

## STOP!

ID: 12579

Time required  
15 minutes

## Activity Overview

*In this activity, students will work with speeds in meters per second, and stopping distances in meters. With a collection of data values, the scatter plot reveals a relationship and a shape to the students. Finally, students are asked to perform the calculations and solve a radical equation themselves.*

## Topic: Radical Equations &amp; Functions

- *Converting between units of speed*
- *Using formula with square roots*
- *Comparing table of values with a function*

## Teacher Preparation and Notes

- *Prior experience entering formulas in lists and setting up a scatter plot is helpful but not required.*
- *An alternative method to using the program is detailed in the following pages. If this method is used the student worksheet will need to be modified.*
- *If the program is used, after the activity is completed students should press **[STAT]**, select **SetUpEditor**, and press **[ENTER]** to reset the List Editor.*
- **To download the student and student worksheet and calculator files, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter “12579” in the keyword search box.**

## Associated Materials

- *STOP\_Student.doc*
- *STOPDATA.8xp (program)*

## Suggested Related Activities

*To download any activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the keyword search box.*

- *Solve Square Root Equation (TI-84 Plus family Study Cards) — 1643*
- *Radical Transformations (TI-84 Plus family) — 11574*
- *Braking and Total Stopping Distances (TI-84 Plus family with TI-Navigator) — 5617*
- *Forensics Case 13, Life in the Fast Lane (TI-84 Plus family) — 6304*

**Problem 1 – Conversions**

Students in the United States are more familiar the customary units versus metric units. The first problem allows students to covert between miles per hour and meters per second, preparing them for making judgments in the second problem.

Two speeds are given, which can be used as a point of reference for students. 35 miles per hour and 45 miles per hour are relatively common speeds for local roads.

To enter the formula in **L2**, students need to move the cursor to the top of list L2. Then enter “**L1\*0.447**”. Explain to them that the formula must be in quotation marks so that list L2 will update each time a speed is entered in list L1.

Students can enter additional mph speeds in L1 to see the related meter/second rate.

L1	↵	⊛	L3	2
35			15.645	-----
45			20.115	-----
-----			-----	
L2 = "L1*0.447"				

L1	↵	⊛	L3	1
35			15.645	-----
45			20.115	-----
30			13.41	-----
65			29.055	-----
-----			-----	
L1(5)=				

**Problem 2 – Stopping Distance and Speed**

Students are given the formula for computing speed given the stopping distance (this will be entered later in L4). They are first asked to evaluate the formula when  $l = 20$ , using algebra.

$$r = 2\sqrt{5 \cdot 20} = 2\sqrt{100} = 2 \cdot 10 = 20 \text{ m/sec}$$

This first computation will help them estimate the stopping distance of a car that is driving through a school zone (i.e. a low speed). They may need to use a meter stick to help with their estimation.

Students are to enter their distance in **L3**. Then they need to enter the formula in **L4** and view the speed given in meters per second.

Then, students will enter the speed of a car on a highway in **L5** to determine the stopping distance in **L6** (enter the shown formula). They can use speed they found in Problem 1 if they are having trouble with m/s.

Discuss with students how both calculations were found using the same formula.

L3	↵	⊛	L5	4
20			20	-----
-----			-----	
L4 = "2*√(5*L3)"				

L5	↵	⊛	-----	6
10			5	-----
-----			-----	
L6 = "L5^2/20"				

Students will now compare the two variables length,  $l$ , and rate,  $r$ , in the formula  $r = 2\sqrt{5l}$ . They can do this two ways. The first method below is also outlined on the worksheet.

**Method 1**

Students are to run the program **STOPDATA**. This will setup lists **LNHT** and **RATE** in the List Editor. They will need to arrow down to see the entire set of values.

The list **LNHT** shows the stopping distance of several speeds. The list **RATE** is the related speed, in meters per second, of the stopping distance.

LNHT	RATE	----- 1
14	16.733	
9	13.416	
6	10.954	
0	0	
30	24.495	
20	20	
10	14.142	
LNHT(1)=14		

**Method 2**

Students can use lists **L3** and **L4**, by entering more values into list L3. Remind them that L3 is the stopping distances and L4 is the rate or speed of the car.

If using this method, students will need to select L3 for **Xlist** and L4 for **Ylist** when setting up the scatter plot.

L3	L4	L5
20	20	10
14	16.733	-----
9	13.416	
6	10.954	
0	0	
-----	-----	
L3(6) =		

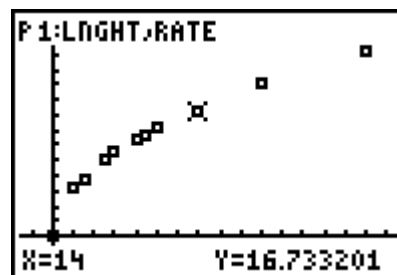
Students are to make observations, determining the general trend of the data and the relationship between the length and the rate. Help the students to find words that are descriptive and appropriate to the scenario such as increasing, directly proportional, not linear, etc.

One possible interpretation is “as the rate increases, so does the length, and vice versa.”

Students should understand that the pair (0, 0) represents a car that has a speed of zero (already stopped), which does not have a stopping distance.

Then, students are to look at the scatter plot and discuss the shape or relationship between the variables length and rate. Have students be as specific as they can. Compare their observations to previous functions studied (i.e. quadratic)? Can they discuss domain or range of this relationship?

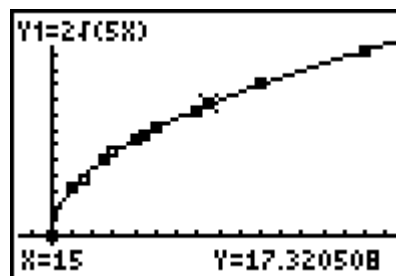
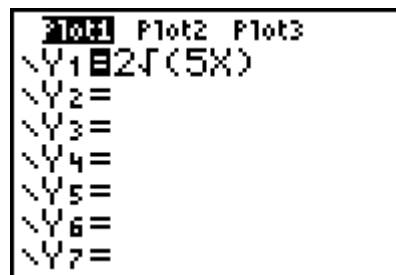
Pressing **TRACE** will allow students to view the values of each point.



Next, students will enter the formula for rate in **Y1**, replacing  $t$  with  $X$ , and press **GRAPH** to view the graph and scatter plot. They may need to zoom out to see the overall pattern of the function.

Students may need to revise the statements they made about the scatter plot describing the shape of the graph or the relationship between the variables. Discuss with students the properties of the graph (i.e. where it starts and the domain and range).

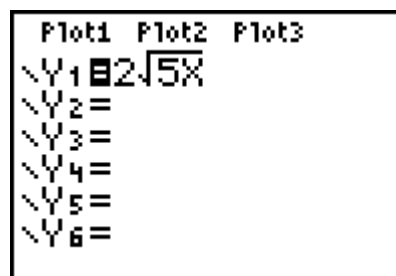
Some students may see half of a parabola, while others may have already seen a square root function.



At this time, you may wish to use the name *Square Root Function*, and compare its shape to that of a parabola. (Only the right half of the parabola would be graphed due to restrictions on the domain). That function would be  $t = \frac{r^2}{20}$ , which is a very wide parabola, with only positive values for rate.

**If using Mathprint OS:**

When entering the function in **Y1** and students press **2nd** **[√]**, the cursor will move under the square root bracket. Enter **5X** and press **ENTER**. No parentheses are needed.



**Homework Problem**

Students are given a formula that contains a square root. They will calculate the value of the length or the area when given the value of the other variable. Students should show their work and they algebraically solved the problem. They should see that the length of the room is easier to calculate because the formula is already “solved” for that variable.

**Extension**

Students can graph the “inverse” function for stopping distance, which is  $I = \frac{r^2}{20}$  by plotting ordered pairs (by hand on paper) from earlier lists in the activity, or by setting up the scatter plot with the variables reversed.

To do this, change the stat plot by selecting **RATE** for **Xlist** and **LNGHT** for **Ylist** (or L4 for Xlist and L3 for Ylist if using Method 2).



Discuss the independent and dependent variables in each form of the equation. *Does stopping distance depend on the rate of the car, or does the rate of the car depend on the length of the stopping distance (skid mark)?* This is an interesting scenario to discuss! Make sure that the graphing window is set up to view only the first quadrant, as all other values are irrelevant to the problem.