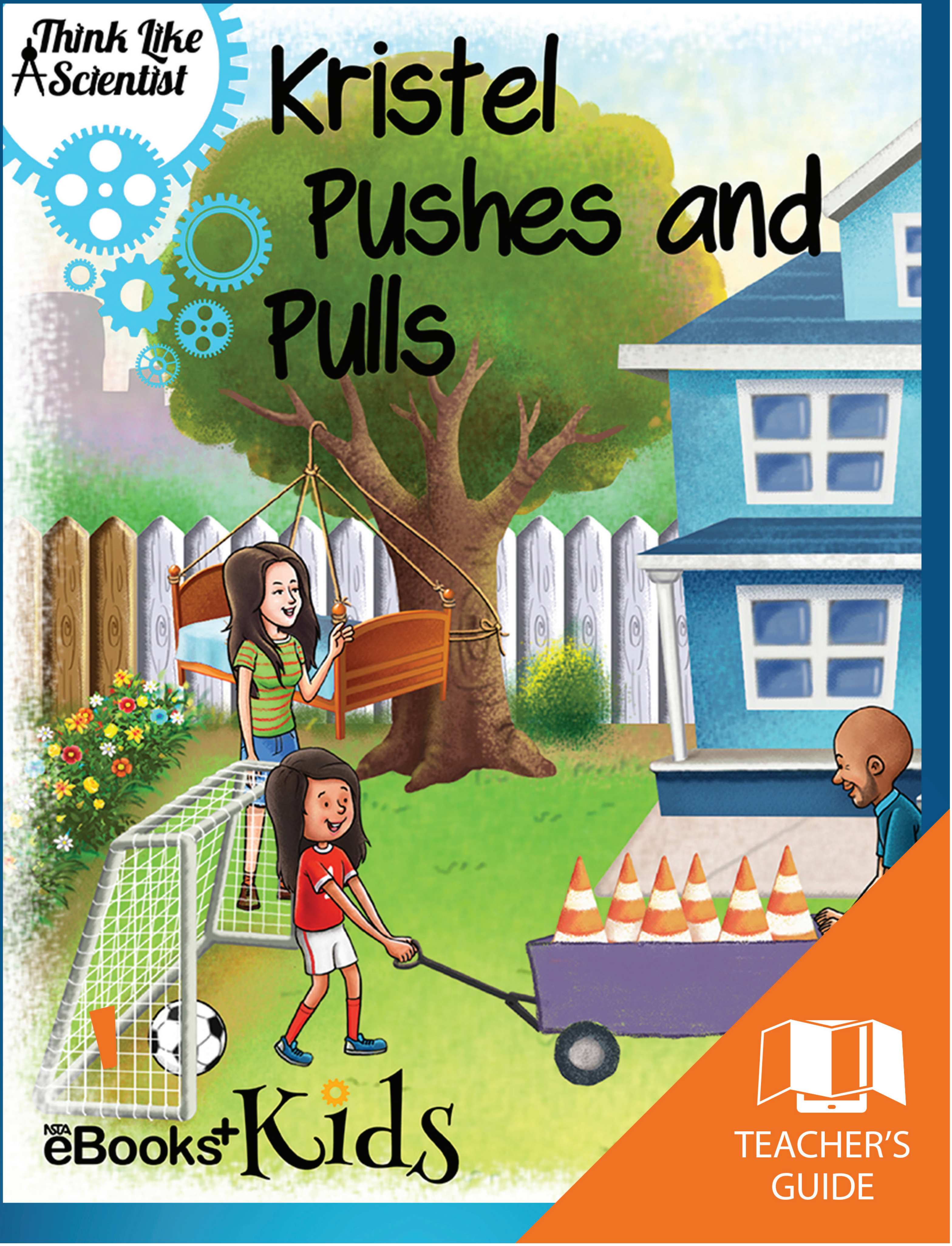
Kristel Pushes and Pulls



Overview

This teacher's guide is designed to provide ideas for how to use pages of the *Kristel Pushes and Pulls* e-book with students. It explains the concepts and suggests what to look for in students' learning, while also supplying information about how they are practicing science and using crosscutting concepts.

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The goals of this teacher's guide are as follows:

- engage students in grade-level appropriate, three-dimensional learning;
- use the e-book as a tool in class-wide, small group, or independent explorations of its content;
- provide additional ideas and activities that utilize the e-book content but are not included in the e-book;
- explore how STEM content can be effectively integrated into literacy (English language arts);
- facilitate investigations that utilize the e-book content and connect it with students' own classroom and community; and
- assess students on the second-grade content standards to which this e-book is aligned and additional *Common Core State Standards*, in English language arts and mathematics suggested throughout the e-book.

Book Description

The *Kristel Pushes and Pulls* e-book follows a young girl's sense-making through everyday activities at home and soccer practice to explain how her mother's bed mysteriously ended up in the tree in the front yard. Throughout her day, she explores how forces cause objects to change position, move different distances, and change speed and direction, as well as what happens when two forces collide with one another. Kristel guides students through the e-book's interactive activities, in-class hands-on activities, and productive discussion to put into perspective how pushes and pulls control the motion of all our interactions with the world around us.

Many of the activities in this e-book and guide are intended to be used as a method of integrating the curriculum as well as differentiating for various populations in your class. All extensions and suggestions should be adjusted to meet the needs of the various academic, physical, and intellectual levels of your students.

Please adjust the verbiage in the suggested questions to meet the language needs of the populations you serve.

The Driving Question

A driving question is one that drives the teaching and learning for a given unit, or even an entire school year. It provides context for the purpose of student exploration and understanding of a phenomenon. This e-book is written around the driving question:

How did the bed get up in the tree?

Three-Dimensional Learning and the *Kristel Pushes and Pulls* E-book

You will notice throughout the document that certain words and phrases are highlighted in different colors: blue, green, and orange. These colors correspond to the science and engineering practices (blue), crosscutting concepts (green), and disciplinary core ideas (orange). The book also incorporates engineering design (purple). This will help you quickly notice how each of the three dimensions and engineering design are used on a page. Refer back to this section for the full descriptions.

This e-book does not use all of the grade-level elements for the practices and crosscutting concepts, but that does not mean that you should not be aware of the other practices and concepts your students need to know. For a full list of all grade-level elements for the science and engineering practices and crosscutting concepts, refer to Appendix A.

For engaging in literacy ideas, refer to Appendix B.

Disciplinary Core Ideas (DCIs)

This e-book examines an anchor phenomenon related to the following 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.**

This e-book also partially addresses the disciplinary core idea:

PS2.B: Types of Interactions **When objects touch or collide, they push on one another and can change motion.**

Science and Engineering Practices

> Engaging in the practices of science helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. The actual doing of science or engineering can also pique students' curiosity, capture their interest, and motivate their continued study.

(NRC Framework for K-12 Science Education, 2012)

Through classroom experiences supported by this e-book, students should be capable of performing the following practices:

The specific science and engineering practices addressed include:

Asking Questions and Defining Problems

- **Ask questions based on observations to find more information about the natural and/or designed world(s).**
- **Ask and/or identify questions that can be answered by an investigation.**

Planning and Carrying Out Investigations

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.
- Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
- Make predictions based on prior experiences.
- Events have causes that generate observable patterns.

Analyzing and Interpreting Data

- Record information (observations, thoughts, and ideas). Use and share pictures, drawings, and/or writings of observations.
- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
- Analyze data from tests of an object or tool to determine if it works as intended.

Using Mathematics and Computational Thinking

- Describe and display data using simple graphs.

Constructing Explanations and Designing Solutions

- Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.

Engaging in Argument from Evidence

- Construct an argument with evidence to support a claim.
- Make a claim about the effectiveness of a solution that is supported by relevant evidence.

Obtaining, Evaluating, and Communicating Information

- Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.
- Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.
- Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Crosscutting Concepts

The crosscutting concepts are the lenses through which scientists think about the natural world. They are the big ideas that connect the sciences and help to understand nature and how science and engineering work. Students who understand the crosscutting concepts will have a deep framework for integrating and understanding science ideas across disciplines.

Through classroom experiences supported by this e-book, students should be able to use the crosscutting concepts in the following ways appropriate for students in kindergarten:

The specific crosscutting concepts elements addressed include:

Patterns

- **Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.**

Cause and Effect

- **Simple tests can be designed to gather evidence to support or refute student ideas about causes.**

Common Student Misconceptions About Pushes and Pulls

Students will have intuitive ideas about motion that don't always match scientific ideas. Students have these ideas because they seem to fit their everyday experiences, and overcoming them usually requires reasoning and abstract thinking. For that reason, in K–2 it is probably best to focus on observation and description and not worry about whether students' explanations are strictly accurate. For example, students at this age are likely to think that the only "natural" state of an object is to be at rest. Regardless of what kinds of motion they are observing, students should be offered many opportunities to make careful observations and provide descriptions of what they see.

Students should be applying pushes and pulls to see how they change the way things move. Pushes and pulls are forces, but at this point, explanations using the term *force* aren't important. Students should be focused on giving descriptions, taking notes, drawing pictures, and asking questions.

The way to change how something is moving is to give it a push or a pull. It is important to make clear that shoves and kicks and throws act just like pushes and pulls, too. Of course, all of these actions are forces, but students will likely use the word *force* in common, everyday ways—associating it with power or strength, for example—and students of all ages struggle with the scientific definition of force. Now is not the time to worry about accurate use of the word. However, students are likely to have intuitive ideas about forces that you can begin to challenge at this stage, at least implicitly. Students tend to think of forces as getting things going (being active) but not stopping them (being passive). They also are likely to think that forces act only in the direction of motion. You can help students overcome these preconceptions by making sure they have at least some experiences starting objects from rest, stopping objects in motion, and seeing the effect of pushes or pulls that are not in the direction of motion. The key point is that students need a range of concrete experiences, and they need practice observing and describing what they see. These experiences will be the foundation for more abstract reasoning in later grades.

A Note About Safety

Throughout this e-book teacher's guide are hands-on activities and demonstrations that help to foster the learning and understanding of science. The reader will find safety notes and safety statements that help to make it a safer learning experience for students and teachers. In most cases, personal protection equipment (PPE) like glasses/goggles, non-latex gloves and aprons are required. Sanitized safety glasses and/or indirectly vented safety goggles noted must meet the ANSI/ISEA Z87.1 D3 safety standard. When dealing with hazardous chemicals, consult with the Safety Data Sheets prior to doing the activity. Make sure there are appropriate engineering controls; e.g., eyewash, shower, etc. The safety procedures and use of PPE must be followed based on legal safety standards and better professional safety practices.

For additional safety information, check out the NSTA Safety Portal at http://www.nsta.org/safety/. A safety acknowledgement form ("Safety in the Science Classroom, Laboratory, and Field Sites"), which is designed to review safety-operating procedures for students, needs to be used to address safety and teacher liability. A sample form is available at http://static.nsta.org/pdfs/SafetyAcknowledgmentForm-ElementarySchool.pdf.

Be aware that conditions of actual use of activities and demonstrations may vary and the safety procedures and practices described in this e-book teacher's guide are intended to serve only as a guide. Additional precautionary measures may be required. NSTA and the authors/reviewers do not warrant or represent that the procedures and practices in this e-book meet any safety code or standard of federal, state, or local regulations. NSTA and the authors/reviewers disclaim any liability for personal injury or damage to property arising out of or relating to the use of this e-book, including any of the recommendations, instructions, or materials contained therein. Selection of alternative materials or procedures for these activities may jeopardize the level of safety and therefore is at the user's own risk.

How to Work: Nine Steps Toward a Safer and More Productive Classroom

Teaching children how to work together safely in groups is crucial for creating a positive educational environment. Present students with the following guidelines:

1. Always ask permission.
2. Wear appropriate protective gear when directed, e.g., safety goggles, boots, and other outdoor gear. Teachers must have all participants wear safety glasses or goggles during all phases of this inquiry activity (set-up, hands-on investigation, and take down) when required.
3. Share all materials.
4. Walk indoors; never run.
5. Give each member of your group a chance to speak.
6. Listen when each person speaks.
7. Respect each team member's suggestions.
8. Take turns.
9. Ask for help if disagreements arise that can't be resolved by the team.

Consider using this e-book in the classroom as a digital Big Book. Project this onto a screen then decide when you want the class to break into groups to discuss an item in the e-book or to collaborate on an idea. This can help students with independent reading and language development, as well as model how children can participate in science.

Topic 1

What Are Forces?

This topic introduces students to the world of forces. They will discover that nearly everything we do in a routine day is a result of two types of forces: a push or a pull. They will also learn to distinguish between the two forces and describe where an object acted upon ends up in relation to the force exerted on it. Students will engage with these concepts by following a young girl through a typical day off from school.

By the end of the topic, students will be able to:

- ask questions based on observations that the cause of all objects' movement is one of two types of forces: a push or a pull;
- construct an argument using evidence to explain how a force we exert that causes an object to move away from us is a push; and
- construct an argument using evidence to explain how a force we exert that causes an object to move toward us is a pull.

Page 1

Meet Kristel, our main character, who, with the help of her parents and teammates, will help us explore the world of forces. The book begins as her day begins.

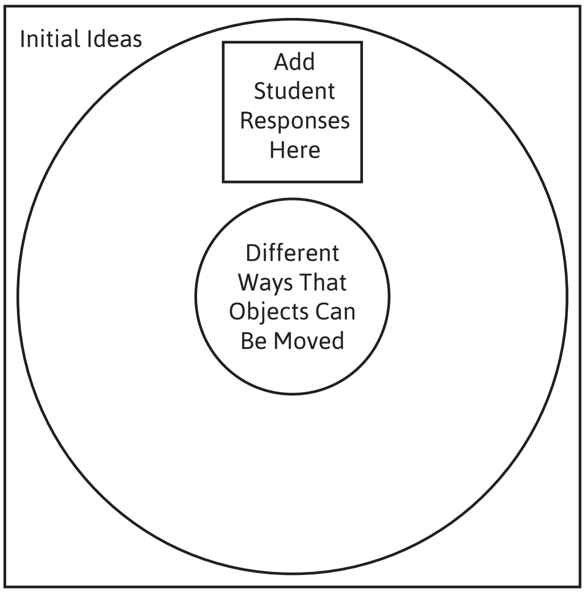
Kristel is staring out of her second-floor bedroom window. She sees her parents' bed hanging from the large tree in the front yard.

Engage students in a discussion by having them ask questions about how the bed was moved and define problems that may have been encountered when it happened.

- How do you think the bed ended up in a tree? *(Someone, or something, must have moved it there.)*
- Where was the bed before? *(The bed was probably inside of the house in the bedroom.)*
- How could it go from its original place to where it is now? *(Someone carried it or they used a machine to move it there.)*
- What problems (obstacles) do you think would make that hard to do? *(The bed is heavy. It would be hard to move the bed through the house. You can't just lift a bed into the air.)*

Use a circle map like the one below to chart the students' initial ideas and move toward student-generated investigations that are more focused. In the center of the circle use words, numbers, pictures, or any other sign or symbol to represent the object, person or idea your students are trying to understand or define. In the outer circle, write or draw any information that puts the idea in context.

Engage the students in a discussion by having them respond to the following prompts:



- Have you ever noticed that something of yours had moved when you were not there or not looking? What was it? *(Students may say that their parents move clothes, dishes, and toys left around the house.)*
- How do you think it was moved? *(My mother or father picked it up.)*

Allow students to voice their ideas without any correction at this point. They may respond with answers such as, "It was stolen," "Someone picked it up," or "It disappeared."

Then ask:

- Can an object move all by itself? *(No.)*

Students may believe that this is possible because of invisible forces such as wind and gravity, but you will address this later in the e-book.

Note: High-level thinkers may be able to discuss these phenomena to some extent; however, beware of going too far off topic.

Before continuing with the book, have the students investigate (draw pictures of) all the things they see people move over the next day. Then have them sort their ideas (look for patterns) into categories that they believe separate the types of movement (forces) and their possible causes.

Possible categories may be: carrying, kicking, falling/spilling, rolling, pushing, and pulling objects.

Page 2

Kristel is seated with her parents at the dining table. In order for everyone to eat, food must be passed back and forth amongst the diners. Students are asked to help Kristel and her parents pass the food. While doing this they will observe that there's a pattern in the passing of the food. Pushing moves the food away and pulling moves the food closer.

Students are introduced to three interactive elements on this page. (1) The glossary, which provides a pop-up definition for the word pass. (2) The actions of pushing and pulling, which students do by sliding objects with their fingers. (3) The "Check Your Thinking" button, which allows students a quick check of their understanding of the most important objective on the page.

Students will be prompted to investigate the ways they can move items on the table. The interactive will direct students to help Kristel or one of her parents push or pull items on the table.

Note: You may need to define, explain, and model moving items toward and away.

Either Kristel or one of her parents will ask for each item to be passed. This will cause the student to use the opposite force (push or pull) to serve the same item. Ask:

- How did Kristel get the salt? *(She picked it up. She grabbed it. She pulled it across the table.)*
- Did she use the same motion to give the bacon to her father? *(No.)*

Turn to your table partner and explain what caused the objects to move.

- What caused the object to move the opposite direction? *(The direction that Kristel passed [pushed or pulled] it.)*
- What else will Kristel and her parents push or pull when they get up to leave the table? *(Their chairs, their bodies, etc.)*

When the students have investigated all the ways to move food around the table, they can check their thinking by clicking on that interactive element.

Differentiated Instruction

If students are having difficulty with the concepts of push and pull, do the following. Place a piece of masking tape on a desk. Have students stand behind the masking tape. Put an object on the masking tape. Tell students to push the object away from themselves. Tell students to pull the object towards themselves.

Safety Note: Make sure that students are not throwing the materials or hitting things with them so they do not hurt themselves.

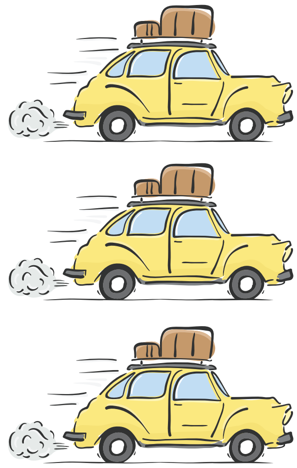
Create a chart (or bulletin board) with the headers *Push* and *Pull* as shown in the example below.

Push	Pull
 	 

Have students analyze the pictures they drew the previous day and ask them to make a claim why they believe one or more of their observations should be categorized as a push or a pull.

Mathematics Connections

Once the chart above has been created, introduce students to a simple bar graph by stacking their pictures to compare quantities of pushes and pulls.

Push	Pull
	

Ask them:

- What patterns do you see in the different things we put in our push and pull columns? *(Answers will vary.)*
- Based on our data, do we move more things by pushing or pulling? *(Answers will vary.)*

Encourage students to continue investigating the different ways they see objects move each day.

You might narrow the focus to motions they perceive as pushes and pulls to avoid reinforcing any preconceptions about more complex topics (gravity, wind, etc.). You may decide to chart the particular motions that recur often in order to develop additional mathematical content.

Mathematics Connections

Revisit this chart from time to time to add updated observations and to recount the number of items on each side.

Safety Notes:

1. Always ask permission.
2. Wear appropriate protective gear when directed, e.g., safety goggles. Teachers must have all participants wear safety glasses or goggles during all phases of this inquiry activity (set-up, hands-on investigation, and take down) when required.
3. Use caution when using scissors or handling other sharp objects so as not to cut yourself.
4. Share all materials.
5. Walk indoors, never run.