Lesson 2.2
Strong and Gentle Forces
Lesson Overview

Students learn about strong and gentle forces and how the strength of forces can affect the distance an object travels. As they get ready to incorporate these forces into the Class Pinball Machine, students are introduced to several examples of forces in the reference book, *Forces in Ball Games*, and practice using and hearing language related to strong and gentle forces through a game of Rugball. They also sort images of different moving objects by visualizing if a strong or a gentle force is causing those objects to move different distances. Students use a language frame to practice explaining why the object moved a certain distance, connecting it to the kind of forces exerted on it. The purpose of this lesson is to provide students with vocabulary to talk about the relationship between the strength of a force exerted on an object (the cause) and the distance that object travels (the effect).

Anchor Phenomenon: Pinball machines allow people to control the direction and strength of forces on a ball.
Everyday Phenomenon: The rugball moves different distances.

Students learn:

- An object moves a long distance when a strong force is exerted on it.
- An object moves a short distance when a gentle force is exerted on it.
The teacher reads aloud from the unit’s reference book. Students pantomime strong and gentle forces in the context of specific ball games.

Instructional Guide

1. Connect to previous learning.

- We are pinball engineers. We are working to design a solution to our problem: to design a pinball machine that does all the things we want it to do. We can then share what we learn with others.

Refer to the Pinball Machine Design Goals chart as you read the two new goals aloud.

- We have two new design goals to help us make a pinball machine that does all the things we want, just like the one in the video: Make the pinball move a short distance, and Make the pinball move a long distance.

Read aloud the Chapter 2 Question, pointing to each word as you read.

- To help us meet our design goals, we will need to answer this question: How do we make a pinball move as far as we want?

2. Remind students of the Investigation Question. Point to the question as you discuss, using gestures for short and long distances.

- Pinball engineers have to figure out what makes an object move short or long distances. This helps them figure out how to make the pinball move different distances.

- Figuring out how to make a pinball move different distances will help us design a pinball machine that moves our pinball short distances and long distances, just like the machine in the video we watched.

3. Hold up Forces in Ball Games and show students the front cover. Let students know they will be reading this book to learn more about different kinds of forces. Point to and read the title; then, ask students what they notice about the images on the cover.
This book is different from many of the books we have read together. Instead of reading this book from beginning to end, you can read specific parts of the book to gather information.

4. Introduce the contents page.

This is the contents. The contents page tells readers the important sections of the book. It also tells them what pages contain the information they are looking for so that they can find it.

Name a few sections listed in the contents and mention that this entire book is about how balls move in different ball games, such as baseball, basketball, and bowling. Briefly turn to the examples with baseball, basketball, and pool (pages 6–11). Explain that each new section has two pages that talk about a different ball game.

5. Return to the contents page to model how you can locate the introduction.

This says that I can find the introduction section on page 4. I am going to turn there.

6. Read aloud the introduction on pages 4–5. Model how you would visualize movement to think of the forces being exerted.

I can visualize that if a goal is nearby I need to exert a gentle force to get the ball in. If a goal is very far away, I visualize that I need to exert a strong force to get the ball in.

7. Use the contents page to locate and read aloud the section on baseball. On pages 6–7, point to the pictures as you describe strong and gentle forces. Ask students to visualize the movements of the baseball players and pantomime a strong force on a baseball and a gentle force on a baseball.

8. Locate and read aloud the section about bowling. As you read pages 10–11 aloud, invite students to visualize the movements of the bowler and how the ball moved. Ask students to share what they learned from those pages, and emphasize that the bowling ball moved a long distance because the boy exerted a strong force on the ball.

9. Highlight more examples of strong and gentle forces. Time allowing, turn to and read aloud the following pages, asking students to share what they learned about strong and gentle forces for the following ball games:

   - croquet (pages 12–13)
   - football (pages 16–17)
   - golf (pages 20–21)
   - mini-golf (page 26–27)

10. Let students know they will return to this book in the future. Explain that they will have other chances to learn more about different ball games and how people make different types of balls move.
Teacher Support

Background

About the Book: *Forces in Ball Games*

*Forces in Ball Games* is the reference book for this unit. It explores the types of forces in many different ball games, both familiar and new. Showing how forces are exerted in the context of games helps solidify the connection between the physics content that students are learning and the pinball machines they are creating. The reference book is used during a Partner Read and in Read-Alouds throughout the unit and offers an opportunity to look for changes of direction, stopping and starting motion, and strong and gentle forces.

Literacy Note: About Reference Books

Reference books provide in-depth information about specific topics and are typically read for particular purposes. For this reason, students do not read every section in reference books, nor do they read reference books from beginning to end. Rather, they search for the information they need and then read the relevant sections carefully. In this lesson, students will be introduced to the table of contents and the introduction and will be given the opportunity to explore the book. This will prepare students to use the reference book in later lessons, and it encourages students to read complex text both purposefully and carefully as a scientist would.

Rationale

Pedagogical Goals: Relative Measures of Strength and Distance

In this unit, we use comparative descriptions of distance and strength; we only use the word *long* in comparison with another shorter distance, and we use the word *strong* in comparison with the word *gentle*. Relative descriptions such as these serve to support the learning goals in the unit, whereas assigning more objective measurements (e.g., 5 feet) may add a level of difficulty for kindergartners that detracts from their current focus on forces. In using these relative descriptions, it is important when we ask students to reason about long and short or strong and gentle that we limit the situation we are asking them to describe. Objects that are different weights can move different distances under the same force (e.g., exerting the same force on a table-tennis ball compared to a bowling ball), and objects moving over different surfaces can move different distances (e.g., rolling a ball across pavement compared to rolling it across grass). In this unit, students think about and experience the same object (a tennis ball, rugby, or “pinball”) moving different distances over the same surface (e.g., the floor or the bottom of the Box Model).
Reading: Forces in Ball Games

The teacher reads aloud from the unit’s reference book. Students pantomime strong and gentle forces in the context of specific ball games.

Instructional Guide

1. Connect to previous learning.

Somos ingenieros de pinball. Estamos trabajando para diseñar una solución a nuestro problema: diseñar una máquina de pinball que haga todas las cosas que queremos que haga. Luego podemos compartir lo que aprendemos con otros.

Refer to the Pinball Machine Design Goals chart as you read the two new goals aloud.

Tenemos dos metas de diseño para ayudarnos a hacer una máquina de pinball que haga todas las cosas que queramos, justo como lo del video: Hacer que la pelota de pinball se mueva una distancia corta y Hacer que la pelota de pinball se mueva una distancia larga.

Read aloud the Chapter 2 Question, pointing to each word as you read.

Para ayudarnos a cumplir nuestras metas de diseño, necesitaremos responder esta pregunta: ¿Cómo hacemos para que una pelota de pinball se mueva tan lejos como queramos?

2. Remind students of the Investigation Question. Point to the question as you discuss, using gestures for short and long distances.

Los ingenieros de pinball tienen que averiguar qué hace que un objeto se mueva distancias cortas o largas. Esto les ayuda a averiguar cómo hacer que la pelota de pinball se mueva diferentes distancias.

Averiguar cómo hacer que una pelota de pinball se mueva diferentes distancias nos ayudará a diseñar una máquina de pinball que mueva nuestra pelota de pinball distancias cortas o distancias largas, igual que la máquina en el video que vimos.
3. Hold up *Forces in Ball Games and show students the front cover*. Let students know they will be reading this book to learn more about different kinds of forces. Point to and read the title; then, ask students what they notice about the images on the cover.

Este libro es diferente a muchos de los libros que hemos leído juntos. En vez de leer este libro desde el principio hasta el final, pueden leer partes específicas del libro para reunir información.

4. Introduce the contents page.

Este es el contenido. La página del contenido les dice a los lectores las secciones importantes del libro. También les dice qué páginas contienen la información que están buscando, para que puedan encontrarla.

Name a few sections listed in the contents and mention that this entire book is about how balls move in different ball games, such as baseball, basketball, and bowling. Briefly turn to the examples with baseball, basketball, and pool (pages 6–11). Explain that each new section has two pages that talk about a different ball game.

5. Return to the contents page to model how you can locate the introduction.

Aquí dice que puedo encontrar la sección de introducción en la página 4. Voy a pasar a esa página.

6. Read aloud the introduction on pages 4–5. Model how you would visualize movement to think of the forces being exerted.

Puedo visualizar que si una portería está cerca necesito ejercer una fuerza liviana para meter la pelota. Si una portería está muy lejos, visualizo que necesito ejercer una fuerza firme para meter la pelota.

7. Use the contents page to locate and read aloud the section on baseball. On pages 6–7, point to the pictures as you describe strong and gentle forces. Ask students to visualize the movements of the baseball players and pantomime a strong force on a baseball and a gentle force on a baseball.

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10. **Let students know they will return to this book in the future.** Explain that they will have other chances to learn more about different ball games and how people make different types of balls move.

## Teacher Support

### Background

**About the Book: Forces in Ball Games**

*Forces in Ball Games* is the reference book for this unit. It explores the types of forces in many different ball games, both familiar and new. Showing how forces are exerted in the context of games helps solidify the connection between the physics content that students are learning and the pinball machines they are creating. The reference book is used during a Partner Read and in Read-Alouds throughout the unit and offers an opportunity to look for changes of direction, stopping and starting motion, and strong and gentle forces.

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