Understanding Light & Color
Part 2: Predicting the Colors Absorbed by Objects

Background
We can analyze the spectrum of light produced by an object emitting EMR, like the sun or an LED bulb. We can also consider the spectrum of light reflecting off an object.

When light hits an object, the atoms/molecules in that object absorb certain wavelengths. Other wavelengths do not interact with the atoms/molecules and are reflected back.

When we look at an object, we see the light that is reflected off of it. The object will appear a particular color based on what colors are reflected back to our eyes.

Pre-lab Questions
1. In Part 1 of this lab, we could not look directly at the sun with our spectroscopes, because this could harm our eyes. Therefore, we looked at the sunlight reflected off a white object, like a cloud or piece of paper. What colors of sunlight are reflected off a white object? How does your brain interpret these colors?

2. What colors of light do you think a black object reflects? What colors of light will a black object absorb?

3. For an object to appear red under natural sunlight, what colors do you think it absorbs?

Objectives
• Can you determine how the color of an object will change based on the colors of light illuminating it?
• Can you make a reasonable prediction of what colors are being reflected, and what colors are being absorbed by different objects?

Materials
• Color changing LED light source
• Set of objects of 8 different colors
Procedure
1. Each group of students will receive 8 objects of different colors – white, black, red, orange, yellow, green, blue, and violet. Students should line up their objects near the LED bulb, but not directly in front of it. If too much LED light hits the object, the results will be more challenging to interpret compared to when the objects are illuminated by diffuse light.
2. When instructed by the teacher, turn your LED bulbs to red.
3. Record the appearance of each of the eight objects under red light in Table 2.
4. When the teacher directs, turn your LED bulb to orange. Record the appearance of each of the eight objects under orange light in Table 2.
5. Take a moment to consider the results using red and orange light. In Table 2, predict what color each object will appear under yellow, green, blue, and violet light.
6. Complete the experiment, changing the LED to the following four colors and recording the color of each object.

Analysis
1. In Table 2, use a grey color pencil to lightly shade all of the boxes that report “black” as a color so they can be easily seen.

2. a. How will a red object appear under red light? Why?

b. How will a red object appear under green light? Why?
### Data

Table 2. Color of various objects under different LED light settings

<table>
<thead>
<tr>
<th>Color of Object Under White Light</th>
<th>Observed Color for Various LED Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>actual</td>
</tr>
<tr>
<td>White</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>Violet</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

1. When an object appears black in a certain lighting condition, what is happening to the light illuminating the object? Why does it appear black?

2. Our LEDs use red, green, and blue light emission to produce a variety of colors of light. For example, to produce orange light, both red and green light is emitted from the LED.
   
   a. Explain how additive color, as explained above, relates to the blue appearance of a “blue object” under violet light?

   b. Explain how additive color relates to the black appearance of a “red object” under cyan light.

3. On Day 1 we looked at three pieces of paper under green light and predicted their color. Use Table 3 to update your prediction.

   Paper 1 –
   Paper 2 -
   Paper 3 –

   ***Once all students have submitted Part 2, the three color papers will be viewed with white light and the true colors revealed to the class***

4. Can you determine how the “color” of an object will change based on the color of light illuminating it?