Student STEM Notebook:

This is a STEM notebook that will be your guide for the week. You can print this and write in the spaces provided. Also included are the printed words to cut for the experiment on day 2.

Each day you will explore STEM tasks as a scientist. You will have the opportunity to show what you know on day 4. The STEM notebook will be a great resource to use as you plan to demonstrate what you know on day 4.

We hope you will join us for STEMXpress summer edition.

Table of Contents:

Add Headings (Format > Paragraph styles) and they will appear in your table of contents.

Day 1: How does light travel?

Answer the questions below:

What do scientists do?

_____

_____

What <u>skills</u> do scientists need?

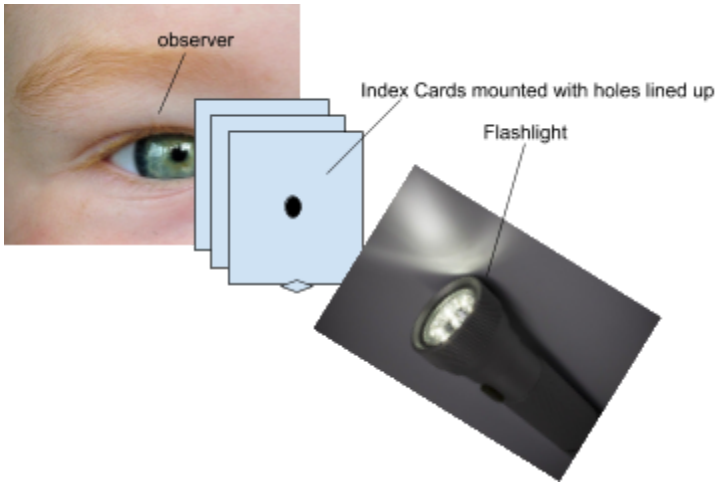
_____

_____

Step 1: Observing and Questioning

What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event)	**What am I wondering?** (What questions or predictions do you have about the object or event?

Label Diagram (Illustration or Picture): Questions



In your STEM notebook, reflect on the following questions.

1. 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.

Materials: three index cards, sticky tack or tape, flashlight or taper candle, hold puncher, ruler
Procedure:

1. Take each index card, use a ruler to draw lines connecting opposite corners of the card.
2. 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.
3. 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.
4. Place the flashlight or taper candle at one end of the index cards and turn off the light in the room.
5. Arrange the index cards so that light can be seen through all of the holes.
6. Observe and record your observations.

Planning the Experiment
Step 2 (a): What could I measure or observe about the object, or event?

Possible Dependent Variables

Step 2(b): What could I change or vary about the object or event that may affect what I could measure or observe?
Reflection Questions:

1. What would happen if the holes were smaller?
2. What would happen if the index cards were not lined up equally? How do you know?

Variables

Planning the Experiment

Step 3 (a) What will I change?

One variable I will change:

I WILL MEASURE OR OBSERVE THE RESULT

Independent Variable

Dependent Variable

Step 3(b): What will I not change?

What conditions will be held constant so it is a fair test?

Controlled Variable

Controlled Variable

Planning the Experiment

Step 3 (a) What will I change?

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Dependent Variable

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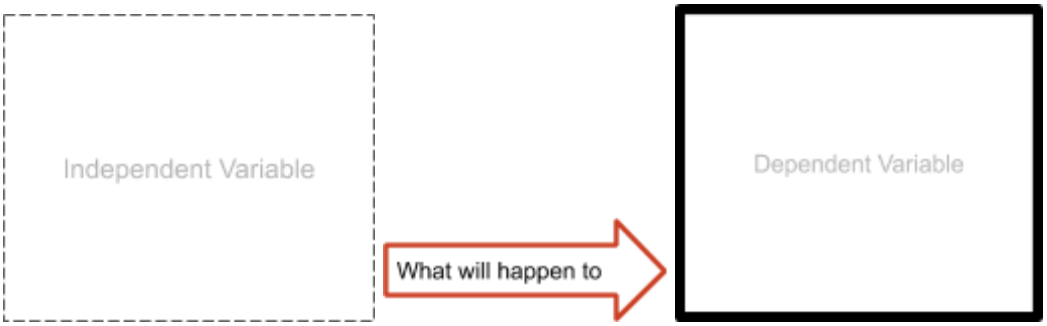
Controlled Variable

Controlled Variable

Experiment Design and Perform

Step 4: What is the question I want to explore?

If I change 

compared to the control?

Step 5: What is my hypothesis (what and why)?

Based upon my question, I predict that:

If the _____ is _____

Independent variable — how the independent variable will be changed (increased or decreased, heated or cooled, moved)

Then the _____ will _____

Dependent variable — how the dependent variable will be affected (increased or decreased, heated or cooled, moved)

I think this will happen **because** _____

_____

_____

_____

Reflection questions:
Draw or illustrate the experiment in the box provided. Label the illustration. Use this labeled illustration in your explanations below.

1. How can light be seen through all of the index cards?

2. What does the experiment prove about the path that light travels?

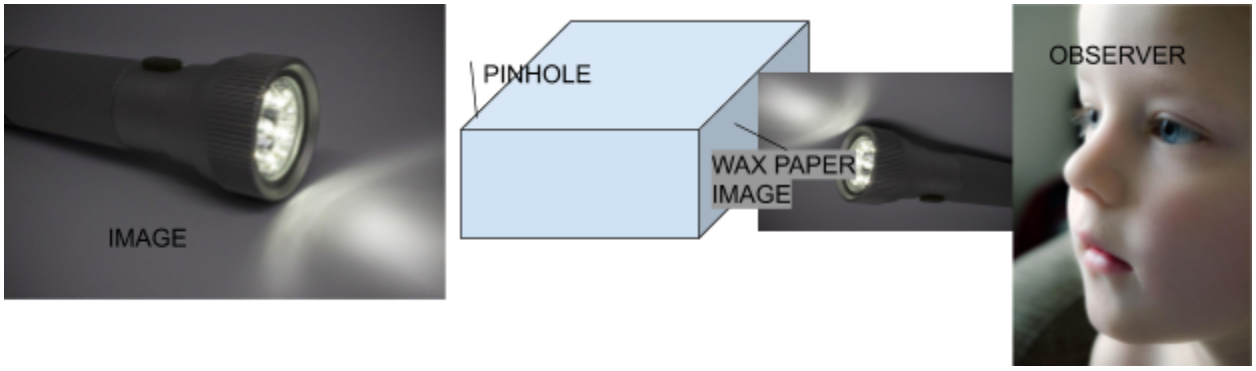
3. What would happen if the holes were smaller?

4. What would happen if the index cards were not lined up equally? How do you know?

Reading:
Light travels in a straight line.

Day 2: How does a pinhole camera affect light?

Planning the Investigation



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).

Step 1: Observing and Questioning

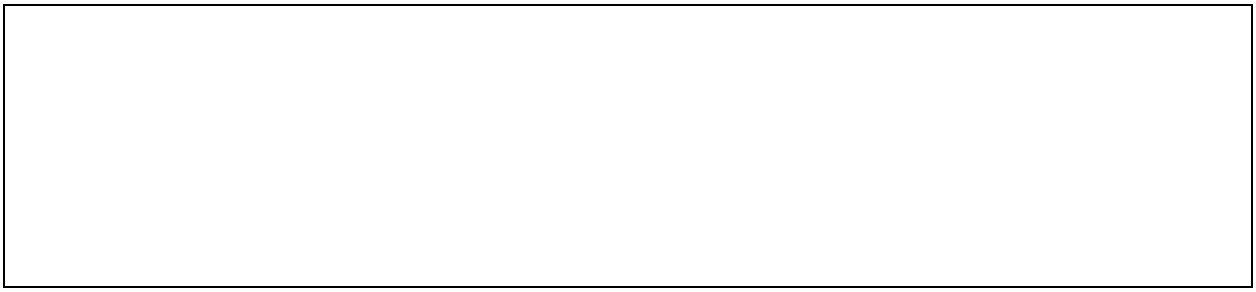
1. What do you observe on the wax paper that is taped to the end of the box? (Observe: See, Smell, Hear, Touch, Taste)

What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event)	**What am I wondering?** (What questions or predictions do you have about the object or event?

Label Diagram (Illustration or Picture): Questions

In your STEM notebook, reflect on the following questions.

2. 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.



Planning the Experiment

Step 2 (a): What could I measure or observe about the object, or event?

Possible Dependent Variables

Step 2(b): What could I change or vary about the object or event that may affect what I could measure or observe?

Reflection Questions:

5. What would happen to the image if the pinhole was made bigger or enlarged?

Variables

Planning the Experiment

Step 3 (a) What will I change?

One variable I will change:

I WILL MEASURE OR OBSERVE THE RESULT

Independent Variable

Dependent Variable

Step 3(b): What will I not change?

What conditions will be held constant so it is a fair test?

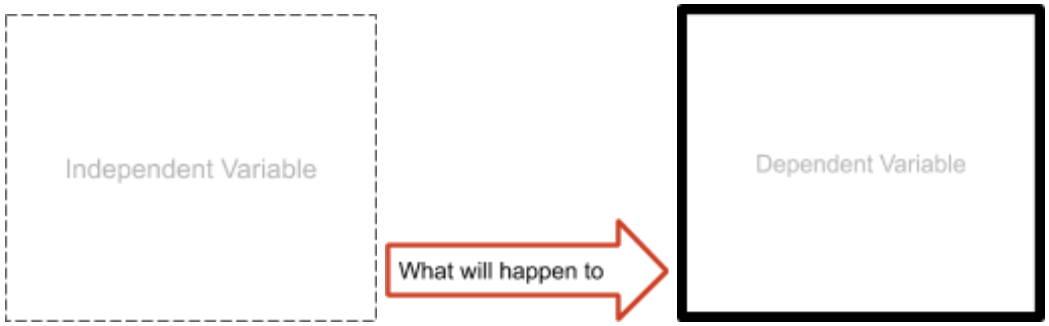
Controlled Variable

Controlled Variable

Controlled Variable	Controlled Variable

Experiment Design and Perform

Step 4: What is the question I want to explore?



If I change

compared to the control?

Step 5: What is my hypothesis (what and why)?

Based upon my question, I predict that:

If the _____ is _____

Independent variable — how the independent variable will be changed (increased or decreased, heated or cooled, moved)

Then the _____ will _____

Dependent variable — how the dependent variable will be affected (increased or decreased, heated or cooled, moved)

I think this will happen **because** _____

_____

_____

_____

Reflection questions:
Draw or illustrate the experiment in the box provided. Label the illustration. Use this labeled illustration in your explanations below.

3. Why is the image on the paper always upside down?

4. How does the light rays travel from the object to the image?

_____

_____

_____

_____

_____

6. What would happen to the image if the pinhole was made bigger or enlarged?

_____

_____

_____

_____

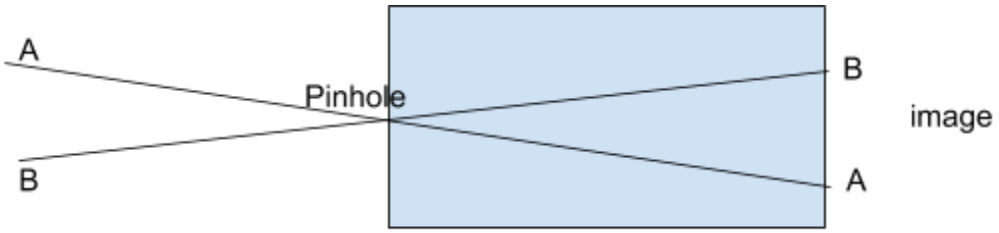
_____

Reading:

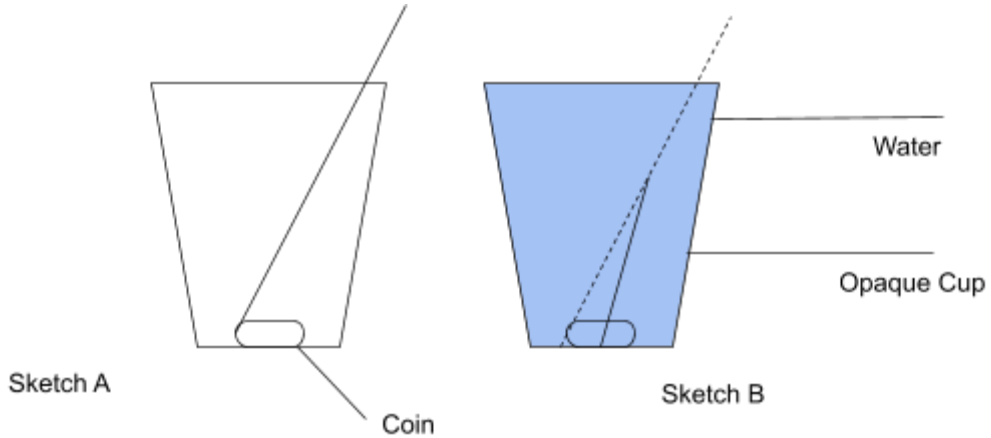
The pinhole acts like a lens and diffracts light as it passes through. We can see the image because light reflects off of everything. Only a small amount of reflected light traveling in a particular direction can go through the hole and that's what we see on the screen. This was originally called a camera 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).



DAY 3: What happens when light is refracted?

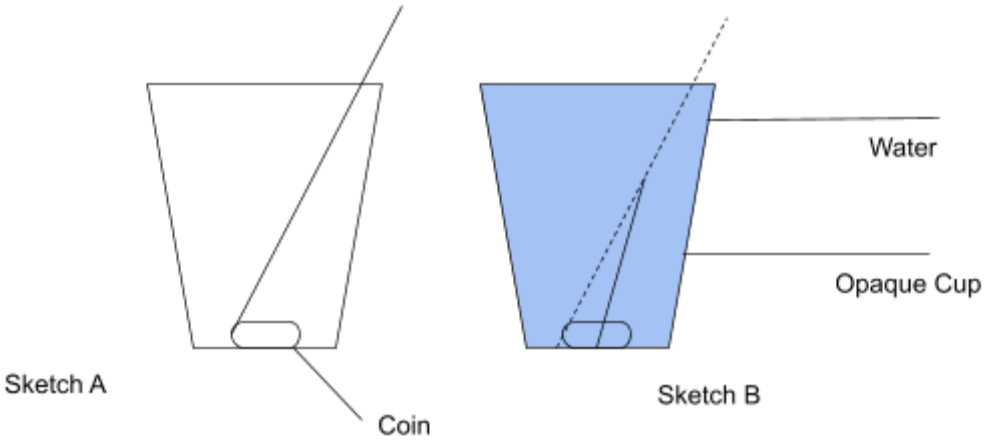


Step 1: Observing and Questioning

1. What do you observe on the wax paper that is taped to the end of the box? (Observe: See, Smell, Hear, Touch, Taste)

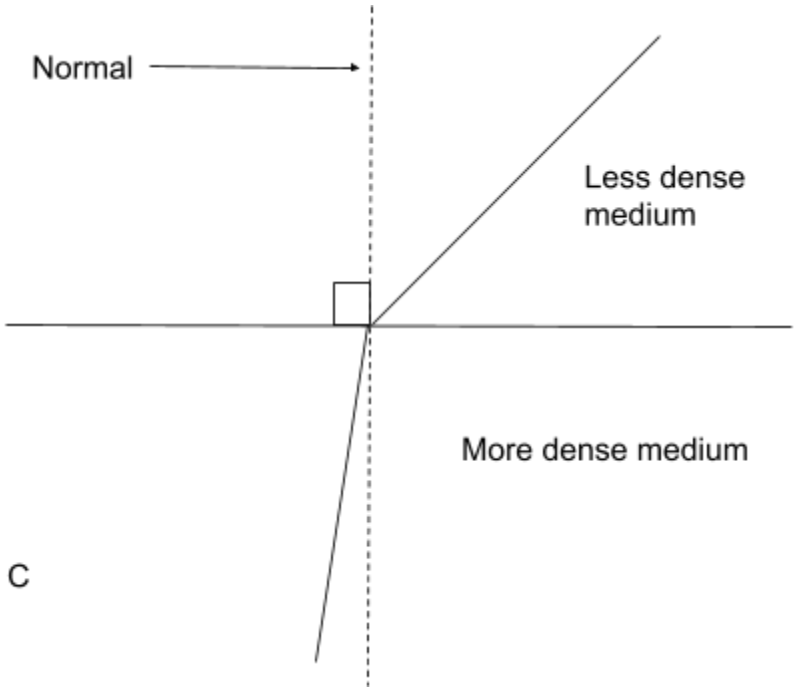
What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event)	**What am I wondering?** (What questions or predictions do you have about the object or event?

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
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. 1. 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	2. What made the coin disappear before the water was poured? _____ _____ _____ _____ 3. What made the coin reappear? _____ _____

	_____ _____ 4. Did you have to move the position of your eyes to see the coin again? _____ _____ _____ _____ 5. What can you tell about the path of the light rays coming from the coin? _____ _____ _____ _____ 6. 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

1. When the bowl is full of water the light bends over the edge so you can see the coin.

2. 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