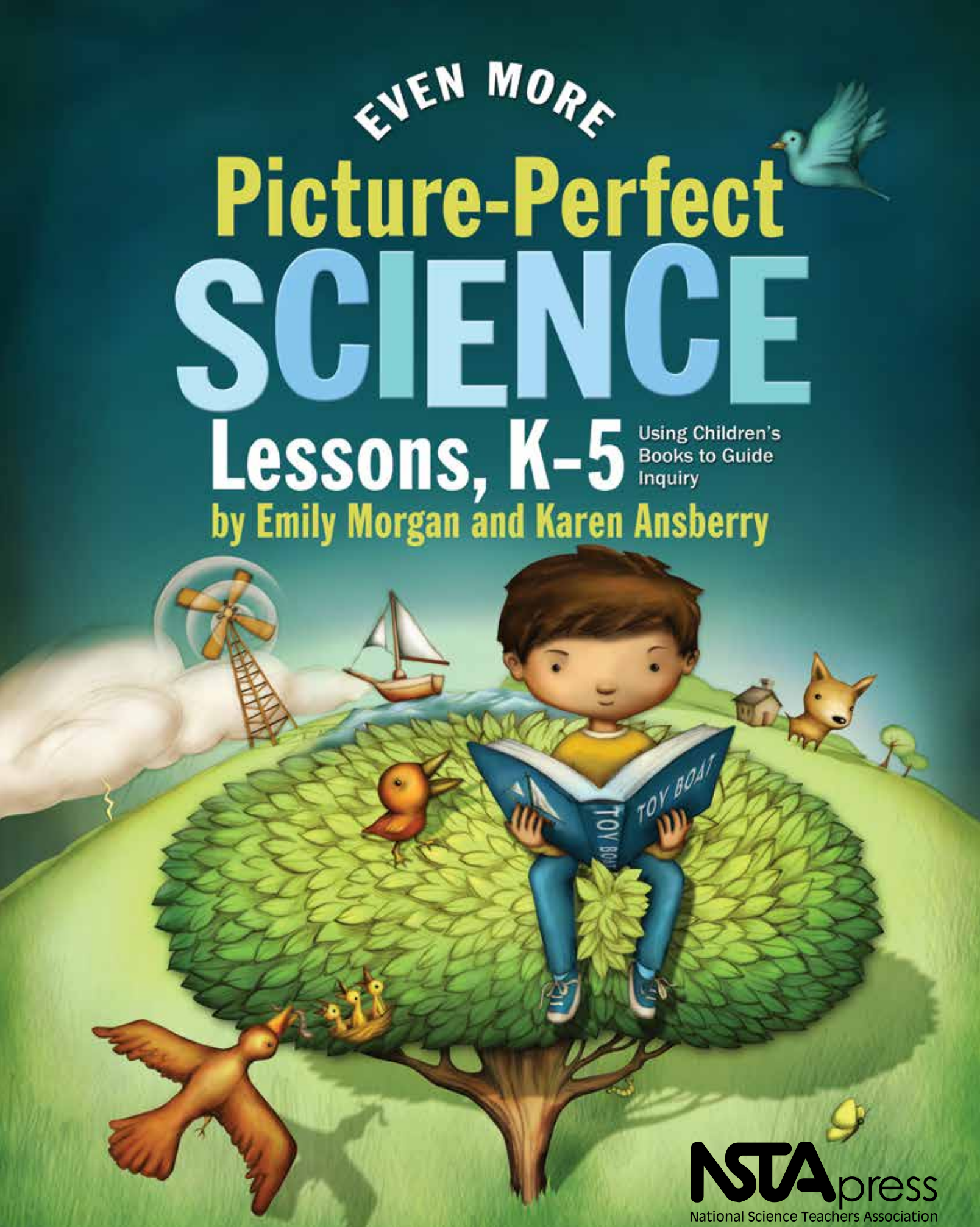
EVEN MORE

Picture-Perfect SCIENCE Lessons, K–5

Using Children's Books to Guide Inquiry

by Emily Morgan and Karen Ansberry



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NSTApress
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Arlington, Virginia

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1840 Wilson Blvd., Arlington, VA 22201
www.nsta.org/store
For customer service inquiries, please call 800-277-5300.

16 15 14 13 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Ansberry, Karen Rohrich, 1966-
Even more picture-perfect science lessons : using children's books to guide inquiry, K-5 / by Karen Ansberry and Emily Morgan.
pages cm
Includes index.
ISBN 978-1-935155-17-1
1. Science--Study and teaching (Elementary) 2. Picture books for children--Educational aspects. I. Morgan, Emily R. (Emily Rachel), 1973- II. Title.
LB1585.A568 2013
372.35044--dc23
2013001262

Cataloging-in-Publication Data are also available from the Library of Congress for the e-book.
e-ISBN: 978-1-938946-89-9

Contents

Preface

A class of fifth-grade students listen as their teacher reads *The Boy Who Harnessed the Wind*. This is the true story of William Kamkwamba, a 14-year-old African boy whose perseverance and ingenuity brought electricity and running water to his drought-ravaged village. With nothing but scraps from a junkyard and the knowledge he acquired from library books, William built a windmill and waited for the wind. Students sit in awe as the teacher reads the dramatic account of what happened next. "Like always, it came, first a breeze, then a gusting gale. The tower swayed and the blades spun round. With sore hands once slowed by hunger and darkness William connected wires to a small bulb, which flickered at first, then surged as bright as the sun. 'Tonga!' he shouted. 'I have made electric wind!'" The teacher asks the class, "How do you think William's windmill was able to light a lightbulb?" In a lesson inspired by this extraordinary story (Chapter 9, "Harnessing the Wind"), students discover the answer to this question by first investigating how a simple handheld generator, the Dynamo Torch, transforms energy of motion into electrical energy. Students then build on this experience by reading an article about energy transformations and listening to a nonfiction read-aloud that explains how wind turbines produce electricity. Eventually, students develop explanations that explain how William's windmill was able to light a bulb. They elaborate on what they have learned by researching various energy resources. Through hands-on inquiries and high-quality readings and picture books, students learn difficult concepts about energy—all within the context of William's remarkable true story.

What Is Picture-Perfect Science?

This scenario describes how a children's picture book can help guide students through an engaging, hands-on inquiry lesson. *Even More Picture-Perfect Science Lessons, K–5* contains 20 science lessons for students in grades K through 5, with embedded reading comprehension strategies to help them learn to read and read to learn while engaged in inquiry-based science. To help you teach according to *A Framework for K–12 Science Education* (NRC 2012), the lessons are written in an easy-to-follow format for teaching inquiry-based science according to the BSCS 5E Instructional Model (Bybee 1997, used with permission from BSCS; see Chapter 4 for more information). This learning cycle model allows students to construct their own understanding of scientific concepts as they cycle through the following phases: engage, explore, explain, elaborate, and evaluate. Although *Even More Picture-Perfect Science Lessons* is primarily a book for teaching science, reading comprehension strategies and the Common Core State Standards for English Language Arts (Common Core ELA; NGA for Best Practices and CCSSO 2010) are embedded in each lesson. These essential strategies can be modeled while keeping the focus of the lessons on science.

Use This Book Within Your Science Curriculum

We wrote *Even More Picture-Perfect Science Lessons* to supplement, not replace, an existing science program. Although each lesson stands alone as a carefully planned learning cycle based on

clearly defined science objectives, the lessons are intended to be integrated into a more complete unit of instruction in which concepts can be more fully developed. The lessons are not designed to be taught sequentially. We want you to use the lessons where appropriate within your school's current science curriculum to support, enrich, and extend it. And we want you to adapt the lessons to fit your school's curriculum, your students' needs, and your own teaching style.

Special Features

Ready-to-Use Lessons With Assessments

Each lesson contains engagement activities, hands-on explorations, student pages, suggestions for student and teacher explanations, opportunities for elaboration, assessment suggestions, and annotated bibliographies of more books to read on the topic. Assessments include poster sessions with rubrics, teacher checkpoint labs, and formal multiple-choice and extended-response questions.

Reading Comprehension Strategies

Reading comprehension strategies based on the book *Strategies That Work* (Harvey and Goudvis 2000) and specific activities to enhance comprehension are embedded throughout the lessons and clearly marked with an icon  . Chapter 2 describes how to model these strategies while reading aloud to students.

Standards-Based Objectives

All lesson objectives are grade-level endpoints from *A Framework for K–12 Science Education* (NRC 2012) and are clearly identified at the beginning of each lesson. Because we wrote *Even More Picture-Perfect Science Lessons* for students in grades K–5, we used two grade ranges of the *Framework:* K–2 and 3–5. Chapter 5, "Connecting to the Standards," outlines the component ideas from the *Framework* and the grade band addressed for each lesson.

The lessons also incorporate the Common Core State Standards for English Language Arts. In a box titled "Connecting to the Common Core" you will find the Common Core ELA strand the activity addresses (e.g., reading, writing, speaking and listening, or language) as well as the grade level and standard number (e.g., K.9 or 5.1). You will see that writing assignments are specifically labeled with an icon  .

Science as Inquiry

As we said, the lessons in *Even More Picture-Perfect Science Lessons* are structured as guided inquiries following the 5E Model. Guiding questions are embedded throughout each lesson and marked with an icon . The questioning process is the cornerstone of good teaching. A teacher who asks thoughtful questions arouses students' curiosity, promotes critical-thinking skills, creates links between ideas, provides challenges, gets immediate feedback on student learning, and helps guide students through the inquiry process. Chapters 3 and 4 explore science as inquiry and the BSCS 5E Instructional Model, and each lesson includes an "Inquiry Place" box that suggests ideas for developing open inquiries.

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Bybee, R. W. 1997. *Achieving scientific literacy: From purposes to practices*. Portsmouth, NH: Heinemann.

Harvey, S., and A. Goudvis. 2000. *Strategies that work: Teaching comprehension to enhance understanding.* York, ME: Stenhouse Publishers.

National Governors Association Center (NGA) for Best Practices, and Council of Chief State School Officers (CCSSO). 2010. *Common core state standards for English language arts and literacy*. Washington, DC: National Governors Association for Best Practices, Council of Chief State School.

National Research Council (NRC). 2012. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Children's Book Cited

Kamkwamba, W., and B. Mealer. 2012. *The boy who harnessed the wind.* New York: Dial Books for Young Readers.

Editors' Note

Even More Picture-Perfect Science Lessons builds on the texts of 31 children's picture books to teach science. Some of these books feature animals that have been anthropomorphized, such as a caterpillar that does magic tricks. While we recognize that many scientists and educators believe that personification, teleology, animism, and anthropomorphism promote misconceptions among young children, others believe that removing these elements would leave children's literature severely underpopulated. Furthermore, backers of these techniques not only see little harm in their use but also argue that they facilitate learning.

Because *Even More Picture-Perfect Science Lessons* specifically and carefully supports scientific inquiry—the "Amazing Caterpillars" lesson, for instance, teaches students how to weed out misconceptions by asking them to point out inaccurate information about caterpillars and butterflies in a storybook—we, like our authors, feel the question remains open.

Acknowledgments

We would like to dedicate this book to the memory of Sue Livingston, who opened our eyes to the power of modeling reading strategies in the content areas and for teaching us that every teacher is a reading teacher.

We appreciate the care and attention to detail given to this project by Jennifer Horak, Agnes Bannigan, Pat Freedman, and Claire Reinburg at NSTA Press.

And these thank-yous as well:

- To Linda Olliver for her "Picture-Perfect" illustrations
- To the staff and students of Mason City Schools, Cincinnati Public Schools, and Lebanon United Methodist Preschool and Kindergarten for field-testing lessons and providing "photo ops"
- To Jackie Anderson, Fliss LaRosa, Jeff Morgan, and Rhonda Vanderbeek for contributing photographs
- To Shannon Homoelle for sharing her expertise with the Common Core State Standards for English Language Arts
- To Don Kaufman and Cecilia Berg for giving us the opportunity to share Picture-Perfect Science as part of the GREEN Teachers Institute at Miami University in Oxford, Ohio
- To Bill Robertson for sharing his content knowledge

The contributions of the following reviewers are also gratefully acknowledged:

- Carol Collins
- Miriam Jean Dreher
- Christine Pappas

Contributors

Ideas and activities for the lessons in this book were contributed by the following talented, dedicated teachers. We thank them for their creativity, willingness to share, and the important work they do each day in their classrooms.

Jackie Anderson is a multiple disabilities teacher at Roselawn Condon School in Cincinnati, Ohio. Jackie contributed to Chapter 11, "Do You Know Which Ones Will Grow?"

Missy Breuer is a fifth-grade teacher at Pattison Elementary School in Milford, Ohio. Missy contributed to Chapter 20, "Problem Solvers."

Tim Breuer is a seventh-grade teacher at Milford Junior High School in Milford, Ohio. Tim contributed to Chapter 18, "What Will the Weather Be?"

Katie Davis is a second-grade teacher at Mason Early Childhood Center in Mason, Ohio. Katie contributed to Chapter 14, "Ducks Don't Get Wet"; Chapter 16, "Fossils Tell of Long Ago"; and Chapter 17, "Reduce, Reuse, Recycle."

Allyson Day is a sixth-grade math and science teacher at Monroe Elementary School in Monroe, Ohio. Allyson contributed to Chapter 7, "Float Your Boat."

Jenny DeBord is a first-grade teacher at Monroe Primary School in Monroe, Ohio. Jenny contributed to Chapter 7, "Float Your Boat."

Jenny Doerflein is certified to teach art K–12. Jenny contributed to Chapter 11, "Do You Know Which Ones Will Grow?"

Karen Eads is a first-grade teacher at Sharpsburg Elementary School in Norwood, Ohio. Karen contributed to Chapter 6, "Freezing and Melting."

Maria Eshman is a first-grade teacher at Sharpsburg Elementary School in Norwood, Ohio. Maria contributed to Chapter 6, "Freezing and Melting."

Kathy Gall is a second-grade teacher at Monroe Primary School in Monroe, Ohio. Kathy contributed to Chapter 7, "Float Your Boat."

Michelle Gallite is a third-grade teacher at Western Row Elementary School in Mason, Ohio. Michelle contributed to Chapter 8, "The Wind Blew," and Chapter 15, "Amazing Caterpillars."

Lisa Haines is a title one reading teacher at Wilmington City Schools in Wilmington, Ohio. Lisa contributed to Chapter 11, "Do You Know Which Ones Will Grow?"

Faye Harp is a teaching and learning consultant at Lakota Local Schools in West Chester, Ohio. Faye contributed to Chapter 12, "Seeds on the Move."

Aubrey McCalla teaches first grade at Williamsburg Elementary School in Williamsburg, Ohio. Aubrey contributed to Chapter 11, "Do You Know Which Ones Will Grow?"

Colleen Phillips-Birdsong taught second grade for 11 years and now is a Reading Recovery teacher and reading specialist at Mercer Elementary School in Cincinnati. Colleen contributed to Chapter 10, "Sounds All Around"; Chapter 13, "Unbeatable Beaks"; and Chapter 19, "Sunsets and Shadows."

Katie Woodward is a second-grade teacher at Monroe Primary School in Monroe, Ohio. Katie contributed to Chapter 7, "Float Your Boat."

About the Authors

Emily Morgan is a former elementary science lab teacher for Mason City Schools in Mason, Ohio, and seventh-grade science teacher at Northridge Local Schools in Dayton, Ohio. She has a bachelor of science in elementary education from Wright State University and a master of science in education from the University of Dayton. She is also the author of the *Next Time You See* picture book series from NSTA Press. Emily lives in West Chester, Ohio, with her husband, son, and an assortment of animals.

Karen Ansberry is an elementary science curriculum leader and former fifth- and sixth-grade science teacher at Mason City Schools in Mason, Ohio. She has a bachelor of science in biology from Xavier University and a master of arts in teaching from Miami University. Karen lives in historic Lebanon, Ohio, with her husband, two sons, two daughters, and too many animals.

Emily and Karen, along with language arts consultant Sue Livingston, received a Toyota Tapestry grant for their Picture-Perfect Science grant proposal in 2002. Since then, they have enjoyed facilitating teacher workshops at elementary schools, universities, and professional conferences across the country. This is Emily and Karen's third book in the *Picture-Perfect Science Lessons* series.

Emily and Karen would like to dedicate this book to the memory of Sue Livingston.

About the Picture-Perfect Science Program

The Picture-Perfect Science program originated from Emily Morgan's and Karen Ansberry's shared interest in using children's literature to make science more engaging. In Emily's 2001 master's thesis study involving 350 of her third-grade science lab students at Western Row Elementary, she found that students who used science trade books instead of the textbook scored significantly higher on district science performance assessments than students who used the textbook only. Convinced of the benefits of using picture books to engage students in science inquiry and to increase science understanding, Karen and Emily began collaborating with Sue Livingston, Mason's elementary language arts curriculum leader, in an effort to integrate literacy strategies into inquiry-based science lessons. They received grants from the Ohio Department of Education (2001) and Toyota Tapestry (2002) to train all third- through sixth-grade science teachers, and in 2003 they also trained seventh- and eighth-grade science teachers with district support. The program has been presented at elementary schools, conferences, and universities nationwide.

For more information on Picture-Perfect Science teacher workshops, go to *www.pictureperfectscience.com.*

Lessons by Grade

Chapter	Grade	Picture Books
6	K–2	*Wemberly's Ice-Cream Star* *Why Did My Ice Pop Melt?*
7	3–5	*Toy Boat* *Captain Kidd's Crew Experiments With Sinking and Floating*
8	3–5	*The Wind Blew* *I Face the Wind*
9	3–5	*The Boy Who Harnessed the Wind* *Wind Energy: Blown Away!*
10	K–2	*What's That Sound?* *Sounds All Around*
11	K–2	*Do You Know Which Ones Will Grow?* *What's Alive?*
12	K–2	*Flip, Float, Fly: Seeds on the Move* *Who Will Plant a Tree?*
13	K–2	*Unbeatable Beaks* *Beaks!*
14	3–5	*Just Ducks!* *Ducks Don't Get Wet*
15	K–2	*Houdini the Amazing Caterpillar* *From Caterpillar to Butterfly* *The Very Hungry Caterpillar*
16	3–5	*Fossil* *Fossils Tell of Long Ago*
17	K–2	*The Three R's: Reuse, Reduce, Recycle* *Michael Recycle*
18	3–5	*Come On, Rain!* *What Will the Weather Be?*
19	3–5	*Twilight Comes Twice* *Next Time You See a Sunset*
20	3–5	*Now & Ben: The Modern Inventions of Benjamin Franklin* *Build It: Invent New Structures and Contraptions*

Chapter 19

Sunsets and Shadows

Description

In this lesson, students make observations of sunrise and sunset and learn that they are caused by Earth's rotation. They also learn about the effect of Earth's rotation on length and direction of shadows as well as the illusion that the Sun and stars appear to move across the sky.

Suggested Grade Levels: 3–5

LESSON OBJECTIVES *Connecting to the Framework*

EARTH AND SPACE SCIENCES

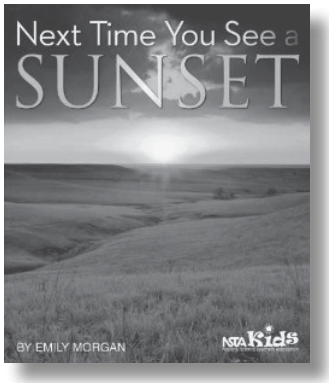
Core Idea ESS1: Earth's Place in the Universe

ESS1.B: Earth and the Solar System

By the end of grade 5: The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the Moon; and different positions of the Sun, Moon, and stars at different times of the day, month, and year.

Featured Picture Books

TITLE: ***Twilight Comes Twice***
AUTHOR: **Ralph Fletcher**
ILLUSTRATOR: **Kate Kiesler**
PUBLISHER: **Clarion Books**
YEAR: **1997**
GENRE: **Story**
SUMMARY: *This book combines poetic language with beautiful paintings to show the happenings at dusk and dawn.*



TITLE: ***Next Time You See a Sunset***
AUTHOR: **Emily Morgan**
PUBLISHER: **NSTA Press**
YEAR: **2013**
GENRE: **Non-Narrative Information**
SUMMARY: *This book from the* Next Time You See *series provides explanations of what is really happening at sunset and encourages a sense of wonder about this daily phenomenon.*

Chapter 19

Time Needed

This lesson will take about a week. Suggested scheduling is as follows:

Day 1: **Engage** with *Twilight Comes Twice* Read-Aloud and Sunrise/Sunset Take-Home Page

Day 2: **Explore** with Changing Shadows Part 1

Day 3: **Explain** with *Next Time You See a Sunset* Read-Aloud and Changing Shadows Part 2

Day 4: **Elaborate** with Modeling Earth's Rotation

Day 5: **Evaluate** with Sunsets and Shadows Assessment

Materials

For* Twilight Comes Twice *Read-Aloud (per student)

- 3"× 5" or 4" × 6" index cards

For Changing Shadows Part 1

- Sidewalk chalk (per pair)
- Clock or watch (for teacher use)

For Modeling Earth's Rotation

Per class

- Lamp that shines in all directions

Per team of three to four students

- Globe
- Small sticky notes
- Small piece of modeling clay

Student Pages

- Sunrise/Sunset Take-Home Page
- Changing Shadows Part 1
- Changing Shadows Part 2
- Sunsets and Shadows Assessment

Background

A Framework for K–12 Science Education suggests that by the end of grade 5 students should understand that because of the position and motion of the Earth, Sun, and Moon we experience regular, predictable patterns including day and night, Moon phases, and seasons. This lesson focuses on the phenomena we observe as a result of the rotation of the Earth: day and night, changing position of the Sun in the sky, and changes in length and direction of shadows. It is important for students to understand that even though the Sun appears to move across the sky in a daily cycle and the stars appear to move across the sky at night, it is Earth's rotation that causes this illusion. The Sun seems to "rise" in the sky as your place on Earth turns toward the Sun, reaches its maximum height at midday, and "sets" as your place on Earth then turns away from the Sun. While it is day in the Western Hemisphere, it is night

in the Eastern Hemisphere and vice versa. The Sun is always shining. Students are introduced to this concept by focusing on the time between day and night, twilight. They watch a sunrise or sunset for homework and then use globes and lamps to find the line between day and night, where people who live in that location on Earth would be experiencing twilight. Another way to sense Earth's rotation is to observe the change in the length and direction of shadows throughout the day.

engage

Twilight Comes Twice Read-Aloud

Connecting to the Common Core
Reading: Informational Text
Key Ideas and Details: 3.1, 4.1, 5.1

Questioning

Show students the cover of *Twilight Comes Twice* and introduce the author and illustrator. Read the title and *ask*

- ? What is twilight?
- ? What do you think the title of the book means? Tell students that as you read the book aloud, you would like them to listen for what the word *twilight* means and how it comes twice. Then read the book aloud to students.

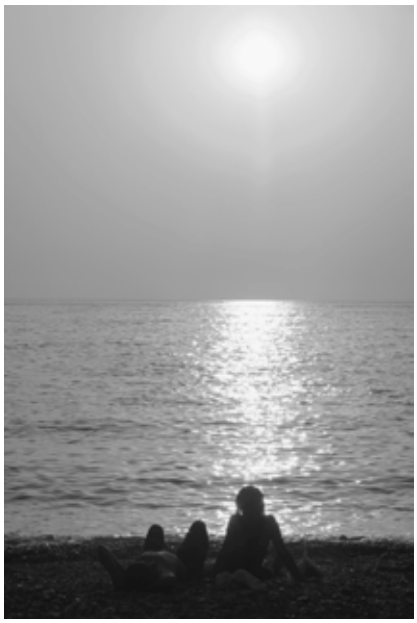
After reading, *ask*

- ? What is twilight? (the time between day and night)
- ? Does it really come twice? (Yes, it happens in the morning and the evening.)
- ? What is morning twilight called? (dawn)
- ? What is evening twilight called? (dusk)
- ? Does everyone experience dusk and dawn at the same time? (Answers will vary.)

Then *ask*

- ? What causes dawn and dusk to occur twice each day? What is actually happening at those times? (Answers will vary.)

Give each student an index card and have them explain what causes dawn and dusk, using both words and pictures. Collect the cards and use them as a preassessment.



Watching a sunset

Making Connections: Text-to-Self

Ask

- ? Have you ever watched a sunrise or sunset?
- ? Where were you?
- ? What did it look like?

SAFETY

- Bring some form of communication, such as a cell phone or two-way radio, when taking students outdoors, in case of emergency.
- Warn students to never look at the Sun directly or through reflected light from it. Direct sunlight can seriously injure eye tissue.

Give students the Sunrise/Sunset Take-Home Page. Tell them that their homework is to go outside with an adult helper sometime in the next few days and observe a sunrise or sunset. (You may want to provide a resource for sunrise/sunset times, such as the printable calendars available at *www.sunrisesunset.com*). Students will need to either take a photograph or draw a picture of it and then write down some of their observations and questions. The student page includes a brief note to parents, a list of items to bring, tips for observing a sunrise or sunset, and a chart for observations and wonderings chart.

After students have completed their Sunrise/Sunset Take-Home Page, have them share their pictures and some of their observations and wonderings in small groups. Invite students to share their most compelling wonderings with the rest of the class. Then display the pictures in the classroom or hallway.

explore

Changing Shadows: Part 1

This phase of the lesson is about shadows and includes observations that take place over the course of a day. Be sure to do the following activities on a clear, sunny day. If possible, take a photograph of one of the student's shadows in the morning, midday, and afternoon as an example to refer to the next day.

Morning: Tell students that they are going to learn some things about the relationship between Earth and the Sun by making some observations of their shadows. First thing in the morning, give each pair of students a piece of sidewalk chalk and take them outdoors to a place where they can trace their shadows, such as the playground or sidewalk. Be sure to choose a place that will remain untouched throughout the day so the tracings will not be erased. Have students spread out so their shadows do not overlap. As one partner stands very still, have the other partner trace his or her shadow. After tracing, have them write the name of the person on the feet of the shadow and the time (including "a.m." or "p.m.") in the head of the shadow. Next have the partners switch and repeat the same procedure. Cautioning students to not look directly at the Sun, have them point in the direction of the Sun in the sky and notice that their shadows are in the opposite direction of the Sun.

Midday: As close to noon as possible, go outside to the same place where they traced their shadows in the morning and have students repeat the procedure with their feet in the same exact spot they were in the morning. Have students compare the size and direction of the morning shadows with the midday shadows. Students should notice that the midday shadows are shorter than the morning shadows and that the two shadows are in different directions. Have students point in the direction of the Sun in the sky and notice that their shadows are, once again, opposite the direction of the Sun.

Afternoon: As late as possible in the afternoon, take your students back to the place where they traced their shadows and have them repeat the procedure again. Have students compare the size and direction of the three shadows and notice the position of the Sun in the sky. Give each student a copy of the Changing Shadows Part 1 student page and have them answer the four questions on the page while they are outdoors observing their traced shadows.

1. When was your shadow the longest? (Students should record the morning or afternoon time when their shadows were traced, depending on which one was longest.)
2. When was it the shortest? (Students should record the midday time when their shadows were traced.)
3. How did the direction of your shadow change throughout the day? (Students should recognize that the shadows were in different directions. At this point, they don't necessarily need to use the words *east* or *west.* The important thing is that they notice that the shadows in the morning and afternoon were in different

Tracing shadows

directions and the midday shadow was somewhere in between.)

4. How did the position of the Sun in the sky change throughout the day? (Students should note that the Sun appeared lower in the sky in the afternoon and morning and higher in the sky at midday. Although they may not use the words *east* and *west* yet, they should describe what part of the sky the Sun was in at different times using landmarks such as the school, road, playground, and so forth.)
5. Why do you think your shadow changed throughout the day? (Answers will vary but should include the idea that as the position of the Sun in the sky changed, the direction and size of their shadows changed.)

With partners or in small groups, have students discuss their ideas about why their shadows changed throughout the day. Tell students that the next day you will be sharing a book with them that will help them understand more about this phenomenon.

explain

Next Time You See a Sunset Read-Aloud

Connecting to the Common Core
Reading: Informational Text
Key Ideas and Details: 3.1, 4.1, 5.1

Show students the cover of *Next Time You See a Sunset.* Introduce the author, Emily Morgan, and tell students that she has always been fascinated by the time between day and night. Tell them that this is a nonfiction book that can help them learn more about the reasons for dawn and dusk as well as the answers to some of the questions they have about sunrises, sunsets, and changing shadows. Read the book aloud, stopping after reading page 17.

Questioning

After reading page 17, *ask*

? What is really happening during a sunset? (Your place on Earth is turning away from our star, the Sun.)

? What is really happening during a sunrise? (Your place on Earth is turning toward our star, the Sun.)

Read pages 18 and 19, which explains the changing position of the Sun in the sky throughout the day. *Ask*

? How does this explanation relate to the position of the Sun in the sky yesterday when we traced our shadows? (Students should connect this explanation to their observation of the changing position of the Sun in the sky and should now be able to figure out which direction is east and which is west based on their experience with the Sun and shadows.)

Continue reading and stop after you read page 23, which explains the changes in the size and direction of shadows throughout the day. *Ask*

? When were your shadows the shortest? (in the middle of the day, around noon)

? Where was the Sun at that time? (right above us)

? When were your shadows the longest? (in the morning and afternoon)

? Where was the Sun at those times? (in the eastern sky in the morning and in the western sky in the afternoon)

? What causes this change in position of the Sun in the sky? Is the Sun really moving across the sky? (No, it just appears that way because Earth is rotating.)

? Do you think your shadows would look similar if you did this again tomorrow? (Yes, because Earth is always turning in the same direction.)

Next *ask*

? We know the sun always rises in the eastern sky and sets in the western sky, but in which direction do the moon and stars rise and set?

Allow student time to think about this and share their ideas with partners. Then read page 25, which explains that the stars "appear" to move across the sky from east to west. Explain that from Earth everything in the sky (Moon, stars, planets) "rises" in the east and "sets" in the west because Earth is always turning in the same direction.

Changing Shadows: Part 2

Finish reading the book aloud. Then give students the Changing Shadows Part 2 student page. Have them answer the questions using their own experience and what they learned from the book. Students should be able to explain that the two people are not running at the same time of day because their shadows are very different sizes. They should infer that Person A is running in the morning or afternoon because his shadow is very long. The sun appears lower in the sky at those times of day, creating longer shadows. They should infer that Person B is running more toward the middle of the day, when shadows are shorter. The Sun appears higher in the sky at those times of day, which makes shadows shorter. All of this occurs because of Earth's rotation.

NOTE: It is important to know that size and direction of shadows also change seasonally. But because the objective of this lesson is for students to learn the effects and patterns caused by Earth's rotation, it is not necessary to introduce the seasonal changes in shadows due to Earth's tilt and revolution at this time.

elaborate

Modeling Earth's Rotation

SAFETY

- When working with electrical devices, lightbulbs, etc., keep away from water or other liquids to prevent electric shock.
- Use caution when working in a darkened area. Make sure all trip/fall hazards are removed.
- Be careful working with lamp bulbs. Skin can be burned from the high temperatures and heat.

These modeling activities work best if your classroom is as dark as possible, with the lamp the only light source in the room. Close blinds, pull down the window shades, and cover windows with black paper to make the room as dark as you can.

Provide each team of three to four students with a globe. Place a lamp that shines in all directions in the center of the room and have students form a circle around it with their globes. Tell them that the globes represent the Earth and the lamp represents the Sun. *Ask*

? Does the Sun ever stop shining? (no)

Tell them that because the Sun never stops shining, you will keep the lamp lit in the center of the room. Next ask students to locate the areas of land and water on the globe and then pinpoint their location using a small sticky note. *Ask*

? Can you model daytime in your location? (They should make their location on Earth face the lamp.)

? What are some places that are experiencing night as we are experiencing day? (places directly opposite)

? Can you find the arrow on the globe that points in the direction that Earth turns? Slowly spin the globe in that direction. (Students should be spinning the globe counterclockwise.)

Explain that because the Earth is always turning in the same direction, we always see the Sun in the eastern sky in the morning (as our location turns toward the Sun) and in the western sky in the evening (as our location turns away from the Sun).

Have students use small sticky notes to label the parts of the Earth experiencing day (facing the lamp), night (turned away from the lamp), sunrise (the line between light and darkness on one side that would be turning toward the lamp), and sunset (the line between dark and light that would be turning away from the lamp). Check to see that students' globes are properly labeled.

? Provide each team of students with a small piece of clay to place on their globe representing a person standing on Earth. Have them

Modeling Earth's rotation

practice using the globe, lamp, and clay to model the answers to the following questions:

- ? Why does a person's shadow look different throughout the day? (Light from the Sun is coming at the person in different directions throughout the day because the Earth is rotating.)
- ? When is it the longest, shortest? (Shadows are longest in the morning and afternoon and shortest in the middle of the day.)
- ? Can you model sunrise for a clay person standing on Earth? (Check students' models to make sure the clay person is just entering the lamplight as the globe is rotating counterclockwise.)
- ? Can you model sunset for the clay person standing on Earth? (Check students' models to make sure the clay person is just leaving the lamplight as the globe is rotating counterclockwise.)

evaluate

Sunsets and Shadows Assessment

Writing

Connecting to the Common Core
Writing
Text Types and Purposes: 3.2, 4.2, 5.2

Give each student a copy of the Sunset and Shadows Assessment, which includes two questions about sunrise/sunset and shadows:

- ? Why is it not scientifically accurate to say the Sun is "going down" at sunset? (Students should explain that the Sun is not moving up and down in the sky. When sunset happens, that place on Earth is turning away from the Sun into the darkness of space, which makes the sun *appear* to go down.)
- ? If you go outside on a sunny day, you will see your shadow. Sometimes your shadow is longer than you are, and other times it is shorter than you are. How can this difference in the length of your shadow be explained? Use a labeled drawing to help explain your answer. (Students should explain that the length of their shadow changes throughout the day as the position of the Sun in the sky changes and that the change in the position of the Sun in the sky is due to Earth's rotation. Their drawings should support this explanation.)

Websites

Day and Night World Map
www.timeanddate.com/worldclock/sunearth.html

Sunrise and Sunset Times for Your Location
www.sunrisesunset.com

U.S. Naval Observatory: Day and Night Across the Earth
http://aa.usno.navy.mil/data/docs/earthview.php

More Books to Read

Bailey, J. 2006. *Sun up, Sun down: The story of day and night*. Minneapolis, MN: Picture Window Books.
Summary: This book follows the path of the Sun from dawn to dusk. Cartoonish illustrations and entertaining text make the concept of day and night fun for the reader.

Branley, F. 1986 *What makes day and night*. New York: Harper & Row.
Summary: This *Let's-Read-and-Find-Out Science* book explains what causes day and night and includes instructions for demonstrating this phenomenon.

Schuett, S. 1997. *Somewhere in the world right now.* New York: Dragonfly Books.
Summary: This book takes children around the world to show what's going on at the exact same moment in other areas of the world. A time zone map on the endpapers, which includes the times and names of places shown in the pictures, allows readers to follow the action around the globe.

Inquiry Place

Have students brainstorm questions about day and night. Examples of such questions include

? How does a sundial work? Research it, then try it!

? Does sunrise/sunset always happen at the same time every day? Investigate it, or research it!

? What is daylight savings time, and why do some places on Earth use it? Research it!

Then have students select a question to research or investigate as a class, or have groups of students vote on the question they want to research or investigate as a team. Students can present their findings in a poster session or a gallery walk.

Sunrise/Sunset Take-Home Page

Dear Parent,

At school, we are studying Earth's patterns and cycles. Your child's homework assignment is to go outside with an adult helper and observe a sunset or a sunrise. As you look at the sky with your child, help him or her record "Observations" and "Wonderings" (questions) on the attached chart. Also, have your child either take a photograph or draw a picture of the sunrise or sunset. Below is a list of items to bring outside with you and some tips on making the most of this experience. The purpose of this assignment is to give your child the opportunity to observe this daily phenomenon firsthand and wonder about it. In class, we will be building on this experience by reading about it and modeling the Earth and Sun relationship.

This assignment is due by_____ .

Items to bring:

- Sunrise/Sunset Take-Home Page
- Flashlight
- Clipboard or notebook
- Camera or art supplies
- Pen or pencil

Sunrise/sunset viewing tips:

1. Do not look directly at the Sun. Sunlight can cause eye damage.

2. Find a place, without a lot of trees or buildings, where there is a clear view of the eastern sky (sunrise) or western sky (sunset). Be sure to bring a flashlight with you so you can find your way before sunrise or after sunset.

3. Watch the colors of the sky change. Discuss what colors you see, how the temperature of the air feels, and how your shadows look. Share your ideas and wonderings about what is happening.

Observe a sunrise or sunset with an adult helper. Record your observations, wonderings, and a photo or drawing below.

Date _____ Time_____

Photo or Drawing

Observations	Wonderings

Name: _____

Part 1

Changing Shadows

SAFETY NOTE: Do not look directly at the Sun for an extended period of time. Sunlight can cause eye damage.

1. When was your shadow the longest? _____

2. When was it the shortest? _____

3. How did the direction of your shadow change throughout the day?

_____

_____

4. How did the position of the Sun in the sky change throughout the day? _____

_____

_____

5. Why do you think your shadow changed throughout the day?

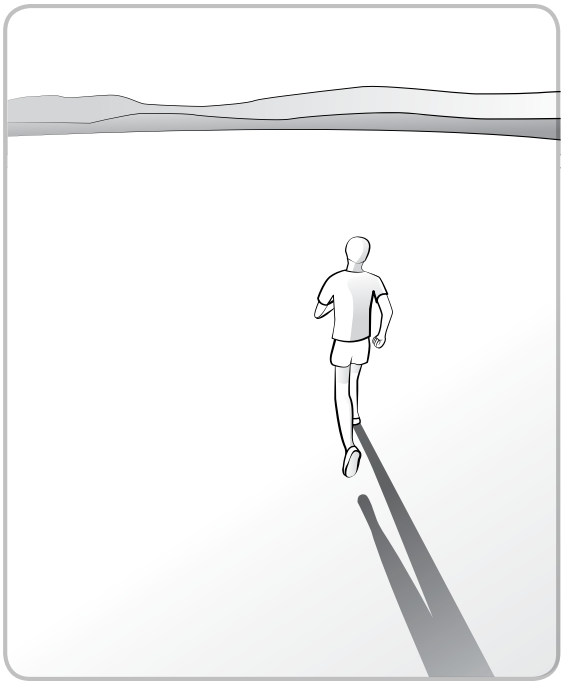
_____

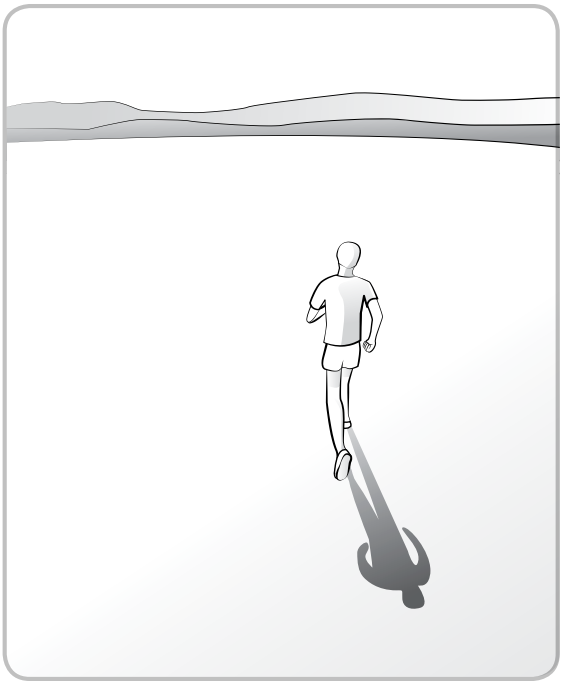
_____

_____

Part 2

Changing Shadows





Compare the two pictures.

Do you think these two people are running at the same time of day?

How do you know? Explain your thinking.

Name: _____

Sunsets and Shadows Assessment

1. Why is it not scientifically accurate to say the Sun is "going down" at sunset?

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2. If you go outside on a sunny day, you will see your shadow. Sometimes your shadow is longer than you are, and other times it is shorter than you are. How can this difference in the length of your shadow be explained? Use a labeled drawing to help explain your answer.

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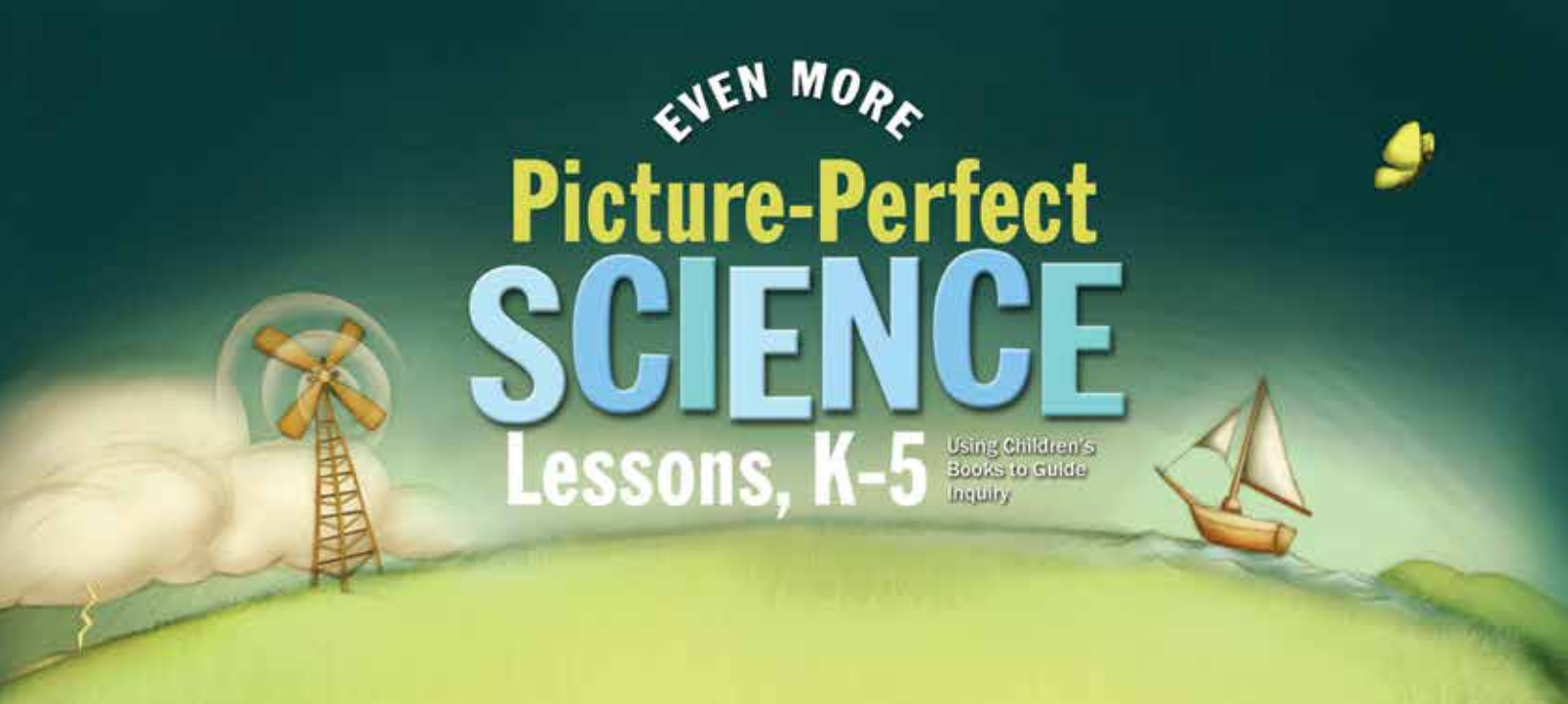
Index

Page numbers printed in **boldface** type indicate tables or illustrations.



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ISBN: 978-1-935155-17-1