Celsius 232.78

Lesson Plan

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Goal: The goal is to derive an approximate Celsius to Fahrenheit conversion formula from observed temperature data. A secondary goal is to practice linear equation-solving skills by using the formula to convert several temperatures. In particular, we will determine what the title of a famous science fiction book would have been had Ray Bradbury been used to the Celsius scale!

Grade and Course: ninth grade Algebra I

KY Standards: **MA-11-4.2.2** Students will:

- identify an appropriate curve of best fit (linear, quadratic, exponential) for a set of two-variable data;
- determine a line of best fit equation for a set of linear two-variable data; and
- apply line of best fit equations to make predictions within and beyond a given set of data.

Objectives: The students will:

1. gather temperature data from a cooling cup of water in both Fahrenheit and Celsius
2. display Fahrenheit vs. Celsius data using a scatter plot
3. use the TI-83's linear regression package to fit a line to the data
4. gain experience using technological aides for problem solving
5. use the regression equation as a formula for converting between Fahrenheit and Celsius

Resources/materials needed: The logistics of this lesson are fairly demanding and students will need to work in groups of three or more. The following items are needed:

- calculator Based Laboratories with **two** temperature sensors each. Be aware that the CBLs usually only come with a single temperature sensor, so for each CBL you plan to use you will need two kits. While it would be optimal to have groups of three students per CBL, this will likely be impossible for large classes.
- a TI-83 calculator with DataMate installed is needed for each CBL
- each group will need a cup half-filled with lukewarm water and a separate cup of ice. The cup of water should have a wide enough base to be stable while holding the temperature sensors
- more accurate results will be obtained if each pair of sensors are held together with cable ties

Description of Plan: This lesson assumes that students have been introduced to scatter plots and lines of best fit. The lesson begins with a brief discussion about the Fahrenheit and Celsius temperature scales. It is pointed-out that the Celsius scale is widely used internationally and for scientific applications so that it is advantageous to be able to convert between scales. Next, students immerse two temperature probes, one configured to record in Fahrenheit and the other in Celsius, in lukewarm water. The water is cooled by continuously adding ice while data points are recorded at ten to twenty second intervals. Data collection ends when at least ten data points have been recorded. The TI-83 is used to produce a scatter plot of the Celsius-Fahrenheit pairs and to use regression to fit a line to the data. Students are then asked to complete a worksheet that involves using their regression equation as a Celsius to Fahrenheit conversion formula.

Lesson Source: This lesson was modified from the Getting Started with the CBL 2 manual.

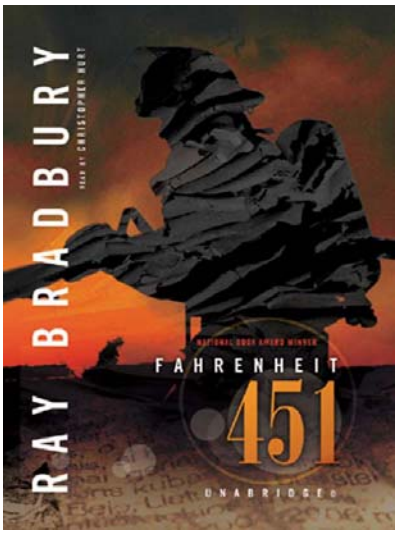
Instructional Mode: Brief discussion followed by a hands-on data gathering activity. Display and analysis of the data are achieved with the help of technological aides,

providing the students experience with such strategies. The lesson concludes with the completion of a worksheet and, time permitting, a summary discussion.

Date Given: May 4, 2007

Estimated Time: this lesson can easily be completed in a single class period as long as the CBLs and calculators are configured beforehand and each workstation is set-up before class.

Date Submitted to Algebra^3: May 7, 2007



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Fahrenheit 451 – Now, what would that be in Celsius?

Have you read Ray Bradbury's classic science fiction book? The title refers to the temperature at which paper will burn. We are used to the Fahrenheit scale in the U.S., but most places in the World (including your science class!) use a different scale called the Celsius scale. If you are listening to a weather report in London, England or are measuring the heat from a chemical reaction in chemistry class, the temperature will probably be reported in degrees Celsius. So how do the two scales relate? Is there an easy way to convert a temperature in Celsius to the scale that you are more familiar with? What would the title of Bradbury's book be in Celsius?

In this lesson we will:

1. Collect temperature data from ice water in both Fahrenheit and Celsius.
2. Graph a scatter plot of the data on the TI-83.
3. Use the calculator to perform a linear regression on the data.
4. The regression will provide a linear equation that relates Fahrenheit to Celsius.

<u>DATA COLLECTION</u>:

The CBL has two temperature sensors in the glass of water. One sensor is set to record in Fahrenheit and one in Celsius. Once we press START, each time your press ENTER the calculator will record a pair of numbers (*C*,*F*) where *C* is the temperature in Celsius and *F* the temperature in Fahrenheit.

- Press [2] START to begin recording
- Begin adding ice to the water by dropping in an ice cube about once every five seconds.
- Record data points by pressing ENTER at 10 to 20 second intervals. Use the sensors to stir the water before you record each point.
- When you have at least 10 data points, save your data by pressing STO.
- Press [1] to return to the main screen.

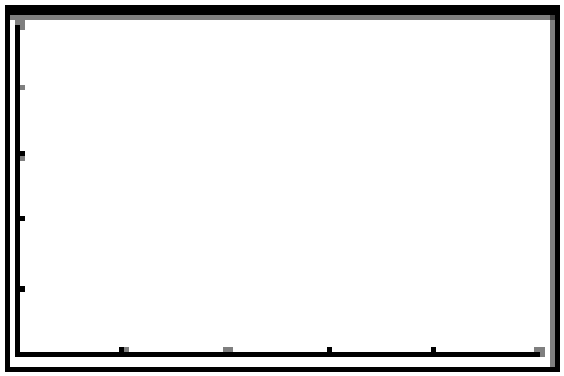
DATA ANALYSIS

- Select [3] GRAPH. View the graph of CH2 VS CH1 by using the down arrow to select it and then pressing ENTER. When you are finished viewing the graph, press ENTER to return to the list. Use the graph to **answer question 1 on the worksheet.**
- Press [1] MAIN SCREEN
- From the Main Screen, press [4] ANALYZE.
- Press [2] CURVE FIT to find the function that best fits your data for CH2 VS. CH1.
- Press [6] LINEAR (CH2 VS CH1) to perform a linear regression. This is a routine for finding the line of best fit to a set of data. The line of best fit is a linear function that relates Fahrenheit to Celsius based on your data.
  Answer question 2 on the worksheet.
- R is a measure of how well the line fits the data. If it is near 1, then it is a good fit. Is your line a good fit?
- Press ENTER to see how well the regression line fits the data.
- Use the conversion formula you have found to **answer questions 3 – 6**.

Worksheet

Name_____

1. Observe the scatter plot of CH2 VS CH1. Sketch the scatter plot below and label the axes. Is Celsius on the *x*-axis or the *y*-axis? Also, label the (*x* , *y*) values of each point.



2. Write the linear equation that you found with the calculator. Round A to the nearest tenth and B to the nearest integer:

_____

a. What is the slope?_____

b. What is the *y*-intercept?_____

c. Rewrite the equation you found, but now use *F* for Fahrenheit and *C* for Celsius instead of *y* and *x*. This is the conversion formula:

_____

d. Solve the equation you found in part [c] for *C*. This is the Fahrenheit to Celsius conversion:

_____

3. The average high temperature for Owingsville in July is 30° Celsius. What is this temperature in Fahrenheit?

4. The average low temperature for Owingsville in April is 41° Fahrenheit. What is this temperature in Celsius?

5. Water freezes at around 32º Fahrenheit. What is freezing on the Celsius scale? (**hint:** your equation is an approximation. The actual formula is $F = \frac{9}{5}C + 32°$)

6. What would the title of Ray Bradbury's book have been if he had used the Celsius scale?