A Wet Welcome Home
ID: 11542

<div align="right">

Time Required
45 minutes

</div>

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 $\boxed{\text{LIST}}$.

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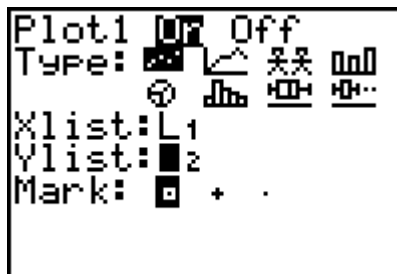
6. Press [GRAPH]. Next, press [ZOOM], and then select **7:ZoomStat.** On your worksheet, describe the shape of the graph. What does its shape say about the drip?

Note: You may prefer to have students select an appropriate viewing window instead of using **7:ZoomStat.**
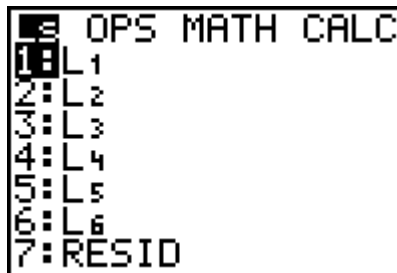
7. A line drawn on a scatter plot that passes close to most of the data points is called a line of best fit. It can also be called a trend line or a regression line. It can be used to make predictions. To find the best fit line, begin by pressing [2nd] [STAT].

Note: You may wish to have students first manually draw a trend line using Manual Fit. See Appendix for help with Manual Fit.
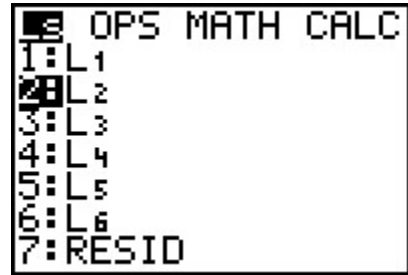
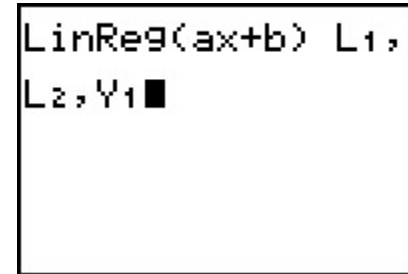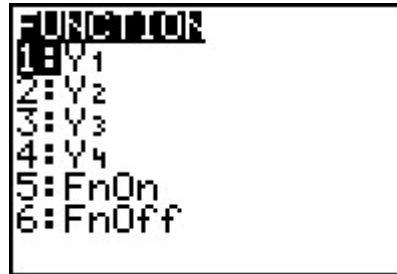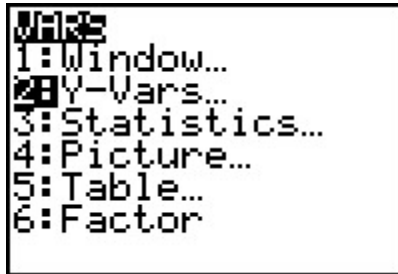**8.** Use the arrow keys to highlight CALC and select **5: LinReg(ax+b).**
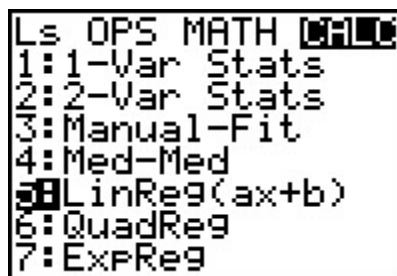
9. Press [2nd] [STAT] and select L1.

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

```
█ OPS MATH CALC
1:L₁
▓█L₂
3:L₃
4:L₄
5:L₅
6:L₆
7:RESID
```

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

```
█████
1:Window…
▓█Y-Vars…
3:Statistics…
4:Picture…
5:Table…
6:Factor
```

```
█████████
1█Y₁
2:Y₂
3:Y₃
4:Y₄
5:FnOn
6:FnOff
```

```
LinReg(ax+b) L₁,
L₂,Y₁█
```

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

```
LinReg
 y=ax+b
 a=.6892857143
 b=.4666666667
```
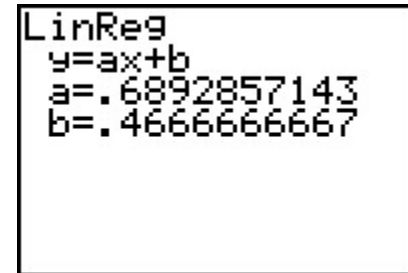
11. Press [Y=] to view the equation, then [GRAPH] to see the best fit line graphed on your plot.

```
████ Plot2 Plot3
\Y₁█.68928571428
571X+.4666666666
67
\Y₂=
\Y₃=
\Y₄=
```
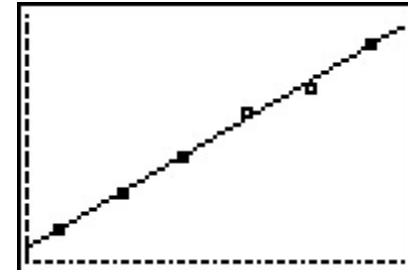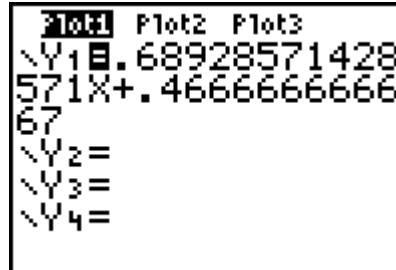
12. Press [2nd] [QUIT] and calculate how many seconds are in 30 days. Write this number in the space provided on your worksheet.

```
TABLE SETUP
 TblStart=29520…
 ₔTbl=1
Indpnt: ████ Ask
Depend: ████ Ask
```

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.

```
 X     │ Y₁
██████ │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
X=2952000
```

```
 X     │ Y₁
2.95E6 │ █████
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
2.95E6 │ 2.03E6
Y₁=2034771.89524
```

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.

```
2035 liter▶gal
        537.5901265
```
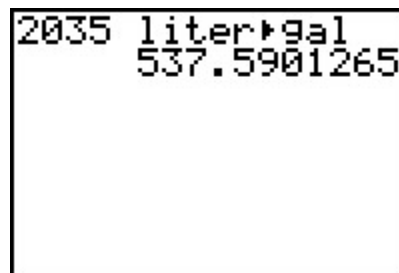
5. If you are satisfied with your plot, sketch it on the axes on your worksheet. If not, press ENTER, choose **5: REPEAT SAMPLE,** and then try again.

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.