



# DISCOVERY GUIDE

## LESSON MISSION: MOTION 2



PRE-K-2 STEM LESSONS  
FEATURING ONLINE VIDEO + ACTIVITIES



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## STEM from the START Overview

### MEET THE QUINKS

Each video lesson in STEM from the START features the Quinks, three curious explorers from outer space – Quazar, Neutrina and Fluxx – who have come to Earth to learn more about how things on the planet work! With the help of a human friend, they explore basic principles of physical science.

### SCIENTIFIC METHOD

Each lesson in STEM from the START is presented as a mission. In each mission students are asked to observe, research, develop hypotheses, make predictions, experiment and reach conclusions – just like real scientists!

### DISCOVERY BREAKS

Each video lesson includes short segments where a concept or idea is introduced and explored and followed by a Discovery Break. Each Discovery Break features a question posed directly to students. The video lesson is designed to be paused or stopped at this point so students can engage in an activity or exploration found in the Discovery Guide. Activities and explorations in the Discovery Guide are designed so that they can easily be done with items found in most classrooms or homes.

### DISCOVERY QUIZ

In addition to Discovery Breaks, the video lessons include a Discovery Quiz. These present a series of questions to the students, with time after each question to pause the video lesson for students to respond.

### STEM IN THE REAL WORLD

The Quinks visit real scientists and engineers, who explain the concepts covered in each video lesson.

Each Discovery Guide is a template for using the lessons with young learners. Educators and parents are encouraged to adapt and extend the ideas found in this guide and to share their experiences at [nhptv.org/stem](http://nhptv.org/stem).

# MISSION: MOTION 2

## Lesson Introduction

### OVERVIEW

Willow and the Quinks explore how the strength and direction of a force effects the motion of an object. The lesson picks up where Motion 1 left off, with a speeding baseball headed towards Quazar! Willow and the Quinks see a pitcher throwing a baseball at a batter, when the batter hits the ball, it changes direction.

### SCIENCE FOUNDATIONS

This lesson looks at Newton's three laws of motion.

1. An object at rest will stay at rest. An object in motion will stay in motion at the same speed and in the same direction, unless it is acted upon by a force.
2. Force = Mass times Acceleration! (Heavier objects require more force to move the same distance as lighter objects.)
3. For every action, there is an equal and opposite reaction.

### OBJECTIVES

**At the end of the lesson learners will:**

- Describe what is needed to move an object at rest.
- Identify whether an object has been moved by a push or a pull.
- Demonstrate how a push or a pull can put an object into motion, stop an object in motion or change the direction of an object in motion.
- Identify pushes and pulls as forces.
- Demonstrate that a bigger force can

move an object further than a smaller force.

### KEY VOCABULARY

**Object** - something that you can see and touch that is not alive

**Motion** - changing location or position

**Force** - a push or a pull

**Push** - a force that moves something forward or away from you

**Pull** - a force that draws something closer to you

### Next Generation Science Standards

#### **K-PS2-1 Motion and Stability: Forces and Interactions**

Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

#### **Disciplinary Core Ideas**

##### **PS2.A: Forces and Motion**

Pushes and pulls can have different strengths and directions.

Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

##### **PS2.B: Types of Interactions**

When objects touch or collide, they push on one another and can change motion.

##### **PS3.C: Relationship Between Energy and Forces**

A bigger push or pull makes things speed up or slow down more quickly. (secondary)

#### **K-PS2-2 Motion and Stability: Forces and Interactions**

Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

## Discovery Break One

### OVERVIEW

Quazar shares how he was almost hit by a baseball that changes direction when the batter hit it.

### Objectives

Students can demonstrate how a moving object can change direction when it is met with another force.

Students can explain what needs to happen for an object in motion to change direction.

### Previewing Activity

Ask students if they have ever seen an object in motion change direction? Can they give some examples? What do they think made the object change direction?

### Viewing

Play the video and pause at **Discovery Break One** – Can you change the direction of an object in motion?

### Hands-on Activity - Straw Soccer

#### Materials

Index Cards	Straws
Tape	Cotton Balls

Tell students they are going to play a game called straw soccer.

Groups student in pairs. Give each pair one cotton ball, two straws and two index cards.

Make sure each team has a fair-sized flat surface to serve as their soccer field. At each end of the "field" have them tape their index card, this will serve as their goals!

The object of the game is to use the straw to blow the cotton ball onto the index cards to score a goal.

You can group students in large teams with a larger playing surface.

# MISSION: MOTION 2

## Discovery Break Two and Discovery Questions

### OVERVIEW

The Quinks go and see how a force can change the direction of an object already in motion. They observe three children kicking a soccer ball.

### Objectives

Students demonstrate how a force can put an object in motion, change the direction of an object already in motion, or stop an object in motion.

### Viewing

#### Discovery Questions

Pause the video each time the question **“How did the ball’s motion change?”** appears and have students explain what they observed. Encourage them to use the words force and motion and direction to describe what they observe.

Willow explains that a force can put an object in motion, stop an object in motion or change the direction of an object already in motion.

Pause the video at **Discovery Question Two**: How many ways can you change the motion of an object?

### Post-Viewing PE Activity

Take the class to the gym or outside. Have them sit in a large circle. Place a ball in front of one child have them put the ball in motion by rolling it to another student. Have the children put the ball in motion, change its direction and stop it by calling out directions to the students.

You can play variation of this game with a balloon and see how long they can keep the balloon from hitting the floor or you can have students kick the ball in a circle.

You can also break the students up into smaller groups.

## Discovery Break Three

### OVERVIEW

The Quinks return to find Willow hitting a ball with a filed hockey stick and observing its motion. Quazar states that they now know everything there is to know about how forces can change the motion of an object. Willow challenges that statement. She asks them what will happen if she pushes the ball with the hockey stick and Fluxx states that she will put the ball in motion, after she put the ball in motion, she then asks them what they think will happen if she hits the ball with more force.

### Objectives

Students can predict what will happen to the motion of an object when it is pushed or hit with different levels of force.

### Viewing

Say to students: Let's see what Willow and the Quinks are learning about motions and forces!

Play the video and pause at **Discovery Break 3** – What will happen if Willow hits the ball with more force?

### Hands-on Activity - Ball Toss

Students explore how the motion of an object changes when it is pushed or hit with different levels of force!

### Materials

Balls or beanbags	
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### Procedure

Take students to the gym or playground. Have them form pairs. Give each pair a ball or a beanbag. Have students from a line and then stand back-to-back with their partner and take five paces and face each other.

Have them throw the ball or beanbag to their partner. Have them take five steps backward and then throw the ball or beanbag again.

Have them continue to take five steps back after each throw. Continue this until they are too far away from each other to make a successful throw and catch.

Ask the students what they had to do as they moved further and further apart from their partner.

They may say throw the ball harder guide them to using the word force to describe their actions!

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## Discovery Break Four

### OVERVIEW

The Quinks think that if the ball is hit with more force it will move faster. Willow thinks that is a good guess, but she wants to know for sure. Neutrino suggests that they conduct an experiment.

### Objectives

Students can predict what will happen to an object if the strength of a force applied to it varies.

Students can construct an experiment to test a theory about the strength of a force and the movement of an object.

### Vocabulary

Experiment	Force
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### Viewing

Say to students: We just learned that we need to apply more force to move an object a greater distance. Let's see if greater force might change anything else about how an object moves!

Play the video and pause at **Discovery Break 4**- Can you think of an experiment?

### Brainstorming an Experiment

Have students work in groups of 3-4 and design an experiment to test whether the amount of force applied to an object will change the speed of an object.

Have each group describe their idea for an experiment to the class. You can also do this as a whole class activity.



## Discovery Break Five

### OVERVIEW

Willow sets up an experiment to test if hitting a ball with more force will change the speed at which the object moves. She marks off a starting point and ending point and then hits three balls different levels of force. She times how long it takes each ball to reach the ending point.

### Objectives

Students observe how the speed of three balls changes depending on how hard they are hit.

### Viewing

Say to students: We are going to observe how fast a red ball, a green ball and a blue ball travel when Willow hits them. You will need to observe very carefully and look at the digital clock at the top right of the screen (point to where the top right of the screen is for students) to see how long it takes each ball to reach the finish line. When you see the speed say stop and I will stop the lesson and we can record the speeds. Are you ready?

Play the video and pause when students say stop. Record the speeds for each ball for the class on a flip chart or on the board.

Red Ball 1.9  
Green Ball 1.5  
Blue ball 2.2

Ask students which ball was the fastest, which was the slowest and which was in the middle.

Students may not be familiar with how long a second is or how time can be kept in fractions of a second.

Explain that 1.5 seconds is faster than 1.9 and 2.2. So the Green ball was the fastest, the red ball was in the middle and the blue ball was the slowest.

Explain or show students that in races and sports, times are often kept in decimals or parts of seconds. If you have a cell phone, you can show them the stopwatch feature on your phone's clock. You can also show them clocks on the internet. (Google has an online stopwatch. Just type stopwatch into the Google search box.)

Younger children may have difficulty understanding duration and time. You can spend some time having them count "One-one-thousand, two-one-thousand... to get a better idea of how long a second last or have them count to a second hand on a clock or a projection of a digital stopwatch.

After determining which ball was the fastest, which was the slowest and which was in the middle ask students what they think Willow did to the ball that travelled the fastest.

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## Discovery Break Six

### OVERVIEW

The Quinks meet Todd, a robotics engineer. He explains how he uses pushes and pulls to move things with his robots.

### Objectives

Students use trial and error and problem solving skills use a clothes pin, a bottle cap, and a piece of wood to make a ping-pong ball fly into a cup.

### Vocabulary

Engineer	Robot
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### Viewing

Say to the students:

The Quinks are going to meet an engineer who builds robots that move things!

Resume the video. Pause right after Todd asks, "Can you think like an engineer and figure it out?"

### Post-viewing

Do you think you can build something that make a ping-pong ball fly into a cup?

### Hands-on Activity

Students create a ping pong ball mover using a clothes pin, glue, craft sticks and bottle caps. You can replace the ping-pong balls with marshmallows or cotton balls.

### Materials

clothes pins with springs	craft sticks
ping-pong balls	cups
plastic bottle caps	glue

### Procedure

Have students (working in small groups or individually) come up with a blueprint for a machine that will let them move a ping-pong ball into a cup. After they have come up with a blue print, have them build and test their machine and make any need adjustments!

## Review

### OVERVIEW

In this lesson the Quinks learned that the amount of force applied to an object can change how far and how fast an object travels. They also learned that force can put an object into motion, change the direction of an object in motion and stop an object in motion.

### We're Explorers

We're explorers.  
Explorers!  
The world that's what we explore!  
We're explorers.  
Explorers!  
Day after day...  
Learning more and more!

### Review Questions

1. What are three things a force can do to the motion of an object?

**Answer:** Put it in motion, change its direction, stop it.

2. What is an experiment?

**Answer:** A careful test to see if something is true or not.

3. What will happen if you hit the same object twice, but you hit it harder the second time?

**Answer:** It will travel faster (and further.)

### EXTENSIONS

#### Science

Cut a paper towel tube in half along its length so you have an open tube. Rest the tube on a stack of books. Place a matchbox car at the end of the tube. Place a ball at the top of the tube and let it go so it hits the car. Measure how far the car travels when it is pushed by the ball. Change the weight of the car by taping a penny to it. What does that do to the distance the car travels? Add more pennies and see what happens. Add or take away a book from the stack. What does that do to the distance the car traveled?

#### Language Arts

Vocabulary Development: Have students create a list of words that describe movement. For example: push, pull, drag, drop, roll, slide, bump, nudge, bounce, slither, wiggle, etc.

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**STEM from the START is an innovative, online video-plus-activities curriculum for PreK-2 learners available at [www.nhptv.org/STEM](http://www.nhptv.org/STEM).**

Featuring kid-friendly animated characters called QUINKS, the goal of STEM from the START is to nurture students' natural curiosity and love of discovery, while laying the groundwork for ongoing success in STEM (Science, Technology, Engineering and Math) subjects.

## **DISCOVERY GUIDE**

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*9/2016*

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# CERTIFICATE OF ACHIEVEMENT

THIS CERTIFIES THAT

\_\_\_\_\_

IS AN EXPLORER AND KNOWS ALL ABOUT

## MOTION 2

DATE: \_\_\_\_\_

