CEREAL CITY SCIENCE by BCAMSC

Teacher Guide and Student Journal
Sample Activity and Planning Pages

Structure, Function, and Information Processing 4LNG

SECOND EDITION

A fourth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

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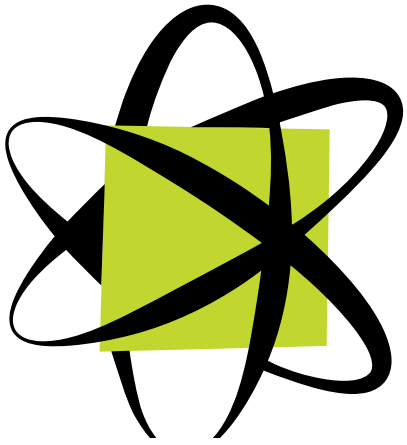
Structure, Function, & Information Processing

4LNG

A fourth-grade unit supporting **Next Generation Science Standards** and the **Michigan Science Standards** developed and written by the Battle Creek Area Mathematics and Science Center for



CEREAL CITY SCIENCE

by BCAMSC

Structure, Function, & Information Processing

Pre-activity Informational Pages

Activities

Appendix

NEXT GENERATION SCIENCE STANDARDS

DISCIPLINARY CORE IDEAS	Activities
PS4.B: Electromagnetic Radiation • An object can be seen when light reflected from its surface enters the eyes.	1,2,3
4-PS4-2.Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	1,2,3
LS1.A: Structure and Function • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	4,5
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	1,2,3
LS1.D: Information Processing • Different sense receptors are specialized for particular kinds of information, which may then be processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	1,2,3
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	2,3,5

NEXT GENERATION SCIENCE STANDARDS

SCIENCE AND ENGINEERING PRACTICES	Activities
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model to describe phenomena. • Use a model to test interactions concerning the functioning of a natural system.	1,2,3,4,5
4-PS4-2.Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	1,2,3
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	2,3,5
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model. • Construct an argument with evidence. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	2
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	1,2,3

CROSSCUTTING CONCEPTS	Activities
Cause and Effect • Cause-and-effect relationships are routinely identified, tested, and used to explain change.	2
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	1,2
Systems and System Models • A system can be described in terms of its components and their interactions.	4
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	1,2,3
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brains, and respond to the information in different ways.	1,3

COMMON CORE STATE STANDARDS - READING

Reading Standards for Informational Text—Grade 4	Activities
Key Ideas and Details	
RI.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.	3,4,5
RI.4.2: Determine the main idea of a text and explain how it is supported by key details; summarize the text.	3,4,5
RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.	3,4,5
Craft and Structure	
RI.4.4: Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.	3,4,5
RI.4.5: Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	3,4,5
RI.4.6: Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.	4
Integration of Knowledge and Ideas	
RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.	3,4,5
RI.4.8: Explain how an author uses reasons and evidence to support particular points in a text.	3,4,5
RI.4.9: Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.	3,4
Range of Reading and Level of Text Complexity	
RI.4.10: By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.	3,4,5

COMMON CORE STATE STANDARDS - WRITING

Writing Standards—Grade 4	Activities
Text Types and Purposes	
W.4.1: Write opinion pieces on topics or texts, supporting a point of view with reasons and information. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which related ideas are grouped to support the writer's purpose. a. Provide reasons that are supported by facts and details. b. Link opinion and reasons using words and phrases (e.g., *for instance, in order to, in addition*). c. Provide a concluding statement or section related to the opinion presented.	1,3,4
W.4.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension. b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. c. Link ideas within categories of information using words and phrases (e.g., *another, for example, also, because*). d. Use precise language and domain-specific vocabulary to inform about or explain the topic. e. Provide a concluding statement or section related to the information or explanation presented.	1,2,3,4,5
W.4.3: Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences. a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally. b. Use dialogue and description to develop experiences and events or show the responses of characters to situations. c. Use a variety of transitional words and phrases to manage the sequence of events. d. Use concrete words and phrases and sensory details to convey experiences and events precisely. e. Provide a conclusion that follows from the narrated experiences or events.	4

COMMON CORE STATE STANDARDS - WRITING

Writing Standards—Grade 4	Activities
Production and Distribution of Writing	
W.4.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)	1,2,3,4,5
W.4.5: With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.	2,4,5
W.4.6: With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting.	4,5
Research to Build and Present Knowledge	
W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.	2,3,4,5
W.4.8: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	2,3,4,5
W.4.9: Draw evidence from literary or informational texts to support analysis, reflection, and research. Apply grade 4 reading standards to literature (e.g., "Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text [e.g., a character's thoughts, words, or actions]."). Apply grade 4 reading standards to information texts (e.g., "Explain how an author uses reasons and evidence to support particular points in a text.").	3,4,5
Range of Writing	
W.4.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.	1,2,3,4,5

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 4	Activities
Mathematical Practices	
1. Make sense of problems and persevere in solving them.	
2. Reason abstractly and quantitatively.	
3. Construct viable arguments and critique the reasoning of others.	
4. Model with mathematics.	
5. Use appropriate tools strategically.	
6. Attend to precision.	
7. Look for and make use of structure.	
8. Look for and express regularity in repeated reasoning.	
4.OA Operations and Algebraic Thinking	
Use the four operations with whole numbers to solve problems. 1. Interpret multiplication equations as a comparison, e.g., interpret $35=5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. 2. Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.	
Generate and analyze patterns. 1. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.	
4.NBT Number and Operations in Base Ten	
Generalize place value understanding for multi-digit whole numbers. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. 1. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. 2. Use place value understanding to round multi-digit whole numbers to any place.	

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 4	Activities
3. Use place value understanding and properties of operations to perform multi-digit arithmetic. 4. Fluently add and subtract multi-digit whole numbers using the standard algorithm. 5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	
4.MD Measurement and Data	
Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. 1. Know relative sizes of measurement units within one system of units, including km, m, cm; kg, g; lb, oz; l, ml; and hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. 2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems that require expressing measurements given in a larger unit in terms of the smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature measurement.	
Represent and interpret data. 1. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots.	
4.G Geometry	
Draw and identify lines and angles, and classify shapes by properties of their lines and angles. Draw points, lines, line segments, rays, angles (right, obtuse, acute), and perpendicular and parallel lines. Identify these in two-dimensional figures.	

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goals	Phenomena	Summary: Students Will…
1 Light and Sight	Preparation: 35 min. Activity 1: 5 classes Lesson 1A: 45–50 min., 2 classes Lesson 1B: 45–50 min. Lesson 1C: 45–50 min. Lesson 1D: 45–50 min.	Develop and use models to explain how light travels in a straight path, illuminates objects in its path, and is necessary for sight.	Outside/Inside: ability to see when going from a very bright light to a dim light.	• Collaborate to develop models of what happens to our eyes when we go from very bright sunshine outside to a dimly lit room inside. • Collect data on the ability to see objects with no light, some light, and bright light. • Make and use models to demonstrate how light travels in a straight path and illuminates objects in its path. • Conduct an investigation to find out how light reflects off different materials.
2 Our Eyes in Bright Light and Darkness	Preparation: 35 min. Activity 2: 2 classes Lesson 2A: 45–50 min. Lesson 2B: 45–50 min.	Plan and carry out an investigation into the reaction of the eye when going from dark to light conditions.	Outside/Inside: ability to see when going from a very bright light to a dim light.	• Conduct an investigation to find out how the human eye reacts to light and darkness. • Collect data based on observations. • Compile class data from their investigations to explain the phenomenon. • Develop a model of the reaction of the eye to light and dark, based on data from their investigation. • Evaluate and critique each other's models based on evidence from their investigations.
3 Animal Eyes	Preparation: 40 min. Activity 3: 4 classes Lesson 3A: 45–50 min., 2 classes Lesson 3B: 45–50 min., 2 classes	Obtain, apply, and share information about animal eyes and how they help in survival.	Eyeshine: animal eyes that shine or glow in the dark	• Role play as predator and prey to find out the importance of eyesight in animal survival. • Compare different animals to the role of the mountain lion (predator) and the role of the rabbit (prey). • Determine how the shape and position of the eyes in predators and prey differ to help each survive. • Read two different texts about different animals and their eyes.

UNIT AT A GLANCE

Students Figure Out How to:	Practices and Crosscutting Concepts	Assessment
• Develop and use a model to explain what happens to our eyes when we move into and out of different light conditions. • Raise questions based on observations. • Analyze and interpret data to make sense of how the eyes need light for sight. • Revise model based on new information. • Construct an explanation, based on evidence from investigations, to explain how light is necessary for sight.	**Asking Questions And Defining Problems** **Developing and Using Models** **Analyzing and Interpreting Data** **Constructing Explanations and Designing Solutions** **Planning and Carrying Out Investigations** **Cause and Effect**	**Formative Assessment** initial models, Science Talk adjusted models handout Journal Entry **Summative Assessment** revised models Science Talk Journal Entry
• Plan and carry out an investigation into the reaction of the eye when going from very bright to very dim or dark. • Obtain evidence from investigations to find out how the eye reacts to bright light and dim light. • Revise models and thinking based on evidence from investigations. • Relate their findings from their investigations to the Outside/Inside phenomenon. • Share and evaluate each others' models.	**Developing and Using Models** **Constructing Explanations and Designing Solutions** **Engaging in Argument from Evidence** **Planning and Carrying Out Investigations** **Analyzing and Interpreting Data** **Cause and Effect**	**Summative Assessment** revised models revisions to probe in Student Journal final model Science Talk Activity Page Respond to Text
• Make comparisons of animal eyes to determine how the shape and position of the eyes help the animal to survive. • Obtain information from text to find out the different traits of eyes and how they help animals sense their surroundings. • Share and compare information from two different texts on animal eyes.	**Asking Questions And Defining Problems** **Constructing Explanations and Designing Solutions** **Systems and System Models**	**Formative Assessment** Science Talk Activity Page group models **Summative Assessment** Journal Entry final models

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goals	Phenomena	Summary: Students Will…
4 **On One Flower**	Preparation: 25 min. Activity 4: 6–8 classes Lesson 4A: 45–50 min., 2 classes Lesson 4B: 45–50 min., 2–3 classes Lesson 4C: 45–50 min., 2–3 classes	Make observations of the diversity of plants and animals in the schoolyard to find out how their internal and external structures help them to survive.	*On One Flower*/ stinkbug	• Develop a model of a goldenrod blossom as a habitat for different animals. • Read about one flower plant as a habitat for a variety of animals. • Write about their own experiences in making observations of different plants and animals. • Plan and build a classroom habitat for plants and animals that live in the schoolyard. • Make observations and collect specimens of plants and animals that live in the schoolyard. • Explore the Project Noah website. • Share research and data entry to find patterns in structure and function of animal and plant traits.
5 **Animal Defenses**	Preparation: 15 min. Activity 5: 6 classes Lesson 5A: 45–50 min., 2 classes Lesson 5B: 45–50 min., 2 classes Lesson 5C:45–50 min., 2 classes	Make observations and obtain information about the different structures of animals that function as a defense.	The tail of the blue-tailed skink and how it functions to help the skink defend itself.	• Observe a video of the blue-tailed skink. • Draw and label a model that explains how the structures of the skink help it to survive. • Research the structures and function of the blue-tailed skink. • Share research and findings. • Create a class chart that categorizes the different kinds of animal defenses and if memory is important in that defense.

UNIT AT A GLANCE

Students Figure Out How to:	Practices and Crosscutting Concepts	Assessment
• Develop a model of a goldenrod blossom as a habitat for different animals. • Obtain and apply information from text to their own schoolyard observations and specimens. • Determine the needs for survival of specimens collected in the schoolyard and placed in the classroom habitat. • Make careful observations of collected specimens to determine the internal and external structures they have that function in survival. • Record and upload information to the Project Noah website. • Look for patterns in observations and research to determine the structure and function in the traits of different plants and animals.	**Asking Questions and Defining Problems** **Obtaining, Evaluating, and Communicating Information** **Developing and Using Models** **Planning and Carrying Out Investigations** **Systems and System Models**	**Summative Assessment** models Respond to Text Science Talk Journal Entries Activity Page
• Conduct research on the blue-tailed skink to find out the function of the blue tail. • Raise questions for research on the skink. • Determine the internal and external structures that function to help the skink recognize danger, detach its tail, and run away. • Discuss and determine how memory might help animals to survive. • Obtain information from text about animal defenses. • Relate information from text to learn about and categorize animal defenses. • Apply information from research and text to the animals in the classroom habitat.	**Asking Questions and Defining Problems** **Obtaining, Evaluating, and Communicating Information** **Developing and Using Models** **Cause and Effect** **Systems and System Models**	**Formative Assessment** group models Science Talk Activity Page Journal Entry **Summative Assessment** final models Journal Entries Activity Pages

Dear Parent,

Your child is beginning a unit created at the Battle Creek Area Mathematics and Science Center. This unit was designed by area teachers to promote inquiry-based science and is complete with materials to accompany the activities. During the next twelve weeks, your child will be actively involved with the unit *Structure, Function, and Information Processing*. This unit is designed for fourth-grade students and focuses on how plants and animals sense and react to their surroundings. Students focus on:

- How do we provide evidence that light reflects off objects and enters the eyes so we can see? How do different materials react to light?
- How do sensory organs and internal and external structures help plants and animals obtain information, react to stimuli, and survive in an ecosystem?

During this unit of study, your child will begin to explore how plants and animals use their senses to find food, sense danger, build shelters, and protect themselves. Your child will be given the opportunity to observe, compare, and contrast different organisms and how they react to their surroundings. The class will research a variety of habitats, change in habitats, and related topics to obtain and share information.

We hope you enjoy discussing the concepts involved in *Structure, Function, and Information Processing* with your child. Suggestions for activities to do at home are included with this letter. These activities will reinforce the concepts taught during this unit instruction. Let us know if we may be of assistance.

The Outreach Staff

Battle Creek Area Mathematics and Science Center
(269) 213-3907 or (269) 213-3908

ACTIVITIES TO DO AT HOME

1. Take this opportunity to explore ecosystems within your backyard, neighborhood, and local parks. Turn over a rock or log and see how many organisms make it their home. Discuss the different physical traits of the organisms. When your child observes an animal, ask what they think it is doing and what internal and external structures help it to complete the task.
2. Take a close look at the plants in your home and garden. Help your child to identify the different plant parts: roots, stems, leaves, flowers, seeds. Discuss how the different structures function to help the plant take in water, make food, capture sunlight, and reproduce.
3. Find a closet or bathroom without windows or cracks around the door and have your student experience how, no matter how long they try, they are unable to see when there is no light available. If a small amount of light is let into the dark room, they will begin to see outlines of images. Full light allows them to see colors and details.
4. Discuss with your student when they have seen animal eyes that appear to shine in the dark. If you have a pet dog or cat, use a flashlight when they are out in the yard in the dark and observe how their eyes shine. Explain that eye shine is a characteristic that helps them to see better in the dark.

ACTIVITY 1

LIGHT AND SIGHT

Teacher Background Information
Some objects emit light and are light sources. Examples of light sources are the sun, a lamp, or a lightning bug. Other objects do not emit light, and they can only be seen when they are illuminated by light from some source. Examples are the moon, the page of a book, and a lightning bug during the day when it is not flashing its light. Light strikes an object and is reflected off it to our eyes. Most objects are textured so light striking them is diffused, or sent in all directions. Diffusion of light allows us to define the objects. If all surfaces reflected light like a smooth, shiny surface does, all we would see would be a reflection of the light source, such as when you shine a flashlight into a mirror.

One misconception students may have is that the moon produces light. The moon's surface reflects the light from the sun and the reflected light reaches Earth.

Engage the Learner
This phase of the learning encourages students to think about how we use our sense of sight and the connection between light and our ability to see. Students are encouraged to make their initial thinking about the phenomenon visible through the development of models. They raise questions that drive the following lessons.

Considerations for Students with Special Needs
All prompts and passages in the Student Journal should be read aloud, with repeated directions and checking for understanding prior to writing.

Students are asked to draw and write in their Student Journals. Students may benefit by working with a partner in the longer writing pieces. Students with an IEP should be allowed to dictate their ideas and answers.

Advance Preparation
Prepare a What We Think About Light and Sight chart.

What We Think About Light and Sight

What We Think	Questions We Have	What We Did	What We Figured Out	How Does That Help Us to Figure Out the Phenomenon?

ESTIMATED TIME
Lesson 1A: 45–50 minutes, 2 classes
Lesson 1B: 45–50 minutes
Lesson 1C: 45–50 minutes
Lesson 1D: 45–50 minutes

LESSON LEVEL LEARNING GOAL
Develop and use models to explain how light travels in a straight path, illuminates objects in its path, and is necessary for sight.

MATERIALS NEEDED
For each student:
student page
For each group of four:
Outside/Inside cartoon strip,
Teacher provides:
chart paper
markers

PS4.B: ELECTROMAGNETIC RADIATION
- An object can be seen when light reflected from its surface enters the eyes.

LS1.D: INFORMATION PROCESSING

- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

DEVELOPING AND USING MODELS

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- **Identify limitations of models.**
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- **Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.**
- **Develop and/or use models to describe and/or predict phenomena.**
- ~~Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.~~
- ~~Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.~~

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.

Preview the *Outside/Inside* card set. Be prepared to read the phenomenon with expression and drama.

The investigations into light are best performed in a darkened room. Be prepared to draw curtains or blinds and block as much light from entering the room as possible.

Duplicate copies of the unit Parent Letter and Activities to Do at Home to be sent home.

LESSON 1A: TURN ON THE LIGHTS!

Procedure

Engage the learner.

Project the *Outside/Inside* card set. Read the captions (dialog balloons) to the class. As a class, discuss the phenomenon the children in the cartoon are experiencing and allow time for students to share their own experiences with the phenomenon.

Record the students' initial thinking about what causes the phenomenon. Accept all ideas at this time.

Divide the class into groups of four students. Distribute one *Outside/Inside* card to each group. Ask the groups to discuss the phenomenon from the cards and develop a model that explains why it is so difficult for the child to see when he came inside. Remind the students that this model represents their initial thinking and they will have the opportunity to revise as the unit progresses. Ask students to use their Student Journal for brainstorming their models.

Use the space below to draw and label a model that explains what is happening to the children in the Outside/Inside cartoon. Include arrows to help show how light travels. Write questions you have as you develop your model.

Facilitate the group activity by circulating among the students and listening to their initial ideas. To help students communicate their current understanding, ask:

- Can someone tell me what you have discussed so far?
- Did someone record that idea in the Student Journal?
- How does your model explain why it was difficult for the children to see when they went from the bright sunlight to the dim inside light? What do you think caused that?
- Tell me more about how light interacts with our eyes. Do the rest of you agree? Why or why not? Does your model represent your ideas about light?
- What do you mean when you say…?

- What more do you think you need to know to complete your model?
- What questions do you have? Can someone write down the questions to share with the rest of the class?

After the groups have had the opportunity to complete their initial models, distribute markers and chart paper or white boards to each group. Have them draw a group consensus model on chart paper and display their models around the room. Ask each group to discuss their models and as a class look for common ideas and unique ideas. Ask the class if the development and presentation of the models gave them more ideas and questions to add to the What We Think chart. To help the students elaborate on their explanations of their models, ask:

- _____, I heard you use the term _____. Can you tell us more about that?
- What does _____ represent on your model? What makes you think that?
- Tell us more about what you mean when you say _____.
- How can we make our wonderings into questions we can investigate? What more do you think you need to find out to figure out the problem of sight when going from the bright outdoors to indoors?

Take this opportunity to develop the driving questions for following lessons by building on students' initial ideas. Help students to turn wonderings into questions that can be answered in future activities. Driving questions examples include:

- How are we able to see objects?
- How does light affect how we see objects?

Ask students for their ideas of how they can find out more information about the cause-and-effect relationship between light and our ability to see. Record their ideas on the What We Think chart.

Listen for ideas that relate to eyes adjusting to the light, inability to see detail in limited light, and that light is necessary for sight.

Assessment: Formative
Use the initial models to assess the students' initial ideas and ability to describe how light reflects from objects and enters the eye, allowing objects to be seen.

TEACHING TIP
The students will continue to work in the same groups for several lessons. It is beneficial for the groups to stay together to develop the initial model that explains the phenomenon and the final model that shows their conceptual shifts in thinking.

ASKING QUESTIONS AND DEFINING PROBLEMS
Asking questions and defining problems in grades 3–5 builds from K–2 experiences and progresses to specifying qualitative relationships.

- ~~Ask questions about what would happen if a variable is changed.~~
- **Identify scientific (testable) and non-scientific (non-testable) questions.**
- **Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.**
- Use prior knowledge to describe problems that can be solved.
- ~~Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.~~

LESSON 1B: NO LIGHT! NO SIGHT!

Teacher Background Information

Students may continue to have mixed ideas about their ability to see without light. Many students have the idea that, given enough time, their eyes will "adjust" and they will be able to see objects in a completely dark room. This lesson is intended to help students recognize that light is necessary for sight and that the amount of light available has an effect on the details they are able to see.

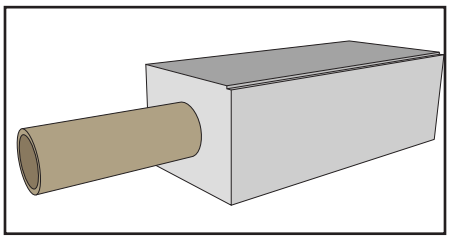
Explore the concept.

This phase of the learning provides students with the opportunity to explore their questions and understandings about the relationship between light and the ability to see objects. Students will be engaged in exploring the properties of light and planning investigations into how light illuminates objects.

Advance Preparation

Materials for preassembled box: 1 box, 1 plastic figure, 1 cardboard tube, masking tape.

Assemble the eight boxes. Open the boxes. Tape a plastic figure inside on the bottom of each box at the end farthest from the hole for the tube.



Close the lids on the boxes and place a tube halfway into each box.

Procedure

Explore the concept.

Review the driving questions and What We Think About Light and Sight chart developed in the previous lesson. Review student-generated models that exhibited ideas about how light sources illuminate objects, how light is reflected off objects, or how the reflected light enters the eye, allowing us to see the objects. To further assess students' thinking about light and the ability to see, have students complete the probe in the Student Journal.

Imagine you are sitting in a room, looking at a new toy. Your friend doesn't know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room.

Choose the answer that describes how you would see the toy.

A. *Your eyes will adjust to the darkness and you will eventually see the toy.*

MATERIALS NEEDED

For each student:
- student pages

For each group of four:
- 1 preassembled box (see Advance Preparation)

Teacher provides:
- chart paper
- markers
- Post-It Notes
- masking tape

PS4.B: ELECTROMAGNETIC RADIATION

- An object can be seen when light reflected from its surface enters the eyes.

TEACHING TIP

Your unit is supplied with a light box to help students test their predictions. If you have access to a totally dark room (no windows or cracks around the door), allow students to take an object into the dark room to test their predictions.

ANALYZING AND INTERPRETING DATA

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- **Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.**
- **Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.**
- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- ~~Analyze data to refine a problem statement or the design of a proposed object, tool, or process.~~
- ~~Use data to evaluate and refine design solutions.~~

TEACHING TIP

For students who predicted that given time their eyes would adjust to darkness, ask them to take a long look in the closed-lid box and describe if there was any change in their ability to see the object over time.

B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.

C. You will see the faint outline of the toy after your eyes have had time to adjust.

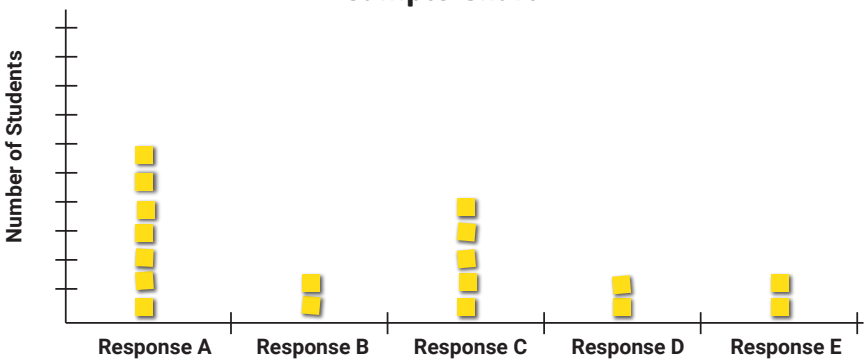
D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.

E. You will see the shadow of the toy after your eyes have had time to adjust.

Write why you chose that answer.

Allow sufficient time for students to complete the probe. Make a bar graph on the board or chart paper. When students have decided on an answer to the probe, have them place a sticky note on the graph above their answer. Allow sufficient time for students to justify their predictions.

Sample Chart



Explain the concept and define the terms.

Ask students for ideas of how they can test their ideas about the ability to see in the dark room. Have students return to their groups of four from the previous lesson. Distribute the boxes to each group. Darken the room. Ask students to look through the cardboard tube into the box. Tell students to keep their observations to themselves until each person in the group has had the opportunity to look in the hole. After each group member has had a turn, tell them to discuss what object they saw in the box and record their observations in the Student Journal.

Describe the object in your box:

Position of lid	*Closed lid*	*Lid slightly raised*	*Lid open*
Observations:			

Have students repeat the observations and recording with the lid slightly raised and then finally with the lid open.

Science Talk
Take this opportunity to help students think through, discuss, and engage in argument on their explanations. Return to the class bar graph from the probe and ask students if their observations with the box gave them evidence to support or dispute their choices. Have students reconcile what they believed would happen and their actual findings. Ask students to share any new ideas they have about the probe and their models from Lesson 1A. Ask:

- What conclusion can we draw from our observations using the light box?
- What can we say about light and the ability to see?
- What was the effect of opening the box a little? All the way?

Return to the What We Think chart and make additions and revisions as explained by the students. Review with the class the driving questions. Ask: Now that they have an understanding that we need some light to be able to see, what other information do we need to confirm our models that explain the Outdoor/Indoor phenomenon? Look for students to recognize - no light, no sight!

Assessment
Use the Science Talk and students' adjustments to the class charts to assess the students' ability to present an argument from evidence about their understanding that light is necessary for sight.

TEACHING TIP
Student responses and discussion may indicate that students have the common misconception that pupils "adjust to the dark" by dilating or getting bigger, rather than understanding that the pupils get bigger to allow more light to go into the eye, even if there is no light.

TEACHING TIP
Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.

LESSON 1C: HOW LIGHT TRAVELS

Teacher Background Information

The experience with the light box in the previous lesson provides an ideal time to introduce the role of light reflecting off an object and entering our eye to explain how we see. In this lesson, students explore the path a light source travels and what happens to our ability to see the object when illuminated.

Advance Preparation

Place an object in a dark corner or under the desk. Prepare to darken the room.

Procedure

Elaborate on the concept.

Turn on a flashlight and direct the light at the object 2 to 3 yards (2 to 3 meters) from the flashlight. Ask students to observe the path the light travels from the flashlight to the object. Tell the class:

This makes me wonder how we are able to see the object.

Ask two student volunteers to take the piece of string and "map" the path of the light. Have one student hold the string at the center of the light source and the other pull the string along the light path until it lands on the object. Ask students to describe the string.

Shine the flashlight on a second object within the same range. Ask different students to map the path of the light from the flashlight and then describe their observations of the string. Ask another student to shake the powder, using the cotton balls, along the students' mapped beam of light to make the path more visible. (Note: The particles of powder will become illuminated along the path of light, demonstrating the straight path.)

Ask students to draw their findings from mapping the light in their Student Journals. Have students work in pairs and then share with their group of four.

1. *Your teacher used a flashlight to see an object in a dark place. Draw and label a model of how you were able to see the object.*
2. *Write how mapping the path of light from the flashlight to the object provided evidence of how light travels.*

MATERIALS NEEDED

For each student:
- student page

For the class:
- string, 3 meter length
- powder (talcum)
- cotton balls
- flashlight with batteries

Teacher provides:
- chart paper
- markers
- masking tape

PS4.B: ELECTROMAGNETIC RADIATION

- An object can be seen when light reflected from its surface enters the eyes.

DEVELOPING AND USING MODELS

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- **Identify limitations of models.**
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- **Develop and/or use models to describe and/or predict phenomena.**
- ~~Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.~~
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships.**
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.
- ~~Apply scientific ideas to solve design problems.~~
- ~~Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.~~

Science Talk

Discuss the findings from the mapping of the light from the source to the object. Ask groups to share their responses in the Student Journal and explain how they were able to see the object. Use the demonstration with the object and flashlight in orchestrating discourse to help students revise their original models and further develop their conceptual understanding. After the groups have presented their ideas, ask:

- What information did we gain from the light demonstration? Did any patterns in information come through after sharing our Journal Entries?
- What do you think about what _____ said about the way light travels?
- Do the rest of you agree? Why or why not?
- Can someone summarize our conclusions from the light demonstration?
- How does this relate to the outdoor/indoor problem?
- Do we have sufficient information to explain the phenomenon?
- What more do we need to know?

Add any new or revised information to the What We Think chart from Lesson 1A. At this point in their learning, students may not yet have the idea that the object reflects light, which travels to the eye. Their understanding should include that light travels from the light source in a straight path going out in different directions from the source and illuminates objects that are in its path.

Allow time for groups to make adjustments to their models from Lesson 1A and their responses in the Student Journal. Ask students to collaborate with their group and discuss if their original responses in the Student Journal included a representation of the light source, light traveling in a straight path, and light illuminating objects. Then ask if the new information would help in their models from Lesson 1A. Facilitate the groups' revisit and revise activity by circulating among the students and listening to their ideas. To help students build confidence and rely on their new understandings of how light travels, ask:

- Have you considered the light source in the demonstration and the light sources in the outdoor/indoor phenomenon? Are they represented on your models?

- How does considering the light source help us to figure out the phenomenon?
- How does that relate to our ability to see?
- Can you think of an example of when something like the outdoor/indoor phenomenon might happen in a different situation?

Ask groups that feel they have completed their revisions to share with another group.

Assessment: Formative
Use the revised Student Journal models and revisions to models from Lesson 1A to assess the students' ability to use models to represent understanding and their understanding of how light travels in a straight path and illuminates objects in its path.

LESSON 1D: REFLECTING LIGHT

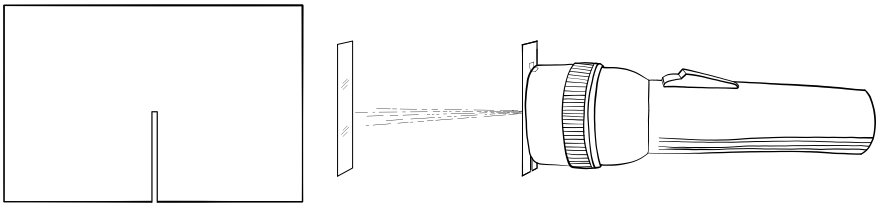
Teacher Background Information

In the previous lessons, students gathered evidence that light travels in a straight path and illuminates objects in the path of light. This lesson provides students with information about the reflection of light and how objects are illuminated and reflect light. It is the reflected light from objects that enters the eye and enables us to see them.

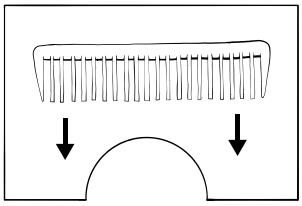
When the students shine light through a comb onto black paper, they should see beams of light traveling in straight lines. When the light hits the mirror, they should see that the lines of light change direction in other straight paths. When they shine the light through a comb onto white paper, they should see the same thing. The difference between the white and black paper is that the reflection of the light will be more clear with the white paper. The black paper actually absorbs some of the light.

Advance Preparation

Make a small slit in the center of the 3" x 5" cards. Prepare one card for each group of four students (see illustration). Tape the card to the end of the flashlight.



Cut a half circle in the center of the 5" x 8" index cards. Prepare one card for each group of four students (see illustration).



Prepare an area on the whiteboard or chart paper to make a class chart that displays the collective observations of the class (see Procedure).

Observations of Light

Group	Light traveling through the hole in the index card and comb	Observations using the mirror	Observations of the path of light on the white paper	observations of the path of light on the black paper

MATERIALS NEEDED

For each student:
- student pages

For each group of four:
- mirror
- comb
- index card (3"x 5") with narrow slit
- index card (5"x 8") with half circle cut out
- black construction paper
- white construction paper
- pencil
- chalk
- flashlight with batteries
- books (to prop up mirror)

Teacher provides:
- chart paper
- markers
- masking tape
- books (to prop up mirror)
- pencils

PS4.B: ELECTROMAGNETIC RADIATION

- An object can be seen when light reflected from its surface enters the eyes.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships.**
- **Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.**
- Identify the evidence that supports particular points in an explanation.
- ~~Apply scientific ideas to solve design problems.~~
- ~~Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.~~

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.

Procedure

Elaborate further on the concept.

Divide the class into their groups of four. Distribute one flashlight with narrow slit, one comb, one mirror, black paper, white paper, one 5" x 8" index card with a half circle cut out, and two pieces of tape to each group. Have each group tape the 5" x 8" index card to the comb with the teeth of the comb covering the half circle. Review the Activity Page with the class before they begin their exploration.

1. *Write and draw your observations with the comb, flashlight, and mirror. Draw how you used your materials and what you observed.*

Ask a student volunteer to explain what they are to record in their Student Journals. Tell students that they will refer to their drawings and observations to explain what they discovered to others. Show the class chart that they will use to collectively display their observations.

Give the groups sufficient time to "mess about" with the materials and make observations and discoveries on their own before introducing a common set of procedures for the groups to follow. Facilitate the exploration by circulating among the groups, observing their activity and listening to their explanations. To check student progress, ask:

- What have you tried so far? Can someone explain what you observed?
- Can you think of another way to use the materials? What happens when you shine the light straight through the half circle and the comb? What are the dark lines? What are the light lines?
- Have you tried it at an angle? What happens if you hold the mirror at an angle? What do you think causes that to happen?
- Does it look different on the white paper than the black paper? Why do you think that?
- What have you recorded on your Activity Page so far? How would you explain what you observed to someone else?

When groups appear to be concluding their exploration with the materials, have them join another group to share what they discovered and combine materials for further exploration. Have the groups prepare and discuss what they will present to the class.

Science Talk
Ask each group to share their observations with the rest of the class. Provide a document projector and have students display their work.

Organize and record each group's observations by entering their findings on the class *Observations of Light* chart. The chart will also help to guide the students in their presentations.

Record common language the groups use to describe their observations. Groups that present later will demonstrate the common observations. Validate their findings with a check mark or tally mark.

After all groups have had the opportunity to present their findings, discuss their observations on the class chart. Ask students what they can conclude from the class observations. Review each column and ask the class to make a statement based on the data. Look for responses that include:

Column 1: The observations from the light traveling through the hole in the index card and comb provide evidence that light travels in a straight path.

Column 2: The observations using the mirror provide evidence that light bounces off the mirror and changes direction and travels in a straight path in the new direction.

Column 3: The observations of the path of light on the white paper were easier to see; both colors of paper provided evidence of light traveling in a straight path. (Listen for ideas about reflected light.)

Column 4: The observations of the light on the black paper more difficult to see than the white paper. (Listen for ideas about light that is absorbed.)

Evaluate the students' understanding of the concept.
As a class, make a statement supported by the student findings. (Light travels in a straight path until it strikes an object. Light reflects or bounces off a mirror and then continues to travel in a straight path in a different direction.) Write the class statement on the board and have students write the statement in their Student Journals.

2. *Write the class statement based on the observations of each group.*

In their groups of four, redistribute a flashlight, index card with narrow slit, mirror, and black and white paper, along with a pencil, chalk, and large book to prop up the mirror. The bottom rim of the flashlight and bottom of the index card should be able to rest on the table or desk. (See illustration in Advance Preparation.)

ANALYZING AND INTERPRETING DATA
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- **Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.**
- **Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.**
- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- ~~Analyze data to refine a problem statement or the design of a proposed object, tool, or process.~~
- ~~Use data to evaluate and refine design solutions.~~

PLANNING AND CARRYING OUT INVESTIGATIONS

Planning and carrying out investigations in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- ~~Plan and~~ **conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.**
- **Evaluate appropriate methods and/or tools for collecting data.**
- **Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.**
- Make predictions about what would happen if a variable changes.

Have the students refer to the illustration in their Student Journals to set up their materials.

1. *Use the illustration below to set up your materials.*
2. *Turn on the flashlight and observe the path of light in three different positions (straight in front, angle to left, and angle to right).*
3. *Draw the path of the light from the flashlight and mirror on the white and black paper.*
4. *Draw and write your observations.*

   Straight in front, angle to left, angle to right

Facilitate the group activity by circulating among the students, observing their procedures and listening to their observations and ideas. At this stage provide little assistance with their procedure and thinking. Assess the groups' ability to apply what they have learned to the slightly different materials and state what they have learned about how light travels and interacts with a mirror.

To check for understanding and help students elaborate on their explanations, ask:

- What have you observed so far? What do you think caused that to happen?
- How is this investigation with the slit in the card similar to the investigation with the comb? How is it different?
- Tell me more about the effect of the flashlight at an angle. What did you draw on the paper? What do you think would be the effect of increasing the angle of the flashlight to the mirror? Decreasing the angle? What causes the difference in the path of light?
- Do you think if you repeated the procedure you would get the same results?

Evaluate the students' understanding of the concept

Science Talk

Discuss any new information students discovered from the investigation with the comb, flashlight, mirror, and flashlight with slit. Listen for ideas that include that they gained evidence that light travels in a straight path and can be reflected off objects (mirrors) and change direction.

Return to the object that was illuminated by the flashlight in Lesson 1C. Ask students to discuss the connection between how the light traveled to the object and how the light traveled to the mirror. Write the term *reflected light* on the board or chart paper and ask students to explain the importance of reflected light and our ability to see. Review how we have evidence that

light reflects off mirrors from their investigation. Ask students if light reflected off the object in Lesson 1C. Encourage students to engage in discourse over the idea of light reflected off of all objects and not just shiny objects like mirrors. Help students to make the connection between light reflecting off objects and the reflected light they observed on the white and black paper using the comb and mirrors. Ask students to explain how they were able to see the streaks of light on the paper.

As a class, develop a working definition of the terms *reflected light* and *absorbed light*. After the class has reached a consensus for their definition of the terms, have students write them in the Key Terms of the Student Journal.

Ask students how this new information might be helpful in explaining how we see things and the outdoor/indoor phenomenon. Allow sufficient time for students to regroup and make revisions and additions to their models. Facilitate the revision making by circulating among the groups and listening to their ideas. To help groups that may be stuck and to check group progress, ask:

- How would you describe the problem we are trying to solve by revising our models?
- What new information have we learned that is not represented in your original model?
- Would it be helpful to begin again with a new model? Would it be helpful to make a model that represents outdoors and indoors similar to a before and after?
- What about putting things in order when we look at an object? What has to happen for us to see it?

Take time for groups to share their new/revised models of the outdoor/indoor phenomenon.

Return to the What We Think chart and have the students describe What We Did, What We Figured Out, and How Does That Help Us to Figure Out the Phenomenon. Ask:

- How does understanding the properties of light and how light travels help us to figure out the inside/outside phenomenon?

Accept all ideas at this time.

Assessment
Use the revised models and Science Talk to evaluate the students' understanding of how light reflected off objects makes it possible for us to see things.

DEVELOPING AND USING MODELS
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- **Identify limitations of models.**
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- **Develop and/or use models to describe and/or predict phenomena.**
- ~~Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.~~
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

ENGINEERING DESIGN PROCESS

The Engineering Design Process provides students with a series of steps to guide them as they solve problems and design and test products, models, and solutions. The process is cyclical, yet not necessarily in an order. Students are encouraged to evaluate as they progress through the process, revisit the mission often, and revise thinking and their plan multiple times as the process unfolds.

Engineers do not always follow the Engineering Design Process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change the design. Engineers must always keep in mind the mission or problem they are trying to solve and the limitations (cost, time, material, etc.) that are part of the solution to the problem. Two key elements in working as an engineer are teamwork and design-test-and-redesign.

Mission
- Defines the problem and what the engineers are trying to design or build.
- Describes the limitations within which the engineers must solve the problem.

Brainstorm Ideas
- Imagine, discuss, and sketch possible solutions.
- Conduct research into what has already been done.
- Discover what materials are available, time frame, and other limitations.

Plan and Design
- Draw and write a plan.
- Design your solution through drawing and manipulating materials.
- Develop a plan or steps and a schedule.

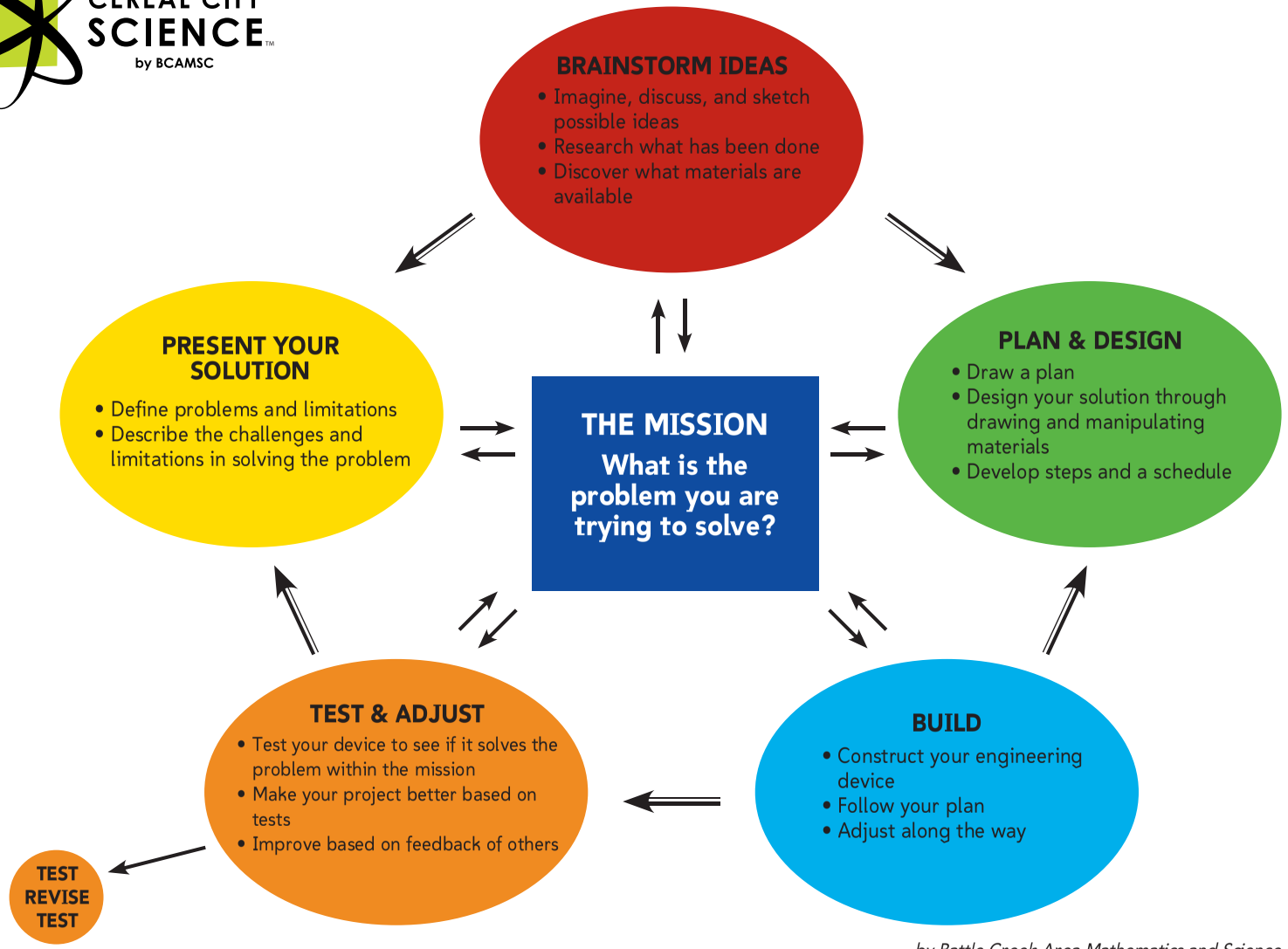
Build
- Construct your engineering device or project.
- Follow your plan.
- Adjust and test along the way.

Test and Adjust
- Test your device to see if it solves the problem within the mission and limitations.
- Make your project better based on tests: Test → Revise → Test.
- Improve based on feedback of others.

Present Your Solution
- Demonstrate how your solution solves the problem.
- Define problems and limitations.
- Describe the challenges and limitations in solving the problem.
- Describe additional revisions that could improve the device or project.

CEREAL CITY SCIENCE™ by BCAMSC

ENGINEERING DESIGN PROCESS



by Battle Creek Area Mathematics and Science Center
Cereal City Science
Adopted from the Carnegie Mellon Robotics Academy

APPENDIX

CEREAL CITY SCIENCE by BCAMSC

Student Journal
4.LS.NGSS

Structure, Function, and Information Processing 4LNG

SECOND EDITION

A fourth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

Name:_____

Name: _____

Date: _____

ACTIVITY **1A**

Turn on the Lights

Use the space below to draw and label a model that explains what is happening to the children in the outside/inside cartoon. Include arrows to help show how light travels. Write questions you have as you develop your model.

1B ACTIVITY
No Light! No Sight!

Name: _____

Date: _____

Imagine you are sitting in a room looking at a new toy. Your friend doesn't know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room. Choose the answer that describes how you would see the toy.

A. Your eyes will adjust to the darkness and you will eventually see the toy.

B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.

C. You will see the faint outline of the toy after your eyes have had time to adjust.

D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.

E. You will see the shadow of the toy after your eyes have had time to adjust.

Write why you chose that answer.

Name: _____

Date: _____

ACTIVITY **1B**

No Light! No Sight!

Describe the object in your box.

Position of lid	Closed lid	Lid slightly raised	Lid open

1C ACTIVITY
How Light Travels

Name: _____

Date: _____

1. Your teacher used a flashlight to see an object in a dark place. Draw and label a model of how you were able to see the object.

Name: _____

Date: _____

2. Write how mapping the path of the light from the flashlight to the object provided evidence of how light travels.

1D ACTIVITY
Reflecting Light

Name: _____

Date: _____

1. Write and draw your observations with the comb, flashlight, and mirror. Draw how you used your material and what you observed.

Name: _____

Date: _____

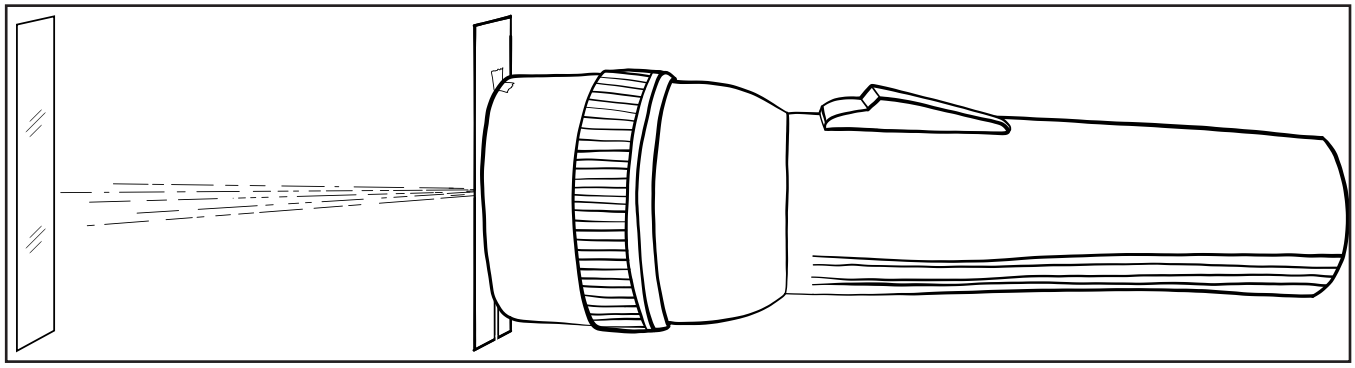
2. Write the class statement based on the observations of each group.

1D ACTIVITY
Reflecting Light

Name: _____

Date: _____

1. Use the illustration below to set up your materials.



2. Turn on the flashlight and observe the path of light in three different positions. (straight in front, angle to left, and angle to right)
3. Draw the path of the light from the flashlight and mirror on the white and black paper.
4. Draw and write your observations.

straight in front:

Name: _____

Date: _____

angle to left:

angle to right:

K E Y T E R M S

Name: _____

Date: _____