Stopping Distance Simulation

Background: This activity focuses on the effect of car speed upon stopping distance. The simulation involves a toy car rolling down a hill, hitting a box, and skidding to a stop. The height from which the car is released can be modified. The speed of the car at the bottom of the hill (prior to contact with the box) is reported. The distance that the car (and box) skid before stopping can be measured. Run the simulation for each of the provided heights and record the corresponding pre-collision car speed and the stopping distance. The background grid on the simulation screen can be used to determine the stopping distance. Each square on the grid is 10 cm in length along its edge.

Getting Ready:
  Visit: http://www.physicsclassroom.com/Physics-Interactives/Work-and-Energy/Stopping-Distance

Navigational Path:
  physicsclassroom.com ➔ Physics Interactives ➔ Work and Energy ➔ Stopping Distance
  (Or use the link on the course page.)

Tap on the **Launch Interactive** button. Use the Full-Screen icon (top-left) or the smaller Expand icon (bottom-right) to enlarge the size of the Interactive. Read the Introduction on the opening screen and tap on the **Begin Activity** button. Run experiments for all possible Initial heights in order to collect the data for the table below. Click the **Release** button each time in order to run an Experiment. To measure the stopping distance, measure from the starting position to the ending position for the same point on the box (e.g., back edge). Click on a height button to run a different trial. Once you have collected all the **Data**, perform the **Analysis** (back side). Remember: 1 square = 10 cm in length.

Data:
  Run several trials in the simulation in order to collect the following data:

Initial Height (cm)	Pre-Collision Speed (m/s)	Stopping Distance (cm)
0.0	0.0	0.0
10.0		
20.0		
30.0		
40.0		
50.0		
60.0		
70.0		
80.0		

Analysis:

1. Log onto one of the Desktop computers in the back of the room and open Logger Pro as found on the Desktop.

2. Enter values for Stopping Distance (y) vs. Speed (x). Double-click on the column headings of the table (**X** and **Y**) and give them the appropriate names.

3. Right click on the graph; a pop-up menu appears. Select **Autoscale From Zero** from the **Autoscale** sub-menu of the pop-up and watch the magic happen to your graph.

4. Highlight all the values on your graph (drag across the graph from left to right). With the entire graph highlighted, choose **Curve Fit** from the **Analyze** menu. Select either linear, quadratic or inverse from the list of possible functions. Click **Try Fit!** to determine the best fit line. Write the equation below:

5. Print your graph and staple it to this sheet. But keep your Logger Pro open.

6. From the **Analyze** menu, select **Examine**. Move your *mouse* (i.e., the cursor) inside the graph window and over the line. Position the cursor at 1.0 m/s, 2.0 m/s, and 3.0 m/s in order to get the distance values for points on the line at these three speeds. Record in the table at the right. Use your values to answer the questions below.

Speed (m/s)	Stopping Distance (cm)
1.0	
2.0	
3.0	

7. As the speed is doubles from 1.0 m/s to 2.0 m/s, the stopping distance increases by a factor of _____. Show a calculation to support your claim.

8. As the speed is tripled from 1.0 m/s to 3.0 m/s, the stopping distance increases by a factor of _____. Show a calculation to support your claim.

9. In this lab, the independent variable is the _____

   and the dependent variable is the _____.

10. The relationship between stopping distance and speed can be described as _____ (circle one).

   Linear   Inverse   Quadratic   Constant