



Build a Microscope

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 investigate the effects of observing objects with 2 converging lenses.

Lesson Objective:

Children will be able to know that light travels in a straight line. They will notice the different effects of looking at objects through 2 converging lenses nested within mailing tubes. The children will in effect construct a simple low-power microscope from the two converging lenses and will be able to see how a microscope works. This is an introductory lesson and the teacher does not use the word microscope with the children. The teacher only discusses this as a tool.

Materials Used:

For each group:
2 converging lenses (convex lenses)
telescoping tubes (mailing tubes)
a selection of materials to view with the hand-made microscope
a magnifying lens
clay

For teacher demo in Engage:
Magnifying lens
Index card

Classroom Management:

Setting up: Before the lesson, assemble the materials and photocopy the worksheet. Children will be grouped into 2 per group.

During Explore: While the children are observing the effects of the two converging lenses in the investigation, teacher will walk around, observe, ask questions, and supervise.

Clean Up: After Explore, collect the materials.

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

Funding and Credits:

This project was funded by the National Science Foundation Centers for Chemical Innovation award #1414466 and #0802913 to V. Ara Apkarian, Ph.D. at the University of California, Irvine, Department of Chemistry. This lesson was written by Therese B. Shanahan, Ed.D., University of California, Irvine, School of Education and Cal Teach and taken from **NASA's Optics--light, color, and their uses: An educator's guide with activities in science and mathematics. Document EG-2000-10-64-MSFC. Retrieved on August 25, 2005 from <http://spacelink.nasa.gov>**

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 them to remember the lesson in which they used a lens to investigate properties of light.

Teacher's Role	Teacher Questions	Children's Role
Teacher gets the children interested in the lesson by asking them to remember the previous lesson when they used a lens to look at objects outside and projected the image onto the index card. Teacher shows the children these materials to give them some context for their thoughts. Teacher scripts their words.	Remember the investigation when you went to the gym door and looked at the objects outside by using a lens and an index card? What did the light do when it passed through the lens?	<i>"Yes. Everything was upside down and smaller than they really are."</i> <i>"The clouds were on the bottom and the grass was on the top."</i> <i>"Chris was waving his arms but his arms were down and his head was down too."</i>
Teacher shows the children the two converging lenses that they will use in today's investigation.	Today we are going to investigate what happens when we look at objects through two lenses, not just one.	<i>"It changed speed and direction."</i>

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: The microscope the children will construct uses two converging lenses of short focal length (one with a focal length less than 25 mm and the other with a focal length more than 25 mm). Two cardboard telescoping tubes that fit snugly one inside the other will be the body of the microscope.

1. To build the microscope, place the lens identified as the eyepiece (ocular) lens (focal length more than 25 mm) on the end of the cardboard tube having the smallest diameter.
2. Take the other lens (focal length less than 25 mm), the one identified as the objective lens, and place it on the end of the cardboard tube having the largest diameter. You might need clay to anchor the lens in the tube.
3. Slide the two cardboard tubes together. You have now assembled a simple microscope. View several items. Slide the two cardboard tubes in and out until you have a clear image.

Teacher's Role	Teacher Questions	Children's Role
<p>Organize the children into their groups.</p> <p>Teacher models what to do in each step.</p> <p>Teacher asks the children to predict what they think will happen when they look at the objects with the two converging lenses.</p>	<p>You are going to do some investigations by looking at objects through your tool. But first you have to build it.</p> <p>The children follow the teacher's directions.</p> <p>But before you do your investigation, you will do what scientists do: make a prediction.</p> <p>What do you think will happen?</p> <p>As teacher walks around the room, teacher asks each group:</p> <p>What do you notice?</p> <p>Use this sentence frame:</p> <p>I see _____ when the light travels through the two lenses.</p>	<p>Children tell what they think will happen. Answers may vary.</p> <p><i>"Things will get smaller."</i></p> <p><i>"Things will be upside down."</i></p> <p>The children do the investigation once the teacher hears their predictions.</p> <p><i>"Things are blurry."</i></p> <p><i>"Things are upside down."</i></p> <p><i>"Things are bigger."</i></p> <p><i>"I see things upside down when the light travels through the two lenses."</i></p> <p>Ask questions if they are</p>

		unclear or unsure. Children are responsible for their own safety and the safety of others.
<p>EXPLAIN: <i>Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding</i> Estimated time: 20 minutes</p> <p>Description of Explain: The children list the various objects that they examined through their tool. They describe their observations and compare what everyone saw with their tool.</p>		
Teacher's Role	Teacher Questions	Children's Role
Teacher asks groups probing and clarifying questions.	<p>What objects did you examine through your tool?</p> <p>What happened when you looked at those objects?</p> <p>What do you think happens to the light when it goes through the two lenses?</p>	<p><i>"a pencil, the table, the carpet, the wall, my shoe"</i></p> <p><i>"They got bigger."</i></p> <p><i>"It changes direction just like it does with one lens."</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: Then the children take two of the objects that they examined through their tool and look at them through just one lens. Teacher asks what differences they observed when they looked through the tool they made and the single lens. Which is the better tool? What makes that tool better?</p>		
Teacher's Role	Teacher Questions	Children's Role
Teacher monitors the children's understanding and asks them to look at two of the objects through a single lens.	<p>Now look at two of your objects through this magnifying lens (6X).</p> <p>What is the same between looking with one lens and two lenses?</p> <p>What is different?</p> <p>Which tool is better? Why?</p>	<p>Children use the one lens and look at two of their objects again.</p> <p><i>"Things get bigger."</i></p> <p><i>"The two lenses do something else to the objects. They are not just upside down."</i></p> <p><i>"Using only 1 lens, makes things bigger."</i></p>

		<p><i>“But using 2 lenses makes things even bigger.”</i></p> <p><i>“But you see less of the object.”</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 and children sing “Do You See What I See?” song.</p>		
Teacher’s Role	Teacher Questions	Children’s Role
Teacher shows the children the words to the song.	Let’s sing the song together.	Children sing the words along with the teacher.

Data Table.

Object	Drawing of What You See With 2 Lenses	Drawing of What You See With 1 Lens

Teacher Background Knowledge

In a microscope, the lens, placed next to the object to be magnified, is called the objective lens, while the lens held next to the eye is called the eyepiece. The eyepiece should have a focal length of about 25 millimeters, while the objective should have a focal length of 25 millimeters or less to be suitable for building a microscope. The distance to the enlarged image formed by the objective lens is 160 millimeters. The enlarged image formed by the objective lens is magnified by the eyepiece.

Do You See What I See?
(To the tune of the Christmas song, Little Drummer Boy)
By Dr. Terry Shanahan, June 25, 2013

Do you see what I see? Do you see what I see?
Things getting bigger all the time?
Do you see what I see? Do you see what I see?

A shape, a shape,
Turning upside down.
It gets bigger
And flips all around.
It gets bigger
And flips all around.

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.