



# How Many Pennies?

Boys and Girls Club After School Science  
NSF Center for Chemical Innovation  
Chemistry at the Space Time Limit (CaSTL)  
<https://www.castl.uci.edu/>

## Standard(s) Addressed:

- Children know an object is seen when light traveling from the object enters the eye.
- Children observe the effects of the change in the speed of light as it enters water and other materials.
- Light reflects.

## Lesson Objective:

Children will be able to know that light travels in a straight line but changes speeds when it enters different materials. They will notice the effects of the change in speeds by observing how many penny images they can see when a penny is placed into a cup of water and when it is placed outside the cup of water.

## Materials Used:

For each group:

Penny

Clear plastic cup

Water

Paper towels

## Classroom Management:

Setting up: Before the lesson, get large container of water and small plastic cups of water. Children will be grouped into 2-3 per group.

During Explore: While the children are investigating the effects in the investigation, teacher will walk around, observe, ask questions, and supervise.

Clean Up: After Explore, use paper towels to clean up the water.

Signal: Stand silently in front of the room, raising hand in the air to get the children's attention.

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**ENGAGE:** *Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary* **Estimated time: 5 – 10 minutes**

**Description of Engage:** Teacher will engage the children in a discussion regarding light by discussing one of the properties of light (that light travels in a straight line).

<b>Teacher’s Role</b>	<b>Teacher Questions</b>	<b>Children’s Role</b>
<p>Teacher gets the children interested in the lesson by asking what they learned last week with the lens and looking outside.</p> <p>Teacher scripts their words.</p> <p>Teacher then introduces today’s investigation: refraction</p>	<p>Remember last week’s investigation with the lens and looking outside.</p> <p>What is one thing you learned about how light travels?</p> <p>Today we are going to continue to investigate what happens to light when it passes through different materials.</p>	<p><i>“The lens made the picture go upside down.”</i></p> <p><i>“The light went through the lens and turned upside down.”</i></p> <p><i>“The picture was smaller than the real tree.”</i></p>

**EXPLORE:** *Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding* **Estimated time: 10 – 15 minutes**

**Description of Explore:** Each group will have 2 – 3 children. Each group will have a clear plastic cup about  $\frac{3}{4}$  full of water. The children will place a small piece of paper towel under the cup. The towel will make it easier to see the penny images clearly. Then the children will place a single penny **in** the cup. They will observe the cup from a variety of angles and positions.

<b>Teacher’s Role</b>	<b>Teacher Questions</b>	<b>Children’s Role</b>
<p>Organize the children into their groups.</p> <p>Teacher models what to do with the cup and the penny.</p>	<p>You are going to do investigate what happens to light when it passes through water by looking at a penny in the cup.</p> <p>As teacher walks around the room, teacher asks each group:</p> <p>1. How many pennies can you</p>	<p>The children move their head to see how many pennies they can observe.</p> <p>“2”</p>

	<p>see when you move your head to different positions?</p> <p>2. Can you move your head so that you see no penny?</p> <p>Now move the penny to different places in the cup (e.g., in the center, near the rim, leaning against the side.</p> <p>Move your head around the cup and count the pennies you see.</p> <p>Now you will remove the penny from the cup of water, and place it outside the cup, near the base.</p> <p>How many pennies can you see now?</p> <p>Try moving the penny to different places outside the cup, but near the cup's base.</p> <p>Make observations.</p>	<p>“4”</p> <p>Children complete a worksheet to record their observations.</p> <p>Children are responsible for their own safety and the safety of others.</p> <p>The children will move their head again to see how many pennies they can observe.</p> <p><i>Answers will vary.</i></p>
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**EXPLAIN: *Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding*** **Estimated time: 20 minutes**

**Description of Explain:** Children will present their findings to the class one group at a time. The teacher will encourage discussion by asking questions about their observations of the light slowing down and changing direction.

<b>Teacher's Role</b>	<b>Teacher Questions</b>	<b>Children's Role</b>
Teacher asks groups probing and clarifying questions.	<p>What materials did the light pass through so that you could see the penny?</p> <p>What do you think happens to the light when it goes into the plastic and the water? Think about these materials. Would they slow down the light or</p>	<p><i>“plastic and water”</i></p> <p><i>“air”</i></p> <p><i>“It slows down because it bumps into the plastic and the water.”</i></p>

	<p>speed it up?</p> <p>Why did you see so many pennies?</p> <p>What do you think was happening to the light in all of these investigations?</p> <p>Why do you think it did that?</p> <p>Remember last week when I tried to get through all the children in the aisle? Did I slow down or did I go faster?</p> <p>When I touched each of you, I shook you. This is a model of what light does when it hits a small particle called an atom or molecule.</p> <p>What happened to my direction when I tried to get through the aisle?</p>	<p><i>“The light was slowing down in the water but it was reflecting on the water too.”</i></p> <p><i>“The light changed direction.”</i></p> <p><i>“It was bumping into the plastic and the water.”</i></p> <p><i>“Slowed down.”</i></p> <p><i>“You shared some energy with us.”</i></p> <p><i>“You tried to go straight but you moved to the side.”</i></p>
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**EVALUATE: Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding** **Estimated time: throughout**

**Description of Evaluate:** The children will be assessed whether or not they learned that light travels in a straight line but changes direction when it travels through different materials by their responses to the discussion questions.

<b>Teacher’s Role</b>	<b>Teacher Questions</b>	<b>Children’s Role</b>
Teacher monitors the children’s understanding to be sure they know that light travels in a straight line but changes direction when it	What happens when light tries to pass through a material?	<p><i>“It slows down.”</i></p> <p><i>“It shares energy with the little particles in the material.”</i></p>

travels through different materials.		<i>“It changes direction.”</i>
<p><b>EXTEND/ELABORATE:</b> <i>Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas</i>      <b>Estimated time: 5 – 10 minutes</b></p> <p><b>Description of Extend/Elaborate:</b> Teacher asks children to think about some real world examples.</p>		
<b>Teacher’s Role</b>	<b>Teacher Questions</b>	<b>Children’s Role</b>
Teacher facilitates discussion to connect the lesson to the real world.	<p>Some people wear glasses to help them see better.</p> <p>The glasses have lenses for each eye.</p> <p>What do you think happens to light as it passes through the lens of the glasses?</p>	<i>“The light changes direction and speed just like in our investigation.”</i>



Name \_\_\_\_\_

## How Many Pennies?

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CaSTL program at UC Irvine

Data Table

<b>Position of Penny</b>	<b>How Many Pennies Do You See?</b>	<b>Drawing of Set Up (include where your eye is in relation to the penny)</b>
Middle of the cup		
Side of the cup		
Leaning against the side of the cup		
Outside of the cup		

# Teacher Background Knowledge

Light travels in straight lines. It travels at different speeds in different materials. When light passes from one material into another that is different and enters that second material at an angle, its path changes. It still travels in a straight line but now travels that straight line at a different angle. We say that the light “bends”. This does not mean it is curvy, only that the angle of its path has changed. We call this **refraction**.

Reflection is the bouncing of light off a surface. Refraction is the bending of light as it passes through materials of differing densities (air, water, plastic). Reflection, refraction, and the combination of the two cause numerous images to be seen of the single penny.

# **Common Characteristics of Lesson Plans**

**Get Children into the Learning--Connect to Their Prior Knowledge**

**Exploration/Investigation/Hands-On Learning**

**Making Meaning--Teachers and Children Together**

**Evaluation/Assessment**

**Extension to the Real World or Other Curricular Areas**

## **Other Aspects to Consider:**

**The lesson is Child-Centered--the child is listening, speaking, reading, writing and drawing. The child is thinking.**

**The children talk more than the teacher talks.**