Forces

Did you know?

Force is a push or a pull that makes something move. **Gravity** is a force.

Let's Roll!

This race car has no motors.
So what gets it going? Gravity!

Every summer in Akron, Ohio, children race in the All-American Soap Box Derby. They race in cars they built themselves.

Every racer gets a kit from the Soap Box Derby. The kit comes with the car's body, brakes (for stopping), a steering wheel (to turn the car), and a helmet. Wheels come separately.

But the cars don't have motors. So what makes them move? **Gravity**—the force that pulls down on us—pulls the cars down the hill!

Racers have to figure out how to make their cars go fast. They can ask an adult for help. What do you think can help these cars go faster?

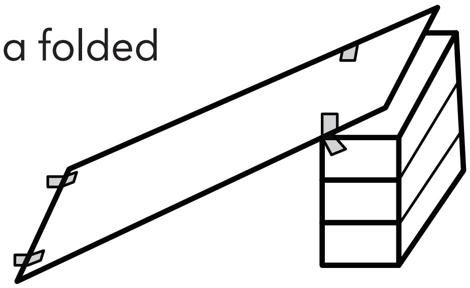
What Gives More Push?

Find out if an empty bottle has more or less push than a full bottle!

Materials

- ★ game board
- ★ blocks
- ★ masking tape
- ★ 2 plastic bottles, one full and one empty
- ★ empty cereal box
- ★ "What Gives More Push?" data sheet

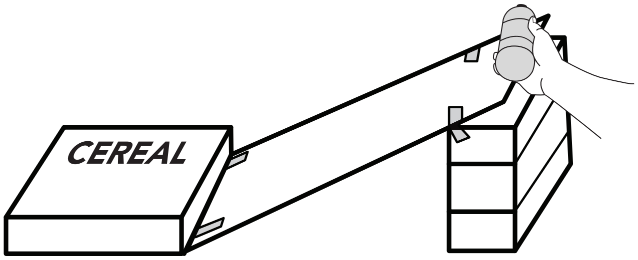
1. Make a ramp using a folded game board and blocks. Tape the pieces in place.



2. Hold your hand at the bottom of the ramp. Have a partner roll the empty bottle down the ramp. Let the bottle push your hand. How did the push feel?

3. Repeat Step 2 with the full bottle. Which bottle gave your hand a bigger push? Why?

4. Place the cereal box in front of the ramp, as shown. **Predict:** What will happen if you roll the empty bottle down the ramp? Test your prediction. Record your results.



5. Put the cereal box back in front of the ramp. **Predict:** What will happen if you roll the full bottle down the ramp? Test your prediction. Record your results. How much did the box move with the bigger push? Why do you think this happened?

Name: ______________________________

What Gives More Push?

1. Do Steps 1 and 2 of the Task Card. How did the push feel?

____

2. Do Step 3 of the Task Card. Which bottle gave your hand a bigger push? Why do you think that is?

____

3. Do Step 4 of the Task Card. **Predict:** What will happen if you roll the empty bottle down the ramp?

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4. What happened when you rolled the empty bottle?

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5. Do Step 5 of the Task Card. **Predict:** What will happen if you roll the full bottle down the ramp?

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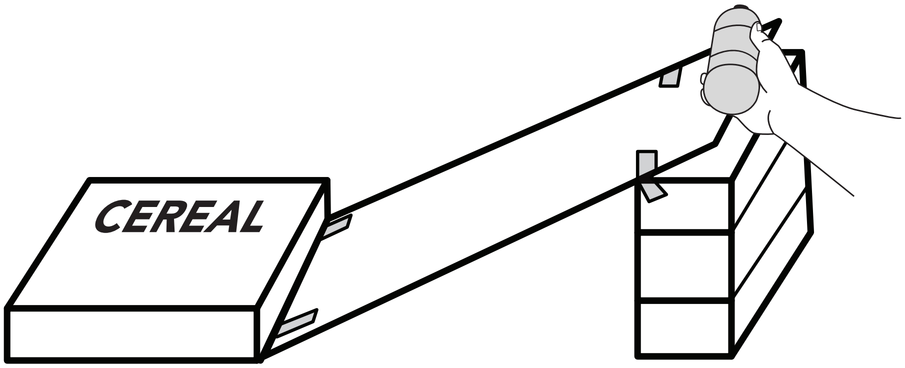
6. How much did the box move with this bigger push? Check one:

☐ farther ☐ the same ☐ not as far

Why do you think this happened? Write on the back of this sheet.

Go Farther!



Materials

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- ★ masking tape
- ★ full plastic bottle
- ★ empty cereal box
- ★ "Go Farther!" data sheet

How can you make a bigger push? Try this!

1. Follow the steps from Task Card 1 to make a ramp. Repeat Step 5 with the cereal box and the full bottle. If the box moves, put a piece of tape on the floor to mark its new position.

2. **Think:** What one thing could you change to make the box move farther? Think about the box, the bottle, and the ramp. What could be changed about each one? (For instance, in Task Card 1 you used a light, empty bottle, then changed to a heavy, full bottle.) Pick one idea to try.

3. Now make up an experiment to test the change. It's important to test only one change at a time. Everything else in your experiment should stay the same. What one thing will you change? What will you keep the same?

4. Write the steps of your experiment on your data sheet. Then do your experiment! Record what happened.

Name: ________________________________

Go Farther!

1. Do Steps 1 and 2 of the Task Card. What could you change to make the box move farther? List your ideas.

____

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2. Pick one idea. I will try this change:

____

3. Write down the steps of your experiment.

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4. Do your experiment. On the back of this paper, record what happened.

Next Generation Science Standards
PS2.A Forces and Motion
PS2.B Types of Interactions
ETS1 Engineering Design

Background

"Soapbox" is the term commonly used for a 4-wheeled, motorless vehicle that is raced on a downhill road. Another name for it is "gravity racer." Typically, a heavier cart will do better than a lighter one. However, lighter wheels tend to accelerate faster than heavier wheels. The ramp or track also affects how a cart will perform. A cart that goes fast down one track may not do as well on a different track. Racers take all of these and more into account when they build and design their soapbox racers.

Hands-On Hints

Task Card 1: What Gives More Push?

Use small plastic bottles, like individual serving water bottles or 20-oz. soda bottles. If possible, use matching pairs of empty and full bottles so it's clear to children they are changing just one variable.

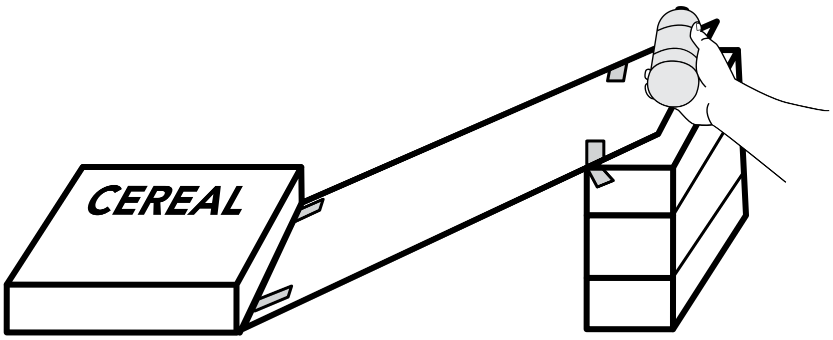
Children should be able to feel that the full bottle gives a bigger push, with more force (Steps 2 and 3). Both rolling bottles will give the box a push away from the ramp. The heavier full bottle will push the box farther (Steps 4 and 5).

Task Card 2: Go Farther!

Remind children to test one change at a time. This way, they'll know which change led to a difference in performance.

For experimental purposes, provide additional blocks (for making a taller ramp), different-sized boxes, and different-sized bottles. If you have something that can serve as a longer ramp, make that available as well. If you have multiple floor surfaces (like carpet vs. tile), you can suggest children think about changing the location of their ramp.

Children may find that the following changes increase the distance the box moves: a steeper ramp (unless it gets too steep), a longer ramp, a lighter box, a smaller box (assuming it's not so small the bottle rolls over it), a heavier bottle, a bigger bottle (assuming it doesn't roll over the box), or a smoother floor surface.



Photos ©: cover, purple soap box: Charles Schug/Getty Images; bottle: Peng Li/iStockphoto; red and yellow soap box: Andrew Rich/Getty Images.
Card: Photo © MargarytaVakhterova/iStockphoto.

For optimal results, we suggest following these steps:

1. Introduce the topic by reading aloud the nonfiction acticle. The article helps build background knowledge and provides context for the hands-on activities. You can project it onto your interactive white-board as you read it aloud. There is also a printable version that you can distribute to students so they can read along.
2. Divide the class into small groups. Hand each group a Task Card, and give each student a Data Sheet. (We recommend starting with Task Card 1.) Together with the class, read aloud the steps of the activity to ensure everyone understands what to do. You may also want to have each group conduct an inventory of their materials to make sure they have everything they need.
3. Have students do the activity and record on their Data Sheets.
4. Make sure to leave enough time before the end of the period so you can have a class discussion about the activity. Invite groups to share their findings and results, including any challenges they may have faced.
5. Gather students' data sheets to assess for understanding.

If you plan to continue the unit in your next lesson with the second Task Card, you might want to review the article with the class. In some cases, Task Card 2 builds upon Task Card 1, so you may want to quickly go over the first activity as well.

At the end of a unit, consider asking students to evaluate the topic and activities. This can be as simple as a thumbs-up or thumbs-down. Engage them in a discussion about what they liked or did not like and why. You might find this feedback useful for future lessons.

The two Task Cards feature hands-on activities that incorporate the following eight science and engineering practices—identified by the NGSS as essential for all students to learn:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

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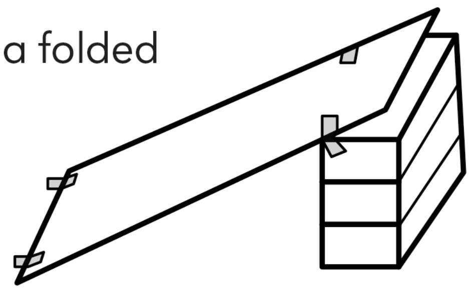

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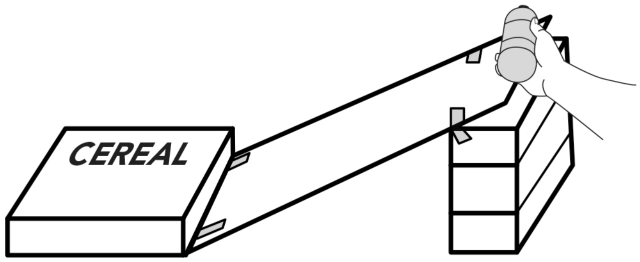

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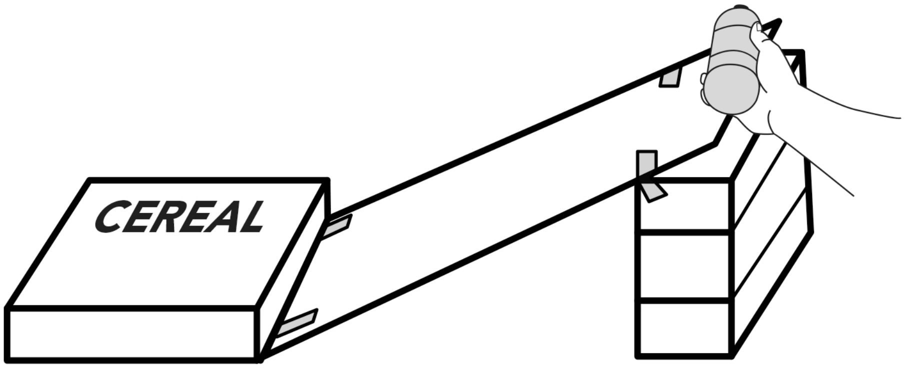

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