Grade Two

Physical Science: Exploring Pushes and Pulls Kit

Contents of this Science Kit:

4 cardboard ramps (not in plastic container)
4 wood blocks
1 roll of string
2 boxes of paper clips
1 package of rubberbands
4 donut magnets
1 bar magnet
4 packages of small washers
3 packages of large washers
4 plastic spoons
4 popsicle sticks
1 roll masking tape

Items Teachers May Need to supply:

Rulers
Markers
Wax paper
Alumuniun foil
Plastic wrap
Paper towel tubes
Toilet tissue/paper towel tubes
Popsicle sticks

GRADE TWO

PHYSICAL SCIENCE: EXPLORING PUSHES AND PULLS KIT

Standard 2.P.4: The student will demonstrate an understanding of the effects of pushes, pulls, and friction on the motion of objects.

2.P.4A. Conceptual Understanding: An object that is not moving will only move if it is pushed or pulled. Pushes and pulls can vary in strength and direction and can affect the motion of an object. Gravity is a pull that makes objects fall to the ground. Friction is produced when two objects come in contact with each other and can be reduced if needed.

Performance Indicators: Students who demonstrate this understanding can:

2.P.4A.1 Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object.

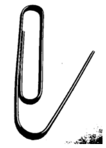
For Discussion:

- What is the difference between a push and a pull?
- Can someone tell about a time when they pushed something?
- Can someone tell about a time when they pulled something?
- Can someone demonstrate pushing something in the room?
- Can someone demonstrate pulling something in the room?
- Why do we push or pull on objects?
- Is it considered pushing or pulling if we exert this force, but the object doesn't move? (*Yes, it is still a push or pull, but it may not be strong enough. A push or pull that does not result in motion is called a balanced force.*)
- Consider playing tug-o-war as long as you think it is safe, and you design it to be played safely.
- What games can we play that involve pushing or pulling?
- What's the heaviest thing you have ever pushed/pulled?
- What's the lightest thing you have ever pushed/pulled?

Investigation #1: How many washers will move the wood block?

1. Cut 48cm of string.

2. Tape it to the wood block or tie a knot around the wood block.



3. Tie a paperclip to the other end of the string. Bend it to a hook shape.

4. Set the wood block on a table and allow the end of the string with the paperclip to hang.

5. Begin adding small washers, one at a time until the block begins to move. How many does it take?

6. Remove all of the small the washers, reset the wood block.

7. Add large washers, one at a time until the block begins to move?

8. Try adding various objects beneath the wood to see if the same number of washer makes it move. (a sticky note, tape, paper, sand paper, fabric, etc.)

   NOTE: Here (#8) students are testing friction. They are placing objects that may increase or decrease the amount of friction between the block and the surface. Friction is addressed in later standards 2.P.4A.4 and 2.P.4A.5, but this extension can be completed now then referenced when friction is addressed, or you may wait and complete the extension later once your are actually studying friction.

Questions:

A. What caused the wood block to move?

B. How many washers did it take to move the wood block?

C. Why didn't the block move when only 2-3 washers were hanging?

D. Were the washers pushing or pulling the wood?

E. If you had 2 wood blocks tied together, would it take more washers or less washers to move them?

F. Did you try any objects beneath the wood (step 8)? What was the effect?

Investigation #2: How many paperclips will a magnet attract?

1. Cut 12 inches of string and tie it around a ruler.

2. Tie a donut magnet to the other end of the string.

3. Suspend the ruler between 2 student desks (or desk chairs) allowing the magnet to hang.

4. Students should bring paperclips towards the magnet, what happens? How many paperclips will it attract? Is this a push or a pull? (You may require that they bring the paperclips one at a time towards the magnet.)

5. Students should bring small washers towards the magnet, what happens? How many washers will it attract? Is this a push or a pull? (This may also need to be done one at a time.)

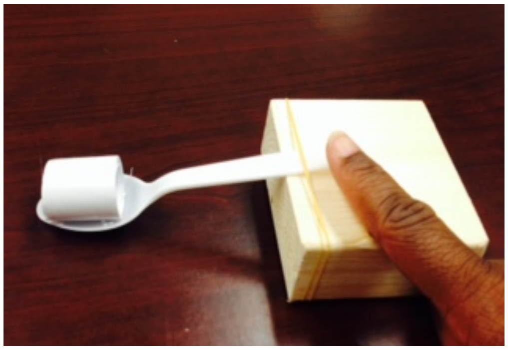
Questions:

A. Do magnets push objects or pull objects?

B. Did the magnet attract more paperclips or washers? Why was there a difference?

C. If you were to try this with the large washers, do you think it would attract more or less of them? Why?

Activity #3: Lets Make a Catapult



*Teacher will need to provide marshmallows for this activity.

Using a plastic spoon, a rubberband and a wood block, students should make a catapult to send the marshmallow into the air. See picture.

Students should attempt to use different amounts of strength on the catapult and record what happens to the marshmallow.

How will you measure different amounts of strength quantitatively? Students could compare the motion of the marshmallow when a large vs. a small washer is dropped on the spoon handle. Students could look at what happens when 1 vs. 2 vs. 3 washers are dropped onto the spoon handle.

Questions:

A. What will happen when you lower your finger on the spoon handle?

B. Is lowering your finger on the spoon handle a push or a pull?

C. Notice what happens to the marshmallow, is the spoon pushing on it or pulling on it?

D. What do you notice about the direction of the 2 pushes happening in this example?

E. How can we make it move higher into the air?

F. How can we measure how high it flies?

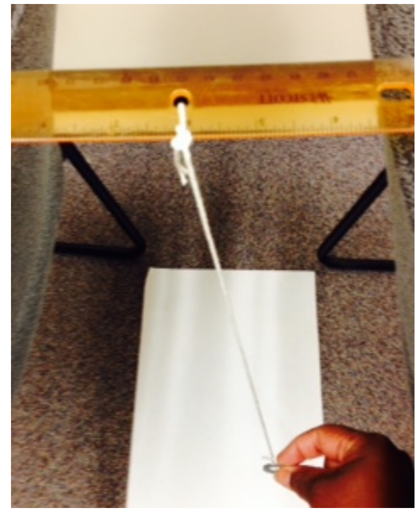
G. How can we measure how hard we are pushing on the spoon?

H. If you had an object heaver than a marshmallow, would you need more or less strength to move it?

I. What other catapult designs could you develop from a spoon?

2.P.4A.2 Develop and use models to exemplify the effects of pushing and pulling on an object.

Investigation #4: Swinging Washers



1. Cut 18 inches of string and tie it around a ruler.

2. Tie a paperclip to the other end of the string.

3. Suspend the ruler between 2 student desks (or desk chairs) allowing the paperclip on the end of the string to hang.

4. Students should hang a washer on the paperclip.

5. Pull the paperclip back and let it go, what happens.

6. Watch, the washer until it stops swinging. Why do you think it stops?

7. Push the washer forward and let it go, what happens?

8. Watch, the paperclip until it stops swinging. Why do you think it stops?

Extensions:

9. Add washers, does this change the motion? In what way does the swing change?

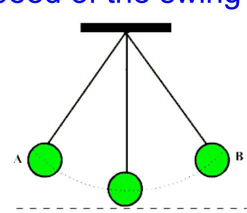
10. Wrap the string around the ruler once to shorten it. Try swinging the washers again, is the motion the same? Shorten the string more, does the swinging change? (See picture)

11. Tie a pencil to the string and make it the perfect length to park on a sheet of paper. Observe the marks made by the pencil.

12. Bring a magnet towards the washer(s) from the right, the left and from below, what happens each time.

NOTE TO TEACHER: The students are making a pendulum. It is gravity that makes it stop swinging eventually. A pendulum swings faster with a shorter string length. A pendulum swings slower with a longer string length. The amount of weight hanging does not change the speed of the swing, although to little eyes who want to see a change, they may report that it does cause a change. Changing the angle at which the weight is let go does not change the speed of the swing either.

You may have students make tally marks to count the number of swings. If they do this, 1 swing is the time it takes for the washer to swing from A to B then back to A, see diagram.



2.P.4A.3 Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected.

Investigation #5: Watch for Falling Objects

Students should drop various objects and make notes about their falling motion. Objects to drop include: sheets of paper, coins, plastic cups, balls, etc. See charts below. Think of other objects to drop and compare.

	Sheet of paper held horizontally	Sheet of paper held vertically	Sheet of paper crumpled to a ball
What do you observe?			
Draw it falling			
How fast does it fall?			

	paper cup dropped with open side up	paper cup dropped with open side down
What do you observe?		
Draw it falling		
How fast does it fall?		

Questions and Observations:

A. Do they all fall in the same way?

B. Do they all move in the same direction?

C. Do they all move straight?

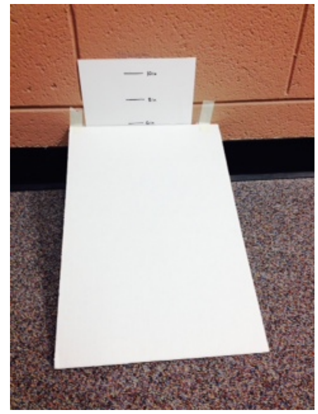
E. Do they all move at the same speed?

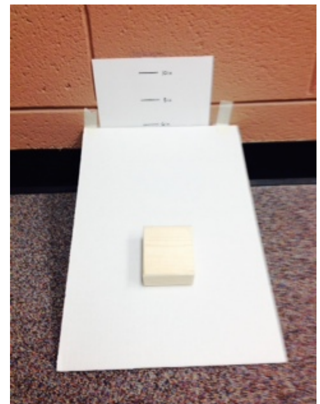
F. If two objects are the same weight, will they fall in the same way?

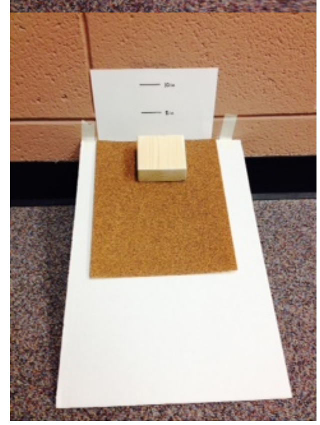
NOTE TO TEACHER: The pull of gravity is the same for all of the objects. It is the shape of the objects that causes air to have a greater or lesser effect on the speed (and direction) of the objects as they fall.

2.P.4A.4 Conduct structured investigations to answer questions about the relationship between friction and the motion of objects.

INVESTIGATION #6: Watch for Sliding Wood







1. Using a ruler and a blank sheet of blank typing paper, draw a short line a 2in, 4in, 6in, 8in, 10in. (NOTE: If marking the paper is too difficult, setup the ramp on 1 book, 2 books, 3 books, etc.)

2. Tape the sheet of paper to wall at floor level making sure it is secure at the top.

3. Prop the ramp (it may need to be secured with tape) at 2in and set the block on the ramp. Does the wood block sit or slide off?

4. Move the ramp up to the 4in mark, secure it to the wall, and set the block again, does it sit or slide off? Continue to raise the ramp to each level you marked and record observations.

5. Tape the sandpaper to the ramp. Again prop the ramp at 2in, and set the block atop the sandpaper. Record whether it sits or slides. NOTE: You may want to cut the sandpaper so that more of the ramp will be covered by sandpaper in a pathway for the wood.

6. Continue to move the ramp to each level and record whether or not the block sits or slides.

Observations. Write sit or slide in each box.

	Without Sandpaper	With Sandpaper
2 inches		
4 inches		
6 inches		
8 inches		
10 inches		

Questions:

A. Was the ramp rough or smooth? Was the sandpaper rough or smooth?
B. At what level did the sandpaper make a difference in keeping the block in place?
B. Why did the sandpaper keep the block from sliding?
C. What role did gravity play in this investigation?
D. What role did friction play in this investigation?
E. How do you think other types of objects would behave in a similar investigation?

NOTE: It is friction between the board and/or the sandpaper that prevents the wood from sliding, or makes it slide slower. It is gravity pulling the wood down the board. Both friction and gravity are types of forces. In this case they are working against each other. Gravity is trying to make the wood speed up (accelerate) while friction is slowing it down.

There are 3 types of friction: Sliding friction is between a sliding object and its surface. Rolling friction is between a rolling object and its surface. Static friction is between an object that is not moving and it's surface. Static friction can become sliding friction or rolling friction once an object starts moving. You and your students will observe this occurrence in this activity.

2.P.4A.5 Define problems related to the effects of friction and design possible solutions to reduce the effects on the motion of an object.

For Discussion:

- What is friction?
- Does friction make objects move faster or slower?
- Think about the ramp you made, where was the friction?
- Did the sandpaper add friction or ease the effect of friction?
- Would it be possible to slide the wood block down the board without any friction?
- If so, how would the wood move—faster or slower?
- Why do we need friction? We say friction slows things down, but are there any instances when we need friction?

→We often refer to necessary friction as *traction*. Car tires need traction so the car does not slide off the roadway especially during rainy weather. We need traction when we are walking so we don't slip and fall. We need traction so that we can turn doorknob, we cannot do this when our hands are wet.

INVESTIGATION #7: Slide Faster!

- What are some ways you can think of reduce the friction between the wood and the ramp—referring to Investigation #6?

→Some things students may suggest, and the teacher should allow them to try include, flipping the cardboard ramp to the brown side, lining the ramp with wax paper or aluminum foil, or typing paper (as lubrication) between the board and the wood. These items are not in your kit, but your 1st grade counterparts may allow you to borrow them from their kit or you may bring some from home. Students may suggest rolling something down the ramp—paper towel tubes, toilet tissue tubes, etc.

→Teachers, you probably have a stopwatch feature on your phone. For better quantitative data, time the objects to slide/roll down the ramp and maybe out to a designated position.