A Wet Welcome Home

ID: 11542

Time Required
45 minutes

Activity Overview

When the Mendoza family returned from their Amazon vacation, they found their living room to be as wet as the rainforest. It turned out that a pipe above the ceiling had been leaking for the past 30 days. In this adventure, students will conduct an experiment that will determine how many gallons of water leaked from the Mendoza's pipe.

Topic: Probability, Statistics, and Data Analysis; Measurement

- *Create a scatter plot*
- *Find the equation of the line of best fit*
- *Convert units from metric to customary*
- *Use a variety of tools and methods to conduct a scientific inquiry*
- *Collect, record, and analyze information using tools*

Teacher Preparation and Notes

- *For practice and review of the coordinate plane before beginning this activity, download and use the Rhino Game under the SMILE Math Application.*
- *For help downloading applications, see Appendix A. For information and help using the Rhino Game, see Appendix C.*
- *You will need the following materials to complete this activity.*
  - *Graduated cylinder (measured in mL)*
  - *Plastic cup*
  - *Bottle of water*
  - *Safety pin*
  - *Stopwatch*
  - *Paper towels*
- ***To download the student worksheet and TI-Navigator file, go to education.ti.com/exchange and enter "11542" in the quick search box.***

Associated Materials

- *SciAct04_WetWelcome_worksheet_TI73.doc*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *TI-73 and CBL in Data Collection (TI-73 Explorer) — 6623*
- *An Olympic Plot (TI-73 Explorer) — 6696*

Setup

1. This activity works well with 3 or 4 students per group.
2. Punch a small hole in the bottom of the plastic cup. Punch the hole from the inside of the cup. Punching from the outside can result in plastic pieces sticking up, interfering with a smooth drip.
3. One student will hold the plastic cup over the graduated cylinder and pour the bottle of water into the plastic cup. A second student will run the stopwatch. A third student will read the level of water in the cylinder. A fourth student will record the results of the experiment.

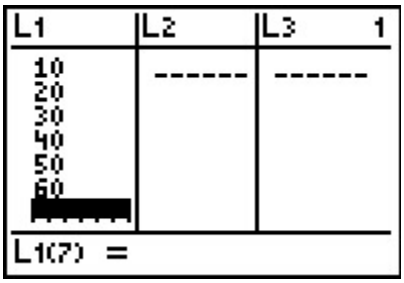
NOTE

- Students may need to run several trials to generate accurate data.
- If there are only three people in a group, then the person reading the level of water can also record the results.

Data Collection

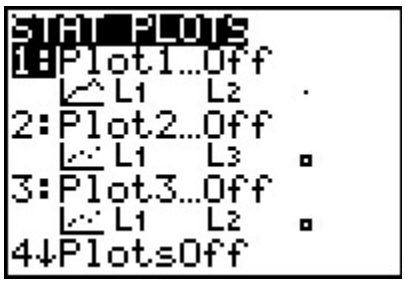
1. Hold the plastic cup over the graduated cylinder.
2. Set the stopwatch to zero.
3. When the student with the stopwatch says “Go,” pour water from the water bottle into the plastic cup.
4. The student with the stopwatch announces when the timer reaches 10 seconds, 20 seconds, 30 seconds, 40 seconds, 50 seconds, and 60 seconds.
5. A student reads the level of the water at each 10 second time interval and another student records the levels in the table of the student worksheet.

Data Analysis

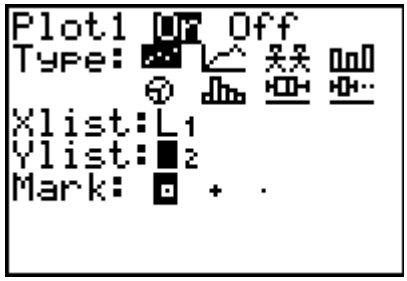


1. To build a list in the calculator, press [LIST].
2. In L1, type in the times for which the water levels were recorded.
3. In L2, type in the amount of water that corresponds to each time.

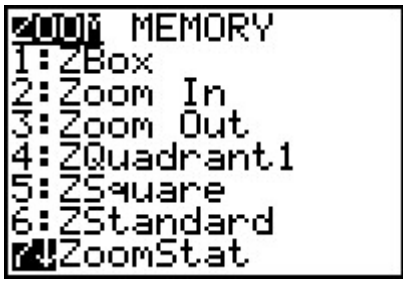
4. To make a scatter plot of the data, begin by pressing 2nd [PLOT] to access the Stat Plot menu.

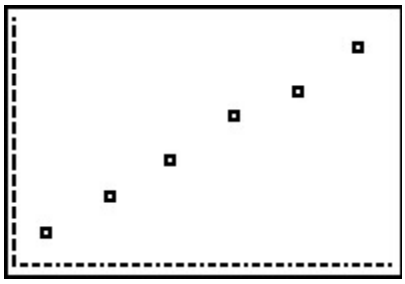


5. Press 1 to access **PLOT1**. Use the arrow keys to move to each row. Turn the plot ON, choose the scatter plot graph and use lists L1 and L2.



6. Press GRAPH. Next, press ZOOM, and then select **7:ZoomStat.** On your worksheet, describe the shape of the graph. What does its shape say about the drip?



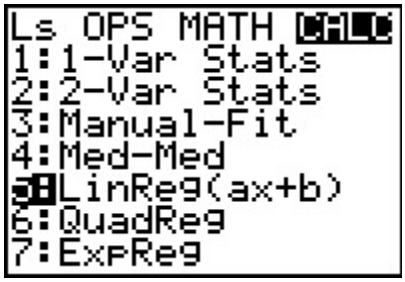


Note: You may prefer to have students select an appropriate viewing window instead of using **7:ZoomStat.**

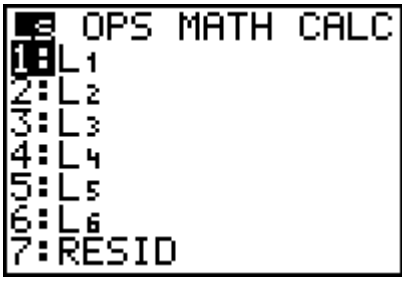
7. A line drawn on a scatter plot that passes close to most of the data points is called a line of best fit. It can also be called a trend line or a regression line. It can be used to make predictions. To find the best fit line, begin by pressing 2nd [STAT].

Note: You may wish to have students first manually draw a trend line using Manual Fit. See Appendix for help with Manual Fit.

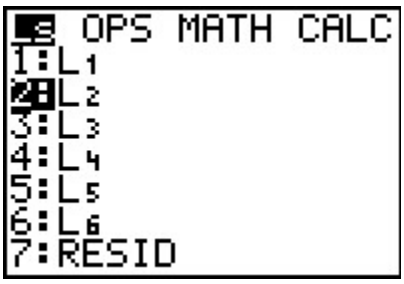
8. Use the arrow keys to highlight CALC and select **5: LinReg(ax+b).**



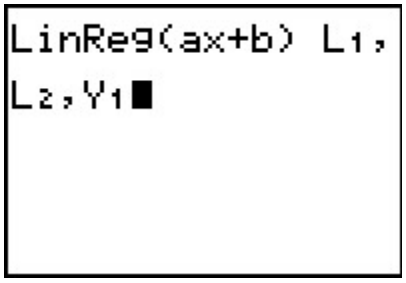
9. Press 2nd [STAT] and select L1.



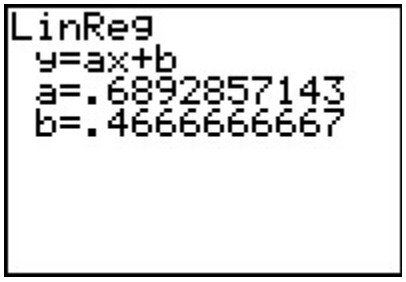
Then, press , 2nd [STAT] and select L2.



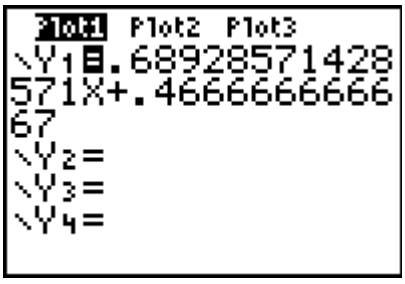
Finally, press , 2nd [VARS] select **2:Y-Vars**, and **select 1: Y1**.

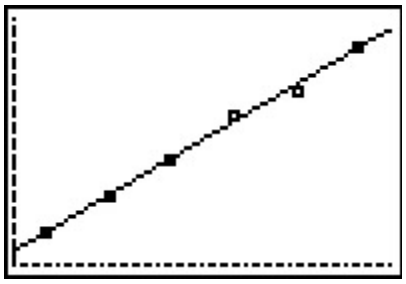


10. Press ENTER. This is the equation of the best fit line. Write the equation on your worksheet in the space provided.



11. Press Y= to view the equation, then GRAPH to see the best fit line graphed on your plot.

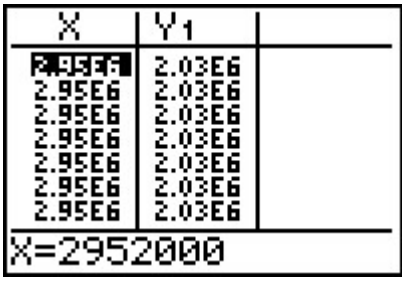


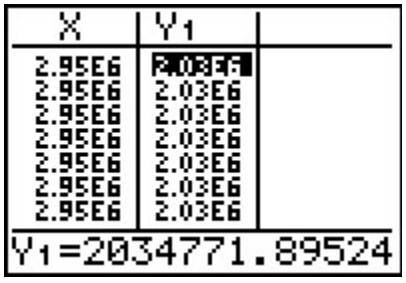


12. Press 2nd [QUIT] and calculate how many seconds are in 30 days. Write this number in the space provided on your worksheet.

13. Press 2nd [TBLSET]. Set the TblStart at the number of seconds in 30 days.

14. Press 2nd [TABLE]. This is the table of values for the line of best fit. At first, it may look like all the values are the same. However, the numbers in the table are rounded and written in scientific notation. Read the full numbers at the bottom of the screen as they are highlighted.





NOTE

- You may want to show students how scientific notation is shown on the calculator: 1.8E6 means 1.8 x 106, or 1,800,000.
- In step 13, you can also change the increments by which the *x*-values increase or decrease. Ask students why someone would choose increments of 3600.

15. Record the *y*-value that corresponds with the *x*-value of 2,592,000. This is the number of milliliters that leaked out in 30 days. Record this value on your worksheet.

16. Convert the number of milliliters that leaked to liters. Record this value on your worksheet.

17. Press [2nd] [QUIT]. Type in the number of liters that leaked in the 30 day period. Press [2nd] [CONVERT] and choose **3:Volume.** Select **1: liter,** then select **2: gal.** Then press [ENTER]. This is the number of gallons that leaked. Enter this on your worksheet.

5. If you are satisfied with your plot, sketch it on the axes on your worksheet. If not, press [ENTER], choose **5: REPEAT SAMPLE,** and then try again.

6. Use ◀ and ▶ to move along the Distance-Time plot. Keep in mind that the *x*-coordinate represents the time in seconds since the beginning of data collection and the *y*-coordinate represents the distance in meters from the CBR 2 to the coffee filters. Answer the questions about Trial 2 on your worksheet.

Discussion Notes

Linear equations have constant first differences. That is, as the *x*-coordinates change by a constant amount, the *y*-coordinates also change by a constant amount. Have students find the first differences for their data.

Because of human error in timing and reading the water levels, they will probably not be exactly constant, but they should be close. Ask students how this can be seen on their graphs.

Extension Activity

Suppose that on day 15 during the leaking time period, that the crack in the pipe got larger and water started leaking out at a greater rate than before. Sketch a graph for the 30 days that shows this scenario.

Worksheet Answers

1. Answers will vary.

2. Time is independent; Water level is dependent.

3. Possible answer: The points appear linear; the rate of change between points is nearly constant, so the pipe is dripping at a steady rate.

4. Answers will vary.

5. 2,592,000 seconds

6a-c. Answers will vary.

Extension: Answers will vary. For the first half, the rate of change is moderate and equal. Halfway through, the rate of change increases and the line is steeper.

TI-Navigator™ Extension Activity

1. Have one person from each group submit their equation for their line of best fit. (Tell students to round the values of *a* and *b* first.) Show all the graphs in the Activity Center simultaneously.

2. Ask:

- Which “pipe” leaked at the fastest rate? How can you tell?
- Which “pipe” leaked at the slowest rate? How can you tell?

3. Show the equations and graphs in the Graph-Equation window. Highlight each equation to show how the slope affects the steepness of line. Remind students that the slope is the rate of change, so the larger the slope, the faster the water is leaking out.

Appendix A – Downloading and Installing Apps

To Download an App to Your Computer:

- Go to TI's Web site, education.ti.com. Click on "DOWNLOADS" at the top of the webpage.
- From the **Calculator Software Applications (Apps)** section, click the link "**Download Apps and OS**".
- Select TI-73 Explorer™ from the list of calculators under the **Latest** section (left side of webpage).
- Select the APP you want to download by clicking on the name of the APP. Press the DOWNLOAD button. Accept the license agreement and click on the App name.

To Install an App on Your Calculator:

1. You will need a TI Connectivity cable and TI Connect™ Software. If you have TI Connect, skip to step 2. Otherwise:

- Go to TI's website at **education.ti.com**.
- Mouse over "**DOWNLOADS**" in the upper left corner of the Web page.
- Click on Apps & Software from the drop-down list.
- Click on TI-73 Explorer ™, then click on the appropriate application from the list.
- Select the name of the application with the downward arrow next to it. Then, follow the prompts to save the software to your computer.
- To install, double click on the installer icon and follow the onscreen directions.
- Launch TI Connect. The application will open to the TI Connect Desktop screen.

2. Connect your calculator to your computer using a TI Connectivity cable. Browse for the location of the App file(s) that you saved.

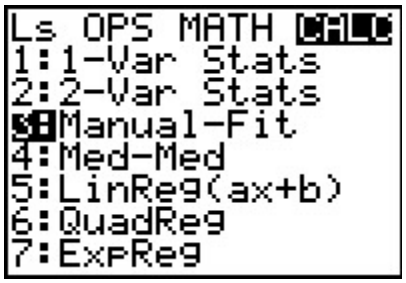
- **For TI Connect for Windows® Users:** Drag and drop the App file(s) onto the TI Connect icon or open TI Device Explorer™ window.
- **For TI Connect for Macintosh® Users:** Launch TI Connect for Macintosh. On the menu bar, select "**Connection**" and then select your calculator. Select the port to which the TI Connectivity cable is connected and click "**Connect**". (The TI Device Explorer window will open.) Drag and drop the App file(s) into the TI Device Explorer window.
- **For TI Connect for Mac OS X Users:** Launch TI Device Explorer from within TI Connect. A device window will open listing the connected calculator. Drag and drop the App file(s) on the name of the calculator upon which you would like the App file(s) installed.

NOTE The TI-73 Explorer™ has 8 "App spaces." These are chunks of memory into which you can load Apps. Some Apps take up only 1 space and other Apps take up to 4. You can delete an App you no longer need or want to make room for another App. Simply press [2nd] [MEM], select Delete, select Apps, move the cursor to the App name to be deleted, and press [ENTER].

Appendix B – Using Manual Fit

With Manual-Fit, students can fit a line to plotted data on the screen manually. This is an alternative to having the calculator draw the line automatically.

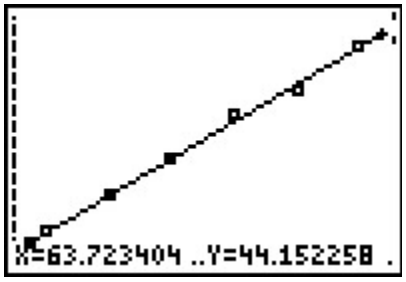
1. After the data is plotted, go to the calculator home screen by pressing [2nd][QUIT].



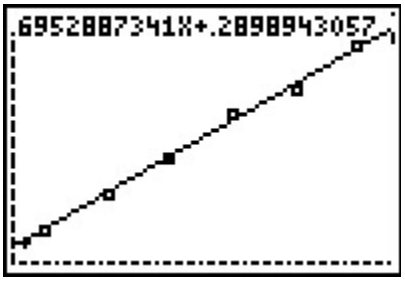
2. Press [2nd][STAT]◀**3: Manual Fit.** This pastes the command on the home screen. Press [2nd][VARS], then select **2:Y-Vars,** and then **1: Y1.** This will store the equation of your line in Y1 after you draw it. Press [ENTER].

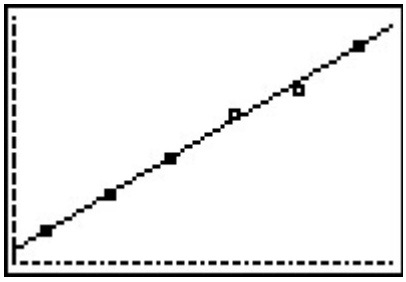
3. Press [GRAPH]. Position the cursor at the beginning of the line segment that you want to draw and press [ENTER].

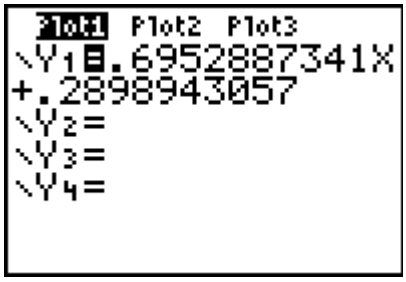
4. Continue to press the arrow keys to draw the line. When you have matched the plotted points, press [ENTER]. The line is drawn and the equation appears at the top of the screen. You can continue to change the position of the line by using the arrow keys. The equation will update as the line is moved.



5. Press [ENTER] when you are satisfied with the fit of the line. The equation will be stored in the Y1.







Appendix C – SMILE Mathematics App: Rhino Game

Introduction

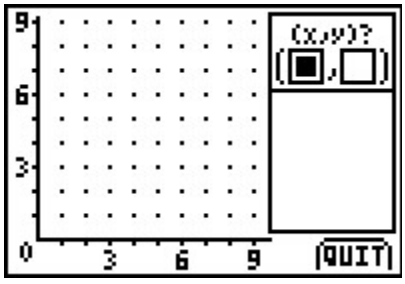
The SMILE Mathematics application is a suite of five games: Minimax, Box, Matching Fractions, Angle, and Rhino.

Press APPS and select **SMILEMth**. Press any key to move along the introductory screens. When the SELECT A GAME menu is displayed, select **5: Rhino** and press ENTER.

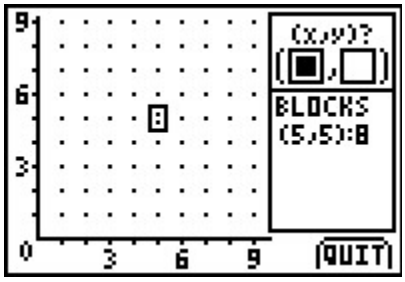
Rhino is a puzzle game based on coordinates. At its simplest, it reinforces the concept and use of coordinate notation to express position. After a little practice, the Rhino game becomes a strategy challenge. You have to discover the rhino's position using the minimum number of guesses. Information about the actual position of the rhino is displayed on screen after each turn.

You can select **1:View Help** for extra help.

Playing the Rhino Game



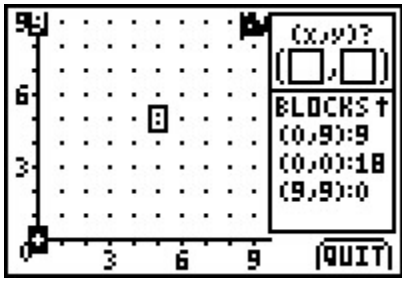
At the game's start screen, enter an *x*-coordinate and press ▶. Then enter a *y*-coordinate. The coordinates you entered are shown in the boxes at the top right. Below that, your coordinates will repeat, followed by another number. The number represents the number of blocks the rhino is away from that position. The result is also shown on the grid.



Enter another pair of coordinates and notice that the result is displayed in the same way. Continue to enter pairs until you find the rhino. The three most recent results will be displayed on the right side of the screen. You can scroll through all the results by pressing ▼ and ▲ as needed. All results are shown on the grid.

If the rhino is more than 10 blocks from the guessed location, the number will appear, but then be replaced with a **+** symbol.

When you correctly guess the rhino's position, your total number of guesses will be displayed. The lower the number of guesses, the better.



A Wet Welcome Home

Name _____

Class _____

In this adventure, you will conduct an experiment that will determine how many gallons of water leaked from a pipe during a given time period.

1. Fill in the table with the data generated by the investigation.

Time (sec)						
Water Level (mL)						

2. Which is the independent variable? Which is the dependent variable?

3. Describe the shape of your graph. What does its shape say about the drip?

4. What is the equation of the line of best fit? Round decimals to the nearest tenth.

5. How many seconds are in 30 days?

6a. How many milliliters leaked during 30 days?

6b. How many liters leaked during 30 days?

6c. How many gallons leaked during 30 days? Round to the nearest gallon.

Extension

Suppose that on day 15, during the leaking time period, the crack in the pipe got larger and water started leaking out at a greater rate than before. Sketch a graph for the 30 days that shows this scenario.