



Penny, Penny: Who Has the Penny?

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 light is reflected from mirrors and other surfaces.

Lesson Objective:

Children will be able to know that light is reflected from mirrors and other surfaces by using two mirrors taped together at an edge to reflect multiple images of a penny. Children will understand that, to see the most images, the angle opening between the two mirrors must be very small.

Materials Used:

2 mirrors per groups of 2 children
1 penny per groups of 2 children

Classroom Management:

Setting up: Before the lesson, tape the 2 mirrors together. Gather enough pennies so that each group has 1 penny. Have extra pennies on hand, in case pennies get lost or dropped.

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 asking the children what they already know about mirrors from the previous week's lesson.

Teacher's Role	Teacher Questions	Children's Role
Teacher reminds the children about the previous week's lesson of light reflection using the laser pointers and mirrors	Who can tell us something about last week's investigation?	"We bounced (reflected) the laser light onto a mirror to put the red dot on the alien."

<p>as well as shiny objects.</p> <p>Teacher then asks the children what they already know about mirrors.</p> <p>Teacher scripts the children's words.</p>	<p>What can you say about how light travels?</p> <p>Here is a mirror. What do you know about mirrors?</p> <p>Why can you see yourself in the mirror?</p>	<p><i>"Light travels in a straight line."</i></p> <p><i>"Mirrors are shiny"</i></p> <p><i>"I can see myself in the mirror"</i></p> <p><i>"Light bounces off a mirror"</i></p>
<p>EXPLORE: Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding</p> <p style="text-align: right;">Estimated time: 10 – 15 minutes</p> <p>Description of Explore: Each group will have 2 children. Each group will be given a penny and 2 mirrors taped together beforehand.</p>		
Teacher's Role	Teacher Questions	Children's Role
<p>Organize the children into their groups.</p> <p>Ask one member of each group to collect the materials.</p>	<p>You are going to try to get images of the penny using the 2 mirrors.</p> <p>Use your 2 mirrors joined together at an edge. Put the penny where the 2 mirrors meet.</p> <p>Can you see 2 images of the penny?</p> <p>4 images?</p> <p>6 images?</p> <p>8 images?</p> <p>3 images?</p> <p>5 images?</p> <p>1/2 image?</p>	<p>Ask questions if they are unclear or unsure.</p>

	<p>Who can see the most money?</p> <p>As teacher walks around the room, teacher asks each group:</p> <p>Which was easier: getting an even number of images or getting an odd number of images?</p>	
<p>EXPLAIN: <i>Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding</i> Estimated time: 20 minutes</p> <p>Description of Explain: Children will present their findings to the class one group at a time. The teacher will encourage discussion by asking questions such as inquiring how the children managed to see multiple images in the mirrors.</p>		
Teacher's Role	Teacher Questions	Children's Role
Teacher asks groups probing and clarifying questions.	<p>What happened as you made the opening between the 2 mirrors bigger?</p> <p>What happened when you made the opening between the 2 mirrors smaller?</p> <p>What did you have to do to get ½ image?</p>	<p><i>"We got fewer images."</i></p> <p><i>"We got more images."</i></p> <p><i>"We had to bend the mirrors backward."</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 and can be reflected off shiny surfaces by their responses to the discussion questions.</p>		
Teacher's Role	Teacher Questions	Children's Role
Teacher monitors the children's understanding to be sure they know that light travels in a straight line between the two mirrors to form the images.	<p>What do you think the path of the light is that makes the images in the 2 mirrors?</p> <p>Think about what we already know about how light travels.</p>	<p><i>"The light travels in a straight line and bounces (reflects) from one mirror to the other back and forth."</i></p>

EXTEND/ELABORATE: *Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas* Estimated time: 5 – 10 minutes

Description of Extend/Elaborate: Teacher asks children if other shiny objects would be able to produce images of the penny.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher facilitates discussion to connect the lesson to the real world.</p> <p>Teacher asks probing questions to get the children to understand that the materials must be highly polished and flat so that the light will reflect sharply from the surface.</p>	<p>What happens if we use aluminum foil to try to make images of the penny?</p> <p>Can we do this investigation with aluminum foil?</p> <p>What are some other materials you want to try to make the same kind of images? Why can't we see images in other shiny materials?</p> <p>How is the mirror the same as the aluminum foil?</p> <p>How is the mirror different from the aluminum foil?</p>	<p><i>"We can see some pennies but we cannot make many images of the penny."</i></p> <p><i>"Some of the shiny things we used last week."</i></p> <p><i>"Both are shiny."</i></p> <p><i>"The aluminum foil is bumpy but the mirror is not."</i></p> <p><i>"The mirror is flat."</i></p>



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NAME _____

For each image, draw the opening of the mirrors as you look at the mirrors from above.

Image	Angle of the Mirrors (Drawing)
2	
4	
6	
8	
3	
5	
$\frac{1}{2}$	
The most	

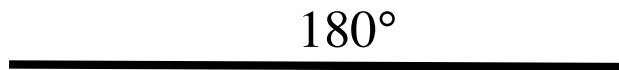
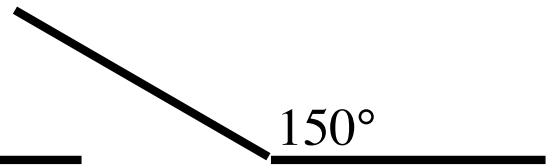
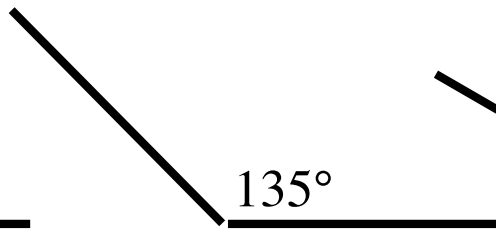
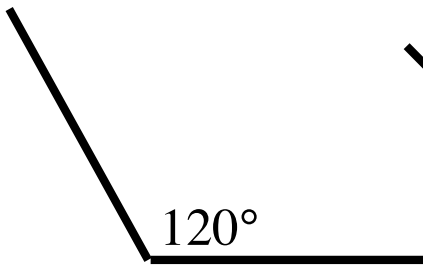
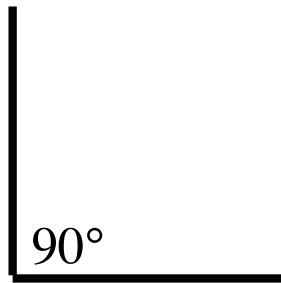
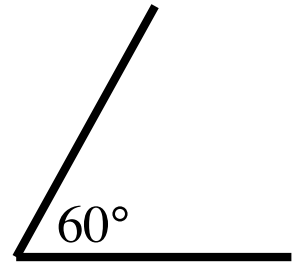
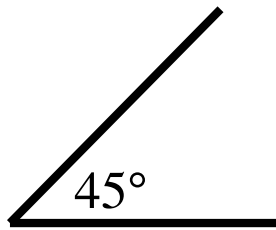
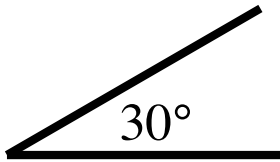
Conclusion.

When I made the opening of the mirrors bigger, I saw _____
images. *(more or fewer)*

Use this angle guide to complete the data table with older children.

Reference Sheet:

Angle Measures



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.