



Light Changes Speeds

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.

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 a pencil in a clear plastic cup, a penny in a cup of water, and the image produced by a double convex lens.

Materials Used:

For each group:
spoon
pencil
9 oz clear plastic cup
water
pitcher for water
paper towels
Small double convex lens
3 x 5 white index card

Classroom Management:

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

During Explore: While the children are investigating the effects in the two stations, 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.

Funding and Credits:

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Department of Chemistry. This lesson was written by Therese B. Shanahan, Ed.D., University of California, Irvine, School of Education and Cal Teach.

<p>ENGAGE: <i>Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary</i> Estimated time: 5 – 10 minutes</p> <p>Description of Engage: Teacher will engage the children in a discussion regarding light by demonstrating one of the properties of light (that light travels in a straight line). Then the teacher will ask the children whether they have put a spoon in a clear glass of water.</p>		
Teacher’s Role	Teacher Questions	Children’s Role
<p>Teacher gets the children interested in the lesson by asking what they learned last week with the penny and the mirrors.</p> <p>Teacher scripts their words.</p> <p>Teacher then introduces today’s investigation: refraction</p>	<p>Remember last week’s investigation with the penny and the mirror and shiny objects.</p> <p>What is one thing you learned about how light travels?</p> <p>Have you ever put a spoon into a clear glass of water? Did you notice anything interesting?</p> <p>Today we are going to investigate what happens to light when it passes through different materials.</p>	<p><i>“The light travels in a straight line.”</i></p> <p><i>“The light reflected off the mirror better than it reflected off the shiny object.”</i></p> <p><i>“The spoon looks broken”</i></p> <p><i>“The spoon looks bigger.”</i></p>
<p>EXPLORE: <i>Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding</i> Estimated time: 10 – 15 minutes</p> <p>Description of Explore: Each group will have 2 – 3 children. Each group will do the two investigations to make observations about the property of light called refraction. They will put a pencil into a cup and make observations. They will use double convex lenses to view a scene from outside the classroom and project this onto an index card.</p>		
Teacher’s Role	Teacher Questions	Children’s Role
<p>Organize the children into their groups.</p>	<p>You are going to do two investigations:</p>	

<p>Teacher models what to do for each investigation.</p>	<p>1. Teacher places a pencil into a cup of water then the children do this with the materials in front of them and make observations.</p> <p>What do you observe?</p> <p>2. An outdoor station with a magnifying lens</p> <p>As teacher walks around the room, teacher asks each group:</p> <p>1. What does the water do to the light so that you can see the pencil?</p> <p>2. What does the lens do to the light coming from the outside? Compare the image on the index card to the real objects outside.</p> <p>3. Why can you see objects with your eye? Trace the path from the object to your eye.</p> <p>Use this sentence frame:</p> <p>The light _____ the object, _____ off the object, and travels _____ to my eye.</p>	<p>Children observe the pencil at an angle and notice that it appears broken but when they lift the pencil it is whole and not broken. When the children look at the pencil from above, it does not look broken.</p> <p><i>“Sometimes it looks broken. Sometimes it doesn’t.”</i></p> <p>The children go to an open door with the teacher and with their backs to the outside, they hold up a lens and an index card and focus the image of the outside scene onto their card.</p> <p><i>“The water changes the direction of the light.”</i></p> <p><i>“It turns upside down.”</i></p> <p><i>“The image is smaller and upside down.”</i></p> <p><i>“The light hits the object, reflects off the object and travels in a straight line to my eye.”</i></p> <p>Ask questions if they are unclear or unsure.</p> <p>Children are responsible for their own safety and the safety of others.</p>
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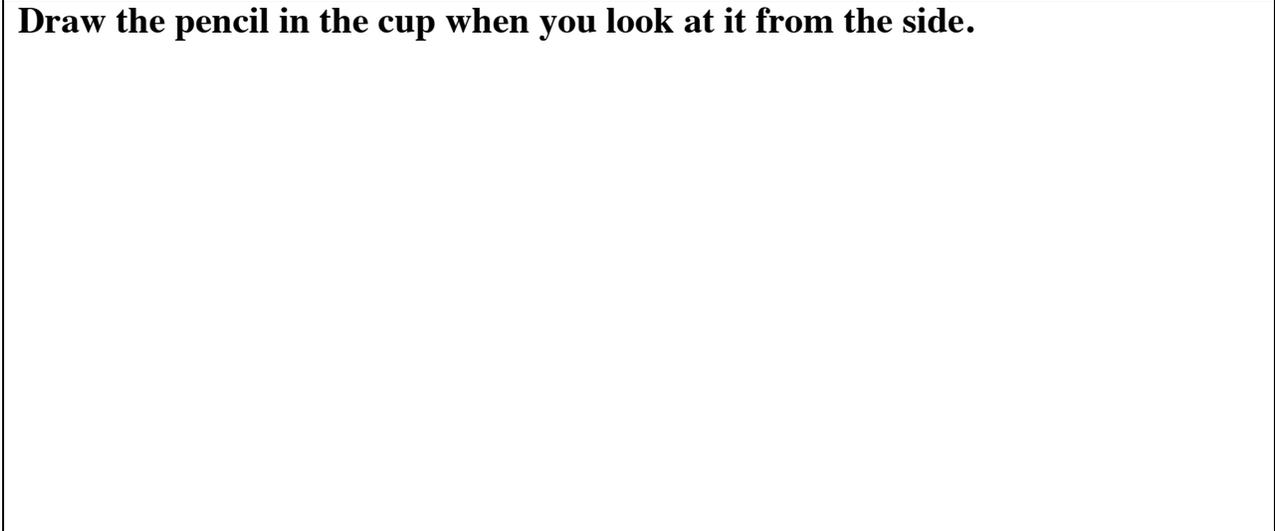
<p>touches to model sharing energy with the child just as light shares energy with each atom or molecule it hits. She says, “Here’s some energy” every time she shakes a child. Finally, the teacher is diverted into an opening that is different from the end of the aisle.</p>	<p>small particle called an atom or molecule.</p> <p>What happened to my direction when I tried to get through the aisle?</p>	<p><i>“You tried to go straight but you moved to the side.”</i></p>
<p>EVALUATE: <i>Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding</i> Estimated time: throughout</p> <p>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.</p>		
<p>Teacher’s Role</p>	<p>Teacher Questions</p>	<p>Children’s Role</p>
<p>Teacher monitors the children’s understanding to be sure they know that light travels in a straight line but changes direction when it travels through different materials.</p>	<p>What happens when light tries to pass through a material?</p>	<p><i>“It slows down.”</i></p> <p><i>“It shares energy with the little particles in the material.”</i></p> <p><i>“It changes direction.”</i></p>
<p>EXTEND/ELABORATE: <i>Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas</i> Estimated time: 5 – 10 minutes</p> <p>Description of Extend/Elaborate: Teacher asks children to think about some real world examples.</p>		
<p>Teacher’s Role</p>	<p>Teacher Questions</p>	<p>Children’s Role</p>
<p>Teacher facilitates discussion to connect the lesson to the real world.</p>	<p>Show children the 2 pictures—one a photo and the other a cartoon.</p> <p>See the fisherman trying to catch a fish with a spear. He is standing next to the water and looks down and sees a fish.</p> <p>He throws his spear down into the water where he thinks the fish is.</p>	

	What do you think will happen? Will he catch the fish?	<i>“No. The fish is in a different place than where his eye sees the fish.”</i>
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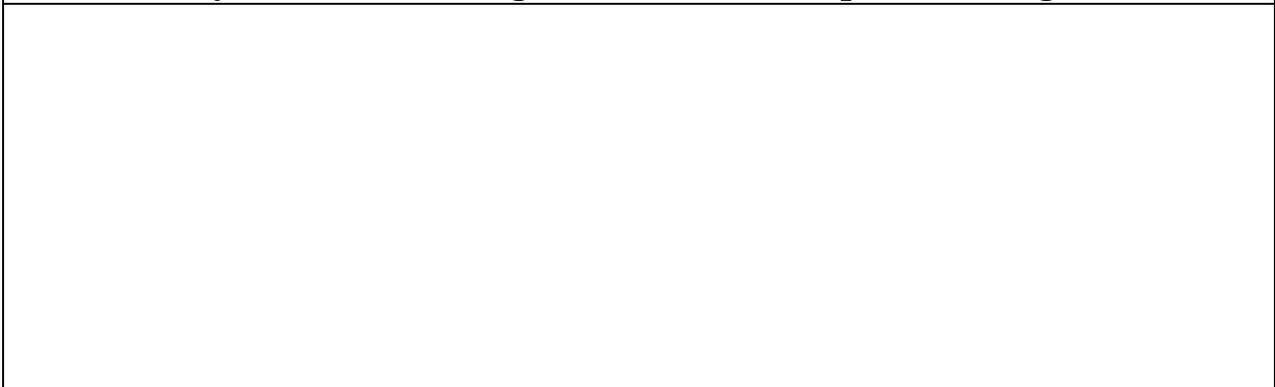
Name _____

Light Changes Speed

Draw the pencil in the cup when you look at it from the side.

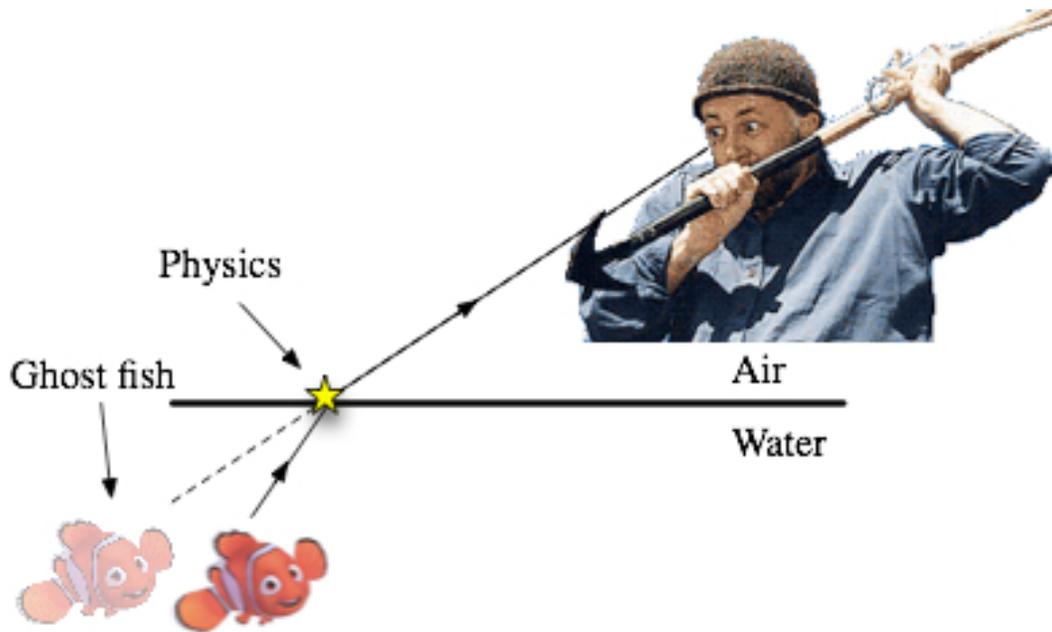


Draw what you see when the light from the outside passes through the lens.

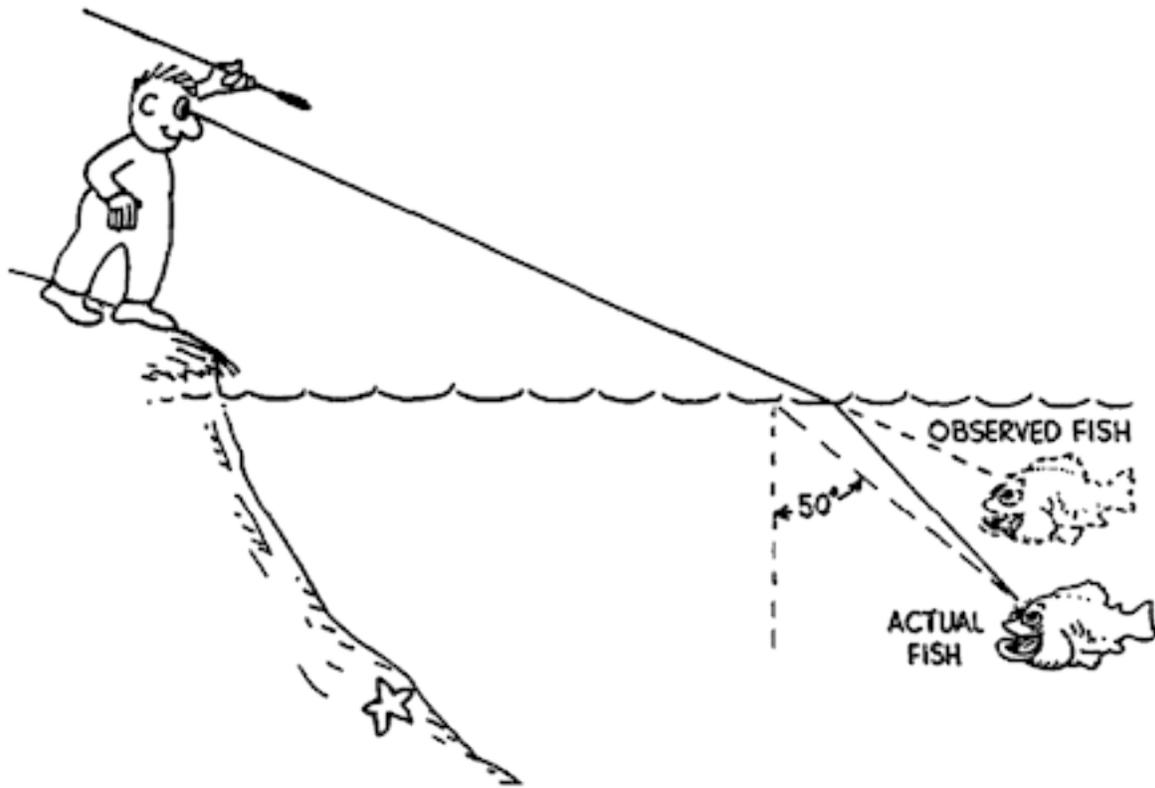


What happens to the light when it passes through materials like plastic or water?

When the light passes through plastic and water, it _____.



<http://sjesci.wikispaces.com/file/view/harpoon-refraction.jpg/150881891/harpoon-refraction.jpg>



<http://dev.physicslab.org/img/234ad295-ff45-4314-b3e7-f3e7307f0fae.gif>

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**.

In the “broken pencil” task, the light passed into the cup through the plastic and water and reflected off the pencil. The light rays passed through the water and through the plastic into the air to get to your eye. Each time the light entered a new material at an angle, the angle of its path changed. So the pencil looks broken. When you look at the pencil directly and not at an angle, the light passes in a straight line with no change in angle. The pencil does not look broken then.

In the “reappearing coin” task, by adding water to the cup, the light rays that were reflecting from the coin were now moving at a different angle (because of the water) so the image of the coin was able to enter your eye. The different material bent the path of the light rays by changing the angle of the path.

In the “produce an image of the window” task, the double convex lens changed the path of the light rays so that the image projected on the index card was upside down. The path of the light rays was changed several times in moving from air through the glass to air again. The front face of the lens is reflective at the same time so you see an erect image of the outside view on the surface of the lens and an upside down image of the view on the index card.

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.