Setting the Stage
Episode 4:
Who needs a television? An introduction to projectors

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SC Grades 4 & 8
NC Grades 4 & 6
SOUTH CAROLINA STATE STANDARDS

4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.

4.P.4A.4 Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

**Vocabulary:** absorb, reflect, refract, concave, convex.

8.P.3A.1 Construct explanations of the relationship between matter and energy based on the characteristics of mechanical and light waves.

8.P.3A.2 Develop and use models to exemplify the basic properties of waves including frequency, amplitude, wavelength, and speed.

8.P.3A.3 Analyze and interpret data to describe the behavior of waves (including refraction, reflection, transmission, and absorption) as they interact with various materials.

NORTH CAROLINA STATE STANDARDS

4.P.3 Recognize that energy takes various forms that may be grouped based on their interaction with matter.

4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical, and magnetic) as the ability to cause motion or create change.

4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

6.P.1 Understand the properties of waves and the wavelike property of energy in earthquakes, light and sound waves.

6.P.1.1 Compare the properties of waves to the wavelike property of energy in earthquakes, light and sound.
PART I - HISTORY OF PROJECTORS

The first projector was called the magic lantern. It was invented in the 1600s by Dutch scientist, Christiaan Huygens, using a candle, a convex lens, a concave lens, and a small painting. According to Wikipedia, “the magic lantern used a concave mirror in the back of a light source to direct the light through a small rectangular sheet of glass—a ‘lantern slide’ that bore the image—and onward into a lens at the front of the apparatus.”

Watch the video by The Henry Ford below to learn more about the history of the magic lantern.
PART I - HISTORY OF PROJECTORS

According to David Aleksanderson in *A Short History of Projection*, “the first movie projector was the Zoopraxiscope, by the pioneering British photographer Eadweard Muybridge in 1879. To create motion, the Zoopraxiscope rapidly projected images from rotating glass disks. But it was the Lumière brothers who invented the first really successful movie projector based on the work of the French inventor Léon Bouly: the cinematograph. This was a film camera, projector and printer in one.”

Inventors continued to update the model with the invention of the film projector, overhead projector, document camera, and digital projector. Your teacher uses a digital projector today to project images on your SMART Board or Prometheum Board in your classroom. Projectors no longer need pictures painted on slides or reels; the image is sent directly from a computer.
CLICK THE IMAGE ABOVE TO WATCH THE WORKSHOP

Now that we know the history of projectors, let’s learn how projectors use light. Watch the video above that features the Gaillard Center’s Exhibition Hall Technical Supervisor, Hunter Laird.
PART II - VIDEO WORKSHOP

As mentioned in the video, light is energy coming out of the projector which bounces off the wall and goes into your eyes. Projectors use a **convex lens** to bend light and create a large, or magnified, version of an image. **Convex** means the object has a surface like the inside of a sphere.

Light in a projector is produced with a lamp. We choose what colors and shapes to send out into the world with images, and the projector sends that image through a convex lens. The light energy reflects off of a surface and into your eyes.

Now consider the surface on which an image is projected. Is it **reflecting** the light to our eyes? Is the surface **absorbing** the light or **refracting** the light? Projector screens are white for a reason. White screens reflect the light so that it bounces back to our eyes. If we projected an image on a black screen, it would absorb the image, and our eyes would see nothing.

For example, when you go outside, the sunlight shines on an object. That object absorbs some colors and reflects other colors into your eyes, and that’s what you see.
PART III - EXPERIMENTS

Before you begin the experiments, you will need a science notebook. Use your science notebook to document the scientific process for each one of the experiments. Include one drawing of each experiment in your science notebook as part of your response.

1. Ask a question: what are we trying to find out?

2. Gather information and observe: what do you know about this topic?

3. Make a hypothesis: what do you think will happen?

4. Experiment and test your hypothesis.

5. Analyze your test results.

6. Present a conclusion: what happened? Was your hypothesis correct or incorrect? What did you learn?
PART III - EXPERIMENTS

Experiment 1 - Make Your Own Projector

With simple items, you can make a projector on your own. This projector will show you how the lens works in a real projector and how different colors and materials absorb, reflect, or refract light. For this experiment, use your smart device as a source of light rather than a bulb, like in a projector. Use your magnifying glass as your lens. The video from your smart device will travel through the lens and project onto the wall.

Instructions
1. On one of the short ends of your shoebox, cut out a circle that fits your magnifying glass. Tape your magnifying glass over the circle.
2. Place your smart device on the other end of the box facing towards the magnifying glass. Note that your box needs to fit your smart device, so if you are using a tablet or laptop, you will need a larger box.
3. Move your smart device back and forth until the projection is focused. You will need to add a prop or something to hold your device up inside the box.
4. Play a video from your device (you may need to lock the screen to keep it from rotating).
5. Close the box so no light enters other than from the magnified side.
6. Project the image on a wall in a dark space. You may need to move your smart device forward or backward to focus the image.
7. Put the projection on a dark piece of paper or wall. Did the dark color absorb the light? Now try a light-colored wall and then a mirror or piece of glass. Testing your projection on different materials helps you understand how light is absorbed and reflected when it hits an object. The lens (magnifier) on your projector is bending the light as it passes through, which is refraction. That is why the screen looks larger.
8. Keep playing around with this. Once you get it just right you can project movies for your entire family!
9. Write about it in your science journal.
PART III - EXPERIMENTS

Experiment 2 (optional)
Make Your Own Magnifying Glass

**Instructions**

1. On the top of the soda bottle, cut out two large circles. You have to do it on the curve of the soda bottle towards the top so that your circles are convex and fit together.

2. Fit the two circles together so that you create a flattened sphere shape.

3. With your hot glue gun, glue the sides or seams of the circles to one another. Leave a space at the top so that you can fill the flattened sphere with water.

4. Fill the flattened sphere with water and then hot glue the remaining opening. Check for leaks by spinning the disc around. Repair any leaks.

5. Test out your magnifying glass over a piece of paper with writing. See how the light bends through the disc and makes the words appear larger?

**Supplies:**
- Clear soda bottle
- Scissors
- Hot glue gun
- Water
Hunter Laird has been in the live events, IT, and A/V industry for over sixteen years. He started his career in a TV broadcast studio where he learned the art of recording audio and information technology. From there, he pursued a career in A/V systems integration installing sound, lighting, video, and rigging systems all over the Southeastern United States. Permanent A/V installations progressed into temporary setups, and live events were his new passion. He has managed many events ranging from presidential rallies, festivals, and weddings; he continues to progress his career at the Charleston Gaillard Center.

**Research for this lesson plan:**
https://newsandviews.dataton.com/a-short-history-of-projection

**Photos for this lesson plan:**

- Magic Lantern: https://etc.usf.edu/clipart/4300/4396/magic-lantern_1.htm
- Zoopraxiscope: https://commons.wikimedia.org/wiki/File:Zoopraxiscope_16485u.gif
- Overhead Projector: https://commons.wikimedia.org/wiki/File:OHP-sch.JPG
- Lumière: https://commons.wikimedia.org/wiki/File:Institut_Lumi%C3%A8re_-_CINEMATOGRAPHE_Camera.jpg
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