Pre-Kindergarten:

Unit 6, Light

Essential Question: How and why do we use different kinds of light?
Lesson Plans: *TBA*
Objectives:

Standards	Reasoning
P-PS3-1: Plan and conduct an investigation to determine the effect of sunlight on Earth's surface. *[Clarification Statement*: Examples of effects could include illumination, shadows cast, and the warming effect on living organisms and nonliving things.] [*Assessment Boundary*: Assessment of effects is limited to relative measures: e.g., warm/cool, bright/dark.]	**TBA**

The text in the "Disciplinary Core Ideas" section is reproduced verbatim from A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas unless it is preceded by (NYSED). The performance expectations above were developed using the following elements from the NRC document A Framework for K–12 Science Education:

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Planning and Carrying Out Investigations ■ With guidance, plan and conduct an investigation in collaboration with peers. **(NGSS: P-PS3-1)** **Analyzing and Interpreting Data** ■ Analyze data from tests of an object or tool to determine if it works as intended. **(P-PS3-1)** **CONNECTIONS TO NATURE OF SCIENCE** Scientific Investigations Use a Variety of Methods ■ Scientists use different ways to study the world. **(P-PS3-1)**	**PS3.B: Conservation of Energy and Energy Transfer** ■ Sunlight warms Earth's surface. **(P-PS3-1)** **PS4.B: Electromagnetic Radiation** ■ Objects can be seen if light is available to illuminate them or if they give off their own light. (P-PS3-1)	**Cause and Effect** ■ Simple tests can be designed to gather evidence to support or refute student ideas about causes. **(P-PS3-1)**

Kindergarten: N/A

1st Grade:

Unit 1, Exploring Light and Solar Patterns

Essential Question: Why do we see objects?
Lesson Plans: Eye Model, Physics of the Eye (Dissection + DIY)
Objectives:

Standards	Reasoning
1-PS4-2. Make observations (firsthand or from media) to construct an evidence-based account that objects can be seen only when illuminated. ▲ **Physics is partially addressed in the unit of study (and appears in another unit in the same grade level or band).** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.] **1-PS4-3.** Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]	Students will have the opportunity to use a DIY kit, which features a light source and lenses to understand **1.** How Illumination could be from an external light source or by an object giving off its own light (in the dark or in a light room.) **2.** How light (beam of light) travels as a particle and wave. **3.** How materials interact with light. a. Such materials could include the comparison of those that are transparent (such as DIY lens), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Constructing Explanations and Designing Solutions ■ Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2) ■ Make observations (firsthand or	**PS4.B: Electromagnetic Radiation** ■ Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2) ■ Some materials allow light to	**Patterns** ■ Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-2) **Cause and Effect** ■ Simple tests can be designed to

from media) to construct an evidence-based account for natural phenomena. (1-PS4-2)	pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: *The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.*) (1-PS4-3)	gather evidence to support or refute student ideas about causes. (1-PS4-2), (1-PS4-3)

2nd Grade: N/A

3rd Grade:

Unit 2, Interdependence

Essential Question: How do the traits of an organism help it to survive in its environment?
Lesson Plans: Eye Dissection
Objectives:

Standards	Reasoning
3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [*Clarification Statement*: Examples of cause and effect relationships could include plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to produce offspring.]	This lesson will allow educators to use the dissection of a cow's eye to better understand how traits of a cow's eye influence a cow's behavior and helps it survive in its environment (a cow's living ecosystem.) For ex. 1. Domesticated cattle often live in grasslands. They spend parts of the day grazing on grass. Thus, a cow's ***cornea*** has many layers to make it thick and strong. When the cow is *grazing*, blades of grass may poke the cow's eye— but the cornea protects the inner eye. 2. With natural selection and adaptation, cows have a ***tapetum***, which helps them to see in dark and provides a large visual field so that they can see their hunters much earlier and prevent them from danger.

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Analyzing and Interpreting Data ■ Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1) **Constructing Explanations and Designing Solutions** ■ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-PS4-2) **Engaging in Argument from Evidence** ■ Construct an argument with evidence, data, and/or a model. (3-LS2-3)	**LS4.B: Natural Selection** ■ Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2) **LS4.C: Adaptation** ■ For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)	**Cause and Effect** ■ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-2), (1-PS4-3) **CONNECTIONS TO NATURE OF SCIENCE** **Science Is a Human Endeavor** ■ Science affects everyday life. (3-ESS3-1)

4th Grade:

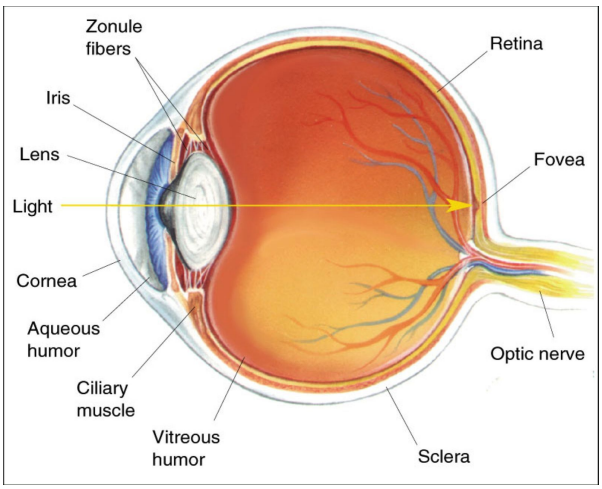
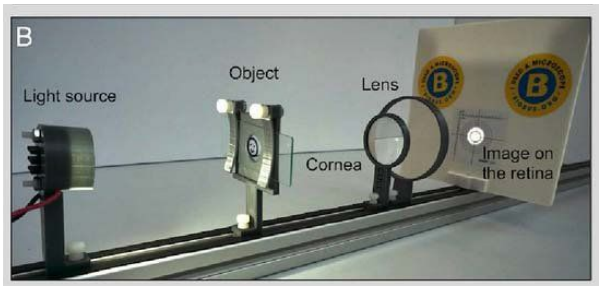
Unit 2, Transfer of Energy and Information

Essential Question: How do we know energy is conserved as it is transformed from one form to another?

Lesson Plans: Physics of the Eye (Dissection + DIY)

Objectives:

Standards	Reasoning
4-PS3-2. Make observations to provide evidence that energy is conserved as it is transferred and/or converted from one form to another. [Clarification Statement: Examples of forms of energy could include sound, light, heat, and electrical.] [Assessment Boundary: Assessment does not include quantitative measurements of energy. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. ∗ [*Clarification Statement*: Examples of devices could include electric circuits that convert electrical energy into energy of motion of a vehicle, light, or sound; batteries	Students will have the opportunity to dissect a cow's eye and use a DIY kit, which features a light source and lenses to model the communication process of an eye. With this grade, students can observe the structure of the ***retina/optic nerve*** in cow eye dissection; and understand the distance of a light source to the retina in a DIY assembling (model a cow or human eye)**.** Overall, students will understand how with the retina: light is converted from light energy into neural activity for visual processing.

that convert chemical energy to electrical energy; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary*: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]	 Ex: 

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Constructing Explanations and Designing Solutions ■ Apply scientific ideas to solve design problems. (4-PS3-4) **Engaging in Argument from Evidence** ■ Construct an argument with evidence, data, and/or a model. (3-LS2-3)	**PS3.A: Definitions of Energy** ■ (NYSED) Energy can be transferred by moving objects or by sound, light, heat, or electric currents. (4-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** ■ Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) ■ (NYSED) Energy can also be transferred by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2), (4-PS3-4)	**Energy and Matter** ■ Energy can be transferred in various ways and between objects. (4-PS3-2), (4-PS3-4) **CONNECTIONS TO ENGINEERING, TECHNOLOGY, AND APPLICATIONS OF SCIENCE** **Interdependence of Science, Engineering, and Technology** ■ Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3) **Influence of Engineering, Technology, and Science on Society and the Natural World** ■ Engineers improve existing technologies or develop new ones. (4-PS3-4) **CONNECTIONS TO NATURE OF**

	PS3.D: Energy in Chemical Processes and Everyday Life ■ The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) **PS4.C: Information Technologies and Instrumentation** ■ Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information. (4-PS4-3)	**SCIENCE** **Science Is a Human Endeavor** ■ Most scientists and engineers work in teams. (4-PS3-4)

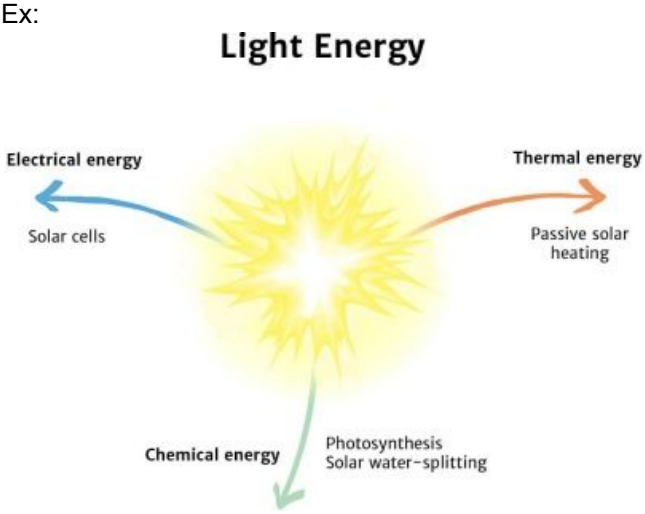
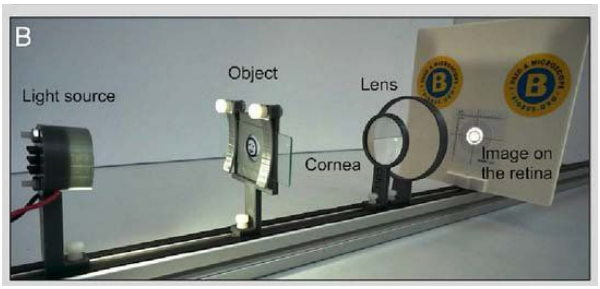
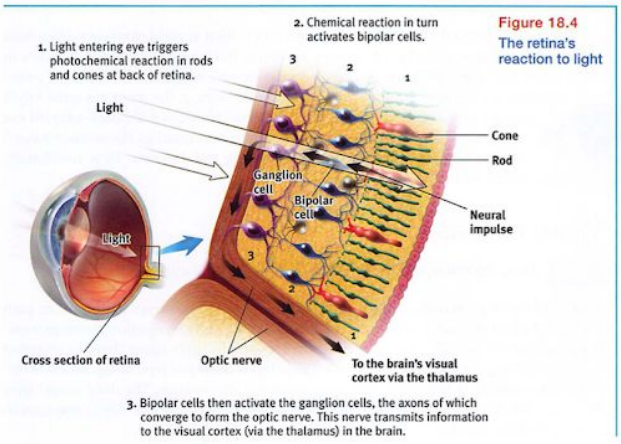
5th Grade: N/A

6th Grade:

Unit 2, Engineering and Energy Transformations

Essential Question: How can we minimize or maximize the transfer of heat?
Lesson Plans: Physics of the Eye (Dissection + DIY)
Objectives:

Standards	Reasoning
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy during a chemical and/or physical process. ✱ [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and amount of a substance. [Assessment Boundary: Assessment is limited to the criteria of substance amounts, reaction time, and observed temperature changes.]	Students will have the opportunity to **design/assemble** a DIY microscope kit, which features an adjustable light source and lenses to model the communication processes of an eye. With this grade, students can observe the visible 'light' as a form of radiation, which can be defined as an **energy** that travels in the form of electromagnetic waves and as a flow of particle-like 'wave-packets', called photons. In addition, how light can serve as electrical energy, thermal energy, and chemical energy, in which emphasis for the lesson will be on chemical energy. Students will learn about **photochemical reactions**, as the **retina** absorbs the chemical energy of light rays, converts (transforms) it into electrical impulses,

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. ✱ [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] ✱ The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.	and releases it into the optic nerve for visual processing. Students will also measure the **focal length** of light rays as well with the lenses. Ex:   

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Constructing Explanations and Designing Solutions ■ Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	**PS1.B: Chemical Reactions** ■ (NYSED) Some chemical reactions release energy, others absorb energy. (MS-PS1-6)	**Energy and Matter** ■ The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6), (MS-PS3-3)

(MS-PS3-3) ■ Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) **Engaging in Argument from Evidence** ■ Construct an argument with evidence, data, and/or a model. (3-LS2-3) --- **CONNECTIONS TO NATURE SCIENCE** **Scientific Knowledge Is Based on Empirical Evidence** ■ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-4)	**PS3.A: Definitions of Energy** ■ (NYSED) Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, phases (states), and amounts of matter present. (MS-PS3-3), (MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** ■ (NYSED) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the mass of the sample, and the environment. (MS-PS3-4)	

7th Grade:

Unit 3, Structures of Life

Essential Question: Why are cells considered the smallest unit of life?
Lesson Plans: Eye Dissection
Objectives:

Standards	Reasoning
MS-LS1-1. Plan and conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one cell or many and varied cells.] **MS-LS1-2.** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	This lesson will allow educators to use the dissection and **model of a cow's eye** (usually, part of a living organism) to better understand how an eye is made up of **cells** that give function to **structuralized parts.** While dissecting, students will come across different parts of the eye, including a thick covering of fat and muscle tissues. Educators can use this opportunity to discuss how all of the parts of an eye are made up of different types of cells to carry out a specific function. But most of all, how they are needed for visual processing. When coming across the structure of a **retina** (made

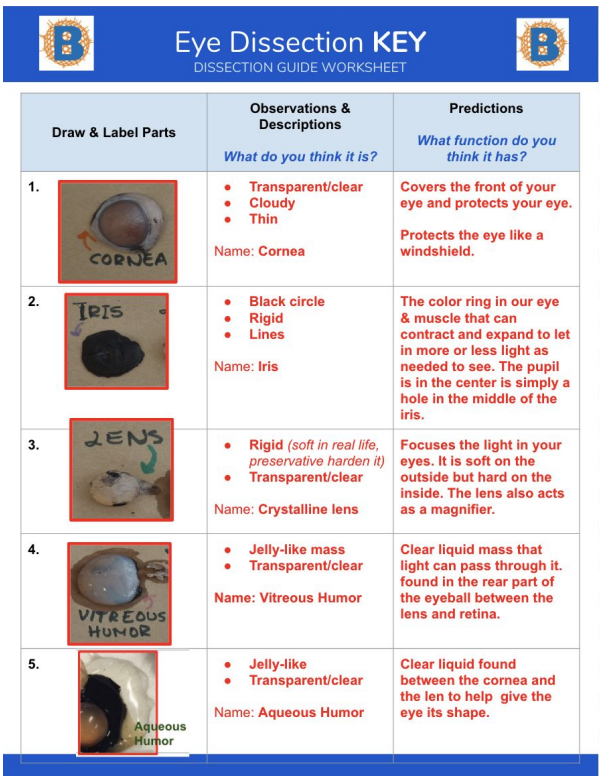
[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.]

[Assessment Boundary: Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical details related to the functions of cells or cell parts.]

up of photoreceptor cells) students will also learn about the concept of **information processing**.

This lesson will include a dissection guide for *advanced students* (also high schoolers) in which they can identify parts of the eye that are made up of cells, understand how those cells give each part certain functions, cause/effect, and explain why.

Ex:



Eye Dissection **KEY**

DISSECTION GUIDE WORKSHEET

Draw & Label Parts	Observations & Descriptions *What do you think it is?*	Predictions *What function do you think it has?*
1. CORNEA	• Transparent/clear • Cloudy • Thin Name: Cornea	Covers the front of your eye and protects your eye. Protects the eye like a windshield.
2. IRIS	• Black circle • Rigid • Lines Name: Iris	The color ring in our eye & muscle that can contract and expand to let in more or less light as needed to see. The pupil is in the center is simply a hole in the middle of the iris.
3. LENS	• Rigid *(soft in real life, preservative harden it)* • Transparent/clear Name: Crystalline lens	Focuses the light in your eyes. It is soft on the outside but hard on the inside. The lens also acts as a magnifier.
4. VITREOUS HUMOR	• Jelly-like mass • Transparent/clear Name: Vitreous Humor	Clear liquid mass that light can pass through it. found in the rear part of the eyeball between the lens and retina.
5. Aqueous Humor	• Jelly-like • Transparent/clear Name: Aqueous Humor	Clear liquid found between the cornea and the len to help give the eye its shape.

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Developing and Using Models ■ Develop and use a model to develop, use, describe, test, and predict more abstract phenomena. (MS-LS1-2) ■ Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) **Constructing Explanations and Designing Solutions** ■ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws	**LS1.A: Structure and Function** ■ All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) ■ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) ■ In multicellular organisms, the body is a system of multiple interacting subsystems. These	**Cause and Effect** ■ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) **Systems and System Models** ■ Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. (MS-LS1-3) **Structure and Function** ■ Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be

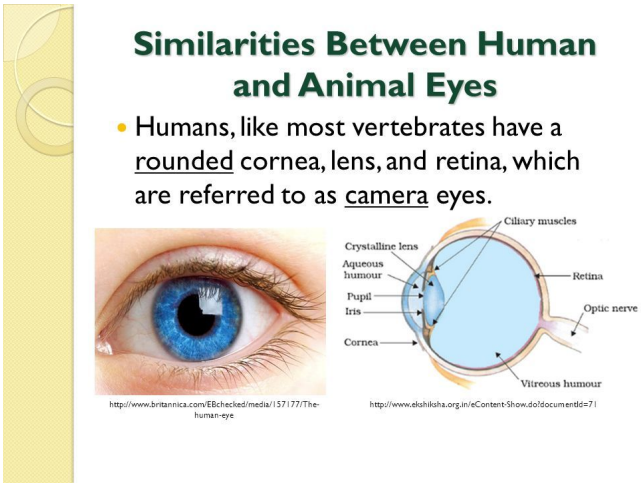
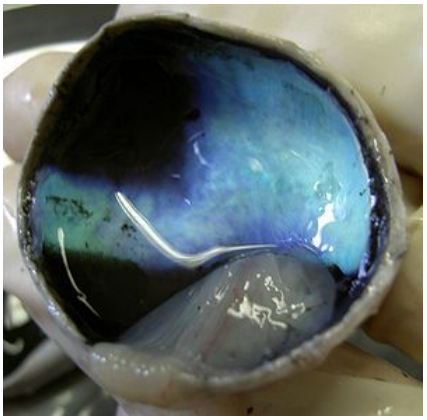
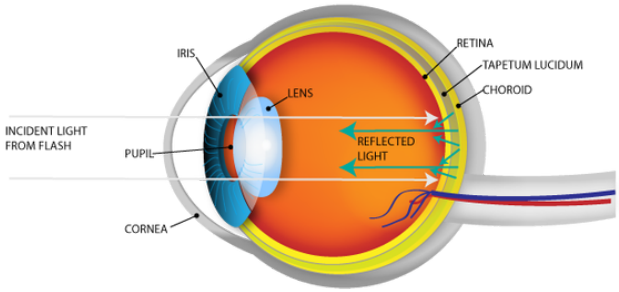
that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-3)	subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.D: Information Processing** ■ Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. (MS-LS1-8)	analyzed to determine how they function. (MS-LS1-2) **CONNECTIONS TO ENGINEERING, TECHNOLOGY, AND APPLICATIONS OF SCIENCE** **Interdependence of Science, Engineering, and Technology** ■ Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1) **CONNECTIONS TO NATURE OF SCIENCE** **Science Is a Human Endeavor** ■ Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3).

8th Grade:

Unit 4, Evolution, Natural Selection, and Adaptations

Essential Question: How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms?
Lesson Plans: Eye Dissection
Objectives:

Standards	Reasoning
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms	This lesson will allow educators to use the dissection of a cow's eye to help students understand the anatomical similarities/differences of a human eye. Cows and Humans both have a cornea, lens, sclera, retina, and optic nerve as *similarities*. But a cow has a **tapetum lucidum for night vision**, which humans do

of similarity or differences of the gross appearance of anatomical structures as evidence of common ancestry.]	not have as a *difference.* 
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]	During dissection, students will come across the ***tapetum lucidum*** of a cow's eye, a form of **natural selection** that was developed as cow's **evolved**. Educators can use this opportunity to talk about how these are needed for a cow's survival during the night time for protection from cattle predators such as, "coyotes, cougars, bobcats, lynx, dogs, wolves, vultures, bears and others." Without much survival of male/female cattle, there will be a huge strain on reproduction overtime.  

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Constructing Explanations and Designing Solutions ■ Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) **CONNECTIONS TO NATURE OF SCIENCE** **Scientific Knowledge Is Based on Empirical Evidence** ■ Science knowledge is based upon logical and conceptual connections betw	**LS4.A: Evidence of Common Ancestry and Diversity** ■ Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) **LS4.B: Natural Selection** ■ (NYSED) Natural selection can lead to an increase in the frequency of some traits and the decrease in the frequency of other traits. (MS-LS4-4) **LS4.C: Adaptation** ■ Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	**Patterns** ■ Patterns can be used to identify cause and effect relationships. (MS-LS4-2) ■ Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1), (MS-LS4-3) ■ Similarities and differences in patterns can be used to sort and classify organisms. (MS-LS4-2) **Cause and Effect** ■ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6) **CONNECTIONS TO NATURE OF SCIENCE** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ■ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1), (MS-LS4-2)