

## Poking Fun at Science: Color Mixing

Get colorfully enlightened with enlarged pinholes

**Recommended Grade Level:** 3<sup>rd</sup>-12<sup>th</sup> grades

### NGSS Science & Engineering Practices:

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and Interpreting data
- Designing solutions

**Time:** 5 minutes prep, 45 minutes activity

### Materials and Assembly:

- Please refer to the activity **Poking Fun at Science: The Basic Set-Up** for materials, assembly and basic operation of your device.
- Print the simple table on the next page to collect and record your data.

### Background Information:

By using a pinhole viewer and a red, green and blue light, mix colored lights together. Red, Green and Blue (or RGB) color perception is the basis of how we perceive color. Use your pinhole viewer to conduct a simple scientific investigation into color perception. Collect real data to understand how we see color.

### To Do and Notice:

1. See **Poking Fun at Science: The Basic Set-Up** to see how to create your apparatus.
2. On the foil side of your pinhole viewer, use a pushpin to tear a single hole in the center of the aluminum foil.
3. Enlarge the hole with your finger. The hole shouldn't be larger than a few centimeters. It can be ragged or circular.
4. Turn on 2 lights on your light source.

Try one (and eventually all) of the following light combinations:

- a. Red and green



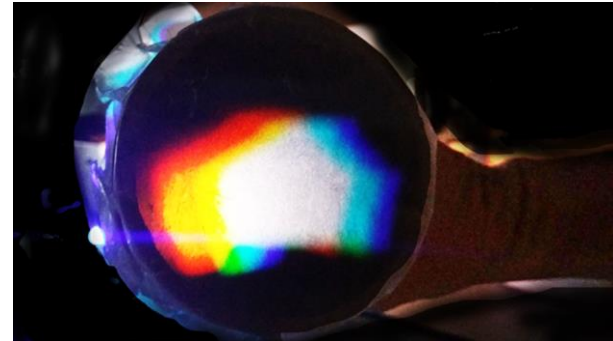
- b. Red and blue



- c. Green and blue

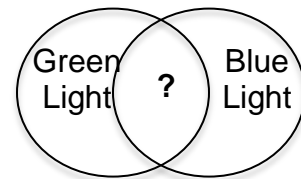
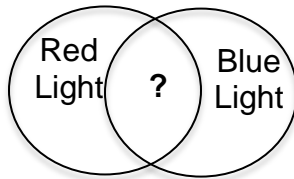
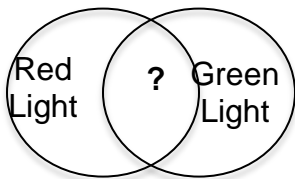


5. Turn off the room lights.
6. Point your pinhole viewing device at the lights so that the foil (and large hole) are pointed towards the lit bulbs.
7. View the wax paper screen.
8. Now, try to get the two colors of light to overlap. It might help if you:
  - a. Walk around the lights.
  - b. Hold your device closer or further from the light source.
  - c. Rotate your device in your hand.
  - d. Rotate the light source.



e. Or, make your hole even larger.

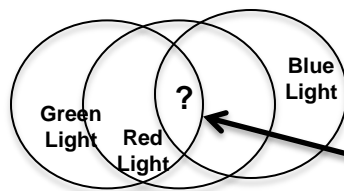
9. What do you see where the images of the colored bulbs overlap? Fill in the table below.



Color of Bulb 1		Color of Bulb 2		Color of light at overlap
Red	+	Green	=	
Red	+	Blue	=	
Green	+	Blue	=	

10. Take a guess...what will you see if all three colored lights overlap: Red, Green and Blue?

11. Try it and record your observations!



Color of all three lights at overlap

Color of Bulb 1		Color of Bulb 2		Color of Bulb 3		Color of light at overlap
Red	+	Green	+	Blue	=	

### What's going on?

Did the combinations surprise you?

It turns out, you only have three color receptors in your eyes: one for Red, Green and Blue (RGB)...that's it! These receptors, located in the back of your retina are called cones.

All the colors you see are caused by light of a certain wavelength stimulating one, two or all three of your RGB cones. When these cones are stimulated, a signal is sent to your brain, you process it and you perceive color. Depending on how much stimulation each of your RGB cones receives, you interpret a different color.

- We don't have yellow cones in our eyes. Although there is such a thing as yellow light (or a wavelength that corresponds to yellow), your eye-brain system causes you to perceive yellow when your red and green cones are stimulated.
- We don't have magenta (or purple/pink) cones in our eye. Your eye-brain system totally makes this color up when your red and blue cones are activated.
- We don't have a Cyan (or aqua blue/turquoise) cone...again this color is made up in our heads by light activating your blue and green cones.
- Overlap and activate all three cones and what do you see? White light! That's the way our eye-brain system works!

**Going Further:**

Many major technologies rely on our ability to perceive all the colors of the spectrum by only using RGB lighting. Investigate this! Try dimming down one or more of your RGB lights. Can you make other colors?

Did you notice that as the pinhole got bigger, the image got brighter, but also blurrier? Is there a better way to get a bright and sharp image? Try some other designs with your viewer and bulb apparatus.