

ROBERSON MUSEUM AND SCIENCE CENTER

Pre-Visit Microscopes: Exploring the World of Lenses

Grade Level: 4th -10th

New York State Standards: M S & T 1, 4, & 5

Pennsylvania State Standards: S & T 3.2 & 3.7

Objective: Students will explore the basic properties of lenses and construct a simple lens and a simple microscope. They will also perform some lens activities.

Materials:

- Cardstock
- Marker
- Clear glass
- Water
- Scissors
- Black paper
- Magnifying glass
- Light Source
- Glass jar 2 inches in diameter
- Ruler
- Plastic box
- Old bucket
- String
- Clear plastic
- A coin
- A dropper
- Ping-pong ball

Procedure:

1. Tell students we use lenses everyday whether we know it or not. There are two lenses in each of our eyes: the cornea and the crystalline lens which focus light onto our retinas. Lenses are used not only to correct and focus our vision, but to enhance it by letting us see parts of our world we normally wouldn't be able to see, via microscopes and telescopes. In fact, "The majority of life cannot be seen with the human eye," hence we need assistance by lenses other than those in our eyes.

2. Part I: Making a Simple Microscope

a) Put a drop of water on a clear sheet of plastic to form a water lens 5 millimeters (mm) or greater in diameter. Use a bright lamp (desk lamp) as a light source and hold it over a paper so you can estimate the focal length with a ruler. You'll find the focal length to be about 5 millimeters, maybe more, maybe less. The focal length is defined as the distance between the lens and the light source at which an object comes into focus.

b) Can you estimate the magnification by measuring a known object (for example, hair is about 70 micrometers in diameter)? Compare the width of the image with the diameter of your water lens which you can measure.

c) Next students will make an improved water-drop magnifier. Take a stiff card about 10 centimeters (cm) long and 3 cm wide about the size of a microscope slide. Punch a hole about 5mm wide (standard size of a hole punch is 7mm in diameter and may be too big). Put a piece of clear plastic over the hole, tape it down, and then put a drop of water on the plastic over the hole with the droplet big enough to extend beyond the hole. Now you have a portable water simple microscope.

3. Part II: Other Fun Activities

a) Place a magnifying lens over the drawing of an arrow. Hold the magnifying lens about arms length away from your eye, and slowly lift the magnifying lens off the picture bringing it closer to your eye. Keep lifting the magnifying lens until the image you are watching turns upside down.

b) What happened? As you first began to move the magnifying lens further away from the page, the image should have grown larger and then at one point become fuzzy and then back into focus again, but this time upside down. This is because of the way the magnifying lens bends the light traveling to your eye from the page. When the magnifying lens is close to the page, you see what is known as the **virtual image**. This is an upright image that is larger than the image on the page. As you move the magnifying lens closer to your eye and away from the page, you see what is called the real image, which is upside down.

c) **The Refractory Arrow:** Using markers, draw two right pointing arrows, about 4 inches apart, on a card that you can fold and stand up like a tent. Some distance away in front of one of the arrows (you will have to experiment) stand an empty glass. Keep watching the arrow behind the glass, as you pour water to fill the glass. The arrow behind the glass (now a water-lens) changes in direction.

d) **Puzzles with water-lenses:** Get a smooth sided (cylinder-shaped) glass jar, measuring about 2 inches across. Nearly fill it with water. Dip your thumb in the water and examine it through the side of the jar. The glass shapes the water into a kind of lens. Does your thumb look longer, shorter, fatter, thinner? Now imagine pushing a ping-pong ball under the water. Try to draw what it will look like. Check your guess by doing a test. Empty the water and stand the empty jar in the middle of a plastic box containing water. Hold a ruler upright inside the jar. Look at it through the water. Notice how its shape changed by the refraction of light. Place the ping-pong ball inside the jar when you take the ruler out. How do you think it will look?

e) **Shaping water into a lens:** Find an old bucket and cut two large holes in the side so that you can look through the bucket. Depending on the size of the bucket, each hole can be as big as 6 inches in diameter. Stretch a piece of plastic over the top and tie it on with string. Now pour some water on top of the plastic sheet. The weight of the water stretches the plastic into a lens shape. Place a coin on the palm of your hand and look through your water lens by placing your hand through the bucket holes underneath. What does the coin look like now? Try looking at other objects in the same way.

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