2.1 Using a Scientific Model to Predict Speed

Question: Can you predict the speed of the car at any point on the ramp?

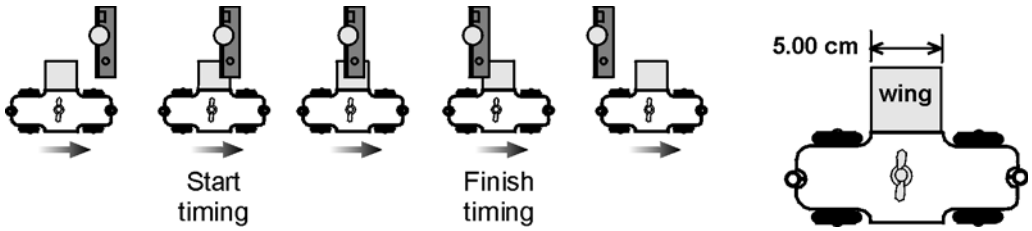
In this Investigation, you will:

1. Determine the speed of the car at different points as it rolls down the ramp.
2. Make a speed vs. position graph with your collected data.
3. Predict speed at any point on the ramp by using your graph.

What happens to the speed of the car as it rolls down the ramp? You can answer this question by measuring its speed at different points. By making a graph of the car's speed according to its position, you can see how speed changes. This graph can be used to predict how fast the car will be moving anywhere on the ramp. Record your observations and data from the Investigation in your notebook.

1 Finding the speed of the car at different points along the ramp

Using two photogates far apart gives you a measure of the average speed of the car between the photogates. The car could be going faster at the lower photogate and slower at the upper one. To get a true picture of how the speed of the car changes, you will need to measure the speed with one photogate.



Remember, with one photogate the timers measure the time that the beam is broken. As the car passes through the photogate, the light beam is broken for the width of the wing. The speed of the car is the width of the wing (distance traveled) divided by the time it takes to pass through the light beam (time taken). The advantage to this technique is that it is easy to move a single photogate up and down the ramp to make measurements of the speed at many places.

$$\text{speed} = \frac{\text{width of wing}}{\text{time through photogate}}$$

1. Select between 5 and 10 locations along the ramp to measure the speed of the car. The places should be at regular intervals such as every 10.0 centimeters.
2. At each location record the position of the photogate and the time through the light beam. The distance traveled will be the same for every position since it is the width of the wing.
3. Calculate the speed of the car using the car wing length (5.00 cm) and the time measurement. Record this value in the table.

Speed, Position, and Time Data

Position of photogate A (cm) from top of ramp	Time from photogate A (sec)	Distance traveled by car (cm) Wing width (5.00 cm)	Speed of the car (cm/sec)

2 Graphing and analyzing your results

a. Do you notice a trend in your measurements? How does the speed of the car change as it moves down the ramp?

b. Graph the speed of the car vs. position. Place speed of the car on the *y*-axis and position of photogate A on the *x*-axis. Add labels to each axis and title the graph.

c. What does the graph show about the speed of the car?

3 Using your graph to predict the speed of the car

a. Choose a spot on the ramp where you did not measure the speed of the car.

b. Use your graph to find the predicted speed of the car at that distance. Record your predicted speed.

c. Place the photogate at the distance you selected in step A and record the time it takes for the car to pass through the photogate.

d. Use the wing length (5.00 cm) and the time to calculate the speed. Record the actual speed.

e. How does the predicted speed compare with the actual measured speed? What does this tell you about your experiment and measurements?

4 Calculating percent error

a. Find the difference between the predicted speed and the actual, calculated speed.

Predicted speed – Actual speed = Difference

b. Take this difference and divide it by the predicted speed, then multiply by 100.

(Difference ÷ Predicted speed) × 100 = Percent error

c. Use the percent error to calculate percent correct.

100 – Percent error = Percent correct