

## How a Microscope Works

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**Date Created:** Spring 2017

**Subject:** Physics

**Grade Level:** Middle and High School

**Standards:** Next Generation Science Standards ([www.nextgenscience.org](http://www.nextgenscience.org))

**MS-PS4-2** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

**HS-PS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

**Schedule:** 90 minutes

**CCMR Lending Library Connected Activities:**

Light Waves

Demystifying Diffraction



<p><b><u>Objectives:</u></b></p> <p>Students will explore how lenses alter the path of light and how this can be used to allow us to magnify an object.</p>	<p><b><u>Vocabulary:</u></b></p> <p>Prism                  Convex Lens                  Focal Point                  Focal Length                  Light Ray                  Ray Diagram                  Compound Microscope                  Objective Lens                  Eyepiece Lens                  Magnification                  Thin Lens Equation</p>
<p><b><u>Students Will:</u></b></p> <ul style="list-style-type: none"> <li>- See the similarities between how light bends in a prism and in a convex lens.</li> <li>- Identify the focal point and measure the focal length of a lens.</li> <li>- Construct a microscope using two lenses.</li> <li>- Observe that the distance between two lenses is equal to their combined focal lengths.</li> <li>- Use the thin lens equation to calculate the magnification of their microscope.</li> </ul>	<p><b><u>Materials:</u></b></p> <p><b>For Each Group (2-4 students)</b></p> <ul style="list-style-type: none"> <li>___ Laser</li> <li>___ Flashlight</li> <li>___ Prism</li> <li>___ Adaptors w/3 Different Lenses (#1= 20cm, #2= 5cm, #3= 50cm)</li> <li>___ PVC Microscope Tube</li> <li>___ PVC Sample Cap w/acrylic disc</li> <li>___ Printed Graph Paper w/Binder Clip</li> </ul> <p><b>For Class</b></p> <ul style="list-style-type: none"> <li>___ Objects for Viewing</li> </ul> <p><b>Teacher Will Need to Provide</b></p> <ul style="list-style-type: none"> <li>___ Meter Sticks or measuring tape</li> </ul>
<p><b>Safety</b></p>	<p>Students need to be careful when using the lasers.</p>

### **Science Content for the Teacher:**

Refer to reading and resource list.



## **Classroom Procedure:**

### **Activity 1 (15 minutes)**

This activity will show the students why light bends when it moves through a different material. Students will see the similarities between how light bends in a prism and in a convex lens.

### **Activity 2 (15 minutes)**

In this activity students will learn about the focal point and measure the focal length of 3 different convex lenses.

### **Activity 3 (30 minutes)**

In this activity students will construct a microscope using two convex lenses of different focal lengths. They will find out that the distance between the two lenses is equal to the focal lengths of both lenses.

### **Activity 4 (30 minutes)**

In this activity students will calculate the magnification of their microscope. To do this, they will be introduced to the thin lens equation. They should calculate their magnification to be around 5x. They will then spend some time looking at some samples with their microscope.

### **Activity 5 (30 minutes)**

This is an optional activity that you can offer as a bonus for students who complete the other ones. In this activity, students will change around the lenses to see if they can improve the magnification of their microscope.

## **Resources:**

"Lenses and Geometrical Optics - Optics For Kids - The Optical Society ...."

<http://www.optics4kids.org/home/content/other-resources/articles/lenses-and-geometrical-optics/>. Accessed 12 Jan. 2017.

"Physics for Kids: Lenses and Light - Ducksters."

[http://www.ducksters.com/science/physics/lenses\\_and\\_light.php](http://www.ducksters.com/science/physics/lenses_and_light.php). Accessed 12 Jan. 2017.

Nikon. "MicroscopyU". <https://www.microscopyu.com/>. Accessed 13 Jan. 2017.

Matthew Parry-Hill and Michael W. Davidson. "Perfect Two-Lens System Characteristics". Nikon MicroscopyU Tutorials. <https://www.microscopyu.com/tutorials/twolenssystem>. Accessed 13 Jan. 2017.

John C. Long and Michael W. Davidson. "Tube Lens Focal Length". Nikon MicroscopyU Tutorials. <https://www.microscopyu.com/tutorials/offaxisrays>. Accessed 13 Jan. 2017.



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### **Extra Activities:**

Have the students try to figure out and explain, with drawings, why the image from the microscope is inverted.



## Assessment:

The following rubric can be used to assess students during each part of the activity. The term “expectations” here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

- 4= exceeds expectations
- 3= meets expectations consistently
- 2= meets expectations occasionally
- 1= not meeting expectations

	<b>Engage</b>	<b>Explore</b>	<b>Explain</b>
4	Shows leadership in the discussion and actively participates in group.	Completes work accurately while providing an explanation for what is observed.	Provides an in depth explanation of findings. Fills out worksheet clearly.
3	Participates in the discussion and participates in group activities.	Completes work accurately and works cooperatively with group.	Provides clear explanation of findings. Fills out worksheet clearly.
2	Contributes to the discussion, but could be more involved in group activity.	Works cooperatively with partners, but makes some mistakes with the procedure.	Provides a limited explanation of findings. Fills out some of the worksheet.
1	Does not participate in discussion and is not involved in group activities.	Has trouble working with partner. Does little to complete the procedure.	Is not clear in explanation of findings. Does not fill out worksheet.

