

Title: Two Different Numbers Can Represent the Same Measurement

Link to Outcomes:

- **Problem Solving** Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers, problems which are solved in a cooperative atmosphere, and problems which are solved with the use of technology.
- **Communication** Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics in an interdisciplinary approach.
- **Connections** Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.
- **Statistics** Students will demonstrate their ability to organize and display data and will interpret information obtained from displays.
- **Algebra** Students will demonstrate their ability to apply algebraic concepts in real-world situations (e.g., algebraic expressions, equations, tables, and graphs)
- **Technology** Students will demonstrate their ability to use a graphing calculator to solve problems.
- **Reasoning** Students will demonstrate their ability to reason mathematically, to gather data, and to make and test conjectures.
- **Measurement** Students will demonstrate their ability to read a thermometer.
- **Real-World Applications** Students will demonstrate their ability to develop mathematical models for real-world problems.

Brief Overview:

This is an interdisciplinary unit on temperature. Scatter plots will be done from data found in the daily newspaper, road atlas and classroom. Cooperative learning and technology (TI-80) are utilized. This lesson, with modifications, is appropriate for different levels.

Grade/Level:

Grades 6- 8

Duration/Length:

This lesson can range from 3 to 4 periods depending upon the level and background of the students.

Prerequisite Knowledge:

- Students should have working knowledge of the TI-80 graphing calculator (or equivalent device).
- Students should be able to read a thermometer.
- Students should be able to evaluate simple expressions.

Objectives:

- Students will be able to sketch a scatter plot using data from the newspaper and the classroom.
- Students will be able to find the equation of the line that best fits the data using a TI-80 graphing calculator (or equivalent device).
- Students will be able to use the graphing calculator to evaluate linear expressions.
- Students will be able to find the best model that fits their data.

Materials/Resources/Printed Materials:

- TI-80 Graphing Calculator (or equivalent device)
- National Temperatures of major cities from the newspaper
- activity sheets
- road atlas
- map of the USA
- hot water
- warm water
- cold water
- thermometer

Development/Procedures:

Day 1:

Interpreting data from a National Temperature chart: The teacher will introduce interpreting data from a weather chart on the first day. This cooperative learning activity requires four students per group. Each group will select a group leader. **Activity 1** will be distributed to the students. After the students work in their groups, the group leaders will share their solutions.

Interpreting data from a map of the United States of America: The students will continue working in the same groups. **Activity 2** engages the students in locating cities throughout the United States and interpreting data to real-life applications.

Graphing data from a National Temperature chart: **Activity 3** engages the students in graphing data with technology.

Day 2:

Evaluating algebraic expressions: **Activity 4** involves evaluating algebraic expressions by using the graphing calculator.

Investigating temperature changes: **Activity 5** is an experiment that involves the students in reading a thermometer.

Comparing Celsius to Fahrenheit: **Activity 6** involves the students in comparing two units of measurement for a particular situation. They must be able to choose the appropriate unit of measurement for the prescribed condition.

Day 3:

Determining temperature changes: **Activity 7** involves the students in determining the resulting temperature after a rise or drop on the thermometer.

Investigating temperature changes within a classroom: **Activity 8** engages the students in collecting data for an experiment. They will collect data at different times of the day in particular places in the classroom with students in the room and without students in the room. Their investigation will result in a writing activity to support their findings.

Evaluation:

Circulate throughout the groups, checking to see if the students are on-task and involved in this learning unit. Students will be asked to select an activity to place in their **Interdisciplinary Portfolio**.

Extension/Follow Up:

Have students brainstorm the many possible real-world applications of two different numbers that measure the same quantity.

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National Temperatures, The Sun, June 19, 1995

City	Yest. Hi/Lo	Today Hi/Lo	Tomrw. Hi/Lo	Forecast for today
Albany	89/56	93/64	84/67	Sunny
Atlanta	85/65	84/65	83/65	Ptcldy
Boston	91/68	98/70	88/73	Sunny
Buffalo	85/66	88/65	86/67	Ptcldy
Charleston, S.C.	82/71	84/67	86/68	Mocldy
Charlotte	82/61	82/64	86/66	Mocldy
Chicago	93/71	91/66	91/67	Sunny
Cincinnati	88/60	89/62	86/65	Sunny
Cleveland	91/65	89/63	89/65	Sunny
Dallas	90/67	90/68	91/68	Ptcldy
Denver	78/48	86/50	85/57	Sunny
Detroit	93/63	94/67	94/70	Sunny
Harrisburg	88/61	91/63	91/68	Sunny
Houston	86/72	90/71	92/68	Ptcldy
Indianapolis	90/63	91/65	88/66	Sunny
Jacksonville	84/66	87/66	88/63	Ptcldy
Kansas City	88/66	89/66	89/66	Ptcldy
Las Vegas	88/59	96/65	98/67	Sunny
Los Angeles	81/58	83/61	83/62	Sunny
Louisville	88/64	87/64	88/66	Ptcldy
Memphis	88/64	88/65	88/67	Ptcldy
Miami Beach	84/77	86/75	85/76	Mocldy
Milwaukee	96/74	94/75	92/74	Ptcldy
Mpls.-St. Paul	92/71	91/71	87/68	Sunny
Nashville	87/61	85/62	84/64	Ptcldy
New Orleans	88/65	90/67	92/64	Sunny
New York	90/68	95/70	94/73	Ptcldy
Oklahoma City	83/60	86/63	89/65	Fair
Orlando	87/71	86/69	87/70	Ptcldy
Philadelphia	90/63	93/68	94/72	Sunny
Phoenix	94/63	90/71	90/74	Sunny
Pittsburgh	89/56	90/63	90/66	Haze
Portland, Me.	88/61	96/65	86/67	Vryhot
Portland, Ore	63/53	64/52	67/50	Shwrs
Raleigh Durham	80/62	81/63	85/64	Mocldy
Richmond	84/57	83/62	88/67	Ptcldy
St. Louis	89/70	90/70	89/70	Ptcldy
Salt Lake City	77/47	77/52	74/47	Ptcldy
San Antonio	89/67	88/69	90/70	Ptcldy
San Diego	72/58	71/59	71/60	Sunny
San Francisco	65/54	68/53	76/53	Sunny
Seattle	64/49	67/47	72/48	Ptcldy
Tampa	89/71	90/71	89/71	Ptcldy

Distance from Baltimore

City	Mileage from Baltimore
Albany	339
Atlanta	654
Boston	427
Buffalo	401
Charleston, S.C.	568
Charlotte	418
Chicago	717
Cincinnati	534
Cleveland	358
Dallas	1357
Denver	1643
Detroit	514
Harrisburg	113
Houston	1404
Indianapolis	569
Jacksonville	751
Kansas City	1070
Las Vegas	2401
Los Angeles	2647
Louisville	639
Memphis	911
Miami Beach	1094
Milwaukee	790
Mpls.-St. Paul	1113
Nashville	702
New Orleans	1135
New York	199
Oklahoma City	1313
Orlando	892
Philadelphia	102
Phoenix	2312
Pittsburgh	245
Portland, Me.	536
Portland, Ore	2797
Raleigh Durham	298
Richmond	150
St. Louis	828
Salt Lake City	2067
San Antonio	1632
San Diego	2681
San Francisco	1185
Seattle	2708
Tampa	950

Name _____

Date _____

Class _____

ACTIVITY # 1

Use the National Temperatures chart to answer the following questions.

1. What kind of information is presented in this chart?
2. How is it arranged?
3. What is the purpose of the last column?
4. What city had the highest temperature yesterday?
5. What city had the lowest temperature yesterday?
6. Which city had the greatest difference in its temperature yesterday?
7. Which city had the highest temperature over the period of the chart?

8. Which city has had the lowest temperature over the period of the chart? Why?

9. What is the projected high for Orlando, Florida tomorrow?

10. Which city is projected to be the warmer tomorrow: Detroit or St. Louis?

11. Which of the three Texas cities had the lowest temperature yesterday?

12. How can this information be helpful to you?

Name _____

Date _____

Class _____

ACTIVITY # 2

Use a map of the United States and the Distances from Baltimore chart to answer the following questions.

1. What is the location (state) of the following cities?

A. Kansas City _____

B. Milwaukee _____

C. Seattle _____

D. Boston _____

E. Harrisburg _____

F. Houston _____

G. San Diego _____

H. Jacksonville _____

I. Buffalo _____

2. Of the cities listed, which is closest to Baltimore, Maryland?

3. Which city on the chart is farthest from Baltimore?

4. Which of the following cities (Richmond, Oklahoma City, Tampa, or Louisville) can be reached within a 3 hour drive traveling at 55 m.p.h.?

5. In which direction would you travel to reach Indianapolis from Baltimore?

6. Locate Atlanta and Denver on a map. Which is most likely to be the shortest drive if you were traveling from Baltimore?

7. Which cities are closest together: Miami and Jacksonville, New York and Philadelphia, or Charlotte and Las Vegas?

8. Rounding to the nearest thousand, which city is approximately 3,000 miles away from Baltimore: Seattle, Houston, or New Orleans?

9. Use the formula $\text{Distance} = \text{Rate} \times \text{Time}$. Rate is 55 m.p.h. How long would it take to reach these two cities from Baltimore?

a. Harrisburg

b. Richmond

Name _____

Date _____

Class _____

ACTIVITY # 3

1. Using the National Temperatures page of the newspaper, list the major cities that have a forecast for today of being Sunny.

2. **SITUATION:** You live in Baltimore, Maryland and plan to drive the shortest distance to one of the major cities listed in problem #1 for a sunny day vacation. List 8 major cities that would have the shortest driving distance from Baltimore, Maryland (use the Road Atlas as a reference).

3. Complete the table below for the 8 major cities that have the shortest driving distance from Baltimore, Maryland. Make sure you use today's high and low temperatures.

CITIES	HIGH	LOW

4. Make a scatter plot of the temperature data in problem # 3. Make sure that your graphing calculator is using the appropriate window.
5. Experiment with different models for this data including linear, quadratic and exponential. Which model seems to fit the best? Why?

Name _____

Date _____

Class _____

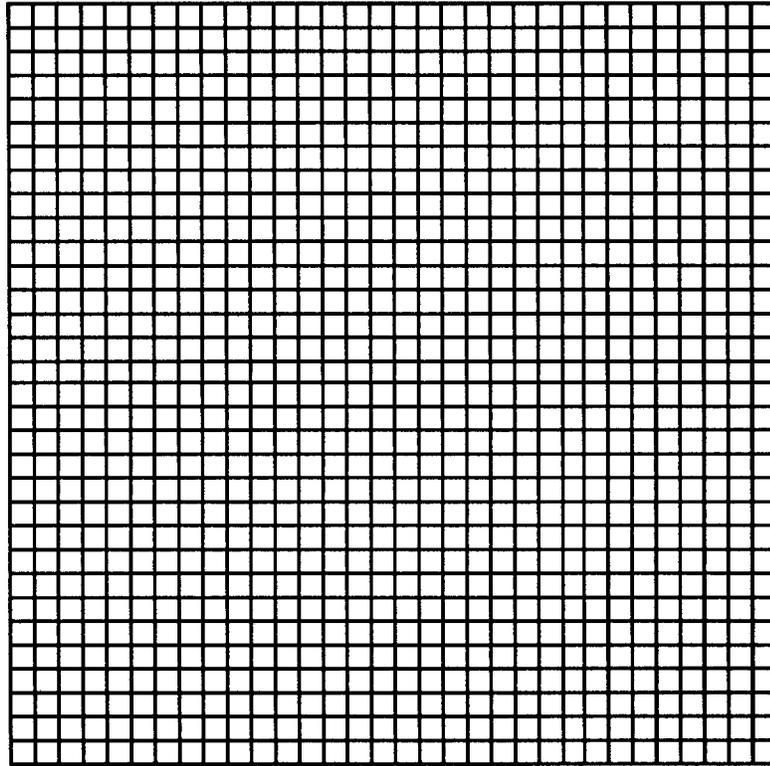
ACTIVITY # 4

1. Complete the chart by using the graphing calculator as an evaluator of algebraic expressions.

$$C = \frac{5}{9} (F - 32)$$

F	C
32	
40	
50	
60	
65	
75	
85	
100	

2. Make a scatter plot of the above data on the grid that follows and label the graph **“Two Numbers Represent The Same Measurement.”**



3. Investigate the model to see if it is linear, quadratic, or exponential. Which model seems to fit the best? Why?

Name _____

Date _____

Class _____

ACTIVITY # 5

1. You all have a sense of temperature. You can tell when things feel warm or cool. But sometimes your sense of temperature can be fooled.

Fill a pan with very cold water. Put warm water in another pan. Fill a third pan with water as hot as you can touch. Submerge your hands in the warm water. Does the temperature of the water feel the same to both hands?

Response: _____

2. What do you think the temperature of the warm water is on the Fahrenheit scale?

Response: _____

3. Using a Fahrenheit thermometer, find the temperature of the warm water. Was your prediction the same as the actual reading on the Fahrenheit scale?

Response: _____

4. Dry your hands. Now put one hand into the cold water, and the other hand into the hot water. Leave them there for about a minute. Then put both hands directly into the warm water again. How does the water feel now?

Response: _____

5. Does the temperature of the water feel the same to both hands?

Response: _____

6. Why do you think your sense of temperature is fooled when you do this?

Response: _____

7. To justify your response for the last question, find the temperature of each of the three pans of water.

Response: _____

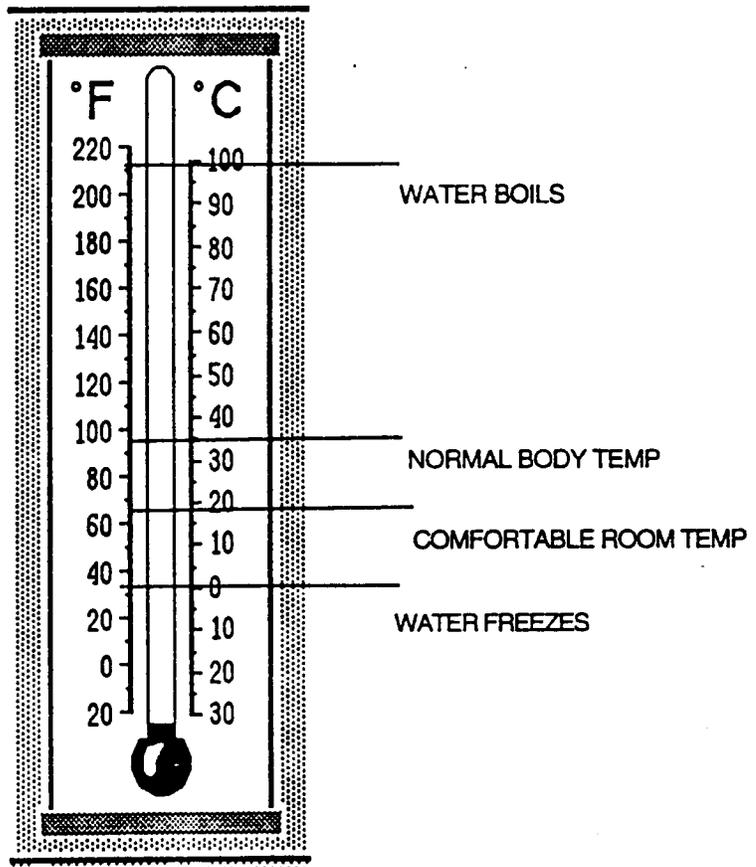
Name _____

Date _____

Class _____

ACTIVITY # 6

The two points of reference on the Fahrenheit scale are 32 and 212 degrees. Respectively, they are the freezing and boiling point of water. The corresponding points on the Celsius scale are 0 and 100 degrees.



What do you think?

Is the temperature likely to be C or F?

1. A pleasant summer day of 23 degrees. _____
2. A cold winter day of 15 degrees. _____
3. Baking a cake at 350 degrees. _____
4. Freezing ice cream at -10 degrees. _____
5. A chilled glass of milk at 38 degrees. _____
6. A high fever of 102 degrees. _____
7. A hot day at 40 degrees. _____
8. Sunbathing at 35 degrees. _____
9. A snowball fight at 28 degrees. _____
10. Cold enough to have a heater on
at 40 degrees. _____
11. Too hot to be outside playing
at 105 degrees. _____
12. Too cold to go to school
at -5 degrees. _____

If you disagree with any of the solutions, then justify your solution by explaining how you chose Celsius or Fahrenheit.

Name _____

Date _____

Class _____

ACTIVITY # 7

Temperature varies across the United States. For example, in 1982 the lowest temperature recorded in Portland, Oregon was 14 degrees Fahrenheit. In Indianapolis, the lowest temperature in 1982 was - 22 degrees Fahrenheit. How much higher was the lowest temperature reading in Portland than the lowest temperature reading in Indianapolis?

Response: _____

Each of these problems gives the record low temperature for a city. Determine how much lower each temperature is than the record low 14 degrees Fahrenheit for Portland, Oregon.

1. Atlanta, -5 degrees F _____
2. Memphis, 0 degrees F _____
3. St. Louis, -15 degrees F _____
4. Fairbanks, -43 degrees F _____
5. Cleveland, -17 degrees F _____
6. Boston, -9 degrees F _____

What do you think the new temperature is?

7. 54 degrees F rises 18 degrees F _____

8. -4 degrees C rises 12 degrees C _____

9. -11 degrees C drops 4.5 degrees C _____

10. 15 degrees F drops 20 degrees C _____

11. 60 degrees F rises 32 degrees F _____

12. 24 degrees C rises 12 degrees C _____

Name _____

Date _____

Class _____

ACTIVITY # 8

Using a thermometer, move about in your classroom and find the temperature in various areas of the room: by the doors, by the windows, near the lights, in the front of the room, in the back of the room, etc. Make a table giving the location in the room and the temperature during the time that your class is in the room. Return to the classroom after school and record the temperature of those same locations in the room. Were the temperature readings the same? Were they different? If so, why do you think that they were different? Justify your answer by writing a paragraph about your data.

TABLE:

LOCATION IN THE CLASSROOM	TEMPERATURE DURING YOUR CLASS PERIOD	TEMPERATURE AFTER SCHOOL
FRONT OF ROOM		
BACK OF ROOM		
NEAR THE WINDOW		
NEAR THE DOOR		
*ADD TO THIS LIST		

Before writing your paragraph, you might want to consider the number of students in the classroom during your class period, the location of your classroom in the building (over the boiler, on the sunny side, in an area where the doors are kept open all of the time, etc.) and whatever variables could effect the temperature in the room at various locations. Now, write your paragraph and discuss the data that you collected.

Also make a scatter plot of the temperature during your class period versus the temperature after school. Investigate the model to see if the data fits a linear, quadratic, or exponential function.

Procedure For Evaluating Algebraic Equations On The TI-80

1. Place the expression in Y1: Press Y1. Now, enter the expression.

For Activity 4:

$$Y1 = (5/9) (X-32)$$

Emphasize the importance of using parentheses.

2. Enter a value for X and repeat this process until all of your data is evaluated.

2ND VARS

HIGHLIGHT Y1

ENTER YOUR VALUE AT

Y1(VALUE) THEN PRESS ENTER

TI-80 PROCEDURE TO MAKE A SCATTER PLOT

- 1) Enter data.
STAT
1: EDIT
enter numbers in L1 (high)
enter numbers in L2 (low)
- 2) Make a graph of the data.
2ND Y = (STAT PLOT)
5: PLOTS ON
ENTER
2ND Y = (STAT PLOT)
1: PLOT1
PRESS ENTER AND HIGHLIGHT THE FOLLOWING.
TYPE: DOT
XLIST: L1
YLIST: L2
MARK:
PRESS ENTER
2ND MODE (QUIT)
PRESS GRAPH
MAKE SURE YOU USE THE APPROPRIATE WINDOW.
- 3) FIND THE LINE THAT BEST FITS THE DATA.
LINEAR MODEL:
STAT CALC
3: LINREG (aX + b)
2ND 1 (L1)
PRESS THE COMMA KEY
2ND 2 (L2) ENTER
YOUR DISPLAY WILL SHOW YOU:
LINREG(aX + b)
Y = aX + b
a = value
b = value
r = value
Y = VARS 2: STATISTICS ENTER
YOUR DISPLAY WILL SHOW YOU:
X/Y E EQ BOX
CURSOR OVER TO EQ AND THEN PRESS 5: REGEQ

YOUR DISPLAY SHOULD NOW SHOW YOU THE EQUATION OF THE LINE.

PRESS GRAPH.

QUADRATIC MODEL:

STAT CALC

4:QUADREG

2ND 1 (L1)

PRESS THE COMMA KEY

2ND 2 (L2) ENTER

YOUR DISPLAY WILL SHOW YOU:

QUADREG

Y =

a =

b =

c =

Y = CLEAR (CLEAR THE OLD VALUES OUT OF Y1)

VARS 2: STATISTICS

CURSOR OVER TO EQ AND THEN PRESS 5: REGEQ

YOUR DISPLAY SHOULD NOW SHOW YOU THE QUADRATIC EQUATION FOR THE DATA.

PRESS GRAPH.

EXPONENTIAL MODEL:

STAT CALC

7:EXPREG

2ND 1 (L1)

PRESS THE COMMA KEY

2ND 2 (L2)

YOUR DISPLAY WILL SHOW YOU:

EXPREG

Continue the same process for the exponential as you did for the linear and quadratic models.