



Forces Push and Pull

Boys and Girls Club After School Science
NSF Center for Chemical Innovation
Chemistry at the Space Time Limit (CaSTL)
<https://www.castl.uci.edu/>

Standard(s) Addressed: Next Generation Science Standards

PS2.A: Forces and Motion

Objects pull or push each other when they collide or are connected.

- 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.
- An object sliding on a surface or sitting on a slope experiences a pull due to friction on the object due to the surface that opposes the object's motion.

PS2.B: Types of Interactions

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

Lesson Objective: The children will begin to understand the nature of forces as they apply to moving objects. The children will investigate forces by pushing and pulling boxes across a flat surface and they will be able to identify pushes and pulls they see in images.

Materials Used:

- Parachutes with objects attached--*plastic bags, string, small models (one per 3 children)*
- Cardboard boxes
- Heavy weights—*empty milk bottles filled with water*
- Towels
- Images of objects to show push and pull

Student Talk Strategies Used:

Talk to your partner

Think/pair/share

Classroom Management:

Conversation: quiet indoor voices

Help: ask the teacher, ask helpers/volunteers

Activity: work with group of three or four children, brainstorm/answer questions

Movement: groups move from station to station

Participation: working well in groups, doing task, working cooperatively

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Department of Chemistry. This lesson was written by Therese B. Shanahan, Ed.D., University of California, Irvine, School of Education and Cal Teach with activities taken from Darling, G. (2012, October). How does force affect motion? *Science and Children*, 50(2), 50 – 53.

<p>ENGAGE: <i>Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary</i> Estimated time: 5 minutes</p> <p>Description of Engage: The children complete the survey about forces and motion individually. They circle the choices they agree with. They draw pictures of forces in action based on their experiences.</p>		
Teacher's Role	Teacher Questions	Children's Role
<p>Teacher tells children that they are going to investigate forces today.</p> <p>But first the teacher wants to find out what they know about forces.</p> <p>Teacher may read the questions to the children if they need help.</p>	<p>In our first 3 sessions, we have been using our senses like scientists to investigate the world around us.</p> <p>Today we are going to do an investigation like scientists.</p> <p>We are going to investigate forces.</p> <p>But first before we start, I need to have you fill out a survey.</p> <p>Please do this by yourself.</p>	<p>Children complete the survey individually.</p>
<p>EXPLORE: <i>Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding</i> Estimated time: 30 minutes</p> <p>Description of Explore: The children will conduct an investigation of forces by first throwing a parachute and attached object into the air then by getting into teams to have a competition to see which team is the fastest to push and pull a box across the gym floor. In this investigation all the boxes have the same weights and the children will be asked which was easier: pushing or pulling? The last investigation involves using different weights and only pushing the boxes back and forth.</p>		

Teacher's Role	Teacher Questions	Children's Role
<p>The first investigation involves having the children throw a parachute and object into the air.</p> <p>The next investigation involves the children getting into 3 teams of 4 to 6 children each. The teams will divide their members into 2 groups facing each other.</p> <p>AAA AAA BBB BBB CCC CCC</p> <p>The teacher assigns the groups. Then models for the children how to do the investigation.</p> <p>In this investigation all the boxes have the same weights.</p>	<p>Now we are going to conduct our investigations about forces.</p> <p>The first investigation involves your tossing the plastic as high as you can.</p> <p>What happened?</p> <p>What force caused this to happen? What did gravity do to the plastic?</p> <p>Why did the plastic not fly off into the air?</p> <p>Is gravity a force?</p> <p>In this next investigation, you will get into teams and we will go into the gym but first let me explain what we are going to do.</p> <p>You will get into 3 teams. Teacher assigns the teams. The teacher tells the children where to stand.</p> <p>The team on the left will push a box to the members of the team on the right. The team on the right will pull the box back to the other team members. You will continue to push and pull the box until each member of the team has had a chance to move the box.</p> <p>Then we will talk about our findings.</p>	<p>Children toss the plastic upward on the teacher's signal.</p> <p><i>The toy went up and down.</i></p> <p><i>Gravity</i> <i>Gravity pulled the plastic down.</i></p> <p><i>Gravity pulled on the plastic.</i></p> <p><i>Yes, it is a pulling force.</i></p> <p>The children get into their groups.</p> <p>The children watch the demonstration.</p> <p>Then the children investigate the forces acting on the box as they push and pull the box in turn.</p>

<p>In the last investigation, the boxes have different weights. All the teams will push the box back and forth.</p> <p>One of the boxes has two gallon milk jugs filled with water.</p> <p>One box has three gallon milk jugs filled with water.</p> <p>One box has four gallon milk jugs filled with water.</p> <p>The boxes have a towel under them to avoid scratching the floor.</p>	<p>Now you will do another investigation by only pushing the boxes back and forth between team members.</p>	<p>The children do the next investigation. Each group will investigate all three boxes with the different weights.</p>
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EXPLAIN: *Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding* **Estimated time: 10 minutes**

Description of Explain: The children discuss which they think was easier: pushing their box or pulling their box. Then they will discuss how much force they needed to use to move the boxes with the different weights.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher leads the discussion about the two box investigations.</p> <p>The teacher tries to have the children explain their thinking.</p>	<p>What was the box doing before you started your investigation?</p> <p>What did you have to do to get the box to move?</p> <p>What do you think was easier to do: push the box or pull the box? Talk to your partner.</p> <p>Explain your thinking.</p> <p>Then you investigated the forces you needed to use to push boxes with different weights in them.</p> <p>Which one was easiest to</p>	<p><i>It was just sitting on the floor.</i></p> <p><i>It was sitting still.</i></p> <p><i>We had to push it.</i></p> <p>Children talk to their partners to decide how to answer this question.</p> <p><i>Answers may vary.</i></p> <p><i>The one with the least weight</i></p>

	<p>move?</p> <p>And which one was hardest to move?</p> <p>Which box needs more force to move it?</p> <p>What would you say to your little brother or sister about today's investigations?</p> <p>Think about this for a minute. Then pair with your partner and tell your partner what you would say. Finally, share with all of us.</p>	<p><i>in it.</i></p> <p><i>The one with the most weight in it.</i></p> <p><i>The heavier one.</i></p> <p><i>Gravity pulls things down.</i></p> <p><i>It is harder to pull a box than to push it.</i></p> <p><i>It takes force to move a box.</i></p> <p><i>It takes more force to move a heavy box.</i></p> <p><i>A force can be a push or a pull.</i></p>
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EVALUATE: *Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding* **Estimated time: 5 minutes**

Description of Evaluate: The children look at images that involve pushes, pulls and both pushes and pulls. They complete the worksheet and provide evidence for their thinking. The images involve: kite flying, Tom Brady throwing a football, a basketball player dunking a basketball into a hoop, a soccer player kicking a soccer ball, rock climbers pushing down on the rock with their feet while their hands pull them upwards, a fisherman pulling on a fishing pole to bring a fish into the boat, children pulling on a rope in a tug of war game, a boy trying to pull a heavy wagon.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher introduces the pictures.</p> <p>Teacher walks around the room to listen to the children talking.</p> <p>Some of the pictures may contain both a push and a pull. Teacher asks questions to lead the children to this understanding.</p>	<p>Now look at each of these pictures.</p> <p>Can you find the forces in each of them? Talk to your partner.</p> <p>What force is the boy applying to the kite string? What force is the wind applying to the kite?</p>	<p>The children look at the pictures and complete the worksheet to show their new understanding of force as a push or a pull.</p> <p><i>The boy is pulling on the string. The wind is pushing the kite.</i></p>

EXTEND/ELABORATE: *Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas* Estimated time: 5 minutes

Description of Extend/Elaborate: The children think of some examples of forces in their lives. Teacher reminds the children that they were acting like scientists by doing investigations by asking questions, using their senses to observe the boxes and the other children pushing and pulling, and by touching the boxes to make them move.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher elicits everyday examples about forces the children may be familiar with.</p>	<p>Now that we have done some investigations about forces, can you think of some forces that you see or use everyday?</p> <p>How did you act like scientists today?</p> <p>What did you do?</p> <p>What senses did you use?</p>	<p><i>My Dad pushes the lawn mower to cut the grass.</i></p> <p><i>The staff pulls the cart to bring our snack.</i></p> <p><i>The cue stick pushes the ball on the pool table.</i></p> <p><i>We push our chairs under the table.</i></p> <p><i>We pull on our back packs.</i></p> <p><i>We did investigations.</i></p> <p><i>We observed. We asked questions. We pushed and pulled the boxes.</i></p> <p><i>Sight and touch.</i></p>

Survey

Directions for Question 1: Circle all of the ways a force can change the motion of an object. Use a descriptive, complete sentence to give an example of each way that you circle.

(1) A force can cause an object to:

move

stop

change speed

change direction

Examples: Write some sentences to give some examples of each of these changes.

Draw pictures to show some examples.

Taken from Darling, G. (2012, October). How does force affect motion? *Science and Children*, 50(2), 50 – 53.

Directions for Questions 2 and 3: Read each of the following statements carefully. Circle whether you agree or disagree with each statement, and then explain your thinking in a descriptive, complete sentence.

(2) After you kick a ball in a straight line on the soccer field, there is a force that keeps the ball moving.

Agree or Disagree? Circle one.

Explain your thinking:

(3) A book sitting at rest on the desk has forces acting on it.

Agree or Disagree? Circle one.

Explain your thinking:

Draw a picture to show your thinking.

Taken from Darling, G. (2012, October). How does force affect motion? *Science and Children*, 50(2), 50 – 53.

Forces Push and Pull

Do you see a push or a pull or both a push and a pull in these pictures?

Give some evidence for your answer.

Activity	Push? Pull? Both a push AND a pull?	Evidence
Kite Flying		
Football		
Basketball		
Soccer		
Rock Climbing		
Fishing		
Tug of War		
Boy with Wagon		

Common Characteristics of Lesson Plans

Get Students into the Learning--Connect to Their Prior Knowledge

Exploration/Investigation/Hands-On Learning

Making Meaning--Teachers and Students Together

Evaluation/Assessment

Extension to the Real World or Other Curricular Areas

Other Aspects to Consider:

The lesson is Student-Centered--the student is listening, speaking, reading, writing and drawing. The student is thinking.

There is more Student Talk than Teacher Talk.