LESSON 3.8

A Hot Day

You will need:

graph paper

The sign at Algebank near Abe's house gives the time and temperature. The temperature is given two ways, using both the Celsius and Fahrenheit temperature scales. One hot day Abe made a record of the time and temperature at several times during the day. He tried to look at the bank sign exactly on the hour, but usually he was off by a few minutes. His data appear below.

Time	Temp (C)	Temp (F)
11:03	31	87
12:00	32	90
2:00	35	95
3:04	35	95
4:08	34	93
8:03	27	81

1. **Exploration** Abe heard on the radio that the low for the night had been 74 degrees (Fahrenheit) at 4:30 A.M. and the high for the day had been 97 degrees at 3:30 P.M. Using the information in the table, estimate what you think the Celsius readings on the bank sign would have been at those two times. Explain how you got your answers.

TEMPERATURE VARIATION

2. a. Draw a pair of axes on graph paper. Label the horizontal axis *Time* and the vertical axis *Temp*.

b. Plot the points that show how the Celsius temperature changes with time. Your first point will be (11:03, 31).

3. a. Draw another pair of axes like the first one.

b. Plot the points that show how the Fahrenheit temperature changes with time. Your first point will be (11:03, 87).

4. Write a short description of what your graphs show. Compare the two graphs.

COMPARING TEMPERATURE SCALES

A graph will help to show how the two temperature scales are related.

5. Draw a pair of axes. Put the Fahrenheit temperature on the vertical axis (label it *F*) and the Celsius temperature on the horizontal axis (label it *C*). Put the axes in the middle of your graph paper and leave plenty of room to extend your graph in all directions. Plot the points in Abe's table. Your first point will be (31, 87).

6. The points of your graph should fall approximately in a straight line. Draw a straight line that seems to go through most of the points.

Use your graph to estimate the answers to these questions. If necessary, extend your graph.

7. Approximately what is the

a. Fahrenheit temperature when the Celsius temperature is 25°?

b. Celsius temperature when the Fahrenheit temperature is 50°?

c. Celsius temperature when the Fahrenheit temperature is -30°?

8. Is there a temperature where a Fahrenheit and Celsius thermometer show the same number? If so, what is it?

Abe's sister Bea wanted to estimate the Fahrenheit temperature for 17° Celsius. Someone had told her that the best way to remember the Celsius-Fahrenheit relationship was to memorize the fact that 16° Celsius is 61° Fahrenheit. Abe joked, "So 17° Celsius must be 71° Fahrenheit!" Bea replied, "I'll just add one degree. That means 17° Celsius must be 62° Fahrenheit."

9. Explain what Bea did wrong. Use your graph. Give examples explaining to Bea how to make the conversion correctly.

10. Judging from your graph, if you increase the Celsius temperature by one degree, by about how much does the temperature increase on the Fahrenheit scale?

CONVERTING CELSIUS TO FAHRENHEIT

Bea and Abe's parents, Mr. and Mrs. Gral, were planning a trip to Europe, where temperatures are given in Celsius. They asked their children to help them figure out how to convert from Celsius to Fahrenheit.

Abe asked his science teacher, who gave him the following rule: To get the Fahrenheit temperature, multiply the Celsius temperature by 1.8, then add 32.

11.
   a. Write a formula for this rule. Use F for the Fahrenheit temperature and C for the Celsius temperature.
   b. Check your formula by using it to convert one of the Celsius temperatures in Abe's table.

Bea looked up the subject in an almanac, which gave these instructions: To get the Fahrenheit temperature, multiply the Celsius temperature by 9, divide by 5, then add 32.

12.
   a. Write a formula for this rule.
   b. Check your formula by using it to convert one of the Celsius temperatures in Abe's table.

13. Compare the two formulas you wrote. Do you think they always give the same results? Explain, giving examples.

14. Use either method to convert these two Celsius temperatures to Fahrenheit.
   a. 20° Celsius = ___ Fahrenheit
   b. 21° Celsius = ___ Fahrenheit

15. According to your calculation in problem 14, when you increase the Celsius temperature by one degree, by about how much does the temperature increase on the Fahrenheit scale? Where does this number appear in the formula? Explain.

CONVERTING FAHRENHEIT TO CELSIUS

A journalist from Spain, G. Balear, is staying with the Grals. She is writing an article for a Spanish newspaper about her experiences in the United States. She wants to convert Fahrenheit temperatures to Celsius for her article.

16. The Fahrenheit temperature dropped to 41°. Bea is trying to help Ms. Balear convert it to Celsius. She has the idea of working backwards using the rule from the almanac. Use this method, or another method you think might work, to convert 41° F to Celsius.

17. Describe the method you devised in problem 16 for converting Fahrenheit to Celsius. Explain why it works. Show that it works for other temperatures by using it to convert some of the temperatures in Abe's table.

THINKING WRITING 3.B Opposites and Reciprocals

OPPOSITES

The function $y = -x$ can be thought of as the *opposite function,* since y and x are opposites.

1. a. Make a function diagram for the function $y = -x$.
   b. Describe the in-out lines. (Are they parallel? Do they meet in a single point? If so, where is that point?)
2. To answer these questions, look at the diagram you made for problem 1.
   a. As x increases, what happens to y?
   b. Are x and y ever equal? Explain.
   c. When x increases by 3, what happens to y?
3. Find the number and its opposite that are described. Use trial and error. Look for patterns. Try to develop a shortcut strategy.
   a. a number 16 more than its opposite
   b. a number 0.5 more than its opposite
   c. a number 21 less than its opposite
   d. a number A less than its opposite
   e. a number 8 more than twice its opposite.
4. Report In a few paragraphs, summarize what you learned about opposites and their function diagrams. Include examples.

RECIPROCALS

The function $y = 1/x$ can be thought of as the *reciprocal function,* since y and x are reciprocals.

5. a. Make an in-out table for the function $y = 1/x$, using the following values for x: -5, -4, -3, -2, -1, -0.8, -0.6, -0.4, -0.2, and the opposites of these numbers (0.2, 0.4, etc.)
   b. Make a whole-page function diagram for the function.
6. Use the function diagram you made in problem 5. Follow y with your finger as x goes up its number line. Answer these questions.
   a. As x increases, what happens to y?
   b. Are x and y ever equal?
7. On your function diagram of $y = 1/x$, as x moves up the number line, answer questions (a-h), describing what happens to y. (Does it move up or down? Fast or slowly? From what to what?)
   a. when x is a negative number far from 0
   b. when x approaches -1
   c. when x passes -1
   d. when x approaches 0
   e. when x passes 0
   f. when x approaches 1
   g. when x passes 1
   h. when x is a large positive number
8. Use your calculator to look for a number and its reciprocal that satisfy these requirements. If you cannot find an exact number, get as close as you can by trial and error. One is impossible.
   a. The number is 9 times its reciprocal.
   b. The number is 1/9 of its reciprocal.
   c. The number equals the opposite of its reciprocal.
   d. The number is 3 times its reciprocal.
   e. The number is one more than its reciprocal.
9. Report Summarize what you learned about reciprocals and their function diagrams. Include examples. (Do not forget to discuss what happens when $x = 0$.)