CEREAL CITY SCIENCE by BCAMSC

Teacher Guide and Student Journal
Sample Activity and Planning Pages

Waves: Light and Sound 1PNG

SECOND EDITION

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

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A first-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

Waves: Light and Sound

Pre-activity Informational Pages

Activities

Appendix

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activities
PS4.A: Wave Properties • Sound can make matter vibrate, and vibrating matter can make sound.	4,5,6
1-PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	5,6
PS4.B: Electromagnetic Radiation • Objects can be seen if light is available to illuminate them or if they give off their own light. • Some materials allow light to 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.	1,2,3
1-PS4-2: Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.	1,2,3
1-PS4-3: Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.	2,3
PS4.C: Information Technologies and Instrumentation • People also use a variety of devices to communicate (send and receive information) over long distances.	5,6
1-PS4-4: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	5,6

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activities
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.	1,2,3,5,6
1-PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	4,5
1-PS4-3: Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.	2,3,
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence- based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Use tools and materials provided to design a device that solves a specific problem.	1,2,3,4,5,6
1-PS4-2: Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.	1,2,3
1-PS4-4: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	6

NEXT GENERATION SCIENCE STANDARDS

Crosscutting Concepts	Activities
Cause and Effect • Simple tests can be designed to gather evidence to support or refute student ideas about causes.	1,2,3,4,5,6
1-PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	4,5
1-PS4-2: Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.	1
1-PS4-3: Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.	1,2,3
Patterns • Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.	2,3,5,6
2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	2,3
Connections to Engineering, Technology, and Applications of Science	
Influence of Engineering, Technology, and Science, on Society and the Natural World • People depend on various technologies in their lives; human life would be very different without technology.	6
1-PS4-4: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	6

COMMON CORE STATE STANDARDS - READING

Reading Standards for Informational Text—Grade 1	Activities
Key Ideas and Details	
RI.1.1: Ask and answer questions about key details in a text.	1,3,4,5
RI.1.2: Identify the main topic and retell key details of a text.	3,4,5
RI.1.3: Describe the connection between two individual events, ideas, or pieces of information in a text.	3,4,5
Craft and Structure	
RI.1.4: Ask and answer questions to help determine or clarify the meaning of words and phrases in a text.	4
RI.1.5: Know and use various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) to locate key facts or information in a text.	
RI.1.6: Distinguish between information provided by pictures or other illustrations and information provided by the words in a text.	1,3,4,5
Integration of Knowledge and Ideas	
RI.1.7: Use the illustration and details in a text to describe its key ideas.	1,3,4,5
RI.1.8: Identify the reasons an author gives to support points in a text.	3,4,5
RI.1.9: Identify the basic similarities in and differences between two texts on the same topic (e.g., in illustrations, descriptions, or procedures).	5
Range of Reading and Level of Text Complexity	
RI.1.10: With prompting and support, read informational texts appropriately complex for grade 1.	4

COMMON CORE STATE STANDARDS - WRITING

Writing Standards–Grade 1	Activities
Text Types and Purposes	
W.1.1 - Write opinion pieces in which they introduce the topic or name the book they are writing about, state an opinion, supply a reason for the opinion, and provide some sense of closure.	1,2,4
W.1.2 - Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.	2,3,4,5
W.1.3 - Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure.	1,4
Production and Distribution of Writing	
W.3.4 - (Begins in grade 3)	
W.1.5 - With guidance and support from adults, focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed.	1,2,3,4,5
W.1.6 - With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.	
Research to Build and Present Knowledge	
W.1.7 - Participate in shared research and writing projects (e.g., explore a number of how-to books on a given topic and use them to write a sequence of instructions).	2,3,4
W.1.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.	1,2,3,4,5,6
W.4.9 - (Begins in Grade 4)	
Range in Writing	
W.3.10 - (Begins in Grade 3)	

COMMON CORE STATE STANDARDS - LANGUAGE

Language Standards—Grade 1	Activities
Conventions of Standard English	
L.1.1: Understand the command of the conventions of standard English grammar and usage when writing or speaking. a. Print all upper- and lowercase letters. b. Use common, proper, and possessive nouns. c. Use singular and plural nouns with matching verbs in basic sentences (e.g., He hops; We hop). d. Use personal, possessive, and indefinite pronouns (e.g., I, me, my; they, them, their; anyone, everything). e. Use verbs to convey a sense of past, present, and future (e.g., Yesterday I walked home; Today I walk home; Tomorrow I will walk home). f. Use frequently occurring adjectives. g. Use frequently occurring conjunctions (e.g., and, but, or, so, because). h. Use determiners (e.g., articles, demonstratives). i. Use frequently occurring prepositions (e.g., during, beyond, toward). j. Produce and expand complete simple and compound declarative, interrogative, imperative, and exclamatory sentences in response to prompts.	1,2,3,4,6
L.1.2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Capitalize dates and names of people. b. Use end punctuation for sentences. c. Use commas in dates and to separate single words in a series. d. Use conventional spelling for words with common spelling patterns and for frequently occurring irregular words. e. Spell untaught words phonetically, drawing on phonemic awareness and spelling conventions.	1,2,3,4,5,6

COMMON CORE STATE STANDARDS - LANGUAGE

Language Standards—Grade 1	Activities
Vocabulary Acquisition Use	
L.1.4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 1 reading and content, choosing flexibly from an array of strategies. a. Use sentence-level context as a clue to the meaning of a word or phrase. b. Use frequently occurring affixes as a clue to the meaning of a word. c. Identify frequently occurring root words (e.g., look) and their inflectional forms (e.g., looks, looked, looking).	3,4,5,6
L.1.5: With guidance and support from adults, demonstrate understanding of word relationships and nuances in word meanings. a. Sort words into categories (e.g., colors, clothing) to gain a sense of the concepts the categories represent. b. Define words by category and by one or more key attributes (e.g. a duck is a bird that swims; a tiger is a large cat with stripes). c. Identify real-life connections between words and their use (e.g., note places at home that are cozy). d. Distinguish shades of meaning among verbs differing in manner (e.g., look, peek, glance, stare, glare, scowl) and adjectives differing in intensity (e.g., large, gigantic) by defining or choosing them or by acting out the meanings	3,4,5,6
L.1.6: Use words and phrases acquired through conversations, reading, and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships.	1,3,4,5,6

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 1	Activities
Mathematical Practices	
1. Make sense of problems and persevere in solving them.	2,3,4,5,6
2. Reason abstractly and quantitatively.	1,2,3,4,5,6
3. Construct viable arguments and critique the reasoning of others.	1,2,3,4,5,6
4. Model with mathematics	2,3,4,5,6
5. Use appropriate tools strategically.	1,2,3,4,5,6
6. Attend to precision.	1,2,3,4,5,6
7. Look for and make use of structure.	1,2,3,4,5,6
8. Look for and express regularity in repeated reasoning.	1,2,3,4,5,6
1.OA Operations and Algebraic Thinking	
A. Represent and solve problems involving addition and subtraction.	
1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions. (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem). 2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20 (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).	3
Understand and apply properties of operations and the relationship between addition and subtraction.	
3. Apply properties of operations as strategies to add and subtract. 4. Understand subtraction as an unknown-addend problem.	3

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 1	Activities
Add and subtract within 20.	
5. Relate counting to addition and subtraction (e.g., by counting on 2 add 2). 6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting; making ten; decomposing a number leading to addition and subtraction; and creating equivalent but easier or known sums.	3
Work with addition and subtraction equations.	
7. Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. 8. Determine the unknown whole number of an addition or subtraction equation relating three whole numbers.	3
1.NBT Number and Operations in Base Ten	
Extend the counting sequence.	
1. Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral.	
Understand place value.	
2. Understand that two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases: c. 10 can be thought of as a bundle of ten ones, called a “ten.” d. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones. e. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones). 3. Compare two 2-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <.	

COMMON CORE STATE STANDARDS - MATHEMATICS

Mathematics—Grade 1	Activities
1.MD Measurement and Data	
Measure lengths indirectly and by iterating lengths in units.	
1. Order three objects by length; compare the lengths of two objects indirectly by using a third object. 2. Express the length of an object as a whole number of length units by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps.	2,3,4
Tell and write time.	
3. Tell and write time in hours and half hours using analog and digital clocks.	3
Represent and interpret data.	
4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.	1,2,3,4
1.G Geometry	
Reason with shapes and their attributes.	
1. Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes. 2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter circles) or three dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. 3. Partition circles and rectangles into two and four equal shares, describe the shares using the words halves, fourths, and quarters, and use the phrases half of, fourth of, and quarter of. Describe the whole as two of or four of the shares. Understand for these examples that decomposing into a larger number of equal shares creates smaller shares.	3

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
1 No Light! No Sight!	Preparation: 20 min. Activity 1: 4 classes Lesson 1A: 45-50 min. 2 class periods Lesson 1B: 45-50 min. 2 class periods	Investigate how light is necessary for sight. Use a model to provide evidence that the amount of light is related to how well objects are seen.	Engineering Challenge: Light for a Tree House	• Brainstorm ideas about light • Make observations of objects with no light shining on them and different amounts of light shining on them. • Compare initial ideas about light.
2 Path of Light	Preparation: 25 min. Activity 2: 6 classes Lesson 2A: 45-50 min. 2 class periods Lesson 2B: 45-50 min 2 class periods. Lesson 2C: 45-50 min. 2 class periods	Use demonstrations and models to provide evidence of how light travels and interacts with different material.	Engineering Challenge: Light for a Tree House	• Be introduced to a problem of using available light to provide sufficient light and dark areas in a tree house. • Use models to demonstrate how light travels. • Make observations to determine the path of light from its source. • Explore how light travels using a variety of materials. • Plan and carry out an investigation into how different materials interact with light. • Collect data to construct an explanation about how some materials allow light to pass through, reflect light, or block light.
3 What Can We Learn From a Shadow?	Preparation: 15 min. Activity 3: 7 classes Lesson 3A: 50-55 min. Lesson 3B: 50-55 min. 2 class periods Lesson 3C: 50-55 min. 2 class periods Lesson 3D: 50-55 min. 2 class periods	Obtain data through investigations to construct an explanation of how the position of a light source affects the size and shape of a shadow.	Engineering Challenge: Light for a Tree House Nothing Sticks Like a Shadow	• Use information from a storybook to develop questions about shadows. • Trace and measure shadows in the morning, noon, and afternoon. • Collect data from shadow measurements. • Design a tree house using their information about light and materials

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	PE at Lesson Level and Assessment
• Construct explanations of the concept of how we see objects through observations. • Determine that light is necessary for sight.	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations Developing and Using Models Cause and Effect	**Formative Assessment** What We Think chart Activity Page Journal Entry Science Talk
• Construct explanations of the path of light using tools and models to demonstrate how light travels. • Plan and carry out an investigation to produce evidence that light travels in a straight path. • Begin to apply what they have learned to solve the problem of lighting a tree house. • Use their findings about different materials and light to solve a problem of the appropriate amount of light in a tree house.	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations Obtaining, Evaluating, and Communicating Information Developing and Using Models Patterns Cause and Effect	**Formative Assessment** Activity Page Science Talk What We Think chart Journal Entry **Summative Assessment** Journal Entry Science Talk What We Think chart
• Make measurements and collect data to construct evidence-based explanations. • Plan and conduct an investigation as a member of a team to find out how the position of the light source affects the size and shape of a shadow. • Use patterns in data to construct an explanation.	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations Obtaining, Evaluating, and Communicating Information Analyzing and Interpreting Data Developing and Using Models Patterns Cause and Effect	**Formative Assessment** Respond to Text Science Talk **Summative Assessment** Science Talk Journal Entry Engineering Product and Presentation Classroom Data Chart Tree House Models

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goals	Phenomenon/ Engineering Challenge	Summary: Students will...
4 Sounds We Have Heard	Preparation: 15 min. Activity 4: 5 classes Lesson 4A: 45-50 min. Lesson 4B: 45-50 min. 2 class periods Lesson 4C: 45-50 min. 2 class periods	Use tools and models to provide evidence that vibrating material produces sound and the sound can make nearby objects vibrate.	Vibrating salt on a stretched balloon.	• Make observations of vibrating objects that produce sounds. • Make observations of sounds that vibrate nearby objects. • Compare a variety of sounds to determine the source of vibrations that produce the sound. • Use tuning forks as a tool to demonstrate how vibrations produce sounds. • Read informational text regarding sounds and vibrations.
5 Good Vibrations!	Preparation: 20 min. Activity 5: 4 classes Lesson 5A: 45-50 min. 2 class periods Lesson 5B: 55-60 min. 2 class periods	Relate sounds to their sources of vibrations. Demonstrate evidence that sound vibrations can travel through air, water (liquid), and solid objects.	Engineering Challenge: Design, build, and present an instrument or noise-maker using a variety of materials.	• Develop a model of vibrations using a plucked ruler. • Relate the back-and-forth motions of the ruler to vibrations. • Use observations to determine if sounds can be heard in liquids and solids. • Construct explanations of sound through the designing and building of instruments or sound making devices..
6 People Use Light and Sound	Preparation: 10 min. Activity 6: 3-4 classes Lesson 6A: 45-50 min. 3-4 class periods	Work collaboratively to use tools and a variety of materials to design and develop a communication system that uses light and/or sound.	Engineering Challenge: Design a communication system using light and/or sound to signal different community emergency personnel.	• Use the Engineering Design Plan to design and build a model of a communication system to solve a problem in a community.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	PE at Lesson Level and Assessment
• Produce different sounds using a variety of materials. • Identify the source of vibrations that are producing the sound. • Use a model to demonstrate how sound can make nearby objects vibrate. • Classify sounds by their origin. • Produce sounds using a variety of materials to demonstrate the source of the sound. • Use information from text to construct explanations.	Constructing Explanations and Designing Solutions Developing and Using Models Obtaining, Evaluating, and Communicating Information Cause and Effect	**Formative Assessment** Science Talk Activity pages **Summative Assessment** Respond to Text Science Talk Activity Page Journal Entry
• Use a model of a plucked ruler to explain vibrations. • Use the Engineering Design Plan to make a device that produces a sound.	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations Developing and Using Models Cause and Effect Patterns	**Summative Assessment** Journal Entries Instrument/Sound Maker and Presentation Science Talk Consensus model
• Work collaboratively. • Design and demonstrate their communication system. • Apply knowledge about light and sound to their engineering design. • Apply their communication system to a situation.	Constructing Explanations and Designing Solutions Developing and Using Models Influence of Engineering, Technology, and Science on Society and the Natural World Cause and Effect Patterns	**Summative Assessment** Student Presentations Journal Entry

Dear Parent,

Your child is beginning a unit created at the Battle Creek Area Mathematics and Science Center. This unit was designed to promote science and engineering literacy and integrate reading and writing skills into high-interest science content. During the next eight weeks, your child will be actively involved with the *Waves: Light and Sound* unit. This unit is geared for first-grade students and focuses on the big ideas of obtaining information to determine how light is necessary for sight, that light interacts differently with different materials, and that sound is caused by vibrations.

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- Obtain information through investigations, models, and discussions to discover that light must be present in order to view objects.
- Plan and conduct investigations using translucent, transparent, opaque, and reflective materials to determine the effect of light striking various materials.
- Obtain information through investigations and discussions to discover that vibrating materials can make sound and sound can make materials vibrate.
- Plan and design a method for communicating over a distance using light or sound.

First-grade students are also encouraged to think and act like scientists and engineers and begin to develop observation and communication skills in science.

- Make purposeful observation of objects in dark and light.
- Generate questions based on their observations.
- Plan and conduct simple investigations into how different materials interact with light.
- Manipulate simple tools that aid observation and data collection.
- Construct simple charts from data and observations of how different materials interact with light.
- Make purposeful observations of how sounds are produced and produce different sounds using a variety of materials.
- Identify the source of vibrations that are producing sounds.
- Design, build, and present an instrument that makes sounds.
- Work in teams to design a communication system using light and/or sound to signal different community emergency personnel.

In this unit the activities are geared to build on the inherent knowledge and experience that young students have already acquired and use their knowledge in a wider range of tasks. Your child will be given the opportunity to examine, measure, reflect upon, describe, and discuss how light is necessary for sight and how sounds are produced. Suggestions for activities to do at home are included with this letter. These activities will reinforce the concepts taught during this unit instruction.

May you enjoy quality time with your child while discussing the concepts involved with the *Waves: Light and Sound unit*. Let us know if we may be of assistance.

The Outreach Staff
Battle Creek Area Mathematics and Science Center
(269) 213-3907 or (269) 213-3905

ACTIVITIES TO DO AT HOME

1. Play light tag with your child using small mirrors and flashlights. Someone is tagged when he/she is touched with light reflected from the mirror.
2. Explore shadows with your child by using objects such as hand puppets, kitchen tools, and toys. You can make a good shadow using a strong flashlight shining against a light-colored wall or a hanging sheet.
3. Help your child find and identify translucent objects (such as wax paper or very thin material), transparent materials (such as clear glass or plastic wrap), and opaque materials (such as wood, dark paper, or foil). Use a flashlight to see if and how light can pass through these materials.
4. Have your child describe the pupil and iris of one of his/her eyes. Go in a darkened room with your child. After a few minutes turn on the lights and watch each other's pupils adjust to the light.
5. Go on a walk in the moonlight with your child. Keep track of the number of different shadows you observe. Determine the objects and the light sources that are making the shadows.
6. Take a sound hike with your child. Go to various locations (in the city, in the country, by a lake, at a fair, at a shopping center) to listen to the variety of sounds. Make a list of sounds and categorize them according to their properties: pitch (the highness or lowness of a sound), volume (loud or soft), and type (human-made or natural).
7. Make simple instruments using common household items. Drums can be made from oatmeal boxes; shakers can be made by filling a dry bottle or film canister with such items as paper clips, pasta, rice, marbles, or coins and then shaking the container to hear the sounds; stringed instruments can be made by stretching rubber bands of varying thickness across baking pans; and bottle pipes can be made by filling narrow-necked glass bottles with different amounts of water and then blowing gently across the top of each bottle.
8. Make string telephones and carry on a conversation with your child. Attach cans or plastic cups to the ends of a long piece of string by putting a hole in the can or cup and tying the string to a paper clip, which will anchor the string to the inside of the cup. Experiment by using different lengths of string and various techniques on how taut the string has to be for the sound to travel through the string. Take turns talking into the cup/can and listening to what is being said. Help your child realize that the sound stops if the string is loose and cannot vibrate.
9. Go to the library and check out books to read related to light and sound. Example titles:

   Sound Waves by Ian F. Mahaney
   What is Sound (Sounds All Around Us) by Charlotte Guillain
   Sound: Loud, Soft, High and Low by Natalie Rosinsky
   Light: Shadows, Mirrors, and Rainbows by Natalie Rosinsky
   All About Light by Lisa Trumbauer
   Light is All Around Us by Wendy Pfeffer
   What Makes a Shadow? by Clyde Bulla

ACTIVITY 1

NO LIGHT! NO SIGHT!

Teacher Background Information
Some objects emit light. Examples are the sun, a lamp, and a lightning bug. These are called light sources. 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 relatively rough, or 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 naive idea the students may have is that the moon produces light. This is incorrect. The sun's light shines on the moon and the planets. This light is reflected, and we can see it. In this activity the students will be looking at an object without a light source and then with a light source to aid in seeing the object.

Engage the Learner
This initial phase of learning activates students' prior knowledge and preconceptions regarding light. Students begin to make connections between what they have experienced in their ability to see things in the light and the dark and the learning task. Before exploring basic properties of light, the class will be introduced to an engineering/building challenge and brainstorm their preconceptions about light, make the connection to light as necessary for sight, and make a list of what they need to know and understand about light to solve the challenge.

Considerations for Students With Special Needs, Diverse Backgrounds, and Emerging Bilingual Learners
Read *Light in the Tree House* aloud to students and have them follow along in the Student Journal. Ask a bilingual speaking student to translate or reread the story in Spanish or other language that is common in your classroom.

All prompts and passages 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.

ESTIMATED TIME
Lesson 1A: 45-50 minutes
2 classes
Lesson 1B: 45-50 minutes
2 classes

LESSON LEVEL LEARNING GOALS
- Investigate how light is necessary for sight.
- Use a model to provide evidence that the amount of light is related to how well objects are seen.

MATERIALS NEEDED
For each student:
student pages
For each team of 2:
1 flashlight
2 batteries
1 golf tee
1 mirror
For the class:
story: *Light in the Tree House*
aluminum foil
wax paper
Teacher provides:
chart paper
markers
miscellaneous items

TEACHING TIP
Throughout the activities in the Teacher Guide you will notice that specific student instructions from the Student Journal pages are given first and italicized. Additional information for the teacher follows the italicized instructions in plain print.

PS4.B ELECTROMAGNETIC RADIATION

- **Objects can be seen if light is available to illuminate them or if they give off their own light.**
- Some materials allow light to 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.~~

READING

Key Ideas and Details

RI.1.1: Ask and answer questions about key details in a text.

RI.1.2: Identify the main topic and retell key details of a text.

FORMATIVE ASSESSMENT

Use the student responses to the What We Think chart as an on-going assessment of student understanding and conceptual shifts. Refer to students' initial ideas and emerging ideas as a result of observations, evidence, and information gathering.

LESSON 1A - NO LIGHT! NO SIGHT!

Advance Preparation

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

Prepare a What We Think chart to record students' initial ideas, investigation ideas, and conclusions throughout their explorations in the properties of light.

What We Think: Focus on Light

What We Think About Light	What Questions Do We Have?	What We Did?	What We Figured Out	How Does This Help Us to Light the Treehouse?

Collect miscellaneous objects from the classroom for students to investigate with the flashlight (plastic shapes, blocks, markers, erasers, etc.). Include items that may be transparent and reflective if possible. (plastic baggies, plastic cups, aluminum foil, waxed paper, hand mirror)

Darken room to help students recognize the effect of light when observing the different items.

Procedure

Engage the learner

Ask the class what they think they will be exploring in a unit called *Waves: Light and Sound*. Tell students that they will be focusing their attention on learning about light in the first half of the unit and then exploring sound in the final activities.

Introduce the story, *Light in the Tree House*, about the building of the tree house and how the children are considering the best position of the openings to allow light to pass through and the covering of the openings for blocking light. Read the story to the class. Ask the students what information the students in the story need to gather before they can design and build their tree house. Record any student questions about light which may come up during the discussion.

Inform the class that they are going to act like engineers and investigate light to gather information to solve the problem of light in the tree hours.

Discuss ideas that your students may have to solve the problem in the reading. Tell the students that it may be helpful to make a chart to keep a record of their ideas, questions, and what new information they need to know to help solve the problem. Tell the students that in the following lessons they will be exploring light and learning about how different materials interact differently with light. Then they will be able to use their new information to help solve the problem in the story.

Show the class the What We Think chart. Explain that the chart will be used to keep track of their beginning ideas and what they learn as the unit progresses. The chart will remain in view and will be used as a resource for writing and raising new questions to investigate. If students have initial ideas regarding light that they are eager to have recorded on the chart, write their ideas prior to starting the activity. Tell the class that they are going to be given the opportunity to explore light and how it interacts with different objects to help them raise questions and learn more about light to complete the engineering design challenge. Pose a simple question for the students to explore in the initial phase of their learning. Write the question on the chart:

What happens when I shine a light on different objects?

Divide the class into teams of two students. Distribute one flashlight (with batteries), one golf tee, and a variety of the miscellaneous items to each team. Give students sufficient time to mess about with the materials. Encourage students to talk about what they are observing. Have students record their observations on the Activity Page in their Student Journals. Choose one object to record observations together as a scaffold for students to use with the remaining items. Example:

What happens when I shine a light on an object?

	Objects	*Draw It!*	*Write About It!*
1.	*golf tee*		*The golf tee was dull white with no light and brighter white with light. The golf tee had a shadow when the light was pointed at it.*

Vocabulary: *light, bright, brighter, dark, darker, shine, dull, shadow*

Facilitate the student activity by circulating among the groups, listening to their ideas and observing how they manipulate the materials with the flashlight. To check student progress and help students construct explanations and elaborate on ideas, ask:

- Can someone tell me what you have observed so far? What do you think causes that to happen? How would you draw or write your observations?
- Tell me more about the effect of when the flashlight is turned on and when the flashlight is turned off. What changes do you see?

TEACHING TIP

Keep the What We Think chart visible and refer to it often as the unit progresses. At this point in their learning, most students are non or emergent readers and writers. Be sure as you record their ideas that it is in the students' words and reflect their ideas and questions. Review and read the chart often to help students to hear their learning story unfold. A key to student understanding is the ability to recognize and verbalize when and why they have had a shift in their thinking about different concepts.

PLANNING AND CARRYING OUT INVESTIGATIONS

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- ~~Plan and~~ conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.

CAUSE AND EFFECT

- **Simple tests can be designed to gather evidence to support or refute student ideas about causes.**

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 a circle. Conversations should be student-to-student with minimal teacher-led question and answer. (See Science Talk and Developing Effective Questions to Facilitate Science Talk in the Appendix, pps. 116-17.)

TEACHING TIP
Throughout this unit you will find examples of questions that will aid in facilitation of student-led discussion and collaboration. This facilitation guide is intended to draw ideas from previous knowledge, observations, and investigations.

- What was the effect (what did you see) when you directed the flashlight toward the different objects? Can you explain what caused this to happen?
- What causes shadows to be made? What effect does changing the position of the light have on the shadow?
- What do you mean when you say . . . ?

Conduct a whole-class sharing of their findings. Ask the class if they discovered any evidence about what happens when light shines on objects. Look for ideas that relate to making the object brighter, observing more detail and color, and possibly the casting of shadows by the objects. As a class, make a statement to answer the question:

What happens when I shine a light on different objects?

Science Talk
Ask students to share their observations when the light was shone on different objects. Ask:

- Who would like to share one observation with an object and the flashlight?
- Who can add on to that idea? Did anyone observe something different? Similar?

Have students brainstorm ideas about what they already think about light. Record their ideas in the What We Think column of the chart.

Ask students for ideas of how they can find out more about light. Look for ideas that relate to their exploration with the flashlight and different materials and early thinking about light sources, light from the sun, light as a necessity for sight, reflection, and the production of heat from a light source.

Note: Remember, this is a list of their initial thinking and should not be challenged at this point in their learning.

If the class struggles for ideas, ask a "What would happen if . . ." question such as: "What would happen if the sun disappeared?"; or "What would happen if we didn't have any electricity for lamps at night?"; or "What would happen if you lost something in a closet with no light?"

Record student ideas on the chart. Ask students for ideas of how they could find out if their initial ideas are correct. Refer to student suggestions that identify a connection between the ability to see objects and the availability of light.

Take this opportunity to review the student ideas on the What We Think chart. Check for vocabulary that might be useful to define or find a common meaning (*light*, *sight*, *bright*, *dark*). Have the students discuss the terms and enter the class definition or meaning in the Key Terms of the Student Journal.

Read the Journal Entry as a class. Ask the students to write if they agree with Jake and explain why they agree or disagree. Encourage students to use the terms they entered in the Student Journal.

Journal Entry

Izzy and Jake were talking about the light in the tree house. Jake said, "Our eyes will get used to the dark, so we will be able to see without light."

Write if you agree or disagree with Jake. Tell why you think that.

I _____ *with Jake because* _____.

Assessment: Formative

Use the Activity Page and class discussion to assess the students' ability to plan and carry out a simple investigation.

Use the Activity Page and class discussion to assess the students' understanding that objects can be seen if light is available.

Use the Journal Entry to assess the students' initial ideas about how light is necessary for sight.

WRITING

Text Types and Purposes

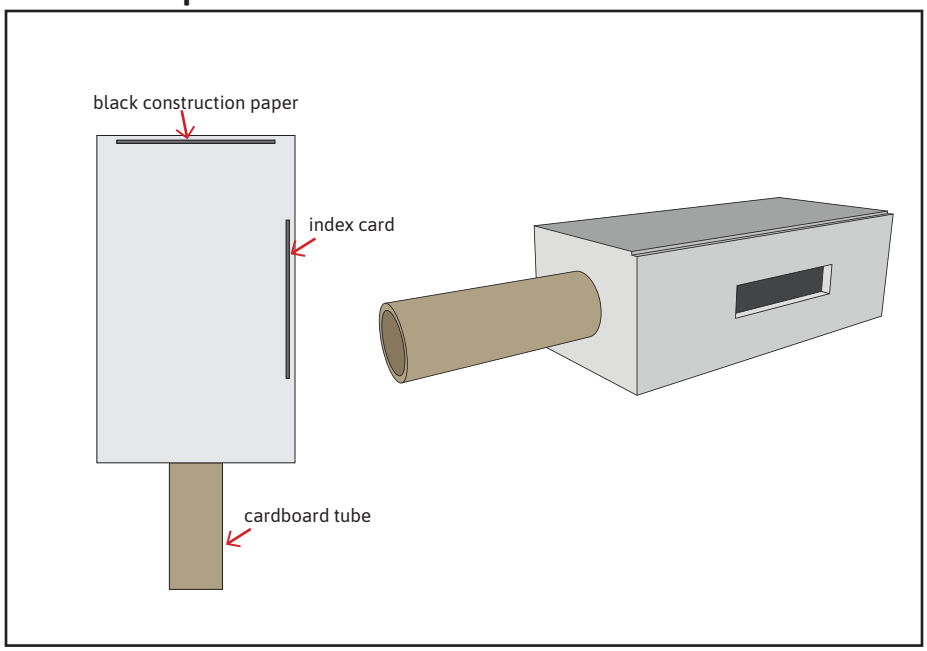
W.1.1 - Write opinion pieces in which they introduce the topic or name the book they are writing about, state an opinion, supply a reason for the opinion, and provide some sense of closure.

TEACHING TIP

Set up a Light Activity Center for students to visit in pairs or on their own. Have a variety of materials available for students to observe using the flashlight. If possible, include a second light source such as a Maglite or flashlight without a reflector.

LESSON 1B: NO LIGHT! NO SIGHT!

Advance Preparation



Cut 1 piece of black construction paper in 3" x 4" size.

Materials for pre-assembled boxes: 1 box, 1 plastic figure, 1 index card, 1 piece of black construction paper, one cardboard tube.

Assemble the boxes. Open the boxes and tape one plastic figure inside on the bottom sections of each box.

Place an index card in front of the slit on the side of the box. Place the piece of black construction paper in front of the hole in one end of the box. Close the lid on the box. Place a tube halfway into the box. Tape over any areas where the light shines through.

Keep the box assembled as it will be used again in following lessons.

Post a chart to collect the class data from their light box investigations.

What Did We See?			
Position of Lid	Closed	Slightly Raised	Open
Observation			

MATERIALS NEEDED

For each student:
- student pages

For each team of 2:
- pre-assembled box
  - 1 box
  - 1 plastic figure
  - 1 index card
  - 1 piece black paper
  - 1 cardboard tube
- flashlight
- batteries

Teacher provides:
- charts from Lesson 1A
- chart paper
- markers
- black construction paper
- masking tape

TEACHING TIP

Demonstrate how to look into the box with the lid closed, then with the lid slightly open, and so on, gradually allowing light into the box. Students may want to go from all dark to all light in one step. Encourage them to open the box in stages so they can observe more details of the object as they let more light into the box.

Wrap masking tape around the tube approximately one quarter of the way from the opening to prevent students from pushing the tube too far into the box.

PS4.B ELECTROMAGNETIC RADIATION

- **Objects can be seen if light is available to illuminate them or if they give off their own light.**
- Some materials allow light to 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.~~

PLANNING AND CARRYING OUT INVESTIGATIONS

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- ~~Plan and~~ conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question.

CAUSE AND EFFECT

- **Simple tests can be designed to gather evidence to support or refute student ideas about causes.**

Procedure

Explore the concept.

Have students return to their teams of two students. Darken the room and show the boxes. Inform the students that there is a mystery figure inside each box. Demonstrate how to look through the tube into the box . Explain that the class will work in teams of two and each team member will have the opportunity to look through the tube into their box to find out what mystery figure is in there.

Distribute the closed box to each team. Encourage the students to keep their observations to themselves until each team member has had the opportunity to look in the hole. After each student has had a chance to make an observation, ask them to discuss, with their team member, what they saw in the closed box.

Conduct a whole class discussion and collect student data on the What Did We See? chart in the Lid Closed column. Check for student responses that include “It was too dark.” Ask students why they think the amount of light in the box is important. Record student responses on the What We Think chart. Ask students if they had similar observations and lead students to validate one another through their common observations.

Ask students what they think they could do to see inside the box. Ask students to explain their ideas.

- Why do you think you could not see the mystery figure inside the box?
- Why do you think that would help you to see what is inside the box? What makes you think that?
- Do the rest of you agree? Why or why not?
- How could we find out?

Demonstrate how to raise the lid of the box slightly or remove the index card and have the teams allow a small amount of light into their boxes then repeat the observations. Ask them to describe what they observed and explain the difference between the first and second observations. Record their second observations before moving on to the final observation with the lid mostly open.

As a class, have students share findings between each observation and team. After the final observation, ask students what statement they can make about what they found out in the box investigation. Ask a student volunteer to describe the difference between each observation and what changed in the investigation to make the difference in observations.

Look for responses that include:

The amount of light allowed into the box changed the ability to see:

- The object
- The outline of the object
- The color of the object
- The details on the object

Ask them to share experiences they have had in a darkened place, such as in a closet, under the bed, or in a bathroom without windows and the light turned off. Ask students to explain why it was difficult to see and what they could do to make it easier to see.

Science Talk

Revisit the What We Think chart from the beginning of the activity. Ask students to gather around the chart and tell what they have learned about light. Ask:

- Can someone explain what information our data on the chart gives us?
- Who can add to _____'s idea?
- What do you mean when you say _____?
- Do the rest of you agree? Why or why not?
- Who can describe what we did to figure out what _____ said?

Record their responses in the What We Did and What We Figured out columns of the What We Think chart. Discuss how the new information may be helpful in solving the engineering problem with the tree house. Ask the class for ideas of how the children building the tree house might be able to design the tree house where light comes in to illuminate the items in the tree house and if there might be areas where they only want a little light or to block light. Discuss ideas that may solve the problem of not enough light to see.

As a class, read the Journal Entry.

ANALYZING AND INTERPRETING DATA

Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Record information (observations, thoughts, and ideas).
- Use and share pictures, drawings, and/or writings of observations.
- **Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.**
- **Compare predictions (based on prior experiences) to what occurred (observable events).**

LANGUAGE

L.1.1: Understand the command of the conventions of standard English grammar and usage when writing or speaking.

L.1.6: Use words and phrases acquired through conversations, reading, and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships.

WRITING

Text Types and Purposes

W.1.3: Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure.

Production and Distribution of Writing

W.1.5: With guidance and support from adults, focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed.

Research to Build and Present Knowledge

W.1.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- **Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.**

Pre-Writing Strategy

Think Aloud: Model how to write a personal response or story using a "think aloud." Relate a personal experience of when it was too dark to see by telling students that "looking for the figure in the box reminds me of a time when . . ." Invite three or four students to share similar experiences. Write key words, such as light, dark, see, eyes, looking, feeling, and searching for students to use in their own responses in the Student Journal.

By creating a collaborative writing response to a shared observation or investigation, students will know how to respond more effectively to the prompt.

Journal Entry

Draw and write a story about a time when it was too dark to see. Tell how you could make it easier to see.

Assessment: Formative

Use the Science Talk, What Did We See? chart, What We Think chart, and Journal Entry to assess the students' ability to make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.

APPENDIX

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.

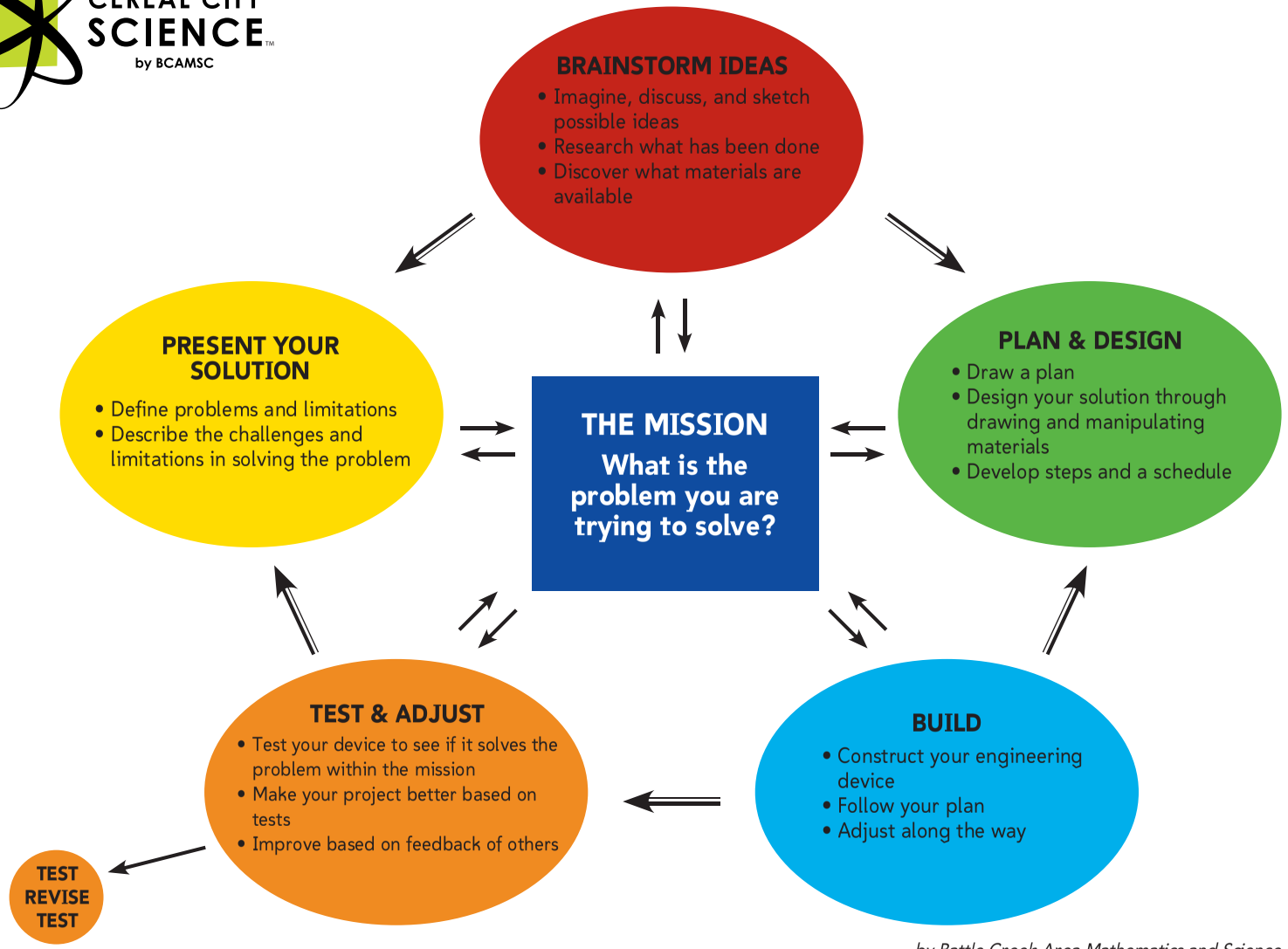
Build
- Construct your engineering device or project.
- Follow your plan.
- Adjust and test along the way.

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
1.PS.NGSS

Waves: Light and Sound
1PNG

SECOND EDITION

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

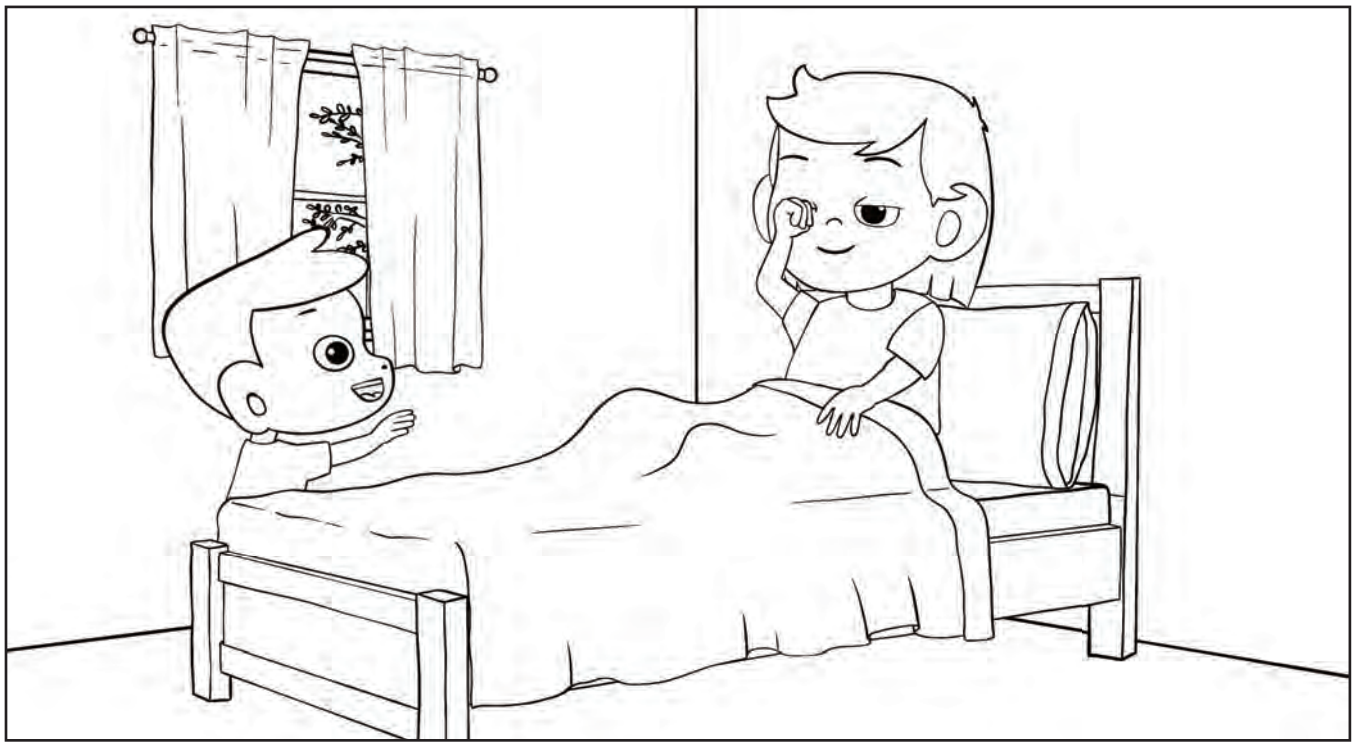
Name:_____

Name _____

Date _____

INFORMATIONAL TEXT **1A**

No Light! No Sight!



LIGHT IN THE TREE HOUSE

"What is that noise? Who or what is making that banging sound?"

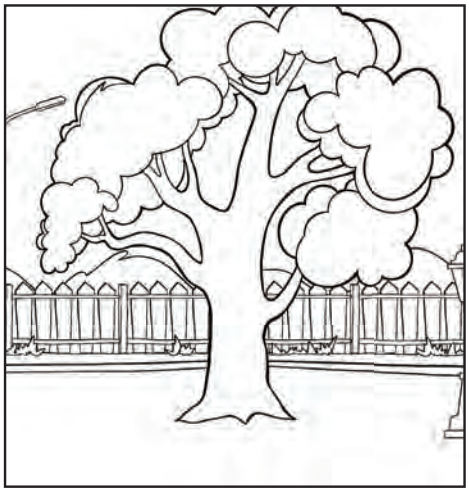
"Wake up, Izzy! Get up! Today we are building the tree house," Jake exclaimed. All week long Izzy and Jake had been waiting for Saturday morning to arrive. Finally it was here.

Izzy sprang out of bed to get dressed and Jake ran back to his room to change.

Jake and Izzy had only lived in their new house for two weeks. They moved from the country to the city and every day they missed their old house in the country where they had trees to climb and spent the whole day outside.

Name _____

Date _____

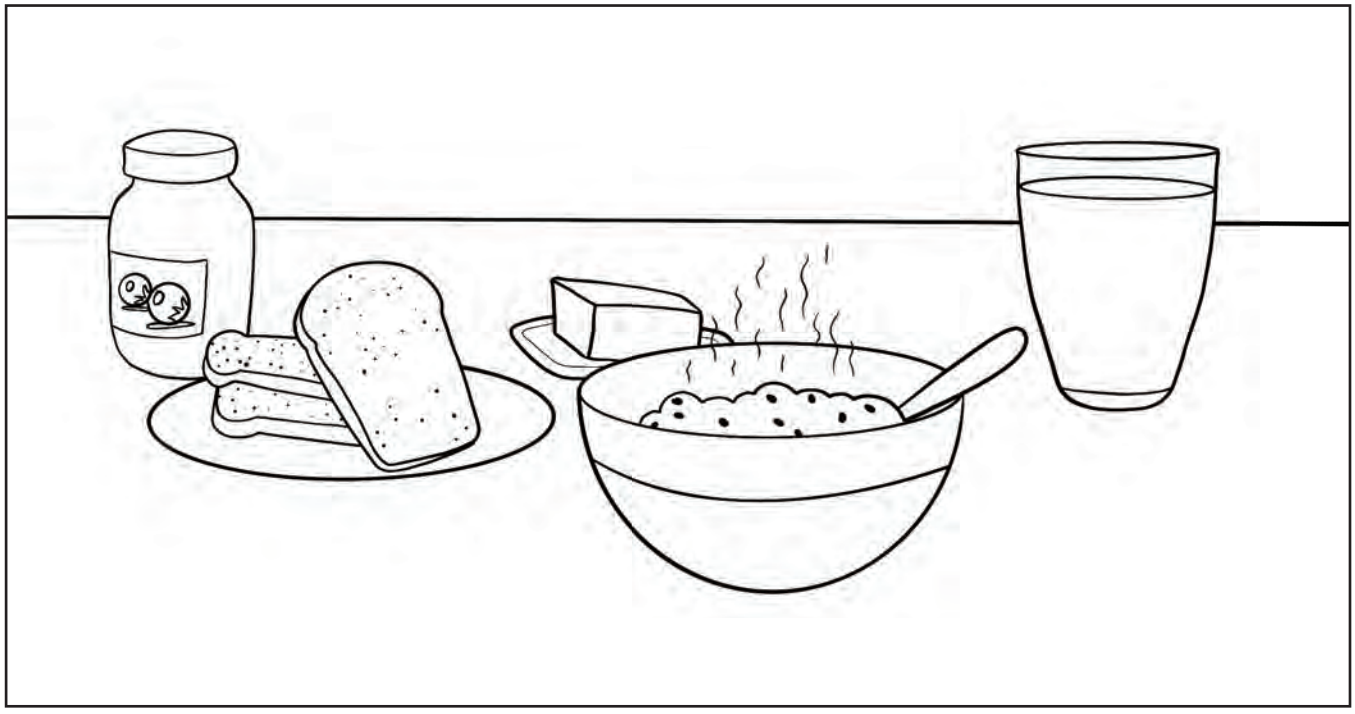


Father suggested that they use the big oak tree in the corner of the backyard and build a tree house, so that Jake and Izzy could have a tree to climb and be outside.

Izzy and Jake quickly dressed, ran down the stairs, and headed for the back door.

"Hold on you two," said mother. "You better have some breakfast if you are going to work outside today."

She prepared some oatmeal with raisins and toast with jam for Izzy and Jake. They ate quickly and joined father, mother, grandfather, and Aunt Sue in the back yard.



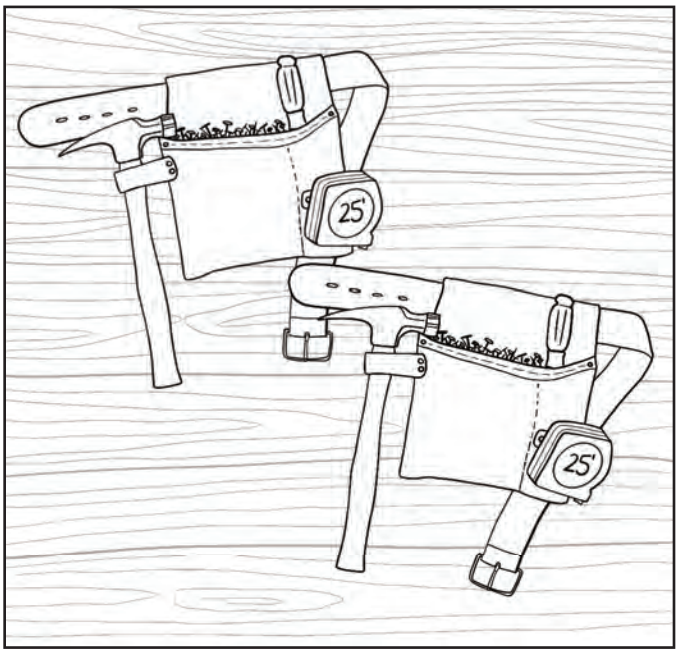
Name _____

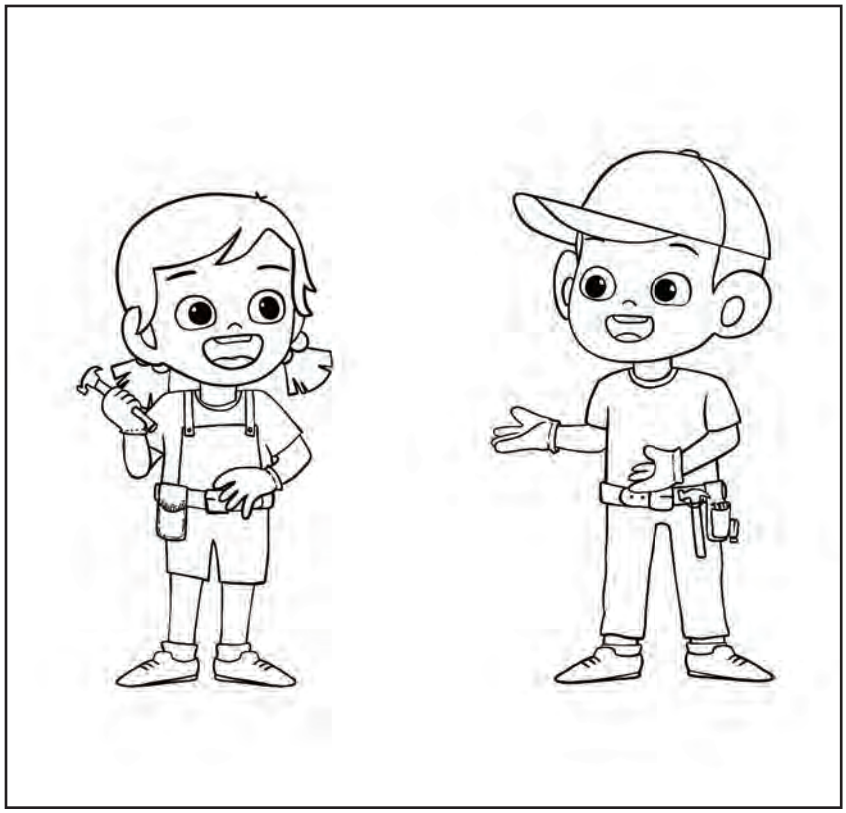
Date _____

No Light! No Sight!

"What can we do to help?" asked Izzy.

"Well," replied father, "Take a look over there on the picnic table. If you are going to be carpenters today, you will need to put on some work gloves and a tool belt where you can keep your hammer, nails, and measuring tapes."



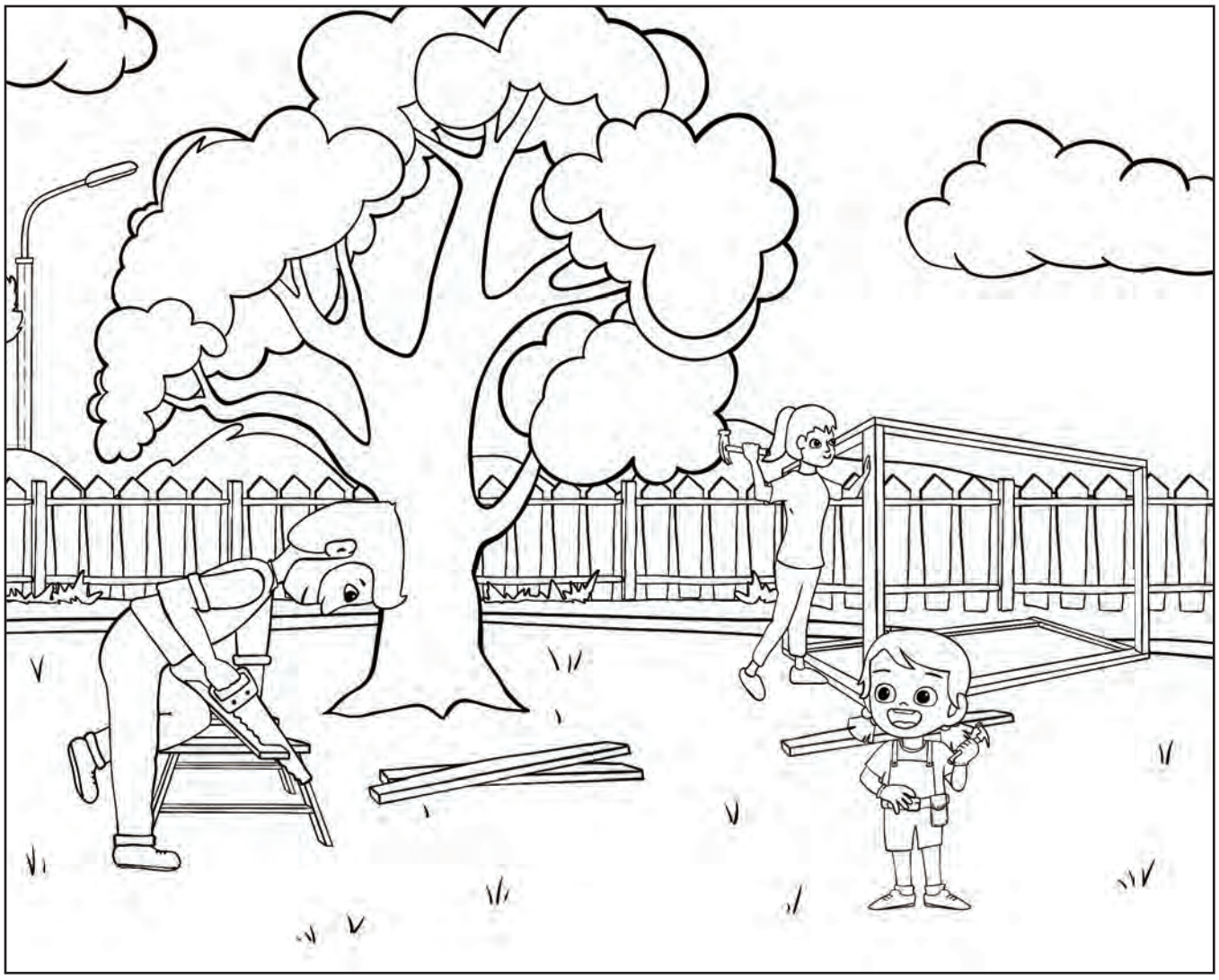


Izzy and Jake strapped on their new tool belts and put on their gloves. They were too excited for words.

1A INFORMATIONAL TEXT
No Light! No Sight!

Name _____

Date _____



Izzy teamed up with Aunt Sue and father while Jake worked with grandfather and mother. They worked all day with one short break for lunch. They built the platform, made the ladder, put up walls and finished the roof. As they were finishing, the sun was beginning to set and the streetlights were just flickering on.

Name _____

Date _____

No Light! No Sight!

Izzy, Jake, father, mother, grandfather, and Aunt Sue gathered in the tree house to admire their work. Aunt Sue put her arms around Jake and Izzy's shoulders.

"I am very proud of both of you. You worked very hard today and now look at the wonderful tree house you can use for a very long time," she said.

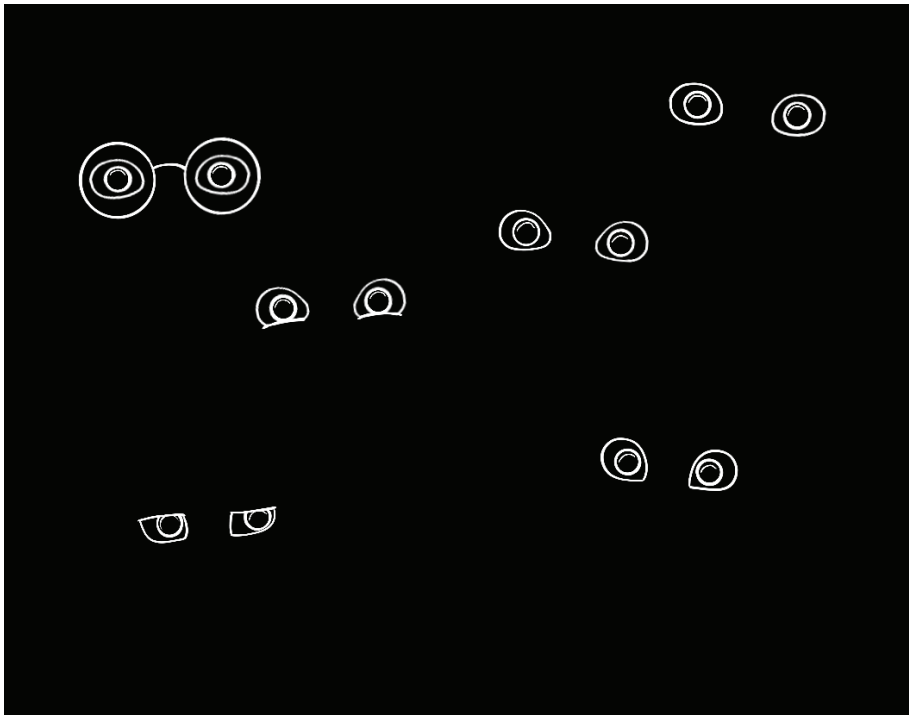
"Thanks!" said Izzy and Jake.

"That was a job well done," father agreed. "But Izzy and Jake, you have one more thing to do before the tree house is complete."

"What do you mean?" asked Jake. "We have our floor, walls, a roof, and a ladder to climb up. What more do we need?"

"Do you notice something missing?" he asked as he closed the door to the tree house.

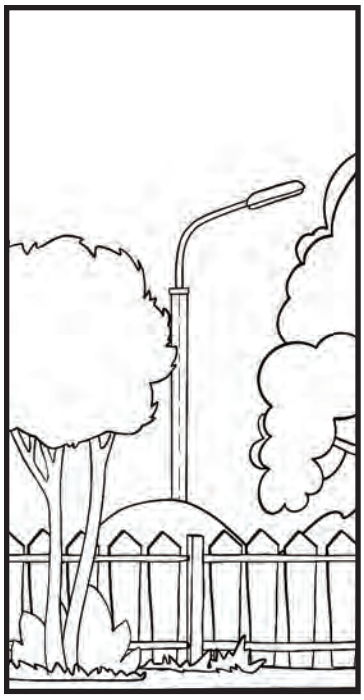
"Wait a minute! Open the door, it's too dark in here," said Izzy. "Windows, we need windows!"



Name _____

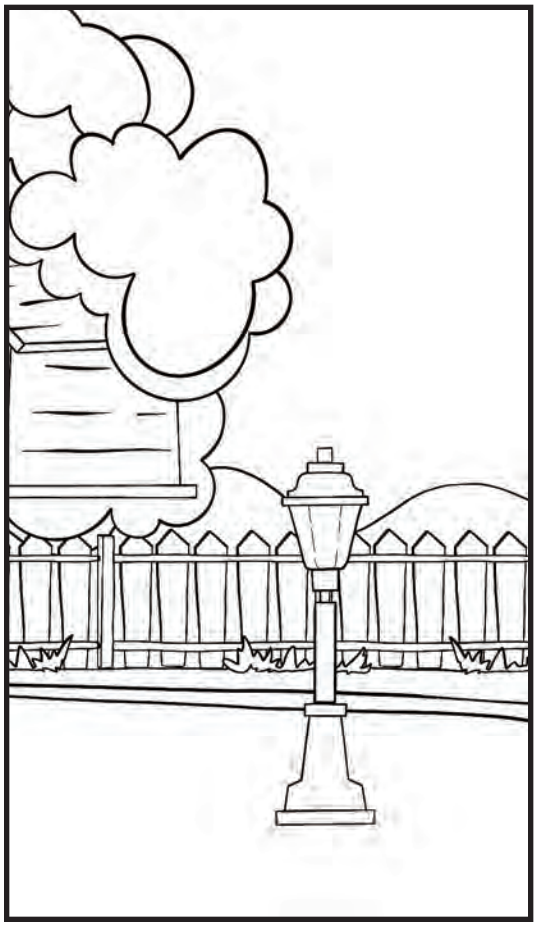
Date _____

"But not today", said mother. "It is time for two children to get cleaned up, have some dinner, and get ready for bed. Tomorrow is another day."



"And besides," added grandfather, "you will need to decide where you want the windows and what you want covering the windows."

"You have the streetlight in the alley, two porch lights, and the light from the sun to consider."



"You must ask yourselves how you can have light to play and work up here and how you can reduce the light when you want to sleep up here in the tree house."

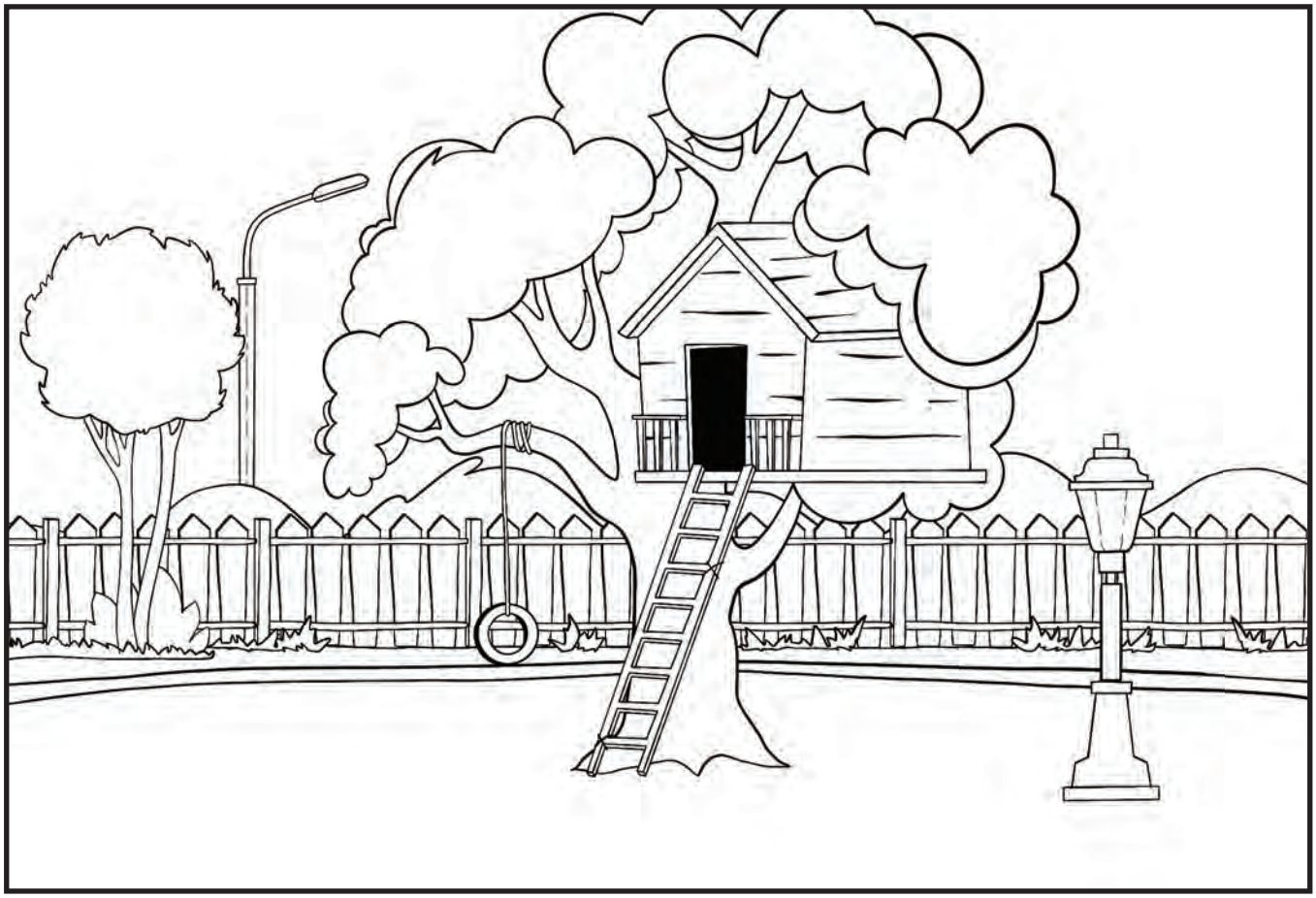
When you have done some brainstorming and made a plan, we will make the windows for the tree house."

Name _____

Date _____

No Light! No Sight!

Everyone climbed down from the tree house and headed for the house. Izzy and Jake turned around several times to stop and admire the tree house and consider the windows and light for the tree house. They had started brainstorming already.

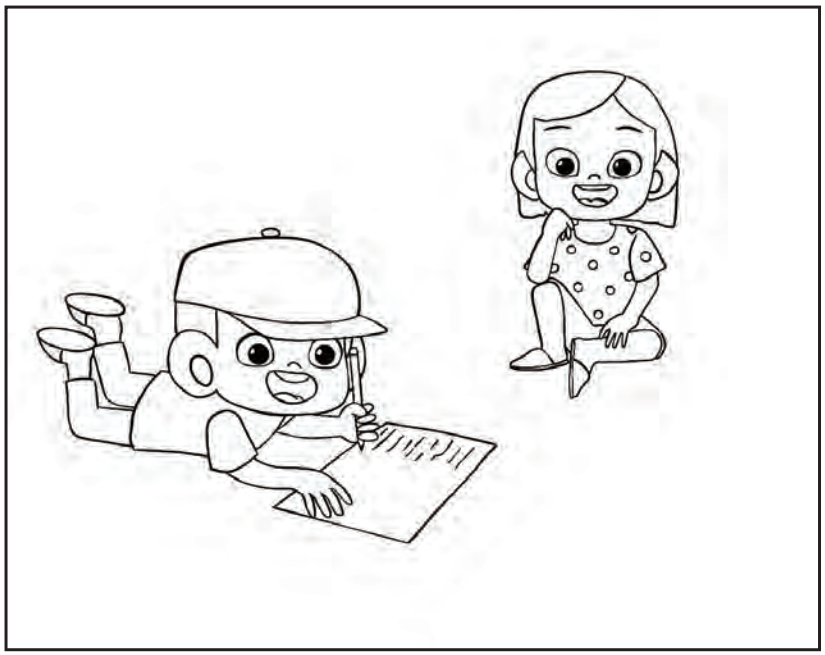


"Come on, Izzy and Jake," called mother. "You can make your plan for windows after you get cleaned up and eat some dinner. "

1A INFORMATIONAL TEXT
No Light! No Sight!

Name _____

Date _____



After dinner Izzy and Jake met in Izzy's room. Izzy had collected some paper, crayons, and pencils.

"What's all this?" asked Jake.

"I think we should make a list of all the activities we might be doing in the tree house and then we will know when we need light and when we want it darker. Then we can choose where we want the windows and what material we will use to let light shine through, block the light, let some light through. Maybe we want to use some material that will reflect light," explained Izzy.

"Like a mirror?" asked Jake.

"Exactly," responded Izzy.

Izzy and Jake went to work writing their list of activities and drawing their plans for the windows in the tree house.

After carefully drawing their ideas and making sure they considered the position of the lights in the yard and the position of the sun throughout the day, Izzy and Jake were pleased with their plan.

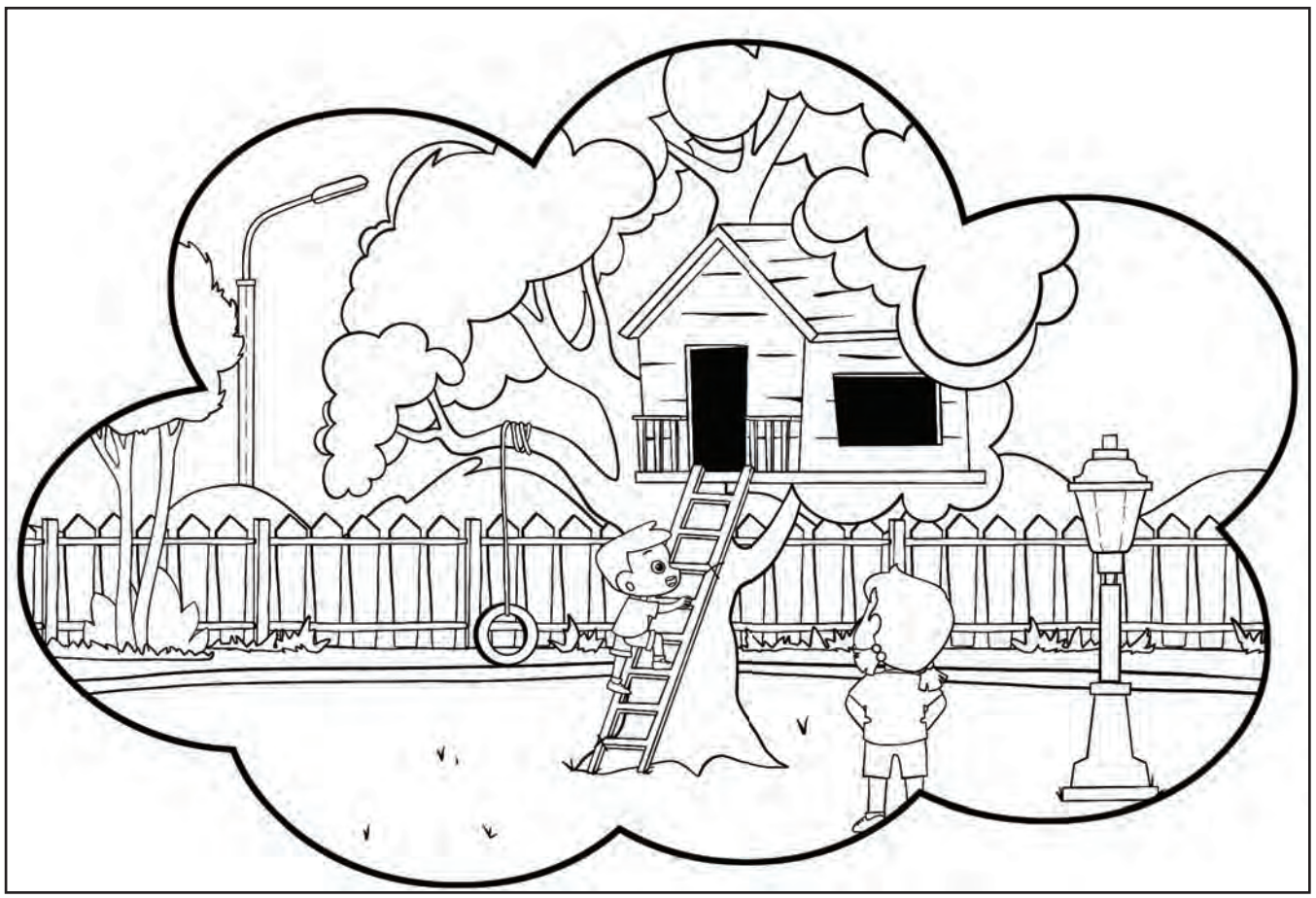
Name _____

Date _____

"Done!" said Jake. "I think we can show father and grandfather our plans for the windows tomorrow."

At the same time, mother was calling for them to brush their teeth, turn out the lights, and go to bed. Izzy and Jake did not argue. They were both tired from a long day of working and planning. Tomorrow they would have the windows in the tree house and then everyday they would climb the tree and be outdoors.

That night they both dreamed of adventures that can only happen in a tree house, way up high in the old oak tree, in the corner of the back yard.



1A ACTIVITY
No Light! No Sight!

Name _____

Date _____

What happens when I shine a light on an object?

	Objects	Draw it!	Write about it!
1.			
2.			
3.			
4.			

Vocabulary: light, bright, brighter, dark, darker, shine, dull, shadow.

Name _____

Date _____

Izzy and Jake were talking about the light in the tree house. Jake said "Our eyes will get used to the dark, so we will be able to see without light."

Write if you agree or disagree with Jake. Tell why you think that.

_____ _____

I ---------- with Jake because ----------

_____ _____

Name _____

Date _____

Draw and write a story about a time when it was too dark to see. Tell how you could make it easier to see.

Name _____

Date _____

_____

Title

KEY TERMS

Name _____

Date _____