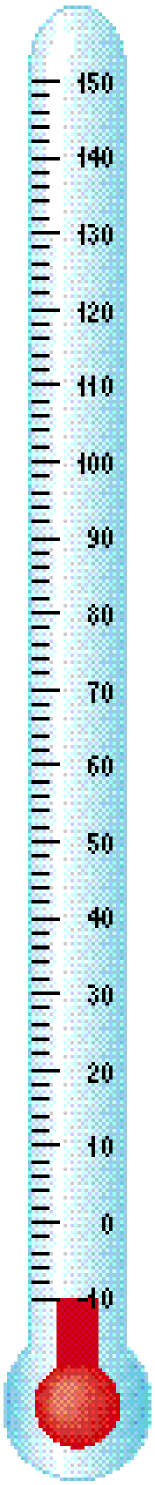
Section 1

Getting Started

In this section, the groundwork for the Skymath unit is put in place. Students reveal what they already know about temperature and the weather, along with misconceptions they may have. (These can be good starting points for student investigations or final projects.) Students begin to exchange e-mail with a partner class as a way to develop their ability to communicate mathematical ideas in writing. They are also introduced to the StowAway™ data logger, which will be used to record real-time data. A class discussion about scales, central tendency, and data representation familiarizes students with some of the ways math helps people understand and use information about temperature.

1 Brainstorming: Temperature and Temperature Changes

What interests students about temperature and temperature changes? In this activity, students list their ideas about temperature and how it changes, pose questions, and launch the StowAway™ data logger.



math goals

- Students identify questions and pose problems that can be solved using mathematics.
- Students are introduced to the Celsius and Fahrenheit temperature scales.

ongoing assessment

This activity will give you some information about students' current knowledge and understanding of temperature. It will also tell you something about what students do not know and how well they are able to pose interesting questions that can be answered mathematically.

advance preparation

materials

chart paper
colored markers
masking tape
StowAway™ data logger
LogBook® software

what students do

1. Using colored markers and a sheet of chart paper, students work in small groups to make two lists.

   Instruct students to use one half of the sheet to write everything they know about temperature, and the other half to respond to the question "What do you know or want to know about how indoor and outdoor temperatures change?"

2. The groups each present the results of their brainstorming to the rest of the class.

   Use probing or follow-up questions to explore students' understanding of temperature and change. Have students explain any point they make that isn't clear to the rest of the class. Ask them to give evidence for what they claim to know, especially if they say something surprising.

   Save the lists for use in Activity 14.

3. The class discusses the results of the brainstorming.

   Initiate a discussion in which students identify the knowledge they have in common and any differences revealed by the presentations. Some differences may be resolved by further discussion; others may be left as open questions. Encourage students to propose ways to settle the differences.

4. Students choose a set of questions they would most like to answer in math class over the next few weeks.

   Explain to students that they will be doing final projects for this unit and that their questions may help them think about what they would like to do as a project.

   Talk with students about how

Teachers'

Teacher A

I found the brainstorming activity a good way to determine what students already knew about temperature. I was surprised at the range of things students said. In one group students talked about wind chill, frostbite, and hypothermia, while in another group Clark reported several details about how hot and cold it gets in different parts of the country. Ariel's group wanted to know how the temperatures on Mars and other planets compare with ours here on Earth. Although it had little to do with temperature, Thai had a great question about why everything smells so good after a warm summer rain. On the other hand, students showed a lot of confusion about certain fundamentals. For example, various students claimed that the boiling point of water was either 32, 100, 212, or 256 degrees Fahrenheit. So I knew my work was cut out for me!

Stories
Teacher B

We passed the probe from student to student. They were amazed to see the changes in the temperature in the LogBook® window.

Then I explained that the StowAway™ would be storing temperature data for the next 18 days. I told students that it had only 1,800 spaces in which it could store information. I asked them how many times per day the StowAway™ would record the temperature. Then I asked them to figure out how long it would be between readings.

Here are some calculations that one group made:

1,800 spaces ÷ 18 days = 100 spaces per day

24 hours is the same as 1,440 minutes

1,440 minutes per day ÷ 100 spaces per day = 14.4 minutes for each space (or 14.4 minutes between each temperature reading)

meteorologists and other people interested in temperature and weather data use mathematics. Help students consider how they might use mathematics to answer some of the questions they have posed.

Post the list of questions in a place where it can be displayed for the duration of this unit. As the unit progresses, encourage students to report to you when they have answered a question; then display the answer next to its question. When students bring in different or conflicting answers, talk with them about why questions may have more than one answer. Discuss the reasonableness of the answers they have found.

5. Students are introduced to the StowAway™ data logger and the LogBook® software.

Show students the StowAway™ data logger and the temperature probe and explain their function. Invite students to help decide where to place the probe to collect outside temperatures for the next three weeks. Connect the StowAway™ to a computer and explain how it records the temperature; have students experiment with the probe, reading the temperature on the screen (see Background Information).

Using the LogBook® software, set the StowAway™ data logger to collect data for 18 days (this will cause it to record the temperature approximately every 15 minutes).

After you launch the StowAway™, place the probe where it can collect temperatures outside your classroom. Leave it until you reach Section 4 of this unit. Then download the data and prepare them for use in Activities 11 and 12.

background information

Brainstorming

Brainstorming is a method for getting many ideas out in the open. Setting a short time period for the brainstorming session and encouraging students to accept each other's ideas uncritically will help them to think quickly and creatively. Prompts like these may help students to write more:

- Who collects temperature data? How do they do it? How do they describe the data?
- How much attention do you personally pay to the temperature? Do you care if the temperature changes? Why or why not?
- How much does the temperature change in a day? In a year?
- When does the temperature change? Where does it change? What causes it to change?

Temperature Factoids

Here, in question-and-answer form, is information relating to questions commonly asked by sixth graders.

What is temperature?

A qualitative definition of temperature is that it is the property of an object that determines how warm or cold it feels to us. If we put a warm object in contact with a cooler one, we say that heat will flow from the warmer to the cooler, and the temperature tells us about the way heat is transferred. If no heat flows, the objects are at the same temperature.

Scientists have explained what heat is on the "microscopic" scale of atoms and molecules. The random motions of these molecules represent a form of energy called thermal energy. Heat is thermal energy being added to or subtracted from a substance. Temperature is a measure of the ability to transfer heat to other objects.

How is temperature measured?

Temperature as a physical concept becomes more meaningful if it can be quantitatively measured. Thus, early scientists and experimenters such as Galileo, Fahrenheit, and Celsius tried to develop devices that would give a measure of the temperature in a consistent and repeatable manner. Such devices are called thermometers.

Who invented the thermometer?

The earliest devices used to measure temperature were called thermoscopes. These usually consisted of a glass bulb filled with air and having a long tube that extended downward into a container of colored water (or wine). The liquid extended up into the tube when some of the air was removed from the bulb, and as the remaining air heated or cooled, the level of the liquid would change. We don't really know who used the first thermoscope, but Galileo Galilei (1561–1612) was one of the earliest.

Gabriel Fahrenheit (1686–1736) is credited with being the first to use mercury in thermometer bulbs. The mercury expands when it is heated, and its silvery appearance makes it easy to read.

What scales are used for measuring temperature?

Fahrenheit calibrated his mercury thermometer by placing it in a mixture of sea salt, ice, and water and calling this temperature zero. He designated two other values—one for ice and water (30) and one for a person's temperature (96). With these calibrations, he found that water boiled at 212 degrees. Later he modified the scale. The boiling point of water was 212 and the freezing point was 32, so that the intervals between the two points could be represented by the more rational number 180.

Carolus Linnaeus (1707–1778) used a simpler scale of 100 divisions between the freezing and boiling points of water. The word *centigrade* (*centi*- meaning 100) was used for this scale. Anders Celsius (1701–1744) used a similar scale in his research, and this scale is now called by his name—Celsius.

How cold is absolute zero?

Although scientists had been considering the nature of temperature since the time of the Greeks, the Industrial Revolution (beginning in Great Britain in the 1700s) focused attention on the workings of machines, such as steam engines. The efficiencies of machines were important to their operations, and friction, which generated heat, was a problem to be studied. In fact, this study of the change in temperatures of machines earned its own name as the study of thermodynamics.

In the course of such investigations, Lord Kelvin in 1848 suggested that a temperature scale be defined such that for a machine working at a temperature of zero on this scale, no heat would be absorbed or ejected and the machine would be working at 100 percent efficiency. Interpreting this scale microscopically, the molecules have no motion; hence, we call this temperature *absolute zero*. Any object that has given up all the thermal energy it possesses is said to be at absolute zero, which corresponds to –273.16 degrees Celsius and –459.69 degrees Fahrenheit. Note that the temperature scales of Fahrenheit and Celsius are relative scales, with an arbitrary selection of two fixed points. Absolute zero, however, is a nonnegotiable point on any temperature scale. Because the Fahrenheit and Celsius scales were defined before the identification of absolute zero, its value on these scales is not an integer. Temperatures measured on the scale using the Celsius interval of 100 degrees between the freezing and boiling points of water and the zero defined as absolute zero are called degrees Kelvin. Thus, water freezes at 273.16 K.

Value of Real-Time Data

During this unit, students will be analyzing temperature data that they collect or examine in “real time” (as it is happening or shortly afterward). Such data help students make connections between symbolic representations (e.g., numbers and graphs) and their own experience—what they have just felt or observed. Real-time data can also help students reflect on how they use data to anticipate what they might feel or observe next.

Installing the LogBook® Software Onto a Macintosh Computer

The LogBook® software allows your Macintosh computer to communicate with the StowAway™ data logger (see page 9). Insert the LogBook® floppy disk into your computer. Install the LogBook® software onto your hard drive by dragging the LogBook® disk icon onto your hard drive. A prompt will appear asking if you want to place a copy of the LogBook® disk onto your hard drive. Select OK to copy the disk.

Installing the LogBook® Software On an IBM-Compatible Computer

The LogBook® software allows your IBM-compatible computer to communicate with the StowAway™ data logger (see below). Insert the LogBook® floppy disk into your computer. In the **Program Manager**, choose **run** from the **File** menu and type **A:\install** (or **B:\install**). The software will direct you to choose a directory into which the software should be placed (LOGBOOK2 is the default).

StowAway™ Data Logger

The StowAway™ data logger is a device that records and stores temperatures. It has an external sensor (the long, insulated black wire) that will record the temperature of the medium around it. The end of the black probe that does not attach to the StowAway™ contains the temperature sensor. The probe itself is waterproof, while the yellow StowAway™ unit is not.

The StowAway™ will store 1,800 data points. It can be set to record the temperature for different time periods (from 15 minutes to 360 days). For each time period, the logger will record the temperature at 1,800 intervals spread evenly over the duration (e.g., if the duration is 45 minutes, the logger will record the temperature every 1.5 seconds). Each time the unit records a temperature reading, the red LED (light-emitting diode) on the surface of the unit blinks brightly.

The flexibility to select temperature samples for different time periods is an important tool whose value must be understood by students. They will have reflected on the best choice for sampling temperatures when they want to answer specific questions, such as how hot and how cold it was yesterday (over 24 hours) or how rapidly the temperature changed during sunrise.

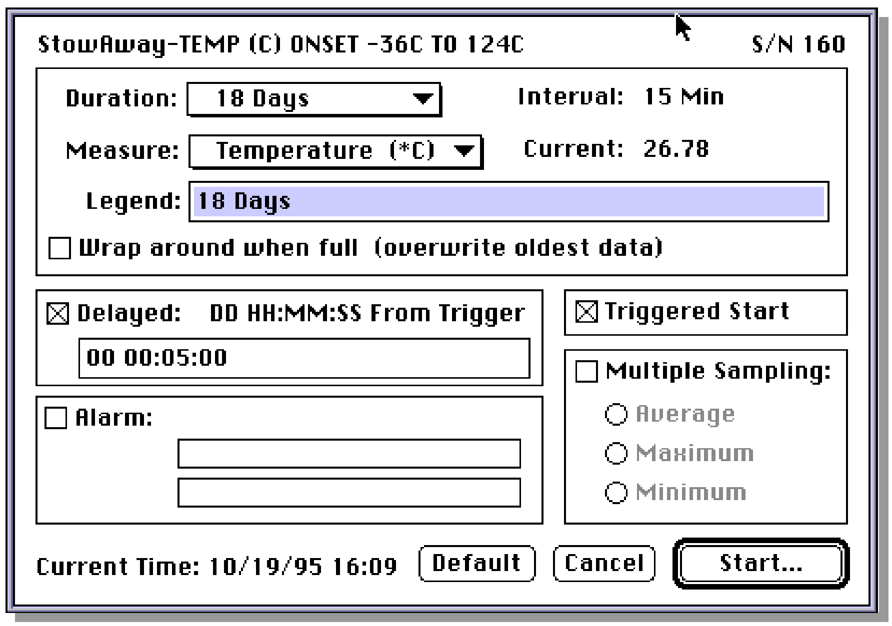
When the data are read from the logger, they will be translated into a line graph showing the temperature fluctuations over that time period. The numerical data that allowed the creation of this graph can be exported as text and used in spreadsheet applications such as ClarisWorks and Microsoft Excel.

Demonstrating the StowAway™

To demonstrate the logger to students, connect one end of the gray cable to the StowAway™ and the other to the communications port ( ) of your Macintosh computer or the DB-9 serial port of your IBM-compatible computer.

Double-click on the LogBook® icon to launch the software.

Pull down the menu entitled **Logger** and select **Launch.** The Launch dialog box will appear. On the right-hand side of the box is listed the current temperature .



Allow students to investigate with the temperature probe. The probe (not the StowAway™ itself) is water resistant and can be submerged in liquid. Students can place the end of the probe in various locations or in hot or cold water and note the temperature reading on the screen to see how the logger works.

CAUTION: Make sure that the “Wrap around when full” box is unchecked or the logger will overwrite your earliest data when all 1,800 data points have been taken.

Setting the StowAway™ to Record Data

Set the StowAway™ to record for 18 days by pulling down the **Duration** menu. The interval shown should be 15 minutes. Name your data set by typing into the **Legend** field. Choose the temperature scale in which your data will be recorded by pulling down the **Measure** menu and selecting Fahrenheit or Celsius. If the **Triggered Start** box is empty, click in it to indicate that you want to start the StowAway™ manually. Click [Start...] to launch the StowAway™.

To protect the StowAway™ from moisture, place it into a small plastic bag with the probe protruding from the bag and seal the opening around the probe. Unplug the serial port cable from the StowAway™. You should notice that the LED on the unit is blinking weakly every 6 seconds, indicating that it is awaiting a triggered start. Place the StowAway™ in the area where it will be collecting data and press the trigger to start it. The StowAway™'s LED should blink once brightly when it is taking a measurement and every 2 seconds weakly in between measurements. If the LED is not blinking in such a manner, press the trigger button again.

Troubleshooting the StowAway™ and LogBook® Software

After you have connected the StowAway™ to your computer and launched the LogBook® software, the Current field in the LogBook® window should read the current temperature.

Q *When selecting Launch or Readout, the software gives the message "Can't connect to data logger." What's wrong?*

A There is probably a problem with the serial port connection. Make sure that

- the proper port is selected in the User Preferences dialog box (Macintosh only),
- the interface cable is pressed all the way into the jack on the logger, and

- the interface cable is connected to a working serial port (if the serial port was recently used for a network or modem, it may still be configured as such).

If you are still having trouble, make sure there are no port conflicts with other software packages. Many terminal and facsimile programs take control of the serial ports.

Also, if AppleTalk is on (Macintosh only), it may tie up the Printer port (check the Chooser). If problems persist, restart the Mac with the shift key held until “No extensions” appears—this should temporarily remove any conflicting extensions

Q *I‘ve checked all of the cables and the port connections and my data logger still doesn‘t work. What else can I do?*

A The battery may be dead. The StowAway™‘s 3.6-volt battery *should* last for two years, although it is suggested that you change it every year. To change the battery, remove the logger‘s cover. Remove the old battery by pulling it straight away from the board. Before installing the fresh battery, touch the terminal of (short) the battery for 1 second with a paper clip. Doing so removes any high internal resistance that builds up when this kind of battery is not in use. When the battery first makes contact with the board, the status LED should blink five times. If it does not, remove the battery, wait 10 seconds, and try again. Finally, replace the cover, lining it up so that the LED shows through the intended spot on the label.

Q *I‘ve checked all of the cables and the port connections and replaced the battery and my data logger still doesn‘t work. What else can I do?*

A Call customer support at Onset at 508-563-9000 between 8:00 AM and 5:00 PM EST, fax 508-563-9477, e-mail onset@ccsnet.com, or write to Onset Computer Corporation at 536 MacArthur Boulevard, Box 3450, Pocasset, MA 02559.

E-Mail Your Partner Class

1. Students figure out how they can explain to their *partner class* (another class of students who, like themselves, are just starting the Skymath unit) where they are so that their partner class can locate them on a map.

   Instruct students to use an atlas, U.S. map, globe, or world map to decide how they can describe their location to their partner class. Tell students they can use major cities or landmarks as reference points, latitude and longitude, compass points, measurements in miles, or another system to describe their location. Let them know that the key is for their partner class to be able to find their location on a map.

2. Students use e-mail to exchange messages with their partner class

   Ask students to fill out Reproducible Master 1 (Introducing...) and to mail their responses to their partner class.

3. As introductory messages begin to arrive from the partner class, print and share them with the class.

   Ask students to use the instructions provided by their partner class to find their partner class's location on a map. If students have trouble finding the location, instruct them to direct questions via e-mail to their partner class.

   Instruct each group to prepare a reply to at least one group from the partner class.

4. Using the information about weather and temperature they got from their partner class, students make comparisons.

   Ask students: How does the weather at your school compare with the weather at your partner class's school? Is it similar? Different? Why do you think so? How about the temperature? Why might it be similar or dissimilar?

E-Mail Your Partner Class

background information

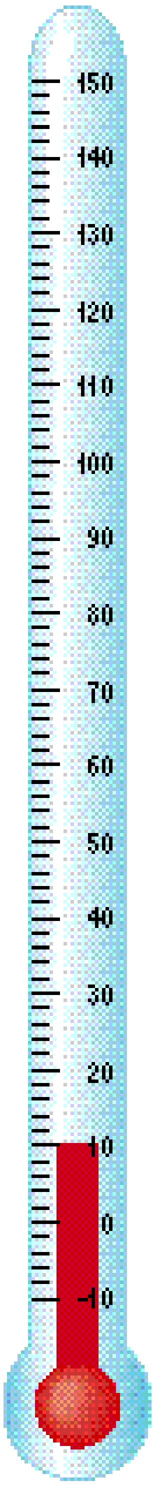
Connecting with a Partner Class

Find a teacher in another part of the country who is using Skymath and arrange for your classes to be Skymath partner classes. Establish a procedure that will allow you to review outgoing messages before they are sent and incoming messages as they arrive.

E-Mail

E-mail and other forms of electronic communication have become an almost indispensable daily experience for adults who use computers in their work, as well for many people who are on the Internet at home. Electronic communication between students has been found to be highly motivating. During this unit, the partner classes will exchange their local data and observations and will compare the temperatures in their classrooms and neighborhoods. Later, students will share their local data by sending it to Blue Skies, where it will become part of a large set of data. The next step for students will be to publish the work they do for their final project by sending it electronically to their partner class or putting it on a Web page if your school can support that technology.

2 Be a Weather Watcher



How are temperature data collected in the United States? In this activity, students learn about the people called weather watchers, who record weather data to be used for climatological studies and weather forecasting. Students begin to make their own weather logs to record data on temperature and weather conditions.

math goals

- Students review what state, national, and world weather data are available and how those data are collected.
- Students design a process for collecting data to answer local weather-related questions.
- Students decide on a common set of data to be collected.
- Students learn how to read a thermometer in Fahrenheit and Celsius scales.
- Students learn how to use a weather log, read and record temperatures, and calculate changes.

ongoing assessment

Use Reproducible Master 2 to assess students' ability to read and interpret Fahrenheit and Celsius temperatures.

advance preparation

materials

overhead from Reproducible Master 2 (Reading a Thermometer)

1 copy of Reproducible Master 3 (Weather Log) for each student

outdoor Fahrenheit–Celsius thermometer

what students do

1. Students reflect on what information they might need to answer questions about the weather.

   Prompt student discussion with questions like these:

   - Was [the highest temperature reading noted by the class] the highest temperature yesterday? Was [the lowest temperature reading noted by the class] the lowest? How would you find out?
   - At what time of day do you think the highest temperature occurred yesterday? The lowest?

   Remind students that to help answer these questions, they have the StowAway™ data logger.

2. Students discuss how weather data are collected and distributed nationally.

   Ask students what types of weather data are collected. They may offer suggestions such as amount of rainfall, temperature readings, and wind speed.

   You may want to provide information about weather watchers (see Background Information).

3. Students discuss the types of data they will be recording in their log.

   Have students look at the Reproducible Master 3 (Weather Log) and discuss how to go about completing it. Ask them to consider questions such as these:

   - What kinds of weather data should we include in our observations?
   - What tools should we use to collect data?
   - When should we collect data?
   - What might we be able to find out if we keep a weather log for several weeks?

Teachers'

Teacher A

Students enjoyed recording the data so much that we continued to keep our weather log for the entire year. We eventually made a line graph that stretched almost completely around three walls of the classroom so that we could see how the temperature changed outside our window. It was comforting to see that line start to climb after such a long cold winter!

Teacher B

At first, I had problems getting students involved in collecting temperature data at home. I provided thermometers for children who didn't have them at home, and I offered extra credit to any student who remembered to record his or her home temperature. With just a few exceptions, however, I was the only one reporting these data. Then it occurred to me that students needed to have a good reason for collecting data—they needed to have a question in mind that the data could answer.

I asked them, "Which radio or television station does the best job of predicting the temperature at your house?" It turned out that many students had strong opinions about this question. Students formed groups based on which weather reporter they favored. For one week, the groups each collected home temperature data as well as the predicted temperatures from their preferred weather reporter. Students kept group records, and as the week progressed, they began to make some interesting observations. I encouraged

Stories

them to write these down so that they could include them in a report to the class on the following Monday. Most groups thought their preferred weather reporter did a good job, but after all groups reported, some began to change their opinions. We made a big table on the board that showed all of the predicted and actual temperatures for each day. That was a lot of information to look at, but it helped students make interesting comparisons. Afterward, two groups continued to collect home temperature data and used the information in their final projects.

4. **Students practice reading a Fahrenheit-Celsius thermometer on an overhead.**

   A Fahrenheit-Celsius thermometer has both scales on a single thermometer. The dual-scale nature of this instrument illustrates that one physical reading (temperature) can be expressed by two different numbers, depending on the scale.

   Ask students to find the temperature of different reference points (normal body temperature, room temperature, freezing point of water, today's outside temperature) in both Fahrenheit and Celsius.

5. **Students decide where to place their outside thermometer and the times they will record data each day.**

   Because students will be using this thermometer to get temperature readings for their weather logs, make sure they record the temperature at times that allow for some differences. Ask students to suggest times during the school day when they think the temperature will be substantially different. In general, it is a good idea to take one early morning reading, one afternoon reading, and one sometime in between. If not all students will be available at those times, set up a schedule of observers who will record the data for the class.

6. **Students make the first entry in their weather logs.**

background information

Weather Watchers

America's weather watchers, perhaps 25,000 or more in number, range in age from as young as 6 or 7, to a full century older. Many become weather watchers after a particular weather event affected them personally: Chicago's big snow of 1967, the Big Thompson Canyon flood of 1972, the great Long Island hurricane of 1938, or, as in my own case, the disastrous Belvidere tornado of 1967. Each event had a major impact in the shaping of a new weather observer.

Today, nearly 11,000 of America's dedicated weather observers directly serve the National Weather Service as members of the National Oceanic and Atmospheric Administration's Cooperative Observer Program headquartered in Silver Spring, Maryland. Some provide a variety of information several times each day, while others methodically and meticulously maintain daily and monthly rainfall, snowfall, temperature, or river level information for the country's permanent climatological record.

Assembled and archived at NOAA's National Climate Data Center in Asheville, North Carolina, this significant historical record includes multiple decades of data from thousands of locations under NOAA's jurisdiction. It is a data base produced by people dedicated to a most important element of our historical record—the climatological history.

Thousands of other observers have as their only reward the personal satisfaction found in simply recording the elements of the atmosphere which blow through, fall upon, and run off their own back yards. They seldom seek personal gain or financial reward, but are justly proud of their intimate understanding of the weather outside their doors.

Though many of these backyard observers do not function in any official capacity, they frequently provide valuable and timely information to local National Weather Service offices, television and radio stations, and emergency services during times of threatening weather. Each year some are cited for their contribution to the safety and well-being of the people within their communities.

—*The Weather Sourcebook* ,
by Ronald L. Wagner and Bill Adler, Jr.,
Globe Pequot Press, Old Saybrook, Connecticut, 1994

Rationale for the Weather Log

The weather log that the class keeps will serve as a model for other data collection activities that come later in the unit or that students do as part of their final project. Students should feel free to modify the log to suit their own purposes. For example, they may want to alter this form so that it has a place for the initials of each student making the observation. When students look at the data from the StowAway™ data logger, in Activities 11 and 12, they will find the log useful in helping to explain the temperature ups and downs they will observe in the graph. The weather log also helps students associate qualitative descriptions of weather with their quantitative measures of temperature.

Making a Class Weather Log

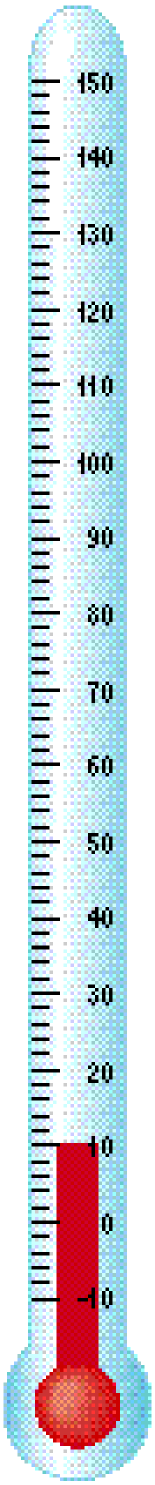
Begin a class weather log on the board. Students will use the data to examine change over the course of a day. At right is an example of a class temperature log.

	Monday			Tuesday			Wednesday			Thursday			Friday		
Time	8	12	3	8	12	3	8	12	3	8	12	3	8	12	3
°F															
Change															
°C															
Change															

Change is a place to record the change in temperature from one reading to the next. The change in temperature between 3:00 PM on one day and 8:00 AM on the next allows you to talk about what might have happened to the temperature in between those two times. For example, if it was 70 degrees Fahrenheit at 3:00 PM and then 54 degrees Fahrenheit at 8:00 AM the following day, did the temperature simply drop 16 degrees Fahrenheit or did something more complex happen? Students should record such a change as –16 degrees Fahrenheit.

Show students how to record positive and negative changes in temperature by using a + and – sign. For example, if the temperature between two readings goes up 16 degress, record the change as +16. If it drops 16 degrees, record the change as –16.

3 Introduction to Blue Skies



How can students use the Internet to examine weather and temperature conditions in the United States? In this activity, students connect to the Weather Underground at the University of Michigan. They use the Blue Skies software to examine temperature and weather data at other locations in the United States They also use a minimum-maximum thermometer to find the minimum and maximum temperatures in their location and then input these into Blue Skies.

math goals

- Students read a min-max thermometer.
- Students record minimum and maximum temperatures and analyze differences.
- Students use maps to identify locations.
- Students look for patterns of differences across the United States.
- Students learn to use Blue Skies to access and upload temperature and weather data.

ongoing assessment

Use Reproducible Master 4 to assess students' ability to read a temperature map.

advance preparation

Establish a way to access Blue Skies from computers in your classroom or the school lab. Be sure your school has a password and can input data into the national map.

materials

one or more computers with Internet access

1 copy of Reproducible Master 4 (Welcome to Blue Skies) for each student

1 min-max thermometer

what students do

1. Working in groups, students complete Reproducible Master 4 (Welcome to Blue Skies) by exploring Blue Skies on-line.
2. Students examine the data from other school sites.

   The following questions may help:
   - What kinds of temperature data are other students putting into Blue Skies?
   - How could we find out the highest and lowest daily temperatures for our school? Would we have to watch the thermometer and record the temperature every minute? Every second?
3. Students examine a min-max thermometer, discuss its function, and decide where outside their classroom they think it should be placed.

   Ask students if they think there are places that will more accurately represent the outside temperature than others. The following questions may help students decide where the thermometer should be located:
   - Should it be in the shade or should it be out in the open?
   - Should it be in an alcove or sheltered area, or would it be better unsheltered?
   - Where would it be most accessible?

   Instruct students to place the min-max thermometer outside the classroom in the spot they chose. Then, ask students to predict answers to questions such as the following:
   - When during the day will the maximum temperature occur? Why?

Teachers'

Teacher A

At our school, teachers have a regular planning meeting each week, and I used some of this time to tell the other teachers about Skymath. Several of them had ideas about how they could help students get more out of this unit. The science teacher, for example, offered to do several activities about heat transfer and convection currents; she also gave me tips about how the min-max thermometer works. The librarian made a special display of books about the weather. The computer coordinator not only showed students how to use e-mail and a spreadsheet but also set up Blue Skies on all of the computers in the lab. Before I took students to the lab, I spent time with the computer coordinator learning how to access Blue Skies and upload data. She gave me a chance to practice with the LCD projector too. Then, when I actually did this activity with my first-period class, I asked her to stay close by in case something went wrong. Although everything went smoothly, it was reassuring for me to have her there just in case. Looking back, I have to admit that I was pretty intimidated by the whole thing. Of course, my students take all this technology for granted. I'm finally starting to feel like I can be as comfortable as they are with computers and the Internet!

Stories

Teacher B

My students wanted to upload their daily high and low temperatures like students at the other schools. I sent an e-mail message to Blue Skies requesting a school ID code. We put the min-max thermometer outside one of the classroom windows. Each morning before school, one group of students read and reset the thermometer, recorded the temperatures on a chart, and uploaded the data from our classroom computer. Students really liked seeing the little dot representing our school on the map in the Blue Skies software. And it didn't take very long before they were checking on the daily highs and lows at other sites they were interested in. Since we did this unit in the middle of winter, this activity gave us all one more reason to be glad we live in a warm climate.

- When will the temperature be the lowest? Why?
- Do the maximums and minimums happen at different times in different seasons? When the weather is different?

4. After 24 hours, students enter the class minimum and maximum temperature data and the group weather observations (from students' weather logs) into Blue Skies.

   Arrange matters so that each group is responsible for entering the data for one day of the week. Be sure students record the minimums and maximums in their weather logs. Then initiate a discussion centering on the following questions:

   - What is the difference between the minimum temperature and the maximum temperature? Or, what is the range in temperature for each day?
   - Do you think that is a typical difference? Why or why not?
   - What relationship, if any, do you see between the weather observations you made yesterday and the minimum or the maximum temperature?

5. Students explore weather sites on the Internet.

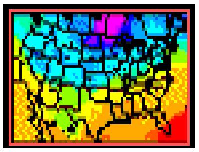
   Ask students:

   - What types of information are available on these sites?
   - How is the information presented?

   Suggest to students that, because of what they have seen on these Web pages, they may want to modify the ways in which they are recording data in their weather logs.

background information

Using Blue Skies



Open the Window to Blue Skies and click on the colorful map of the United States (shown at left) to access the interactive weather maps. There are many Interactive_Weather_Maps. Double-clicking on any of them will bring up a map with information pertaining to its title. In this activity, we will be using the U.S._Visible_Satellite_Map.dot.

Colored dots on all of the maps represent weather stations. When a cursor passes over these dots, the weather data from that location will be shown in the space above the map.

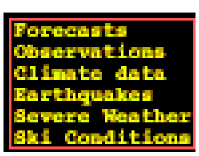
To gain access to a toolbox that will allow you to zoom in on the map, pull down the Windows menu and turn on the Tool Palette option. A toolbox with the arrow pointer, a selection rectangle, a hand tool, and two magnifying glasses, a + and –, will appear. The + magnifying glass will allow you to zoom in on areas of the map.

The Min-Max Thermometer

An analog min-max thermometer records the day's high and low temperatures; it features dual Fahrenheit and Celsius scales. The right side registers the maximum temperature since the last setting, while the left side shows the minimum temperature. Small floats are pushed to each temperature extreme by the two mercury columns and stay there until reset.

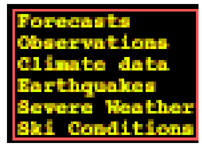
Digital min-max thermometers store the minimum and maximum temperatures in memory and are easier to read than their analog counterparts.

Examining Data from Other Schools



Click on the UM Weather Using Telnet icon (shown at left). Be sure to turn on the Local Echo option under the Session menu. When the UM Weather Menu appears, input (13) to access K–12 School Weather Observations. When the K–12 School Weather Observations menu appears, input (2) to Review school observations. Input your area of the country to review.

Entering Weather Data



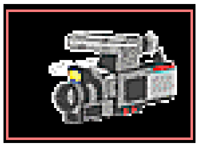
Launch UM Weather Using Telnet (shown at right). Be sure to turn on the Local Echo option under the Session menu. When the UM Weather Menu appears, input (13) to access K–12 School Weather Observations. When the K–12 School Weather Observations menu appears, input (1) to Input observations and send messages. Input your school's six-character login ID. Then input (1) to Input 24-hour High, Low, Precipitation, and Pressure Change.

Weather on the Internet

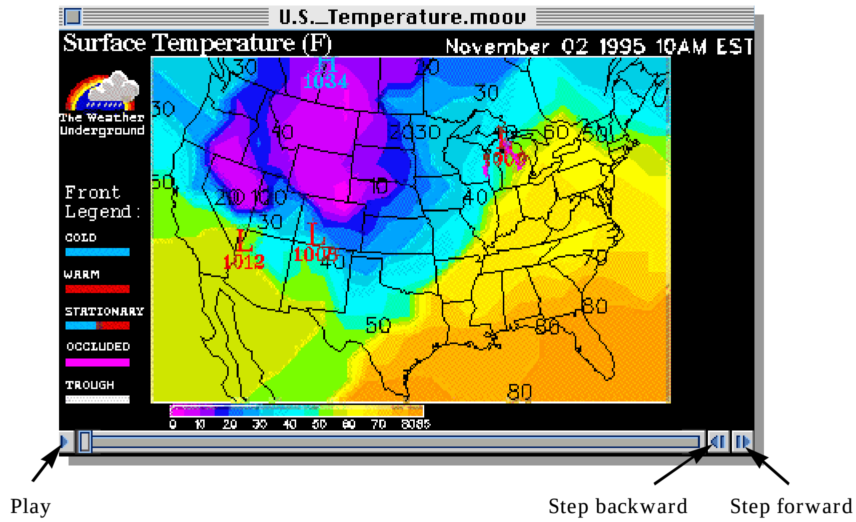
Weather Underground Homepage	http://groundhog.sprl.umich.edu
Weather Page	http://acro.harvard.edu/GA/weather.html
AccuWeather, Inc.	http://accuwx.com/
USA Today Weather	http://www.usatoday.com/leadpage/indexusa.htm#wdex
NCDC Home Page	http://www.ncdc.noaa.gov/
WebWeather	http://cougarxp.princeton.edu
The Lighthouse Weather Server	http://the-tech.mit.edu/Weather/
National Weather Service, Tallahassee, Florida	http://thunder.met.fsu.edu:80/nws/public_html/
Interactive Weather Information Network	http://iwin.nws.noaa.gov/iwin/main.html
Weather Map	http://www.mit.edu:8001/usa.html
INTELLiCast	http://www.intellicast.com/
International Weather Watchers	http://groundhog.sprl.umich.edu/IWW/
Todd Gross' Weather/Astronomy Page	http://www.weatherman.com/
Weather Images and Information	http://typhoon.reading.ac.uk/weather/weather.html
Weather Science	http://sln.fi.edu/tfi/hotlists/weather.html
Live Access to Climate Data	http://ferret.wrc.noaa.gov/ferret/main-menu.html
WEATHER-SENSE! Products	http://www.isn.net/~wxsense/wxsense.html
Hourly U.S. Weather Statistics Page	http://www.ems.psu.edu/cgi-bin/wx/uswxstats.cgi
Interactive Weather Browser	http://rs560.cl.msu.edu/weather/interactive.html
The Weather Channel ® Home Page	http://www.infi.net/weather/
WeatherWatch Magazine	http://northshore.shore.net/~wxcentrl/
WeatherNet	http://cirrus.sprl.umich.edu/wxnet/
Weather Cameras	
Peeping Tom Homepage	http://www.ts.umu.se/~spaceman/camera.html
WeatherNet: WeatherCams	http://cirrus.sprl.umich.edu/wxnet/wxcam.html

Using Blue Skies to View QuickTime Movies of Weather Conditions

Note: You must have the application QuickTime to view these animations.



Click on the video camera icon (shown at left) to get a list of the animations available for viewing. Students can view movies of U.S. precipitation, heat index, wind, and temperature, for example. Double-clicking on any of the available movie icons will download them for viewing. (CAUTION: Movies can be lengthy and take considerable time to download.) Movies are made up of a series of hourly U.S. maps of the specific weather condition being illustrated.



Click on the right-facing triangle at the bottom left of the window to play the movie. The two buttons on the lower left of the window allow you to step through the movie.

Section 1 Assessment

Students use the Section 1 Assessment, found at the end of the collection of Reproducible Masters, for this activity.

Assessment Goals

- Students identify ways in which mathematics is used to understand temperature and the weather: measurement, graphs, charts, scales, data analysis and representation, averages, ranges, and highs and lows.
- Students take temperature readings.
- Students construct data representations.

This activity will help you assess what each student already knows about the mathematics involved in studying and using temperature data. It will also enable you to judge students' creativity and originality in identifying possible applications of mathematics.

Further, this activity will help you assess whether students are each able to take temperature readings from a thermometer and appropriately display the data in a chart or graph. For example, do they construct bar or line graphs? Do they understand that the former is better for comparisons and the latter for showing change over time? Do they label the axes and use equal intervals in their scales? Students' work will help you make decisions about how much time to spend on topics of working with thermometers and data representation.

Go to Section 2