Ready?
Set. Go!

Teacher Guide • Transform a Playground Trip Into a Science Learning Experience

New York Hall of Science
# Table of Contents

2  Introduction
3  Push & Pull My Swing
5  Collision Course
7  Sunny Side Up
9  Playing With Light
11  Making Waves
13  Material Matters
15  Bounce That Ball
17  Step by Step
19  Cruise Control
21  Stop, Drop, Don't Roll
23  Activity Index
24  References
Introduction

The playground science teacher guide supports kindergarten, first and second grade teachers in promoting science learning through the use of playground equipment and children’s physical play activities. Activities in this curriculum will use the typical equipment you find in a standard playground, as well as children’s physical play activities, to provide young learners opportunities to explore complex science concepts. Playgrounds are great laboratories for experiencing physics concepts, such as motion, energy, force, gravity and friction; and learning about scientific practices, such as predicting, observing, classifying, comparing, questioning, deciding, cooperating, experimenting, explaining, inferring, and drawing conclusions.

Embodied Play and Science Learning

This work draws on the learning sciences research dealing with how to transition from embodied play, which anchors children’s learning into familiar experiences, to the exploration of complex scientific concepts in playful learning environments (Abrahamson & Lindgren, 2014; Lee, 2015). Engaging in play activities, such as running, jumping, sliding and swinging, to explore scientific concepts requires children to use all their senses and cognitive abilities (Gelman, Brenneman, MacDonal, & Roman, 2010; Althouse, 1988).

Playgrounds can be ideal places to ignite scientific curiosity and creativity in children. They serve as physical hands-on environments for experiencing and exploring complex science concepts through embodied play. For example, swing activities can provide a good opportunity for young children and their caregivers to grapple with complex words like gravity, motion, time and force.

Science learning in this context is a process of adaptation involving continual interaction between the learner and their physical and social environment (Nell, Drew, & Bush, 2013). The activities focus on helping educators assist children in making sense of their own physical play activities (i.e., running, jumping, sliding); and improving children’s content knowledge, increasing their motivation to learn science, and expanding their scientific imagination and creativity.

How to Use This Curriculum

This teacher guide presents 10 activities that students can do together to promote science inquiry on any school playground. The activities are innovative, diverse and developmentally appropriate. The same playground activities (e.g., climbing, sliding) can be reused to explore a variety of scientific concepts. The embodied-play-focused activities are easy to carry into any school playground and have the potential to be enjoyable and safe activities for all K – 2 students. The activities described in this curriculum align with the Next Generation Science Standards. Each lesson is color-coded by topics and age groups. Each activity features:

• Title and brief description of a playground activity.
• Activity instructional/learning objectives.
• The Next Generation Science Standards and science content that is addressed by each activity.
• Materials/equipment and instructions/facilitation.
• Science background and vocabulary words, with easy-to-understand descriptions and definitions of scientific vocabulary and concepts.
• Teaching tips outlining helpful strategies for implementing the activities.
• Extension activities for teachers to extend the learning of the lesson.

To ensure the activities are implemented in a way that maximizes play and science learning on the playground and in the classroom, teachers should prepare students for each activity, including organizing students into working play groups, providing clear instructions and demonstrations, reviewing previously learned scientific concepts and skills, and encouraging observations, discussions, and reflections on physical activities (Carson & Lima, 2008). Teachers can choose to follow the activity protocols or tweak them to integrate the activities into their regular curriculum.

Teachers: Are you ready to help your students explore the science on their playground?

Ready? Set. Go!
Push & Pull My Swing

Science Concept: Pushes and Pulls

Grades

- Kindergarten

Objective

Students will explore how different strengths of pushes and pulls affect their speed while swinging.

Standards

Next Generation Science Standards: K-PS2-1.
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.

Equipment and Materials

Swings

Vocabulary

Force: a push or pull on an object.
Speed: how fast or slow an object is moving.
Push: a force that moves an object away from something.
Pull: a force that moves an object toward something.
Activity

1. Ask students to think about a time they played on the swings and how they can make themselves swing fast and high. Allow them to share their ideas.

2. Tell students that today they are going to investigate how pushes and pulls make them go different speeds while swinging.

3. Have students work in pairs. One student will ride the swing and the other will push/pull them. Students should switch roles so each gets a chance to ride on the swing.

4. On the playground, have students notice what happens to the speed of the swing when they give their partner a small push versus a large push. Have them repeat this experiment with a small pull and a large pull.

5. Return to the classroom and have students share what they noticed while experimenting with different strengths of pushes and pulls.

6. Discuss as a class if there are any similarities or patterns in what happened.

Extension Ideas

Have students try pushing off with their feet while on the swing instead of having a partner push them. Do they notice anything different about small pushes versus large pushes? Encourage them to discuss if their experiences match those they observed when someone else was pushing them.

Teaching Tips

If a limited number of swings are available, split students into groups of four and assign each person in the group a role (swinger, pusher/puller, distance observer, speed observer). Have students rotate through roles or observe one student on a swing as a class. Students can compare observations and discuss what they notice about the speed of the swing. Be sure to gauge whether students understand what speed means by facilitating their observations.

Science Connections — Did You Know?

When objects are in the process of changing their position in space, they are in motion. Forces that change objects’ positions are often described as “pushes” and “pulls.” But how are they different? Pushes move objects away from the source of the force, while pulls bring objects closer to the source of the force. Think of pushing someone sitting still on a swing, and how they move away from the source of the force: your hands. Now think about pulling someone sitting still on a swing back toward you, and how they move closer to the source of the force: you. In these instances, your push or pull is the force making the person change positions. Now imagine how pushes or pulls affect a swing that is already in motion; a push would make the person swing faster as you add to the already existing motion as they move away from you. However, when the swing reaches its top height, it is pulled back towards the ground by the force of gravity. This is an example of how pushes and pulls can not only start an object’s motion, but vary the speed of an object’s already existing motion.
Collision Course

*Science Concept: Momentum*

**Grades**
- Kindergarten

**Objective**

Students will explore collisions and energy of motion by experimenting with how to increase or decrease the momentum of different balls.

**Standards**

*Next Generation Science Standards: K-PS2-2.*

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

**Equipment and Materials**

- Slide
- Balls of Various Weights
- Heavy Object or Water Bottle

**Vocabulary**

**Collision:** when two or more moving objects bump into/exert forces on each other.

**Impact:** the effect that objects have on one another as the result of a collision.

**Momentum:** the strength something has when it is moving, determining how easy or difficult it will be to stop its current speed and/or direction of travel.
**Activity**

1. Introduce to students that they will be going out on the playground today and playing with different kinds of balls to understand what happens when they collide.

2. Bring students outside. Have them begin the lesson working in pairs colliding the same balls to see how they react and bounce off one another. What happens when they collide?

3. Then have students collide different balls, such as a tennis ball and a basketball, or a baseball and a tennis ball. What observations did you make? How did the size of the ball affect the collisions?

4. Next, have a student place a heavy object such as a filled water bottle at the end of the slide. Divide students into groups of four. Have each group pick a different type of large ball such as a basketball or soccer ball, and experiment with releasing the ball from different heights on the slide: once from lower on the slide and once from the top to see how high and far the ball has to be to knock down the object.

5. While each group has their turn with the slide, have the rest of the class make predictions about what each of the balls will do when released.

6. To help students visualize how the height of the slide affects the collision impact, have the groups that are waiting mimic the experiment on a flat surface parallel to the length of the slide. Have students stand a safe distance away from the slide. Next, place a water bottle where the foot of the slide would be and have students sit where the beginning of the slide would be. Have the students release a ball on the ground giving it a small push toward the water bottle. Did the ball knock down the bottle?

7. Return to the classroom and discuss with students how the distance and height from the object increases the momentum of the ball.

**Extension Ideas**

Students can practice this activity using marbles. Have students work in pairs. Designate one marble as the shooter and another marble as the target. Place a piece of bright colored tape where the target marble will rest. Place the marbles about 45 centimeters apart, using a meter stick for help to set it up. Have students take turns flicking the shooter marble and measuring how far the target marble traveled from its original position which was marked by the piece of tape.

**Teaching Tips**

When having students collide the balls, be sure to choose an open area on the playground where the class can sit together. Have students sit facing their partners with their legs wide and extended, touching the shoes of their partner. Have groups sit back to back in rows in order to ensure you can observe and facilitate their technique, reminding them that rolling the balls to result in a light tap is enough for a collision.

**Science Connections — Did You Know?**

A collision is the event where two (or more) objects exert force on each other. While we often think of collisions as being objects hitting each other with a lot of force, the actual amount of force the objects have on each other does not matter when calling it a collision! Anything from a baseball bat hitting a ball to a butterfly brushing against you can be called a collision in the moment the objects come together. In comparison, an impact is defined as the effect that objects have on one another as the result of a collision. Another way to think about it is that an impact is the product of force applied over time.
Objective

Students will explore how sunlight can change the temperature of surfaces.

Standards

Next Generation Science Standards: K-PS3-1. Make observations to determine the effect of sunlight on Earth’s surface.

Equipment and Materials

Surfaces of Various Types

Vocabulary

Temperature: a measure of the average kinetic energy of a substance; or a measurement of how fast the particles of a substance are moving, determining how hot or cold something is.

Hot: something that has a high temperature.

Cold: something that has a low temperature.

Energy: the ability of something to be active or do work.

Transfer of Energy: the conversion of one form of energy to another or when energy is transferred from one object to another.
Activity

1. Ask students to look around the classroom and think about what different materials or surfaces are made of. Point out wood, plastic, metal, paper, glass, cloth. Ask the students to make predictions about how they think these materials would feel under direct sunlight.

2. Head outside with the students. Bring materials that retain different levels of heat (wood, plastic, metal, paper, glass, cloth) with you to the playground and place them in the path of direct sunlight. Have students feel the materials and pay attention to which ones feel hotter and cooler under the sunlight. Ask them to think about why the same energy from the sun affects the materials differently.

3. Next, move the same materials to the shade. Ask students to feel the materials again and think about why certain materials heat up and stay warm longer than others, while other materials cool down more quickly in the shade.

4. Prompt students to think again about why the same energy from the sun affects materials and surfaces differently.

5. Return to the classroom and have a discussion about how some materials and surfaces retain heat differently (metal retains heat, wood does not retain heat as well as metal). Talk about how these materials can be used for different purposes (metal is a good conductor, glass is a poor conductor but a good insulator, different types of cloth are better for keeping you warm such as wool).

Extension Ideas

When out on the playground, ask students to think about what some of the playground equipment and surfaces are made of. Have them make predictions about how the sunlight will affect the temperature of the different materials and equipment. Then go outside in the morning when the sun is high and have students feel the equipment. Go outside later in the afternoon, when it is shady, and have the students feel the equipment again. Ask students to look back at their predictions and discuss what their results were.

Teaching Tips

While you don’t want to limit the predictions that students make or the way they describe the materials, sometimes additional facilitation is needed to get them thinking more critically. Prompt students with words related to temperature such as hot, warm, cool or cold if they’re having trouble with articulating their predictions. You can also show students how a thermometer is used to measure temperature, and relate this to their descriptions of hot, warm, cool and cold.

Science Connections — Did You Know?

Temperature is a measurement of the average kinetic energy the atoms in a substance (like air, water or even your table) have. This average kinetic energy comes from how fast the atoms are moving. When the atoms are moving fast and have a lot of energy, then the temperature is measured as high. When atoms move slower and have little energy, the temperature is measured as low. Materials that are able to hold more heat have particles that are able to move around more than particles in substances that hold less heat. For example: water’s particles can move around (more kinetic energy) easily, so it would heat up faster than your desk whose particles can’t move as easily.
Playing With Light

Science Concept: Light and Shadows

Grades

- First Grade

Objective

Students will explore how light moves through different materials on the playground.

Standards

Next Generation Science Standards: 1-PS4-3.
Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.

Equipment and Materials

Open Space
Sidewalk Chalk
A Sunny Day
Flashlight
Cardboard
Acetate
Wax Paper

Vocabulary

Opaque: An object that blocks the path of light, creating a shadow.

Translucent: An object that lets some light through, but not all.

Transparent: An object that is see-through and lets light pass through it.

Shadow: A dark area created when an object blocks the path of light.
**Activity**

1. Ask students to think about a time that they could see their shadow. What did it look like? Was it small or big? What shape was it? Where were they when they saw it? Allow students to share their ideas and experiences.

2. Discuss with students that objects can be put in groups based on the type of materials they are made of and if they are opaque, translucent or transparent. Show students a piece of wax paper, cardboard and acetate, and then ask them to predict how much light will go through each one. Using a flashlight, shine light through each object. Ask the students to compare which object let the most and least light through. Explain that each object is an example of an opaque, translucent or transparent object.

3. Take students to the playground and have them hunt for examples of objects that fit into these three categories.

4. Gather students back together and discuss what types of materials they found. Can they all identify something that is opaque, translucent and transparent? If not, have students who found items share examples and discuss which category they belong to.

5. Split students into three groups (opaque, translucent and transparent) and give students in each group a different color of sidewalk chalk (e.g., blue = opaque, yellow = transparent, pink = translucent). Have students hunt for shadows cast by objects in the group they are assigned (shadows of opaque objects, transparent objects or translucent objects). When they find a shadow, have them trace it with the sidewalk chalk.

6. Gather the groups back together and have them take the class on a tour of the shadows their group found. Discuss if each group found shadows and why or why not.

7. Help students notice the patterns in the shadows cast by the three types of materials. Ask students which objects had shadows with hard lines, which had soft, blurry lines, and if there were objects that had no shadows at all.

**Extension Ideas**

Try doing this activity on different days (cloudy, sunny, etc.) and at different times of day (morning, noon, etc.). Have students discuss how the time of day and amount of sun affects the shadows of different objects on the playground. If your playground does not have objects that are translucent or transparent, consider bringing additional objects outside for students to explore (e.g., wax paper, clear plastic, aluminum foil, sunglass lenses, magnifying glasses, etc.).

**Teaching Tips**

Before going out to the playground with your students, spend some time outside scoping out possible materials the students can use for comparison. It won’t be obvious to them right away what they are looking for, and they may need help with testing their materials in the sunlight to see what category the object falls under.

**Science Connections — Did You Know?**

Light travels in a straight line. A beam of light will travel until it is blocked by an object or bent by a reflective surface such as a mirror. Opaque objects block the path of light and a shadow is produced. Light can travel through a transparent object, like a clear window. Because of this, transparent objects will not cast shadows like opaque objects, but they will still appear to have shadows because they interact with light through refraction. Refraction is the bending of light as it passes from one substance to another which is what allows us to see transparent objects at all. Translucent objects allow light to travel through them, but scatter the light. When light travels through a translucent material, a shadow may appear, but it will be blurry instead of sharp.
Objective

Students will explore how waves/vibrations on playground equipment can make sound.

Standards

Next Generation Science Standards: 1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

Vocabulary

Sound Waves: vibrating energy that moves in patterns detectable to human ears.

Vibration: when something moves back and forth or from side to side very quickly.

Pattern: something that is repeated or happens in a repeated way such as a design or repeated motion.

Equipment and Materials

Various Playground Equipment
Metal Ruler
Metal Can
Plastic Wrap
Rubber bands
Tape
Paper
Cotton
Salt
Activity

1. Before class, prepare the metal drums that help students to see and hear the effects of sound waves/vibrations. You will need one drum per group. Place a piece of plastic wrap over an empty metal can. Secure the plastic wrap tightly with a rubber band. If concerned about durability, double the plastic wrap or cut the neck off of a translucent balloon and secure it over the can. Test the drums to make sure that when salt is placed on top of the plastic, it vibrates when tapped with a ruler or using sound/voices through a paper megaphone.

2. Introduce to students that today they will be exploring sounds out on the playground.

3. Have students place their fingers lightly on their voice box on their necks and hum to feel the vibrations. Discuss that the vibrations are from sound waves, exploring the difference between quiet humming and loud humming.

4. Take students outside, have students work in pairs and lightly tap a metal ruler on the different playground equipment. Ask them to pay attention to the vibration of the ruler. Does it wiggle more or less on different equipment? Ask students to compare the sounds and think about how the equipment materials may affect the sound.

5. Return to the classroom.

6. Break up students into four groups. Tell students they are going to test if the sound from their voices can make something vibrate. Have students create their own megaphone using a piece of paper, a piece of tape, and a piece of cotton. Roll the paper like a megaphone, secure with a small piece of tape, and place a small piece of cotton inside on the smaller end to prevent students’ breath from interfering with their tests.

7. Hand out the metal drums that students will use for testing. Place a few grains of salt on the plastic part.

8. First, ask students to test if the grains of salt vibrate when the can is tapped with the metal ruler.

9. Next, ask students to test whether the sound through the megaphone can make the salt vibrate.

10. Summarize today’s activities and discuss with students what they learned about waves, sounds, and vibrations.

Extension Ideas

Have students place a ruler at the edge of their desks with 20 centimeters hanging off. Ask students to strike the ruler and listen to the sound, as well as observe the frequency of the vibrations. Have students experiment with how many centimeters of the ruler is hanging off their desks. Can they make the sound higher or lower?

Teaching Tips

When students are using the metal ruler to tap the playground equipment, ensure they are spread out across the equipment so that one student’s tapping does not cause another student to have inaccurate results. During the metal can tool activity, ensure that students are taking turns when tapping their rulers or using their megaphones with the can.

Science Connections — Did You Know?

Ever wonder why you can hear through a wall, but it doesn’t sound the same as someone in the same room? All sound waves are made up of vibrations passing through a medium like air, walls or even water. Each sound we hear has a particular pattern that we hear as different types of sounds: high or low, loud or quiet. When a vibration passes through air, the pattern of vibration stays the same for a long time as it travels because the air can move back and forth just like the original vibration. But when a vibration passes through a medium that can’t move back and forth as easily — like a wall for example — the pattern changes. That changed pattern can sound kind of like the original vibration pattern, or it can lose most of the pattern and come out unrecognizable. It all depends on the medium the vibration has to pass through to get to your ears.
Material Matters

Science Concept: Physical Properties

Grades

- Second Grade

Objective

Students will explore how the physical properties of different playground equipment affect their usage.

Standards

Next Generation Science Standards: 2-PS1-1.
Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

Equipment and Materials

Slide
Swings
Toys with wheels
Hardback textbooks

Vocabulary

Smooth: a surface that has few bumps or grooves in it, making it easy to slide across.

Bumpy: a surface that has bumps on it, making it harder to slide across, but easy to hold onto.

Rough: a surface that is coarse, jagged or uneven, with bumps and grooves that make it very difficult to slide across and uncomfortable to hold onto.

Flexible: an object that bends easily without breaking.

Physical Property: things we observe about objects by using our five senses such as color, size and shape.
Extension Ideas

In order to help students think critically about the properties of materials out on the playground, you can front-load the words and experiences associated with identifying things through observations. Bring in items made from different materials with differing textures such as fabric, wax paper, newspaper, sandpaper, wood, plastic, glass, metal and rubber. Have students look at and feel the items, connecting that even though some of them are made from the same source, they can look and feel different.

Teaching Tips

Before students try out the playground equipment, demonstrate the safest way to use the equipment. For example, laying down and keeping your arms crossed while sliding down the slide, ensuring you’re a safe distance away from the swing set, slowing down and coming to a full stop before getting off the swings, etc. You can also relate this to how the properties of the equipment help it function safely.

Science Connections — Did You Know?

The physical properties of an object define how everything else in the world interacts with it. Everything from texture to elasticity will determine how an object bends, melts, breaks and grips. Sometimes the texture of a surface can even determine its “shine” or reflection by absorbing and reflecting light in different directions. For example, if you wanted to see your reflection, would you look at a rough white piece of paper or a smooth piece of glass? The white paper is bumpy and does not reflect light back in a perfect reflection of your face, instead scattering light in different directions from its different-shaped bumps. The glass is smooth and reflects light back in a reflection of your face, as the light is reflected back in the opposite direction it hit the glass.
Objective

Students will explore properties of surfaces on the playground by bouncing a ball and measuring how high it bounces using their own bodies.

Standards

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Equipment and Materials

Different Types of Balls
Various Playground Surfaces
Meter Stick

Vocabulary

Texture: the feel or tactile quality of something when you touch it (smooth, soft, rough, hard).
Elasticity: the ability of an object to return to its original shape (snap back) after being stretched or compressed.
Hardness: how difficult it is to press into an object.
Properties of Materials: a characteristic of an object that can be observed, described or measured.
Activity

1. Ask students to name different types of shoes they have (e.g., sneakers, dress shoes, boots, etc.). Ask students if some shoes make it easier to jump/bounce in. Let them share their ideas.

2. Tell students that some of the different types of materials their shoes are made of (e.g., hard sole, squishy sneakers, soft boots) can make them bounce higher than other kinds of shoes.

3. Tell students that today they are going to explore what surfaces/materials make balls bounce the highest. Tell students that they are all going to use the same kind of ball so they can compare what they notice.

4. As a class, make a list of the different surfaces that are on the playground and what they are made out of (e.g., concrete, grass, rubberized play surface). Ask students to predict the surface that a ball will bounce the highest on.

5. Tell students that before they go out onto the playground, they are going to practice dropping the balls. Have students work in pairs. One student will be in charge of dropping the ball, while the other can observe how high it bounces. Have students take turns with roles so they both get a chance to drop the ball and observe.

6. Explain and demonstrate to students that it is important they drop the ball from the same height every time to be consistent (e.g., waist height) and that they drop the ball, not throw it (just hold it up and let go). Demonstrate how they should drop the ball. If you have room in the classroom, have students practice dropping the ball before going out to the playground.

7. Go to the playground and let students experiment with dropping the ball on the different surfaces discussed. Have students write down the measurement of how high the ball bounces on different surfaces. Students can round to the nearest centimeter to make measuring easier.

8. Return to the classroom and have students share what they noticed while experimenting. Create a chart of student measurements for each surface, and compare which surfaces made the ball bounce higher or lower.

9. Discuss as a class if there are any similarities or patterns in what happened and why the different surfaces might impact how high the ball bounces.

Extension Ideas

Have your students try the same activity using different types of balls to see if they get the same results. Discuss why the ball’s material might affect how high it bounces, and how a ball’s material might impact what people use them for.

Teaching Tips

When students are practicing dropping the ball in the classroom, have them use a meter stick as a point of reference. This will help them to remember to drop the ball instead of throwing it and make it easier to measure how high it bounces. Make sure the student measuring kneels down so that they are at eye level with the bouncing ball. This will help capture a more accurate measurement.

Science Connections — Did You Know?

When you are holding a ball, it has energy stored in it. When you drop the ball and it hits the ground, the energy stored in the ball is transferred into the ground, and the energy in the ground is transferred back to the ball. This energy causes the ball to change shape. Because the ball is made of a flexible material, it wants to return to its normal shape, causing it to spring back up. When you drop a ball on a soft surface, the soft surface absorbs the energy stored in the ball rather than returning back into the ball. This results in the surface changing shape instead of the ball, which results in the ball bouncing back less than on a hard surface.
Step by Step

Science Concept: Simple Machines

Grades

- Kindergarten
- First Grade
- Second Grade

Objective

Students will compare the differences between two inclined planes for rolling a ball and slinking a slinky.

Standards

Next Generation Science Standards: K-2-ETS1-3. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Equipment and Materials

- Balls
- Ramp
- Stairs
- Slinky

Vocabulary

Inclined Planes: flat surfaces with one end higher than the other.

Elevation: a measurement of the height above the ground of a location or object.

Work: the amount of energy that is needed to move an object across a distance.

Simple Machines: devices that make it easier to do work; they can change the direction or magnitude of a force, or the point where the force is applied.
Activity

1. Discuss with students how many different types of activities require us to use energy, or do work, in different ways. Introduce that simple machines can help us do this work.

2. Explain how your elbow or a pair of scissors are examples of simple machines. Inform students that simple machines don’t make the amount of energy required to do something less, they just make it easier to do something by doing some of the work for us.

3. Remind students that there are other types of inclined planes all around us designed to solve problems (such as stairs and ramps). Ask students what stairs and ramps help us do? They help us go up and down, from a lower place to a higher place and vice versa.

4. Tell students that they will be testing the effectiveness of these two inclined planes — stairs and a ramp — to move a slinky and a ball down in elevation. Have students make predictions about the movement and speed of the ball and the path of the slinky when they are released one by one at the top of the ramp and at the top of the stairs.

5. Go out to the playground. Divide students into four groups. Have half the students observe and compare what happens when the ball rolls down a ramp versus bounces down the stairs. Which inclined plane made the ball move faster?

6. Have the other half observe and compare with the slinky. Which inclined plane made the slinky move faster?

7. Switch so that the slinky groups are now observing the ball, and the groups observing the ball are now observing the slinky.

8. Go back to the classroom. Ask students to think back to their predictions. Discuss with students why the ramp made the ball go faster, but the stairs worked better for the slinky. Explain how all simple machines help us do work, but they are often used for different purposes based on how effective they are at solving different types of problems.

Extension Ideas

Now that students have an understanding of how inclined planes work, have them explore building different ramps of their own to try and get various balls such as a golf ball, a ping pong ball, or marbles from point a to point b. You can use simple materials such as wood planks, textbooks or rulers as ramps, skewers and masking tape to hold materials together, buckets and blocks to hold up the ramps, and small safety cones with plastic hoops attached to the top as an additional challenge for getting the balls through the hoop. You can even play around with texture by covering the ramps in hand towels, sandpaper, rubber grippy mats, foil or parchment paper.

Teaching Tips

When introducing simple machines to students, pointing out concrete examples found around the classroom can help students better understand how simple machines help us do work by observing them in action. Some everyday simple machines you can find around the classroom or school building are: levers — scissors, broom, shovel; wedges — fork, knife; screws — pencil sharpeners, jar lid; wheel and axles — toy wheels, doorknob, gears; pulleys — flagpole, drapery draw; inclined planes — ramps, stairs, slide.

Science Connections — Did You Know?

While we often think of “work” as being something that takes effort, in physics the term has more to do with changing the form of energy an object has, or changing where the object with energy is. Lifting, dropping, pushing and pulling are all forces that can do work on an object, provided that the object ends up moving with the force. For example, if you pushed against a wall and it failed to move, your push would be said to have done no work. However if you pushed against a box and it moved several meters in the direction you pushed, then your push would be said to have done work!
Cruise Control

Science Concept: Friction

Grades

- Kindergarten
- First Grade
- Second Grade

Objective

Students will use simple materials to build a mechanism that helps slow an object sliding down a slide.

Standards

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Equipment and Materials

- Slide
- Weighted Stuffed Animals
- Simple Materials: Paper, Cardboard, String, Pipe Cleaners, Masking Tape, Hole Punchers, Scissors

Vocabulary

- Force: a push or pull on an object.
- Distance: the amount of space between two objects or points.
- Friction: the resistance of motion when one object rubs against another.
Activity

1. Discuss with students if they have ever gone down the slide with shorts on (so their skin rubs against the slide and they slow down), if they’ve gone down the slide when wet (it tends to be faster) or a water slide. Ask them to compare and contrast those experiences of sliding down.

2. Introduce to students that today they will be exploring how to make the slide work differently. Introduce the test object — a Beanie Baby or other stuffed toy that will easily slide down and fall off the slide. Share with students that their goal is to slow down the stuffed toy to prevent it from falling off.

3. Go out to the playground and have students observe the test object go down the slide without any modifications. Ask students to pay attention to: Did the object slide down fast or slow? Did it keep moving once it hit the ground? How did it land or crash?

4. Bring students back to the classroom and, using simple materials, have them work in groups to construct a holder or mat for the stuffed toy to prevent it from falling off the slide and/or slow it down. Tell students to keep in mind the stuffed toy has to make it to the end of the slide.

5. Students can use a large textbook turned up at an angle against a wall to test their design while in the classroom.

6. Bring students back outside and have groups test their designs.

7. Once back in the classroom, have groups think about if and how they would further modify their design, and why, having now tested the real object.

Extension Ideas

You can incorporate other playground equipment into simple design challenges for your students. Have students try to create a parachute to slow down the speed of the stuffed toy when it is launched from the monkey bars. You can also have students create a jungle gym using toothpicks and rubber bands or gum drops that is strong enough to sustain the weight of the stuffed toy when it “climbs” to the top.

Teaching Tips

Make sure that each student group has at least one Beanie Baby or weighted stuffed toy. As groups are constructing their mechanisms, ask them to pay attention to or give subtle clues as to how the size, shape and weight of the Beanie Baby may affect their design.

Science Connections — Did You Know?

When one object tries to move against another object, the force that slows them down is called “friction.” The amount of friction between two objects — whether that is two blocks of wood, a boat in water, or a wheel on the road — varies depending on the surface of each object in the movement. Objects with relatively smooth surfaces (very little difference between high and low parts of the surface) provide smaller amounts of friction, while objects with rough or textured surfaces (larger difference between high and low parts of the surface) provide larger amounts of friction. Depending on the purpose of the objects moving, different amounts of friction may be desired. When moving a boat through water, we want the water to slide past the boat’s smooth surface with very little resistance. When driving down a road, we want the bumpy tires to grip on the rough road with some resistance, so we can control how fast and in what direction we move.
Stop, Drop, Don’t Roll

Science Concept: Motion

Grades
- Kindergarten
- First Grade
- Second Grade

Objective

Students will design a mechanism to catch their wheeled toy at the end of the slide, stopping its motion.

Standards

Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Equipment and Materials

Slide
Toy with Wheels
Simple Materials: Paper, Cardboard, String, Pipe Cleaners, Masking Tape, Hole Punchers, Scissors, Felt, Paper Clips

Vocabulary

Speed: how fast or slow an object is moving.

Momentum: the strength something has when it is moving, determining how easy or difficult it will be to stop its current speed and/or direction of travel.

Motion: an object moving or changing position from one place to another compared to a place or object that is not moving.
**Activity**

1. Introduce to students that today they will be exploring how to develop and build a tool to change how something is moving. Introduce the test object — a wheeled toy that when released on the slide will drop off the end and crash. Share with students that their goal is to build a mechanism to catch the wheeled toy at the end of the slide and to stop it from crashing.

2. Go out to the playground and have students observe the test object go down the slide without any modifications. Ask students to pay attention to: Where does the object go after it falls off the slide? How long does it keep moving after it falls off the slide?

3. Bring students back to the classroom and divide them into four groups. Ask them to brainstorm and draw their ideas for a tool that would catch the wheeled toy, stopping its motion. Tell students that the wheeled toy has to leave the end of the slide, but can be stopped before or after it touches the ground, but that the wheeled toy cannot crash.

4. Have students continue to work in their groups to construct their toy-stopping tools.

5. Students can practice rolling the wheeled toy into their tool to see how it functions in order to iterate on its design.

6. Bring students out to the playground and have them test their designs with the slide. Be sure to have students stand a safe distance away from the launch path of the toy.

7. Once back in the classroom, have groups think about if and how they would further modify their design, and why, having now tested the real object.

**Extension Ideas**

To further explore momentum in the classroom, try having students experiment with releasing a marble on a slotted ruler that is propped up by books to create a ramp. At the end of the ruler, set an index card that is folded so it stands upright. Have students start with only one book under the ruler and keep adding books after each test, paying attention to how much the index card moves when it is hit by the marble each time. The higher the release point, the more the index card will move back.

**Teaching Tips**

When students are working in groups to design their tools, you can assign roles to each student such as engineers, designer, stunt person, recorder, etc. The designer can be in charge of ensuring they are drawing out and documenting their ideas as well as considering what materials would work best; the engineers can be in charge of making sure they are building the mechanism according to their plans or modifying accordingly after each test; the stunt person can be in charge of directing and releasing the toy during the practice tests in the classroom and final test on the playground; and the recorder can document the results obtained with each toy-stopping design.

**Science Connections — Did You Know?**

Momentum depends on the mass, speed and direction of an object. A moving object has momentum that will keep it moving in the same way until something causes it to slow down or change direction. Because momentum involves the mass of the moving object, this means a heavy object will have more momentum than a light object moving at the same speed. The best way to think about this is if you were to try to stop a rolling bowling ball versus a paper airplane moving at the same speed. While you might be able to blow on the paper airplane to make it slow down or change its direction, it is very unlikely that same breath would make any difference to the speed or direction of the bowling ball!
<table>
<thead>
<tr>
<th>Activity Index</th>
<th>Equipment and Materials</th>
<th>Vocabulary</th>
<th>Science Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push &amp; Pull My Swing</td>
<td>Swings</td>
<td>Push, Pull, Speed, Force</td>
<td>Pushes and Pulls</td>
</tr>
<tr>
<td>p. 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collision Course</td>
<td>Slide, Balls of Various Weights, Heavy Object or Water Bottle</td>
<td>Collision, Impact, Momentum</td>
<td>Momentum</td>
</tr>
<tr>
<td>p. 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunny Side Up</td>
<td>Surfaces of Various Types</td>
<td>Temperature, Hot, Cold, Energy, Transfer of Energy</td>
<td>Energy</td>
</tr>
<tr>
<td>p. 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing With Light</td>
<td>Open Space, Chalk, A Sunny Day, Flashlight, Cardboard, Acetate, Wax Paper</td>
<td>Opaque, Translucent, Transparent, Shadow</td>
<td>Light and Shadows</td>
</tr>
<tr>
<td>p. 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Waves</td>
<td>Various Playground Equipment, Metal Ruler, Metal Can, Plastic Wrap, Rubber Bands, Tape, Paper, Cotton, Salt</td>
<td>Sound Waves, Vibration, Pattern</td>
<td>Waves</td>
</tr>
<tr>
<td>p. 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material Matters</td>
<td>Slide, Swings, Toy with Wheels, Hardback Textbooks</td>
<td>Smooth, Bumpy, Rough, Flexible, Physical Property</td>
<td>Physical Properties</td>
</tr>
<tr>
<td>p. 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounce That Ball</td>
<td>Different Types of Balls, Various Playground Surfaces, Meter Stick</td>
<td>Texture, Elasticity, Hardness, Properties of Materials</td>
<td>Properties of Materials</td>
</tr>
<tr>
<td>p. 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step by Step</td>
<td>Balls, Ramp, Stairs, Slinky</td>
<td>Inclined Planes, Elevation, Work, Simple Machines</td>
<td>Simple Machines</td>
</tr>
<tr>
<td>p. 17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruise Control</td>
<td>Slide, Weighted Stuffed Animals, Simple Materials: Paper, Cardboard, String, Pipe Cleaners, Masking Tape, Hole Punchers, Scissors</td>
<td>Force, Distance, Friction</td>
<td>Friction</td>
</tr>
<tr>
<td>p. 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop, Drop, Don’t Roll</td>
<td>Slide, Toy with Wheels, Simple Materials: Paper, Cardboard, String, Pipe Cleaners, Masking Tape, Hole Punchers, Scissors</td>
<td>Speed, Momentum, Motion</td>
<td>Motion</td>
</tr>
<tr>
<td>p. 21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ABOUT NYSCI

The mission of the New York Hall of Science (NYSCI) is to nurture generations of passionate learners, critical thinkers and active citizens through an approach called Design, Make, Play. Design, Make, Play emphasizes open-ended exploration, imaginative learning, and personal relevance, resulting in deep engagement and delight in science, technology, engineering and mathematics. NYSCI was founded at the 1964 – 65 World’s Fair and has evolved into New York’s center for interactive science serving a half million students, teachers and families each year. For more information, visit nysci.org or call 718-699-0005.

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