Name: ______________________

Understanding Light & Color
Part 1: Emission Spectra of Different Light Sources

Background
Visible light is a range of wavelengths of electromagnetic radiation (EMR) capable of being detected by the human eye. Visible light ranges from low energy red light (700 nanometers) to high energy violet light (400 nm).

Objects emit, or give off, energy as EMR. Sunlight, for example, is an emission of infrared, visible, and ultraviolet light. Infrared and ultraviolet are outside of the visible spectrum. Other forms of EMR outside of the visible spectrum include microwaves and X-rays.

A spectroscope is a tool that can separate the different colors of visible light, and show the intensity of each color. Classroom spectroscopes use a diffraction grating to separate the light.

Pre-lab Questions
1. Name some common objects that separate visible light into different colors.

2. Predict how the spectrum of sunlight will appear with a spectroscope.

3. Predict the spectra of red light and orange light produced by an LED.

4. Your teacher held up three pieces of paper. Record your personal prediction of the color of each paper:
   
   Paper 1 –
   Paper 2 –
   Paper 3 –
Objectives
What colors/wavelengths are present in sunlight?
What colors/wavelengths are emitted by a multicolor LED bulb at different color settings?

Materials
• Spectroscope
• Color pencils
• White paper
• Multicolor LED light source and remote control

Safety
• Never look directly at the sun, even with a spectroscope.

Procedure
1. Go outside with your teacher and use a spectroscope to determine the spectrum of sunlight. Look at the sunlight as it is reflected off a piece of white paper, or off a cloud. NEVER look directly at the sun.

2. Record your observations in Table 1 below. Include as much detail as possible. Use color pencils to show the colors of light, and vary how much color you use to show intensity.

3. Now your teacher will darken the classroom and instruct you to use the remote control to turn ALL of the LED lamps to red.

4. Look at the red light with the spectroscope, and record the spectrum in Table 1. Draw in bars of appropriate color and intensity. Make sure to line up the color bands with the wavelengths labeled at the top of the table.

5. In the “peak intensity” column, indicate which one or two colors are the brightest and strongest.

6. When your teacher indicates, change color. Go down the colors of the remote control, from red to orange, orange to yellow, etc. as instructed. It is best if all of the LEDs in the room are set to the same color at the same time.

7. Repeat Step 6, using the spectroscope to observe and draw the spectrum of each of the colors in Table 1.

8. Turn off the LED light bulbs and turn on the classroom lights. Record the type of lights and their spectrum in Table 1.
# Data

## Table 1. Emission Spectra (nanometers)

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>700</th>
<th>650</th>
<th>600</th>
<th>550</th>
<th>500</th>
<th>450</th>
<th>400</th>
<th>Peak Colors</th>
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</table>

* For safety, sunlight must be reflected off a white object

## Analysis

1. Look at your results in Table 1. If a light appears violet, is it always true that a significant amount of violet wavelengths are being emitted? Explain why or why not.

2. 
   a. Which LED colors come from mainly one wavelength band?
   
   b. Additive colors are colors produced by combining light of different colors. What colors are additive colors?
Conclusion

1. In Pre-lab Question #3, you made a prediction about the spectrum of orange light produced by the LED bulb. Was your prediction correct? How did your prediction vary from your observations?

2. Orange is an example of additive color. The following diagram can be used to summarize additive color using the RGB (red, green, blue) color model. Please color it in, and label the colors in each region. Use Table 1 to decide which colors go in each region.

3. You recorded the emission spectrum of your classroom lights. What type of lights are they? Research how LEDs produces light, and how your classroom light bulbs produce light. Describe the two processes below, in your own words.