

## Lesson 5.2

### Hoverboard

SAMPLE



## Lesson Overview

Students set a purpose for reading and then read the book *Hoverboard*. The text describes how hoverboards work: magnetic force pushes the board up as Earth pulls the board down with the force of gravity. It describes when the forces on the hoverboard are balanced and when they are unbalanced. After reading, students discuss balanced and unbalanced forces in the book, then use the Word Relationships routine to discuss and write about balanced and unbalanced forces. The purpose of this lesson is to help students further understand how balanced forces can become unbalanced, and to provide an exciting analogous example to help students understand the floating train.

**Anchor phenomenon:** The floating train rises, floats above the track, then later falls back to the track.

**Investigative phenomenon:** A hoverboard floats above a track.

### Students learn:

- Hoverboards work by balancing gravity and magnetic force.
- Some engineers use the science of balanced and unbalanced forces to design inventions.
- If forces are balanced, and then a force is changed, the forces become unbalanced, which can cause an object to start moving.

## Balancing Forces

## Lesson Guides

Lesson 5.2



## Lesson at a Glance

ACTIVITY

1

**Reading Hoverboard** (25 min)

This book provides another application of concepts about gravity, magnetic force, and balanced and unbalanced forces. It also prepares students to explain how the floating train works. Included in this activity is another On-the-Fly Assessment to check on students' use of the comprehension strategy of reading with a purpose.



READING

2

**Discussing Evidence from Hoverboard** (15 min)

This discussion helps the class agree on a key concept about unbalanced forces.

TEACHER-LED  
DISCUSSION

3

**Word Relationships** (20 min)

Students explore and deepen their understanding of balanced and unbalanced forces and focus on using key vocabulary words and relating them to one another.

STUDENT-TO-  
STUDENT  
DISCUSSION

SAMPLE



## Materials & Preparation

### Materials

#### For the Classroom Wall

- key concept: *If forces exerted on an object are balanced, and then a force changes, the forces become unbalanced, which can cause the object to start moving.*
- Setting a Purpose for Investigating and Reading chart

#### For the Class

- marker\*
- sticky notes\*

#### For Each Pair of Students

- 1 copy of *Hoverboard*
- 3–5 sticky notes
- 1 set of Word Relationships Cards: Sets 1, 2, 3 and 4, clipped together (15 cards/set)

#### For Each Student

- *Balanced Forces* Investigation Notebook (pages 60–65)

\*teacher provided

### Preparation

#### Before the Day of the Lesson

1. Gather the following materials for the classroom wall:



### VOCABULARY

- attract
- balanced forces
- design
- electromagnet
- engineer
- evidence
- exert
- explanation
- force
- gravity
- magnet
- magnetic force
- repel
- unbalanced forces



### UNPLUGGED?

Digital Devices Not Required

Students can complete this lesson without the use of digital devices.



### DIGITAL RESOURCES

Setting a Purpose for Investigating and Reading: Completed

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## Lesson 5.2 Brief



- key concept: *If forces exerted on an object are balanced, and then a force changes, the forces become unbalanced, which can cause the object to start moving.*
2. **Read *Hoverboard*.** Familiarize yourself with the book that students will read in this lesson.
  3. **Locate Word Relationships Cards: Set 4 (in your *Balancing Forces* kit).** There is only 1 card/set.
  4. **Combine Word Relationships Cards: Sets 1, 2 and 3 with Set 4.** Add the *unbalanced forces* card from Word Relationships Cards: Set 4 to each set of Word Relationships Cards: Sets 1, 2, and 3 (from Lesson 4.2) to make sets of 15 cards. Clip together each set of 15 cards.
  5. **Prepare for On-the-Fly Assessment.** Included in Activity 1 is an On-the-Fly Assessment. This assessment provides an opportunity to again assess students' use of the strategy of focusing on a purpose as they read. Press the hummingbird icon on the menu bar and then select the ON-THE-FLY ASSESSMENT for details about what to look for and how you can use the information to maximize learning by all students.

**Immediately Before the Lesson**

1. **On the board, write the Investigation Question.** If you have erased it, rewrite: "What can make forces not be balanced anymore?"
2. **Have on hand the following materials:**
  - copies of *Hoverboard*
  - sticky notes
  - Word Relationship Card sets
  - marker

## Differentiation

**Embedded Supports for Diverse Learners**

**Partner Reading.** Partner Reading provides opportunities for students to assist each other with reading—with using the reading strategy of reading with a purpose, with decoding, and with comprehension. Partner Reading encourages discussion of the text during reading, which aids comprehension.

**Potential Challenges in This Lesson**

**Reading focus.** Reading science text may still be relatively unfamiliar to some students, and, as in any reading activity, it may be challenging for students who struggle with reading.



**Multiple vocabulary words.** In the Word Relationships routine in Activity 3, students are provided with 15 scientific words to use to create sentences. Some students may benefit from having access to fewer words. If so, consider providing them with a subset of the word cards.

### Specific Differentiation Strategies for English Learners

**Multiple Meaning Words.** Words with multiple meanings may present an obstacle for English learners. To help avoid confusion, before reading, explain that some words have more than one meaning. Have partners work together to complete the optional activity on page 63, Multiple Meaning Words, in the *Balancing Forces* Investigation Notebook.

### Specific Differentiation Strategies for Students Who Need More Support

**Reading with a small group or as a class.** One option for adjusting the lesson to support some students who need more support is to form small groups of students who would work together during a first read and/or have them read with you or another adult. If many students in your class struggle significantly with reading, you can also read the text aloud and ask students to follow along and annotate as you read together.

**Anticipation Guide.** For each book, we provide an optional Anticipation Guide in the Investigation Notebook. Anticipation Guides can help support students by activating prior knowledge before reading, promoting engaged reading, and encouraging students to monitor their comprehension. If you choose to use this optional activity, have students turn to page 62, Getting Ready to Read: Hoverboard, in the Investigation Notebook. Review the directions and explain that students should work with a partner to decide if they agree or disagree with each statement. After reading, ask partners to revisit the statements and discuss whether they want to change any responses based on their reading. Encourage students to refer to the text as they discuss.

### Specific Differentiation Strategies for Students Who Need More Challenge

**Read with a focus on engineers and engineering.** You could challenge students to reread *Hoverboard* with a focus on the work of engineers. Ask students to record a few ideas from the book about what engineers do in their work. Also ask students to record a few questions they have after reading about engineers or engineering.

**Reading Reflection.** A Reading Reflection activity for each book is included in the Investigation Notebook. These are optional written activities designed to reinforce concepts in the books and provide prompts to encourage further thinking about the text. These activities are designed for early finishers to use during Partner Reading and can also be used in a variety of other ways, such as to reinforce concepts on a second read of the book or as homework. The Reading Reflection for this book (on page 62, Reading Reflection: Hoverboard, in the Investigation Notebook) invites students write a caption for the diagram from page 11 in the book *Hoverboard*.

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## Standards

## Key

Practices Disciplinary Core Ideas Crosscutting Concepts

## 3-D Statement

Students engage in oral argumentation about balanced and unbalanced forces based on evidence they obtain by reading about what causes a hoverboard to rise, float, and fall (cause and effect).

## Next Generation Science Standards (NGSS)

## NGSS Practices

- **Practice 7:** Engaging in Argument from Evidence
- **Practice 8:** Obtaining, Evaluating, and Communicating Information

## NGSS Disciplinary Core Ideas

- **PS2.A: Forces and Motion:**
  - Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (3-PS2-1)
- **PS2.A: Forces and Motion:**
  - The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (3-PS2-2)
- **PS2.B: Types of Interactions:**
  - Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3, 3-PS2-4)
- **PS2.B: Types of Interactions:**
  - Objects in contact exert forces on each other. (3-PS2-1)
- **ETS1.B: Developing Possible Solutions:**
  - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)



### NGSS Crosscutting Concepts

- Cause and Effect
- Stability and Change

### Common Core State Standards for English Language Arts (CCSS-ELA)

- **CCSS.ELA-LITERACY.RI.3.1:** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- **CCSS.ELA-LITERACY.RI.3.7:** Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- **CCSS.ELA-LITERACY.SL.3.1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- **CCSS.ELA-LITERACY.SL.3.1.A:** Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
- **CCSS.ELA-LITERACY.SL.3.1.B:** Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
- **CCSS.ELA-LITERACY.SL.3.1.D:** Explain their own ideas and understanding in light of the discussion.
- **CCSS.ELA-LITERACY.L.3.4:** Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 3 reading and content, choosing flexibly from a range of strategies.
- **CCSS.ELA-LITERACY.L.3.6:** Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships (e.g., After dinner that night we went looking for them).

### Common Core State Standards for Mathematics (CCSS-Math)

#### CCSS-Math Practices

- **CCSS.MATH.PRACTICE.MP1:** Make sense of problems and persevere in solving them.





1

READING  
Reading Hoverboard


# Reading Hoverboard

Students set a purpose for reading, then read *Hoverboard*.



## Instructional Guide

**1. Introduce the focus of the lesson.** Point out the Investigation Question and read it aloud.

 What can make forces not be balanced anymore?

Let students know that they will continue investigating this question and thinking about balanced and unbalanced forces.

**2. Introduce page 61 in the notebook, Setting a Purpose for Reading *Hoverboard*, and have partners set a purpose.** Have students turn to page 61 of their notebooks. Point out that pairs will decide on their own reading purpose today.

 Choose a reading purpose that will help you with what we are investigating.

Give pairs a few minutes to discuss and write down a purpose for reading.

**3. Distribute copies of *Hoverboard*.** Distribute one copy of the book to each pair of students.

**4. Distribute 3–5 sticky notes to each pair.** Remind students to use these sticky notes to mark particular places in the text related to the purpose for reading, and add notes about what they found to the Setting a Purpose for Reading notebook page.

**5. On-the-Fly Assessment: Students read *Hoverboard* with a partner.** Circulate as students mark with sticky notes the evidence related to their reading purpose, and add notes about what they found to the Setting a Purpose for Reading *Hoverboard* notebook page. Early finishers can record notes about the evidence they find and/or complete the optional Reading Reflection activity on page 63 in the notebook (Reading Reflection: *Hoverboard*).

 Embedded Formative Assessment**On-the-Fly Assessment 18: Reading with a Purpose**

**Look for:** As you circulate, make note of the purposes that students set for reading. Are students setting a purpose that is relevant to the investigation question: When forces are balanced, what happens if one of the forces changes? Also note how well students are able to use that purpose to guide their reading of the text. Are they using the sticky notes to mark places in the text that are relevant to the purpose they chose? Are they able to articulate the reasons for their choices to their partner and summarize those reasons on their notebook page?

**Now what?** If students have trouble, provide more reminders about how to set a purpose for reading. Find a time when you can model reading with a purpose for students who still need more support in this area. Think aloud as you set a purpose, describing your reasons for choosing that purpose. For instance, you might refer students back to the Investigation Question and remind students that scientists read to help them answer the questions they are investigating. Then read a portion of the book with students. Pause and think aloud about whether or not you have met your purpose. At this point, you may want to invite students to consider whether or not your purpose has been met. If appropriate, read on and pause again to reflect with students on the purpose you set. Then, help students set purposes, have them read, and guide them in reflecting about whether or not they have met their purposes.

## Teacher Support

**Instructional Suggestion****Providing More Experience: Today's Daily Written Reflection**

*What questions do you have about balanced and unbalanced forces?* This prompt, on page 60 of the Investigation Notebook, gives students another opportunity to ask questions about the ideas they have been discovering.

**Background****About the Book: *Hoverboard***

*Hoverboard* introduces students to a real-life futuristic invention—skateboards that float! The text describes how hoverboards work: magnetic force pushes the board up as Earth pulls the board down with the force of gravity. The forces are balanced when the board floats and unbalanced when the board rests on the ground. The concluding pages offer another example of an invention that uses balanced forces and encourage students to think of more examples. The exciting analogous example presented in *Hoverboard* helps students understand the maglev train without giving everything away. The diagrams and explanations support students in constructing their own explanations in the unit.



2

TEACHER-LED DISCUSSION  
Discussing Evidence from  
Hoverboard

# Discussing Evidence from Hoverboard




Students have an opportunity to discuss how the hoverboard works and to share the evidence relevant to the reading purposes.

## Instructional Guide

1. Call on volunteers to share their reading purpose and what they found related to it.
2. Project the first Think-Pair-Share question.

### Think-Pair-Share Question 1

What can make forces not be balanced anymore?

 What can make forces not be balanced anymore?  
[If a force is changed, added or removed.]

 Think.

 Pair.



 Share.

When students share, ask them what their evidence is. Encourage other students to agree and add more evidence or to disagree and explain why.

3. Project the second Think-Pair-Share question.

### Think-Pair-Share Question 2

What can happen to an object when forces exerted on it become unbalanced?

 What can happen to an object when forces exerted on it become unbalanced?  
[It can start moving; it can change how it's moving; it can start to fall.]

 Think.

 Pair.

 Share.

When students share, ask them what their evidence is. Encourage other students to agree and add more evidence or to disagree and explain why.

4. **Post the new key concept.** Read aloud, then post the new key concept: *If forces exerted on an object are balanced, and then a force changes, the forces become unbalanced, which can cause the object to start moving.*



## Teacher Support

### Instructional Suggestion

#### Providing More Experience: Small-Group Discussions

If you have more time and want to give students more opportunity to prepare for the whole-class discussion, first have students discuss in groups of four. Have each pair join with another pair. Have each pair take a turn telling the other pair about the evidence they found.

SAMPLE



3

STUDENT-TO-STUDENT  
DISCUSSION

Word Relationships



# Word Relationships



Students practice using key science vocabulary and construct statements expressing their understanding about balanced and unbalanced forces.

## Instructional Guide

**1. Remind students of the Word Relationships discourse routine.** Remind students that they will once again use Word Relationships Cards to make sentences with a partner, using key science vocabulary they have learned.

 When you think about how these words relate to one another or how they can be used together in a sentence to explain an idea, it helps deepen your understanding of the science concepts we've been studying.

**2. Focus students on balanced and unbalanced forces.** Challenge students to use the terms *balanced forces* and *unbalanced forces*, in several of their sentences. Encourage students to think about their firsthand investigations with the floating paper clip and their reading about the hoverboard as they create sentences.

**3. Distribute Word Relationships Cards.** Distribute one set of 15 cards to each pair of students.

**4. Pairs create sentences orally.** Give pairs approximately five minutes to discuss possible sentences, referring to their word cards as they discuss.

**5. Introduce notebook page.** Get students' attention and have them turn to page 65, Chapter 5: Word Relationships, in their notebooks and read the directions together. Remind students to create at least a few sentences that use the term balanced forces or unbalanced forces.

**6. Students write sentences.** Circulate and provide support if necessary.

**7. Volunteers share sentences with the class.** If time allows, call on a few volunteers to read aloud one of their sentences.



## Teacher Support

### Rationale

#### Discourse Routine: Word Relationships

The Word Relationships routine supports students in thinking deeply about science concepts through interacting with vocabulary they've been learning. This routine allows students to communicate what they know about science words and to receive feedback from you and their peers. In this lesson, students use the Word Relationships routine to deepen their understanding of balanced and unbalanced forces.

## Possible Responses

### Part 1: Floating

**Which forces were acting on the hoverboard while it was floating?**

gravity and magnetic force

**Were the forces balanced or unbalanced? What is your evidence?**

Balanced, because the hoverboard was not moving up or down.

### Part 2: Falling

**Which forces were acting on the hoverboard while it was falling?**

gravity

**Were the forces balanced or unbalanced? What is your evidence?**

Unbalanced. It was not stable. It was moving.

SAMPLE