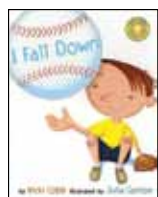


## Gravity and Weight

By Emily Morgan and Karen Ansberry

What goes up must come down...as long as you aren't floating in space, that is! This month's column explores the concept of gravity. In the lesson for grades K–2, students explore gravity through several activities and readings, and learn that the force of gravity is what gives things weight. In the lesson for grades 3–6, students predict how different games and toys would work without gravity and then check their predictions by watching videos of the toys and games in action on the International Space Station (ISS) and the space shuttle.

### This Month's Trade Books



*I Fall Down*  
Written by Vicki Cobb.  
Illustrated by Julie Gorton.  
HarperCollins. 2004.  
ISBN 978-0-688-17842-0.  
Grades K–3

#### Synopsis

From the Vicki Cobb *Science Play* series, this book uses a stop-and-try-it format to explore the basics of gravity.



*Floating in Space*  
Written by Franklyn Branley.  
Illustrated by True Kelley.  
HarperCollins. 1998.  
ISBN 978-0-06-025433-9.  
Grades 4–6

#### Synopsis

This book from the *Let's-Read-and-Find-Out Science* series describes how astronauts deal with weightlessness.

### Curricular Connections

The National Science Education Standards suggest that early elementary students' understanding of force and

motion concepts be developed primarily from manipulating objects and describing their motion. This month's book for grades K–2 poses questions that can be answered by doing activities like dropping objects and observing them fall. After students explore, the book provides an explanation. Some key concepts include: gravity is always pulling things down; as long as you're on Earth, you can't get away from gravity; and gravity gives things weight. In the upper elementary grades, the Standards suggest that students describe the specific forces affecting the motion of an object. To get students thinking about this, the second lesson for grades 3–6 suggests that they try some simple toys and games. Students then predict how the toys and games would work in a weightless environment: the space shuttle or ISS. To check their predictions, the students watch online video segments of the toys being demonstrated in space by astronauts and cosmonauts in the shuttle and ISS. One common misconception about the weightless environment in the space shuttle or ISS is that there is no gravity. Actually, it is Earth's gravity pulling on these spacecraft and everything inside that keeps them in orbit. As they orbit Earth, they are in a state of free fall, which makes everything feel weightless. This concept of the shuttle and space station being in free fall during orbit might be too difficult for some elementary students to understand, so instead of explaining this, we simply refer to the people and objects in the shuttle and ISS as experiencing "weightlessness."

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#### Reference

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

## Grades K–2: Gravity Pulls



### Engage

Tell students that on the count of three, you want them to jump as high as they can. Count “1, 2, 3, jump!” Then ask, “Why do you think you always come down after you jump?” Have students turn and talk with a partner and then share their ideas with the class. Tell students that they will be learning about why they always come back down after they jump up by reading a book and doing some fun activities.

### Explore/Explain

Prior to reading *I Fall Down*, decide which activities you will stop and try during the read aloud and then have those supplies handy. Depending on the age of your students, you may decide to do some of the activities as demonstrations and others as whole-class activities.

Show students the cover of *I Fall Down*. Ask them to signal when they hear the answer to the question “What makes things fall?” Students should signal when you read page 10, which says, “Know what makes things fall? It’s a force called gravity.” Continue reading the book aloud, stopping to try the different activities, and then read the explanations on the following pages.

### Elaborate

Reread pages 10 and 11 of *I Fall Down*, which explains that as long as you are on Earth, gravity is always pulling things down. Tell students that you are going to take them to the playground to see how gravity affects them when they play. When you get to the playground, have students sit together where they can look at the playground equipment. Have a student go down the slide and ask, “What pulled him down the slide?” Have another student throw a ball high up in the air and ask, “What pulled the ball back down to the ground?” Continue to demonstrate gravity with other things on the playground, being sure to use the word “pull” so that students understand that gravity is a pulling force.

### Evaluate

Back in the classroom, ask students to finish the sentence, “Gravity pulls...” and create an illustration to go with it. For example, “Gravity pulls me down the slide.” “Gravity pulls syrup onto my waffle.” “Gravity pulls my paper airplane to the ground.” Display all of the sentences and pictures on a bulletin board titled “Gravity Pulls.”

### Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

#### Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry (K–8)

#### Standard B: Physical Science

- Position and motion of objects (K–4)
- Motions and forces (5–8)

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

## Grades 3–6: Toys in Space

### Engage

As a preassessment of your students' background knowledge of gravity, show them a clip of a hockey game and ask them how Earth's gravity affects the game of hockey. They should realize that gravity pulls the puck to the ice, holds the players down, and basically pulls everyone and everything toward the ground. Then ask, "How do you think the game of hockey would work in space?" Have them turn and talk to a partner. Tell students that astronauts wondered the same thing, so in 2002, they brought a hockey puck and hockey sticks to try out on the ISS. Show them the "International Toys in Space" video online that shows astronauts and cosmonauts in the ISS playing hockey (see Internet Resources). Discuss how the game worked differently in the weightless environment of the ISS than it does on Earth, and how the astronauts and cosmonauts adapted the game to make it work better in weightlessness (e.g., they strapped their feet to the wall, put the puck over the vent).

### Explore

Set up stations around the classroom with various toys from the Toys in Space project, such as a gyroscope, magnetic Whee-Lo, Yo-Yo, jacks, paper airplane, paddleball, Slinky, marbles, and spinning top. Give each student a copy of the Toys in Space student page (see NSTA Connection). They should play with the toy at each station, think about how Earth's gravity affects the way it works, and predict how it worked when astronauts tried it on the ISS or space shuttle. Have students share their predictions.

### Explain

Show the video clips of astronauts using the same toys on the ISS or space shuttle. Students should record how the toy really worked in weightlessness and compare it to their prediction. Next, read *Floating in Space* aloud, which explains more about weightlessness and how astronauts deal with it as they work, eat, and sleep. Have students listen for strategies and tools astronauts use to help them work in a weightless environment (e.g., Velcro, straps, bungee cords, attaching things to the walls).



### Elaborate

Have students choose one of the toys that didn't work well in space and write a paragraph explaining why it works differently in weightlessness. Then, have them write or draw their ideas on how the toy could be modified to perform better in weightlessness. They can incorporate ideas that the astronauts used in the book *Floating in Space*.

### Evaluate

Have students choose one of their favorite toys or games and create a version of it that would work in weightlessness. They can create new rules or strategies, draw pictures of how it would work, and even give it a new name. Have them share their new toys or games with the rest of the class at a "Space Games" convention.

### Internet Resources

Resource Component for Toys in Space

<http://aesp.nasa.okstate.edu/ftp/anderson/toysweb/index.htm>

Toys in Space DVD

<http://corecatalog.nasa.gov/item.cfm?num=009.0-11D>

### NSTA Connection

For a Toys in Space student page, visit [www.nsta.org/SC1201](http://www.nsta.org/SC1201).

