# Force and Motion Activity Bag Height and Speed: Student Activity Guide

Things can go faster or slower when they move. There are many factors that can affect the speed of an object. In this activity, we will explore rolling a marble down a ramp. We will investigate how the height of the ramp affects how fast the marble moves.

### **Materials From The Bag**

- 1 Marble
- Tape Measure
- Food Tray

#### You Will Need

• Stopwatch or a Timer

### Preparation: Ramp Set-Up

The ramp set-up will be used in all 3 parts of this lesson.

- Find a smooth, flat, and level place longer than a meter. Use the tape measure to be sure it's long enough. A countertop, floor, or table will work. Place a marble on the surface you will use. If the marble stays still, the surface is level enough. When you know the surface is level, return the marble to the bag.
- 2. Stretch out the tape measure to its full length on the flat surface.
- 3. Stick a label to the surface at both ends of the tape measure. **Put the label on the surface, not on the tape measure.** The edges of the label next to the tape measure are your start and finish lines. Write "Start" on one and "Finish" on the other. Draw an arrow on each post-it pointing at the tape measure, ending at the edge next to the tape measure. It looks like this:



4. Remove the tape measure and leave the labels. This is the runway. It looks like this:



- Hot Wheels Track
- Labels

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5. Get the Hot Wheels track from the bag and place one end with its edge exactly on the start line.



6. Get the food tray from the bag and turn it upside down on the surface. Lift the end of the ramp not on the start line and slide the upside-down food tray under it so the ramp slopes down, touching the start line. Check the height of the ramp with the tape measure. It should be about 40 mm at the high edge.



7. Get the marble, place it at the top of the ramp, release it, and watch the marble cross the finish line.

#### Part 1: Effect of Height on Speed - Ramp A (ramp height about 40mm) For the next three parts, you will need a stopwatch or a timer.

- 1. Be sure your ramp is set up as shown above with the food tray under it and one end raised about 40 mm.
- 2. You will record how long it takes for **the marble** to travel the whole runway (1 meter).
- 3. To time the marble, release it from the top of the ramp and start the timer when the marble first touches the surface (crosses the start line). Stop when it crosses the finish line. Do this a few times to practice.
- 4. After you practice, time the marble rolling over the runway three times. Each time, measure how many seconds (and tenths of seconds) it takes to travel one meter. Write down your results all three times.
- 5. After you do three trials, calculate the average time it took for the marble to travel 1 meter. To do this, add the results of all three trials and divide by the number of trials (3). Write down the average time.

Example:	Trial $1 = 2.3$ seconds		
	Trial $2 = 2.4$ seco	conds $6.6$ seconds/3 trials = 2.2 seconds to travel 1	meter
	+ $\underline{\text{Trial } 3 = 1.9 \text{ seconds}}$	conds (average time)	
	Total $= 6.6 \sec \theta$	onds	
	+ $\underline{\text{Trial } 3 = 1.9 \text{ second}}$ Total = 6.6 second	onds (average time)	

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What do you think would happen if you **raised the ramp higher** and released the marble from a higher place? What would happen to the average time? Give your reasons for this.

## Part 2: Effect of Height on Speed - Ramp B (ramp height about 50mm)

- 1. Adjust your ramp so the high edge (release point) is higher, about 50mm. To do this, **slide the food tray closer to the start line**. Do not roll the marble yet.
- 2. Predict how many seconds (and tenths of seconds) it will take for the marble to travel the whole runway (1 meter) using this ramp.
- 3. Follow the directions above for Ramp A, steps 2-5.
- 4. Compare the results to your prediction. *What did you notice? What do you think would happen if you lowered the ramp* and released the marble from a lower place?

# Part 3: Effect of Height on Speed - Ramp C (ramp height about 30mm)

- 1. Adjust your ramp so the high edge (release point) is lower, about 30mm. To do this, slide the food tray further from the start line.
- 2. Predict how many seconds (and tenths of seconds) it will take for the marble to travel 1 meter using the lower ramp.
- 3. Follow the direction above in Ramp A, steps 2-5.
- 4. Compare the results to your prediction. *What did you notice? How does the height of the ramp affect the time it takes for the marble to travel 1 meter?*

#### What's happening...

You may have noticed when the ramp was higher the marble's speed was faster than when the ramp was lower. The height of the ramp affects the speed of the marble because the higher the ramp the more energy the marble has. When you release the marble, the force of gravity pulled it down the ramp. Gravity is a force that pulls any object on or near the earth toward it without touching it.