

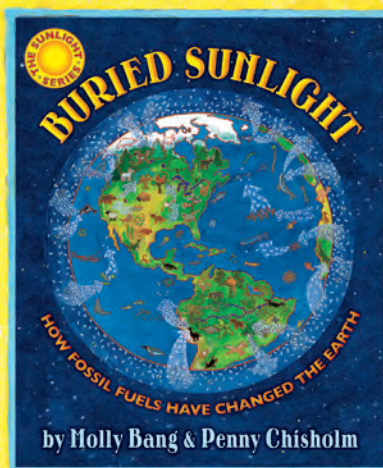
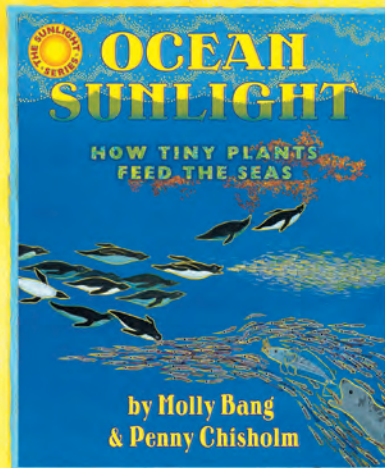
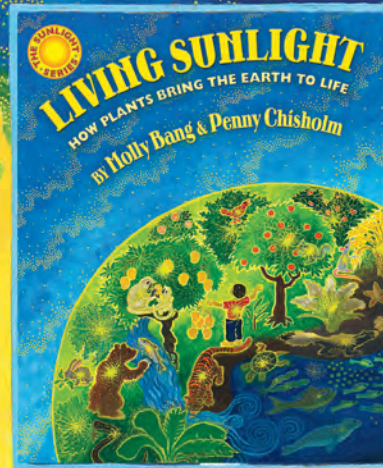
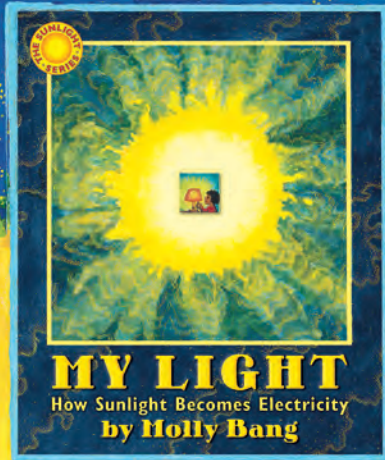
Grades  
K-5

# CLASSROOM GUIDE

# The Sunlight Series

By Molly Bang and Penny Chisholm

Illustrated by Molly Bang



 SCHOLASTIC

open a world of possible

Meets Common Core and Other Standards—SEE INSIDE

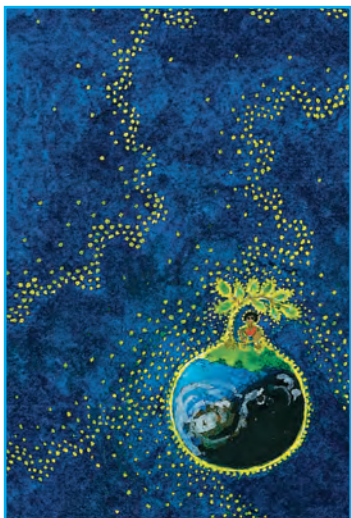
# About the Series

We wrote this series to teach students some of the most basic concepts about how life on Earth works. The first in the series, *My Light*, introduces the sun as the narrator and shows how humans change sunlight into the electricity we use every day. The rest of the series is focused on the sun's role in the biosphere as the engine of life on Earth. These books describe photosynthesis on land (*Living Sunlight*) and in the sea (*Ocean Sunlight*), and how all life depends on this process. In *Buried Sunlight*, we describe the role of photosynthesis in creating fossil fuels, and how our use of this "fossil sunlight" is changing our planet.

These picture books are intended to elucidate the science for adults as well as for children. One of the inspirations for these books was a study that showed that even advanced students—including recent Harvard and MIT graduates—don't understand that photosynthesis produces living matter from carbon dioxide in the air, and is the foundation of the entire biosphere. Because this fundamental concept is so important, we chose the sun as the narrator of the books and photosynthesis as the thread that unites them. We hope our presentation will not only make the science clear, but will leave the reader with a sense of awe and wonder at how the Earth functions—and will help make the information "stick" with readers.

Because of our emphasis on the integration of words and pictures, we urge teachers to concentrate on helping students "read" the pictures as they go from page to page. If children understand what the pictures are saying, they'll be able to describe the scientific concepts in words.

## Visual elements that are consistent throughout the series:



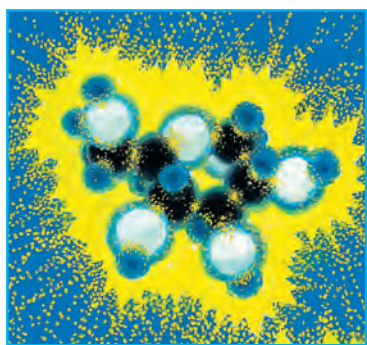
*Living Sunlight*, pg. 1

### Yellow dots

The yellow dots represent energy and the movement of energy. Since energy is often described as both waves and particles, or photons, we represent energy as waves of yellow dots. In all the books, one of the ways to understand the concepts is to "follow the yellow dots." Ask your students questions such as:

- Where are the dots in this picture?
- What do you think this shows?
- What kind of energy did the sunlight-energy get changed into?

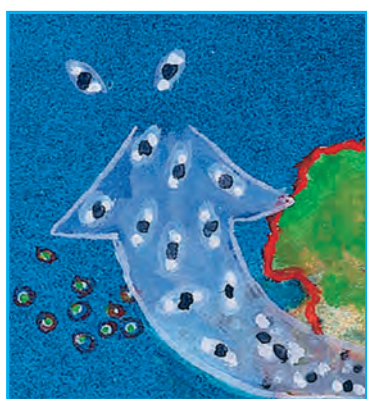
Ask students to draw a diagram for themselves that shows how sunlight-energy affects Earth's land, sea, and air and gives life to plants and animals.



*Living Sunlight*, pg. 18

### Molecules

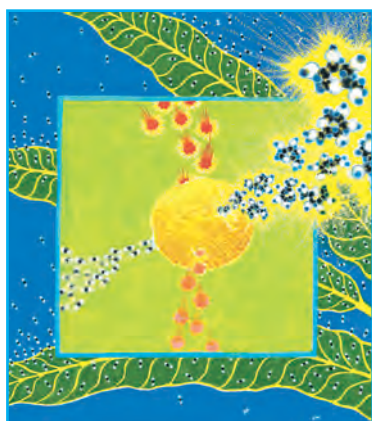
Throughout the series, molecules are visually depicted as combinations of fuzzy dots of consistent colors that represent specific atoms: **Hydrogen** is the smallest atom and is blue; **carbon** is the next in size and is black; and **oxygen** is the largest and is white. These are the most important atoms for life, and are easily identifiable in the illustrations. Even the youngest children can identify these three and can see how they combine into different molecular configurations. Have them see how water is made of two hydrogen atoms and one oxygen atom (and therefore is called  $H_2O$ ), how carbon dioxide (or  $CO_2$ ) is one carbon atom and two oxygen atoms, and how sugar is made from a combination of all three—with a six-carbon “backbone.”



*Buried Sunlight*, pg. 16–17

### Arrows

Life processes are all about flow—the flow of energy and matter through living organisms and all around the planet. In *Ocean Sunlight* and *Buried Sunlight*, we use arrows, composed of the molecules that are flowing, to indicate the directions of these flows. We also illustrate flows by picturing animals outlined in yellow as they eat, and are eaten, and pass on their energy. Be sure the students notice these arrows and flows and can explain what they mean.



*Living Sunlight*, pg. 17

### Inserts

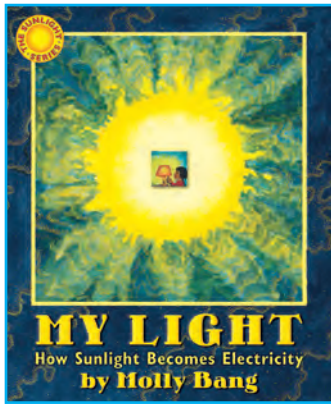
Sometimes a concept is too complicated to show in a single picture or involves a process or description of several steps. In these cases, we use inserts to clarify either a process or a series of steps. Be sure to ask children to explain these inserts as you read the book with them. The pictures enable students to “see” how the process works.

### Notes about the Books

At the end of each book, we have included a few pages of notes that give more detailed explanations. Make sure to read these endnotes before you go over the books with your students. The information in those pages will answer some of the questions the children might ask. Some readers should be able to read the notes themselves.

**Happy reading, teaching, and learning—  
Molly Bang and Penny Chisholm**

The questions and classroom prompts listed above can help meet Common Core Anchor Standards *R.1,3,5,7,10; W.2; SL.1,2*



## Discussion Questions and Activities for *My Light*

This book describes how humans capture energy from sunlight and change it into electricity. On the most basic level, it shows how the energy from sunlight is changed into other forms of energy—wind, moving water, etc.—and how we use that energy to make electricity.

### Discussion Questions

Even very young children can understand the basic message of the book: (Almost all of) our electricity comes from sunlight! But *My Light* introduces older children to more complex concepts. Be sure your students can answer the following questions:

1. Who is the narrator of this story?
2. What do the end pages show?
3. Describe what is illustrated on the title page and the first page of the story.
4. How does the energy from sunlight create wind? How does it create moving water?
5. How is the energy from sunlight stored in wood and coal?
6. How does electricity move from the generators to our cities and homes?
7. There is one picture that shows electricity produced by nature and NOT by humans. Find that picture. What do we call that form of electricity?
8. What are solar cells? How is the way they generate electricity different from all the other ways of generating electricity?

The questions above can help meet Common Core Anchor Standards *R.1,2,3,4,6,7,10; SL.1,2*

### Activities

#### Blowing in the Wind

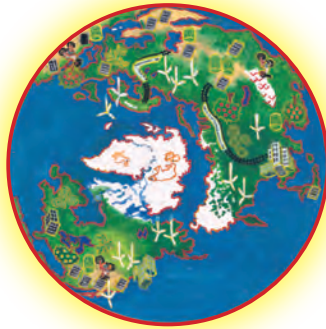
There are many activities that help children understand how wind, water, and heat hold energy that can then turn a turbine. Try one of these examples with your students. Make sure to ask them what they think will happen beforehand and, afterward, have them describe why and how these experiments worked.

- Make pinwheels and either blow on them—requiring energy from breath!—or hold the pinwheels in the wind and watch them spin.
- Pour water onto one side of a rodent wheel to show that falling water holds energy that turns a turbine.
- Show the energy of heat by making a “candle carousel.”

There are many websites that you can use to help design these experiments in more detail, such as [http://www.nrel.gov/education/educational\\_resources.html](http://www.nrel.gov/education/educational_resources.html).

These activities can help meet Common Core Anchor Standards *W.7,8; SL.1,4*

# My Light Crossword Puzzle



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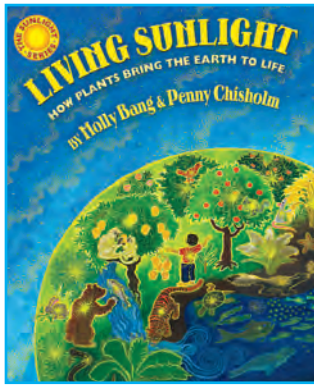


## ACROSS

1. What is the original source of (almost) all our electricity?
2. What do plants become after they are compressed in the Earth over millions of years?
3. We can harness energy from this source when it turns a turbine high on a pole.
4. This substance creates energy by falling—and then turning a turbine that rotates a magnet inside of copper wires to create electricity.

## DOWN

4. What is one of the most common materials that's burned to make heat—which then turns a turbine that rotates a magnet inside of copper wires to create electricity?



## Discussion Questions and Activities for *Living Sunlight*

This book explores how our sun gives us life through photosynthesis. It describes how that process connects all of life, how all life shares the same atoms, and how these atoms cycle on our planet.

### Discussion Questions

#### For all students:

1. What is photosynthesis?
2. Where do plants get their energy to live and grow?
3. Where do all animals (including humans!) get their energy to live and grow?
4. Using their sunlight-energy, what food do plants make to feed themselves?
5. What do plants breathe in and out? What do animals breathe in and out?

#### For older students:

6. What do plants do with the water they suck in through their roots?
7. Where does ALL the oxygen in our air come from?
8. Plants use sunlight-energy to make sugar. What three elements make up sugar? What holds the elements together in the sugar molecule? Where does the energy come from that holds it together?
9. What do animals do to sugar so it gives them energy?

#### For advanced students:

10. Define and explain the process that takes place during respiration. Do the same for photosynthesis. How are the two processes related?

The questions above can help meet Common Core Anchor Standards *R.1,2,3,4,7,10; SL.1,2*

### Activities

The first two activities below demonstrate how the concepts from *Living Sunlight* work in real life. Be sure the students understand the question their experiment is trying to answer. The third activity is a writing exercise directly related to the book itself.

#### Water, Water (Almost) Everywhere!

Main Question: What do plants need in order to live?

Have students put a pea, bean, or radish seed in each of six paper cups filled with wet soil. Place all six on a sunny windowsill. Wait until all six seeds have sprouted. Keep two containers on the windowsill and continue to moisten the soil. Keep another two on the windowsill but stop watering. Then put the last two containers into a dark closet but keep them watered. Have the children check on the changes they see over the next two weeks and explain why things happened the way they did.

This activity can help meet Common Core Anchor Standards *W.7,8; SL.1*

## Make Your Own Bubbles!

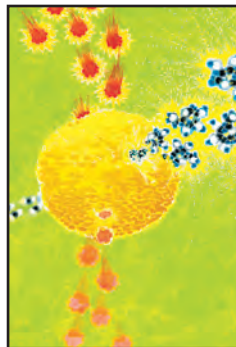
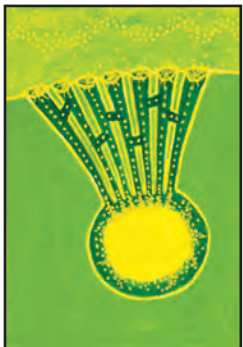
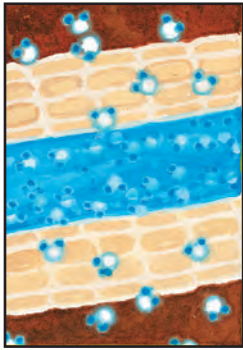
Main Question: What do plants breathe OUT?

Put some Elodea (usually available in pet stores) in a tank or large jar of water. Place it in the sunlight. After a day or two, bubbles should be covering the leaves of the plant. Ask students what they think the bubbles are made of and have them observe what happens to the bubbles. Put the tank or jar in a dark closet for a few days. Then ask students to identify what happened and why. A classic experiment for demonstrating photosynthesis for older students is "the floating disk experiment." There are many versions of this that can be viewed by searching "photosynthesis + floating disk" online.

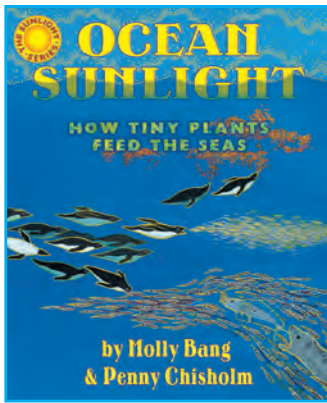
*This activity can help meet Common Core Anchor Standards W.7,8; SL.1*

## The Write Stuff: Photosynthesis (Grades 3–5)

These five pictures show the process of how plants catch sunlight-energy and incorporate it into their bodies. Next to each step of the process, describe what is happening.



*This activity can help meet Common Core Anchor Standards R.1,2,3,7; W.2,7*



## Discussion Questions and Activities for *Ocean Sunlight*

This book is about how photosynthesis feeds life in the oceans. This process is carried out by microscopic plants called phytoplankton that are the base of ocean food webs. This book also shows how all life in the oceans—both in the sunlit surface waters and the deep, dark sea—is connected through the phytoplankton, ocean currents, and the nutrients they carry.

### Discussion Questions

#### For all students:

1. What are phytoplankton and why are they so important to life in the oceans?
2. How are phytoplankton similar to plants on land?
3. Do phytoplankton live both at the surface and the bottom of the ocean? Why or why not?
4. How do phytoplankton reproduce? How long does it take for them to double in number?
5. How much of the oxygen in our air comes from phytoplankton? How much from the plants on land?

#### For older students:

6. What do animals who live in the deep ocean eat? Where does the energy in that food come from?
7. Phytoplankton need a supply of nutrients (“fertilizer”) to grow. How does that supply of nutrients get recycled into the sunlit surface waters?
8. Does sunlight-energy get recycled? Why or why not?
9. When you eat fish, where does the carbon and energy in your food originate?

The questions above can help meet Common Core Anchor Standards *R.1,2,3,4,7,10*; *SL.1,2*

### Activities

#### Grow Your Own Phytoplankton

Collect some pond (or puddle) water and put it in eight one-cup containers. Put four in the dark and four on a windowsill. Add 1–2 drops of Miracle–Gro plant fertilizer to two of each set of four. Wait a week and observe what happens. Those with Miracle–Gro, and in the light, should turn green with phytoplankton. Ask the students to explain how sunlight and nutrients affected the phytoplankton.

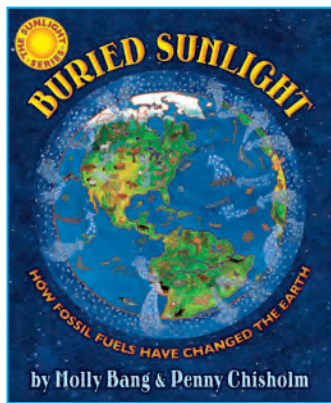
This activity can help meet Common Core Anchor Standards *W.1,7*; *SL.1*

#### Phytoplankton Population Boom

Put students in pairs and give each pair a bag of dried peas. Remind them that phytoplankton reproduce by splitting in two over the course of about a day. Start with one pea and let it divide to make two over a virtual day by taking another pea from the bag and placing it next to the first one. Then let those two “divide” to make four over the next virtual day by laying out two more peas. Continue doing this for another few virtual days. Ask students how many phytoplankton they would have after five virtual days. To illustrate how this feeds the food chain, have one of the students be a zooplankton and start “eating” (removing) only the “new phytoplankton” as fast as they appear. This will demonstrate how the numbers of “phytoplankton” remain stable while still feeding up the food chain.

This activity can help meet Common Core Anchor Standards *W.7*; *SL.1*





## Discussion Questions and Activities for *Buried Sunlight*

*Buried Sunlight* describes the story of fossil fuels. The book explains how coal, oil, and gas are really “buried sunlight,” energy captured in the chemical bonds of plants that were trapped and compressed beneath Earth’s surface millions of years ago. The book ends by describing how burning these fossil fuels is changing our atmosphere.

### Discussion Questions

#### For all students:

1. How did tiny green plants that lived in the sea billions of years ago change Earth forever?
2. How are oil and coal made? What is the origin of the energy stored in these substances?
3. How long did it take for fossil fuels to form? How long have we been burning them? Does this matter, and if so, why does it matter?

#### For older students:

4. There has been a tiny imbalance in the cycle of life over the history of Earth. How has this made a big difference in our atmosphere, and how has that changed the whole planet?
5. How is burning fossil fuels similar to the respiration of animals? How is it different?
6. How is the planet likely to change if we continue to burn fossil fuels, and what measures might we take to slow these changes?
7. How is the buildup of carbon dioxide in our atmosphere different from the “pre-human” changes?

The questions above can help meet Common Core Anchor Standards *R.1,2,3,4,7,8,10; SL.1,2*

### Activities

#### The Greenhouse Effect

Adding CO<sub>2</sub> to air raises its temperature in the presence of light energy. A number of lesson plans demonstrating the greenhouse effect can be found on the Internet. One of these lessons (found here: [http://www.srh.noaa.gov/jetstream/atmos/ll\\_gas.htm](http://www.srh.noaa.gov/jetstream/atmos/ll_gas.htm)) is adapted below.

Before performing the experiment, discuss with your students what they think might happen. Afterwards, discuss what did happen and why, based on what they learned from the book and other research.

#### Procedure:

1. Fill two clear one-liter bottles halfway with water. Put a stopper with a thermometer through the middle in one so the recording end is suspended in the air of the bottle. Record the temperature.
2. Drop 2–3 Alka-Seltzer tablets into the other bottle. The bubbles produced are made of carbon dioxide (CO<sub>2</sub>), which break as they rise into the air, filling the air with CO<sub>2</sub>. Put the stopper and thermometer into the hole and measure the temperature of the air.
3. Turn on a lamp and direct it toward the bottles, making sure both are the same distance from it.
4. At the end of an hour, check the temperatures in both bottles. The temperature in the bottle with the added CO<sub>2</sub> should be considerably higher than the one without.

A video demonstration can be found here: <https://www.youtube.com/watch?v=kwtt51gvaJQ>

A more complex demonstration can be found here: <http://cleanet.org/clean/community/activities/c2.html>

This activity can help meet Common Core Anchor Standards *W.7,8; SL.1,4*

# About the Authors



Photo credit: Jim Green

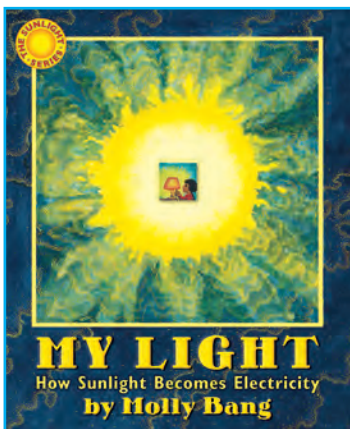
Molly Bang has written and illustrated more than twenty books for young readers, including three Caldecott Honor Books: *When Sophie Gets Angry—Really, Really Angry...*; *Ten, Nine, Eight*; and *The Grey Lady and the Strawberry Snatcher*. Bang divides her time between Falmouth, Massachusetts, and Northern California.



Photo credit: James Long

Penny Chisholm is a professor at MIT where she has been teaching Ecology for more than thirty-seven years. She and her students do research on phytoplankton—tiny plants that feed all life in the oceans. Her long list of prestigious awards includes the National Medal of Science, awarded at the White House in 2013. She lives in Massachusetts.

# About the Books



*My Light: How Sunlight Becomes Electricity*  
by Molly Bang  
Hardcover: 9780439489614  
\$18.99 (CAN \$20.99)

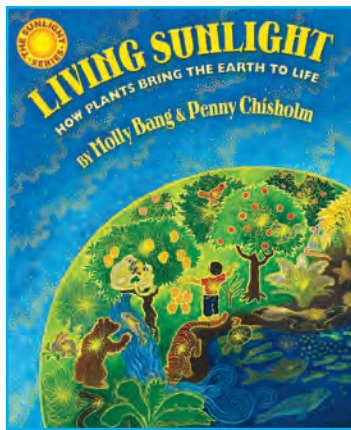
Celebrate the many wonders of the sun, with radiant words and images that illuminate the myriad ways in which the sun gives us energy and power from its light.

Often taken for granted, the sun gives us more than its light. Here, acclaimed author and illustrator Molly Bang presents a celebration of the wonder and power of the sun and its radiance. With dazzling paintings and a simple poetic text, *My Light* follows the paths of the sun's rays, showing the many ways in which we obtain energy from its light. Bang uses a story to explain the basic concepts behind electricity and our energy resources—a compelling and accessible way to present a nonfiction subject.

"With the carefully honed prose and wholly original visual imagination that have long been her hallmarks, Bang explores the many ways in which the sun's light is transformed into the energy that fuels almost everything on the earth."—*Publishers Weekly*

★ "A lovely and illuminating book that presents sound science while expressing the wonder of flipping a switch and flooding a room with light."—*Booklist*, starred review

**An ALA Notable Children's Book**

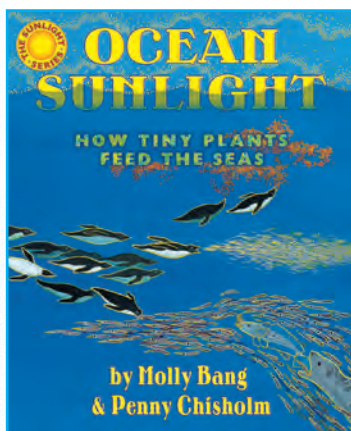


*Living Sunlight: How Plants Bring the Earth to Life* by Molly Bang & Penny Chisholm  
Hardcover: 9780545044226  
\$18.99 (CAN \$20.99)

*Living Sunlight* shows children, teachers, and parents how everything that lives on Earth depends on the energy that comes from the sun. This informative and dramatic book will help readers understand the process of photosynthesis and how plants make living matter. Molly Bang's dynamic and colorful illustrations and straightforward text make these concepts accessible and easy to understand.

★ "If a good picture book does what it sets out to do, a great one sets out to do something huge and succeeds. . . . An outstanding book to read and absorb."  
—*Booklist*, starred review

"Chisholm, a professor of ecology, expands on the theme [photosynthesis], while the intense greens of Bang's gouaches bring it vibrantly to life."  
—*The New York Times Book Review*



*Ocean Sunlight: How Tiny Plants Feed the Seas* by Molly Bang & Penny Chisholm  
Hardcover: 9780545273220  
\$18.99 (CAN \$20.99)

Coauthored by Molly Bang and award-winning MIT professor Penny Chisholm, a leading expert on ocean science, *Ocean Sunlight* is packed with clear, simple science. From tiny aquatic plants to the biggest whale or fish, they present a moving, living picture of the miraculous balance sustaining each life cycle and food chain deep within our wondrous oceans.

★ "This ambitious, beautifully illustrated book offers information seldom covered in science books for young children."—*Booklist*, starred review

★ "Readers will want to visit more than once to capture both the science and the abundant sense of celebration here."—*Kirkus Reviews*, starred review

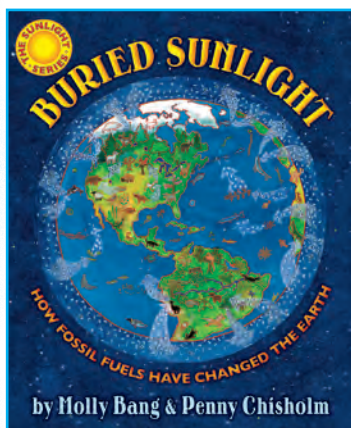
★ "Bang creates dimension and visual drama with her use of gold, blues, and black, forming an ethereal habitat for phytoplankton, jellyfish, and bioluminescent creatures."—*Publishers Weekly*, starred review

**A Kirkus Reviews Best Children's Books of the Year Selection**

**A Booklist Editors' Choices Selection**

**A Book Links Lasting Connections Selection**

**A Bank Street College of Education Best Children's Books of the Year Selection**



*Buried Sunlight: How Fossil Fuels Have Changed the Earth* by Molly Bang & Penny Chisholm  
Hardcover: 9780545577854  
\$18.99 (CAN \$20.99)  
Ebook: 9780545577861  
\$18.99 (CAN \$18.99)

Acclaimed Caldecott Honor artist Molly Bang teams up with award-winning MIT professor Penny Chisholm to present the fascinating, timely story of fossil fuels. This engaging, stunning book explains how coal, oil, and gas are really "buried sunlight," trapped beneath the surface of our planet for millions and millions of years. Using simple language and breathtaking paintings, Bang and Chisholm present a clear, concise explanation of the fossil-fuel energy cycle that began with the sun and now runs most of our transportation and energy use in our world.

★ "Combining an amiable voice with unusual breadth of vision, depth of knowledge, and subtlety of presentation, this is a masterful book in a highly original science series."—*Booklist*, starred review

★ "Bang's illustrations brilliantly represent the chemistry."  
—*The Horn Book*, starred review

★ "Gorgeous illustrations and impressive urgent scientific explanation."  
—*Kirkus Reviews*, starred review

## Common Core State Standards in This Guide

Below are the general Anchor Standards used within this guide, which apply to grades K–5 and cover Reading Literature and Informational Text (R), Writing (W), and Speaking and Listening (SL).

### Reading

#### **Key Ideas and Details:**

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
3. Analyze how and why individuals, events, or ideas develop and interact over the course of a text.

#### **Craft and Structure:**

4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
6. Assess how point of view or purpose shapes the content and style of a text.

#### **Integration of Knowledge and Ideas:**

7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

#### **Range of Reading and Level of Text Complexity:**

10. Read and comprehend complex literary and informational texts independently and proficiently.

### Writing

#### **Text Types and Purposes:**

1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

#### **Research to Build and Present Knowledge:**

7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

### Speaking and Listening

#### **Comprehension and Collaboration:**

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

#### **Presentation of Knowledge and Ideas:**

4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Guide created by Molly Bang and Penny Chisholm.

