Light Digital Sampler

Sample Lesson
Big Ideas
Unit Summary
Lesson 3: The Path of Light
Teacher Background Information
My Science Notebook
Mi Libreta de Apuntes de Ciencias
Assessments
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How To Use This Sampler

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Any text in blue is a link. Clicking blue text will take you to another page of the sample.

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Science Companion

www.sciencecompanion.com
The Teacher Lesson Manual engages and guides teachers to implement hands-on science lessons with their students. Lesson by lesson, students develop strong process skills and in-depth understanding of specific concepts.

The book brings teachers up to speed for the science content through “Teacher Background Information” and in-context lesson notes. Teachers can feel comfortable with leading the class—whether they have a long history of teaching science or not.

Each Teacher Lesson Manual focuses on a set of Big Ideas for a science topic. Each lesson focuses on a Big Idea. Groups of lessons (called clusters) develop a Big Idea through a series of different experiences and discussions.

Lessons Follow a Consistent Sequence

★ Engage – In this section of a lesson, the teacher introduces the topic. The goal is to briefly generate interest, activate prior knowledge, or link the day’s activities to what has come before.

★ Explore – This is often (but not always) a hands-on exploration conducted in small groups. Students record their work in their Science Notebooks. Collaboration with peers is encouraged. Key materials are provided in the ExploraGear kit.

★ Reflect and Discuss – In this important section, the teacher and students discuss what they observed, share ideas and data, and reflect on the day’s activities. This portion of the lesson brings the class back to the Big Idea.

You’ll find that while the lesson format is very consistent, students explore science content and the process of “doing science” in a large variety of ways.

You’ll also find that students LOVE the mix of active, hands-on, minds-on science.
Lessons at a Glance

Science Content: Big Ideas

The Light Unit concentrates on the following Big Ideas. Along with the scientific Habits of Mind discussed on page 6-7, these concepts are reinforced throughout the unit. The lessons in which each big idea is introduced or is a major focus are indicated in parentheses.

• Light is all around us. (Lessons 1, 2)
• If you can see something, then light must be present. (Lessons 1, 2)
• Light travels in straight lines. It moves outward in all directions from a source until it hits something. (Lessons 3, 6, 10, 11)
• When light hits something, one or more of these three things can happen: the light can bounce off the object, go through it, or be absorbed by it. (Lessons 4, 6, 7, 8, 9, 10, 11)
• The eye detects light. (Lesson 5)
• You see when light comes into your eye. (Lessons 5, 10, 11)
• When light goes through a transparent object, it either goes straight through or changes directions. (Lesson 9)
• Scientists use models to represent things that are too big, small, fast, slow, far away, or dangerous to observe in the real world. (Skill Building Activity)
# Unit Summary

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<tr>
<th>Cluster 1: Light Is All Around Us (Lessons 1-2)</th>
<th>Cluster 2: Light Travels in Straight Lines (Lesson 3)</th>
<th>Cluster 3: Light Bounces (Lessons 4-6)</th>
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<tr>
<td><strong>Overview</strong></td>
<td>Children explore and model how light beams travel. Their observations help them understand that not only does light exist in straight lines; it travels in straight lines.</td>
<td>Children establish that light can bounce, or be reflected. They realize that vision is possible because light bounces off objects and into their eyes; the more light there is, the easier it is to see. They also manipulate periscopes to observe a variety of objects.</td>
</tr>
<tr>
<td><strong>Science Content</strong></td>
<td>• If you can see something, then light must be present.</td>
<td>• Light bounces off many materials.</td>
</tr>
<tr>
<td></td>
<td>• Light travels in straight lines. It moves outward in all directions from a source until it hits something.</td>
<td>• Light can bounce directly back (mirror-like reflection) or in many directions (scatter).</td>
</tr>
<tr>
<td></td>
<td>• Shine light into the dark box to target dots on a card.</td>
<td>• We see because light bounces off objects and into the eye.</td>
</tr>
<tr>
<td></td>
<td>• Experiment with shining light through a cloudy solution.</td>
<td>• The more light there is, the easier it is to see things.</td>
</tr>
<tr>
<td><strong>Science Center</strong></td>
<td>• Begin using a “dark box,” which allows children to observe objects through a hole and to control how much light enters the box.</td>
<td>• Bounce light off of smooth and rough materials.</td>
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<tr>
<td></td>
<td>• Experiment with light inside a shoebox.</td>
<td>• Model how light travels to the eye using a cluster of straws.</td>
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<td></td>
<td>• Research light pollution.</td>
<td>• Explore how objects can be seen using a dark box and a flashlight.</td>
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<tr>
<td></td>
<td></td>
<td>• Continue experimenting with the periscopes.</td>
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<tr>
<td></td>
<td></td>
<td>• Modify a periscope by putting it together in different ways.</td>
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<tr>
<td></td>
<td></td>
<td>• Manipulate mirrors and a flashlight to direct light.</td>
</tr>
<tr>
<td><strong>Family Links</strong></td>
<td>• Introduce the Family Link Notebooks.</td>
<td>• Explore how light bounces off objects.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Explain to a family member how light bounces off of objects and into their eyes, enabling them to see.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make periscopes at home with the help of a family member.</td>
</tr>
<tr>
<td><strong>Further Science Explorations</strong></td>
<td>• Discuss the ideas generated during a science talk.</td>
<td>• Bounce light off shiny and matte surfaces.</td>
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<tr>
<td></td>
<td>• Experiment with light inside a shoebox.</td>
<td>• Explore how light bounces off the moon.</td>
</tr>
<tr>
<td></td>
<td>• Research light pollution.</td>
<td>• Model how light travels through a periscope to the eye using a flashlight, a ball and two mirrors.</td>
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<tr>
<td></td>
<td></td>
<td>• Build more elaborate periscopes using longer tubes and multiple mirrors.</td>
</tr>
<tr>
<td><strong>Cross-Curricular Extensions</strong></td>
<td><strong>Language Arts:</strong> Read about scientists who contributed to our understanding and use of light. <strong>Social Studies:</strong> Discuss what life was like before the invention of electric lights.</td>
<td><strong>Art:</strong> Use bouncing light to trace a picture. <strong>Language Arts:</strong> Read the book <em>Stellaluna</em> and discuss with the children if Stellaluna’s idea about vision is correct. <strong>Social Studies:</strong> Research the history of the periscope.</td>
</tr>
</tbody>
</table>
### Cluster 4: Opaque, Translucent, and Transparent Materials (Lessons 7-9)

Children explore what happens to light as it shines on three types of materials: transparent, translucent and opaque. They manipulate an opaque material to make it translucent. They observe pencils in different types of transparent liquids to understand that light changes directions.

- Transparent, translucent and opaque materials let different amounts of light pass through them.
- Translucent materials allow some light to pass through them.
- Opaque materials do not allow any light to pass through them. The light is either absorbed, reflected, or a combination of both.
- Transparent materials allow most light to pass through them.
- Light can change direction as it passes through transparent materials.

### Cluster 5: Summative Lessons (Lessons 10-11)

Children review what they have learned about light by revisiting the questions they asked at the beginning of the unit, and by revising their science notebook models of how light travels. They role play two different scenarios that model the behavior of light.

- Light travels in straight lines. It moves outward in all directions from a source until it hits something.
- When light hits something, one or more of three things can happen: the light can bounce off it, go through it, or be absorbed by it.
- You see when light comes into your eye.

### Overview

- Compare the children's models of light from the beginning of the unit and the end by copying and displaying samples of science notebook pages 2 and 3.
- Use copies of “Light Journal” pages from the children's science notebooks and other representative work to make and display a class book about what they learned about light.

### Science Content

- Continue to test and categorize different types of materials by shining light through them.
- Compare shadows cast by transparent, translucent and opaque materials.
- Read books about transparent, translucent and opaque materials.
- Describe objects viewed through different types of jars.

### Science Center

- Shine a light through a variety of objects and rank them by the amount of light that goes through each.
- Share with family members a reference sheet about opaque, translucent and opaque materials.
- Make shadow puppets and think about why a shadow is cast.
- Create magnifying lens to observe objects in detail.

### Family Links

- Describe to a family member how people can see a tree.
- Role-play additional scenarios about light's behavior: its sources, how it moves, what happens when it hits different kinds of objects, and how it makes vision possible.

### Further Science Explorations

- Experiment with a cup of water and a coin to observe how light changes directions.
- Investigate how corrective lenses help people to see.
- Explore different professions that use lenses.

### Art

- Make light catchers using transparent, translucent and opaque materials. Sketch an object, the shadow it casts and the light reflected off the surface. Study works of cubism.

### Language Arts

- Write “I Learned” pages about light.
- Investigate why pioneers often used oiled paper for windows instead of glass.

### Cross-Curricular Extensions

- Construct a book out of transparent, translucent and opaque materials and write down information learned about all three. Investigate how various lenses are used today. Investigate why pioneers often used oiled paper for windows instead of glass.
Big Idea
Light travels in straight lines. It moves outward in all directions from a source until it hits something.

Overview
Children explore how light travels. They observe a light beam pass through a cloudy solution, and create a model that simulates its straight path. They also consider what happens to light when it hits an object in its path, a topic that is the focus of the remainder of the unit.

Key Notes
- Make sure all the children have completed the Family Link Homework “Sources of Light,” that was sent home after the previous lesson. The children will review it during the introductory discussion.
- Throughout the rest of this unit the children will model how light travels. If the class hasn’t already done Skill Building Activity “Using Models in Science” (on page 170), consider teaching it before this lesson.
- For more information about the science content in the lesson, see the “Light Travels in Straight Lines” section of the Teacher Background Information on page 181.
Standards and Benchmarks

The explorations meet Physical Science Standard B (Light, Heat, Electricity, and Magnetism): “Light travels in a straight line until it strikes an object.” They also meet The Physical Setting Benchmark 4F (Motion): “Light travels and tends to maintain its direction of motion until it interacts with an object or material.”

Lesson Goal

Observe how light travels outward from a source in straight lines.

Assessment Options

Circulate around the room as the children model light with straws. Use criteria A and B on the Interpreting and Using Models checklist to document the children’s understanding of models.

Use the synthesizing discussion to assess the children’s understanding of how light travels in straight lines. Use criteria A and B on Rubric 2 to assess the children’s understanding of how light travels. You can reassess their developing comprehension, as the unit progresses, during Lessons 6 and 10.
Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ExploraGear</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cups, clear</td>
<td>1 per pair</td>
<td>To hold cloudy solution.</td>
</tr>
<tr>
<td>Flashlights</td>
<td>1 per pair</td>
<td>To shine in cloudy solution.</td>
</tr>
<tr>
<td>Night light</td>
<td>1</td>
<td>To show light from a light bulb.</td>
</tr>
<tr>
<td>Straws, clear</td>
<td>5 per pair</td>
<td>To model light beams.</td>
</tr>
<tr>
<td><strong>Classroom Supplies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container, 3.8 L (1 gal)</td>
<td>1</td>
<td>To hold cloudy solution.</td>
</tr>
<tr>
<td>Milk, skim</td>
<td>1 qt</td>
<td>To mix with water to make a cloudy solution.</td>
</tr>
<tr>
<td>Water</td>
<td>3.8 L (1 gal)</td>
<td>To make cloudy solution.</td>
</tr>
<tr>
<td><strong>Previous Lesson</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Link Homework</td>
<td></td>
<td>From Lesson 2.</td>
</tr>
<tr>
<td>“Sources of Light”</td>
<td></td>
<td>(completed)</td>
</tr>
<tr>
<td><strong>Curriculum Items</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Science Notebook</td>
<td></td>
<td>pages 6-7</td>
</tr>
<tr>
<td>Rubric 2: How Light Travels (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checklist: Interpreting and Using Models (optional)</td>
<td></td>
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</tr>
</tbody>
</table>

**Notes**

**Preparation**

- Make a cloudy solution in the container by adding 3 T (44 ml) skim milk to 1 gal (3.8 L) of water. The water should be cloudy enough so that a beam of light shone through it is visible. In other words, the suspended milk particles should reflect some light, so that it is easier to see the light beam as it goes through the liquid.
- Fill the cups with the solution.
- Wash and save the milk carton to use when the class makes periscopes in Lesson 6.

**Vocabulary**

- light beam ............ Light rays all going in one direction.
Teaching the Lesson

Engage

Introductory Discussion
1. Review the sources of light the children identified at home for their Family Link Homework “Sources of Light.”
2. Facilitate a discussion about variations in the light emitted by the different sources the children identified, with questions such as:
   - Does light from different sources always look the same? (No)
   - How does light from different sources look different? (It may have different colors or brightness. Examples include reddish orange light from some streetlights, the light from neon signs, and light from a campfire, candle, fluorescent light, or incandescent light bulb.)
3. Review the ideas the children generated in Lesson 2 about how light from outside sources got into their darkened classroom even when the windows were covered.
4. Tell the children that today they are going to carefully observe a light beam, and see the direction light travels from its source.

Explore

Observing a Beam of Light
Children begin their examination of how light travels as they observe how a beam of light passes through a cloudy solution.
1. Give each pair of children a cup of the cloudy solution and a flashlight.

   **Safety Note:** Remind the children that it’s dangerous to shine a flashlight into someone’s eyes.

2. Dim the classroom, and have one child carefully hold the cup at eye level with both hands and look in through the side of the cup. Then have the other child position the flashlight against the side of the cup and turn the flashlight on (so the light shines horizontally into the cup).
3. Direct the children to make observations about the light and record them on page 6 of their science notebooks.

4. Have the pairs tilt the flashlight so that it shines at a different angle into the cup.

5. After observing what happens to the light, the children can draw a picture of what they saw on page 7 of their science notebooks.

6. When children have completed their drawings, have them answer question 3 on page 7.

**Teacher Note:** The last question in the science notebook is a pre-assessment of children’s understanding of what happens when light hits an object. The class will discuss their answers during Lesson 4, which is devoted to this topic.
**Modeling a Beam of Light**

In several lessons in this unit, children use straws to model how light beams travel. They begin with this simple model of how the light beams travel through the cloudy solution.

1. Hand out five straws to each pair of children.
2. Have the children shine their flashlights into the side of the cup again, then hold the straws next to the cup so that the straws point in the same direction as the path of light through the solution in the cup.

**MANAGEMENT NOTE:** Tell the children not to put the straws into the cloudy solution.

**TEACHER NOTE:** The straws model how the light passes through the cup in a straight line. Consider discussing the limitations of this model since the straws don’t really go through the cup.

3. Tell the children to tilt the flashlight and position the straws so that they point in the same direction as the path of light inside the cup. (Light should continue to pass through the cup in a straight line, and the children should continue to model this with their straws.)

**TEACHER NOTE:** If the children shine their flashlight through the bottom rim of the cup, the light enters the cup from two angles—the bottom and side of the cup. This causes the light to travel through the cup in more than one direction, making the light look scattered. If children notice this phenomenon, discuss how the light enters the cup, and how this affects the path the light follows.
Reflect and Discuss

Sharing
Ask the children to share their observations from the first exploration:

- What did they observe when they shined the flashlight into the side of the cup? (They could see a beam of light going through the cloudy solution in a straight line.)
- What happened to the light when they tilted the flashlight? (The beam of light tilted as well, but was still in a straight line.)

Synthesizing
1. Guide the discussion to help children use the specifics of what they saw to reach a more generalized understanding that light travels in straight lines.
   - Did they notice light traveling in a curved path or in a straight path from the flashlight? (It traveled in a straight path.)
   - Was this true even when they tilted the flashlight? (Yes)
2. Turn on a night light (with no shade) and a flashlight. Broaden the discussion to cover what happens when light travels in more than one direction.
   a. Ask the children to compare the path the light beams travel from each of these sources of light. (The light beams still travel in straight paths, but they travel in all directions from the night light, and are focused in one direction by the flashlight.)
   b. Have volunteers use straws to model how light beams travel from a flashlight and how they travel from a night light. (The light beams from the night light bulb travel outward in all directions, while the flashlight’s bulb has material surrounding it that makes light travel directionally.)

Teacher Note: Do not be surprised if the children model the light coming from the night light in the same way they model the light coming from the flashlight. To reinforce that light travels outward in all directions from a source, put the cup with the cloudy solution near the night light and show the children that there is not a focused beam of light passing through the cup.
3. Have the children compare the bulb in the flashlight with the bulb in the night light:
   - Is the bulb in the flashlight similar to the night light bulb, or different? (*It is similar, just smaller.*)
   - If the flashlight bulb were exposed like the night light bulb, how would light travel from it? (*It would travel in straight lines outward in all directions.*)
   - How is the flashlight like a lamp with a shade on it? (*Both focus the light so it is blocked and cannot travel outward in all directions.*)

**Ongoing Learning**

**Science Center**

*Dark Box, Light Targets*

1. Cover the light hole in the dark box with a piece of aluminum foil and make a small pinhole in it.
2. Draw some dots on a card and number them. Tape the card inside the box opposite the light hole.
3. Have children shine a beam of light onto each of the dots on the card inside the dark box. Suggest that they draw pictures in the "Light Journal" pages of their science notebooks of how they held the flashlight to target each dot.

*Cloudy Solution*

Place a jar of cloudy solution (with a tight lid) in the Science Center for the children to use in the dark box.

**Extending the Lesson**

**Further Science Explorations**

*Lining Up Light*

1. Fold three index cards in half so that they stand upright.
2. Holding two cards together, punch a hole through the top half of the cards, as close to the center as possible.
3. Line up the cards so that a beam of light from a flashlight may be shone through the holes onto the third card without a hole.
4. Move one card slightly aside. Ask the children whether the light will still pass through both holes.

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**Materials: Dark box, flashlight, aluminum foil, pin, tape, white card with dots**

**Materials: Dark box, flashlight, jar of cloudy solution**
**Notes**

### Make a Pinhole Viewer

A pinhole viewer provides a concrete example of how light travels in straight lines.

1. Cut off the open end of an empty cereal box and cover it with a piece of wax paper. Tape the paper to the box so it is tight across the top.
2. Make a small hole in the end of the box opposite the wax paper.
3. Place a lamp with an exposed light bulb on the table.
4. Dim the classroom, turn on the lamp, and align the box with the pinhole between the light bulb and the wax paper.
5. Adjust the position of the box until you can see the image of the light bulb appear on the wax paper. (If done properly, the children should see an inverted, or upside down, image of the light bulb on the wax paper.)
6. Try looking at other light sources or bright images through the pinhole viewer.

**Teacher Note:** The pinhole only lets through the few beams that are heading in just the right direction to shine through the pinhole. The cardboard blocks most of the light beams. Since the light beams from the top of the bulb that can pass through the pinhole slope down at a steep angle, they hit the bottom of the wax paper. The beams of light from the base of the bulb that pass through the pinhole slope up at a steep angle, hitting the top of the wax paper. What you end up seeing is an upside-down, or inverted, picture of the bulb. Right and left are also reversed in a pinhole viewer.

### Planning Ahead

**For Lesson 4**

Read through the children’s science notebooks to familiarize yourself with their ideas about what happens to light when it hits something.

Collect approximately 15 rocks for Lesson 4. They should be larger than ping pong balls, but can be any size and shape. If it is difficult to collect rocks, consider using a pile of books or wooden blocks to create an uneven surface.
Introduction

Most children experience light every day of their lives. Some types of light, like the soft glow of a nightlight at bedtime, a sunny spring day, or the burning of a campfire, can comfort children. Other light, like the sharp crackle of lightning, can be scary or unpleasant. From the time they first perceive their surroundings, children use their sense of sight to observe and learn about the world around them. Yet do we really know what light is? How can such an essential component of our lives be so mysterious?

In this unit children study light in their environment. They look closely at how light surrounds them and think about how light travels, what happens to light when it hits things, and how light enables them to see. Through these explorations of light, children build a foundation for understanding this complex and amazing phenomenon. This foundation is essential in later grades when children study the science of light in more depth.

Unit Overview

The Light Unit focuses on visible light. It begins with a cluster of lessons about where light is and isn’t, and continues with observations to promote understanding that light travels in straight lines. The bulk of the unit addresses what happens when light hits a surface. It can bounce off it, go through it, or be absorbed by it. Different materials affect what happens to the light, and in lessons about opaque, translucent, and transparent materials, the children learn about these distinctions.
Light Travels in Straight Lines

Children in elementary school frequently confuse light with its source (an electric light bulb) or with its effects (an illuminated room). To overcome these misconceptions and to understand that light travels, children need to know that light exists independently in space and that it interacts with objects it encounters. One of the Big Ideas of the unit is that light from a source moves outward in all directions in straight lines until it hits something. In Lesson 3, the children pass light beams through cloudy water and observe their straight path. Children also use straws to model how light travels.

Based on their prior experience seeing shafts of sunlight streaming down between clouds, or noticing that they can't see around a curve when car headlights beam straight ahead, children may seem to accept the idea of light “being” in a straight line. Be aware that their conception may not yet include the idea that light travels.

The Speed of Light

In fact, light travels in straight lines at immense speeds. It travels so fast that its effects appear to be instantaneous. When you turn on a light switch, the room brightens immediately. You don't perceive a delay in the time it takes the light to leave the source and enter your eye. Because it happens so quickly, children do not realize that light travels at a finite speed. Yet it does.

Light travels at a speed of 186,000 miles (300,000 kilometers) per second through a vacuum such as space. At this speed, it takes 8 minutes for sunlight to reach Earth. The starlight we see in the nighttime sky may have left that star millions of years ago. By the time the light reaches our eyes, the star may no longer exist!

Light Bounces

Only something in motion can hit something else. In Lessons 4-9 the children observe what happens to light when it hits things. If the children have not yet understood that light travels, these lessons assist them with that understanding. The idea of light in motion is supported by a Big Idea emphasized in the unit: when light hits something, one or more of three things can happen. It can bounce off the object, go through it, or be absorbed by it. Through various hands-on activities, the children explore each of these scenarios in detail.
The Science Notebook is a student’s ongoing record of his or her work as a scientist. Each Science Companion module for grades 1-6 has a Student Science Notebook tailored for that module.

Student Science Notebooks are age-appropriate. Notebooks for younger grades contain minimal text and opportunities to draw instead of write, so all students can participate and shine as scientists. For older grades, Student Science Notebooks utilize students’ developing skills: they contain procedures for students to follow, and provide support for controlling variables as students develop their own experiments—all leading to increased independence.

All the Student Science Notebooks develop literacy and support mathematics skills. Students apply these disciplines in the highly motivating process of doing science.
Hello, Scientist,

All scientists like to study things carefully. They like to think and ask questions. They try things out and then see what happens. They use their senses to observe things. They describe their observations with pictures and words.

Scientists use science notebooks to write and draw their ideas and their observations about the things they study.

This is your science notebook. You will write and draw some of your ideas and your observations here.

Enjoy it!
Observing Light

1. Draw or describe how the light looked as it shone through the side of the cup.
Observing Light

2. What happened to the light when you tilted the flashlight at a different angle? Draw what you observed.

3. Describe what you think happens when light hits something.
Hola Científico,

A todos los científicos les gusta de estudiar las cosas cuidadosamente. Les gusta pensar y hacer preguntas. Experimentan y luego ven que pasa. Usan sus sentidos para observar cosas. Describen sus observaciones con dibujos y palabras.

Los científicos usan libretas para apuntar y dibujar sus ideas y sus observaciones de las cosas que estudian.

Esta es tu libreta de apuntes para ciencias. Aquí vas a escribir y dibujar algunas de tus ideas y observaciones.

Disfrútalo!
Observando la Luz

1. Dibuja o describe como brilló la luz al atravesar el lado de la taza.
2. ¿Qué le sucedió a la luz cuando inclinaste la linterna a un ángulo diferente? Dibuja lo que observaste.

3. Describe lo que crees que sucede cuando la luz se encuentra con algo.
Assessments

Science Companion supplies a variety of tools to assess children “in-the-act” of doing science, as well as evaluate their understanding and proficiency as they finish clusters of lessons.

**In the Teacher Lesson Manual:**

- Big Ideas and lesson goals are clearly outlined on each lesson’s Quick Look pages.
- Assessment Options in each lesson suggest where pre-assessment and formative assessment can occur in the context of a lesson.

**In the Assessment Book:**

- **Rubrics** are supplied to score understanding of science content. The criteria in each rubric are derived from a module’s Big Ideas and lesson goals.
- **Opportunities Overviews** show where each criteria can be evaluated during pre-assessment, formative assessment and summative assessment.
- **Checklists and Self-Assessments** list criteria that are related to science process skills.
- **Performance Tasks** are used for summative assessment to evaluate students’ understanding of Big Ideas and lesson goals. The Assessment Book supplies evaluation guidelines and blank masters for each Performance Task.
- **Quick Checks**—another summative assessment tool—employ a multiple-choice format.

**The Science Notebook Teacher Guide:**

A final assessment tool is the Science Notebook Teacher Guide. This teacher edition of the Student Science Notebook is annotated to help teachers know what to expect in from children in their Student Science Notebooks.
# Rubric 2: How Light Travels

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<thead>
<tr>
<th>Criterion A (Lessons 1–3, 6, 10, 11)</th>
<th>Criterion B (Lessons 1–3, 10, 11)</th>
<th>Criterion C (Lessons 6, 10, 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light travels in straight lines from a source.</td>
<td>Light travels outward in all directions from a source.</td>
<td>After light bounces off an object, it travels in a straight line in a new direction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4 - Exceeds Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explores content beyond the level presented in the lessons.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3 - Secure (Meets Expectations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understands content at the level presented in the lessons and does not exhibit misconceptions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 - Developing (Approaches Expectations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shows competency with lesson content.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 - Beginning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has no previous knowledge of lesson content.</td>
</tr>
</tbody>
</table>

- **4 - Exceeds Expectations**
  - Understands at a secure level (see box below) and shows interest in investigating the path of light in everyday situations.
  - Understands at a secure level (see box below) and can apply their understanding to control how light travels from a source.
  - Understands at a secure level (see box below) and can apply their understanding to everyday situations. (For example, can explain where light travels after it bounces off a mirror.)

- **3 - Secure (Meets Expectations)**
  - Can model or diagram how light travels in straight lines from a source.
  - Can model or diagram how light travels outward in all directions from a source.
  - Can model or diagram how, once light bounces off an object, it travels in a straight line in a new direction.

- **2 - Developing (Approaches Expectations)**
  - Recognizes that light can travel from a source, but does not understand that it travels in straight lines.
  - Recognizes that light travels outward from a source, but does not understand that it travels in all directions from that source.
  - Recognizes that light can bounce off an object, but doesn’t understand that after it bounces, it travels in straight lines in a new direction.

- **1 - Beginning**
  - Does not understand that light travels.
  - Does not recognize that light travels outward in all directions from a source.
  - Does not understand that light can bounce or that it travels in a straight line.
Opportunities Overview: How Light Travels

This table highlights opportunities to assess the criteria on Rubric 2: How Light Travels. It does not include every assessment opportunity; feel free to select or devise other ways to assess various criteria.

<table>
<thead>
<tr>
<th>Criterion A</th>
<th>Criterion B</th>
<th>Criterion C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lessons 1–3, 6, 10, 11)</td>
<td>(Lessons 1–3, 10, 11)</td>
<td>(Lessons 6, 10, 11)</td>
</tr>
<tr>
<td><strong>Pre and Formative Opportunities</strong></td>
<td><strong>Performance Tasks</strong></td>
<td><strong>Summative Opportunities</strong></td>
</tr>
<tr>
<td>Lesson 1:</td>
<td>Light Travels in Straight Lines Cluster</td>
<td>Light Travels in Straight Lines Cluster</td>
</tr>
<tr>
<td>- Science notebook page 2</td>
<td>Shining a Flashlight, page 29</td>
<td>Pages 40-41: items 1-3</td>
</tr>
<tr>
<td>Lesson 2:</td>
<td>Summative Lessons Cluster My Revised Model of Light, page 34</td>
<td>Light Travels in Straight Lines Cluster</td>
</tr>
<tr>
<td>- Science notebook page 5</td>
<td>Light Challenge 2, page 35</td>
<td>Pages 40-41: items 2, 3</td>
</tr>
<tr>
<td>Lesson 3:</td>
<td>Light Bounces Cluster</td>
<td>Light Bounces Cluster</td>
</tr>
<tr>
<td>- Reflective discussion</td>
<td>Looking at a Dog, page 30</td>
<td>Page 42: items 1, 2; and page 44: item 7</td>
</tr>
<tr>
<td>- Science notebook pages 6-7</td>
<td>Modeling Light in a Periscope, page 31</td>
<td></td>
</tr>
<tr>
<td>Lesson 6:</td>
<td>Summative Lessons Cluster</td>
<td></td>
</tr>
<tr>
<td>- Science notebook page 16</td>
<td>My Revised Model of Light, page 34</td>
<td></td>
</tr>
<tr>
<td>Lesson 10:</td>
<td>Light Challenge 2, page 35</td>
<td></td>
</tr>
<tr>
<td>- Science notebook page 2</td>
<td>Light Challenge 3, page 36</td>
<td></td>
</tr>
<tr>
<td>Lesson 11:</td>
<td>Exploration</td>
<td></td>
</tr>
<tr>
<td>- Exploration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Opportunities Overviews show where ongoing and summative assessment can occur for each criteria.
Checklist: Interpreting and Using Models
Teacher Assessment
(Lessons 3,4,10, and 11)

Determine whether the following elements are evident as the child interprets and uses models. You might assign one point for each criterion the child demonstrates. You can add specific observations or comments in the space below each criterion.

Name _________________________________ Date__________

Criteria:

______ A. Understands that a model is a representation of something.

______ B. Understands that a model can be constructed to represent a scientific idea.

______ C. Can interpret other models.

______ D. Can compare one’s own model to a scientific or peer’s model.

______ E. Can critique one’s own model as well as a scientific or peer’s model.
Self-Assessment: Using Models

Think about the model you used in class. Answer the following questions.

1. How well did the model make you think of the real object?
   - Very well
   - Okay
   - Not very well

2. How well did the model help you understand an idea?
   - Very well
   - Okay
   - Not very well

3. What did you like best about using the model?

4. Did you run into any problems while you were using the model? If yes, what were they?
Shining a Flashlight

Light Travels in Straight Lines Cluster (Lesson 3)

Look carefully at the picture above. If the flashlight is turned on, will light pass through all three holes in the index cards? Explain why or why not.

**TEACHER NOTE:**
Use this assessment after teaching Lesson 3.

**EVALUATION GUIDELINES:**
When evaluating student answers, consider whether they include the following elements in their written explanations:

- Light will only travel through the first two holes closest to the flashlight.
- Light travels in straight lines and the hole in the last index card does not line up straight with the first two holes.
Light Travels in Straight Lines Cluster
Quick Check Items

**TEACHER NOTE:** The following questions relate to the Light Travels in Straight Lines cluster. Use them after teaching the entire cluster, or select the applicable questions immediately following each lesson. You can also compile all of the Quick Check items into an end-of-unit assessment.

1. (Lesson 3) How does light travel?
   
   a. Light travels in curved lines.
   
   b. Light doesn’t travel.
   
   c. *Light travels in straight lines.*

2. (Lessons 3) Circle the picture that **best** shows how light travels out from a flashlight.

   ![Picture 1]
   Picture 1

   ![Picture 2]
   Picture 2

   ![Picture 3]
   Picture 3
3. (Lesson 3) Circle the picture that **best** shows how light travels out from a light bulb.

Picture 1

Picture 2

Picture 3
Teacher Masters and Visual Pack

All the Classroom Tools You Need

Teacher Masters may be reproduced and used during lessons. Their uses vary—they may be used by individuals, in groups, or as reference sheets for teachers or adult helpers in the classroom.

Family Letters (introductions to the module) and Family Links (homework or optional activities) are also in the Teacher Masters.

Visuals include posters and pictures that may be displayed or projected in the classroom during lessons. In some cases, Visuals may also include cardstock games that are used during lessons.

www.sciencecompanion.com
Family Link with Science—Homework

Sources of Light

Today in science class, as part of our study of light, we talked about light sources and attempted to make the classroom completely dark.

With a family member, look for sources of light both inside and outside your home. List as many of these sources of light as possible.

<table>
<thead>
<tr>
<th>Source of the light</th>
<th>Description of light emitted from source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Please complete this assignment for science class.
The ExploraGear® provides all of the hard-to-find, hands-on materials needed to effectively implement a Science Companion module. This kit of non-consumable and consumable items is your go-to place for the tools needed to teach inquiry science. The authors of Science Companion carefully developed the curriculum so that the ExploraGear® items are not overwhelming and unfamiliar, but filled with the most essential, high quality items needed to engage students in a rich, interactive, inquiry science experience.
Science Companion uses the “I Wonder” Circle to help students reflect on how they (and other scientists!) do science.

“I Wonder” Circle®
Doing Science

I Wonder: notice, ask questions, state problems
I Think: consider, gather information, predict
I Try: experiment, model, test ideas, repeat
I Observe: watch, examine, measure
I Record: record data, organize, describe, classify, graph, draw
I Discover: look for patterns, interpret, reflect, conclude, communicate discoveries
What’s in Science Companion?

For the Teacher

- Teacher Lesson Manual
- Assessment Book
- Student Notebook Teacher Guide
- Reference Materials
  - Teacher Reference Materials
  - Lesson O
- Teacher Masters
- Visual Aids
  - Transparencies and Posters
  - I Wonder Circle® Poster in English & Spanish

Teaching and Assessment

Great Classroom Support

www.sciencecompanion.com
Collecting and Examining Life
From collecting animal tracks to dissecting flowers, children deepen their understanding of what makes something alive as well as exploring the similarities and differences among living things.

Rainbows, Color, and Light
Through experiments with prisms, mirrors, bubbles, water, sunlight, and flashlights, children bring rainbow effects into their classroom and onto the playground. They also mix colors to observe that colored light produces different results than mixing pigmented paints, dough, or water.

Solids, Liquids, and Gases
While deciding what makes a solid a solid, watching water disappear from an open cup, or comparing various liquids, children find the value in asking questions and probing the world around them for meaningful answers.

Motion
Through activities that engage children’s bodies and minds, children move their own bodies in various ways to learn about motion, as well as build ramps, roll toy cars, drop and crash marbles, slide pennies and shoes, and even fly paper airplanes.

Life Cycles
From watching a pea sprout to feeding apples to butterflies, children closely study four organisms, including humans, to observe the remarkable growth and change that living things experience during their life spans.

Early Science Explorations
From making a collage of the leaves and seeds they find to constructing a lever from rocks and wood, children are introduced to the wonders of science and scientific exploration. Contains 7 studies in one book: Growing and Changing; Class Pet; Collections from Nature; Constructions; Dirt, Sand and Water; Sky and Weather; and My Body.

Weather
One day students learn to use a thermometer to record temperature, another day they measure rainfall or investigate the nature of ice. Throughout the year, students use their senses as well as scientific tools to discover that weather is a dynamic part of nature.

Magnets
From testing what sort of everyday objects are attracted to magnets to comparing the strength of different magnets, children deepen their observation skills while learning about the nature of magnets.

Rocks
One day children examine fossils, another day they might test minerals. As children collect, examine, describe, and experiment with rocks, minerals and fossils, they hone their observation skills and begin to unravel the puzzle of what rocks are and how they are formed.

Soils
From closely observing soil components and their properties to discovering the importance of earthworms, children use their senses of sight, smell, and touch to explore the wonders of soil.
Habitats
From going on a nature walk to dissecting owl pellets, children are asked to think about how organisms (plants, animals, fungi, and microscopic living things) survive in the places they live, and how they interact with other living things.

Electrical Circuits
Whether exploring static charges, figuring out how to get a light bulb to light, or testing the conductivity of everyday objects, students experience firsthand the excitement of electricity and scientific discovery.

Nature’s Recyclers
By watching composting worms create soil, to modeling the nutrient cycle, students have the opportunity to investigate the organisms that carry out the process of decomposition and recycle nutrients in an ecosystem.

Earth’s Changing Surface
From building river models that explore erosion and deposition to touring the school grounds looking for evidence of the earth’s changing surface, students use hands-on investigations to discover the dynamic nature of the earth’s surface.

Human Body in Motion
By modeling how muscles move bones, testing reflexes, and measuring the effects of exercise on breathing and heart rate, students begin to appreciate the interactions between body parts and recognize the importance of protecting them by making healthy choices.

Force and Motion
By demonstrating and explaining ways that forces cause actions and reactions, as well as gaining a deeper understanding of basic forces such as friction and gravity, students discover the many ways that forces affect the motion of objects around them.

Science Skill Builders
With 21 lessons spanning the breadth and depth of science skills, students develop a core understanding of using tools in science, scientific testing, observation skills, and the importance of analysis and conclusions.

Light
Whether watching light “bend” a pencil in water or building a periscope, the combination of hands-on, multi-sensory learning enables children to understand what light is, how it behaves, and why it makes sight possible.

Our Solar System
One day children chart the moon’s cycles, another day they might make a scale model of our solar system. By observing the world around them, they address questions such as “Why are there seasons?” and “Why does the moon appear to change shape?”

Watery Earth
Whether following a drop of water through the water cycle, measuring their own water usage, or exploring how filters clean dirty water, students are encouraged to use what they learn to have a positive impact on water resources.

Matter
With challenges like exploring what they can learn about an unknown substance called “Whatzit,” students experience the excitement of scientific discovery and gain an appreciation of the scientific method used by professional scientists.

Energy
Whether testing the efficiency of light bulbs, exploring heat conduction, or designing an imaginary invention demonstrating the transfer of energy, students discover that energy is at the root of all change occurring in the world around them.

Design Projects
The design project series was developed to support compatible modules by allowing students to design and/or build animal homes, tools, machines, and designs of their own creation. Taking between 4-6 sessions, the projects strengthen skills and ideas about choosing materials, using tools, working with the limitations of materials, solving problems, and overall project design.
# Unique Features...

<table>
<thead>
<tr>
<th>Program Features</th>
<th>FOSS</th>
<th>Science Companion</th>
<th>STC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepares students to do inquiry-based science</td>
<td>✔️</td>
<td>Lesson O introduces students to the scientific method through the “I Wonder” Circle</td>
<td></td>
</tr>
<tr>
<td>Hardback, colorful, content-rich student reference materials for upper elementary students</td>
<td>✔️</td>
<td>Student Reference Books</td>
<td></td>
</tr>
<tr>
<td>Bound student science notebooks to foster student literacy and reading skills</td>
<td>✔️</td>
<td>The original Student Science Notebooks</td>
<td></td>
</tr>
<tr>
<td>Parallels in instructional design to <em>Everyday Mathematics</em>®</td>
<td>✔️</td>
<td>Developed by the creators of <em>Everyday Mathematics</em>®</td>
<td></td>
</tr>
<tr>
<td>Variety of assessment strategies</td>
<td>✔️</td>
<td>Teacher-friendly formative and summative assessment strategies</td>
<td>✔️</td>
</tr>
<tr>
<td>A variety of pilot options to fit the interests and needs of districts</td>
<td>✔️</td>
<td>Several no-cost pilot options, including an innovative online pilot program</td>
<td></td>
</tr>
<tr>
<td>Correlations to local and state science standards</td>
<td>✔️</td>
<td>Correlated to state standards with customized local standard correlations available upon request</td>
<td></td>
</tr>
<tr>
<td>Teacher must gather minimal teacher supplied items</td>
<td>✔️</td>
<td>ExploraGear and Supplemental Classroom Supplies available</td>
<td>✔️</td>
</tr>
<tr>
<td>Early Childhood activity-based modules available</td>
<td>✔️ (K Only)</td>
<td>Modules developed specifically for PreK-K available</td>
<td></td>
</tr>
<tr>
<td>Unique content offered to meet standards</td>
<td>✔️</td>
<td>Light and Rainbows, Color, and Light modules available</td>
<td></td>
</tr>
<tr>
<td>Children develop science habits of mind in addition to content knowledge</td>
<td>✔️</td>
<td>“I Wonder” Circle integrates modules as tool for student reflection</td>
<td></td>
</tr>
<tr>
<td>Engaging activities nourish children’s curiosity</td>
<td>✔️</td>
<td>Engaging, hands-on activities focused on Big Ideas</td>
<td>✔️</td>
</tr>
<tr>
<td>Supports teachers in reaching Big Ideas</td>
<td>✔️</td>
<td>Reflective Discussions help children integrate their experience and build science knowledge</td>
<td></td>
</tr>
<tr>
<td>Full curriculum available digitally</td>
<td>✔️</td>
<td>Hyperlinked teacher materials (iTLM’s) &amp; digital student materials build affordable access</td>
<td></td>
</tr>
</tbody>
</table>

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An Innovative Free Online Pilot Program!

We know that both time and financial resources are limited for school districts these days.

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Science Companion

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pilot@sciencecompanion.com
Inquiry-based learning in science is exciting, effective, and evocative. It also can be challenging. We can help you take the mystery out of inquiry!

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A half-day session introducing the methodology, pedagogy, and best practices of Science Companion.

Implementation
Building from specific modules your district is using, a hands-on exploration of how to best implement Science Companion in your classrooms.

Assessment and Science
Formative and summative assessment can work together to strengthen teaching and test scores!

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Mix and Match to your needs to build a half day or full day session.

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Cost
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