Experiment 6

Rolling Stock

Teaching Notes

In this experiment, the distance a car rolls from the end of the ramp is a linear function of the height of the ramp. The ramp height is the *independent variable*, and the distance the car rolls from the end of the ramp is the *dependent variable.*

Equipment

marbles or small toy cars, 1 per group

If the floor is bare, use toy cars. Number them and be sure they roll freely. If the room is carpeted, use marbles.

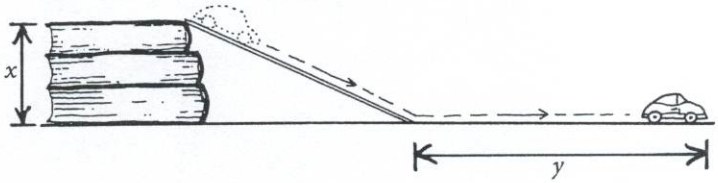
ramps of varying lengths, 15"–22"

Number the ramps. If they are made from slats of wood, bevel the downhill end. Vinyl gutters are inexpensive; most building-supply stores will cut up a 10-foot length for you.

blocks, books, or another material to raise the ramps

yardsticks, 1 per group

graph paper, 1 sheet per student



Procedure

In this experiment, the independent variable is the vertical distance and the dependent variable is a horizontal distance; this should not be the first experiment students conduct. The problems caused by the labels x and y are minimized if students are already accustomed to putting the coordinates of the points to be plotted in columns.

The "best" measurement in this experiment will be the farthest the car traveled for the given ramp height. If you are using marbles, the "best" measurement in this experiment will be the average or middle distance for the given ramp height.

Students will find an equation in the form $y = mx + b$, where $x = h$, the height, and $y = d$, the distance. Emphasize to them that the equation means:

$$\text{Roll distance} = m \times \text{Ramp height} + b.$$

That is, roll distance is a linear function of ramp height.

Have students start the car's rear wheels at the high end of the ramp. Because cars may swerve or lose distance due to friction or bounce, the measurements will tend to be small. Rather than taking an average, use the largest value of the dependent variable. Ramp height should be high enough to move the car, but not so steep as to cause the car to crash. A 15-inch ramp should not be raised more than 8 inches.

For a given ramp height, the *independent variable*, have students measure the distance the car rolls from the end of the ramp, the *dependent variable.*

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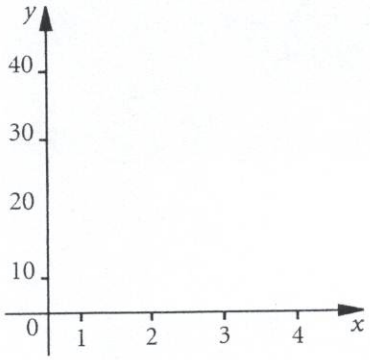
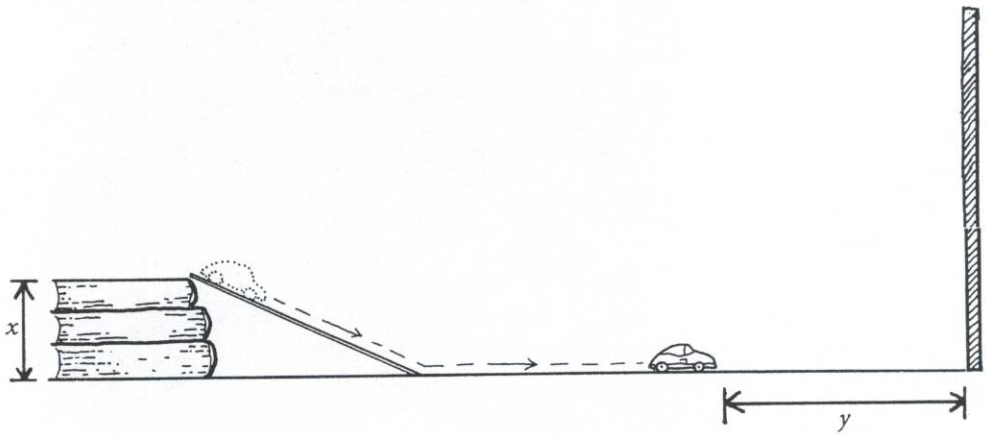
Because of the relative magnitudes of x and y, students will have to use different scales while graphing their points. The chosen scale will affect the apparent slope of the graph, but not the equation.



Extension

Say: Suppose you measure the total distance the car travels (including the ramp). How would your graph be different?

Instead of having students measure the distance the car traveled as the dependent variable, have them measure the distance from where the car stops to a fixed object such as the wall on the other side of the room. They will get a negative slope and a non-zero y-intercept.



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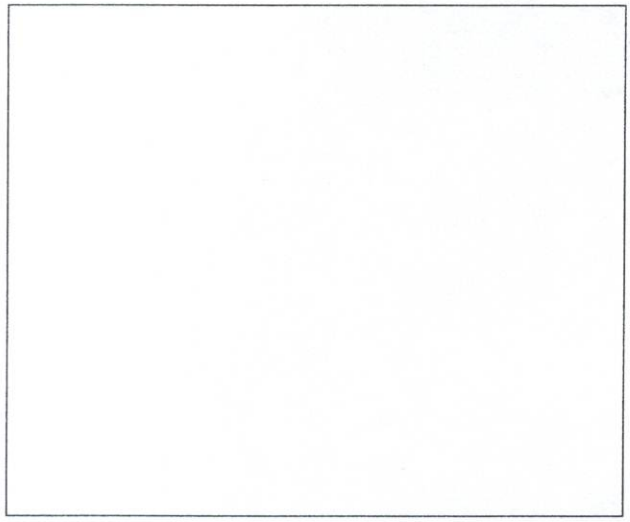
Name _____

Partner _____

Collect the Data

Draw a diagram of the experiment, indicating variables.



Describe the procedure for the experiment.

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_____

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_____

The independent variable, x, is _____ Units _____

The dependent variable, y, is _____ Units _____

Equipment (labels and measurements) Ramp number _____ Length _____

Car _____ Car number _____ or Marble diameter _____

Data Collection

Independent _____	Dependent _____		
	Trial 1	Trial 2	Trial 3

Points to Be Graphed

x	y

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Rolling Stock

Name _____

Find the Equation

After plotting your data on graph paper, draw a straight line through two of your points. Choose the line that best fits your data. Circle the points on your graph and copy their coordinates below.

Your points: (____, _____) and (____, _____)

Use these points to find the equation of your line. Show your work.

Find the slope of the line.

Find the y-intercept of the line.

Write the equation of the line.

$y =$ _____ $x +$ _____ $\quad\quad$ $y =$ _____ $x +$ _____

rational form $\quad\quad$ *decimal form*

Rewrite the decimal form of the equation, using the names of the variables instead of x and y.

_____ = _____ _____ + _____

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Name _____

Interpret the Data
Metric Measures

Write the decimal form of your equation here. $y =$ _____ $x +$ _____

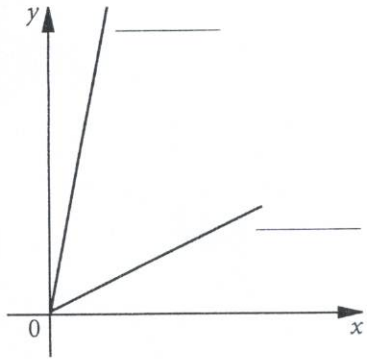
Use this equation to answer Questions 1 through 3. Show your work.

1. How far would the car (or marble) roll if the height of the ramp were 13 cm? _____

2. How high would the ramp need to be to have the car (or marble) roll exactly 51 cm? _____

3. How high would the ramp need to be to have the car (or marble) roll exactly 122 cm? _____

4. Jerry and Arnetta used identical marbles and the same length ramp. Jerry worked in the carpeted library and Arnetta was in the tiled cafeteria. Label their graphs.



5. Describe what you expect would happen to your original graph if the floor were carpeted.

_____

_____

6. Describe what you expect would happen to your original graph if you used a longer ramp.

_____

_____

7. If a longer ramp is available, use your same car (or marble) to test your expectations. What happened?

_____

_____

8. How high can you raise your ramp and still have the car (or marble) roll without crashing? _____

Experiment 6

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Name _____

Interpret the Data
Standard Measures

Write the decimal form of your equation here. $y =$ _____ $x +$ _____

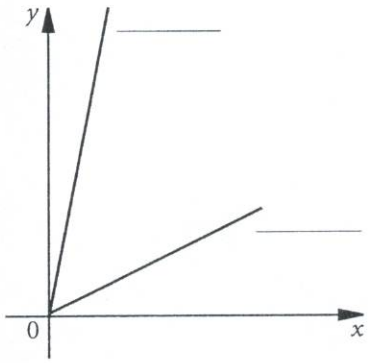
Use this equation to answer Questions 1 through 3. Show your work.

1. How far would the car (or marble) roll if the height of the ramp were 4.2 inches? _____

2. How high would the ramp need to be to have the car (or marble) roll exactly 22 inches? _____

3. How high would the ramp need to be to have the car (or marble) roll exactly 52 inches? _____

4. Jerry and Arnetta used identical marbles and the same length ramp. Jerry worked in the carpeted library and Arnetta was in the tiled cafeteria. Label their graphs.



5. Describe what you expect would happen to your original graph if the floor were carpeted.

_____

_____

6. Describe what you expect would happen to your original graph if you used a longer ramp.

_____

_____

7. If a longer ramp is available, use your same car (or marble) to test your expectations. What happened?

_____

_____

8. How high can you raise your ramp and still have the car (or marble) roll without crashing? _____