

Kindergarten Physical Science

WHICH SHOVEL? Engineering Challenge

Background Information

Shoveling snow and sledding often are winter activities in the Midwest. Both require a force to occur. Pushing or pulling on the item will have different effects on the movement of that item. In the case of sledding, a greater force may result in a faster speed or a greater distance covered by the sled. Applying a force in a different direction may result in a change of direction of the object. Shoveling is more successful when the shovel is pushed rather than pulled.

Performance Expectations

K-PS2-1 Motion and Stability: Forces and Interactions

Plan and conduct an investigation to compare the effects of different strengths or different directions of push and pulls on the motion of an object.

<https://www.nextgenscience.org/pe/k-ps2-1-motion-and-stability-forces-and-interactions>

K-2-ETS1-1 Engineering Design

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.

<https://www.nextgenscience.org/dci-arrangement/k-2-ets1-engineering-design>

K-2-ETS1-2 Engineering Design

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.

<https://www.nextgenscience.org/dci-arrangement/k-2-ets1-engineering-design>

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.

PS3.C: Relationship Between Energy and Forces: A bigger push or pull makes things speed up or slow down more quickly.

ETS1.A: Defining and Delimiting Engineering Problems: A situation that people want to change or create can be approached as a problem to be solved through engineering.

Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)

Before beginning to design a solution, it is important to clearly understand the problem. (K-2-

ETS1-1ETS1.B: Developing Possible Solutions: 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. (K-2-ETS1-2)

ETS1.C: Optimizing the Design Solution: Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Science and Engineering Practices

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

With guidance, plan and conduct an investigation in collaboration with peers.

Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1)

Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Develop a simple model based on evidence to represent a proposed solution.

Crosscutting Concepts

Cause and Effect: Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Structure and Function: The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Objectives

- Students will work collaboratively to follow a procedure.
- Students will observe, test, and collect data.
- Students will identify effects of a push and pull on a snow shovel.
- Students will use data to design an improved snow shovel.
- Students will communicate decisions.

Advanced Preparation

- “Snow” will be needed. Ice cubes or crushed ice may be used as well.
- Determine how the materials will be set up around the room.
- Determine how testing will proceed. Will all groups complete the same test simultaneously?
- Determine what will be accomplished each day.

Materials

- *Which Shovel* Student Pages
- Snow Drift Pictures
- “Snow”
- Plastic Containers
- Shovel Sets (3 different “mini-shovels”)
- Coloring Supplies
- Drawing Paper
- Towels for Cleanup

Suggested Winter Read Alouds

- *When It Starts to Snow* by Phillis Gushator
- *Over and Under the Snow* by Kate Messner
- *Waiting for Winter* by Sebastian Meschenmoser
- *Snowy Day* by Ezra Jack Keats

Suggested Implementation

Distribute a snow drift picture to each group of four students. Groups of students should talk about their picture. Encourage students to discuss possible ideas about the following:

- *What do you see?*
- *Is there a problem here?*
- *What might that problem be?*
- *How might that problem be solve?*
- *What if you lived in that house?*
- *What might you need to do to get to your front door?*

Allow time for each group to show their picture to the class and share their ideas. Explain to students that they are going to test some miniature models of shovels to see which they think might be best to use for shoveling snow. *Note: You may wish to use snow if it is available.*

Post and discuss the questions to be investigated. Below are some suggestions:

- ☆ *What happens when the shovel is pushed?*
- ☆ *What happens when the shovel is pulled?*
- ☆ *What happens when you use the _____ shovel?*
- ☆ *Was this shovel easy or hard to push? Pull?*
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- ☆ *Was this shovel easy or hard to push? Pull?*

Familiarize students with the materials. Distribute materials to student groups of 2. Assist groups as they work through the testing process. When appropriate, have students record their observations on the Shovel student page.

Pull the class together and discuss what they observed. It is suggested to chart the responses. Ask and elicit student responses to the following. “Based on what was observed, what questions would you want to think about if you were buying a snow shovel?”

You may wish to combine pairs of students into groups of four. Have them design and draw

what they think a better shovel would look like based on their investigations. Encourage the use of labels, arrows, and words in the drawings. Groups share their designs and justifications with the class. There are many ways to accomplish this.

Debrief

- ☆ *What was the same with all the shovels?*
- ☆ *How were the shovels different?*
- ☆ *Why do you think there are lots of different kinds of snow shovels?*

Assessment

The following single point rubric can be used to assess student understanding. For each of the criteria listed below, either circle the proficient description or add notes to a box indicating why the student’s performance was either lacking or exceptional.

Areas that need improvement. Developing Performance	Criteria for Proficient Performance	Evidence of exceeding standards. Advanced Performance
	Can explain how the shovel designs were tested and what they found out.	
	When asked “Why did you choose your shovel design?” reference observations from the testing of the materials.	