

Braking and Total Stopping Distances

Introduction

This activity helps students develop an understanding of the formulas for braking distance and stopping distance for a variety of vehicles.

Grades 6-8

NCTM Algebra Standards

- Use mathematical models to represent and understand quantitative relationships
- Model and solve contextualized problems using various representations, such as graphs, tables, and equations

Files/Materials Needed

Braking.act, Stopping.act

1

- Instruct your students to select one of the vehicle types so that each group member has a different vehicle type.
- Ask them to input the information into their calculators by placing the MPH information in L1 and the braking distance data for their vehicle type in L2.
- Instruct them to choose an appropriate viewing window for their data then have them plot the data.
- Each group member should show their plots to all the students in their group and they should determine what kind of function seems to best fit their plots.
- Encourage the group members to share their discussions with the rest of the class. The discussions should include that the plots are not linear and that a quadratic function might be a reasonable model for the data.
- Instruct students to determine the quadratic function that best fits their data by using the features of the calculator to find the quadratic equation for the data in lists L1 and L2.

2

- Launch TI-Navigator™ on the computer and start the session.
- Have each student log into NavNet on their calculator.

3

- Load the activity settings file *Braking.act*.
- Select the **Graph** tab and start the activity.
- Instruct students to press **SEND** to submit their equation.
- Have students log out of NavNet and return to the home screen of the calculator.

4

- Instruct students to continue using the vehicle type they selected earlier and, leaving the data in L1 and L2, enter the total stopping distance data for their vehicle type in L3.
- Instruct them to choose an appropriate viewing window for their data then have them use another plot to see the data for the braking distance and the total stopping distances.
- Each group member should show their plots to all the students in their group and they should determine what kind of function seems to best fit their plots.
- Encourage the group members to share with the rest of the class. The discussions should include that the plots are not linear and that a quadratic function might be a reasonable to model the data.
- Instruct your students to determine the quadratic function that best fits their data by using the features of the calculator to find the quadratic equation for the data in lists L1 and L3.

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- a. Have students log back into NavNet.
- b. Load the activity settings file ***Stopping.act***.
- c. Select the **Graph** tab and start the activity.
- d. Instruct students to press **SEND** to submit their equation. Discuss any errors as needed.
- e. Compare the functions submitted by the students. There should be one function for each vehicle type. Discuss the functions for the various vehicles and note the differences between vehicles.
- f. Discuss the reaction time as part of total stopping time. Ask for estimates of typical reaction times for vehicle drivers. Share that typical drivers reaction times vary between 0.6 and 1.1 seconds.
- g. Compare the functions submitted for the braking distance and total stopping distance.
- h. Have students log out of NavNet and return to the home screen of the calculator.

6

- a. Instruct your students to continue using the vehicle type they selected earlier.
- b. Ask them to leave the data in L1, L2, and L3 from before, and enter the difference between lists L2 and L3 in L4.
- c. Instruct them to choose an appropriate viewing window for their data then have them use another plot to see the data for the braking distance, the total stopping distances and the distance traveled during the reaction time.
- d. Each group member should show their plots to all the students in their group and determine what kind of function seems to best fit their plots of total stopping distance.
- e. Encourage the group members to share their discussions with the rest of the class. The discussions should include the realization these plots appear to be linear and that a linear function might be also be reasonable to model the distance traveled during the reaction phase.
- f. Instruct your students to determine the linear function that best fits their data by using the features of the calculator to find the linear equation for the data in lists L1 and L4.

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- a. Have students log back into NavNet.
- b. Load the activity settings file ***Stopping.act***.
- c. Select the **Graph** tab and start the activity.
- d. Instruct students to press **SEND** to submit their equation. Discuss any errors as needed.
- e. Compare the functions submitted by the students. There should be one function for all vehicle types. Discuss the reason why the functions for the various vehicles should be the same.
- f. Discuss the reaction time as part of total stopping time.
- g. Show how to use the Science Tool App to convert MPH to FPS. The reaction time for each of these data points in the total stopping distance was close to 0.75 seconds.

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Student Activity Page

The following tables include braking distances and total stopping distances for a variety of vehicles traveling at different speeds.

MPH	Braking Distance (rounded to the nearest foot)			
	Small Auto	Mid-size Auto	Large Auto	Large Van Or Pickup
10	5	6	6	8
20	20	22	25	33
30	45	50	56	75
50	125	139	156	208
60	180	200	225	300

Place the MPH in list L1 and the braking distances for one of the vehicles in L2. Plot this data and find a function that fits the data.

MPH	Total Stopping Distance (rounded to the nearest foot)			
	Small Auto	Mid-size Auto	Large Auto	Large Van Or Pickup
10	16	17	17	19
20	42	44	47	55
30	78	83	89	108
50	180	194	211	263
60	246	266	291	366

Use the MPH in list L1 and place the total stopping distances for one of the vehicles in L3. Plot this data and find a function that fits the data.

In L4, compute the difference between L3 and L2. Plot each of these values. These values represent the distance traveled before the brakes are applied. Find a function for that fits this data. Is the function linear, quadratic or something else? Share this with members of your group.

Complete this table using the Science Tools App to convert MPH (miles per hour) to FPS (feet per second) and then compute the distance traveled during 0.75 seconds before braking.

MPH	10	20	30	50	60
FPS					
Distance Traveled in 0.75 seconds					

Use the functions you have found to compute the braking distance, total stopping distance, and distance traveled during 0.75 seconds before braking for 40 MPH and 70 MPH.

Speed of vehicle	Braking Distance	Total Stopping Distance	Reaction Time Distance
40 MPH			
70 MPH			