Simple Microscopes & Telescopes

Overview: Did you know you can create a compound microscope *and* a refractor telescope using the same materials? It's all in how you use them to bend the light. These two experiments cover the fundamental basics of how two double-convex lenses can be used to make objects appear larger when right up close or farther away.

What to Learn: Things like lenses and mirrors can bend and bounce light to make interesting things, like compound microscopes and reflector telescopes. Telescopes magnify the appearance of some distant objects in the sky, including the moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than can be seen by the unaided eye.

Materials

- window
- dollar bill
- penny
- handheld magnifying lenses (2)
- ruler

Experiment

1. Place a penny on the table.
2. Hold one magnifier above the penny and look through it.
3. Bring the second magnifying lens above the first so now you're looking through both. Move the second lens closer and/or further from the penny until the penny comes into sharp focus. You've just made a compound microscope.
4. Who's inside the building on an older penny?
5. Try finding the spider/owl on the dollar bill. (Hint: it's in a corner next to the "1".)
6. Keeping the distance between the magnifiers about the same, slowly lift up the magnifiers until you're now looking through both to a window.
7. Adjust the distance until your image comes into sharp (and upside-down) focus. You've just made a refractor telescope, just like Galileo used 400 years ago.
8. Find eight different items to look at through your magnifiers. Make four of them up-close so you use the magnifiers as a microscope, and four of them far-away objects so you use the magnifiers like a telescope. Complete the table.

Simple Microscope & Telescope Data Table

For the last two columns, measure with your ruler carefully. Don't forget to label your units!

Magnification Used: _____ (multiply the magnification of both lenses together)

Object Looked At	Did you use the Magnifiers as a Microscope or Telescope?	How Far Apart are the Lenses?	How Far is your Eye from the Eyepiece?

Reading

What I like best about this activity is how easily we can break down the basic ideas of something that seems much more complex and intimidating, like a telescope or microscope in a way that kids really understand.

Imagine tossing a rock into a still pond and watching the circles of ripples form and spread out into rings. Now look at the ripples in the water - notice how they spread out. What makes the ripples move outward is energy.

The ripples are like light. Notice the waves are not really moving the water from one side of the pond to the other, but rather moving energy across the surface of the water.

To put it another way, energy travels across the pond in a wave. Light works the same way – light travels as energy waves. Only light doesn't need water to travel through the way the water waves do - it can travel through a vacuum (like outer space).

Light can change speed the same way sound vibrations change speed. (Think of how your voice changes when you inhale helium and then try to talk.)

The fastest light can go is 186,000 miles per second – that's fast enough to circle the Earth seven times every second, but that's also inside a vacuum. You can get light going slower by aiming it through different gases. In our own atmosphere, light travels slower than it does in outer space.

Exercises

1. Can light change speeds?
2. Can you see ALL light with your eyes?
3. Give three examples of a light source.
4. What's the difference between a microscope and a telescope?
5. Why is the telescope image upside-down?

Answers to Exercises: Simple Microscopes & Telescopes

1. Can light change speeds? (Yes, when it travels through different mediums.)
2. Can you see ALL light with your eyes? (No, only visible light, like a rainbow.)
3. Give three examples of a light source. (Answer will vary, but here are mine: sun, a candle, and a glow stick.)
4. What's the difference between a microscope and a telescope? (A microscope magnifies an image before the focal point; a telescope magnifies an image after the focal point. Both are used to make images appear closer and larger. A microscope is used when objects are near; a telescope is used for far away objects.)
5. Why is the telescope image upside-down? (Because you've focused the image beyond the focal point.)