## Force and Motion Activity Bag <br> Mass, Friction, and Motion: Student Activity Guide

We have learned that the height at which the marble is released can change the marble's speed. If the height stayed the same, what would happen to the speed if we changed the mass of the marble? What would happen to the speed if we changed the runway? We will explore other ways to change the marble's speed: mass and friction.

## Materials From The Bag

- 1 Wooden Ball
- 1 Marble
- Salt Packet
- Tape Measure, 1 meter
- Hot Wheels Track (ramp)
- Sheet of Foam
- Food Tray (red and white design)
- Labels


## You Will Need

- Your data from the Measuring Speed Activity, Part 1:Measuring Speed


## Part 1: Effect of Mass on Speed

For this part, you will use a wooden ball. The wooden ball and the marble are the same sizes, but the marble is heavier. The marble weighs 5 grams and the wooden ball weighs 1.5 grams.

1. Record the speed of the marble from Part 1: Measuring Speed in the Measuring Speed Activity. meter per second
2. Predict how you think the speed (the time it takes to travel 1 meter) of the wooden ball will compare to the speed of the marble.
3. Set up Ramp A (a ramp height of about 40 mm ) from the Height and Speed Activity.
4. You will record how long it takes for the wooden ball to travel the whole runway ( 1 meter).
5. Time the wooden ball 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.
6. After you do three trials, calculate the average time it took for the wooden ball 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.
7. Use the average time to calculate the speed of the wooden ball. Remember speed is distance per time.
8. Compare your results to your prediction. In your experiment, how did changing the mass of the ball affect the speed?

## What's happening...

Everything has mass. Mass is the amount of matter that makes up an object. The marble has more mass than the wooden ball. The amount of mass can have an effect on the speed of an object.

## Part 2: Friction Forces

For this investigation use the marble and the Ramp A (a ramp height of about 40 mm ) set-up from the Height and Speed Activity.

1. Place the foam sheet just under the bottom of the ramp so the marble travels on the foam for part of the meter.
2. Predict how you think the speed of the marble rolling over the foam sheet will compare to your results from Part 1: Measuring Speed in the Measuring Speed Activity (no foam).
3. You will record how long it takes for the marble to travel the whole runway ( 1 meter).
4. 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. Write down the average time.
6. Use the average time to calculate the speed of the marble. Remember speed is distance per time.
7. Compare your results to your prediction. How did the speed change when the marble ran across the foam sheet? What do you think could cause the difference?

## What's happening...

When two objects rub against each other, the motion creates friction between them. Friction is a force that works against the motion and acts in the opposite direction. Friction can cause an object to slow down, even stop, and change directions.
8. Follow steps 3-6 and explore how friction can affect the speed of the marble by replacing the foam sheet with

- a piece of paper just under the end of the ramp with a small sprinkle of salt on the paper. What do you predict will happen to the speed of the marble? How did the results compare to your prediction? How did the speed change when the marble ran across the sheet with salt?
- a piece of paper just under the end of the ramp with a lot of salt on the paper. What do you predict will happen to the speed of the marble? How did the results compare to your prediction?

9. Write an explanation, using the term friction, to explain how salt affected the marble.
