Mathematician _____

How Cool It Is

OBJECTIVES

- Record temperature versus time for a cooling object.
- Model the temperature of an object as it cools.

PROCEDURE

1. Connect the temperature probe to the TI-Nspire calculator.

2. Set up the temperature probe to give readings in degrees Fahrenheit. Click on the temperature in the upper right-hand corner. Change the Measurement Units to °F. Click **OK**.

3. Record the temperature of the room.

Room Temperature	

4. Obtain a cup of hot water. Place the temperature probe in the cup of hot water, and leave it there for about 30 seconds.

5. Remove the temperature probe from the water, and rest it on the edge of a table. Do not let anything touch the tip of the temperature probe.

6. Start the data collection by pressing the **green arrow** on the calculator screen. The calculator will automatically stop the data collection after 3 minutes.

7. Disconnect the temperature probe, and carefully clear away the hot water.

ANALYSIS

1. What type of function appears to be a good model for the data? Explain your reasoning.

2. Generate a regression equation, select **menu >Analyze >Curve Fit**. Select a curve fit option and press **enter**.

   a. Write the regression equation. Round to three decimals.

   b. Do you think the regression equation will be a good model for $t > 180$ seconds? Why or why not?

3. a. If we continued to take readings of the temperature of the water, what is the lowest temperature the water would reach?

   b. Is this value consistent with the regression equation? Explain.

4. The regression model does not take into account the room temperature, so you will account for this.
   a. Press **menu >Data >New Calculated Column**.

   b. Enter **Adjusted Temps** as the Name and **A** as the Short Name.

   c. Enter **Temperature-"value"** as the Expression. For example, if the room temperature is 70°F, you would enter **Temperature-70** as your expression. Click **OK**.

5. Press **menu >Send To >List & Spreadsheets**.

6. Complete the table. Round to three decimals.

Time	Adjusted Temp
20	
160	

7. Determine a model for your adjusted data in the form $y = a(B)^x$. Round to three decimals. You may add a calculator page to your document.

Model Equation	

8. Go back to page 1.1. Create a scatterplot with the adjusted temperatures.
   a. Press **menu >Send To >Data & Statistics**.

   b. Click on run1.temperature, and change it to run1.adjusted_temps.

9. Graph your model.
   a. Press **menu >Analyze >Plot Function**.

   b. Enter your model equation.

10. Graph the regression. Press **menu >Analyze >Regression >Show Exponential**. Round to three decimals.

Regression Equation	

11. How does your model compare to the regression equation?

EXTENSION

Hot drinks such as coffee, tea, and hot chocolate seem to cool slowly when we have to wait to drink them and then cool rapidly once they reach the temperature at which we would like to drink them.

1. Is it true that very hot drinks cool very slowly at first, and then cool rapidly after reaching a more reasonable temperature?

2. Explain your answer through use of the cooling data, the graph, and/or the equations you generated for this activity.