THE NATION'S NEWSPAPER

Math TODAY Teacher Edition

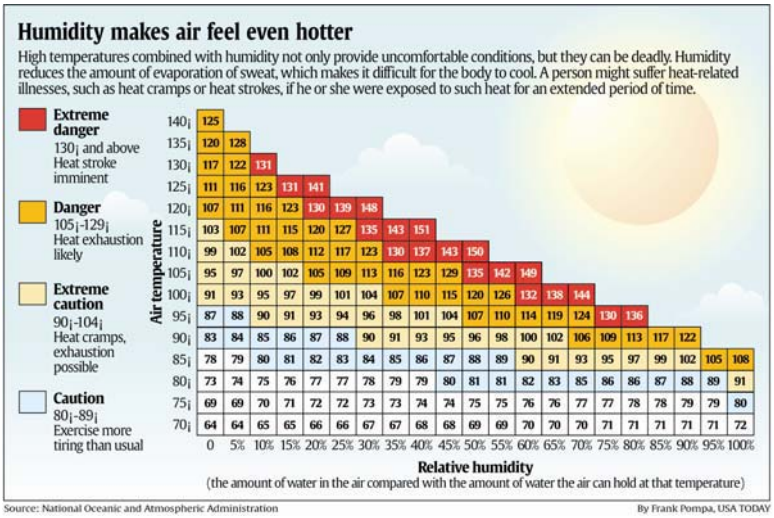
USA TODAY

NO. 1 IN THE USA

Activity 7:

Humidity makes air feel even hotter – Part II

by: Bob Tower



Activity Overview:

Using data from the USA TODAY graphic, "Humidity makes air feel even hotter" students will explore quadratic and cubic functions to determine how well they model the relationship between air temperature and heat index. When the models have been determined, students will use these models to make predictions about the heat index when given a specific temperature.

Concepts:

- Modeling real-world data with quadratic and cubic functions
- Creating scatter plots using real-world data
- Comparing data in graphical and numerical form
- Analyzing rate of change

Activity at a Glance:

- Grade level: 7-10
- Subject: Algebra
- Estimated time: 50 minutes

Materials:

- TI-Navigator™ system
- TI-83 Plus family or TI-84 Plus family of graphing calculators

Recommended:

- USA TODAY Newspapers
- Multimedia Projector
- TI Keyboards

Prerequisites:

Student should know how to:

- build regression models
- create scatter plots

TI navigator

For use with the TI-Navigator™ Classroom Learning System

Student Objectives:

- Explore quadratic and cubic functions that will model the relationship between air temperature and heat index at fixed relative humidity values
- Make generalizations and apply the findings

Background:

Heat index is a measure used to describe the relationship between humidity and temperature, and how this makes us feel on a hot day. Mathematical models of the data will be determined and used to predict the temperature when given the heat index, and to predict the heat index when given the temperature. This activity will look at the difference between data that will generate a linear graph and a quadratic graph.

Preparation:

- Download the activity files to your computer: Teacher Edition, Student Edition, Transparency, Activity Center Settings, Lists, and LearningCheck™ Assessment. (See Appendix B for a list of the files.)
- Make copies of the Student Edition for your class. Students can refer to the Student Edition during the activity and use it to record their work.
- Set up your TI-Navigator system and make sure you are familiar with the following functions: Send to Class, Collect from Class, Screen Capture, Quick Poll, Activity Center, LearningCheck Assessment, and Class Analysis.
- Students will need a TI-83 Plus or TI-84 Plus graphing calculator, either working in pairs or individually.
- Recommendations:
  - Multimedia Projector for sharing the Activity Center, Quick Polls, and Screen Captures with your students
  - TI Keyboards to easily answer LearningCheck assessment questions

Data Source:

National Oceanic and Atmospheric Administration

Activity Extensions:

- Encourage students to research this topic using the National Oceanic and Atmospheric Administration (NOAA) website – www.noaa.org.
- Encourage students to find articles in USA TODAY that relate to the effects of a heat wave on people or the economy of a region.
- Have students use TI's data collection technology to test the heat and humidity in your own area.

Curriculum Connections:

- Health and Physical Education - exploring effects on the human body during exercise or the effects of extreme heat and humidity on the spread of disease
- Anatomy and Physiology - exploring effects on the human body when these extreme conditions prevail
- Environmental Science – examining effects of extreme heat and humidity on the environment
- Agricultural Science - exploring effects of extreme heat and humidity on livestock and crops
- Geography - examining regions that are experiencing extreme heat and humidity

Teacher: **Students:**

Classroom Management Tips:

- You may use the transparency for a class discussion before the students start working. This will give the students a better understanding of how to read the graphic and retrieve data.
- Remind students to carefully read all parts of the graphic before they start collecting data.
- Students can work individually or in small groups on this activity. Working in groups is especially helpful as they learn the various features of the calculator.
- Technology appeals to almost all students. Encourage all students to handle and use the graphing calculators. The TI graphing calculators are designed to be durable for daily classroom use and backpack portability.
- If possible, use an overhead ViewScreen™ graphing calculator for instruction. It will be easier for you to provide instructions and directions if the students can see the display on your graphing calculator.

Activity Step-by-Step:

The following steps represent a suggested TI-Navigator classroom procedure to answer the focus questions.

1. Send to Class – send humidity data files to class in lists L1 and L2
2. Calculator – create a scatter plot of the data
3. Screen Capture – check student understanding
4. Quick Poll – Open Response, what is the air temperature when the humidity is 50% and the heat index is 105°F?
5. Quick Poll – Yes/No does the graph of the quadratic have any other points where the heat index will be 105°F?
6. Quick Poll – Multiple Choice, the range of temperatures for the Extreme danger category
7. Send to Class – send humidity data files to class in lists L3 and L4
8. Calculator – create a scatter plot of the data
9. Screen Capture – check student understanding
10. Activity Center – explore student regression model for the cubic function and scatter plot
11. Quick Poll – Open Response, if the relative humidity is 100% what is the air temperature when the heat index is 105°F?

Focus Questions:

- What is the air temperature when the humidity is 50% and the heat index is 105°F? Which model did you choose to represent the data?
- What is the minimum air temperature when the Extreme danger category is reached if the relative humidity is 50%?
- If the relative humidity is 100% what is the air temperature when the heat index is 105°F? Which model did you choose to represent the data?

Summary:

- Write a summary of your observations of the two previous activities about the relationships among heat index, air temperature, and relative humidity levels.
- Optional: Include the linear function activity in your summary as well.

  (See Activity 6: Humidity makes air feel even hotter – Part I.)

Teacher:

12. Quick Poll – True/False, the higher the relative humidity and air temperature the lower the heat index?
13. LearningCheck Assessment – answer the focus questions and discuss the results with your class to check for understanding

See below for details on each of these steps.

Students:

STEP 1 – SEND TO CLASS

1. After students have logged into TI-Navigator, send the "Humidity makes air feel even hotter" data (MT07L1.8xl and MT07L2.8xl) to the class using **Force send to students now**.

   The data represents the air temperatures from 70°F through 110°F and the corresponding heat index levels at 50% relative humidity.
2. Instruct your students to exit TI-Navigator when you are ready to go to the next step.

1. Press [APPS], select NavNet, and login.
2. Wait for the teacher transfer – the data is downloaded in two lists, L1 and L2.
3. Once the data is downloaded, press BACK ([ZOOM]) and then [4] to EXIT APP.

STEP 2 – CALCULATOR

1. Instruct the class to create a scatter plot for the data in L1 and L2.
2. Instruct your students to use the calculator's regression capabilities to create a quadratic regression based on their scatter plot. They should round the coefficients to three significant digits.
3. Prompt the class to answer the following question using their regression model and record their answer.

   Q. What is the air temperature when the humidity is 50% and the heat index is 105°F?

   A. 93.8°F

1. Press [2nd] [Y=] and adjust the settings for the scatter plot.
2. Press [WINDOW] and set the appropriate window values for your data.
3. Press [GRAPH].
4. To use the regression capabilities, press [STAT] [▶] to access the CALC menu.
5. Press [5] to select QuadReg and enter [2nd] [L1] [,] [2nd] [L2] [,].
6. Press [VARS] [▶] [ENTER] [ENTER].
7. Press [Y=] and enter 105 in Y2.
8. Press [2nd] [TRACE] and use [5]:intersect to answer the question.

USA TODAY

Teacher: **Students:**

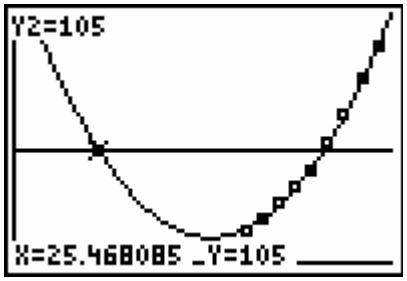
STEP 3 – SCREEN CAPTURE

1. Use **Screen Capture** to check student understanding.

   The scatter plot should look like the image on the right. If not, this is an opportunity to discuss appropriate independent and dependent variables for this problem.

   Students should show all the points where the graph of the quadratic function would reach a heat index of 105°F. (The Window should be changed to xMin = 0.)

2. Instruct your students to return to the TI-Navigator system when you are ready to go to the next step.



1. Press PRGM, select GONAVNET and press ENTER.

STEP 4 – QUICK POLL

1. From the pull-down menu select **Open Response** and check **Resubmit** so that students may change their answers.
2. Press **Start Poll** when you are ready to start.
3. Instruct the class to answer this question:

   Q. What is the air temperature when the humidity is 50% and the heat index is 105°F?

   A. 93.8°F

4. Discuss with your class to check for understanding.

   NOTE: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue.

5. Press **Stop Poll** when you are ready to go to the next step.

1. Input answer and press SEND (Y=).
2. Resubmit answer as needed during the class discussion.

STEP 5 – QUICK POLL

1. From the pull-down menu select **Yes No**; make sure the **Resubmit** option is turned off.
2. Press **Start Poll** when you are ready to start.
3. Instruct your class to mark **Yes** or **No** and send their answer to this question:

1. Mark answer Yes or No and press SEND (Y=).

Teacher: | **Students:**

Q. Yes or No, Does the graph of the quadratic function have any other points where the heat index will be 105°F?

A. Yes (the quadratic function would also reach 105 when x is approximately 25.5)

4. Discuss with your class to check for understanding.

   NOTE: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue.

5. Press **Stop Poll** when you are ready to go to the next step.

STEP 6 – QUICK POLL

1. From the pull-down menu select **Multiple Choice A Thru D** and check **Resubmit** so that students may change their answers.
2. Press **Start Poll** when you are ready to start.
3. Instruct the class to mark and send A, B, C, or D to answer this question:

   Q. The range of temperatures for the Extreme danger category is:

   A) 80-89

   B) 90-104

   C) 105-129

   D) 130 and above

   A. D) 130 and above

4. Discuss with your class to check for understanding.

   NOTE: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue.

5. Press **Stop Poll** when you are ready to go to the next step.

1. Mark answer A, B, C, or D and press SEND (Y=).
2. Resubmit answer as needed during the class discussion.

STEP 7 – SEND TO CLASS

1. Send the "Humidity makes air feel even hotter" data (MT07L3.8xl and MT07L4.8xl) to the class using **Force send to students now**.

   The data represents the air temperatures from 70°F through 85°F and the corresponding heat index levels at 100% relative humidity.

1. Wait for the teacher transfer – the data is downloaded in two lists, L3 and L4.

USA TODAY

Teacher:	Students:
2. Instruct your students to exit TI-Navigator when you are ready to go to the next step.	2. Once the data is downloaded, press BACK (ZOOM) and then 4 to EXIT APP.

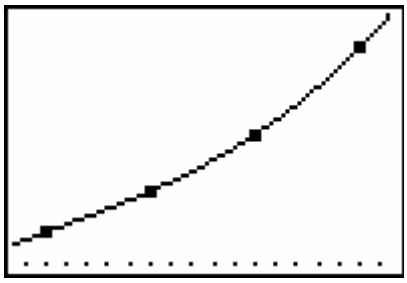
STEP 8 – CALCULATOR

1. Instruct the class to create a scatter plot for the data in L3 and L4. 2. Instruct your students to use the calculator's regression capabilities to create a cubic regression based on their scatter plot.	1. Remember to turn off Y1, Y2, and Plot1. 2. Press 2nd Y= and adjust the settings for a scatter plot in Plot2. 3. Press WINDOW and set the appropriate window values for the data. 4. Press GRAPH. 5. To use the regression capabilities, press STAT ▸ to access the CALC menu. 6. Press 6:CubicReg and enter 2nd [L3] , 2nd [L4] ,. 7. Press VARS ▸ ENTER ENTER.

STEP 9 – SCREEN CAPTURE

1. Use **Screen Capture** to check student understanding.

   The scatter plot and cubic graph should look like the image on the right. If not, this is an opportunity to discuss appropriate independent and dependent variables for this problem.



2. Instruct your students to return to TI-Navigator when you are ready to go to the next step.	1. Press PRGM, select GONAVNET and press ENTER.

Teacher: **Students:**

STEP 10 – ACTIVITY CENTER

1. In Activity Center, use **Load Activity Settings** to load MT_Humidity2.act.
2. Press **Start Activity** to begin.
3. Instruct your students to submit an equation that would reflect the equation given to them over the *x*-axis.
4. As submissions appear, discuss the following with your class to check for understanding:
   - Submissions that are particularly interesting or ambitious
   - Submissions that have common errors

   NOTE: Select **Pause Activity** to have a class discussion. Select **Resume Activity** to continue.

   Sample discussion questions:
   - *Describe what happens to an ordered pairs when reflected through the x-axis? y-axis?*
   - *Discuss the impact on the graph when reflected through the x-axis or y-axis.*
5. Press **Stop Activity** when you are ready to go to the next.
6. In Activity Center, select **Contribute Points**.
7. Select **Configure**, **Number of points per student** 2, **Step Size** 1.
8. Check each of the following: **Display coordinates**, **Let students resubmit points**, and **Send current contents as background**.
9. Press **Start Activity** to begin.
10. Instruct students to mark the vertex of each parabola.
11. As submissions appear, discuss the following with your class to check for understanding:
    - Submissions that are particularly interesting or ambitious
    - Submissions that have common errors

    NOTE: Select **Pause Activity** to have a class discussion. Select **Resume Activity** to continue.

    Sample discussion questions:
    - *What is the axis of symmetry?*
    - *What does the axis of symmetry do to the graph of the quadratic?*
    - *Explain what the vertex represents on the graph.*
12. Press **Stop Activity** when you are ready to go to the next step.

1. From the TI-Navigator Home screen press 1 `Activity Center`.
2. When prompted, enter your equation in `Y2=` and press `SEND` (Y=).

   OPTION: Press `PLOT` (@) to view the graph of your equations before sending.
3. Move to the vertex of each parabola and press `MARK` (Y=).

   OPTION: Press `PLOT` (ZOOM) to view the graph of your points before sending.

Teacher:	Students:
STEP 11– QUICK POLL 1. From the pull-down menu select **Open Response** and check **Resubmit** so that students may change their answers. 2. Press **Start Poll** when you are ready to start. 3. Instruct the class to answer this question: **Q. If the relative humidity is 100% what is the air temperature when the heat index is 105°F?** A. The air temperature would be about 84.3°F. 4. Discuss with your class to check for understanding. **NOTE**: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue. 5. Press **Stop Poll** when you are ready to go to the next step.	1. Input answer and press SEND (Y=). 2. Resubmit answer as needed during the class discussion.
STEP 12 – QUICK POLL 1. From the pull-down menu select **True False**, make sure the **Resubmit** option is turned off. 2. Press **Start Poll** when you are ready to start. 3. Instruct your class to mark **True** or **False** and send their answer for this question: **Q. The higher the relative humidity and air temperature, the lower the heat index.** A. False 4. Discuss with your class to check for understanding. **NOTE**: Select **Pause Poll** to have a class discussion, then select **Resume Poll** to continue. 5. Press **Stop Poll** when you are ready to go to the next step.	1. Mark the answer True or False and press SEND (Y=).

Teacher: **Students:**

STEP 13 – LEARNINGCHECK ASSESSMENT

1. Using **Send to Class**, distribute the LearningCheck assessment file Humid2.edc to your students using **Force send to students now**.
2. Prompt them to open the LearningCheck assignment and answer the following questions:

Q. When the humidity is 50% and the heat index is 105°F, which model would you choose to best represent the data?

A. A quadratic model, $y = ax^2 + bx + c$

Q. What is the air temperature when the humidity is 50% and the heat index is 105°F?

A. The air temperature would be about 93.8°F.

Q. What is the minimum air temperature when the Extreme danger category is reached if the relative humidity is 50%?

A. The air temperature would be about 103.5°F.

Q. If the relative humidity is 100% and the heat index is 105°F, which model would you choose to represent the data?

A. A cubic model, $y = ax^3 + bx^2 + cx + d$

Q. If the relative humidity is 100% what is the air temperature when the heat index is 105°F?

A. The air temperature would be about 84.3°F.

Q. Write a summary of your observations of the two previous activities about the relationships among heat index, air temperature, and relative humidity levels. Optional: Include the linear function activity in your summary as well. (See Activity 6: Humidity makes air feel even hotter – Part I.)

A. Answers will vary but there should be reference to the fact that higher the relative humidity and air temperature, the higher the heat index. When the heat index is high there is potential for fatigue, sunstroke, heat cramps, and heat exhaustion with continued exposure. The sweat glands are used to help the cooling process through sweating. The evaporation of the sweat takes away the heat and will help the body cool. If there is high humidity then the evaporation process is hindered because the air is already saturated.

1. Press BACK (ZOOM) to return the TI-Navigator home screen.
2. Press 2 Network Apps.
3. Select LearnChk.
4. Select the Humid2 assignment and follow the prompts to answer the questions.

***NOTE**: TI Keyboards may be used to answer the questions.*

Teacher:

3. Select **Class Analysis** and make sure all of the students have completed the assignment.
4. Select **Collect From Class**.

   NOTE: Before collecting the answers, we recommend that you check these options:

   - **Delete Answer File from Device after Collect**
   - **Delete Assignment File from Device after Collect**
5. Using **Class Results Slide Show**, discuss the results with your class to check for understanding.

Students: