

# **GLOBE TROTTERS**

## **FORCE & MOTION IN BASKETBALL**



Glacier Ridge Elementary School 5th Graders

# OVERVIEW

In this lesson, 5th graders studied science standards involving force and motion by performing and analyzing 10 different science experiments. Basketball was used as the scenario for studying force and motion within a sport as a way for students to connect their understanding of science topics to movement and interest. On the following slides, an overview of each science experiment is given, along with the 5th graders showing their understanding of the performance and concept.

# OHIO LEARNING STANDARDS

(5.PS.1): The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

*Vocabulary:*

<b><i>Distance</i></b>	<b><i>Exert</i></b>	<b><i>Forces</i></b>
<b><i>Mass</i></b>	<b><i>Motion</i></b>	<b><i>Speed</i></b>
<b><i>Acceleration</i></b>	<b><i>Potential Energy</i></b>	<b><i>Kinetic Energy</i></b>

## **STATION 1:** How does the mass of a basketball and a medicine ball affect the distance it travels?

### **EXPERIMENT:**

- Roll a basketball and a medicine ball down a ramp
- Measure how far each ball traveled

What Happened?

- The basketball traveled farther

Why?

- Acceleration depends on two things, mass and force. We changed the mass in this experiment. When we have the same amount of force the wooden ball rolls farther because it has less mass than the steel ball. We would need to apply more force to the steel ball for it go as far as the wooden ball. More mass means less acceleration.



## **STATION 2:** How does the mass of a basketball and a medicine ball affect its speed?

### **EXPERIMENT:**

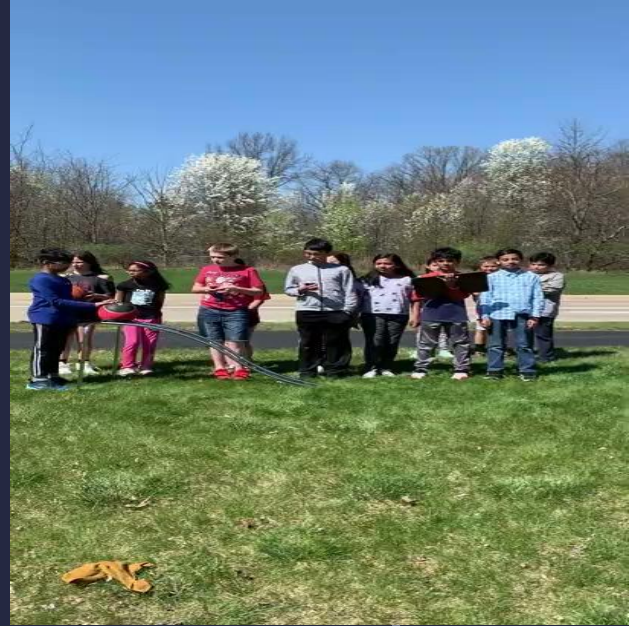
- Roll a basketball and a medicine ball down a ramp.
- Measure the ramp and time how long the basketball was on the ramp.
- Calculate speed.

What Happened?

- The speed was the same for both.

Why?

- The heavier medicine ball has a greater gravitational force and a lower acceleration rate. The lighter basketball has a lower gravitational force and a higher acceleration rate. These two effects exactly cancel to make both balls have the same speed.



## **STATION 3:** How does the height of the ramp affect how far the basketball travels?

### **EXPERIMENT:**

- Roll a basketball down a ramp at two different heights and mark how far each travels.

What Happened?

- The basketball rolled the farthest down the highest ramp.

Why?

- This happens because when the basketball is at the top it has more gravitational potential energy which then converts into kinetic energy which makes the ball go faster and farther but, when the basketball is rolled down the lower ramp, the ball has less gravitational potential energy which makes it have less kinetic energy making it go slower and shorter.



## **STATION 4:** How does the amount of force applied impact how high a basketball bounces?

### **EXPERIMENT:**

- Drop a basketball to the ground and determine how high it bounced.
- Throw a basketball to the ground at the same height and determine how high it bounced.

What Happened?

- The basketball will bounce higher when it was thrown to the ground than when it was dropped.

Why?

- Forces always occur in pairs. Gravity pulled the balls to the ground and the reaction force of the floor “pushing” the ball back up.
- The ball with more force bounced higher because it had more force pushing it down so the reaction force of the bounce was greater.



## **STATION 5:** How does the amount of mass affect how high it bounces?

### **EXPERIMENT:**

- Drop a basketball and a medicine ball from the same height.
- Determine which ball will bounce higher.

What Happened?

- The basketball will bounce higher.

Why?

- Forces always occur in pairs. Gravity pulled the balls to the ground and the reaction force of the floor “pushing” the balls back up. The basketball bounces higher because it has less mass than the medicine ball. Less mass means less force needed for the reaction or bounce.





## **STATION 6:** How do different surfaces affect the distance a basketball travels?

### **EXPERIMENT:**

- Roll a basketball across different surface textures and measure how far it traveled.

#### What Happened?

- The more friction the less distance the basketball traveled, grass. The less friction the farther the basketball traveled sidewalk.

#### Why?

- This happened because the smoother the surface is, the less friction there is to stop it. Friction always opposes motion. Friction is the resistance that one surface or object encounters when moving over another, the basketball over the different surfaces.



## **STATION 7:** What happens when a medicine ball and a basketball are dropped at the same time?

### **EXPERIMENT:**

- Push a basketball and a medicine ball from the same height, at the same time and see which one hits the ground first.

What Happened?

- They hit the ground at the same time.

Why?

- The heavier medicine ball has a greater gravitational force and a lower acceleration rate. The lighter basketball has a lower gravitational force and a higher acceleration rate. These two effects exactly cancel to make both balls have the same speed.



## **STATION 8:** Does a basketball accelerate as it rolls down a ramp?

### **EXPERIMENT:**

- Roll a basketball down a ramp and time how long it takes for the top half and the bottom half.

What Happened?

- The basketball's speed was lower on the top half of the ramp and higher on the bottom half of the ramp.

Why?

- When the ball is placed at the top of the ramp, gravity is acting on the ball pulling downwards. This is an unbalanced downward force, which causes the ball to accelerate as it rolls down the ramp.



## **STATION 9:** How do balanced and unbalanced forces affect a basketball?

### **EXPERIMENT:**

- Roll two basketballs toward each other with the same force.
- Roll two basketballs towards each other but use more force on one of them.

What Happened?

- When the forces are balanced they react the same
- When the forces are unbalanced the one with more force

Why?

- Objects have forces acting on them. If the forces are balanced, the object does what it was doing (if still, it remains still; if moving, remains moving). If the forces are unbalanced, it will cause a change in the ball's speed or direction.



## **STATION 10:** How does the amount of force applied to a basketball affect the distance it travels?

### **EXPERIMENT:**

- Lightly push a basketball, determine distance traveled.
- Forcefully push a basketball, determine distance traveled.

What Happened?

- The basketball with more force applied traveled farther.

Why?

- On level ground, gravity and air friction don't factor significantly into how an object rolls. The amount of force applied to the basketball affects the distance it traveled.
- Some students applied greater force which equaled the basketball to travel farther.

