LIGHT AND KALEIDOSCOPES (G3–6)

Students explore how light moves, bends, bounces, and breaks by exploring with prisms, water lenses, and mirrors. At the end, they use mirrors to create a colorful kaleidoscope to take home. See p. 3 for standards this workshop supports.

SCIENCE CONCEPTS

Light can move in many ways. Light can be:

- **Reflected** by a mirror.
- **Refracted** by a lens.
- **Dispersed** into a rainbow.
- **Absorbed** by the object.

Students learn about **reflection**.

- Light bounces off of mirrors to create images.
- We can also make reflections of a reflection when we use more than one mirror.

Students learn about **refraction**.

- Light bends when it enters a new material, like water or glass, and may emerge in an unexpected way.
- This bending can change the size or focus of an image, or even change its orientation.

Students learn about **colors of light**.

- White light can be broken into a rainbow by a prism or diffraction grating.
- There are also kinds of light beyond the rainbow that we cannot see with our eyes, such as radio waves, ultraviolet light, infrared light, and more.

Everything we see depends on **light**.

- The colors we see through the kaleidoscope depend on the colors of tape the students choose and the colors of the world through the other side of the kaleidoscope.
- The shapes students see through the kaleidoscope do not match the shape of the tape because they see it reflected through the **triangular prism** they build.

BEFORE YOU VISIT

How do our eyes see?	We see because light enters our eyes and sends signals to our brains. Objects must emit or reflect at least some light for us to see them. Without light, we cannot see.
How do we see color?	Materials absorb and reflect light. For example, a red shirt absorbs all colors except red, and reflects red back at our eyes. Each color of light has a different energy called a **wavelength**. By measuring light's wavelength, we can determine its color in a scientific sense. White light is not a color itself, but the effect of combining all the colors together.
How do eyeglasses work?	The lenses in eyeglasses bend light in specific ways to change how it enters our eyes, usually by changing where on our eye the image is focused. We can use different kinds of lenses to make objects appear smaller or bigger, as in telescopes and microscopes.
How do mirrors work?	Light from an object hits the mirror and bounces back the way it came, forming an **image** of the original.

AFTER YOU VISIT

Questions

- How do students' choices in how they attached their tape change what they see through the kaleidoscopes?
    1. What different ways did students find to attach tape to the ends?
    2. Did they overlap their tape colors?
    3. Did they cut their tape?
- Can students observe different shades of the same tape color? Why do you think this is happening? (Answer: students create different shades of tape by layering them over one another. So, red over red may look darker, or blue over red may create darker or more purple shades.)

Activities

- Have students make lists of the different shapes they observe through their kaleidoscopes. Some patterns get very complicated!
- Have students improve on their kaleidoscope designs.
    1. Students might add colored paper, tissue paper, ribbon, or other materials.
    2. They might also draw designs on the tape or the paper.
- Teachers might have students try to make certain shapes appear in the kaleidoscopes by changing the tape on the ends. Students will naturally make many different shapes with their initial designs, so use what they've already made to **reverse engineer** specific shapes.

CAREERS THAT USE ENGINEERING

Telescope maker: Some people use telescopes in their backyards to look at stars, and some people put telescopes on spacecraft to help astronomers study the universe. Both kinds need someone to build the telescope, and this involves building lenses and giant mirrors to focus light from stars and galaxies billions upon billions of miles away.

Optician: People who wear glasses visit opticians to get the right glasses for their vision. Opticians learn how light changes when it travels through glass and use this knowledge to help people see more clearly.

Solar engineer: Some types of solar power use mirrors to concentrate a wide collection of light onto a small point. This industry requires engineers to craft and build these mirrors, which can help provide energy to people and businesses.

Learn about **more careers** that use engineering!

MINNESOTA ACADEMIC STANDARDS FOR SCIENCE K-12

3.1.1.1.1 Provide evidence to support claims, other than saying "Everyone knows that," or "I just know," and question such reasons when given by others.

3.1.1.2.1 Generate questions that can be answered when scientific knowledge is combined with knowledge gained from one's own observations or investigations.

3.1.3.2.2 Recognize that the practice of science and/or engineering involves many different kinds of work and engages men and women of all ages and backgrounds.

3.2.3.1.2 Explain how shadows form and can change in various ways.

3.2.3.1.3 Describe how light travels in a straight line until it is absorbed, redirected, reflected or allowed to pass through an object.

4.1.2.2.2 Generate ideas and possible constraints for solving a problem through engineering design.

4.1.2.2.3 Test and evaluate solutions, considering advantages and disadvantages for the engineering solution, and communicate the results effectively.

6.1.2.1.4 Explain the importance of learning from past failures, in order to inform future designs of similar products or systems.

6.1.2.2.1 Apply and document an engineering design process that includes identifying criteria and constraints, making representations, testing and evaluation, and refining the design as needed to construct a product or system to solve a problem.

6.1.3.1.1 Describe a system in terms of its subsystems and parts, as well as its inputs, processes and outputs.

6.2.3.1.3 Use wave properties of light to explain reflection, refraction and the color spectrum.