



STEM Quest

Make Light Go Where You Want It

How can you use mirrors and lenses to describe how light waves are reflected or transmitted?

Teacher Support

Focus on Next Generation Science Standards This lab builds towards mastery of PE MS-PS4-2. Students will apply the following practices, ideas, and concepts in this activity.

Science and Engineering Practices	Connect to the Core Idea	Crosscutting Concept
Develop and use a model to describe phenomena.	When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Group Size 3 students

Class Time 45 minutes

Safety

1. Urge students to use caution, as mirrors and lenses can chip or break easily, exposing the students to sharp edges.
2. Caution students not to use the mirror or lenses to look at the sun.
3. Remind students to be careful moving around when working in a darkened room to avoid colliding with objects and other people and injuring themselves.

Alternative Materials

You may wish to use plastic rather than glass lenses and mirrors to lessen the chance of breakage and injury from sharp edges.

Sample Data

Plane mirrors create images that appear upright and the same size as the object, but left-right reversed. They reflect light at the same angle at which it strikes their surface.

Convex lenses create images that vary with position; most likely, close objects will appear upright and enlarged (when looking through the lens), while distant objects will appear inverted (and either enlarged or reduced; students can and should form an image by placing an index card on the other side of the lens from the object). The lenses concentrate the light shining through them into a brighter spot on the book page.

Concave lenses create images that appear upright and smaller than the object. The images are virtual, meaning they can be seen only by looking through the lens. They spread out the light shining through them so it appears dimmer on the book page.

Procedure Tips

1. Allow students plenty of time to experiment with the mirror and lenses, both before and after darkening the room. Make sure to explain to them the basic geometric difference between a concave and convex lens.



2. Provide flashlights that are as powerful as possible, and that have as tight a beam as possible.
3. Remind student partners to take turns using the mirror and lenses to create images and view objects. Suggest that one partner hold up the book or mirror for the other while they direct the flashlight at different angles and from different heights, and then reverse positions.
4. In Step 6, students may need your guidance in positioning the flashlight, mirror, and book to illuminate the book page without shining the flashlight directly on it.

TE Annotations: Analyze and Interpret Data

1. Sample Answer: The image of the book page in the mirror looked the same as the actual book page except that it was reversed, so the writing on the back looked backwards.
2. Sample Answer: The convex lens made the text look larger, while the concave lens made it look smaller. The difference is a result of the different shape of the lenses, since the convex lens makes light rays converge and the concave lens makes light rays diverge.
3. Sample Answer: The mirror reflected light. I could tell because when I directed the flashlight at the mirror, the light bounced back and hit the book page.
4. Sample Answer: Both lenses transmitted light. I could tell because I could see the book page when I looked through the convex and concave lenses.

TE Annotations: Quest Follow-Up

1. Sample Answer: Since I observed that the mirror reflects light at the same angle that light hits the mirror, I could use a mirror to reflect and change the direction of light so it can move around a corner of the obstacle.
2. Sample Answer: Since I observed that the convex lens transmits and focuses light, I could shine the light through a convex lens to make the rays converge into a brighter beam before bending them.
3. Students should start to recognize that a mirror can be used in their system to reflect light waves in different directions. They should also recognize that light waves are refracted when transmitted through convex (light waves converge) and concave (light waves diverge) lenses.