Lesson 4.2
Forces Change an Object's Direction
Lesson Overview

Students learn that a force, either from a moving object or a still object, can make a moving object change direction. The lesson opens with students participating in a Read-Aloud of *Forces in Ball Games*, which emphasizes how engineers describe forces being exerted on moving balls by still and moving objects. Students play Rugball to practice describing the concept that a ball changing directions is evidence of a force being exerted and use the Explanation Language Frame to build fluency in their explanations that forces cause an object to change directions. The lesson concludes with a reflection on students’ work with the design cycle, which help them see how their work aligns with the work of engineers. The purpose of this lesson is to develop students’ understanding and use of language to explain that forces redirect movement.

**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 moving rugball changes direction.

**Students learn:**

- A moving object changes direction when another moving object exerts a force on it.
- A moving object changes direction when a still object in its way exerts a force on it.
Reading About Changing Direction

The teacher reads aloud the reference book as students pantomime the motion and discuss the forces exerted when the ball changes direction.

Instructional Guide

1. Refer to the Chapter 4 Question and the Investigation Question.

We are trying to answer the question How do we make a moving pinball change direction? We want to figure out different ways to make our pinball change direction so that we can use what we learn to design our Class Pinball Machine.

To help us think about this, we have used different objects to explore the question What can make a moving object change direction?

2. Connect to prior learning. Remind students they already started figuring out the answer to these questions.

What did you do to make your tennis balls and the rugball change direction?
[We held out our hands. We held out a book. We hit things with our hands and hit things with other objects.]

3. Display the Forces in Ball Games big book and set the purpose for the Read-Aloud. Remind students that they also looked at this book with a partner and visualized different types of balls changing direction.

We want to be able to answer our Investigation Question, just like an engineer would. We are going to read parts of this book again and talk like engineers about what can make a moving object change direction.

4. Turn to page 14 and show students the picture of the foosball table as an example of changing direction with a moving object. Ask students to share if they have ever played foosball or know how to play.

Can anyone tell me what they visualize the players are doing in this picture?
[Moving the rods. Making the little people move. Trying to make the people hit/kick the ball.]
5. **Read aloud pages 14–15.** Trace the motion of the foosball moving toward and away from the moving foosball man on page 15 as you explain how you are visualizing the movement of the ball. Use your other hand to gesture how the foosball man “kicks” the ball. Ask students to pantomime the motion with their fingers in the air.

   Why did the ball change direction?  
   [The foosball man hit the ball. The foosball man exerted a force on the ball.]

   An engineer would say that the ball changed direction because the foosball man exerted a force on the ball in a different direction.

6. **Turn to page 36 and show students the picture of the table-tennis player.** Ask students if they have ever played table tennis or have seen it played.

7. **Read aloud pages 36–37.** Have students visualize a table-tennis ball coming in their direction and ask them to pantomime hitting it with a paddle. Have students point in the direction where they visualize the ball will move after it hits the paddle.

8. **Discuss force being exerted by a moving object.**

   We saw a moving foosball man and a moving paddle make a ball change direction. What would an engineer say made the balls change direction?  
   [Something pushed them. Something exerted a force on the ball.]

   Confirm students’ responses, or restate them using language from the book.

   The ball changed direction because something exerted a force on it.

9. **Show the pictures on pages 8–9 to focus on changing direction with an object that is not moving.** Ask students to stand up and pantomime dribbling a basketball. Read aloud pages 8–9.

   What did the ball do when the player was dribbling the ball?  
   [It changed directions. It hit the floor and bounced up.]

   Narrate what you visualize on page 9 as you trace the movement of the ball down with your finger, with your other hand palm-up to symbolize the floor. Have the movement you trace “bounce” off your open hand (the floor), and go back up. Invite students to trace the movement with their fingers in the air.

   Why did the ball change direction?  
   [It hit the floor and bounced up.]

   The ball changed direction because the floor exerted a force on it.

10. **Summarize the Read-Aloud.**
We have seen a few different ways to make objects change directions. Scientists and engineers say that when the ball changes direction, something exerted a force on it. We will use that language when we play Rugball later.

Teacher Support

Instructional Suggestion

Providing More Experience: Finding Examples in the Reference Book
If students need more examples of a moving object changing direction, the reference book is a resource that can be used beyond what is presented in this lesson. Students can work independently to find more examples in the photographs. Alternatively, you can gather a small group of students who need more support and have them look for and discuss more examples.
Reading About Changing Direction

The teacher reads aloud the reference book as students pantomime the motion and discuss the forces exerted when the ball changes direction.

Instructional Guide

1. Refer to the Chapter 4 Question and the Investigation Question.

Estamos intentando responder la pregunta: ¿Cómo hacemos para que una pelota de pinball en movimiento cambie de dirección? Queremos averiguar diferentes maneras de hacer que nuestra pelota de pinball cambie de dirección, para que podamos usar lo que aprendamos para diseñar nuestra máquina de pinball de la clase.

Para ayudarnos a pensar en esto, hemos usado diferentes objetos para explorar la pregunta: ¿Qué puede hacer que un objeto en movimiento cambie de dirección?

2. Connect to prior learning. Remind students they already started figuring out the answer to these questions.

¿Qué hicieron para lograr que sus pelotas de tenis y la pelota en la alfombra cambiaran de dirección? [Pusimos nuestras manos. Pusimos un libro. Golpeamos cosas con nuestras manos y golpeamos cosas con otros objetos].

3. Display the Forces in Ball Games big book and set the purpose for the Read-Aloud. Remind students that they also looked at this book with a partner and visualized different types of balls changing direction.

Queremos poder responder nuestra Pregunta de investigación, justo como lo haría un ingeniero. Vamos a leer partes de este libro de nuevo y hablar sobre qué puede hacer que un objeto en movimiento cambie de dirección, igual que los ingenieros.

4. Turn to page 14 and show students the picture of the foosball table as an example of changing direction with a moving object. Ask students to share if they have ever played foosball or know how to play.
5. Read aloud pages 14–15. Trace the motion of the foosball moving toward and away from the moving foosball man on page 15 as you explain how you are visualizing the movement of the ball. Use your other hand to gesture how the foosball man “kicks” the ball. Ask students to pantomime the motion with their fingers in the air.

¿Por qué cambió de dirección la pelota? [El muñeco de futbolín golpeó la pelota. El muñeco de futbolín ejerció una fuerza sobre la pelota].

Un ingeniero diría que la pelota cambió de dirección porque el muñeco de futbolín ejerció una fuerza sobre la pelota en una dirección diferente.

6. Turn to page 36 and show students the picture of the table-tennis player. Ask students if they have ever played table tennis or have seen it played.

7. Read aloud pages 36–37. Have students visualize a table-tennis ball coming in their direction and ask them to pantomime hitting it with a paddle. Have students point in the direction where they visualize the ball will move after it hits the paddle.

8. Discuss force being exerted by a moving object.

Vimos a un muñeco de futbolín en movimiento y a una paleta en movimiento hacer que una pelota cambiara de dirección. ¿Qué diría un ingeniero que hizo que las pelotas cambiaron de dirección? [Algo las empujó. Algo ejerció una fuerza sobre la pelota].

Confirm students’ responses, or restate them using language from the book.

La pelota cambió de dirección porque algo ejerció una fuerza sobre ella].

9. Show the pictures on pages 8–9 to focus on changing direction with an object that is not moving. Ask students to stand up and pantomime dribbling a basketball. Read aloud pages 8–9.

¿Qué hizo la pelota cuando la jugadora estaba drileando la pelota? [Cambió de dirección. Golpeó el piso y rebotó hacia arriba].

Narrate what you visualize on page 9 as you trace the movement of the ball down with your finger, with your other hand palm-up to symbolize the floor. Have the movement you trace “bounce” off your open hand (the floor), and go back up. Invite students to trace the movement with their fingers in the air.

¿Por qué cambió de dirección la pelota? [Golpeó el piso y rebotó hacia arriba].
La pelota cambió de dirección porque el piso ejerció una fuerza sobre ella.

10. Summarize the Read-Aloud.

Hemos visto unas cuantas maneras diferentes de hacer que los objetos cambien de dirección. Los científicos y los ingenieros dicen que cuando la pelota cambia de dirección, algo ejerció una fuerza sobre ella. Usaremos esas frases cuando juguemos con la pelota en la alfombra más tarde.

Teacher Support

Instructional Suggestion

Providing More Experience: Finding Examples in the Reference Book
If students need more examples of a moving object changing direction, the reference book is a resource that can be used beyond what is presented in this lesson. Students can work independently to find more examples in the photographs. Alternatively, you can gather a small group of students who need more support and have them look for and discuss more examples.