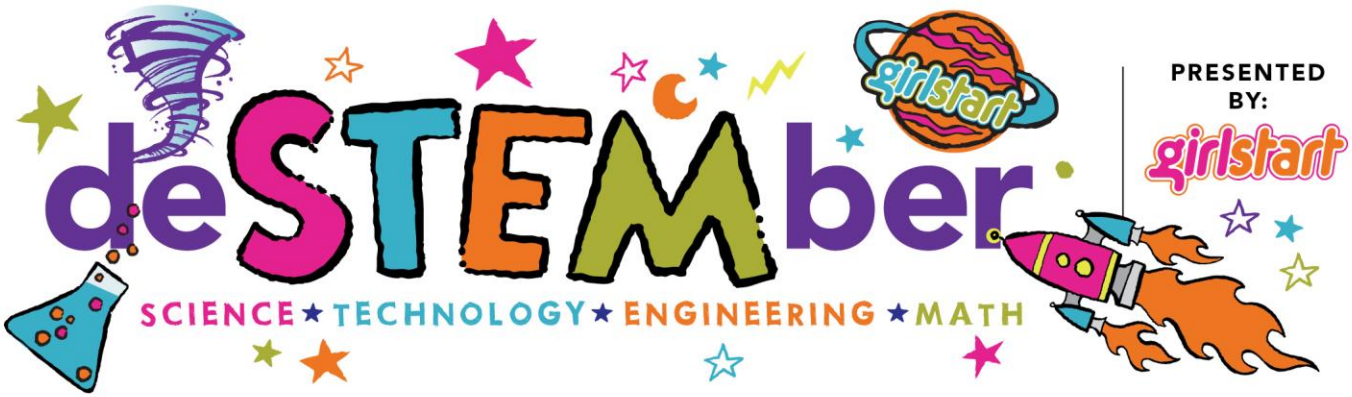

Color Mixing

Have you ever been to a show and seen colored lighting? Make your own colored gel lighting overlays to explore what happens when you add or subtract a particular color gel. Determine the best colors to make your very own light show!

TEKS:

5.4A: Classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy.
5.6A: Explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy.
5.6C: Demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another, and demonstrate that light can be reflected, such as the use of mirrors or other shiny surfaces, and refracted, such as the appearance of an object when observed through water.

Materials:

- At least 2 moveable light sources (3 if possible; clip on lights or lights with a goose neck work best)
- Food coloring (red, green, and blue)
- Small pot (and stove for heating up the pot)
- Smooth, flat plastic surface with a lip*
- Spoon for mixing
- Tablespoon for measuring
- Unflavored gelatin (or Knox gelatin envelopes)
- Water

* Note: The plastic surface is for pouring the liquid gel onto to make the gel molds. Some options for this are:

- A plastic lid such as a coffee can lid; however, it should be completely flat in the middle (non-imprinted).
- A petri dish

How To:

1. Add 3 tablespoons of water to the small pot.
2. While gently stirring the water, sprinkle in 1 tablespoon of unflavored gelatin (or one packet of Knox gelatin envelopes).
3. With adult supervision, place the pot on the stove and turn the heat on low. Stir *very gently* until the gelatin is melted. **Stirring too vigorously will form bubbles that will cloud your lighting gel.**
4. Once all the gelatin has melted, turn off the heat and add your desired food coloring. Be generous with the food coloring. More is better as you want a good solid color! (Note: If using *gel* food coloring, make sure it melts completely — you may need to turn the heat back on low to melt it.)
5. Tilt the pan to one side and use a spoon to skim off any foam or bubbles that have formed.
6. Before pouring the liquid gel into the plastic mold, allow it to cool slightly. You do not want it to melt the plastic!
7. Once the gel has cooled but is still liquid (hasn't begun to thicken), pour a small amount onto your plastic mold.
8. Working quickly, tilt your mold gently in all directions to spread out your liquid gelatin into a thin, even surface. Be careful not to burn yourself — the gelatin will be hot!
9. Repeat the above steps for each different colored gelatin sheet that you wish to make (red, blue, and green).
10. Before handling the gelatin sheets, you will need to let them dry overnight. If you put the sheets under (or next to) a fan turned on low, the sheets will dry faster, and you may be able to handle them in a few hours. However, the thicker the layer of gelatin that you pour, the longer it will take to dry. **Don't rush the process by putting them in a fridge or freezer, as this will make the sheets overly brittle.**
11. Clean your supplies.
12. Once dry, peel your gelatin sheets away from the plastic. Using scissors, cut them into a shape/size that can serve as a filter for your light sources.
13. Now you are ready to experiment with color mixing! Start with two colored gels and two light sources. Cover each light source with one of the colored gels. You can tape them on the lights, but be careful that the light doesn't become too hot as it will melt your gel. Once the lights are covered, turn them on and shine them both at the center of a piece of white paper or at the same spot on a white wall. You want the colored lights to overlap on the white surface. (Note: You will need to turn off all other light sources in the room to see the colors produced by your gel-covered lights.) What color is produced? Experiment with using different colored gels as filters. Record your observations in the chart below.

Colored Gel Combinations *Each gel covers a *separate* light source	**Color Light Produced**
Red + Green	
Red + Blue	
Green + Blue	
Red + Green + Blue	

14. Now try experimenting with stacking the colored gels over one single light source! Tape a red gel and a green gel over one light. Shine the light at a piece of white paper. What color do you see? Try the combinations in the chart below and record your observations.

Colored Gel Combinations *Gels *stacked* over *1* light source	**Color Light Produced**
Red + Green	
Red + Blue	
Green + Blue	
Red + Green + Blue	

STEM Explanation:

Red, green, and blue are the primary colors of light. Combining the three primary colors of light in different proportions can produce any color. In this lesson, when you combined the red and blue filtered light, you produced magenta light. When you combined the blue and green light, you produced cyan. When you combined the red and green light, yellow light should have been produced. Finally, when you combined red, blue, and green light, white light was produced. This is known as additive color mixing. Did you know that computers and TVs only use pixels that emit red, green, and blue light? Our electronics use additive color mixing to produce all of the colors we see on our screens. The white areas of our screens are the places where red, green, and blue light is being emitted at the same time.

Mixing colored lights is different from mixing pigments to make paint. Everything we see that isn't a source of light is actually reflected light! For example, when we look at yellow paint, the pigment is absorbing blue light and reflecting green and red light to make yellow reflected light. So when we see something that is yellow, we are actually seeing green and red reflected light. The more pigments you mix, the more light is absorbed (or subtracted), and the darker the colors that are produced. Mixing pigment colors is known as subtractive color mixing. The three primary colors of pigment are magenta, cyan, and yellow. If you mix the three primary colors of pigment, all light is absorbed and the resulting color is black. You demonstrated this when you stacked your colored gels on top of one another, and no light was allowed to pass through. If you shine a light through a red filter, the red filter allows the red wavelengths of light to pass through, but absorbs all the other colored wavelengths of light. So if you stack a red filter and a green filter together, the red filter will block all light except the red light. The red light will pass through, but then it will be absorbed by the green filter (which would only allow green light through), so no light passes through.

Career Connection:

When you go to a play, a *Lighting Designer* creates different moods by using different colored lights. Red light might make you feel anxious or scared, while blue light can create sadness or a feeling of peacefulness. When creating a lighting design, the lightning designer has to consider not just the story line, but also things like safety, visibility, and cost. In addition to theater, lighting designers can work in areas as diverse as rock and pop tours, corporate launches, art installations, and massive spectacular celebrations like the opening and closing ceremonies for the Olympics. Lighting Designers need to have a strong background not only in art, but also science and math.

Resources:

Courtesy of Topher Stumreiter
Making clear Gelatin sheets: http://www.howtocakethat.com/edible-gelatin-plastic.html
CMYK vs RGB Diagram: http://imulus.com/our-thoughts/additive-color-vs-subtractive-color/