

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.

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All Week: Materials Needed:

Day 1	Day 2	Day 3
Flashlight Large beaker, glass bowl Medicine Dropper Stirrer A few ml of regular cow milk	Mirror Scissors Paper Sharpie	Two raw chicken egg Table salt Two Large beakers or plastic containers Stirrer
Optional: oil, corn syrup, baking soda, sugar, food coloring, flour		

PreWeek: Sneak peek exploring light and density

Day 1 Light Scattering / Refracted: Sunset in a cup of milk	
Introduction	<p><i>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)</i></p> <p><i>Tell the students they will find out how light scatters. Ask them to carefully observe the experiment and encourage them to record their “after” observations. The questions for reflection will deepen their observations.</i></p>
Standards	<p><u>PA Standards Science and Technology and Engineering Education</u></p> <p><i>3.2 Physical Science: Chemistry and Physics</i></p> <p><i>3.2.3.B5 - Recognize that light travels in a straight line until it strikes an object or travels from one material to another.</i></p> <p><i>3.2.4.B5 - Demonstrate how light can be reflected, refracted, or absorbed by an object.</i></p> <p><i>3.2.7.B5 - Demonstrate that visible light is a mixture of many different colors. Describe how light energy is transmitted by waves.</i></p>
Materials	<ol style="list-style-type: none"> 1. A strong flashlight 2. A large beaker or glass container 3. Medicine dropper and stirrer 4. A few ml of regular cow milk
Materials Optional Extension	Oil, corn syrup, milk, baking soda, sugar, food coloring, flour
Vocabulary	<p>Preview the vocabulary and use these words throughout the experiment.</p> <p>Scatter Light: Particles scatter light, this is a fundamental fact and something we all encounter on a daily basis, the sky is blue. This is caused by stronger light scattering of blue light by atmospheric particles than red light.</p>

Refraction of Light: Refraction is the bending of a wave when it enters a medium where its speed is different. The refraction of light when it passes from a fast medium to a slow medium bends the light ray toward the normal to the boundary between the two media. **Refraction** is the bending of a light or sound wave, or the way the light bends when entering the eye to form an image on the retina. An **example of refraction** is a bending of the sun's rays as they enter raindrops, forming a rainbow. An **example of refraction** is a prism.

Step 1: Observing and Questioning

Explain to the student that they are to record observations during the experiment. Observations might include using the senses. Ask the student what the senses are (smell, touch, taste, sight, hear). In addition, they should record questions they have or even predictions they have for the object or event.

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?)

Adult Experiment Procedures

Procedure:

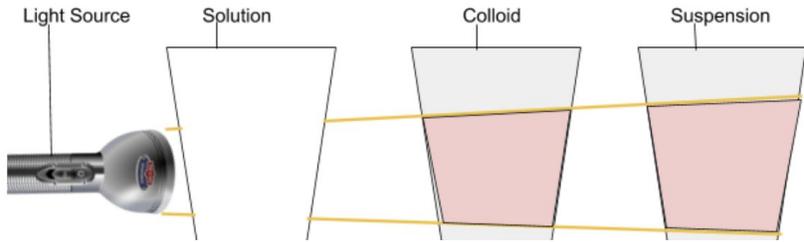
1. Fill the beaker (or glass bowl) nearly full with water.
2. With the medicine dropper, place one drop at a time of milk into the water and stir.
3. After each drop of milk is added to the water, shine the flashlight through the water by holding it to the side of the viewer: let the light beams shine perpendicular to and into the observer's view.
4. Keep adding the drops of milk to the water until the light shone into the student's view becomes red.
5. The student should complete Step 1: What did I observe and What am I wondering.

The explanation section will be helpful for the facilitator as they guide the learning of this experiment.

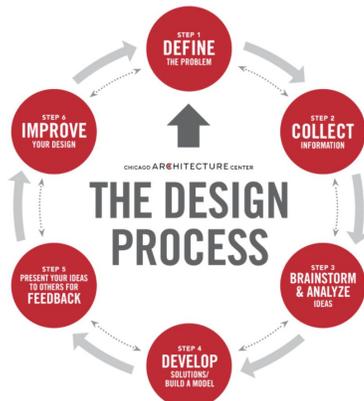
Explanation: Increasing the milk droplets in the water is like increasing the water and dust particles in the atmosphere. When the sun moves to the west approaching sunset, the atmosphere through which we are looking is much thicker. This means we are actually looking through more dust and water particles. When we look to the west during sunset, we look directly into the sun rays, seeing the sun as a red ball. Looking up towards the sky when the sun is in the west, still leaves the sky blue. The sun rays are now

	<p>perpendicular to the direction of our view. This difference in color is caused by the refraction of the blue light. The shorter the wavelength (blue), the more it is bent or refracted by milk droplets. This light with the longer wavelength (red) is not as much refracted and this is why the light from the flashlight is red when we look directly into it (though the beaker with milk).</p>
<p>Step 2 STEM Notebook: Illustration</p>	<p>In the student's STEM notebook an illustration of the experiment should be drawn in the notebook. The drawing should be labeled so that this can be used later in the reflection. In grade 3-6 students should be able to write informative text to examine a topic, convey ideas and information clearly. Students are encouraged to label illustrations, provide details, facts, definitions, and examples in writing.</p> <p>A sample illustration was created for students in the STEM notebook. Students can create their own illustration or use this as a guide to write their own illustration.</p>
<p>Step 3 Reflection Questions</p>	<p>In this section students will answer the questions based on observations. If the student is able to write their thoughts in the reflection and may even be able to explain to the adult more details later after the reading section. The list of questions for this section are:</p> <p>Questions:</p> <ul style="list-style-type: none"> ● What made the color of the light change? ● What purpose does the milk have? ● If the water were the earth's atmosphere and the flashlight were the sun what can the milk droplets be equated with? ● Which of the colors do you think are refracted most? ● Which of the colors do you think were refracted least? <p>Students answer these questions in the STEM notebook:</p>

	<p>Reflection questions: Draw or illustrate the experiment in the box provided. Label the illustration. Use this labeled illustration in your explanations below.</p> <div data-bbox="428 319 1265 653" style="border: 1px solid black; height: 159px; width: 515px; margin: 10px 0;"></div> <p>1. What made the color of the light change?</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>2. What purpose does the milk have in the experiment?</p> <hr/> <hr/>
Step 4 Reading	In this section the student will read more about what is going on during the experiment. In this section the vocabulary is also also explained. Students could finish the reading and then go back to the reflection questions to explain additional details.

	<p>Reading: Why is the sky blue? Why can you see further underwater in a pool than you can in a lake or an ocean? Why can you see distant objects clearly on some days, and on other days, they are shrouded in a haze?</p> <p>In this experiment, when you looked through the glass you may have seen the same orange and red pattern of colors that you can see when the sun goes down at sunset. If you set up the experiment correctly, you created the same physics in a cup that you can see at sunset.</p> <p>Light travels in a straight line. Some objects scatter light while others do not. In the experiment light was scattered. When light scatters off of an object the light acts like a little marble. The different colors of light all bounce off of the large object at the same angle. This type of scattering is called geometric scattering and is the type of scattering that we see most often in our everyday lives.</p> <p>White light consists of all visible colors. Shining white light on an object that is much bigger than the wavelength of the light will cause all of the different colors to all reflect at the same angle. The color patterns in the milk are the same physics that causes sunsets and blue skies. In addition, color patterns in flour and water will look similar to the milk. In the diagram below you can see the light source shining through the water, milk, and flour - water mixtures. The light beam is not visible in the water but is visible for the milk and the water-flour mixture.</p>  <p>The diagram illustrates the experiment with light scattering. On the left, a flashlight labeled 'Light Source' emits a beam of light. This beam passes through three containers. The first container is labeled 'Solution' and contains clear water; the light beam is not visible. The second container is labeled 'Colloid' and contains milk; the light beam is visible as a yellowish line. The third container is labeled 'Suspension' and contains a flour-water mixture; the light beam is also visible as a yellowish line.</p>
<p>Step 5 Thoughts to ponder:</p>	<p>This section is designed to have students reflect on what was learned. On day 4 of this week students will have the opportunity to show what they know. Because this experiment has optional extension activities students may use the extension for their show what they know demonstration on day 4.</p>
<p>Optional Extension Activities (Part 1 - Design Process):</p>	<p>This section is optional. In this section students will explore scientific inquiry through the design process. The purpose of this optional extension is to recreate the experiment and change different elements in order to determine what different variables scatter or refract light. The first step is to read about the design process. Then students will be presented with optional materials in order to design another experiment.</p>

Optional Extension:
What is the design process? Why is it helpful?

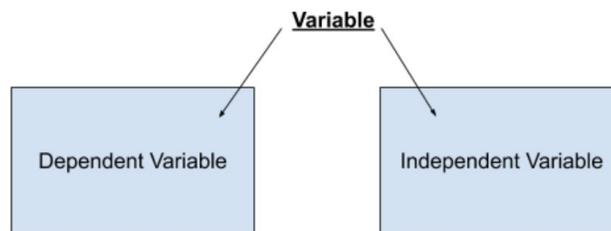


Step 1: Define the Problem; You can't find a solution until you have a clear idea of what the problem is.
 Step 2: Collect information: Collect sketches, take photographs and gather data to start giving you inspiration.
 Step 3: Brainstorm and Analyze Ideas: Begin to sketch, make, and study so you can start to understand how all the data and information you've collected impacts your design.
 Step 4: Develop solutions: Take your preliminary ideas and form multiple small-scale design

Optional Extension Activity (Part 2)

Vocabulary: What is a **variable**? A **variable** is an object, event, idea, feeling, time period, or any other type of category you are trying to measure. There are two different types of variables. The two different types of variables are **independent** variables and **dependent** variables.

Optional Extension Activity (Part 2):



Variable that depends on other factors.

Try to figure out why this dependent variable changes the way it does.

Variable that stands alone. Not changed by other variables we are trying to measure.

Student: Use the design process to determine what other mixtures, solutions, or substances scatter light.

You will be given oil, corn syrup, milk, baking soda, sugar, food coloring, flour. How could you design an experiment to explore this further? You can use the [design process worksheet](#) to record your thoughts:

Student Reflection Questions:

- What would happen if the water was replaced with watered down milk? As the solution is slowly poured into the glass, shine your flashlight up through the bottom. What happens to the light when more liquid is poured in?

Day 2 Light Reflection: Funny Reflections

Introduction	<p><i>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)</i></p> <p><i>Tell the students they will find out how light reflects. Ask them to carefully observe the experiment and encourage them to record their “after” observations. The questions for reflection will deepen their observations.</i></p>
Standards	<p><u>PA Standards Science and Technology and Engineering Education</u></p> <p><i>3.2 Physical Science: Chemistry and Physics</i></p> <p><i>3.2.3.B5 - Recognize that light travels in a straight line until it strikes an object or travels from one material to another.</i></p> <p><i>3.2.4.B5 - Demonstrate how light can be reflected, refracted, or absorbed by an object.</i></p> <p><i>3.2.7.B5 - Demonstrate that visible light is a mixture of many different colors. Describe how light energy is transmitted by waves.</i></p>
Materials	<p>Unframed square or rectangular mirror</p> <p>Paper, Scissors, Marker (Sharpie) or Printed words attached at the end of this guide</p>
Vocabulary	<p><u>Symmetry</u>: the quality of being made up of exactly similar parts facing each other or around an axis.</p> <p><u>Reflectional symmetry</u>: is also called bilateral, line symmetry or mirror symmetry. It occurs when a line is drawn to divide a shape in halves so that each half is a reflection of the other. Some shapes or objects, such as circles, squares and triangles, have one or more lines of symmetry</p>
Step 1: Observing and Questioning	<p>Explain to the student that they are to record observations during the experiment. Observations might include using the senses. Ask the student what the senses are (smell, touch, taste, sight, hear). In addition, they should record questions they have or even predictions they have for the object or event.</p>

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

Adult Experiment Procedures



1. Print the following words on separate pieces of blank paper in large even capital letters. You may wish to use a sharpie black marker to print the words. Words have been attached at the end of the Facilitator Guide and they may be printed for your convenience.

CHEEK, BIKE, DECIDE, BOX, CHICK, CHOK, BOOK, HIDE, CODE, DOCK, COOKIE

2. Cut each piece of paper in half, right through the middle of each word. Leaving the lower half of the word on the paper.



3. Now place the mirror vertically against the paper (perpendicular on the table) and look in the corner of the paper and the mirror.
4. Do this for each one of the words

The explanation section will be helpful for the facilitator as they guide the learning of this experiment.

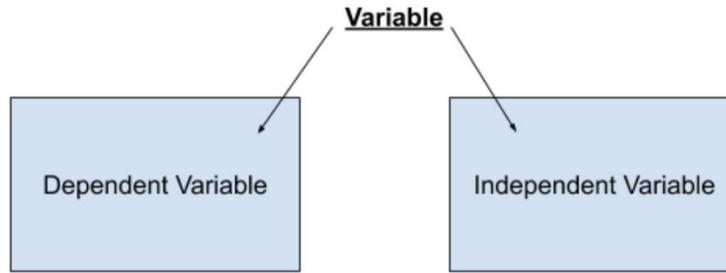
Explanation: This activity will provide the student with the ability to recognize symmetrical objects and printed letters. It gives the student an opportunity to

	<p>manipulate spatial relations. The image in the mirror shows that all images are actually formed behind the mirror.</p> <p>It is only with the letters: B, C, D, E, H, I, K, O, and X that the above activity can be carried out. All other letters will not give the upper half in the mirror. The following can be cut vertically in half and the other half will show up in the mirror, when held against it: A, H, I, M, O, T, U, V, W, X, and Y. This activity gives the students an idea of symmetry and symmetrical shapes.</p>
<p>Step 2 STEM Notebook: Illustration</p>	<p>In the student's STEM notebook an illustration of the experiment should be drawn in the notebook. The drawing should be labeled so that this can be used later in the reflection. In grade 3-6 students should be able to write informative text to examine a topic, convey ideas and information clearly. Students are encouraged to label illustrations, provide details, facts, definitions, and examples in writing.</p> <p>A sample illustration was created for students in the STEM notebook. Students can create their own illustration or use this as a guide to write their own illustration.</p> <p><small>How can we create reflectional symmetry with letters and words? Label Diagram (Illustration or Picture):</small></p>  <p><small>In your STEM notebook, reflect on the following questions or tasks. 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.</small></p> <div data-bbox="435 1283 850 1339" style="border: 1px solid black; height: 27px; width: 256px;"></div>
<p>Step 3 Reflection Questions</p>	<p>In this section students will answer the questions based on observations. If the student is able to write their thoughts in the reflection and may even be able to explain to the adult more details later after the reading section. The list of questions for this section are:</p> <p>Questions:</p> <ul style="list-style-type: none"> ● Will this work with any printed word? ● Which of the letters, when cut in half, will appear whole with the mirror above it? ● Which of the letters, when cut in half vertically, will give the other half in the mirror, when the half letter is held against it? <p>Students answer these questions in the STEM notebook:</p>

	<p>Questions:</p> <p>1. Will this experiment work with any printed word? How do you know</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>2. Which of the letters, when cut in half, will appear whole with the mirror above it?</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Step 4 Reading</p>	<p><i>In this section the student will read more about what is going on during the experiment. In this section the vocabulary is also explained. Students could finish the reading and then go back to the reflection questions to explain additional details.</i></p> <p>When you look into a mirror the image you see is called a reflection. A reflection is the production of an image through a mirror. Light and sound are also able to be reflected. Have you heard an echo or sound waves reflected from a surface? Have you ever had to put on sunglasses near a lake because the sunlight was being reflected from the surface of the water? This experiment explores reflection by holding part of the word up to a mirror and looking at the reflection. Some of these words looked complete in the reflection while others looked like nonsense. What caused this?</p> <p>Another concept that is explored in this experiment is called symmetry. Symmetry is made up of exactly similar parts facing each other. When you held up words into the mirror, were some of the words symmetrical, or exactly the same in the reflection in the mirror? Yes! Some objects are symmetrical.</p> <p>In this experiment some of the words that you looked at demonstrated reflectional symmetry. Reflectional symmetry occurs when a line is drawn to divide a shape or a word in halves so that each half is a reflection of the other. Some of the words demonstrated reflectional symmetry while other words did not demonstrate reflectional symmetry. Some shapes will also demonstrate reflectional symmetry while others will not? Which shapes demonstrate reflectional symmetry? Shapes are circle, square, rectangle, triangle, rhombus, heptagon, parallelogram, hexagon, star, heart, cross, scalene triangle, right triangle, crescent (and others).</p>
<p>Step 5 Thoughts to Ponder</p>	<p>There are more than one line of symmetry in some shapes or objects such as circles, squares and triangles. On day 4 of this week you will show what you know. Will you be able to explain reflectional symmetry? Will you show what</p>

	<p>you know using a shape or an object? How will you show what you know from the experiment on day two?</p>
<p>Optional Extension Activities (Part 1 - Design Process):</p>	<p>This section is optional. In this section students will explore scientific inquiry through the design process. The purpose of this optional extension is to recreate the experiment and change different elements in order to determine what different variables scatter or refract light. The first step is to read about the design process. Then students will be presented with optional materials in order to design another experiment.</p> <p>Optional Extension: What is the design process? Why is it helpful?</p>  <p>Step 1: Define the Problem; You can't find a solution until you have a clear idea of what the problem is. Step 2: Collect information: Collect sketches, take photographs and gather data to start giving you inspiration. Step 3: Brainstorm and Analyze Ideas: Begin to sketch, make, and study so you can start to understand how all the data and information you've collected impacts your design. Step 4: Develop solutions: Take your preliminary ideas and form multiple small-scale design</p>
<p>Optional Extension Activity (Part 2)</p>	<p>Vocabulary: What is a variable? A variable is an object, event, idea, feeling, time period, or any other type of category you are trying to measure. There are two different types of variables. The two different types of variables are independent variables and dependent variables.</p>

Optional Extension Activity (Part 2):



Variable that depends on other factors.

Try to figure out why this dependent variable changes the way it does.

Variable that stands alone. Not changed by other variables we are trying to measure.

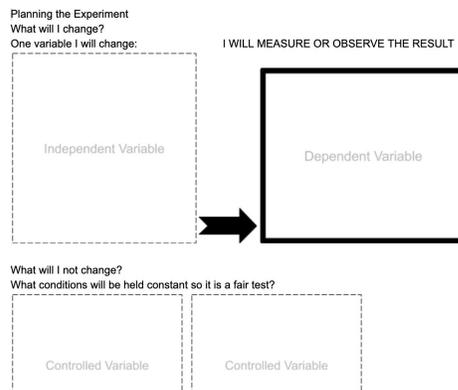
Student: Use the design process to determine if shapes can demonstrate reflectional symmetry. Some shapes will also demonstrate reflectional symmetry while others will not? Which shapes demonstrate reflectional symmetry? Shapes are circle, square, rectangle, triangle, rhombus, heptagon, parallelogram, hexagon, star, heart, cross, scalene triangle, right triangle, crescent (and others).

How could you design an experiment to explore this further? You can use the [design process worksheet](#) to record your thoughts:

Student Reflection Questions:

- What shapes show reflectional symmetry? How do you know?
- What objects show reflectional symmetry? How do you know?
- Some shapes or objects, such as circles, squares and triangles, have one or more lines of symmetry. How do you know?

Students plan the experiment in their STEM notebook and record the ideas in the planning boxes:



Experiment Design and Perform
What is the question I want to explore?

Independent Variable → What will happen to → Dependent Variable

If I change _____ compared to the control?

What is my hypothesis (what and why)?
Based upon my question, I predict that:

If the _____ independent variable is _____ how the independent variable will be changed (increased or decreased, heated or cooled, moved)

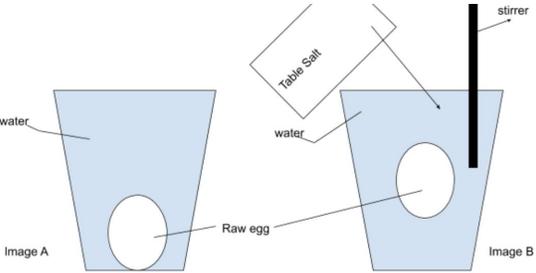
Then the _____ dependent variable will _____ how the dependent variable will be affected (increased or decreased, heated or cooled, moved)

I think this will happen because _____

Day 3: Characteristics of Matter - Density: Float the egg with salt

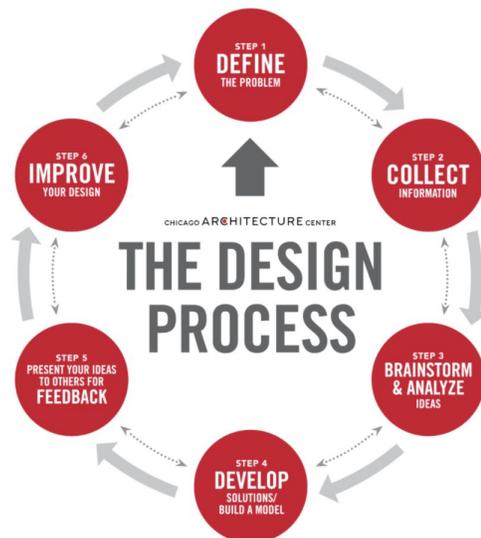
Introduction	<p><i>Ask students what scientists do? What are the skills scientists need? Explain to the students that they will be creating their own experiments to practice the skills of a real scientist. Show the model of the first experiment. Give students time to make their “before” observations. 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)</i></p> <p><i>Tell the students they will find out how water density can affect buoyancy. Ask them to carefully observe the experiment and encourage them to record their “after” observations. The questions for reflection will deepen their observations.</i></p>
Standards	<p><u>PA Standards Science and Technology and Engineering Education</u></p> <p><i>3.2 Physical Science: Chemistry and Physics</i></p> <p>3.2.7.A1 Explain how materials are characterized by having a specific amount of mass in each unit of volume (density)</p> <p>3.2.8.A4 Explain how the oceans from one interconnected circulation system powered by wind, tides, the Earth’s rotation, and water density differences.</p>
Materials	<ul style="list-style-type: none"> ● Two raw chicken eggs ● Table salt ● Two large beakers or plastic containers ● A stirrer
Vocabulary	<p><u>Density</u>: The ratio of its mass (m) to its volume (V), a measure of how tightly the matter within it is packed together.</p> <p><u>Mass</u>: How much matter there is in an object.</p>
Step 1: Observing and Questioning	<p>Explain to the student that they are to record observations during the experiment. Observations might include using the senses. Ask the student what the senses are (smell, touch, taste, sight, hear). In addition, they should record questions they have or even predictions they have for the object or event.</p>

	<table border="1"> <tr> <td data-bbox="440 222 922 327"> What did I observe? (What do you notice about the object or event? Use your senses to describe the object or event) </td> <td data-bbox="922 222 1408 327"> What am I wondering? (What questions or predictions do you have about the object or event?) </td> </tr> <tr> <td data-bbox="440 327 922 491"></td> <td data-bbox="922 327 1408 491"></td> </tr> </table>	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?)		
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?)				
Adult Experiment Procedures	<p>Procedure:</p> <ol style="list-style-type: none"> 1. Fill the beaker about $\frac{2}{3}$ full of water. 2. Ask the observer, "What will the egg do in the water, sink or float?" Immerse the egg carefully into the water. 3. Fill the second beaker half full of water. Add 4 tablespoons of salt into the water. Stir the salt and water mixture. Add water until the beaker is $\frac{2}{3}$ full. 4. Ask the observer, "What will the egg do in the water/salt mixture, sink or float?" Immerse the egg carefully into the water/salt mixture. <p>The explanation section will be helpful for the facilitator as they guide the learning of this experiment.</p> <p>Explanation:</p> <p>(See step 2 for the image) <u>Image A</u> the egg sunk to the bottom of the glass, while in <u>image B</u> the egg floated. Density has to do with the amount of matter contained in a specific space or volume. Because the egg is more dense than the water, in <u>image A</u>, the egg pushed away water particles so it could make space for itself. The egg sank. When the salt was added to the water in <u>image B</u>, the salt dissolved into particles that bonded tightly to the water molecules. This packed more matter into the space. This made the salt water denser than regular water. The more dense the water the easier it is for an object to float in it. Can you now explain why it might be easier to float in saltwater rather than a freshwater lake?</p> <p>From the behavior of the egg in water, it can be seen that the density of the raw egg is a little larger than that of pure water. It can actually be determined by weighing the egg and finding the volume of it by measuring the displaced water (the difference between the water levels), and by dividing this volume into the mass (weight) of the egg.</p> <p>By adding the salt to the water, the density of the water is increased. The mass of the displaced water is therefore also increased, and as this mass equals the buoyant force, the egg gets a larger force acting upwards upon it, and thus at a certain moment floats up. At this moment, the buoyant force is</p>				

	<p>equal to the egg's mass. For this same reason, it is much easier to swim in sea water compared to fresh water.</p>
<p>Step 2 STEM Notebook: Illustration</p>	<p>In the student's STEM notebook an illustration of the experiment should be drawn in the notebook. The drawing should be labeled so that this can be used later in the reflection. In grade 3-6 students should be able to write informative text to examine a topic, convey ideas and information clearly. Students are encouraged to label illustrations, provide details, facts, definitions, and examples in writing.</p> <p>A sample illustration was created for students in the STEM notebook. Students can create their own illustration or use this as a guide to write their own illustration.</p>  <p>Step 2: In your STEM notebook, reflect on the following questions or tasks. 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.</p> <div data-bbox="435 1098 1011 1226" style="border: 1px solid black; height: 60px; width: 100%;"></div>
<p>Step 3 Reflection Questions</p>	<p>In this section students will answer the questions based on observations. If the student is able to write their thoughts in the reflection and may even be able to explain to the adult more details later after the reading section. The list of questions for this section are:</p> <p>Questions:</p> <ol style="list-style-type: none"> 1. Compare the two glasses. Why does one egg stop in the middle of the glass? 2. What would the density of the raw egg be compared to pure water? 3. What two entities are we comparing, when we want to know whether an object will float in a particular liquid or not? 4. Would an egg float in alcohol? In corn syrup? In oil? 5. How can we determine the volume of an egg? 6. How can we calculate the density of an egg? <p>Students answer these questions in the STEM notebook:</p>

	<p>Step 3: Reflection Questions:</p> <ol style="list-style-type: none"> 1. Compare the two glasses. Why does one egg stop in the middle of the glass? <hr/> <hr/> <hr/> <hr/> <hr/> <ol style="list-style-type: none"> 2. What would the density of the raw egg be compared to pure water? <hr/> <hr/>
<p>Step 4 Reading</p>	<p><i>In this section the student will read more about what is going on during the experiment. In this section the vocabulary is also explained. Students could finish the reading and then go back to the reflection questions to explain additional details.</i></p> <p>From the behavior of the egg in water, it can be seen that the density of the raw egg is a little larger than that of pure water. It can actually be determined by weighing the egg and finding the volume of it by measuring the displaced water (the difference between the water levels), and by dividing this volume into the mass (weight) of the egg.</p> <p>By adding the salt to the water, the density of the water is increased. The mass of the displaced water is therefore also increased, and as this mass equals the buoyant force, the egg gets a larger force acting upwards upon it, and thus at a certain moment floats up. At this moment, the buoyant force is equal to the egg's mass. For this same reason, it is much easier to swim in sea water compared to fresh water.</p>
<p>Step 5 Thoughts to Ponder</p>	<p>Other chemicals may affect water density. On day 4 of this week you will show what you know. Will you be able to explain density and mass? Will you show what you know using other substances added to water? How will you show what you know from the experiment on day three?</p>
<p>Optional Extension Activities (Part 1 - Design Process):</p>	<p>This section is optional. In this section students will explore scientific inquiry through the design process. The purpose of this optional extension is to recreate the experiment and change different elements in order to determine what different variables scatter or refract light. The first step is to read about the design process. Then students will be presented with optional materials in order to design another experiment.</p>

Optional Extension:
What is the design process? Why is it helpful?

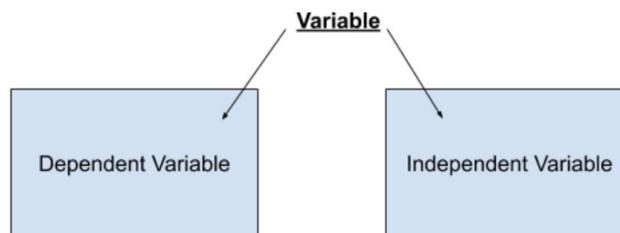


Step 1: Define the Problem; You can't find a solution until you have a clear idea of what the problem is.
 Step 2: Collect information: Collect sketches, take photographs and gather data to start giving you inspiration.
 Step 3: Brainstorm and Analyze Ideas: Begin to sketch, make, and study so you can start to understand how all the data and information you've collected impacts your design.
 Step 4: Develop solutions: Take your preliminary ideas and form multiple small-scale design

Optional Extension Activity (Part 2)

Vocabulary: What is a **variable**? A **variable** is an object, event, idea, feeling, time period, or any other type of category you are trying to measure. There are two different types of variables. The two different types of variables are **independent** variables and **dependent** variables.

Optional Extension Activity (Part 2):



Variable that depends on other factors.

Try to figure out why this dependent variable changes the way it does.

Variable that stands alone. Not changed by other variables we are trying to measure.

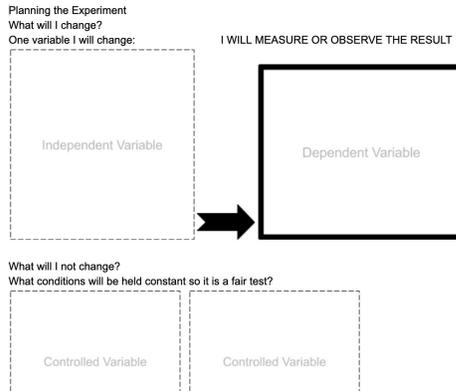
Student: Use the design process to determine if other chemicals affect the density of the water. Instead of using salt in the water use other chemicals like sugar, baking soda, corn syrup, etc.

How could you design an experiment to explore this further? You can use the [design process worksheet](#) to record your thoughts:

Student Reflection Questions:

- How do substances like sugar, corn syrup, baking soda, (other) affect the density of the water? How do you know?

Students plan the experiment in their STEM notebook and record the ideas in the planning boxes:



Experiment Design and Perform
What is the question I want to explore?

Independent Variable

Dependent Variable

If I change _____
compared to the control?

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 _____

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.

Make an Egg Float: <https://www.youtube.com/watch?v=3nJ5R6baL90>

Scatter Light Experiment: <https://sfa.cems.umn.edu/light-refraction-experiment>

Sunset in a Cup Experiment:

<https://wtamu.edu/~cbaird/sq/2015/09/23/can-you-make-a-sunset-in-a-cup-of-milk/>

Design Process: <https://discoverdesign.org/handbook>

Day 2 Printed words: Print the pages. Use scissors to cut the word on the red dotted line.

CHEEK

BIKE

DECIDE

BOX

CHICK

CHOKe

BOOK

HIDE

CODE

DOCK

COOKIE