Lesson 3.2
Building with Forces
Lesson Overview

Students solidify their understanding of how to make an object move to the left and right by reading, talking, and designing their Box Models. They begin by participating in a Shared Reading of the book *Building with Forces*, this time focusing on the language that scientists use to explain forces moving in a particular direction. They use the new language about direction to talk about cause-and-effect relationships that connect a force in a certain direction to the movement in that same direction. Students apply what they have learned as they make changes to their Box Models. The purpose of this lesson is to formalize what students have discovered about moving objects in certain directions and to prepare students to synthesize what they have learned about the strength and direction of forces in the remaining lessons of this chapter.

**Anchor Phenomenon:** Pinball machines allow people to control the direction and strength of forces on a ball.

**Design Problem:** Design a pinball machine.

**Everyday Phenomenon:** A pinball moves in a particular direction.

Students learn:

- An object starts to move in the same direction as the force that starts the motion.
Shared Reading: Building with Forces

The teacher leads students in a Shared Reading of *Building with Forces*, adds to the What We Know About Forces chart, and posts a new key concept.

Instructional Guide

1. **Connect to prior learning.** Point to the Chapter 3 Question and read it aloud.

   - How do we make a pinball move to a certain place?
   - We have been learning a lot about how to answer this question so that we can design our Class Pinball Machine to move the pinball to the right and to the left.

   Refer to the Investigation Question.

   - We have been exploring how to make different objects move in different directions in order to help us learn how to make our pinball move to a certain place.

   Read the Investigation Question aloud.

   - What makes an object start moving in a certain direction?
   - What have we figured out so far about what makes an object start moving in a certain direction?

   Accept all responses related to the activities from the previous lesson. If needed, display a tennis ball or the rugball to help students recall these activities.

2. **Summarize student contributions.** Highlight comments related to students noticing that the rugball or tennis ball started to move in the direction it was pushed.

3. **Set the purpose for the lesson.**
We have some great ideas about how to make an object start to move in a certain direction. Today, we are going to reread this book to hear how it describes an object moving in a certain direction in the way scientists and engineers describe it.

We will use what we learn to make changes to our Box Models.

4. Display the **Building with Forces** big book. Remind students they have already visualized how objects move in different directions by looking at the pictures of construction sites in this book. Invite several students to share examples from the book. Encourage students to act out the movement they visualized.

5. Set the purpose for reading.

We are going to read to find out how a scientist or engineer would describe the movements you just described. As we read, we will visualize the things we read about just like you did last time.

6. Read page 3 aloud.

7. **Starting on page 4, invite students to pantomime the forces being exerted.** Let students know as you read the words in this book, they will use the words and the picture to participate, or share in the reading, along with you.

   For example, when I read “exerting a force in the direction of the roof,” we will all pretend to push the piece of wood up, holding our hands like the man in the picture.

8. Continue to read the text aloud as students pantomime the forces exerted.

9. **Pause at the end of page 7.** Acknowledge the way students had pantomimed pounding on the brick as you read.

   I see you showing how Theo is exerting a force on the brick when he pounds it with his hand.

   In what direction is the force that Theo is exerting?
   [Down.]

   In what direction do you think the brick is moving?
   [Down.]

   Why do you think that?

   If students do not notice, point out that Theo’s hand looks like it is moving, and that brick must also be moving because the cement under the brick is squirting out.

   The brick is moving down because Theo is exerting a force down on the brick.

10. **Continue reading and pause at the end of page 10.**
Pushes and Pulls
Lesson Guides

In what direction is the force that Annie and Jo are exerting? [Up and away from them.]

Where will the frame move? [Up and away from them.]

How do you know that? [They are pulling it up and away. They will push it that way.]

11. Continue reading and pause at the end of page 14. Invite students to pantomime and describe an answer to the question: Which way does his hand go? [Up and down.]

12. Continue reading and pause at the end of page 15. Ask students to choose a picture on this page that they think is interesting. Invite students to share the movement they see in the picture, reminding them that they can point to indicate the direction of the movement. Ask the class to pantomimce the force being exerted for each movement that is shared.

13. Add to the What We Know About Forces chart.

We have some new ideas about why objects move in different ways. We have been investigating why objects move in different directions, and now we will record what we have figured out on our What We Know About Forces chart.

Draw a line below the images for stronger and gentler forces that were added in Lesson 2.2. Under the line, add What We Know About Forces Chart: Icons 3 and 4 (the images of the child representing forces to the left and to the right). Write “direction” on the left side of the chart.

Point to the picture of the child who is kicking to the left. Stand with your back to the class (in the same orientation as the image) to help students understand the perspective.

This person is kicking the ball and the ball is starting to move to the left.

Draw an arrow and the ball to show the ball’s motion to the left.

Why is the ball moving to the left? [Because the force is to the left.]

The ball is moving to the left because the force is to the left.

Write “force to the left” near the child kicking toward the left, saying each word aloud.

Repeat this procedure with the figure on the right. Demonstrate and ask students to describe the ball’s motion to the right, adding the words “force to the right” to the chart.
Now these pictures show what we have figured out—that an object moves in the same direction as the force that is exerted on it.

14. Post and read the key concept.

An object starts to move in the same direction as the force that starts the motion.

Teacher Support

Rationale

Literacy Note: Shared Reading
Shared Reading provides opportunities for students to observe the teacher as an expert reader and to actively join in reading. Using a big book allows you to explicitly show and guide students to understand that informational texts use structural and visual cues to aid in the reading process, to recognize new vocabulary in print, and to practice reading strategies while students are reading to learn new science ideas. Shared Reading provides opportunities for instruction and practice that prepares students for engaging more independently either with a partner or on their own. **Building with Forces** is designed to facilitate visualizing and gives students a rich context in which to ask their own questions about forces. You will guide students in using the strategies of visualizing and interpreting images to make meaning of this text.

Instructional Suggestion

Promoting Deeper Thinking: Examining Images
Visual representations such as photographs are a vital component of science texts. Scientists often share their conceptual thinking visually, so the ability to interpret photographs and diagrams lends itself to an understanding of scientific ideas. In this unit, students learn how to “read” photographs and diagrams by using clues such as the title, colors, and arrows, in order to deeply comprehend the particular science concept that the author is trying to convey. To help students develop their ability to read images and diagrams in science texts, model thinking aloud as you examine the photographs in **Building with Forces**. Engaging in this kind of careful reading of visual representations supports students in visualizing the direction of forces exerted on objects.

Instructional Suggestion

Providing More Experience: Visual References for *Left* and *Right*
The What We Know About Forces chart provides students with an ongoing visual reference for key ideas in this unit. In this lesson in particular, students can use the chart to help them remember which direction is right and which is left. Students who are not yet attending to text will need additional support to look at the first letter in each word to know which is left and which is right. Additionally, you can choose to color-code the direction words to help students identify those words on the chart. Students should be reminded and encouraged to refer to the chart during discussions in order to access the language they need. Visuals are especially helpful for English learners and students who find it challenging to process oral or written language.
Shared Reading: Building with Forces

The teacher leads students in a Shared Reading of *Building with Forces*, adds to the What We Know About Forces chart, and posts a new key concept.

Instructional Guide

1. **Connect to prior learning.** Point to the Chapter 3 Question and read it aloud.

   ¿Cómo hacemos para que una pelota de pinball se mueva hasta cierto lugar?

   Hemos estado aprendiendo mucho sobre cómo responder esta pregunta, de modo que podamos diseñar nuestra máquina de pinball de la clase para mover la pelota hacia la derecha y hacia la izquierda.

   Refer to the Investigation Question.

   Hemos estado explorando cómo hacer que diferentes objetos se muevan en diferentes direcciones para ayudarnos a aprender cómo hacer que nuestra pelota de pinball se mueva hacia determinado lugar.

   Read the Investigation Question aloud.

   ¿Qué hace que un objeto comience a moverse en una cierta dirección?

   ¿Qué hemos averiguado hasta ahora sobre qué hace que un objeto comience a moverse en una cierta dirección?

   Accept all responses related to the activities from the previous lesson. If needed, display a tennis ball or the rugball to help students recall these activities.

2. **Summarize student contributions.** Highlight comments related to students noticing that the rugball or tennis ball started to move in the direction it was pushed.

3. **Set the purpose for the lesson.**
Tenemos algunas ideas excelentes sobre cómo hacer que un objeto comience a moverse en una cierta dirección. Hoy vamos a leer este libro de nuevo para oír cómo describe un objeto moviéndose en una cierta dirección de la manera en la que los científicos y los ingenieros lo describen.

Usaremos lo que aprendamos para hacer cambios a nuestros modelos con cajas.

4. Display the Building with Forces big book. Remind students they have already visualized how objects move in different directions by looking at the pictures of construction sites in this book. Invite several students to share examples from the book. Encourage students to act out the movement they visualized.

5. Set the purpose for reading.

Vamos a leer para averiguar cómo un científico o un ingeniero describiría los movimientos que ustedes acaban de describir. Mientras leemos, visualizaremos las cosas sobre las que leímos igual que la vez pasada.

6. Read page 3 aloud.

7. Starting on page 4, invite students to pantomime the forces being exerted. Let students know as you read the words in this book, they will use the words and the picture to participate, or share in the reading, along with you.

Por ejemplo, cuando leo "Ejerce una fuerza en la dirección del techo", todos fingiremos empujar el pedazo de madera hacia arriba, sosteniendo nuestras manos como el hombre en la foto.

8. Continue to read the text aloud as students pantomime the forces exerted.

9. Pause at the end of page 7. Acknowledge the way students had pantomimed pounding on the brick as you read.

Los veo mostrando cómo Theo está ejerciendo una fuerza sobre el ladrillo cuando lo golpea con su mano.

¿En qué dirección es la fuerza que Theo está ejerciendo? [Hacia abajo].

¿En qué dirección piensan que se está moviendo el ladrillo? [Hacia abajo].

¿Por qué piensan eso?

If students do not notice, point out that Theo’s hand looks like it is moving, and that brick must also be moving because the cement under the brick is squirting out.

El ladrillo se está moviendo hacia abajo porque Theo está ejerciendo una fuerza hacia abajo sobre el ladrillo.

10. Continue reading and pause at the end of page 10.
Pushes and Pulls
Lesson Guides

¿En qué dirección es la fuerza que Annie y Jo están ejerciendo?
[Hacia arriba y en dirección opuesta a ellas].

¿A dónde irá el marco?
[Hacia arriba y en dirección opuesta a ellas].

¿Cómo saben?
[Ellas lo están jalando hacia arriba y en dirección opuesta. Lo empujarán para allá].

11. Continue reading and pause at the end of page 14. Invite students to pantomime and describe an answer to the question: Which way does his hand go? [Up and down.]

12. Continue reading and pause at the end of page 15. Ask students to choose a picture on this page that they think is interesting. Invite students to share the movement they see in the picture, reminding them that they can point to indicate the direction of the movement. Ask the class to pantomime the force being exerted for each movement that is shared.

13. Add to the What We Know About Forces chart.

Tenemos algunas ideas nuevas sobre por qué los objetos se mueven de diferentes maneras. Hemos estado investigando por qué los objetos se mueven en diferentes direcciones, y ahora apuntaremos lo que hemos averiguado en nuestra Gráfica de lo que sabemos sobre las fuerzas.

Draw a line below the images for stronger and gentler forces that were added in Lesson 2.2. Under the line, add What We Know About Forces Chart: Icons 3 and 4 (the images of the child representing forces to the left and to the right). Write “direction” on the left side of the chart.

Point to the picture of the child who is kicking to the left. Stand with your back to the class (in the same orientation as the image) to help students understand the perspective.

Esta persona está pateando la pelota y la pelota está comenzando a moverse hacia la izquierda.

Draw an arrow and the ball to show the ball’s motion to the left.

¿Por qué la pelota se está moviendo hacia la izquierda?
[Porque la fuerza es hacia la izquierda].

La pelota se está moviendo hacia la izquierda porque la fuerza es hacia la izquierda.

Write “force to the left” near the child kicking toward the left, saying each word aloud.

Repeat this procedure with the figure on the right. Demonstrate and ask students to describe the ball’s motion to the right, adding the words “force to the right” to the chart.
Ahora estas imágenes muestran lo que hemos averiguado: que un objeto se mueve en la misma dirección que la fuerza que se ejerce sobre él.

14. Post and read the key concept.

Un objeto comienza a moverse en la misma dirección que la fuerza que inicia el movimiento.

Teacher Support

Rationale

Literacy Note: Shared Reading
Shared Reading provides opportunities for students to observe the teacher as an expert reader and to actively join in reading. Using a big book allows you to explicitly show and guide students to understand that informational texts use structural and visual cues to aid in the reading process, to recognize new vocabulary in print, and to practice reading strategies while students are reading to learn new science ideas. Shared Reading provides opportunities for instruction and practice that prepares students for engaging more independently either with a partner or on their own. Building with Forces is designed to facilitate visualizing and gives students a rich context in which to ask their own questions about forces. You will guide students in using the strategies of visualizing and interpreting images to make meaning of this text.

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