LIGHT AND VISION

differentiated passages

LEXILE®

970L

Name: _____ Date: _____

Nocturnal Sight

Nocturnal animals are creatures that are active at night. In order to get around successfully during the dark hours, these animals need sight adapted to the absence of bright light. The structure of nocturnal animals' eyes is one built for night vision.

Overall, nocturnal animals have larger eyes than **diurnal** organisms that are active during the day. The **pupil** has more room to expand and let more light in when the eyeball itself is bigger. Many nighttime prowlers have eyes that are so large they don't have enough muscles in the eyes to be able to move them in their sockets. To make up for this, some of these nocturnal animals, such as owls, can rotate their necks a surprising amount. This allows them to better take in their surroundings.

Pupil size and shape help nocturnal animals in navigating in the dark as well. Bright light causes pupils to get smaller to protect the **retina**. Darkness makes pupils relax and open. The pupils of nocturnal critters tend to open wider in low light, allowing more light in and letting them see better. Circular pupils are the least effective at opening and closing quickly. Slit pupils, on the other hand, are able to close like two sliding doors coming together. This movement is faster and more complete, allowing for better control in changing light. Most nocturnal animals have slit pupils. The slits can be vertical, horizontal, or diagonal in direction.

A cat's eyes with slit pupils.

Nocturnal Sight Questions

nd contrast the pupils of animals active during the day and nocturnal animals.

om the text supports the claim below:
mals' have a different type of pupil to help them survive at night.
s pupils relax and open.
for better control in changing light.
is faster and more complete.
e other hand, close like two sliding doors.

have no cones in their eyes at all. Explain how they can still see and ave this adaptation.

n the text that supports the claim below:
s nocturnal animals see more clearly at night.

Mag CORE

4th Grade NGSS 4-PS4-2

ABOUT LEXILE LEVELS

MagiCore Learning, LLC is a certified Lexile® Partner. These texts are officially measured and approved by Lexile and MetaMetrics® to ensure appropriate rigor and differentiation for students.

The Lexile Framework® for Reading measures are scientific, quantitative text levels. When the Lexile of a text is measured, specific, measurable attributes of the text are considered, including, but not limited to, word frequency, sentence length, and text cohesion. These are difficult attributes for humans to evaluate, so a computer measures them.

Common Core State Standards uses Lexile level bands as one measure of text complexity. Text complexity ranges ensure students are college and career ready by the end of 12th grade. Lexile measures help educators scaffold and differentiate instruction as well as monitor reading growth.

Grade Band	Lexile® Bands Aligned to Common Core Expectations
K-1	N/A
2-3	420L-820L
4-5	740L-1010L
6-8	1185L-1385L

Keep in mind when using any leveled text that many students will need scaffolding and support to reach text at the high end of their grade band. According to Appendix A of the Common Core Standards, "It is important to recognize that scaffolding often is entirely appropriate. The expectation that scaffolding will occur with particularly challenging texts is built into the Standards' grade-by-grade text complexity expectations, for example. The general movement, however, should be toward decreasing scaffolding and increasing independence both within and across the text complexity bands defined in the Standards."

Light and Vision

4th grade

Table of Contents

Each passage set includes two differentiated passages on a fourth-grade level (one at the beginning of the band, one towards the end) and a question set geared towards comprehension and science mastery. The first question is differentiated to include a fill-in-the-blank diagram (lower complexity) or an open-ended diagram (higher complexity).

How to Use This Resource

This resource was created with the NGSS Science Standards in mind. It includes six differentiated passages aligned to the following standard:

4-LS1-1: Light and Vision

Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (Cause and Effect)

Clarification Statement: None

Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.

Here are some suggestions for using these passages:

- Use as independent work after you have taught an overview of this standard. Assign the different levels based on the passage students can read and comprehend independently.
- Use as a reading center to reinforce key comprehension and science concepts at the same time!
- Use as a homework or review packet.
- Use as an intervention for students who need to revisit science concepts.

760L

Name: _____ Date: _____

Parts of the Eye

Your eyes are responsible for taking in information around you. They see shapes, colors, movements, and more. They send that information to your brain for processing. Humans have two eyes that are about the size of ping-pong balls. They are positioned in hollow areas of the skull called **eye sockets**. Each eye is protected by the **eyelid** which slides over the eye. The eyelid, along with tears, keeps the eye moist. Eyelids also keep the eyes clean by blinking every few seconds. Blinking is **voluntary**, meaning you can control when you blink and how fast. It is also **involuntary**, meaning your eyelids will blink without you having to remind them all the time. Eyelids shut in bright light or if something is coming toward them as a **reflex**, so your eyes don't get damaged. Eyelashes help act as a filter. They keep dust and other unwanted particles out of the eyes.

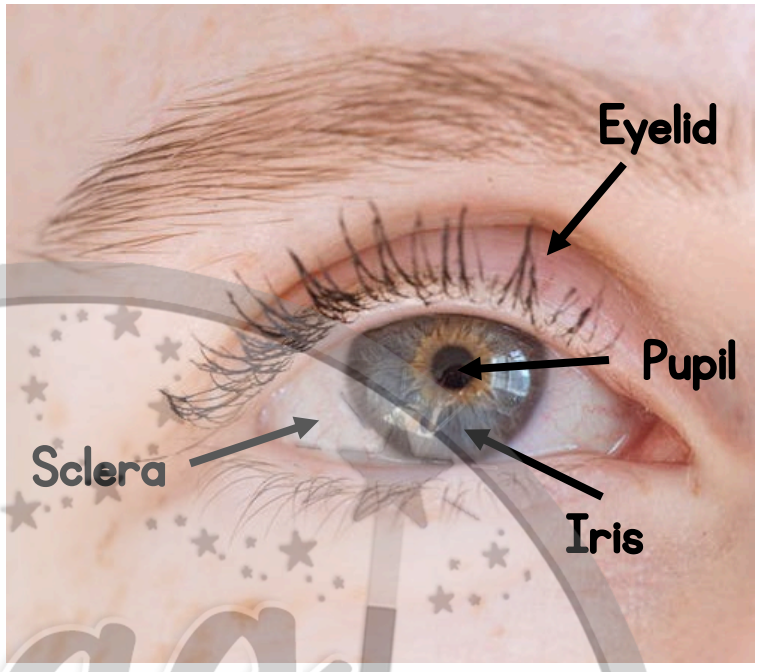
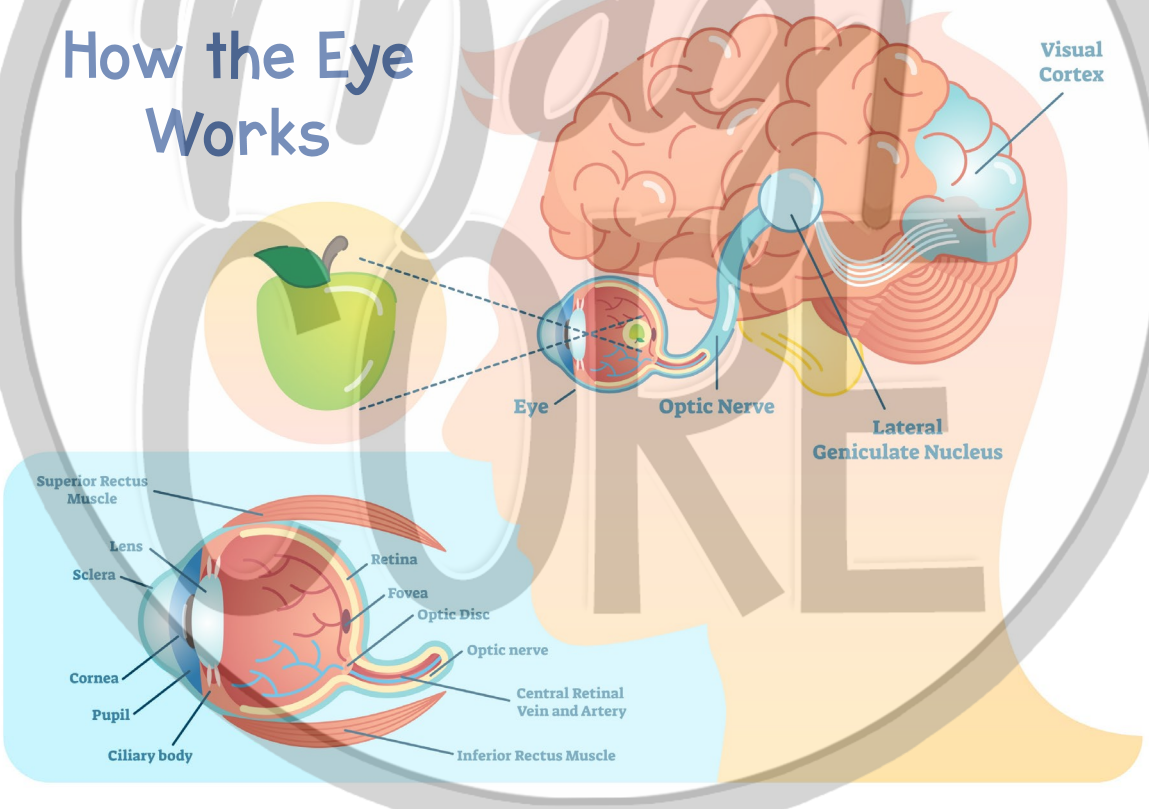


Diagram of the Eye

The **sclera** is the white part of your eye. It is a tough material that covers the eye and has blood vessels in it. The **cornea** is like a window that allows light into the eye. The **iris** is the colored part of the eye. The black part in the center of the iris is the **pupil**. The iris also has muscles that can **contract**. It controls the amount of light that enters the pupil. Pupils are wide in darkness as they try to let light in. They are small in bright light to protect the eye. The space between the cornea and the iris is called the **anterior chamber**. It's filled with a fluid that keeps the eye healthy. The biggest part of the eye is the **vitreous body**. It is a clear, jelly-like material located behind the **lens** that gives the eye its shape.

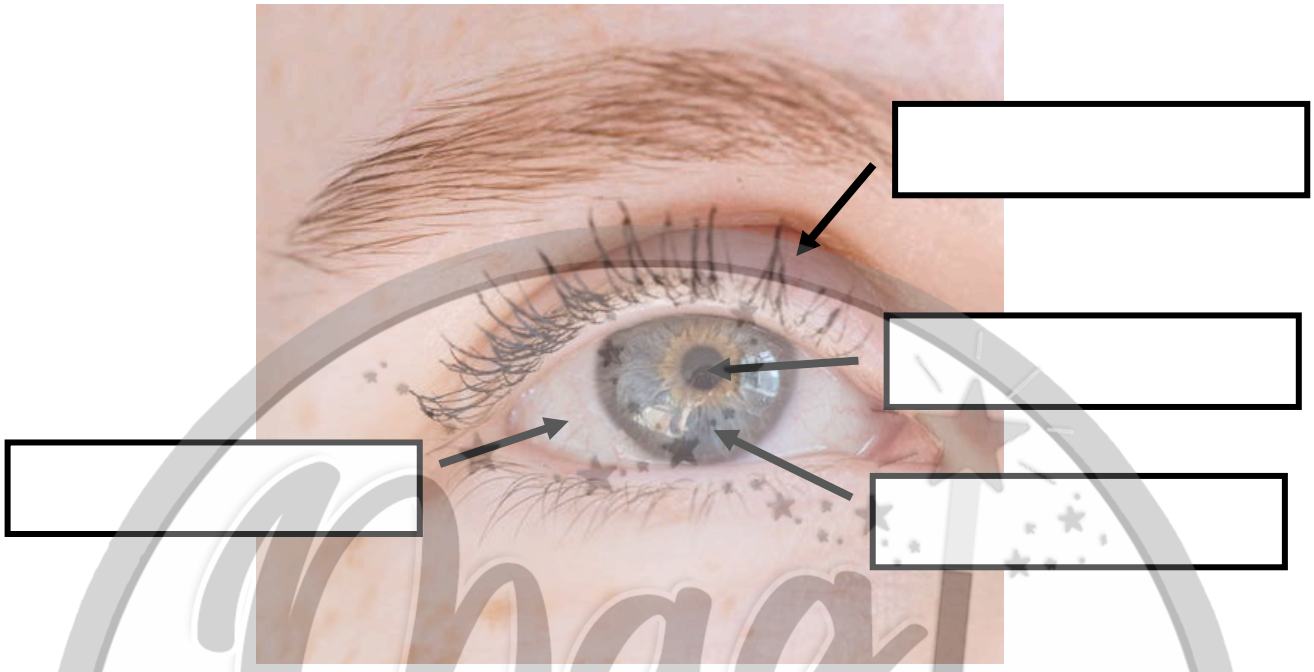
The magic of vision happens because of light. Light enters the pupil. The iris controls how much light comes in. Then the lens, located behind the iris, focuses the light. The lens thickens if your eyes focus on something close. It flattens if the object you're looking at is far away. It can do this because of the **ciliary body**, a muscle connected to fibers attached to the lens. The lens focuses the light on the **retina** at the back of the eyeball. The retina has millions of light-sensitive cells called **rods** and **cones**. Rods see in black, white, and gray and give us information about shape. Cones, on the other hand, sense color. Light is collected by these rods and cones, and they trigger electrical signals which travel through the **optic nerve** to the brain. The brain then figures out what your eyes are seeing and helps you make decisions about what to do.



Your eyes are an important source of information about the world around you. They work with your other senses to help you process your surroundings.

Parts of the Eye Questions

1. Label the parts of the eye on the diagram below:



2. Explain the purpose of eyelids.

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3. How does the pupil work to let light in?

---

4. Which part of the eye sees black and white? _____

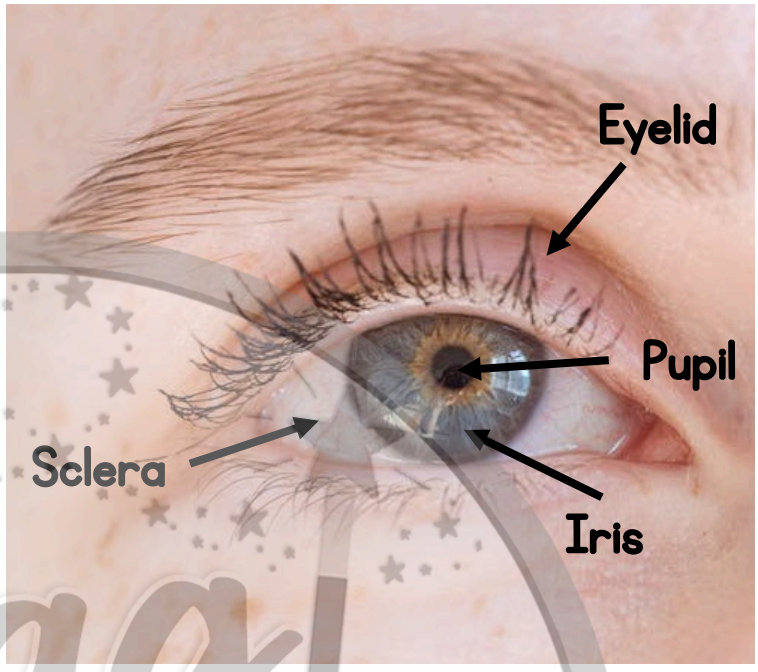
   Which part of the eye sees colors? _____

960L

Name: _____ Date: _____

Parts of the Eye

Your eyes are responsible for taking in information around you. They see shapes, colors, movements, and more and then send that information to your brain for processing. Humans have two eyes that are about the size of ping-pong balls. They are positioned in hollow areas of the skull called **eye sockets**. Each eye is protected by the **eyelid** which slides over the eye. The eyelid, along with tears, keeps the eye moist and clean by blinking every few seconds. Blinking is both **voluntary**, meaning you can control when you blink and how fast, and **involuntary**, meaning your eyelids will blink without you having to remind them all the time. Eyelids shut in bright light or if something is coming toward them as a **reflex**, so your eyes don't get damaged. Eyelashes help act as a filter, keeping dust and other unwanted particles out of the eyes.



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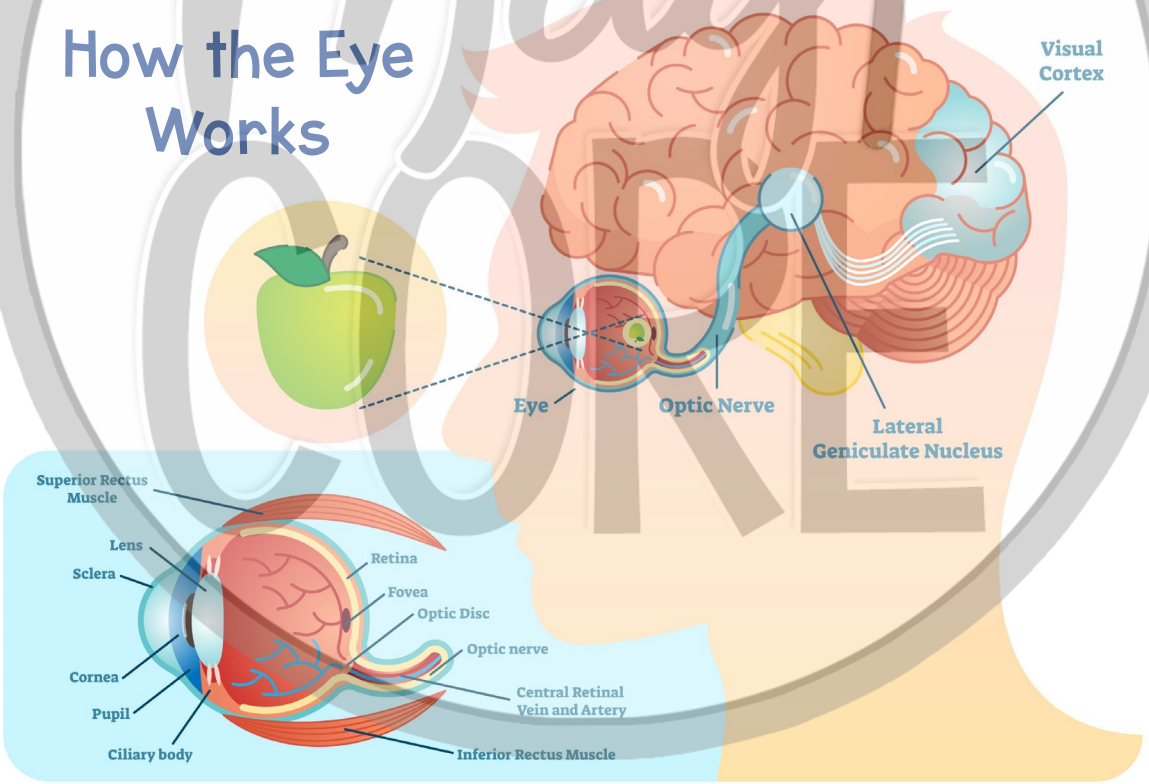
The magic of vision happens because of light. Light enters the pupil, and the iris controls how much light comes in. Then the lens, located behind the iris, focuses the light. The lens thickens if your eyes focus on something close, and it flattens if the object you're looking at is far away. It can do this because of the **ciliary body**, a muscle connected to fibers attached to the lens. The lens focuses the light on the **retina** at the back of the eyeball. The retina has millions of light-sensitive cells called **rods** and **cones**. Rods see in black, white, and gray and give us information about shape while cones sense color. Light is collected by these rods and cones, and they trigger electrical signals which travel through the **optic nerve** to the brain. The brain then figures out what your eyes are seeing and helps you make decisions about what to do.



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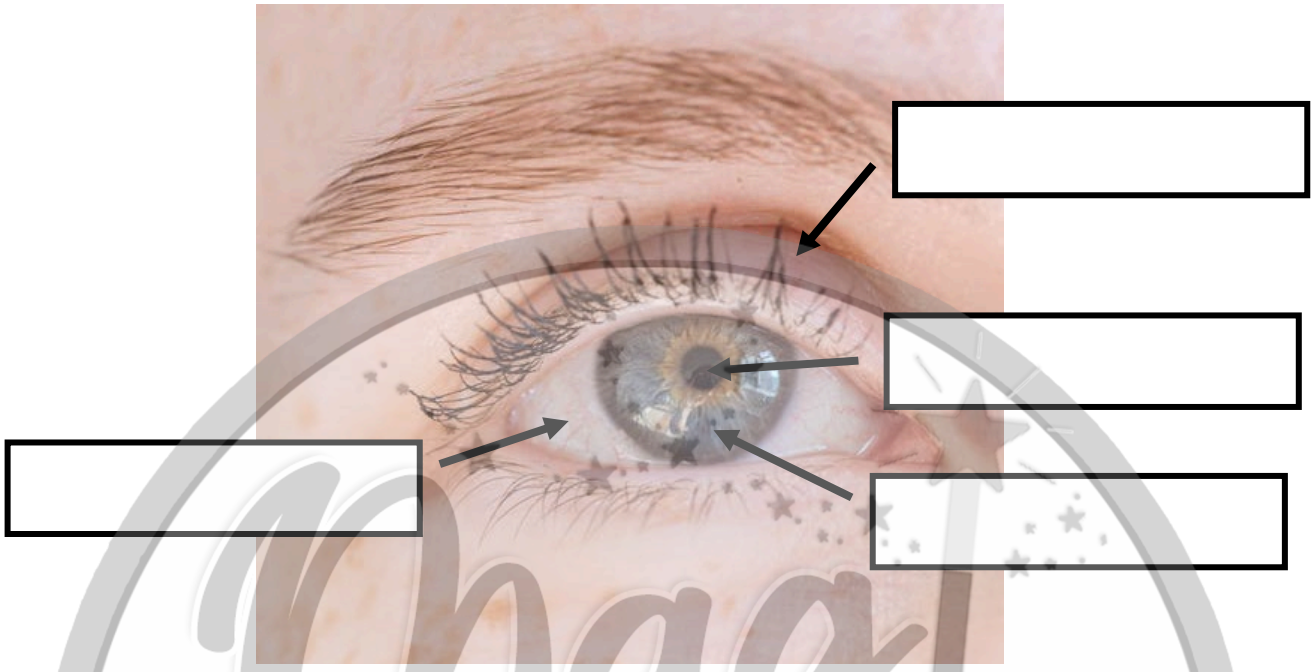

2. Explain the purpose of eyelids.

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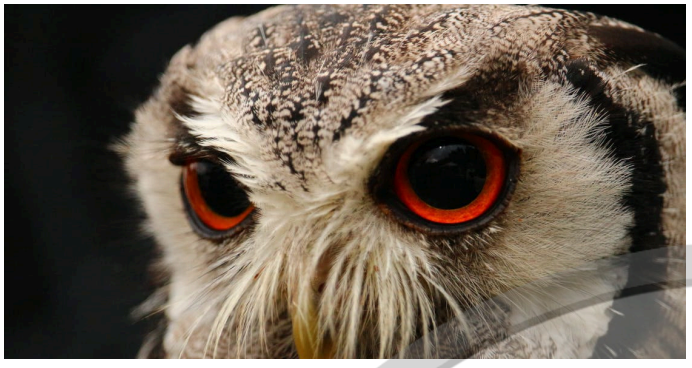
780L

Name: _____ Date: _____

Nocturnal Sight



Nocturnal animals are creatures that are active at night. These animals need to see without bright light in order to get around during the dark hours. Nocturnal animals' eyes are built for night vision.

Overall, nocturnal animals have larger eyes than animals that are active during the day. The **pupil** has more room to open. More light is let in when the eyeball itself is bigger. Many nighttime critters have eyes that are so large they don't have enough muscles in their eyes to move them in their sockets. Some of these nocturnal animals, such as owls, can turn their necks a surprising amount instead. This allows them to better take in the area around them.

Pupil size and shape help nocturnal animals live in the dark as well. Bright light causes pupils to get smaller. This protects the **retina**. Darkness makes pupils relax and open. The pupils of nocturnal animals open wider in low light. More light is let in, and they can see better. Circular pupils are not good at opening and closing quickly. Slit pupils, on the other hand, close like two sliding doors. This movement is faster and more complete. This allows for better control in changing light. Most nocturnal animals have slit pupils.

A cat's eyes with slit pupils.

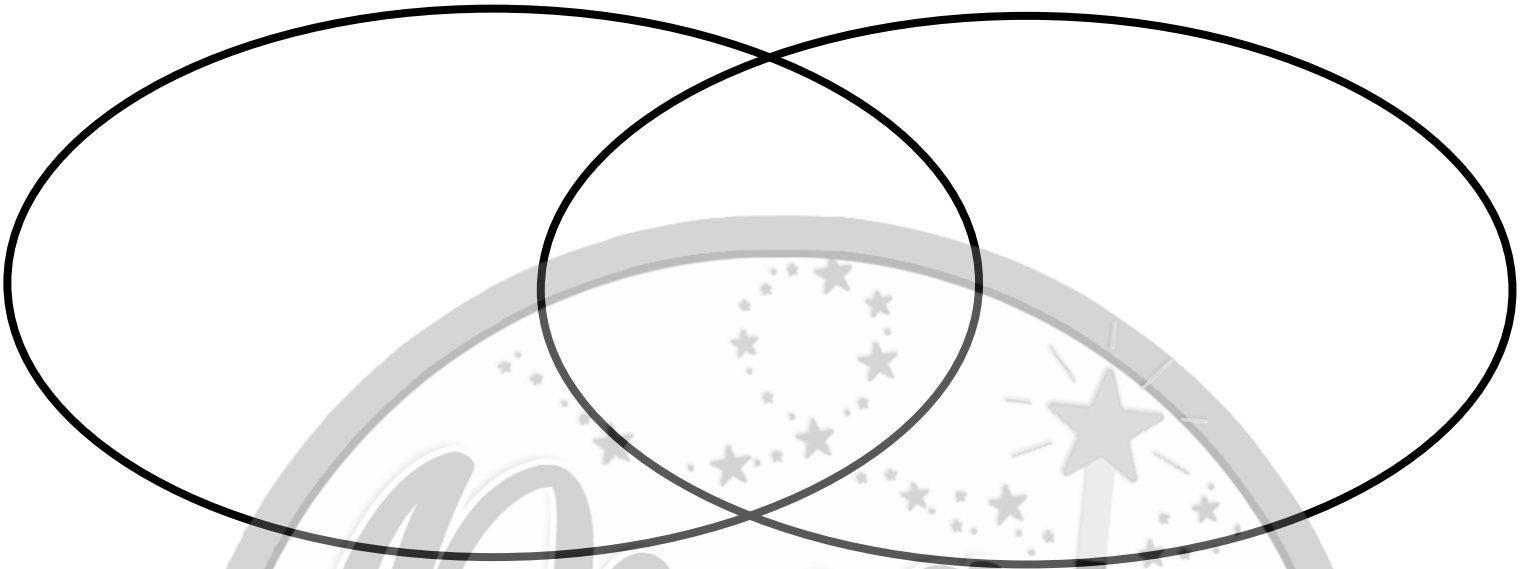
The **lens** focuses light entering through the pupil on the retina at the back of the eye. The retina has light-sensitive cells called **rods** and **cones**. Cones work well in bright light. They pick up color and details. Rods, however, work in low light. They sense movement and shape. Nocturnal animals have special rods in their retinas that help them see better in the darkness. Some animals such as nocturnal snakes have no cones in their eyes at all.

Many nocturnal animals also have an added eye part called a **tapetum**. The tapetum is a mirror-like membrane. It reflects light that has already passed to the retina back to the retina a second time. This gives the light another chance to hit the rods. The animal picks up more information this way. That information is then sent to the brain by the **optic nerve** connected to the retina.

Sight is an important sense for nocturnal animals. Their eyes have been designed to help them see in low light. They are able to hunt prey, avoid predators, and get around with this nighttime vision.

Nocturnal Sight Questions

1. Compare and contrast the pupils of animals active during the day and nocturnal animals.



2. What special cells do nocturnal animals have in their eyes? How do they help them at night?

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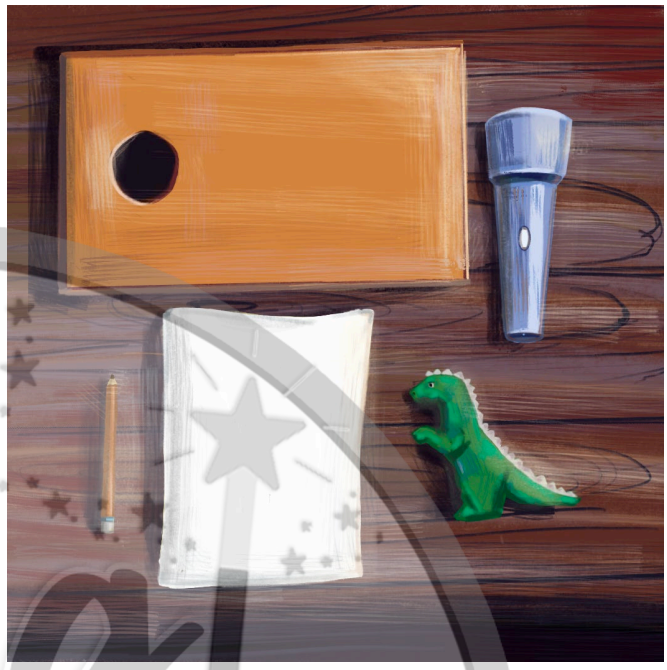
3. Explain the purpose of the tapetum.

910L

Name: _____ Date: _____

Seeing is Believing



Seeing involves three basic things: an object to view, a source of light, and a functional eye. Light reflects off objects and enters our eyes through the pupil. Specialized parts of the eye work together to process that light and send signals to the brain so you know what you are seeing.

You can test that light is needed for vision to work by performing a simple experiment. First, take a deep shoe box and cut a hole in the lid large enough for you to peek through.

Set the box on a table and gather a small object that will fit in the box, such as a toy of some kind. Have a flashlight handy along with a piece of paper and something to write with to record observations.

Place the toy on the table and spend a few minutes examining it in the regular light of the room. Record the details you see, such as color, size, shape, and texture. Use the flashlight to illuminate the object better and survey your list of details. Can you add anything to your description now that *more* light has been used to inspect the object? Do you perhaps see scratches or variations in color, for example?

Next, observe the shoe box, first with the lid off in the regular light of the room. Record your observations, then inspect the box more closely with the flashlight and add any details you didn't notice the first time to your list. Place the lid onto the shoe box and peer inside the hole. What do you see now? How does the box look the same, and how does it look different? Shine the flashlight inside the hole and describe what you see. Can you see the *entire* inside of the box or only a part of the interior?

Now remove the box's lid and put the toy inside. Secure the lid back on the box and without using the flashlight, record your observations. How hard is it to see the toy? Why do you think it's more difficult to see the toy now? Turn off the lights in the room and look in the box. Can you make out as many details of the toy as you did when you first observed it at the start of this experiment? What happens if you completely close your eyes?

Open your eyes again, flick on the flashlight, and shine it into the box. With the reappearance of a light source and your opened eyes, what do you see now? This activity should illustrate to you that in order to see an object, a light source and your working eyes are necessary.

Seeing is Believing Questions

1. List the materials needed for this experiment:
    1. _____
    2. _____
    3. _____

2. Describe the toy under bright light in detail. Be sure to include size, shape, color, and texture.

_____

_____

3. Describe the shoebox with the lid off and with the lid on. What do you see?

_____

_____

4. Describe how well you can see the toy when it is inside the shoebox with the lid closed. What about with the lights off?

_____

_____

_____

5. Describe how well you can see the toy in the shoebox when you shine the flashlight on it.

_____

_____

_____

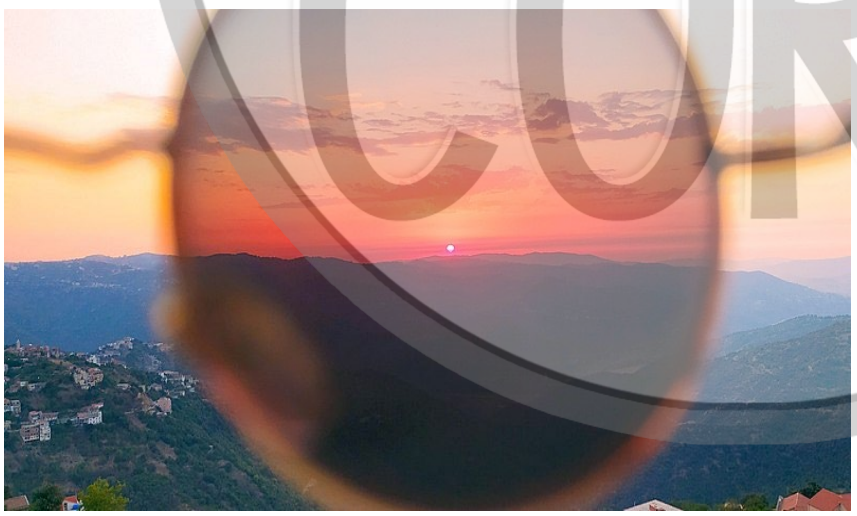
760L

Name: _____ Date: _____

Sunglasses Situations

Sunglasses protect your eyes from harmful light rays. The lenses are designed to block out **UV rays** from the sun. These rays can damage parts of the eye. The lenses of sunglasses are **polarized.** A special chemical coats the lenses in a vertical pattern. This pattern is made to block light reflected off shiny surfaces. The light travels in a horizontal direction. The coating on polarized lenses **absorbs** these light waves. This stops them from passing into your eye.

It gets harder to see through the lenses when you wear sunglasses indoors. Now the dark lenses are keeping the light you need to see out of your eyes. You're missing the details of objects. The colors are off a bit, too. This is all because not enough light is reaching your **retina**. The light-sensitive cells there aren't getting enough information to send to the brain.



View of the sky through sunglasses.

Wearing sunglasses inside is not a great idea for more reasons than lowering visibility. They can tire your eyes. This can cause headaches. Your vision may become blurry, as well. Walking around with dark lenses all the time can also cause your eyes to become sensitive to light when you finally take off the sunglasses.

You may have tried to look at the screen of your phone while wearing sunglasses. You probably had some trouble seeing. The screen may look black in this case. This is because the screen of your phone is made to cut back on glare – just like sunglasses are. They both have the same goal of helping you see better in bright sunlight. Your sunglasses do their job of only allowing light to pass through vertically. Your phone screen sends out horizontally vibrating light while blocking vertical light. The lenses and the screen end up **counteracting** one another. All you see is a dark or even black image on your screen. Turning your phone about 90 degrees can fix this. Now the filters in both your sunglasses and your screen are blocking light waves traveling in the same direction.

Sunglasses are a fun accessory to wear, but they also serve an important purpose. They protect your eyes from damaging sun rays and preserve your vision.

Sunglasses Situations Questions

1. Describe how sunglasses protect your eyes. Be sure to include why they are "polarized."

---

2. Why is it hard to see inside with sunglasses on?

---

3. What happens when you try to look at a phone with sunglasses on? What do you see?

---

3. Describe a time it would be a good idea to wear sunglasses. Why?

950L

Name: _____ Date: _____

Sunglasses Situations

Sunglasses protect your eyes from harmful light rays. The lenses are specially designed to block out **UV rays** from the sun. These rays can damage parts of the eye. The lenses of sunglasses are **polarized** with a special chemical. The chemical coats the lenses in a vertical pattern made to block light reflected off shiny surfaces. This light travels in a horizontal direction. The coating on polarized lenses **absorbs** these light waves, preventing them from passing into your eye.

When you wear sunglasses inside, it gets harder to see through the lenses. Now the dark lenses are keeping the light you need to see out of your eyes. You're missing the details of the objects you are seeing, and the colors are off a bit, too. This is all because not enough light is reaching your **retina,** so the light-sensitive cells there aren't getting enough information to send to the brain.

View of the sky through sunglasses.

Wearing sunglasses inside is not a great idea for more reasons than lowering visibility. They can cause your eyes to become tired which can make headaches occur. Your vision may become blurry when your eyes are tired, as well. Making a habit of walking around with dark lenses all the time can also cause your eyes to become sensitive to light when you finally remove the sunglasses.

You may have tried to look at the screen of your phone while wearing sunglasses and had some trouble seeing. The screen may look black in this case. This is because the screen of your phone is designed to cut back on glare – just like sunglasses are. They both have the same goal of helping you see better in bright sunlight. Your polarized sunglasses do their job of only allowing light to pass through vertically. Your phone screen sends out horizontally vibrating light while blocking vertical light. The lenses and the screen end up **counteracting** one another. All you see is a very dark or even black image on your phone screen. Rotating your phone by about 90 degrees can fix this. Now the filters in both your sunglasses and your screen are blocking light waves traveling in the same direction.

Sunglasses are a fun and stylish accessory, but they also serve an important purpose. They protect your precious eyes from damaging sun rays and preserve your vision.

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1. Describe how sunglasses protect your eyes. Be sure to include why they are "polarized."

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970L

Name: _____ Date: _____

Mirror, Mirror

Round mirror in a park.

A **mirror** is anything with a smooth surface that **reflects** the light that hits it. The surface must be smooth because a rough surface will scatter light instead. Light rays from an object come into contact with a mirror and then bounce off the mirror. Those rays of light enter your eyes through the **pupil**. They travel to the **retina** where special cells pick up details such as color and shape. All this information is sent to the brain along the optic nerve, and your brain registers the mirror image. Mirror images are reversed, so words on a T-shirt, for example, will be backward.

One of the earliest items to be used as a mirror was a dark pool of water. Early people were able to lean over dark water and see their images reflected back at them. The first mirrors that people made were polished stones like obsidian. Polished metals were also used as mirrors. The mirrors we use today are made of clear glass with a coating of thin metal such as aluminum on one side. Light passes through the glass, gets reflected by the metal, and bounces back to your eyes.

Convex mirror in a parking garage.

There are different types of mirrors. Flat mirrors are called plane mirrors. These are the kinds of mirrors you find in bathrooms because they reflect the most accurate image. Curved mirrors come in two types – **concave** and **convex**. Concave mirrors curve inward like bowls and at a distance, make objects appear upside down. Up close, the object appears right side up but larger than its actual size. Convex mirrors curve outward like a dome and make objects appear reversed and smaller than their actual size.

Mirrors are more than tools to help you look your best. They also help you drive with rearview and side mirrors on cars. They are used in science in **microscopes**, allowing doctors and scientists to see things that are too small to see with the human eye. If you want to see objects in space really far away, mirrors can help with that, too, because they are parts of **telescopes**. Mirrors are in many of the everyday machines you enjoy using for entertainment, such as televisions. Without mirrors, our lives would be more challenging.

Mirror, Mirror Questions

1. What is a mirror? Why do they need to be smooth?

---

2. Describe some of the first mirrors ever used. Have you ever noticed these items and thought they were mirrors?

---

3. Describe the difference between plane mirrors, concave mirrors, and convex mirrors.

---

4. Give an example of each kind of mirror:

Plane: _____

Concave: _____

Convex: _____

760L

Name: _____ Date: _____

Moongazing

Many people enjoy observing the night sky, searching for the moon in particular. The moon is a natural **satellite** that **orbits** Earth. It is about 238,900 miles away from Earth. This is still close enough for the moon's gravity to create the tides in Earth's seas. At one-fourth the size of Earth, the moon is made mostly of rock. It has craters along with plains made of lava that erupted from volcanoes billions of years ago.

We are able to see the moon from Earth. This is impressive considering it doesn't give off its own light. The moon reflects light from the sun instead. The sun is a star that is capable of making its own light. The sun's rays hit the moon. The light bounces off the moon's surface back to us. Our eyes allow that light to enter through the **pupil**. The moon often looks very bright in the dark sky, but it actually only reflects between 3 and 12 percent of the sunlight that hits it. The brightness depends on the moon's position on its path around Earth. The moon is lit at different angles by the sun during this trip, and this affects how it appears to us on Earth.

Only half of the moon's surface is facing the sun as it moves around the Earth. Therefore, only half of the moon's surface is lit up for us to see. The other half is always in the shadows because it faces away from the sun. The **phases** of the moon happen because of this movement and reflected light. The moon is brightest when it looks like a complete circle in the sky. This is a full moon. The maximum amount of the moon's surface is facing the sun. The moon appears to decrease in size as it orbits. It really doesn't change in size, though. The amount of surface reflecting light is what changes. The side of the moon reflecting sunlight is facing away from Earth during the new moon. We don't see the moon in the sky then. The moon looks as if it increases in size as it heads toward the full moon phase again.

Reflected sunlight makes moongazing possible. We wouldn't be able to admire the beauty of our closest neighbor in space without sunlight.

Moongazing Questions

1. Explain how we are able to see the moon.

---

2. What determines how bright the moon looks?

---

3. Describe why we can only ever see half of the moon's surface.

---

4. How does the moon appear to change in size over time in the sky?

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