Standards
Refer to Appendix K.2 for NGSS, CCSS (ELA), and California ELD Standards.
Driving Question
How can equipment be moved to the field in one trip?

Storyline Link
In Lesson 1: Exploration Box, free explorations using the exploration box were made with pushes and pulls. Investigations included observing the effects that different pushes and pulls have on motionless objects. (CCC) At the conclusion of Lesson 1: Exploration Box, soccer materials were displayed in the classroom or on K.1.R2: Soccer Equipment. Students generated questions about what they need to know to move the materials to the field.

This challenge represents an engineering problem that will lead to planning an investigation to move many objects to the soccer field in one trip. (SEP) Students start with their list of questions about what they need to know to help the soccer coach move the objects to the field. (DCI) One of their questions might be what materials do we have to move them. They are then presented with a set of material in parents’ cars. The criteria for a successful plan includes making one trip to the field and moving by one person. Plans are discussed and partners develop a model of their solution on a poster to share with the class. (SEP) Class discussions focus on how different designs are more effective solutions. (CCC)

The concepts of cause and effect related to pushes and pulls contributes to the understanding of the anchoring phenomenon.

During Lesson 3: Cruising Discs, students explore how to score by changing the strength of pushes and pulls resulting in objects going different distances. (DCI)

Throughout the lesson, a flag (►) denotes formative assessment opportunities where you may change instruction in response to students’ level of understanding and making sense of phenomena.

Time
30 minutes
10 minutes Engage
10 minutes Explore
5 minutes Explain
5 minutes Elaborate/Evaluate

Materials
Whole Class
- Soccer Supplies: soccer balls, ball bag, cones, water jug, chairs, snacks
- K.2.C1: Class Notebook (continuation of K.1.C1: Class Notebook started in Lesson 1: Exploration Box)
- K.2.R1: Trunk of Car
K.2 Pullapalooza

Individual

- Kindergarten science notebook
- pencil
- crayons

Advance Preparation

1. Place soccer objects in the center of the rug area to set the stage for the problem.
2. Prepare the continuation of the Class Notebook started in Lesson 1: Exploration Box. Review K.2.C1: Class Notebook that is described in the Toolbox for this lesson. Consider making the Criteria and Constraints page before the lesson.
3. Open the K.1.C1 Class Notebook to the page with questions about how to move the objects to the field started in Lesson 1: Exploration Box.
**Procedure**

**Engage (10 minutes)**

*Identify the problem of needing a structure to move soccer equipment to the field.*

1. Display the soccer materials on the meeting place carpet and display the charted questions recorded on the K.2.C1: Class Notebook (from Lesson 1: Exploration Box where the problem was introduced). Continue the discussion of the question “What do we need to know to solve the coach’s problem?” Chart any new responses or questions directly on the notebook.

2. Tell the students one of the parents has some things in their car that might help the coach. Take the students to a car to see the materials placed in the trunk for carrying materials or show K.2.R1: Trunk of Car. Discuss the things they see in the car: boxes, a wagon, rope, plastic garbage bags, a big duffle bag and a large board. Discuss how they might use the different objects to move the soccer equipment.

   - Criteria 1: Equipment must be moved in one trip.
   - Criteria 2: One person must move all the materials.
   - Constraints: Use materials in the trunk of the parent’s car.

4. Ask students to discuss knee-to-knee (student-to-student discourse) this question with a partner: “What could be done to get these objects moved in one trip by one person?” Share ideas using the sentence frame:
   
   My partner says _____.

   Listen to several students share ideas from their partners.

   Chart student ideas.

**TEACHER NOTE**

Some students might suggest driving the car onto the field. Tell them this could not be done as there were buildings in the way, and we can’t drive on the grass. Listen to sufficient ideas to help all students realize there is more than one way to move the materials to the field.

**Explore (10 minutes)**

*Use patterns of movement to design a solution for transporting equipment to the soccer field.*

5. Tell students “Some of your ideas were to pull the equipment, and some of your ideas were to push the equipment. What direction does the pull move? How is that direction different from a push?” After a short discussion, turn to a page of K.2.C1: Class Notebook and tell students, “Let’s try to show what a push is and what a pull is with words and pictures.” Ask students for suggestions for words, symbols, and pictures to show movement.
6. Ask partners to design a way for the coach to move the materials to the field and make a poster by drawing their plan on a sheet of construction paper. Remind students that the move must be done in one trip with the materials from the parent's car.
   a. Be sure and include arrows to show the direction you are moving the equipment.
   b. Use the words push or pull to show how you are using a force to move the equipment.

![Image of students working](Image via Vista Unified School District [Used with Permission]

These students are working in their science notebook instead of construction paper.

**Explain (5 minutes)**

*Communicate a solution to the problem of moving equipment to the field identifying the structure to push or pull.*

7. Have students return to the meeting place with their plans. Ask partners to share their plans for moving the equipment to the field. Remind students to include whether they are pushing or pulling the equipment. Record each partner’s solutions on the **K.2.C1: Class Notebook under A Plan to Move the Equipment.**

**Examples of Student Work**

![Image of student work](Images via WestEd (taken during field tests)
8. Using the recorded solutions, ask students which ideas are a push and which ideas are a pull. Have individual students take turns circling all the pushes in one color and circling all the pulls with another color.

9. Display the Criteria and Constraints page in the K.2.C1: Class Notebook with the recorded solutions. Ask partners to talk about which ideas meet the criteria and constraints.

Elaborate/Evaluate (5 minutes)

Compare pictures (solutions) to determine the easiest structure to push or pull the equipment to the field.

10. ▶ Ask students to review the list of different solutions they planned to move the equipment to the soccer field. Ask partners to pick the solution that they think will work the best, place a small sticky note on the plan, and explain why they think it will push or pull the equipment. Compare the numbers of sticky notes by each plan. Ask students to order the plans from the most selected to the least selected. Lead a discussion that includes the reasons for the selections.

Teacher Note
Listen for the use of push and pull as well as logical cause and effect statements. If students do not use the academic language in the descriptions, continue the choice centers with the cards started in Lesson 1: Exploration Box.

11. Discuss the difference between a push and a pull. Read a selection from the Literacy Links listed below; for example, And Everyone Shouted “Pull!”

12. Ask students to think about the soccer game. “We know how to move equipment to the field and push or pull the motionless ball to play the game.” Brainstorm and chart what else you need to figure out to move the motionless soccer ball to score goals. Record student questions in the K.2.C1: Class Notebook under the heading; “What else do we need to figure out?” Questions might include: How strong do we need to push? How do we stop the ball? How do we change the direction of the ball? Does weather ever make the ball move or stop moving?

Literacy Links

It would be appropriate to have students interact with text to extend their understanding of pulls. These selections can be read aloud at any time after this lesson because students have experienced pushes and pulls. Suggested books include:

Fiction:
- The Gigantic Turnip by Alessio Tolstoy and Niamh Sharkey
- Grandma Lena’s Big Ol’ Turnip by Denia Lewis Hester and Jackie Unvanovic
- The Enormous Potato by Aubrey Davis and Dušan Petričić
- The Giant Carrot by Jan Peck and Barry Root
K.2 Pullapalooza

- *The Giant Cabbage - An Alaska folktale* by Chérie B. Stihler and Jeremiah Trammell
- *The Gigantic Sweet Potato* by Dianne De Las Casas and Marita Gentry
- *The Turnip* by Jan Brett

Nonfiction:
- *And Everyone Shouted, “Pull!”* by Claire Llewellyn and Simone Abel

References


### Toolbox Table of Contents

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### Class Notebook (continued from Lesson 1)

**Pushes and Pulls**

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<td></td>
<td>1. Criteria 1: Equipment must be moved in one trip.</td>
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<table>
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Class Notebook (continued)

Pushes and Pulls

A Plan to Move the Equipment

What else do we need to figure out?
Resource

Trunk of Car

- Box
  - Image via iStock.com/mgkaya
- Rope
  - Image via iStock.com/baona
- Garbage Bag
  - Image via iStock.com/Daniil Dubov
- Boards
  - Image via iStock.com/akinbostinci
- Push Cart
  - Image via iStock.com/Daddybit
- Wagon
  - Image via iStock.com/joel-t
Next Generation Science Standards (NGSS)

This lesson is building toward:

**PERFORMANCE EXPECTATIONS (PE)**

| K-PS2-2 | Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.] |


**SCIENCE AND ENGINEERING PRACTICES (SEP)**

**Constructing Explanations and Designing Solutions**

- Use tools and/or materials to design and build a device that solves a specific problem or a solution to a specific problem.
- Generate and/or compare multiple solutions to a problem.

**Obtaining, Evaluating, and Communicating Information**

- 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.
- Obtain information using various texts, text features (e.g., heading, 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.

**DISCIPLINARY CORE IDEAS (DCI)**

**PS2.A Forces and Motion**

- Pushes and pulls can have different strengths and directions.

**ETS1.A: Defining and Delimiting an Engineering Problem**

- Asking questions, making observations, and gathering information are helpful in thinking about problems.

**ETS1.B: Developing Possible Solution**

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people.
CROSSCUTTING CONCEPTS (CCC)

Structure and Function
- The shape and stability of structures of natural and designed objects are related to their function(s).

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

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Common Core State Standards (CCSS)

CCSS ELA READING

CCSS.ELA-LITERACY.R1.K.1
With prompting and support, ask and answer questions about key details in a text.

CCSS ELA SPEAKING AND LISTENING

CCSS.ELA-LITERACY.SL.K.3
Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

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California English Language Development (ELD) Standards

CA ELD

Part I.K. 5 Interacting with written English (print and multimedia)

EMERGING | EXPANDING | BRIDGING
--- | --- | ---
P1.K.2 Collaborate with the teacher and peers on joint composing projects of short informational and literary texts that include minimal writing (labeling with a few words), using technology where appropriate for publishing, graphics, etc. | P1.K.2 Collaborate with the teacher and peers on joint composing projects of informational and literary texts that include some writing (e.g., short sentences), using technology where appropriate for publishing, graphics, etc. | P1.K.2 Collaborate with the teacher and peers on joint composing projects of informational and literary texts that include a greater amount of writing (e.g., a very short story), using technology where appropriate for publishing, graphics, etc.

In addition to the standard above, you may find that you touch on the following standards in this lesson as well:
P1.K.1 Exchanging information and ideas via oral communication and conversations
P1.K.5 Listening actively and asking or answering questions about what was heard
P1.K.12 Selecting and applying varied and precise vocabulary and other language resources

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