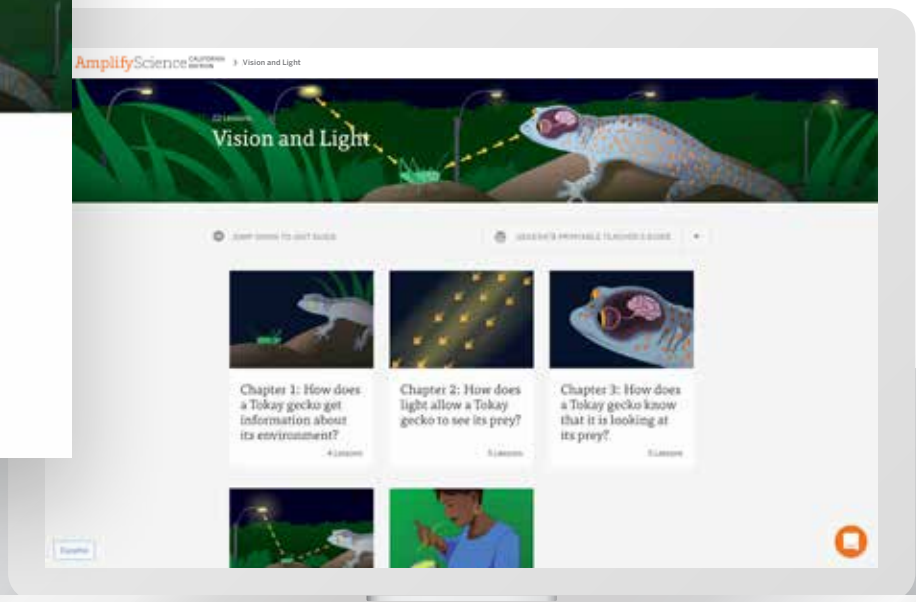
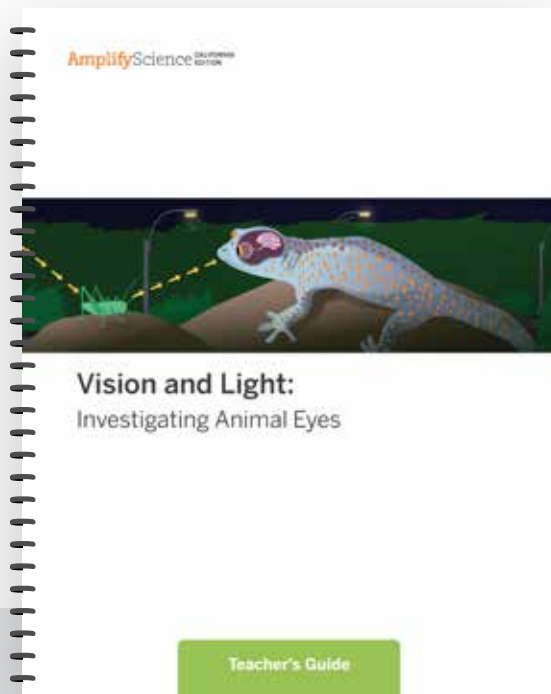


UNIT GUIDE

# Vision and Light





Amplify.



THE LAWRENCE  
HALL OF SCIENCE  
UNIVERSITY OF CALIFORNIA, BERKELEY

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# Welcome to Vision and Light

Humans change the environments in which we live many ways—clearing forests to make roads and houses, removing species of plants and animals that are dangerous to humans, installing lights to make it easier to see at night, and so on. Often these changes affect other species' survival in unanticipated ways. The decline in the number of Tokay geckos living in one area of a rain forest in the Philippines is a prime example.

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

In this unit, students take on the role of conservation biologists and investigate two key ideas: how light travels in a way that allows an animal to see, and how an animal's internal structures work together to process information and form an image the animal can recognize. By the end of the unit, students figure out that the installation of new highway lights in the rainforest is causing too much nighttime light. As a result, the Tokay gecko can't see its prey, which is affecting the species' ability to survive.

**Unit Type:** Investigation

**Student Role:** Conservation Biologists

**Phenomenon:** The population of Tokay geckos in a rain forest in the Philippines has decreased since the installation of new highway lights.

**Core Concepts:** Understanding the role that animal senses, primarily vision, play in the survival of a species

**Target Performance Expectations:**

- 4-PS4-2: Light is Necessary for Sight
- 4-LS1-1: Internal and External Structures
- 4-LS1-2: Patterns to Transfer Information
- 4-PS4-3: Information, Senses, and the Brain
- 3-5-ETS1-1: Defining the Problem
- 3-5-ETS1-2: Developing Possible Solutions
- 3-5-ETS1-3: Improving Designs

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

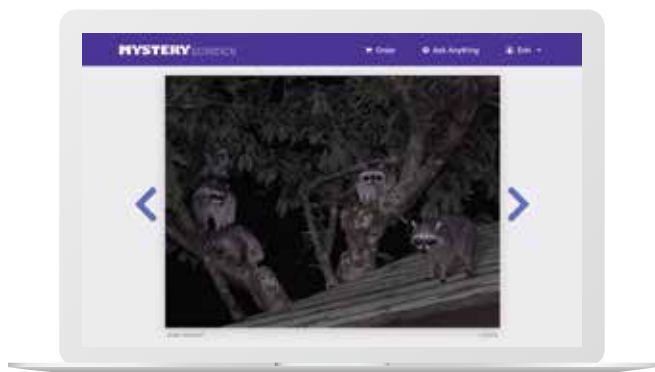
## Student Books



## Hands-On Kit



## Videos



## Simulations



### About technology in this unit:

Amplify Science California gives you the flexibility to use technology in the way that meets your needs best. In 3–5, teachers have the option of using:

- **Student digital licenses** that allow for online completion of work, teacher feedback and grading, and digital class management.
- **Traditional consumable resources** that allow for a more familiar paper and pencil experience.

Whether students use the student digital experience or print workbooks, there are some technology-based activities all students will experience from time to time.

In grade 4, technology-based activities include **Practice Tools** and **digital Simulations**. In this particular unit, 10 of the 22 lessons incorporate the use of devices with 18% of the unit's activities involving the use of a digital tool.

When the use of a digital tool is called for in a lesson, teachers have several implementation options:

- **If limited student devices are available**, students can do activities in pairs or small groups.
- **If no student devices are available**, teachers can project the digital tool to the class and create a whole class experience.

# Chapter 1:

## The storyline begins

### What students investigate:

How does a Tokay gecko get information about its environment?

### What they figure out:

In order to survive, a gecko must avoid predators and find prey. To do this, geckos use structures to get information from their environment. For instance, a gecko uses its ears to hear if there is a predator nearby and its vision to watch for predators.

### How they figure it out:

- Learning that information travels to them from their environment through hands-on investigations with their own senses
- Exploring what senses different animals use to find their food as they read the student book *Investigating Animal Senses*
- Exploring why we need light to see by completing a Mystery Box activity

#### KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT  
DISCUSSION



TEACHER







TEACHER-LED  
DISCUSSION



WRITING

### DAY 1 | LESSON 1.1




#### Pre-Unit Assessment

-  Introducing the Unit (10 min)
-  Discussing What Animals Need for Survival (10 min)
-  How Animals Get Information from the Environment (15 min)
-  Writing Initial Explanations (25 min)

Pre-Unit Assessment

### DAY 2 | LESSON 1.2




#### Introducing Animal Senses

-  Using Senses to Get Information (30 min)
-  Sharing Ideas (15 min)
-  Introducing Structure and Function (15 min)

On-the-Fly Assessment

### DAY 3 | LESSON 1.3




#### Investigating Animal Senses

-  Introducing Asking Questions (10 min)
-  Reading *Investigating Animal Senses* (35 min)
-  Blocking Information About the Environment (15 min)

On-the-Fly Assessment

### DAY 4 | LESSON 1.4

#### Exploring How Animals Survive

-  Observing Animals and Plants (20 min)
-  Writing to Reflect (15 min)
-  Introducing the Mystery Box (25 min)

Critical Juncture Assessment  
Self-Assessment

# Chapter 2:

## The storyline builds

### What students investigate:

How does light allow a Tokay gecko to see its prey?

### What they figure out:

First, light travels from a source to the gecko's prey. Then, it reflects off the prey and travels to the gecko's eyes. As it travels from the prey to the gecko's eyes, it carries information about the prey.

### How they figure it out:

- Researching the structure of the eye by observing cross-section diagrams and vivid close-up photos of various animals as they read the student book *Handbook of Animal Eyes*
- Exploring the path of light from a source to an object and to an animal's eye by using the Sim and as they read the student book *I See What You Mean*
- Improving inaccurate models of how light reaches the eye in order to correct common misconceptions

#### KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT  
DISCUSSION



TEACHER



TEACHER-LED  
DISCUSSION







WRITING



DAY 5 | LESSON 2.1





**Investigating Light**

-  Returning to the Conservation Area (5 min)
-  Introducing the Vision and Light Simulation (15 min)
-  Reading *Handbook of Animal Eyes* (15 min)
-  Investigating Light in the Sim (25 min)

On-the-Fly Assessment

DAY 6 | LESSON 2.2




**Modeling Ideas About Light**

-  Vision and Light Modeling Tool (25 min)
-  Reflecting on the Mystery Box (5 min)
-  Returning to Modeling Ideas (20 min)
-  How We Are Like Scientists (10 min)

On-the-Fly Assessment

DAY 7 | LESSON 2.3




***I See What You Mean***

-  Adding to Asking Questions When You Read (10 min)
-  Reading *I See What You Mean* (35 min)
-  Reflecting on the Book (15 min)

On-the-Fly Assessment





DAY 8 | LESSON 2.4

**Reviewing Models About Vision and Light**

-  Revisiting the Vision and Light Simulation (15 min)
-  Critiquing Models with Evidence (20 min)
-  Modeling New Ideas About the Mystery Box (25 min)

DAY 9 | LESSON 2.5

**Explaining How Light Allows an Animal to See**

-  Introducing Scientific Explanations (10 min)
-  Preparing to Write (15 min)
-  Writing Scientific Explanations (30 min)
-  Thinking About How We Are Like Scientists (5 min)

Critical Juncture Assessment  
Self-Assessment

# Chapter 3:

## The storyline goes deeper

### What students investigate:

How does a Tokay gecko know that it is looking at its prey?

### What they figure out:

Light from a source reflects off the prey and travels to the Tokay gecko's eyes. The light enters the eye through the pupil and then reaches light receptors. The light receptors respond to the light and send information from the light to the brain. The brain processes this information and forms an image. By comparing the image to memories, the gecko can recognize what it is looking at and make a decision that might help it survive.

### How they figure it out:

- Learning that light enters the eye through the pupil and then reaches light receptors by using the Sim and as they read the student book *Handbook of Animal Eyes*
- Investigating how a predator knows if it's looking at prey or at an animal that would be toxic to eat by using the Sim

#### KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT  
DISCUSSION



TEACHER






TEACHER-LED  
DISCUSSION



WRITING

DAY 10 | LESSON 3.1





Exploring Animals  
Eye Structures

-  Exploring Sounds (20 min)
-  Investigating Animal Vision in the Sim (20 min)
-  Reading *Handbook of Animal Eyes* (20 min)

Optional Flexextension: *Designing Ear Structures*

DAY 11 | LESSON 3.2




*Crow Scientist*

-  Introducing *Crow Scientist* (15 min)
-  Reading *Crow Scientist* (25 min)
-  Reflecting on Asking Questions (15 min)
-  Reflecting on Changing One Variable (5 min)

On-the-Fly Assessment

DAY 12 | LESSON 3.3




Investigating  
Information Processing

-  Reflecting on How We Are Like Scientists (15 min)
-  Returning to the Simulation (35 min)
-  Reading *Handbook of Animal Eyes* (15 min)

On-the-Fly Assessment

DAY 13 | LESSON 3.4





Investigating How Animals  
React to Information

-  Thinking About Reactions (20 min)
-  Describing How Animals React (25 min)
-  Discussing Ideas (15 min)

On-the-Fly Assessment

DAY 14 | LESSON 3.5

Explaining How Animals  
Recognize Prey

-  Modeling New Ideas (15 min)
-  Preparing to Write (15 min)
-  New Scientific Explanation Guidelines (10 min)
-  Writing About Recognition (20 min)

Critical Juncture Assessment

# Chapter 4:

## The storyline gets more complex

### What students investigate:

How could more light at night make it hard for a Tokay gecko to see its prey?

### What they figure out:

When light gets to a Tokay gecko's eyes, the gecko's light receptors respond and send information to the brain. The brain processes this information to form an image. Since the highway lights were installed, there is much more light at night. Tokay geckos have light receptors that form clear images in very low-light conditions, so the extra light at night makes it difficult for them to form clear images of their prey.

### How they figure it out:

- Exploring the differences in animals' senses, including how some animals have specialized receptors with varying sensitivities as they read the student book *Seeing Like a Shrimp and Smelling Like a Snake*
- Comparing the vision of nocturnal and diurnal animals in varying amounts of light by using the Sim along with other digital models
- Building physical models of nocturnal and diurnal eyes

#### KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT  
DISCUSSION



TEACHER






TEACHER-LED  
DISCUSSION



WRITING

DAY 15 | LESSON 4.1




**Seeing Like a Shrimp and Smelling Like a Snake**

-  New Message from Rain Forest Conservation Group (15 min)
-  Reading *Seeing Like a Shrimp and Smelling Like a Snake* (35 min)
-  Comparing How Different Animals Sense Information (10 min)

On-the-Fly Assessment




DAY 16 | LESSON 4.2

**Investigating What Different Animals See**

-  What Different Animals See (15 min)
-  Modeling What Different Animals See (20 min)
-  Researching Animal Eyes (25 min)

DAY 17 | LESSON 4.3




**Investigating Receptor Sensitivity**

-  Animal Eye Jigsaw Discussion (25 min)
-  Investigating Sight in Different Amounts of Light (25 min)
-  New Scientist Observations (10 min)

On-the-Fly Assessment

DAY 18 | LESSON 4.4




**Preparing to Build a Model**

-  Modeling Receptor Sensitivity (20 min)
-  Reflecting on Light Sensitivity (20 min)
-  Planning Vision Models (20 min)

Critical Juncture Assessment



DAY 19 | LESSON 4.5

**Building and Explaining Models**

-  Reviewing What Animals See (10 min)
-  Building Vision Models (35 min)
-  Explaining Vision Models (15 min)

DAY 20 | LESSON 4.6

**End-of-Unit Assessment**

-  Sharing Vision Models (20 min)
-  Writing Final Explanations (40 min)

End-of-Unit Assessment  
Self-Assessment

# Chapter 5:

## Application to a new context

### What students investigate:

How do our senses help us understand our environment?

### What they figure out:

By designing an investigation that only changes one variable at a time, it's possible to understand how human structures and receptors inform our senses and help us survive.

### How they figure it out:

- Learning about the importance of only changing one variable in an investigation as they read the student book *Investigating Animal Senses*
- Designing, conducting, and sharing the results of hands-on investigations into one of three human senses: hearing, smelling, or touching
- Comparing results across multiple student-led investigations

#### KEY



HANDS-ON



MODELING



READING



SIM



STUDENT-TO-STUDENT  
DISCUSSION



TEACHER







TEACHER-LED  
DISCUSSION



WRITING

**DAY 21 | LESSON 5.1**





**Planning an Investigation of Your Senses**

-  Sensitivity of Human Smell, Hearing, and Touch (10 min)
-  Changing One Variable (20 min)
-  Focusing on a Sense to Investigate (10 min)
-  Planning an Investigation (20 min)

On-the-Fly Assessment

**DAY 22 | LESSON 5.2**

**Conducting Investigations and Sharing Results**

-  Setting Up the Investigation (10 min)
-  Investigating a Human Sense (30 min)
-  Sharing and Comparing Investigation Results (10 min)
-  How Humans Gather Information Using Their Senses (10 min)

Self-Assessment

# All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science California 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.

## Vision and Light Progress Build

The Progress Build in this unit consists of four levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of how animals use vision and other senses to survive in their environment.

### Progress Build Level 1:

Animals use senses to learn about their environment.

### Progress Build Level 2:

Light allows objects in an environment to become visible to the eye.

### Progress Build Level 3:

Light receptors in the eye respond to light and the brain forms an image.

### Progress Build Level 4:

Different animals have light receptors with different sensitivities to light.



## 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 California 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:

#### Build background knowledge (Example from Lesson 3.1)

The Sounds of the Savanna audio from the Exploring Sounds activity relies partially on an understanding of what the savanna is and what kinds of animals live there. You may want to take some time before this activity to show images of both the savanna environment and some of the animals that live there. English learners can be supported by encouraging them to share words they know in their primary language (e.g., words that describe the environment, such as *grass* or *trees*, or words that describe the animals, such as *lion* or *giraffe*) and then providing them with the English word for these known terms. This will enable students to more easily link these ideas when the class talks about them. You may even want to consider creating a chart or writing these terms both in English and in other languages for your class.

### For students needing more support:

#### More time with the text (Example from Lesson 2.1)

For students who may need support with reading, consider spending some time reviewing and practicing how to find information in a reference text, highlighting the use of text features to locate specific information. Before teaching the lesson, you might also consider previewing the pages that students will read with a small group of students who would benefit from extra support and additional time with the text.

### For students ready for a challenge:

#### Additional research (Example from Lesson 4.3)

Students who need more challenge can be asked to choose new predators that aren't included in *Handbook of Animal Eyes* and write down predictions about what each new predator's eyes would be like, based on what they eat and when. Ask these students to state which organism from *Handbook of Animal Eyes* they think each organism they researched was most like, and why.

# 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.

## Vision and Light 3-D Coverage

SEPs

Science and Engineering Practices

DCIs

Disciplinary Core Ideas

CCCs

Cross-Cutting Concepts

### Unit Level

Students ask and investigate questions about the role that animals' senses, primarily vision, play in survival (structure and function) in order to figure out why there is a decline in the number of Tokay geckos living in one area of a rain forest in the Philippines (cause and effect). Students use a digital model, create their own diagram models, and construct explanations to explain that we need light to see and how we see (systems and system models).

### Chapter Level

#### Chapter 1: How does a Tokay gecko get information about its environment?

Students ask and investigate questions about how animals use sensory structures to get information from their environments (structure and function). Students then focus on the sense of sight as they investigate the role that light plays in vision.

#### Chapter 2: How does light allow a Tokay gecko to see its prey?

Students use and create digital models and ask questions as they investigate how light travels in straight lines from a source, reflects off objects, and then travels to an animal's eyes (cause and effect, structure and function).

#### Chapter 3: How does a Tokay gecko know that it is looking at its prey?

Students ask and investigate questions about the structures that make up an animal's eyes and brain and how those structures function together (structure and function) as part of a whole system (systems and system models) to enable an animal to recognize objects in its environment.

#### Chapter 4: How could more light at night make it hard for a Tokay gecko to see its prey?

Students obtain information and conduct investigations about the structure and function of various animal eyes (structure and function) and then build physical models of the eye, showing how the parts work together (systems and system models). They construct explanations of why more light at night has made it difficult for Tokay geckos to survive (cause and effect).

#### Chapter 5: How do our senses help us understand our environment?

Students design and conduct their own investigations to help them learn more about one of three human senses—hearing, smell, or touch (structure and function, cause and effect).

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

The image displays several overlapping pages from a teacher reference guide for the unit 'Vision and Light'. The pages are numbered 544, 545, 546, and 547. The 3-D Statements page (544) includes a key for Practices, Disciplinary Core Ideas, and Crosscutting Concepts. The Lesson Brief pages (545-547) show lesson plans for various lessons, including Lesson 1.1: Planning an Investigation, Lesson 1.2: Introducing Animal Structures, Lesson 1.3: Investigating Animal Structures, Lesson 1.4: Exploring How Animals Use Structures, Lesson 2.1: Investigating Light, Lesson 2.2: Modeling Ideas About Light, Lesson 2.3: I See What You See, Lesson 2.4: Reviewing Models, Lesson 2.5: Explaining How Light Travels, Lesson 3.1: Exploring Animal Eyes, Lesson 3.2: Crow Scientist, Lesson 3.3: Investigating Information, Lesson 3.4: Investigating How Light Travels, Lesson 3.5: Explaining How Animals Use Light, Lesson 4.1: Seeing Like a Scientist, Lesson 4.2: Investigating What Light Does, Lesson 4.3: Investigating Receptors, Lesson 4.4: Preparing to Build a Model, Lesson 4.5: Building and Explaining a Model, and Lesson 4.6: End-of-Unit Assessment.

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