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Poking Fun at Science: The Basic Set-Up

Create tools for investigating pinholes, light, color and art

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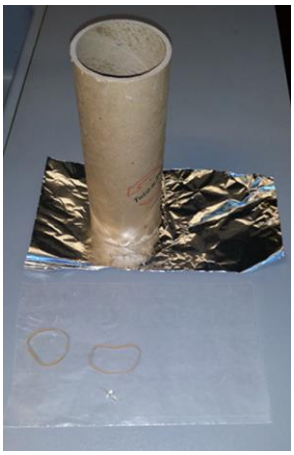
Recommended Grade Level: 3rd -12th grades

NGSS Science & Engineering Practices:
- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and Interpreting data
- Using Mathematics and Computational Thinking
- Designing solutions

Time: 15 minutes prep, 45 minutes activity

The Basic Pinhole Viewer:

Materials:
- A cardboard tube (i.e. inner cardboard tube from a roll of paper towels, toilet paper, gift wrapping paper, aluminum foil, wax paper, etc…)
  Other sources may include:
  Poster tube, PVC or ABS pipe (2 or 3" diameter)
  Lengths of tubing should be cut approximately 15 to 30 cm long
- 2 Rubber bands
- Aluminum foil
- Wax paper (or white translucent plastic bags)
- A pushpin
- A room you can darken
- Optional:
  - 1 sheet of black construction paper
  - 2 more rubber bands



The Basic Multi-Colored Light Source:

Materials:
- Red, Green, and Blue (RGB) light bulbs one of each color.
  You can use various bulb options:
  - Colored incandescent bulbs
  - Colored Compact Fluorescent bulbs
  - Colored LED bulbs
  - Or white bulbs wrapped in colored filters
- 3 screw-in light sockets
- A power strip with at least 3 plugs
- A power outlet
- Optional: 3 dimmer sockets

Background Information:

Build a simple camera obscura, also known as a pinhole viewer, and a multi-colored light source (RGB). Use these tools to investigate, experiment and learn about a variety of concepts.

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Look for the associated activities:

1. **Poking fun at Science: Light Rays and Pinholes**
2. **Poking fun at Science: Math with Pinholes**
3. **Poking fun at Science: Color Mixing**
4. **Poking fun at Science: The Art of Pinholes**

Assembly - the pinhole viewer:

1. Cut the wax paper and the aluminum foil to a size a little larger than the end of the tube.
2. Place the cut sheet of aluminum foil over the end of the tube and secure it with a rubber band.
3. Place the cut sheet of wax paper over the opposite end of the tube and secure it with the other rubber band. Care should be taken to keep the waxed paper as smooth as possible; this will be your viewing screen.
4. Optional:

   For better viewing, you might want to shade your viewing screen (wax paper). This can be done by rolling a sheet of black construction paper over the device at the end with the wax paper. Allow the black paper to overhang the device by at least 10 cm. Secure the black paper around the tube with rubber bands.

Assembly - the multi-colored light source:

1. Screw the bulbs in their sockets.
2. Plug in one, two or three bulbs into the power strip.

To Do and Notice:

1. Poke a single hole in the center of the foil with the pushpin.
2. Turn on your light source
3. Turn off the room lights.
4. Now veiw the lights:
   a. Point the alumnim foil side of the device towards the colored light bulbs (as described above) or point it towards a well lit scene (a window or doorway facing the daylight).
   b. Hold the device so that the wax paper end is facing you. Hold it about 20 cm away from your eyes.
   c. View the wax paper as though you were looking at a small TV screen.
5. You're ready to start exploring.

What's Going On?

Pinholes create images that are interesting and unexpected. Before explaining what's going on here, please follow the links to the following activities:

1. **Poking fun at Science: Light Rays and Pinholes**
2. **Poking fun at Science: Math with Pinholes**
3. **Poking fun at Science: Color Mixing**
4. **Poking fun at Science: The Art of Pinholes**

Each activity listed above will have it's own "What's going on?" section.

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Going Further:
Light passing through a pinhole produces amazing effects. Besides showing you the fundamentals of how pinholes work, the set of associated activities (see above) will help you address many key NGSS science & engineering practices (see the beginning of this document). A pinhole viewer (also known as a camera obscura), is a good starting point for many scientific inquiries and engineering challenges.
What discoveries did you make with your viewer? What problems did you encounter while making it? What new questions do you have after looking through the viewer? How can you pursue your question? What data will you need? How can the viewer be improved to better achieve a desired goal?

To begin your journey into pinhole explorations, check out: **Poking fun at Science: Light Rays and Pinholes**.

References:

Making a Pinhole Viewer – by the Exploratorium: Institute for Inquiry, 1998
http://www.exploratorium.edu/ifi/activities/pinholeinquiry/viewer.html

Pinhole Images --- What's Happening Here?
http://www.exploratorium.edu/ifi/activities/pinholeinquiry/images.html

Camera Obscura – by Zeke Kossover of the Exploratorium Teacher Institute

Colored Shadows – by the Exploratorium Teacher Institute
http://www.exploratorium.edu/snacks/colored_shadows/

Pringles® Pinhole – by the Exploratorium, 1998
http://www.exploratorium.edu/science_explorer/pringles_pinhole.html

Personal Pinhole Theater – by Eric Muller of the Exploratorium Teacher Institute
http://www.exo.net/~emuller/activities/personal_pinhole.pdf

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Modesto Tamez first showed me a variation of this activity in 1994 (Way to go Modesto)!