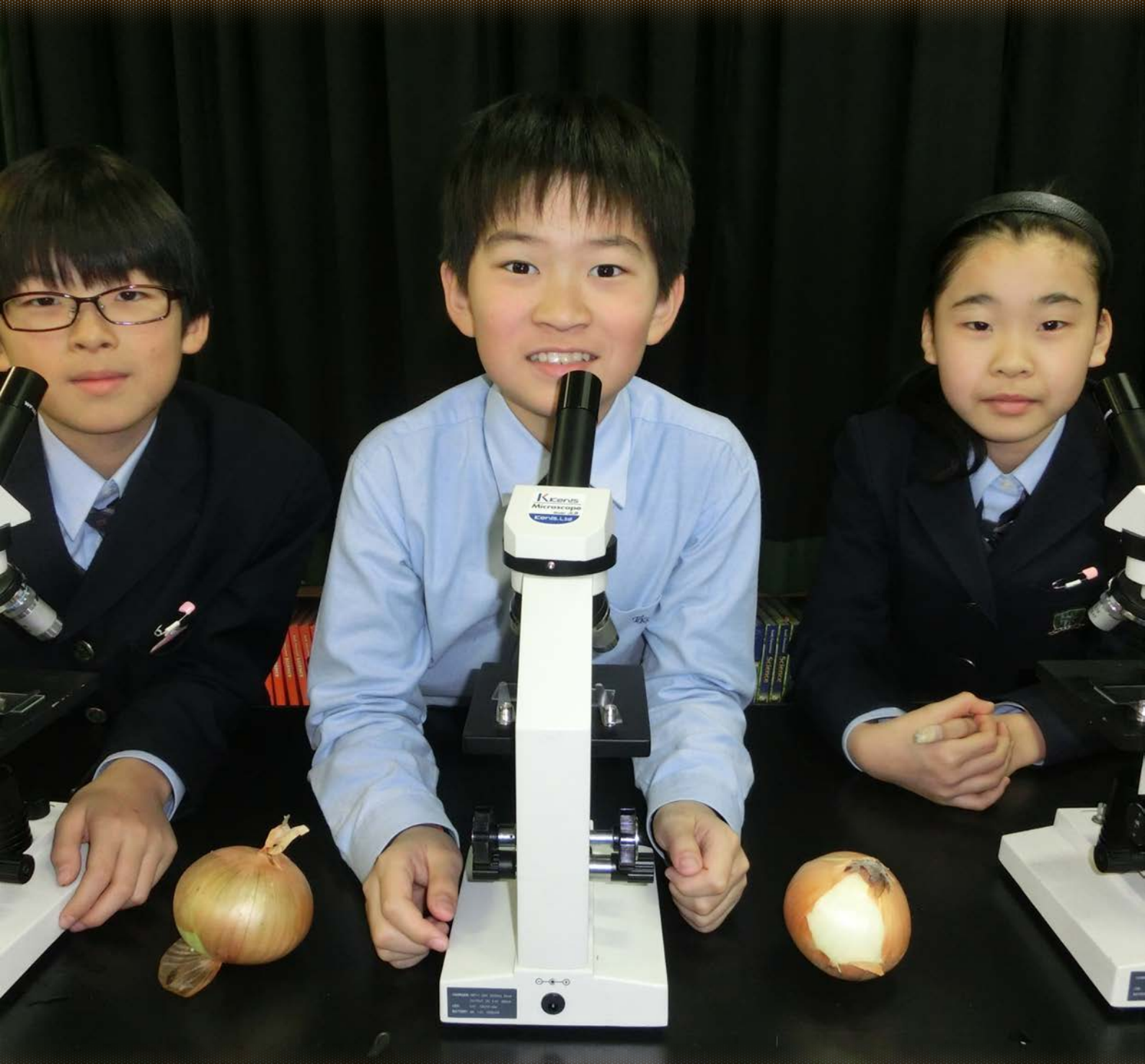
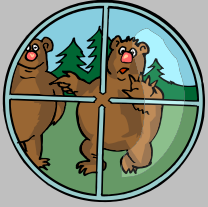


LENSES

This area covers the phenomena created by lenses. A lens is a tool of daily use that can concentrate light by creating refraction or make things appear larger, sparking interest and curiosity in students.

This area mainly deals with refraction of light created by lenses in an assortment of optical instruments, including microscopes and projectors. Students observe how lenses make things appear larger or smaller and understand how a magnifier focuses the sun's rays onto a small point. This area emphasizes the phenomena created by lenses showing the path of light.





TARGETS

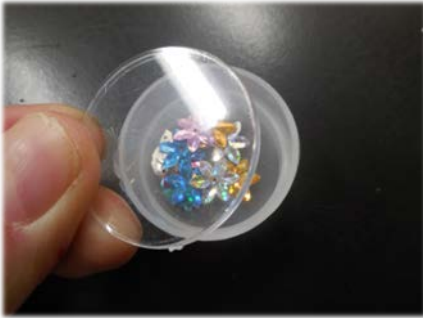
The grade 6 English science unit, Lenses, meets the academic content standards set in the Korean curriculum, which state students should:

- a) Identify the difference between the true appearance of objects and their appearance as viewed through optical instruments.
- b) Understand the phenomena resulting from focusing the sun's rays onto a small point with a magnifier.
- c) Find examples of lenses in daily use and explain their functions.
- d) Design a tool using a lens.

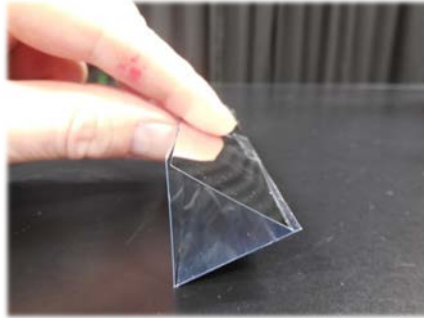


How does a kaleidoscope work?

What do I need to do? You will need a tube, plastic mirrors, a small agar plate with a lid, spangles, a plastic lid with a hole in the middle, scissors, and tape.



1. Add some spangles to the small agar dish and put on the lid.



2. Cut out three plastic mirrors that can fit snugly into a tube when they are taped together as a triangle.



3. Put the mirrors in the tube. Tape the small agar plate to the base. Tape the plastic lid that has a hole in the middle to the other side. Look into it.

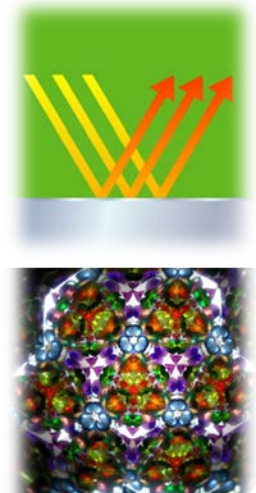
What happened?

Draw a picture to show some of the images you saw.

The science behind kaleidoscopes.

A kaleidoscope is made by using two or more mirrors inside a tube. The light that enters the tube bounces off the mirrors. This is called reflection.

The pieces at the bottom of the kaleidoscope, such as the spangles we used, move around when you shake them. These spangles make unique and attractive designs as their images are reflected off the mirrors. As you continue to shake your kaleidoscope, the pieces will keep moving around. They will make new arrangements and the reflected images will change.



What did I learn?

1. Why can you see attractive designs when you look into a kaleidoscope?

2. What do you think would happen if you look into a kaleidoscope in a dark room? Why?



Why do objects look bent in liquids?

What do I need to do? You will need a jar, a spoon, a straw, water, vegetable oil, paper, and a marker.



1. Half fill a jar with water. Put in a long spoon and a straw. Observe what happens.



2. Take out the spoon and straw from step 1 and add vegetable oil on top of the water. Put the spoon and straw back in and observe what happens.



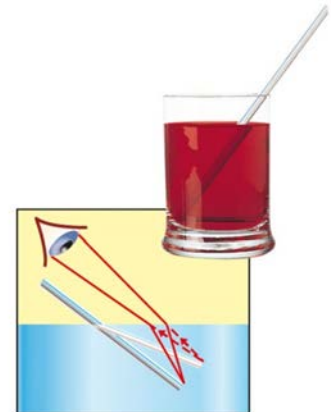
3. Draw an arrow on a small piece of paper. Hold it behind a jar filled with water. Slowly move the piece of paper further from the jar and get your friend to observe what happens.

What happened?

Draw pictures to show what happened in each of the steps.

The science behind bent objects in liquids.

When you look at something, you are seeing the light bouncing off it. Light moves at different speeds when it passes through different substances. Light travels faster in air than in water. As light enters water at an angle, it slows down which makes the object in the water look bent. Light travels even slower in oil, which makes the object in it seem like it has a greater bend. When light bends through different materials, it is called refraction.



What did I learn?

1. Did the objects seem to bend more in water or oil? Why?

2. What happened to the arrow in step 3? Why did this happen?



How can you make something appear to disappear in water?

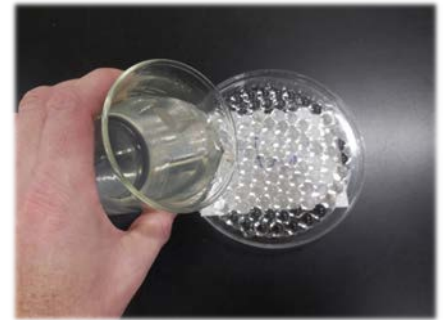
What do I need to do? You will need clear jelly marbles, a plastic or glass cup, a teaspoon, water, a clear plate, paper, and a marker.



1. Add a teaspoon of the jelly marbles to a plastic cup. Fill up the cup with clean water and leave it overnight.



2. Put your hands in the cup and see if you can feel anything. Take out all the jelly marbles and place them on a clear plate.



3. Secretly write a message on a piece of paper. Put this under the plate with the jelly marbles. Ask your friend to try and read the message. Then, pour water into the plate and see the message.

What happened?

Draw pictures to show what happened in step 3.

The science behind making something appear to disappear in water.

Jelly marbles start out hard, but they can absorb about 300 times their weight in water. After they absorb water, they are very difficult to see because the light passing through them is only refracted a little bit along their edges and there is very little reflection.

It was very difficult to read the message under the plate because the light was reflected and refracted in many different directions through the jelly marbles. However, when water was added, the light could move through with very little refraction because the light could travel through the water and jelly marbles at about the same speed.

What did I learn?

1. What did you notice about the message your friend wrote before you added the water?

2. Why could you read the message easily when you added water to the clear plate?



How are convex lenses and concave lenses different?

What do I need to do? You will need Lego, a convex lens, and a concave lens.



1. Make some structures with Lego.



2. Feel the convex lens. Notice its shape. Look through the convex lens at your Lego structures.



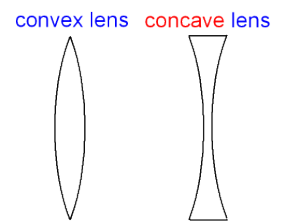
3. Feel the concave lens. Notice its shape. Look through the concave lens at your Lego structures.

What happened?

Draw pictures that show the shape of the two lenses. Then, draw an example of the images you saw through those lenses.

The science behind convex and concave lenses.

Lenses have shapes that allow light to refract through them. The two main shapes of lenses are called convex and concave. The surfaces of convex lenses curve outwards. The surfaces of concave lenses curve inwards. Since the shape of these lenses is different, the light bends differently through them. This means that the images you see through them will be different, too. If the convex lens is close to the object being viewed, the image will be upright and enlarged. The image seen through a concave lens will be smaller and will give you a wide view of the object.



What did I learn?

1. Explain the shape of a convex lens. How was the image you saw?

2. Explain the shape of a concave lens. How was the image you saw?



How can a magnifying glass start a fire?

What do I need to do? You will need a magnifying glass, a thermometer, white paper, and black paper.



1. Place a thermometer on the ground outside on sunny day. Use a magnifying glass to focus the sunlight onto the bulb of the thermometer and observe.



2. Use the magnifying glass to focus the sunlight onto a white piece of paper and observe.



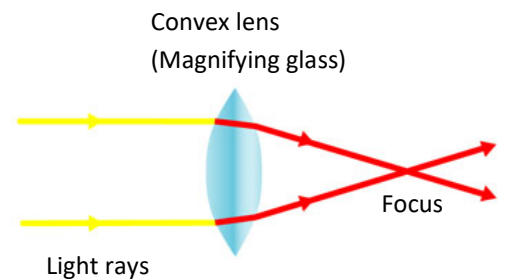
3. Use the magnifying glass to focus the sunlight onto a white piece of paper and observe.

What happened?

Draw pictures to show what happened in each of the steps.

The science behind starting fires with a magnifying glass.

Magnifying glasses are made with convex lenses. They are known as converging lenses. This type of lens makes parallel light rays going through it come together. The point at which they appear to come together is called a focus. If you direct all the sunlight to this point, it will be extremely hot. It can easily make black paper be set on fire, as black absorbs light. It is a little more challenging to set white paper on fire, as white is good at reflecting light.



What did I learn?

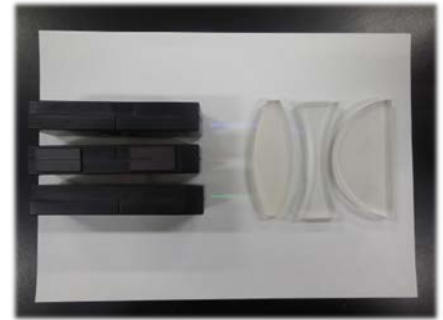
1. Why did the temperature on the thermometer go up in step 1?

2. Why was it easier to set fire to the black paper?



How does light pass through converging and diverging lenses?

What do I need to do? You will need lasers, a convex prism, a concave prism, and other prism blocks.



1. Shine some lasers at a convex prism. Turn off the lights. Observe how the lasers are refracted.
2. Shine some lasers at a concave prism. Turn of the lights. Observe how the lasers are refracted.
3. Put the prisms after each other. Add different prisms if you have them. Observe how the lasers are refracted.

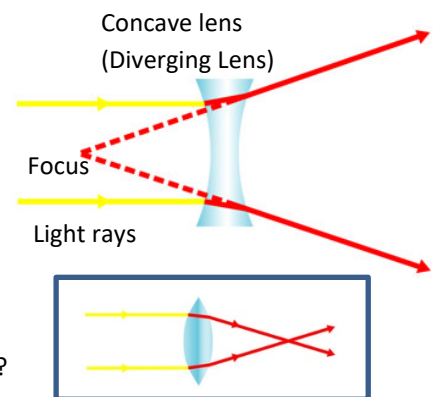
What happened?

Draw pictures to show what happened in each of the steps.

The science behind light passing through converging and diverging lenses.

A convex lens is a converging lens. Parallel rays of light passing through it come together at a focus. We saw this in the magnifying glass experiment when we set the black paper on fire.

A concave lens is a diverging lens. This means that parallel rays of light spread out as they pass through the lens. If you look at the concave lens to the right, the light rays appear to come from the focus.



What type of lens is this?

What did I learn?

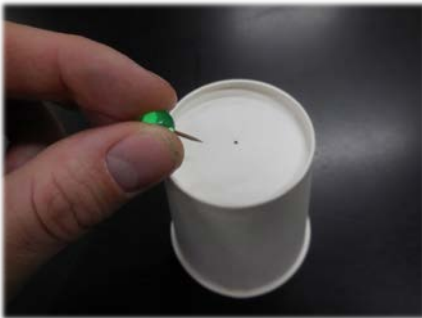
1. What type of lens is a concave lens? What does this mean?

2. Explain what would happen to the light rays if you put a convex lens in front of a concave lens?



How do your eyes work?

What do I need to do? You will need a cup, wax paper, an elastic band, a pin, a candle or light, and a lighter.



1. Use a pin to put a small hole at the bottom of a cup.



2. Cover the open end of the cup with wax paper. Keep the wax paper in place with an elastic band.



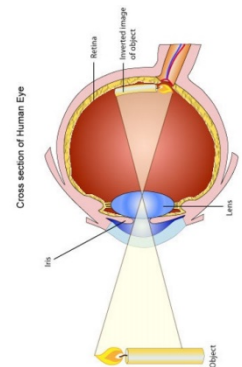
3. Light the candle. Make the room dark. Point the pinhole towards the flame and observe the image on the wax paper. Move the cup closer and further away and observe.

What happened?

Draw pictures of the flame or light as seen through the cup.

The science behind how eyes work.

The front part of your eye is a convex lens. As light is reflected from objects and enters your eye, the lens refracts the light so that an image is formed at the back of the eye on a layer called the retina. The light rays from the bottom go through the lens (or pinhole in this case) to the top of the image. This is why the image is upside-down. It is your brain that makes sense of this image and allows you to see things the right way up. The image is said to be a real image as the light travels to a point where the image occurs. These images can be projected onto a surface, like your retina (or wax paper).



What did I learn?

1. What type of lens is in your eye and what happens to the image that ends up on your retina?

2. What happened to the image when you moved the cup further away from the flame?



What is the difference between a real and virtual image?

What do I need to do? You will need a Fresnel lens, objects to look at, a candle, a lighter, and white paper.



1. Stand behind the lens and look at objects that are close to the lens and objects that are far away from the lens. Observe how the images are different.



2. Hold the lens about 1 meter from a lit candle. Hold a large piece of white paper against the side of the lens that faces away from the candle. Move the paper until the object comes into focus.



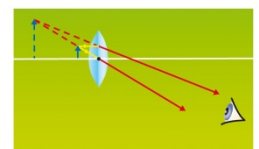
3. Hold the lens about 20 centimeters from a lit candle. Look through the lens and observe the image that is made.

What happened?

Draw pictures to show what happened in steps 2 and 3.

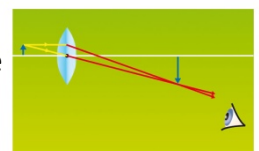
The science behind real images and virtual images.

In previous activities, we saw that magnifying glasses made objects appear larger. This happens when the object you are looking at is closer than the focal point (focus). This image appears to be on the same side as the object and is magnified. This type of image is called a virtual image because it cannot be focused on a piece of paper.



Virtual Image

In the eye activity, we saw that the image was upside-down. This happens when the object you are looking at is farther away than the focal point (focus). This image can also be focused on a piece of paper. This type of image is known as a real image.



Real Image

What did I learn?

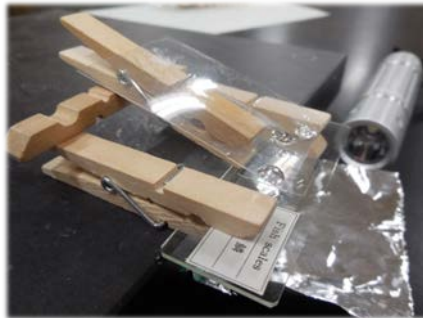
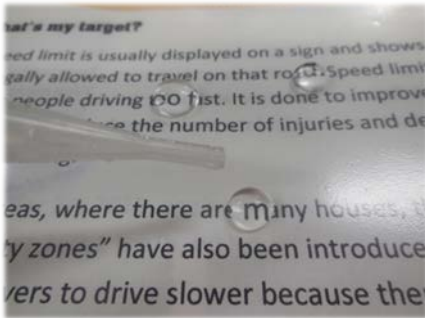
1. Was the image in step 2 a virtual or real image? How did you know this?

2. Was the image in step 3 a virtual or real image? How did you know this?



How does a microscope work?

What do I need to do? You will need a plastic sleeve, a pipette, water, a flashlight, aluminum foil, stiff plastic, a hole punch, pegs, glue, a microscope, and prepared slides.



1. Use a pipette to put some water drops on some writing that is protected by a plastic sleeve. Observe the writing.
2. Use the materials provided to construct a water drop microscope. Look at a prepared slide through your creation.
3. Observe a range of different slides through an actual microscope. Look at the slides through 4x, 10x and 40x magnification.

What happened?

Draw pictures to show what you could see through the microscopes.

The science behind a microscope.

Microscopes use lenses and mirrors to make images look larger. The microscopes we use at our school are called compound optical microscopes. These microscopes have an objective lens which refracts light from the object to make a larger, upside-down image. The eyepiece also refracts light to make the image even bigger and also turns the image the right way up. There is a nosepiece which holds three lenses of different magnification. A mirror at the bottom of the microscope reflects light through a hole in the stage onto the object.

What did I learn?

1. What is the job of the eyepiece and objective lens?

2. Why do the microscopes also use mirrors?





How does a projector work?

What do I need to do? You will need a large box, cutter knife, magnifying glass, tape, digital camera or smartphone and a smooth surface for your images.



1. Trace the magnifying glass near the bottom of your box and carefully cut around the circle. Tape the magnifying glass over the hole that was made.
2. Record a movie or take photos with a digital camera or smartphone. Put it on playback mode and place the camera in the box.
3. Turn off the lights and see the image on a smooth surface. Move the camera so that you get a crisp image on the screen. Try turning the camera upside down.

What happened? Draw an example to show what your image looked like with the camera the right way up and upside-down.

The science behind a projector.

Projectors work similar to the human eye. Light passes through the magnifying glass which turns the image upside-down. In this activity you just needed to turn the digital camera upside-down for the image to be turned the right way up on the wall. The image that is projected onto your screen or wall is much bigger than the lens on your projector. This is because the convex lens bends the light to make the image bigger. The image is a real image because it can be put on a screen or wall.

What did I learn?

1. Why did you need to put the digital camera upside-down in the box?

2. Is the image a real or virtual image? How do you know this?

