Lesson 3.1
Exploring Animal Eye Structures
Lesson Overview

Students listen to familiar and unfamiliar sounds to encourage them to think about why it is important for an animal to recognize things they sense in their environment. Then students receive a message from the Rain Forest Conservation Group, which introduces the new Chapter and Investigation Questions. Students return to the Vision and Light Simulation and investigate the structures inside the body—the eye and brain—that allow the predator to see its prey. The lesson concludes with students using the Handbook of Animal Eyes reference book to read about the structures that help an animal see and recognize what it is looking at. The purpose of this lesson is for students to begin to understand how various structures in an animal’s eye and brain function.

Anchor Phenomenon: The population of Tokay geckos in a rain forest in the Philippines has decreased since the installation of new highway lights.
Investigative Phenomenon: Students are able to recognize different sounds

Students learn:

- Just seeing or hearing something may not be enough to identify what it is.
- Different structures have particular functions that together allow an animal to know what it is looking at.
Investigating Animal Vision in the Sim

Students investigate several prey organisms in the Sim in different amounts of light to understand how predators sense their prey.

Instructional Guide

1. Return students’ Investigation Notebooks.

2. Project the latest message from Rain Forest Conservation Group. Read it aloud.

   To: Conservation Biologists
   From: Rain Forest Conservation Group
   Subject: Another Question About Tokay Geckos

   Thank you for explaining how light allows Tokay geckos to see their prey. Your explanations made us wonder: How does a Tokay gecko know when it is looking at its prey?

   Please explain how Tokay geckos see and recognize their prey. This might help us to understand why the Tokay geckos are not finding enough food in their environment.

3. Post the Chapter Question to the classroom wall.

   How does a Tokay gecko know that it is looking at its prey?
Just as we discussed how you recognized the sounds you heard from the savanna, we need to investigate how all animals recognize, or know, what they’re looking at. This could help us explain why the Tokay gecko is not surviving in this part of the rain forest.

4. **Introduce the Investigation Question.** Read it aloud.

How do an animal’s structures allow it to see its prey?

Call on a few students to share their initial ideas.

5. **Introduce purpose for Sim activity.** Let students know that they will use the Sim to figure out what is happening inside the body after the information carried by the light enters the predator’s eye.

When we used our hearing to listen to the animal sounds, it was not enough for the information from sound to get to our ears in order for us to know what we were listening to.

It’s similar when we use our vision: it’s not enough for the information from light to get to our eyes for us to know what we’re looking at. Let’s investigate what happens with the information from light once it gets inside the predator’s body.

6. **Introduce notebook page.** Have students turn to page 41, Investigating Animal Structures, in their notebooks. Read aloud the instructions about what students will do in the Sim and how they will complete the notebook page. Emphasize that you’d like students to observe what happens with the structures in the predator’s body after light reaches its eye.

7. **Designate pairs and distribute devices.** Have students work in the Sim and with their notebooks. Circulate to provide support as needed.

8. **Discuss students’ observations.** Review the what students have recorded in their notebooks.

What did you observe happening with the structures inside the body when the predator could see its prey?

[The light went into the eye through the pupils, and then got to receptors at the back of the eye. The optic nerve glowed and sent the information about the prey to the predator’s brain, where an image of the prey formed.]

9. **Transition to the next activity.** Let students know that next they will use the reference book in order to further investigate the body structures that made it possible for the predator to see its prey.

**Teacher Support**

**Instructional Suggestion**

**Providing More Support: Reviewing Structure and Function**

Since the terms *structure* and *function* were not referenced in Chapter 2, you may find it useful to review these terms with your students. This will be especially helpful for the upcoming lessons and Chapter 4, in which students have many activities and discussions related to the structure and function of eye parts.
Background

Student Thinking: Addressing Misconceptions About Light and the Brain
At this point, some students may think that light is traveling all the way to the brain when an animal sees something. Light actually only travels as far as the light receptors in the eye. Information is then passed through nerves to the brain in the form of small electrical impulses. Don’t worry if students’ understanding is partial at this stage; they will gather more information as they read the reference book. Although they will not learn details about the form in which information is passed from the light receptors to the brain, they will eventually understand that the light itself does not travel all the way to the brain.

Possible Responses

Vision and Light Simulation

What students should do and notice:

Students should change the direction of light and the amount of light so the predator can see the prey. Students should notice that after the light arrows reflect off the prey, they enter the predator’s eye and hit the light receptors at the back of the predator’s eye. When light arrows hit the light receptors, the optic nerve lights up to show that information is being sent to the brain. The brain then lights up and an image of the prey appears in the thought bubble.
What did you observe happens after the light gets to the predator’s eye?

The light arrows go to the back of the eye. Then, the triangles at the back of the eye light up. These are called light receptors. Next, the optic nerve glows and once the glowing part reaches the brain, the predator sees its prey.

1. Light arrows enter the predator’s eye through the pupil (D).

2. Information from light gets to the light receptors at the back of the predator’s eye (C).

3. Information is sent from the light receptors, through the optic nerve, to the brain (B).

4. The predator’s brain forms an image of the prey (A).
Investigating Animal Structures

1. Open the Sim in Recognizing Prey mode.
2. Adjust the light so the predator can see its prey.
3. Observe what happens after the light gets to the predator’s eye.

What did you observe happens after the light gets to the predator’s eye?

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___________________________________________________________________
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___________________________________________________________________
Students refer to the *Handbook of Animal Eyes* to read how an animal knows what it is looking at.

### Instructional Guide

1. **Set purpose for revisiting the reference book.**
   
   Let’s read the reference book to learn more about what we just observed in the Sim. Let’s see how both light and the structures inside an animal allow it to see.

2. **Pairs read the reference book.** Distribute a copy of *Handbook of Animal Eyes* to each pair. Have pairs read page 4 together. Encourage students to read the diagram as well as the text.

3. **Introduce the matching notebook activity.** Have students turn to page 42, How Animals’ Structures Help Them See, in their notebooks. Review the directions.

4. **Students work in their notebooks.** Encourage pairs to work together and use the reference book as a resource.

5. **Discuss how information from light gets to an animal’s brain.**

   The pupil is the hole that lets light into the eye. We know that this light carries information about what is in the environment.

   Based on what you read about how the various structures in the eye and brain work, how does information from the light get to an animal’s brain?
   
   [Light comes in through the pupil, gets to the light receptors in the back of the eye, and the light receptors send information to the brain. The brain forms an image.]

6. **Introduce and post the receptor vocabulary card.**
A receptor is a structure that responds to information from the environment.

The function of the light receptors in the eye is to take information from light and send it to the brain.

7. **Project the Sim to discuss how each structure works together.** Go to the Student Apps Page and select the Vision and Light unit. Then, select the Simulation and open Recognizing Prey mode. Make sure the predator is set to have an open pupil. Adjust the light settings so that the predator can see its prey clearly. Follow the path of light into the predator’s eye. Point to each of the following structures and call on students to explain what happens in each of the structures. Highlight how all the structures function together to allow the predator to see its prey.

- The pupil. [It lets in the light/information.]
- The light receptors. [They respond to information from the light and send that information to the brain.]
- The optic nerve. [It carries the information from the light receptors to the brain.]
- The brain. [It makes a picture with the information.]

8. **Reset and run the Sim with the closed pupil setting.** Point out that if light can’t enter the predator’s eye through the pupil, it can’t see.

When one of these structures doesn’t function, the predator can’t see. This shows us that each of these structures each plays an important role in how an animal knows what it is looking at. In the Sim, these structures function together to allow the predator to see it’s prey. If just one of the structures doesn’t serve its function, the predator is not able to see its prey.

9. **Collect digital devices and conclude the lesson.** Let students know that they will continue to learn more about how animals know what they are looking at in the next lesson.

**Teacher Support**

**Instructional Suggestion**

**Student Thinking: Reflection Time**
You may wish to provide additional time for reflection to help students make sense of what they have been learning, synthesize ideas, and apply their learning to the central question about how an animal knows what it is looking at. You could choose to have students reflect in writing, through pair discussion, or through class discussion. Providing additional time for reflection allows students to consolidate their learning and also offers the teacher a window into students’ thinking, which can be helpful for identifying and addressing alternate conceptions or partial conceptions.

**Background**

**Crosscutting Concept: Structure and Function Across Chapter 3**
In Chapter 3, students investigate the questions *How do an animal’s structures allow it to see its prey?* and *How do animals know how to react when they get information about their environment?* These questions require students to build on their knowledge of structure and function, which they began developing when they investigated senses in Chapter 1, by narrowing in on the specific eye structures that help animals see things in their environment. Through
investigation with the Sim and reading the books *Handbook of Animal Eyes* and *Crow Scientist*, students discover how each structure helps an animal see things in their environment, and how one structure, the brain, can recognize objects and allow the animal to make decisions that could affect their ability to survive.

**Background**

**Crosscutting Concept: What Is Meant by Systems and System Models?**

Systems and System Models is a crosscutting concept called out by the Next Generation Science Standards. It is one of seven powerful ideas that are widely useful across scientific topics and subdisciplines. Making use of the crosscutting concept of Systems and System Models involves defining the system you want to study, specifying its boundaries, identifying that system's interacting parts, and making explicit a model of that system. Thinking about a phenomenon in this way provides an impactful approach to understanding and testing ideas and is applicable throughout science and engineering. In this unit, we do not refer explicitly to the term *system*, but instead refer to the parts of a whole and how they work together to serve a specific function. The main system that students work with is the vision system, consisting primarily of the eye and its internal and external structures, the optic nerve, and the brain.

**Background**

**Crosscutting Concept: Systems and System Models Across Chapter 3**

In Chapter 3, students investigate the question: *How does a Tokay gecko know that it is looking at its prey?* Students focus on the role that eyes play in helping an animal know what it’s looking at. Building on what they learned in Chapter 2, the system that students are investigating in this chapter is the system of the eye and brain and their interacting parts—pupil, light source, optic nerve, receptors, and brain. By focusing on the role that the internal structures of the animal’s eyes and brain play in helping an animal know what it’s looking at, students come to understand how the parts of the eye and brain interact as parts of a system that allows the animal see and recognize what it needs to survive.

**Rationale**

**Pedagogical Goals: Supporting the Crosscutting Concept of Structure and Function**

When students use the Simulation in Activities 1 and 2, they have a rich opportunity to consider how multiple structures—pupil, light receptors, optic nerve, and brain—each perform different functions that, together, enable an animal to see. To support the connection between these individual structure-function relationships and how the eyes structures each contribute to the overall function of vision, draw students' attention to the complete path of light once it enters the eye through the pupil, travels to the light receptors at the back of the eye, and, eventually, forms an image that is processed by the brain as information about the environment. This is also an opportunity to invite students to consider analogous structure- and substructure-function relationships (e.g., how a bike has differently shaped parts that enable each to perform different functions, which together contribute to the overall function of transportation). Encouraging students to explicitly consider these relationship may not only help them apply this crosscutting concept to their understanding of science concepts in this unit, but also position them for success in applying the idea of structure and function to other relationships in the future.
Possible Responses

Investigation Notebook
How Animals' Structures Help Them See (page 42)

1. D
2. C
3. B
4. A
Lesson 3.1
Exploring Animal Eye Structures
Lesson Overview

Students listen to familiar and unfamiliar sounds to encourage them to think about why it is important for an animal to recognize things they sense in their environment. Then students receive a message from the Rain Forest Conservation Group, which introduces the new Chapter and Investigation Questions. Students return to the Vision and Light Simulation and investigate the structures inside the body—the eye and brain—that allow the predator to see its prey. The lesson concludes with students using the Handbook of Animal Eyes reference book to read about the structures that help an animal see and recognize what it is looking at. The purpose of this lesson is for students to begin to understand how various structures in an animal’s eye and brain function.

Anchor Phenomenon: The population of Tokay geckos in a rain forest in the Philippines has decreased since the installation of new highway lights.
Investigative Phenomenon: Students are able to recognize different sounds

Students learn:

- Just seeing or hearing something may not be enough to identify what it is.
- Different structures have particular functions that together allow an animal to know what it is looking at.
Investigating Animal Vision in the Sim

Students investigate several prey organisms in the Sim in different amounts of light to understand how predators sense their prey.

Instructional Guide

1. Return students’ Investigation Notebooks.

2. Project the latest message from Rain Forest Conservation Group. Read it aloud.

   Para: Biólogos/as de la conservación
   De: Grupo de Conservación del Bosque Lluvioso
   Asunto: Otra pregunta sobre los geoces tokay

   Gracias por explicar cómo la luz permite a los geoces tokay ver a su presa. Sus explicaciones nos hicieron preguntarnos: ¿Cómo sabe un gecko tokay cuando está mirando a su presa?

   Por favor, expliquen cómo los geoces tokay ven y reconocen a su presa. Esto podría ayudarnos a entender por qué los geoces tokay no están encontrando suficiente alimento en su ambiente.

3. Post the Chapter Question to the classroom wall.

   ¿Cómo es que un gecko tokay sabe que está mirando a su presa?
4. Introduce the Investigation Question. Read it aloud.

¿Cómo es que las estructuras de un animal le permiten ver su presa?

Call on a few students to share their initial ideas.

5. Introduce purpose for Sim activity. Let students know that they will use the Sim to figure out what is happening inside the body after the information carried by the light enters the predator’s eye.

Cuando usamos nuestro oído para escuchar los sonidos de animales, no bastó con que la información del sonido llegara a nuestros oídos para que pudiéramos saber qué estábamos escuchando.

Es similar cuando usamos la visión. No basta con la información de la luz que nos llega a los ojos para que sepamos qué estamos viendo. Investiguemos qué sucede con la información de la luz una vez que entra en el cuerpo del depredador.

6. Introduce notebook page. Have students turn to page 41, Investigating Animal Structures, in their notebooks. Read aloud the instructions about what students will do in the Sim and how they will complete the notebook page. Emphasize that you’d like students to observe what happens with the structures in the predator’s body after light reaches its eye.

7. Designate pairs and distribute devices. Have students work in the Sim and with their notebooks. Circulate to provide support as needed.

8. Discuss students’ observations. Review the what students have recorded in their notebooks.

¿Qué observaron que pasaba con las estructuras dentro del cuerpo cuando el depredador podía ver su presa? [La luz llegó al ojo a través de las pupilas y luego llegó a los receptores en la parte posterior del ojo. El nervio óptico resplandeció y envió la información sobre la presa al cerebro del depredador, donde se formó una imagen de la presa].

9. Transition to the next activity. Let students know that next they will use the reference book in order to further investigate the body structures that made it possible for the predator to see its prey.
Teacher Support

Instructional Suggestion

Providing More Support: Reviewing Structure and Function
Since the terms *structure* and *function* were not referenced in Chapter 2, you may find it useful to review these terms with your students. This will be especially helpful for the upcoming lessons and Chapter 4, in which students have many activities and discussions related to the structure and function of eye parts.

Background

Student Thinking: Addressing Misconceptions About Light and the Brain
At this point, some students may think that light is traveling all the way to the brain when an animal sees something. Light actually only travels as far as the light receptors in the eye. Information is then passed through nerves to the brain in the form of small electrical impulses. Don’t worry if students’ understanding is partial at this stage; they will gather more information as they read the reference book. Although they will not learn details about the form in which information is passed from the light receptors to the brain, they will eventually understand that the light itself does not travel all the way to the brain.

Possible Responses

*Vision and Light Simulation*

**What students should do and notice:**

Students should change the direction of light and the amount of light so the predator can see the prey. Students should notice that after the light arrows reflect off the prey, they enter the predator’s eye and hit the light receptors at the back of the predator’s eye. When light arrows hit the light receptors, the optic nerve lights up to show that information is being sent to the brain. The brain then lights up and an image of the prey appears in the thought bubble.
What did you observe happens after the light gets to the predator’s eye?

The light arrows go to the back of the eye. Then, the triangles at the back of the eye light up. These are called light receptors. Next, the optic nerve glows and once the glowing part reaches the brain, the predator sees its prey.

1. Light arrows enter the predator’s eye through the pupil (D).

2. Information from light gets to the light receptors at the back of the predator’s eye (C).

3. Information is sent from the light receptors, through the optic nerve, to the brain (B).

4. The predator’s brain forms an image of the prey (A).

Investigation Notebook

Investigating Animal Structures (page 41)

*What did you observe happens after the light gets to the predator’s eye?*

The light arrows go to the back of the eye. Then, the triangles at the back of the eye light up. These are called light receptors. Next, the optic nerve glows and once the glowing part reaches the brain, the predator sees its prey.
Investigar las estructuras de los animales

2. Ajusta la luz para que el depredador pueda ver su presa.
3. Observa lo que sucede después de que la luz llega al ojo del depredador.

¿Qué observaste que sucede después de que la luz llega al ojo del depredador?

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Reading: Handbook of Animal Eyes

Students refer to the *Handbook of Animal Eyes* to read how an animal knows what it is looking at.

### Instructional Guide

1. **Set purpose for revisiting the reference book.**

   Leamos el libro de referencia para aprender más sobre lo que observamos recién en la Simulación. Veamos cómo es que tanto la luz como las estructuras dentro del animal le permiten ver.

2. **Pairs read the reference book.** Distribute a copy of *Handbook of Animal Eyes* to each pair. Have pairs read page 4 together. Encourage students to read the diagram as well as the text.

3. **Introduce the matching notebook activity.** Have students turn to page 42, How Animals’ Structures Help Them See, in their notebooks. Review the directions.

4. **Students work in their notebooks.** Encourage pairs to work together and use the reference book as a resource.

5. **Discuss how information from light gets to an animal’s brain.**

   La pupila es un agujero que deja que pase luz al ojo. Sabemos que esta luz lleva información de lo que hay en el ambiente.

   Basándose en lo que leyeron sobre cómo funcionan las varias estructuras en el ojo y el cerebro, ¿cómo llega al cerebro de un animal la información de la luz? [La luz entra por la pupila, llega a los receptores de luz en la parte posterior del ojo y los receptores de luz envían información al cerebro. El cerebro forma una imagen].

6. **Introduce and post the receptor vocabulary card.**
7. Project the Sim to discuss how each structure works together. Go to the Student Apps Page and select the Vision and Light unit. Then, select the Simulation and open Recognizing Prey mode. Make sure the predator is set to have an open pupil. Adjust the light settings so that the predator can see its prey clearly. Follow the path of light into the predator’s eye. Point to each of the following structures and call on students to explain what happens in each of the structures. Highlight how all the structures function together to allow the predator to see its prey.

- The pupil. [It lets in the light/information.]
- The light receptors. [They respond to information from the light and send that information to the brain.]
- The optic nerve. [It carries the information from the light receptors to the brain.]
- The brain. [It makes a picture with the information.]

8. Reset and run the Sim with the closed pupil setting. Point out that if light can’t enter the predator’s eye through the pupil, it can’t see.

9. Collect digital devices and conclude the lesson. Let students know that they will continue to learn more about how animals know what they are looking at in the next lesson.

Teacher Support

Instructional Suggestion

Student Thinking: Reflection Time
You may wish to provide additional time for reflection to help students make sense of what they have been learning, synthesize ideas, and apply their learning to the central question about how an animal knows what it is looking at. You could choose to have students reflect in writing, through pair discussion, or through class discussion. Providing additional time for reflection allows students to consolidate their learning and also offers the teacher a window into students’ thinking, which can be helpful for identifying and addressing alternate conceptions or partial conceptions.

Background

Crosscutting Concept: Structure and Function Across Chapter 3
In Chapter 3, students investigate the questions How do an animal’s structures allow it to see its prey? and How do animals know how to react when they get information about their environment? These questions require students to build on their knowledge of structure and function, which they began developing when they investigated senses in Chapter 1, by narrowing in on the specific eye structures that help animals see things in their environment. Through
investigation with the Sim and reading the books *Handbook of Animal Eyes* and *Crow Scientist*, students discover how each structure helps an animal see things in their environment, and how one structure, the brain, can recognize objects and allow the animal to make decisions that could affect their ability to survive.

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**Background**

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**Rationale**

**Pedagogical Goals: Supporting the Crosscutting Concept of Structure and Function**

When students use the Simulation in Activities 1 and 2, they have a rich opportunity to consider how multiple structures—pupil, light receptors, optic nerve, and brain—each perform different functions that, together, enable an animal to see. To support the connection between these individual structure-function relationships and how the eyes structures each contribute to the overall function of vision, draw students’ attention to the complete path of light once it enters the eye through the pupil, travels to the light receptors at the back of the eye, and, eventually, forms an image that is processed by the brain as information about the environment. This is also an opportunity to invite students to consider analogous structure- and substructure-function relationships (e.g., how a bike has differently shaped parts that enable each to perform different functions, which together contribute to the overall function of transportation). Encouraging students to explicitly consider these relationship may not only help them apply this crosscutting concept to their understanding of science concepts in this unit, but also position them for success in applying the idea of structure and function to other relationships in the future.
Possible Responses

Investigation Notebook
How Animals' Structures Help Them See (page 42)

1. D
2. C
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