IMHOTEP'S LEGACY ACADEMY

7.8 Seeing is Believing (Making a "Hologram" Projector)

Grade 7 Activity Plan

Reviews and Updates

- Hologram & Optical Illusion activity added by Fola Akpan in July 2017
- Background information updated by Fola Akpan in July 2017

7.8 Seeing is Believing ("Hologram" Projector)

Objectives:

1. To demonstrate that light needs to be reflected off of particles in order for us to see it
2. To show that light travels in straight lines and in all directions
3. To demonstrate that images are projected upside-down onto our retinas
4. To demonstrate how reflection and refraction create 'holographic' images
5. To demonstrate how the brain processes the information that comes from our eyes

Keywords/concepts: light, photon, lens, optical illusion, perception, 3-D image

Take-home product: Mini Phone Holograms, Paper Optical Illusion

Segment	Details
African Proverb and Cultural Relevance (2 min.)	"When the moon is not full the stars shine more brightly." **Buganda, Uganda.**
Pre-test (2 min.)	What is essential to sight? Introduce light and how important it is to sight. Ensure everyone understands the concept of a photon, and the speed at which light travels.
Demo 1: How is light seen? (3 min.)	Using a laser pointer and chalk dust, demonstrate how light is seen and the path it travels.
Demo 2: How does light travel? (5 min.)	Cover a lamp with black construction paper, and make various pinholes to observe the manner in which light travels
Demo 3: How is light reflected? (5 min.)	Using a garbage bag and can, demonstrate how images are reflected upside down onto our retinas
Activity 1:Making Hologram Projector (15 min.)	Use a clear presentation folder to create a holographic image with a phone
Activity 2 (20 min.)	Using paper to create optical illusions
Post-test (5 min.)	Lead students in completion of a Cross-word Puzzle

Suggested interpretation of the proverb: When something goes wrong, pick up the slack.

BACKGROUND INFORMATION

Light is nature's way of transferring energy through space. Light travels very rapidly, but it does have a finite velocity. In a vacuum, the speed of light is 186,282 miles per *second* (or nearly 300,000 kilometres per second). Physics experiments over the past hundred years or so have demonstrated that light has a dual nature. In many instances, it is convenient to represent light as a "particle" phenomenon, thinking of light as discrete "packets" of energy that we call *photons*. The other way of representing light is as a *wave* phenomenon. An analogy is sound waves. High pitched notes have shorter *wavelengths*, or distances between each successive wave. Likewise, blue light and red light are both just light, but the blue light has a higher frequency of vibration (or a shorter wavelength) than the red light.

View 9.7- Background information for the science of refraction.
View 7.2 Background information for how the science of how eyes see

A **hologram** is a 3-Dimentional image created by interference patterns of light beams. The "hologram" projector in this activity is not an actual hologram, but is an optimal illusion called **Pepper's Ghost.** The transparent material has a different **refractive index** than the air around it. When the light reaches the new medium, some of the light is refracted. The 'holograph' videos use the refractive properties of light to create a image that appears to be 3-D. The videos use the 4 perspective of the same object to trick the brain into interpreting the reflections as a 3-D object. The information from our eyes travels through the optic nerve to the visual cortex in the occipital lobe of the brain (back). **Visual illusions** occur when there is a disassociation between physical reality and the perception of an object.

Additional Information & References
Explaining the Pepper's Ghost Illusion
https://www.comsol.com/blogs/explaining-the-peppers-ghost-illusion-with-ray-optics/

How Smartphone 'holograms' work
https://www.quora.com/How-do-smartphone-holograms-work

The Neuroscience of illusion
https://www.scientificamerican.com/article/the-neuroscience-of-illusion/

The science of perception
http://www.wired.co.uk/article/optical-illusions-science-perception

Optical Illusions
http://www.optics4kids.org/home/content/illusions/

More Anamorphic Illusions
https://www.youtube.com/watch?v=GIvD-_ITco8

Demo 1: How is light seen?

Purpose: To demonstrate that light needs to be reflected off of particles in order for us to see it

Item	**Quantity (for mentor)**
Laser Pointer	1
Chalkboard Eraser	1

Procedure:

1. **Shine a laser** at a wall. Show students how they can see where the light begins at the source and where it ends on the wall, but not the path the light travels.
2. Demonstrate how to **show the path** of the laser by getting *a* student to clap two chalk board erasers together to make a dust cloud around the laser beam. The path of light now becomes visible. Why?

Demo 2: How does light travel?

Purpose: To show that light travels in straight lines and in all directions

Item	**Quantity (for mentor)**
Lamp with shade	1
Black Construction Paper	1
Pin	1

Procedure:

1. **Draw** both a curvy and straight line on the board, and ask students to choose the one *that is the shortest*.
2. **Cover lamp shade** with black construction paper.
3. To demonstrate that light travels in a straight line, **poke holes** in the construction paper with a pin. Darken the room and look at how light shines through the pinholes.

Demo 3: How is light reflected?

Purpose: To demonstrate that images are projected upside-down onto our retinas

Suggested format: Mentor demonstrates first, and then invites students to come try for themselves

Item	**Quantity (for mentor)**
Black garbage bag attached to can	1

Procedure:

1. Hold the can in one hand about a foot away from your face, so that the flat screen is facing you, and the hole is pointed towards a light source (a window works well).
2. Turn off the lights.
3. Place the garbage bag over your head to block other light sources, and observe the image that appears on the screen.

Activity 1: Making a Hologram Projector

Source: https://diyhacking.com/diy-hologram/

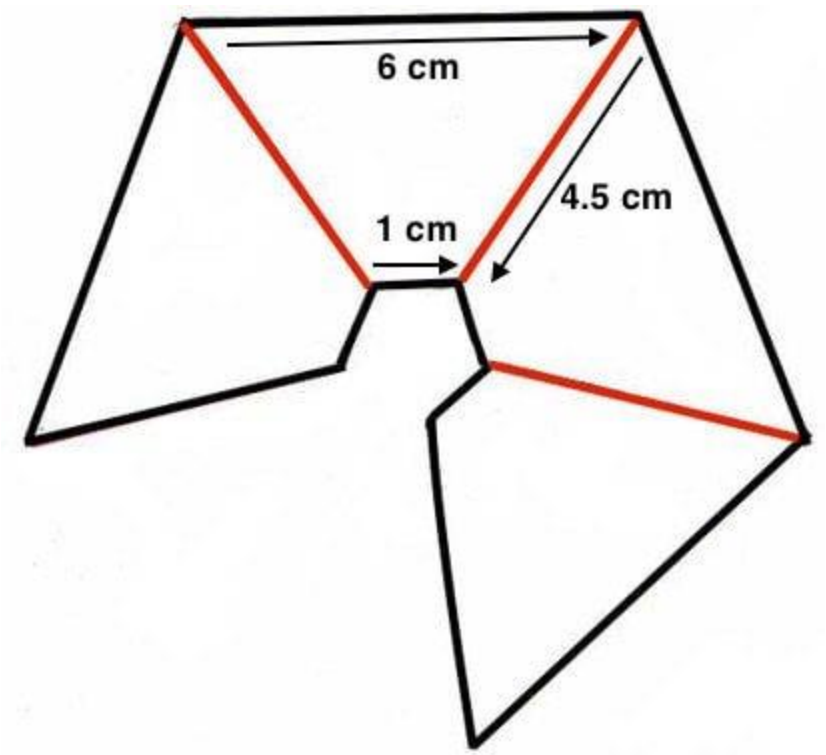
Purpose: To demonstrate how reflection and refraction create 'holographic' images

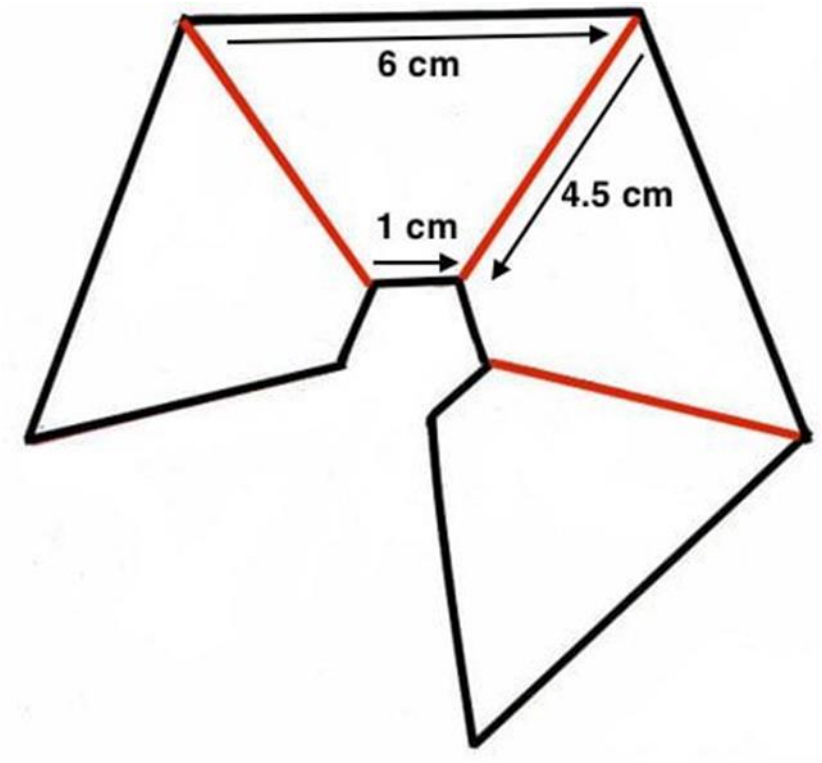
Item	**Quantity (10 Students)**
Clear Presentation Folders	5
Clear Tape	2 Packs
Scissors	10
Paper	10
Pen or Marker	10
Ruler	10
Phone	1

Procedure:

1. Print out the hologram template
2. Trace the hologram template onto the clear plastic part of the presentation folder with a pen and a ruler to ensure that the edges are as close to the template as possible
3. Cut out the traced out plastic
4. Using one of the scissor blades, score the edges of the pyramid and bend the plastic into the pyramid shape
5. Tape unattached edge of the plastic
6. Place the hologram projector onto the phone and play one of the following hologram videos

https://www.youtube.com/watch?v=NLTqazgsSBM
https://www.youtube.com/watch?v=W68LvwRLjv4
https://www.youtube.com/watch?v=ASX_d0H0HYw


6 cm
4.5 cm
1 cm


6 cm
4.5 cm
1 cm

Activity 2: Viewing & Creating Optical Illusions

Purpose: To demonstrate how the brain interprets and processes the information coming from our eyes

Suggested format: Work individually

Item	**Quantity (10 students)**
Paper	1 Pack
Rulers	10
Pencils	10
Markers	2 packs
Laptop	1

Procedure:

1. Pick one or two of the optical illusions for the kids to create using the paper, markers and rulers

DIY 3-D Ladders
https://www.youtube.com/watch?v=PidKqNjTWM8

Anamorphic hole
https://www.youtube.com/watch?v=KnZQYXPJnXU
https://www.youtube.com/watch?v=B9Ke7GvPCVc

Floating Letter A
https://www.youtube.com/watch?v=JafeTxLUq8Q

Optical Illusion Triangle
https://www.youtube.com/watch?v=ZW0evfflxEM