Lesson 3.5
Applying Strength and Direction
Lesson Overview

Students synthesize their learning about forces from Chapter 3 and reflect on their work, applying what they learned to designing the Class Pinball Machine. They begin by using what they designed in their Box Model in the previous session to make changes to the Class Pinball Machine. In a Shared Writing activity, they write about these changes and how the ball moved depending on the force exerted on it. The lesson closes with students applying what they have figured out about combined strength and direction of forces to visualize movement in ball games using the reference book. The purpose of this lesson is to give students the opportunity to apply what they have learned about the combined strength and direction of forces to real-world contexts.

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 to a target.

Students learn:

- Engineers talk and write in order to share their solutions and ideas.
- Engineers use evidence to explain their thinking.
Visualizing Movement and Forces

Partners look at pictures in *Forces in Ball Games* to visualize and discuss the strength and direction of forces in the games.

Instructional Guide

1. **Lead students in an Embodied Forces Routine.** Ask students to visualize their favorite ball game. Invite several volunteers to share their favorite game. Have one student at a time lead the class in pantomiming the movement involved in their favorite game. Ask each volunteer to describe the strength and direction of the force used in this game. Have other students mimic the actions and ask them to guess what kind of force is being shown.

2. **Display the *Forces in Ball Games* big book.**

   - Remember that this book is a little bit different than some of the other books we read. We can read specific parts of the book to gather the information we need instead of reading it from beginning to end.
   - We used the book to learn about strong and gentle forces. We also used the book to learn about making objects move shorter and longer distances.
   - Today we will use the book to help us think about what we have learned about moving an object to a certain place.

3. **Revisit visualizing.**

   - We have been learning to visualize to help us better understand forces. What does it mean to visualize? [Make a movie in your mind. Make a picture in your head.]
   - Today we will visualize different types of balls moving to certain places as we read *Forces in Ball Games*. Visualizing will help us better understand the different forces being exerted on the balls.

4. **Turn to page 26 and invite students to visualize.** Point to the picture of the girl playing mini-golf.
Pushes and Pulls
Lesson Guides

1. Look closely at this picture and visualize what you think is happening. What do you think this girl is doing? [Hitting the ball.]

2. What makes you think that? [Her arms look like they are swinging the club just a little bit toward the hole.]

Invite students to pantomime the movement of swinging the club into the ball with you.

3. What did you visualize is happening to the ball? [It is moving slowly away from the girl toward the hole.]

4. We can visualize the ball moving a short distance away from the girl toward the hole. Why do you think the ball moved a short distance away from the girl to the hole? [Because she hit it gently and in that direction. Because she exerted a gentle force toward the hole.]

5. Set the purpose for partner work.

You and your partner will look at the photographs in this book and then talk about how the ball in each game is moving to a certain place and why you think it is moving that way. For each photograph, you and your partner will visualize the distance and direction the ball travels to get to a certain place. Remember to talk about why you think the ball is moving.

6. Revisit Partner Reading Guidelines. Invite a volunteer to be your reading partner. Read each guideline and model the corresponding behavior with a partner:

• Sit next to your partner.
• Put the book between you.
• Take turns reading and listening.

7. Assign partners and distribute books.

8. On-the-Fly Assessment: Students discuss photographs. Circulate and listen for how students are describing the ball’s movement in the pictures in the Forces in Ball Games book.

9. Collect books and conclude the chapter. Preview the next chapter by letting students know that they will continue to figure out how to make the pinball move in many different ways in the Class Pinball Machine.

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Embedded Formative Assessment

On-the-Fly Assessment 9: Visualizing and Discussing Both Direction and Force

Look for: Students visualize movement as they synthesize and apply a number of new ideas in order to describe or explain movement of the ball to a certain place. Listen as students describe what they noticed in the photographs in order to visualize movement. Support their ideas of how the ball moves to a certain place. For example, students may note that the ball is moving far, based on the ball looking blurry in the photograph. They may also note that the ball is being hit hard, based on the way the batter is moving his body. Or, they may notice impact, based on prior knowledge of a heavy bowling ball that can knock down pins. Also note if students are able to describe both the strength and direction of forces when talking about the ball games.

Now what? If you notice that students need additional support to synthesize all these ideas, consider using any of the following supports during the activity or as students revisit the book at other times during the day.

• Gather a small group for more guided work.
• Create a checklist that mirrors the images on the What We Know About Forces chart to remind students to consider both strength and direction.
• Call for students’ attention after a few minutes of work time and ask volunteers to share examples they found.
• Flag (with sticky notes) one or two clear examples in students’ books ahead of time.

Teacher Support

Background

Literacy Note: About Text Features in the Reference Book
Text features are aspects of the text that help organize information or help readers navigate the text. Text features include headings, tables of contents, bold print, illustrations, captions, graphs, etc. Using these features is a strategy that students can employ to locate and make sense of information in nonfiction texts. In the the book Forces in Ball Games, there is a table of contents, a glossary, and an index, all of which can be highlighted during any lesson in which the reference book is used.
Visualizing Movement and Forces

Partners look at pictures in *Forces in Ball Games* to visualize and discuss the strength and direction of forces in the games.

Instructional Guide

1. **Lead students in an Embodied Forces Routine.** Ask students to visualize their favorite ball game. Invite several volunteers to share their favorite game. Have one student at a time lead the class in pantomiming the movement involved in their favorite game. Ask each volunteer to describe the strength and direction of the force used in this game. Have other students mimic the actions and ask them to guess what kind of force is being shown.

2. **Display the Forces in Ball Games big book.**

   1. Recuerden que este libro es un poquito diferente a algunos de los otros libros que leemos. Podemos leer partes específicas del libro para reunir la información que necesitamos en vez de leerlo desde el principio hasta el final.

   2. Usamos el libro para aprender acerca de fuerzas firmes y livianas. También usamos el libro para aprender acerca de hacer que los objetos se muevan distancias más cortas y más largas.

   3. Hoy usaremos el libro para ayudarnos a pensar en lo que hemos aprendido sobre mover un objeto hacia un cierto lugar.

3. **Revisit visualizing.**

   1. Hemos estado aprendiendo a visualizar para ayudarnos a entender mejor las fuerzas. ¿Qué significa visualizar? [Hacer una película en tu mente. Hacer una imagen en tu cabeza].

   2. Hoy visualizaremos diferentes tipos de pelotas moviéndose hacia ciertos lugares mientras leemos *Las fuerzas en los juegos con pelota*. Visualizar nos ayudará a entender mejor las diferentes fuerzas que se ejercen sobre las pelotas.
4. Turn to page 26 and invite students to visualize. Point to the picture of the girl playing mini-golf.

Miren atentamente esta foto y visualicen lo que piensan que está sucediendo. ¿Qué piensan que está haciendo la niña? [Golpeando la pelota].

¿Qué les hace pensar eso? [Sus brazos parecen estar balanceando el palo solo un poquito hacia el hoyo].

Invite students to pantomime the movement of swinging the club into the ball with you.

¿Qué visualizaron que le está sucediendo a la pelota? [Se está alejando lentamente de la niña y se está acercando hacia el hoyo].

Podemos visualizar la pelota alejándose una distancia corta de la niña hacia el hoyo. ¿Por qué piensan que la pelota se alejó una distancia corta de la niña hacia el hoyo? [Porque ella la golpeó suavemente y en esa dirección. Porque ella ejerció una fuerza liviana hacia el hoyo].

5. Set the purpose for partner work.

Miran las fotos en este libro y luego hablarán en parejas sobre cómo la pelota en cada juego se está moviendo hacia un cierto lugar y por qué piensan que se está moviendo hacia allá. En cada foto, visualizarán la distancia y la dirección en la que viaja la pelota para llegar a un cierto lugar. Recuerden hablar sobre por qué piensan que la pelota se está moviendo.

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