that it took about the same amount of time to cool down as to warm up (about 12 hours each). Now, we all began to wonder why.

Stories

Teacher B

Two students were so interested in the StowAway™ that I invited them to work together and plan a final project using data loggers. They decided to find out whether the temperatures and the pattern of change were different in different parts of town. We have two StowAway™s, and so they were able to take them home. One student lives in a house shaded by many trees; the other, in a south-facing apartment. Before they launched the StowAway™ loggers, I had them write their expectations about how the patterns would compare. It will be interesting to see what they find out.

6. Each student writes a narrative description about the temperature outside the classroom for the time period recorded by the StowAway™ logger.

   Direct students to use data collected in their weather logs, the StowAway™ graph, and any other information they have collected.

   In their narratives, students should address questions like the following:

   - Did a pattern of daily change occur across the whole period?
   - Did you find blocks of days that seemed to have a common pattern? If so, what was the pattern?
   - Did some days show a different pattern? If so, which days were they? How were they different? Can you explain the reasons for the difference? Could you remember what the weather on that day was like, without looking in the log?
   - Would you expect to see the same patterns at a different time of year?

7. Students share and discuss their narratives.

8. Students e-mail their partner class and exchange StowAway™ data files.

   Encourage students to compare the line graphs for both locations and to discuss similarities and differences.

background information

Rate of Change

The average rate of change is the amount of change that occurs in a given time period. For the purposes of this unit, students will be calculating changes in temperature over hours or days.

For example, if the high temperature is 65 degrees Fahrenheit at 3:00 PM and the low is 22 degrees Fahrenheit at 5:00 AM, the range is 43 degrees. The temperature changed 43 degrees from 5:00 AM to 3:00 PM—a 10-hour period. So, the rate of change is as follows:

$$43° \div 10 \text{ hours} = +4.3° / \text{hour}$$

The temperature increased at an average rate of 4.3 degrees per hour.

When rate of change is used to describe a decrease in temperature, the rate of change should be reported as a negative value.

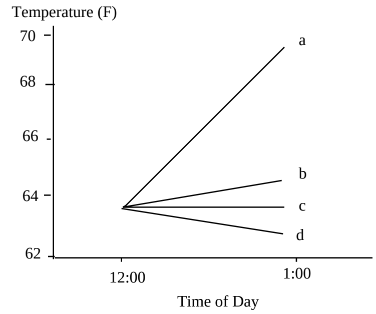
For example, if the temperature changed –43 degrees from 3:00 PM. to 5:00 AM—a 14-hour period—then the average rate of change is as follows:

$$–43° / 14 \text{ hours} = –3.07° / \text{hour}$$

The temperature decreased at an average rate of 3.07 degrees per hour.

Slope and Rate of Change

The slope of a line is a measure of its steepness. For example, in the graph shown below, Lines a, b, c, and d have different slopes.



The slope of a line tells us whether the rate of change was relatively fast or slow. The steeper the slope, the faster the rate of change. Line a in the graph above shows the fastest rate of change; Line b shows a slower rate of change. The direction of the slope tells us whether the change was a positive or a negative one. Lines a and b show positive changes, from cooler to warmer; Line d shows a negative change. Line c , which is parallel to the *x*-axis, shows that there was no change at all.

1. Students send their description of the temperature outside their classroom for the past two weeks to their partner class.

   If possible, have students enclose the data file that was exported from the StowAway™.

2. When they receive the data from their partner class, students discuss the differences between their partner class's temperatures and their own.

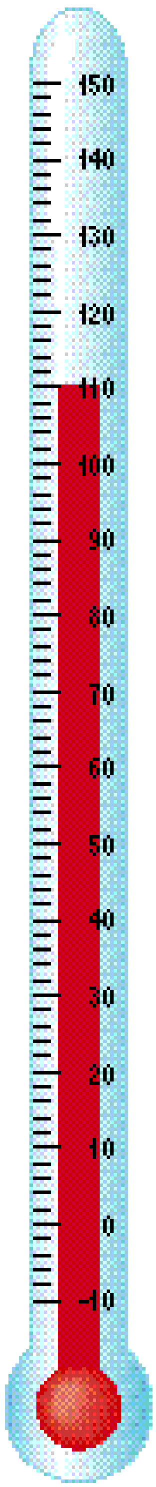
   If the partner class has included a data file, print out the graph and have students compare it with their own.

3. Students formulate and send questions about their partner class's data.

4. Students reply to their partner class's questions.

E-Mail Your Partner Class

13 Were the Predictions Correct?



Were the predictions made by forecasters at *USA Today* for yesterday's high temperature correct? In this activity, students gather data about yesterday's high temperatures around the nation and make a temperature map to graphically display their findings. They compare their map of the actual high temperatures with that of the predicted ones and try to explain any differences they find.

math goals

- Students read and interpret a temperature map and discuss legends, labels, patterns, and differences between predicted and actual high temperatures.
- 💻 Students use computers to gather data about high temperatures in selected cities and compare the actual high temperatures with the predicted highs.
- Students represent national highs as color bands on a map.
- Students construct a temperature map of the United States and compare actual to predicted highs for the day.
- Students discuss reasons for differences between predicted and actual temperatures.

ongoing assessment

This activity is an opportunity for you to evaluate students' collaborative problem solving as they construct temperature maps and compare them with a published temperature map for the same time period.

advance preparation

Obtain at least one copy of the weather page of *USA Today* from the past two days.

materials

Reproducible Masters 19–24 (regions of the United States) and 25–30 (city codes)

what students do

1. Students read information from a color temperature map (such as the maps in *USA Today*).

   Ask questions like the following:
   - What information is this map giving us?
   - What does the legend indicate?
   - What do the numbers represent?
   - How many temperature bands are represented on the map?
   - What might explain some of the patterns?
   - How would an actual high-temperature map compare with this map of predicted temperatures?

2. Students discuss how a temperature map might be constructed.

   Encourage students to think about what quantity of data points might be required to make an accurate representation and in what way the temperature regions might be delineated.

3. Groups of students gather yesterday's high-temperature data for six regions of the United States: Northeast, Midwest, Northwest, Southwest, Southern Plains, and Southeast.

   Give each group one copy of the reproducible master for its region (Reproducible Masters 19–24) and the city codes for that region (Reproducible Masters 25–30). Instruct the groups to decide how many cities (from those available on-line) they will include in their set of data in order to make an accurate representation of their region's temperature data. Then ask the groups to locate and mark the cities they chose on their regional maps.

Teachers'

Teacher A

A couple of the groups in my class had heated debates about how many cities they should sample in order to make their maps. The group in charge of the Northeast region decided to plot data from all of the cities in the region because the number of cities there is relatively few. But the group with the Southwest region had exactly the opposite problem, with 36 possible cities in California alone. They finally decided they should divide the states in their region into zones and make sure they sampled data from each of the zones. For example, they divided California into 10 zones and sampled data from one city in each of those zones. They felt that getting data from each of the cities they chose would allow them to paint an accurate picture of the temperatures in their region.

Stories

Teacher B

Once they had completed coloring the class map, my students compared it with the *USA Today* forecast map. They immediately saw many differences between their map and the forecast map. Many students saw slight differences that they attributed to errors in their demarcation strategies. But the actual temperatures in the Midwest were considerably lower than the predicated ones. Students were all very excited that the predictions were not completely correct.

4. Students learn how to log in to UM-Weather Using Telnet to view temperature data for the preceding day.

   See Background Information for instructions.

5. Using colors that match the *USA Today* legend, students color-code their regional maps.

   Remind students of the earlier discussion about how to make a temperature map. Encourage them to work together to decide how to draw the boundaries for each temperature region.

6. Students cut and paste their regional maps in order to make a class map of the entire country.

   Ask students: What method did you use to delineate regions? Did the number of cities sampled seem to affect the construction of the temperature bands?

7. Students discuss the differences and similarities between their map and the map of yesterday's USA Today predictions.

   Ask students questions like the following:

   - In what ways does your map resemble the predictions?
   - In what ways does it differ?
   - Why do you think the differences occurred?

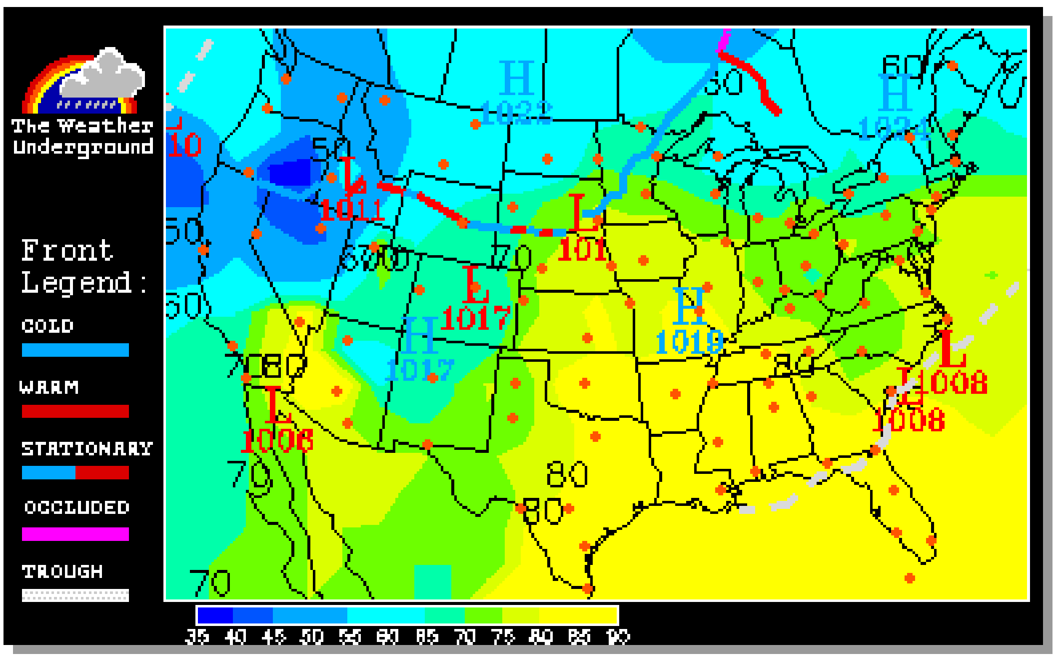
   Help students consider how their methods may have differed from the method used by the map makers. Or perhaps the predictions were incorrect.

background information

Weather Maps

A weather map is an analyzed chart that depicts weather conditions over an area at a particular time. In this unit, students construct temperature maps—weather maps with only temperature data.

Below is one example of a temperature map from the Blue Skies software.

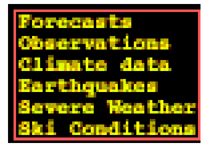


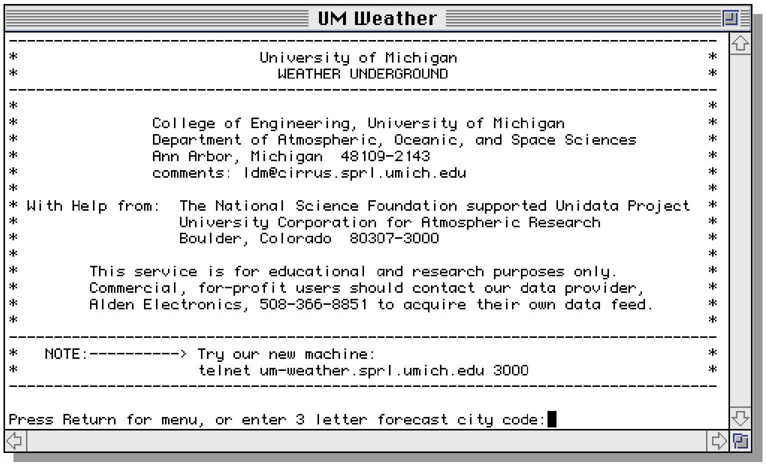
In the above representation, temperatures are marked by numerals in many locations, but the overall patterns of the temperatures in the United States are shown by colored bands, each representing a different temperature range.

In the United States, on the day the above map was generated, the temperatures ranged from the lows of 35 to 40 degrees in the southeastern corner of Oregon to the highs of 85 to 90 degrees in the southeastern part of the country and in the southeastern California / southwestern Arizona region. Temperatures are generally cooler from southeast to northwest, although some fluctuations in this trend occur in the middle of the country.

Launching UM-Weather Using Telnet

From the Window to Blue Skies menu, launch UM-Weather Using Telnet by clicking on the icon (at right). The Telnet program will load and access the UM Weather site.





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UM Weather
---------------------------------------------------------------------------
*                        University of Michigan                           *
*                         WEATHER UNDERGROUND                             *
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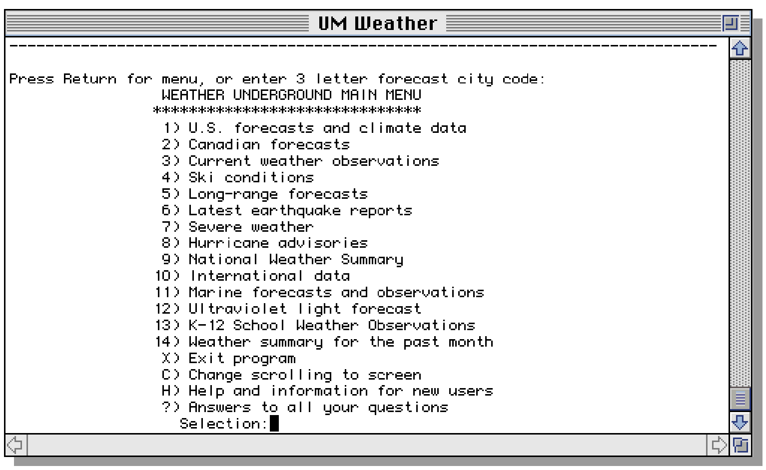
*                                                                         *
*              College of Engineering, University of Michigan             *
*              Department of Atmospheric, Oceanic, and Space Sciences     *
*              Ann Arbor, Michigan  48109-2143                            *
*              comments:  ldm@cirrus.sprl.umich.edu                       *
*                                                                         *
* With Help from:  The National Science Foundation supported Unidata Project  *
*                  University Corporation for Atmospheric Research        *
*                  Boulder, Colorado  80307-3000                          *
*                                                                         *
*         This service is for educational and research purposes only.     *
*         Commercial, for-profit users should contact our data provider,  *
*         Alden Electronics, 508-366-8851 to acquire their own data feed. *
*                                                                         *
---------------------------------------------------------------------------
*   NOTE:----------> Try our new machine:                                 *
*                      telnet um-weather.sprl.umich.edu 3000              *
---------------------------------------------------------------------------

Press Return for menu, or enter 3 letter forecast city code:
```

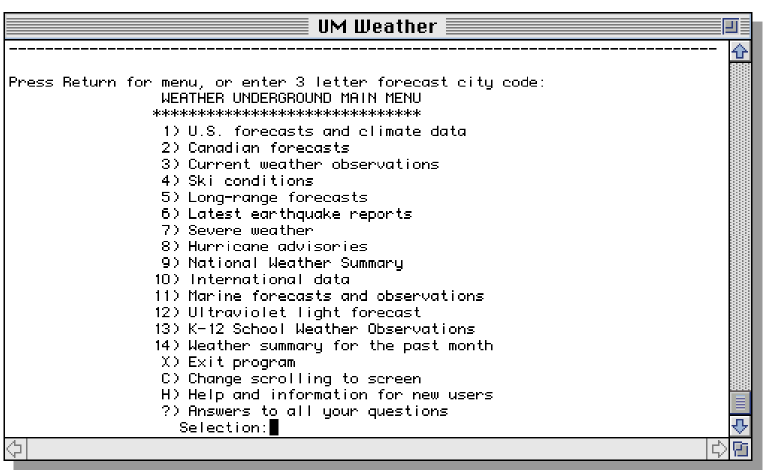
Press <RETURN> and select 1 (U.S. forecasts and climate data) from the WEATHER UNDERGROUND MAIN MENU.



```
UM Weather
---------------------------------------------------------------------------

Press Return for menu, or enter 3 letter forecast city code:
                 WEATHER UNDERGROUND MAIN MENU
                ******************************
                 1) U.S. forecasts and climate data
                 2) Canadian forecasts
                 3) Current weather observations
                 4) Ski conditions
                 5) Long-range forecasts
                 6) Latest earthquake reports
                 7) Severe weather
                 8) Hurricane advisories
                 9) National Weather Summary
                10) International data
                11) Marine forecasts and observations
                12) Ultraviolet light forecast
                13) K-12 School Weather Observations
                14) Weather summary for the past month
                 X) Exit program
                 C) Change scrolling to screen
                 H) Help and information for new users
                 ?) Answers to all your questions
                   Selection:
```

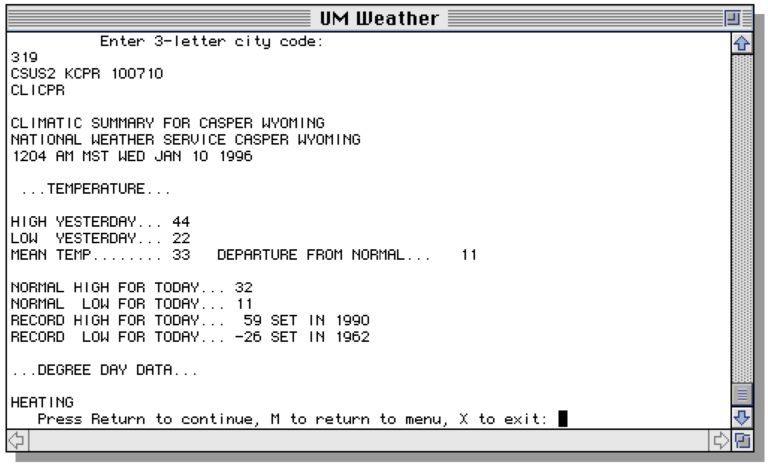
Select 2 (Print climatic data for selected city).



```
UM Weather
---------------------------------------------------------------------------

Press Return for menu, or enter 3 letter forecast city code:
                 WEATHER UNDERGROUND MAIN MENU
                ******************************
                 1) U.S. forecasts and climate data
                 2) Canadian forecasts
                 3) Current weather observations
                 4) Ski conditions
                 5) Long-range forecasts
                 6) Latest earthquake reports
                 7) Severe weather
                 8) Hurricane advisories
                 9) National Weather Summary
                10) International data
                11) Marine forecasts and observations
                12) Ultraviolet light forecast
                13) K-12 School Weather Observations
                14) Weather summary for the past month
                 X) Exit program
                 C) Change scrolling to screen
                 H) Help and information for new users
                 ?) Answers to all your questions
                   Selection:
```

Using the city codes on Reproducible Masters 25–30, choose a city from which you'd like climatic data. For example, the screen below represents data from Casper, Wyoming, on January 10, 1996. The HIGH YESTERDAY is the important piece of data for students to recognize. Some students might want to keep track of other pieces of information.



Section 4 Assessment

Students use the Section 4 Quiz, found at the end of the collection of Reproducible Masters, for this assessment.

Assessment Goals

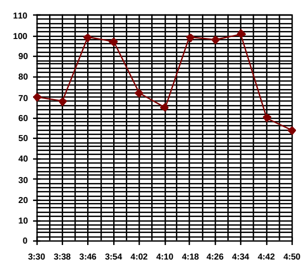
The items in this assessment test students' ability to construct and interpret data displays. To perform well on this assessment, students should be able to

- construct bar graphs of data with positive and negative values,
- construct line graphs, and
- interpret data presented in bar and line graphs.

Answer Key

Many good answers are possible for these open-ended questions. A scoring rubric is in development. Shown below are examples of the kinds of graphs students should make, along with answers to questions related to the data displays.

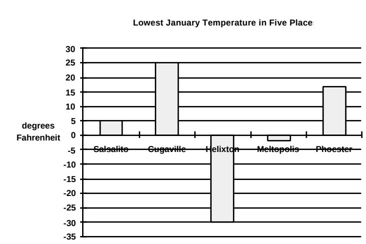
1a. A line graph is useful for showing change in temperature over time, as in the adjacent example.



1b. The temperature was dropping; then it shot up and stayed high for at least 8 minutes. It dropped back down to where it was before for at least 8 minutes; then it shot up again for at least another 16 minutes. Then it dropped even lower than ever.

1c. The dog might have been in the doghouse between 3:38 and 4:02 and between 4:10 and 4:42. Or maybe the sun was very strong at those times, but something blocked the sun from the doghouse the other times.

2a. A bar graph is useful for comparing temperatures at different locations, as in the adjacent example.



2b. Meltopolis.

2c. Phoester.

Go to Section 5