

<b>Main Topic</b>	Motion
<b>Subtopic</b>	Average Velocity
<b>Learning Level</b>	Middle
<b>Technology Level</b>	High
<b>Activity Type</b>	Student

Description: To compare the times for two marbles to roll on two different ramps that share starting and ending points.
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Required Equipment	Racing Marbles apparatus, two 3/4" steel marbles, two photogates and datalogger.
Optional Equipment	

## Educational Objectives

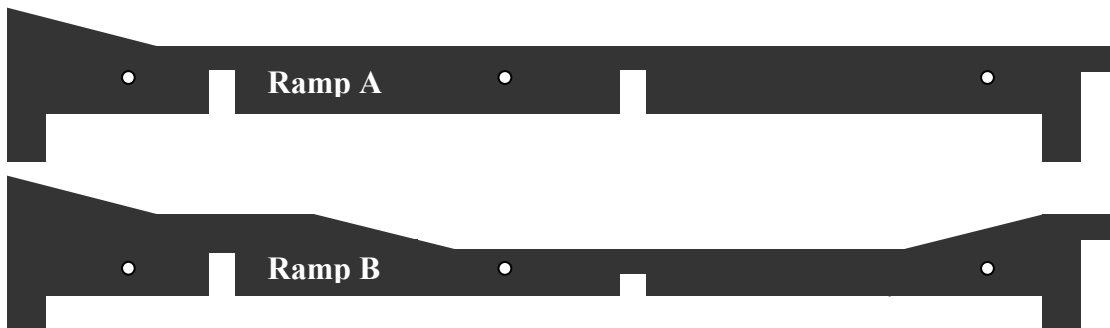
- To compare the times for two marbles to roll on two different ramps that share starting and ending points.

## Key Question

- How does the shape of an object's path affect its time of travel?

## Concept Overview

Two marbles will roll simultaneously on different paths, starting and ending at the same height. Students will predict and then observe the results of a "race" between the two marbles, and explain the results. Quantitative analysis of the motion will be done with photogates. Ramp A is the nearly horizontal ramp, and Ramp B dips down in the middle.



Students will find that the velocities are identical at the first position, Ramp B is faster at the second position, and the velocities are identical at the third position. The marble on Ramp B, then, has the higher average velocity for the whole trip and will win the race.

## Lab Tips

Even though the subject of this lab is Average Velocity, it may best be used as a review during the students' study of conservation of energy. Use this lab AFTER students have completed Conservation of Energy: Racing Marbles.

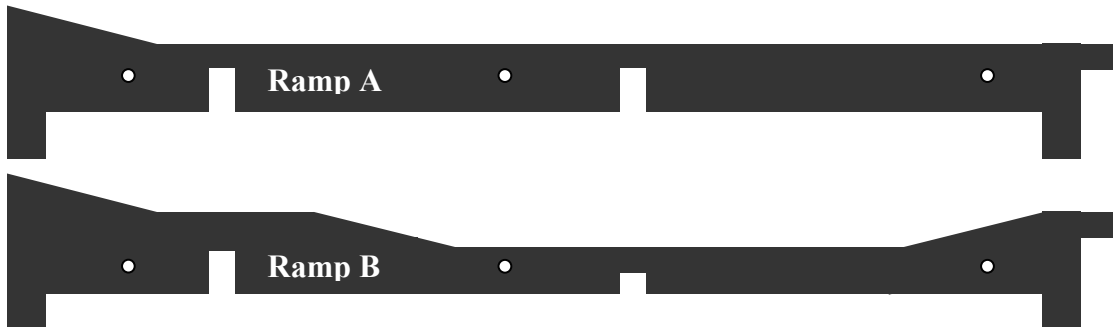
## Racing Marbles: The Race

**Objective:** To compare the times for two marbles to roll on two different ramps.

**Materials:** Racing Marbles apparatus, two  $\frac{3}{4}$ " steel marbles, two photogates and datalogger.

### Background:

Two marbles will roll simultaneously on different paths, starting and ending at the same height. Students will predict and then observe the results of a "race" between the two marbles, and explain the results. Quantitative analysis of the motion will be done with photogates. **Ramp A** is the nearly horizontal ramp, and **Ramp B** dips down in the middle.



**Physics Workshop**  
**Racing Marbles 2**

Name: \_\_\_\_\_  
\_\_\_\_\_

**Procedure:**

1. Place the Racing Marbles apparatus on a level table or floor.
2. Prediction: If marbles are released simultaneously on both ramps, which marble will reach the end of its ramp first? \_\_\_\_\_
3. Hold the marbles at the top end of the ramps. Release them at the same time and observe.
4. Describe your observations. Was your prediction in #2 correct?

\_\_\_\_\_  
\_\_\_\_\_

5. Place a photogate in the first cut-out position on each ramp. Program the datalogger to measure velocity (the marble's diameter is 1.9cm). Release the balls again and record their velocities in the table below.
6. Repeat the measurements for the 2<sup>nd</sup> and 3<sup>rd</sup> positions on each ramp, and record the results in the table.

<b>Position</b>	<b>Velocity on Ramp A</b>	<b>Velocity on Ramp B</b>
1		
2		
3		

7. Compare the velocities at Position 1. \_\_\_\_\_
8. Compare the velocities at Position 2. \_\_\_\_\_
9. Compare the velocities at Position 3. \_\_\_\_\_
10. Which marble has the higher average velocity for the entire race?

11. Use the velocity measurements to explain the results of the race.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_