stemXpress Summer Edition #stemXp

Facilitator Guide:

This guide is created to help guide the facilitator with the lessons in this guide. This will contain the materials needed, procedures for the experiments, questions for student reflection, as well as the explanation.

Students will use the "student guide" as a STEM notebook. This resource will act as a guide to help the student master the concepts as well as to practice scientific inquiry and literacy skills.

Table of Contents:

All Week: Materials Needed:

Day 1	Day 2	Day 3
three index cards, sticky tack or tape, flashlight or taper candle, hold puncher, ruler	shoebox, thin paper like wax paper, candle (birthday candle or taper candle) or flashlight	An opaque cup (foam or polystyrene), a coin or small object that will sink in the water.

Week 1 Overview: Light

Overview: Students will develop an understanding of how light behaves.
S4.A.2.1.3 Observe a natural phenomenon (e.g., weather changes, length of daylight/night, movement of shadows, animal migrations, growth of plants), record observations, and then make a prediction based
S4.C.2.1.1 Identify energy forms, energy transfer, and energy examples (e.g., light, heat, electrical).
At the end of this module, students will be able to independently use their learning to:

- **Day 1: Light travels in straight lines**
- **Day 2: Real images may be formed by holding a lens between a light source and a paper card**
- **Day 3: Light is refracted towards the normal when coming from a less dense medium into a denser medium**

DAY 1: HOW DOES LIGHT TRAVEL?

Introduction	*Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before" observations serve the purpose to give students a sense of what the experiment may produce. Observations may include the senses. What are the senses? (see, touch, smell, hear, taste)* Hook: Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before"

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<tr><td>Standards</td><td>3.1.3.A2. Describe the basic needs of living things and their dependence on light, food, air, water, and shelter.
3.2.3.B2 Explore energy’s ability to cause motion or create change. Explore how energy can be found in moving objects, light, sound, and heat.
3.2.6.B2. Describe energy as a property of objects associated with heat, light, electricity, magnetism, mechanical motion, and sound.
3.2.5.B4. Demonstrate how electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.
3.2.7.B5. Demonstrate that visible light is a mixture of many different colors.
3.2.3.B5. Recognize that light travels in a straight line until it strikes an object or travels from one material to another
3.2.4.B5. Demonstrate how light can be reflected, refracted, or absorbed by an object.</td></tr>
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<tr><td>What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event)</td><td>What am I wondering? (What questions or predictions do you have about the object or event?</td></tr>
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</table></td></tr>
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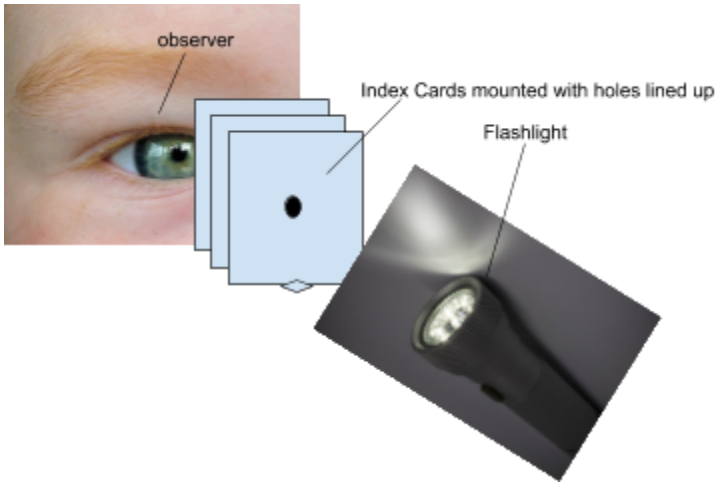
Adult Experiment Procedures	1. Take each index card, use a ruler to draw lines connecting opposite corners of the card. 1. At the intersection of the two lines, use a hole puncher to punch a hole in the center of all three of the index cards. 2. For each card, use a small piece of sticky tack or tape to mount the cards standing vertically. Each card should be placed equal distance from each other. 3. Place the flashlight or taper candle at one end of the index cards and turn off the light in the room. 4. Arrange the index cards so that light can be seen through all of the holes. 5. Observe and record your observations.
Step 2: STEM notebook Illustration	Draw an illustration of the experiment that you performed in your notebook. Label your drawing. Use this drawing and labels to help explain the questions below. 
Step 3: Reflection Questions	1. How can light be seen through all of the index cards? 2. What does the experiment prove about the path that light travels? 3. What would happen if the holes were smaller? 4. What would happen if the index cards were not lined up equally? How do you know?

Step 4: Reading	Index Card Experiment: https://www.ducksters.com/science/experiment_light_travel.php Light Basics: https://www.sciencelearn.org.nz/resources/171-light-basics

Day 2: MAKE A PINHOLE CAMERA	
Introduction	*Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before" observations serve the purpose to give students a sense of what the experiment may produce. Observations may include the senses. What are the senses? (see, touch, smell, hear, taste)* Hook: Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before" observations serve the purpose to give students a sense of what the experiment may produce. Tell the students they will find out how light travels. Ask them to carefully observe the experiment and encourage them to record their "after" observations. The questions for reflection will deepen their observations.
Standards	3.1.3.A2. Describe the basic needs of living things and their dependence on light, food, air, water, and shelter. 3.2.3.B2 Explore energy's ability to cause motion or create change. Explore how energy can be found in moving objects, light, sound, and heat. 3.2.6.B2. Describe energy as a property of objects associated with heat, light, electricity, magnetism, mechanical motion, and sound. 3.2.5.B4. Demonstrate how electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced. 3.2.7.B5. Demonstrate that visible light is a mixture of many different colors.

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<tr><td>Materials</td><td>Materials: shoebox, thin paper like wax paper, candle (birthday candle or taper candle) or flashlight
Procedure:
1. Take the shoe box and cut out the side of the one end of the box. Tape the wax paper to the end of the box to replace the side of the end that was cut out.
2. Make a small round hole in the other end of the box and tape the lid to the box. The hold should be a little larger than a pin hole.
3. Point teh hole-end of the box towards a window or light source. The light source could be a lamp or a taper candle.
4. Observe the image on the wax paper (prevent light from falling on the outside of the wax paper).</td></tr>
<tr><td>Vocabulary</td><td>Vocabulary words:
In your STEM notebook, write these vocabulary words and explain what they mean in your own words.
1. Light -
2. Observation -
3. Straight Line -</td></tr>
<tr><td>Step 1: Observing and Questioning</td><td>Step 1: Observing and Questioning
1. What do you observe on the wax paper that is taped to the end of the box? (Observe: See, Smell, Hear, Touch, Taste)<table><tr><td>What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event)</td><td>What am I wondering? (What questions or predictions do you have about the object or event?</td></tr><tr><td></td><td></td></tr></table></td></tr>
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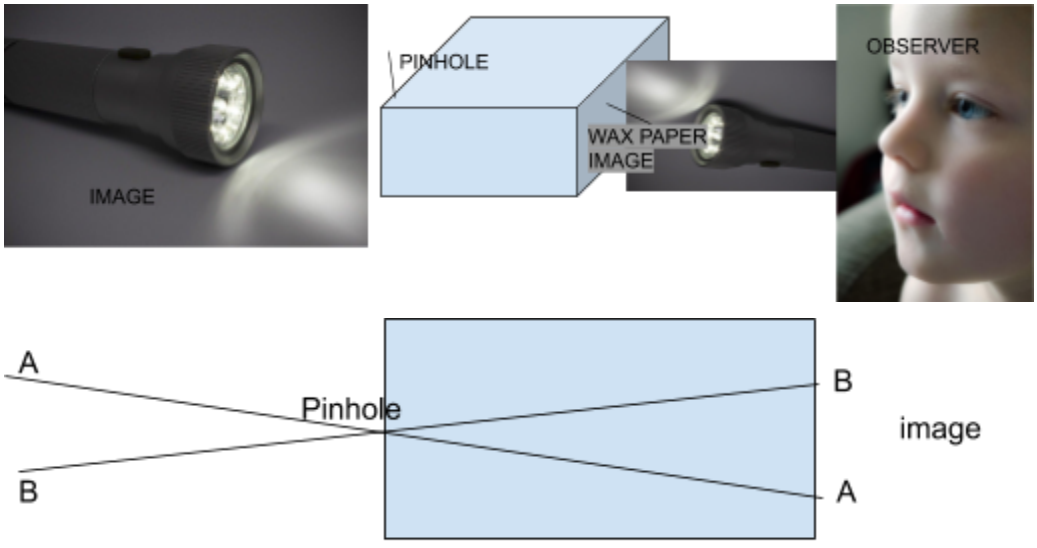
Adult Experiment Procedures	1. Take the shoe box and cut out the side of the one end of the box. Tape the wax paper to the end of the box to replace the side of the end that was cut out. 2. Make a small round hole in the other end of the box and tape the lid to the box. The hold should be a little larger than a pin hole. 3. Point teh hole-end of the box towards a window or light source. The light source could be a lamp or a taper candle. 4. Observe the image on the wax paper (prevent light from falling on the outside of the wax paper).
Step 2: STEM notebook Illustration	Questions:  In your STEM notebook, reflect on the following questions.

	• Draw an illustration of the experiment that you performed in your notebook. Label your drawing. Use this drawing and labels to help explain the questions below. • What do you observe on the wax paper that is taped to the end of the box? (Observe: See, Smell, Hear, Touch, Taste) • Why is the image on the paper always upside down? • What would happen to the image if the pinhole was made bigger or enlarged? • How does the light rays travel from the object to the image?
Step 3: Reflection Questions	1. Why is the image on the paper upside down? 2. How does the light rays tavel from the object to the image? 3. What would happened to the image if the pinhole was made bigger or enlarged?
Step 4: Reading	The pinhole acts like a lens and diffracts light as it passes through. We can see the image because light reflects off of everything. Only a small amount of reflected light traveling in a particular direction can go through the hole and that's what we see on the screen. This was originally called a camera obscura. Light travels in straight lines. This is why the image is always inverted. The light from point A of the object travels in a straight line through the pinhole to point A on the wax paper of the box, and point B to point P on thus inverting the image. When the pinhole is enlarged the image will get blurred. The smaller the hole (aperture in a camera), the sharper the image. The wax paper at the end of the box may be replaced with a photographic plate and expozed for a short time (but make sure you hold the box steady). Reading source: https://www.toppr.com/guides/science/light/light-travels-along-a-straight-line/ Reading flip book: https://www.toppr.com/content/story/amp/rectilinear-propagation-of-light-46366/ Pinhole Camera: https://wonders.physics.wisc.edu/make-a-pinhole-camera/

Day 3: HOW IS LIGHT REFRACTED?	
Introduction	Refraction Video (Britannica) https://www.britannica.com/video/214984/Experimenting-with-refraction-overview-concept-refraction *Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before" observations serve the purpose to give students a sense of what the experiment may produce. Observations may include the senses. What are the senses? (see, touch, smell, hear, taste)* Hook: Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their "before" observations. The "before" observations serve the purpose to give students a sense of what the experiment may produce. Tell the students they will find out how light travels. Ask them to carefully observe the experiment and encourage them to record their "after" observations. The questions for reflection will deepen their observations.
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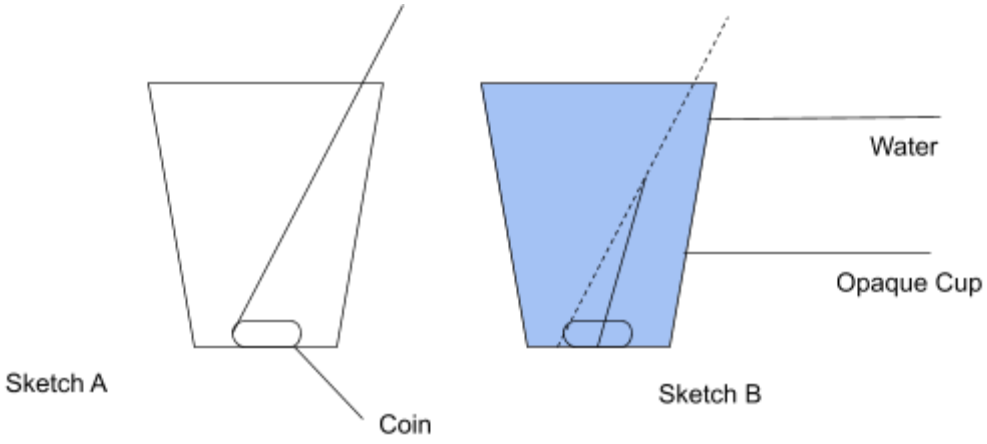
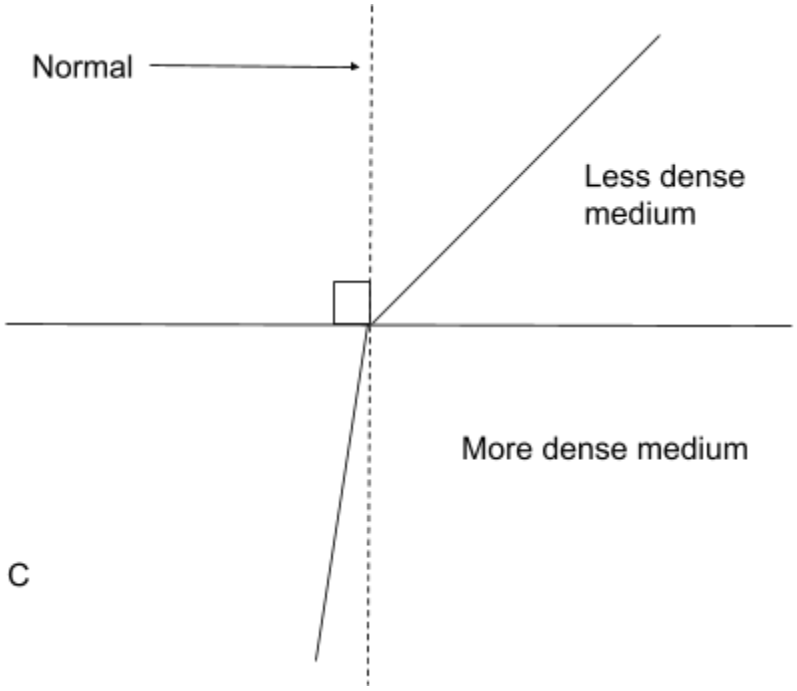
Materials	An opaque cup (foam or polystyrene), a coin or small object that will sink in the water.
Vocabulary	Vocabulary words: In your STEM notebook, write these vocabulary words and explain what they mean in your own words. Dense, Opaque
Step 1: Observing and Questioning	
Adult Experiment Procedures	1. Place the coin in an opaque cup and move your head around up and down from where you can see the coin to where you can not see the coin (because it disappears behind the rim of the cup). Students should hold their eyes steady at the spot (Sketch A - the coin may be taped to the bottom of the cup, so that it won't slide when water is poured into the cup. 2. Pour water into the cup until it is almost full: coin reappears!
Step 2: STEM notebook Illustration	 In your STEM notebook, reflect on the following questions. ● Draw an illustration of the experiment that you performed in your notebook. Label your drawing. Use this drawing and labels to help explain the questions below.

Step 3: Reflection Questions	• What made the coin disappear before the water was poured? • What made the coin reappear? • Did you have to move the position of your eyes to see the coin again? • What can you tell about the path of the light rays coming from the coin? • What other liquids can be used instead of water?
Step 4: Reading	The eyes were positioned, such that the light rays coming from the coin were blocked by the rim of the cup. By adding water to the cup, these same light rays from the coin are now refracted away from the normal, as it travels from denser to a less dense medium (see sketch b and c). The normal is the line perpendicular to the surface separating the two media through which the light ray travels. Other liquids with high refractive indices, usually denser ones, may replace water in this case. This phenomenon is the reason some deep waters looks shallow.  Sketch C
Step 5: Thoughts to Ponder	When the bowl is full of water the light bends over the edge so you can see the coin. Have you ever noticed that things at the bottom of a pool or river always look closer to the surface than they really are?

Day 4: SHOW WHAT YOU KNOW

Today is the day you show us what you know. Use this choice board and submit the evidence on Flipgrid.

Flipgrid link: https://flipgrid.com/f8e837a2 or scan the QR code below:

New to Flipgrid? No problem! Check out this cheat sheet here to get started.

Resources:

Liem, T. L., (1987) Invitations to science inquiry (2nd ed.). Lexington, MA: Ginn Press.
Index Card Experiment:
https://www.ducksters.com/science/experiment_light_travel.php
Light Basics: https://www.sciencelearn.org.nz/resources/171-light-basics
Better source for reading:
https://www.toppr.com/guides/science/light/light-travels-along-a-straight-line/
Reading flip book:
https://www.toppr.com/content/story/amp/rectilinear-propagation-of-light-46366/
Pinhole Camera: https://wonders.physics.wisc.edu/make-a-pinhole-camera/
Why a pinhole camera works:
https://www.forbes.com/sites/briankoberlein/2017/08/14/how-to-build-a-pinhole-camera-and-why-it-works/#6f871deb43f4
Ten percent summary writing:
http://collinsed.com/PDFs/10_summary_focus_sheet_START.pdf
How is light refracted: https://www.sciencelearn.org.nz/resources/49-refraction-of-light
Rising coin experiment: https://www.lovemyscience.com/risingcoin.html

Resource (index card)
https://scrapbookingsinn.blogspot.com/2019/03/how-does-light-travel-in-straight-line.html
Resource (index card) https://www.wikihow.com/Prove-That-Light-Travels-in-a-Straight-Path
Design Process: https://discoverdesign.org/handbook