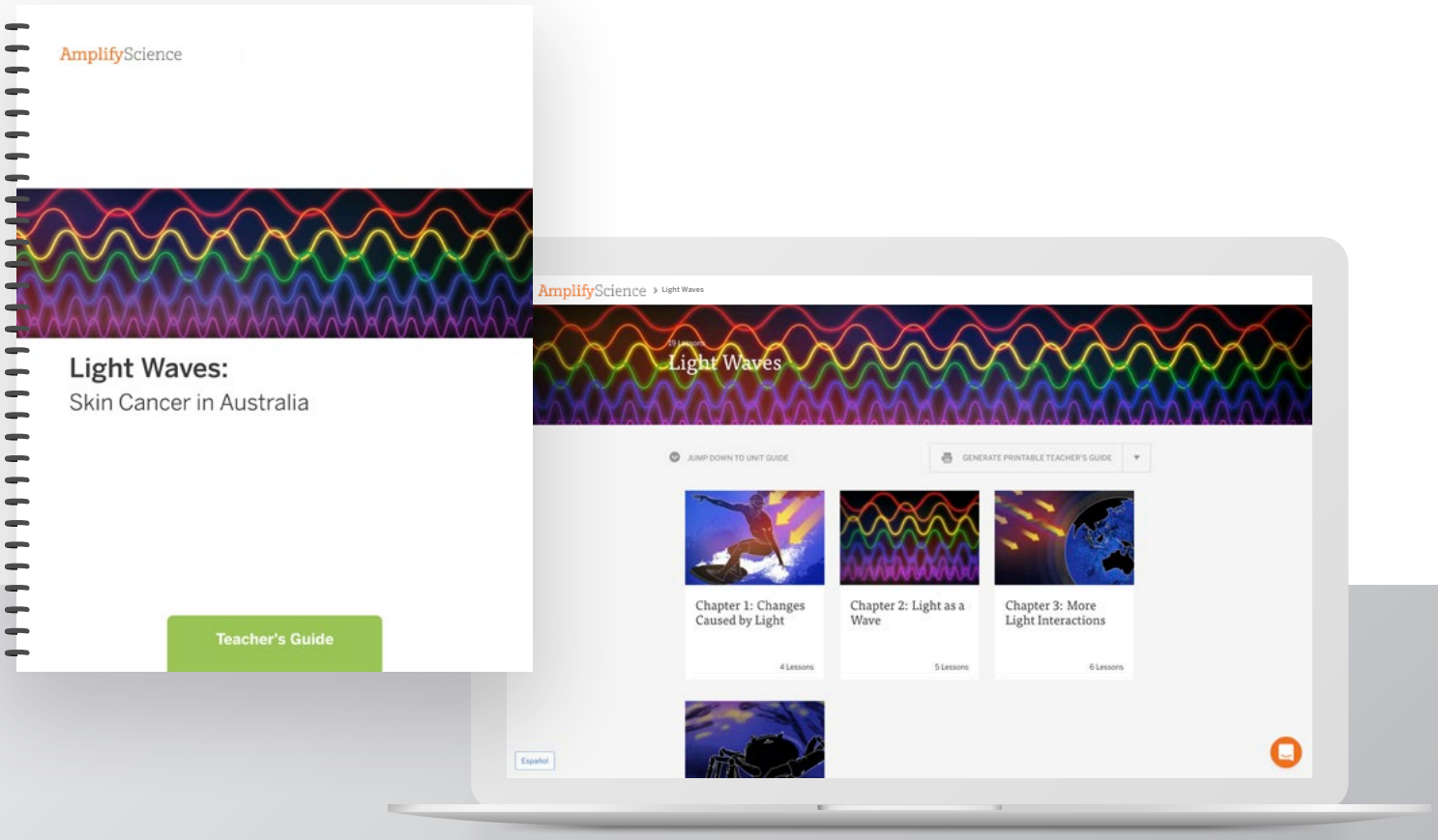
Amplify Science

Grade 8

UNIT GUIDE

Light Waves



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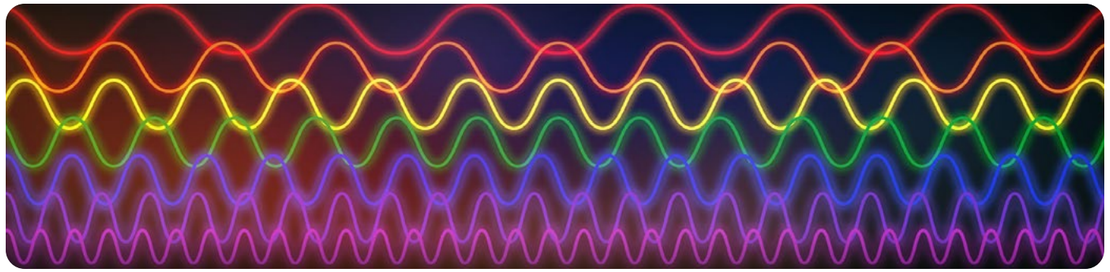
THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY



Welcome to Light Waves

Students intuitively know that light can cause changes: They have felt the light from the sun warm their skin and have probably experienced sunburns. Amplify Science helps students draw on these intuitions to build a deeper understanding around the ways in which light interacts with materials. In addition, by focusing on Australia's skin cancer rate, students have an authentic opportunity to arrive at a multi-causal, complex explanation, taking into account how ultraviolet light interacts with different substances in the atmosphere and how ultraviolet light interacts with melanin.

> Unlike a typical curriculum, Amplify Science anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of spectroscopists. Their job is to help the fictional Australian Health Alliance investigate why Australia's cancer rate is so high. Working together, they figure out how light interacts with materials and how these interactions affect our world, from the colors we see to changes caused by light from the sun, such as warmth, growth, and damage. The unit concludes with a Science Seminar in which students use what they have learned about light to help explain whether a species of crab can see the plankton that it eats near the ocean floor.

Unit Type: Core

Student Role: Spectroscopists

Phenomenon: The rate of skin cancer is higher in Australia than in other parts of the world.

Core Concept: Understanding how light interacts with materials

Target Performance Expectations:

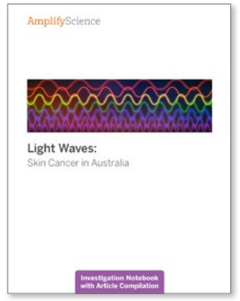
- PS4-1: Amplitude and Waves
- PS4-2: Waves Interact with Materials
- PS4-3: Digitized Signals and Waves

Related Performance Expectations:

- LS1-1: Living Things Made of Cells
- LS1-2: Cell Parts
- LS1-6: Photosynthesis
- LS1-8: Sensory Receptors
- ESS3-5: Factors for Global Temperature

Students figure out the unit phenomenon through the use of a variety of resources.

Student Investigation Notebook



Hands-On Kit

Videos

Digital Tools

About technology in this unit:
All Amplify Science lessons were designed with device sharing in mind, and never assume that every student has a separate device.

In grade 8, student-facing technology includes Practice Tools and digital Simulations. When the use of a digital tool is called for in a lesson, teachers have several implementation options:

If limited student devices are available—teachers can have students do activities in pairs or small groups.

If no student devices are available—teachers can project the digital tool to the class and either "drive" the digital tool themself or invite students to "drive" by using their device.

If internet access is unavailable—teachers can "pre-load" the digital tool on their device for use offline.

Chapter 1:
The storyline begins

What students investigate:

How does light from the sun cause skin cancer?

What students figure out:

Light causes skin cancer because the energy from light can damage materials in cells. When light hits a material, the material can absorb energy from the light. When a material absorbs energy from light, the energy causes the material to change. Sunlight is causing the changes to cells that lead to skin cancer, but Australia gets the same or even a lesser amount of sunlight than some places with much lower skin cancer rates.

How they figure it out:

- Investigating the effect of light on water, a solar-powered toy, and a material that changes color when exposed to light
- Watching a documentary video about a light scientist
- Testing which materials are affected by sunlight in the Sim
- Creating visual models showing their understanding of how light causes skin cancer

KEY

- CLASS
- HANDS-ON
- HOMEWORK
- MODELING
- READING
- SIM
- STUDENT-TO-STUDENT DISCUSSION
- TEACHER
- TEACHER-LED DISCUSSION
- WARM-UP
- WRITING

DAY 1 | LESSON 1.1

Pre-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2

Light and Energy

- Warm-Up (5 min)
- Interview with a Spectroscopist (10 min)
- Skin Cancer in Australia (10 min)
- Evidence of Energy from Light (20 min)
- Homework: Anticipation Guide

On-the-Fly Assessment

DAY 3 | LESSON 1.3

Explaining Changes from Light

- Warm-Up (5 min)
- Energy and Light (20 min)
- Explaining Why Light Changes Materials (10 min)
- Investigating Genetic Material in the Sim (10 min)
- Homework

On-the-Fly Assessment

DAY 4 | LESSON 1.4

Explaining Sunlight and Skin Cancer

- Warm-Up (5 min)
- Modeling the Cause of Skin Cancer (20 min)
- Write and Share: Discussing Claim 1 (20 min)
- Homework
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 2:
The storyline builds

What students investigate:

How can the same amount of sunlight cause different rates of skin cancer?

What they figure out:

Australia's skin cancer rate is affected by the amount of ultraviolet light that Australia receives, and also by the levels of melanin in the skin cells of the Australian population. There are different types of light that can change a material in different ways. A light source can emit more than one type of light. Different types of light have different wavelengths. A material absorbs energy from some types of light and not others. Australia gets more ultraviolet light from sunlight than many other places do. Melanin in cells absorbs ultraviolet light and prevents it from being absorbed by other parts of the cell which can be damaged. Many people in Australia have low levels of melanin.

How they figure it out:

- Investigating the effects of light from a normal flashlight and a UV flashlight on materials
- Reading an article about photosynthesis and solar power
- Watching a video about waveforms
- Investigating different types of light in the Sim and observing their effects on skin cells
- Analyzing and writing about evidence related to melanin and skin cancer
- Creating models showing their understanding of the factors affecting skin cancer in Australia

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- WARM-UP
- WRITING

DAY 5 | LESSON 2.1

Investigating Different Light Sources

- Warm-Up (5 min)
- How Different Light Sources Change Materials (25 min)
- Video: Sun Paper Demo (5 min)
- Reflecting on the Investigation Question (10 min)
- Homework

On-the-Fly Assessment

DAY 6 | LESSON 2.2

"Harvesting Sunlight"

- Warm-Up (5 min)
- Reading "Harvesting Sunlight" (25 min)
- Discussing Annotations (15 min)
- Homework

On-the-Fly Assessment

DAY 7 | LESSON 2.3

Wave Properties

- Warm-Up (5 min)
- Rereading "Harvesting Sunlight" (15 min)
- Investigating Different Types of Light (15 min)
- Video: The Shape of Waves (5 min)
- Reflecting on Wave Properties (5 min)
- Homework

DAY 8 | LESSON 2.4

Effects of Different Types of Light

- Warm-Up (5 min)
- Investigating Light's Effects on Genetic Material (30 min)
- Discussing the Cause of Skin Cancer (10 min)
- Homework

On-the-Fly Assessment

DAY 9 | LESSON 2.5

Analyzing Evidence About Melanin and UV Light

- Warm-Up (5 min)
- Write and Share: Evidence About Melanin (20 min)
- Discussing Skin Cancer Factors (20 min)
- Homework
- Self-Assessment (Optional)

Self-Assessment

Chapter 3:
The storyline gets more complex

What students investigate:

Why does Australia get more ultraviolet light than other parts of the world?

What they figure out:

Ozone in the atmosphere blocks ultraviolet light, but there is less ozone over Australia than in other places, allowing more ultraviolet light to transmit. Light travels in a straight line. When a light wave hits a material, the light can be absorbed by the material, transmitted through the material, or reflected off the material. A material transmits or reflects some types of light and not others. When light is transmitted through or reflected off a material, the energy is not absorbed, so the material does not change.

How they figure it out:

- Using a laser obstacle course to investigate transmission and reflection
- Reading an article about how eyes detect light in order to see
- Investigating absorption, transmission, and reflection in the Sim
- Analyzing evidence about how light interacts with different gases in the atmosphere
- Modeling the effect of the ozone hole on light reaching Australia
- Writing their final explanations of the skin cancer problem in Australia

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- TEACHER-LED DISCUSSION
- WARM-UP
- WRITING

DAY 10 | LESSON 3.1

Following the Path of Light

- Warm-Up (5 min)
- Investigating the Path of Light (25 min)
- Testing Glass and Aluminum Foil (15 min)
- Homework

DAY 11 | LESSON 3.2

"What Eyes Can See"

- Warm-Up (5 min)
- Reading "What Eyes Can See" (25 min)
- Discussing Annotations (15 min)
- Homework

On-the-Fly Assessment

DAY 12 | LESSON 3.3

Reflection, Transmission, and Energy

- Warm-Up (5 min)
- Energy in Reflection and Transmission (20 min)
- Rereading "What Eyes Can See" (20 min)
- Homework

On-the-Fly Assessment

DAY 13 | LESSON 3.4

Critical Juncture Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Critical Juncture Assessment

DAY 14 | LESSON 3.5

Light and Atmosphere

- Warm-Up (5 min)
- Preparing for the Sim Activities (5 min)
- Light Traveling Through the Atmosphere (30 min)
- Sharing Results (5 min)
- Family Homework Experience (Optional)

DAY 15 | LESSON 3.6

Explaining Australia's Skin Cancer Rate

- Warm-Up (5 min)
- Modeling Ultraviolet Light in the Atmosphere (20 min)
- Preparing to Write (20 min)
- Homework
- Self-Assessment (Optional)

Self-Assessment

Chapter 4:
Application to a new storyline

What students investigate:

Scientists from the fictional Australian Institute of Marine Biology know that a species of crab that lives near the ocean floor eats plankton. What they don't know is whether the crabs can see the plankton they eat given the low level of visible light near the ocean floor.

What they figure out:

Scientists must communicate how their claims and evidence are supported with reasoning in a convincing scientific argument. A written scientific argument needs to state a claim, describe specific evidence, and explain how the evidence supports the claim to convince its reader. A claim can sometimes be supported more effectively if you consider the combination of several different pieces of evidence.

How they figure it out:

- Reviewing available evidence to make an argument
- Engaging in oral argumentation in a student-led discourse routine called a Science Seminar
- Writing final arguments

KEY

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- TEACHER
- TEACHER-LED DISCUSSION
- WARM-UP
- WRITING

DAY 16 | LESSON 4.1

Analyzing Evidence

- Warm-Up (5 min)
- Introducing the Science Seminar (10 min)
- Evidence Cards (15 min)
- Sorting Evidence (15 min)

DAY 17 | LESSON 4.2

Science Seminar

- Warm-Up (5 min)
- Preparing for the Science Seminar (10 min)
- Introducing the Science Seminar (5 min)
- Participating in the Science Seminar (25 min)
- Homework

DAY 18 | LESSON 4.3

Writing a Scientific Argument

- Warm-Up (5 min)
- Using the Reasoning Tool (15 min)
- Preparing to Write (10 min)
- Writing Scientific Arguments (15 min)
- Homework
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

DAY 19 | LESSON 4.4

End-of-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

End-of-Unit Assessment

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Light Waves Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of how light interacts with materials.

Progress Build Level 1:
Light carries energy that can be absorbed by a material, causing the material to change.

Progress Build Level 2:
Different types of light can change a material in different ways; a material can absorb energy from some types of light but not others.

Progress Build Level 3:
Light can be absorbed, reflected, or transmitted by a material; if the light is reflected or transmitted, the energy is not absorbed and the material will not change.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief**.

Below are a few examples of strategies embedded in this unit.

For English learners:

Provide more time for the Modeling Tool activity (Example from Lesson 1.4)
The Modeling Tool can be supportive for English learners and other students who might need more support with written communication because it provides a powerful way for students to express themselves visually. However, using the Modeling Tool can also be challenging. Students need to interpret and use the visuals and features in the Modeling Tool while they are reflecting on the science content they are learning. Modeling Tool explanations involve multiple steps. To make sure that English learners get the maximum benefit from this opportunity to visually demonstrate their understanding, consider providing additional time. Invite students to discuss their models with a partner, and allow students to discuss their ideas in English or their primary languages, if possible. Also, extended teacher modeling can provide more support for students' independent work.

For students needing more support:

More time for Sim activities (Example from Lesson 3.5)
In this lesson, students complete Sim activities with a partner. Some students might benefit from having more time to interpret their observations from the Sim. To get the most out of the Sim activities, help students engage in reflection by asking a fairly open-ended question such as "What is something you can conclude from what you observed?" Have students think silently to themselves for a minute or two and then discuss with a partner.

For students ready for a challenge:

Reordering materials in the Path of Light Mission (Example from Lesson 3.1)
In Activity 2, students arrange the materials such that the red laser light touches every object, which means it is reflected once, transmitted twice, and finally absorbed. Since both the transparency and the red cube transmit the laser light, there are several different arrangements that the materials can be placed in that will achieve the same goal. For added challenge, ask students to come up with four different setups of materials that allow the light to touch every object (mirror, red cube, transparency paper, green cube; mirror, transparency paper, red cube, green cube; transparency paper, red cube, mirror, green cube; red cube, transparency paper, mirror, green cube).

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Light Waves 3-D Coverage

SEPs
Science and Engineering Practices

DCIs
Disciplinary Core Ideas

CCCs
Cross-Cutting Concepts

Unit Level

Students use a digital model, obtain information from articles, and conduct hands-on investigations to discover how different types of light interact with different types of matter (energy and matter). They use these ideas and analyze data to construct explanations about the cause of Australia's high rate of skin cancer (cause and effect).

Chapter Level

Chapter 1: Changes Caused by Light

Students gather evidence from a digital model, articles, and hands-on investigations about how energy from light can cause matter to change (energy and matter), including how energy from sunlight can cause changes to genetic material, which can lead to skin cancer (cause and effect).

Chapter 2: Light as a Wave

Students analyze evidence from a digital model, articles, and hands-on investigations to determine that different types of light have different wavelengths and can cause different changes when interacting with matter (energy and matter, cause and effect) and that the amount of melanin in skin can influence the risk of skin cancer.

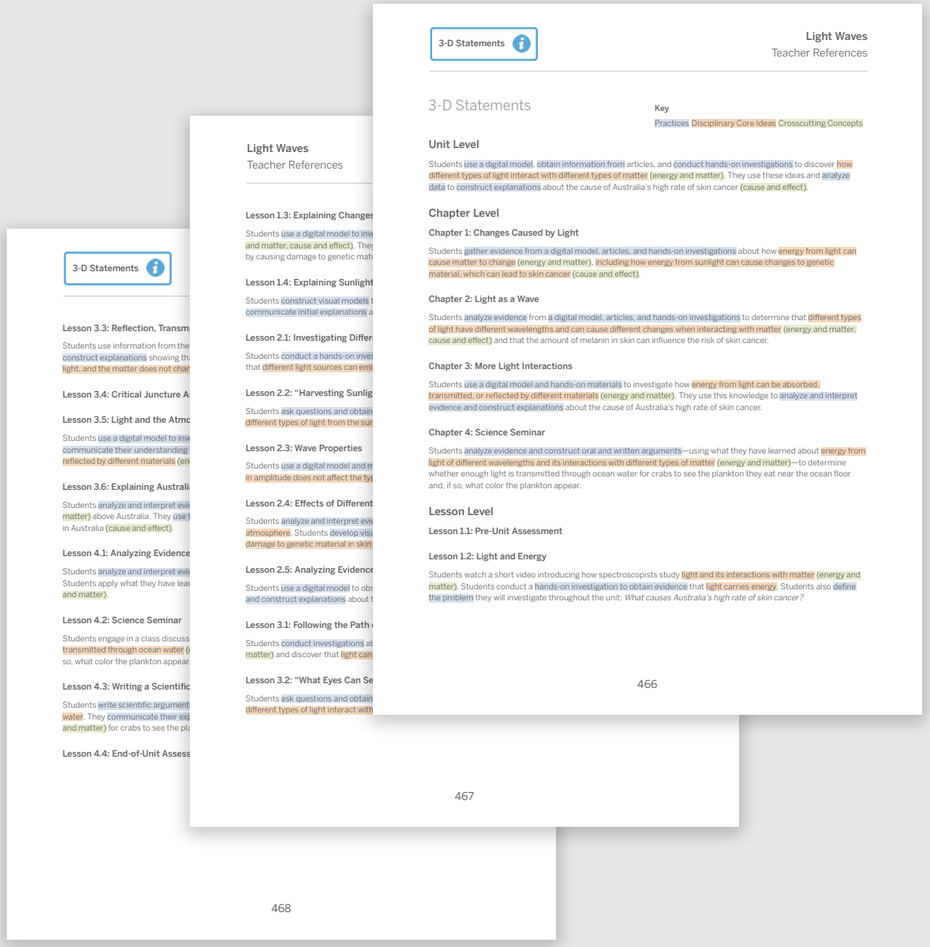
Chapter 3: More Light Interactions

Students use a digital model and hands-on materials to investigate how energy from light can be absorbed, transmitted, or reflected by different materials (energy and matter). They use this knowledge to analyze and interpret evidence and construct explanations about the cause of Australia's high rate of skin cancer.

Chapter 4: Science Seminar

Students analyze evidence and construct oral and written arguments—using what they have learned about energy from light of different wavelengths and its interactions with different types of matter (energy and matter)—to determine whether enough light is transmitted through ocean water for crabs to see the plankton they eat near the ocean floor and, if so, what color the plankton appear.

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.



Notes

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For more information on Amplify Science, visit **amplify.com/science**.

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