Name:
Group Members:

Lab 2

There are four sets of activities in this lab. Unfortunately, there is not enough equipment for everyone to work on the same lab activities at once, so about half the groups should start with the "Intensity" activities (in Room 322) and about half should start with the "Spectra" activities (in Room 324, hallway, and Room 325).

I. **Intensity:**

Taking place in Room 322. Each group needs a flashlight and some measuring sticks.

(A) **Intensity and Distance:** Flashlights don't exactly follow the inverse square law (their optics are designed to reduce the tendency of light to spread, so as to provide a strong forward beam), but you can still get a sense of the effect here. The idea is that as light spreads out it gets less intense.

Have one person hold a meter stick against the wall while another shines a flashlight at it, standing roughly 10 cm to 20 cm from the wall. Depending on your flashlight, make sure you are far enough away so that you get a nice circle defining the center of your beam, rather than any combination of individual LEDS.

1. Measure the diameter of the circle, then the distance from the flashlight to the wall. Enter your measurements in the first line of Table 1, and calculate the area of the circle of light.

Distance from Wall	Diameter of Light Circle	Area of Light Circle

Table 1: Table of light circle measurements.

2. Take a few steps back until the circle of light on the wall is noticeably less bright. Repeat your measurements from before and enter them in the second line of Table 1.
3. What is the ratio of the diameter of the larger circle to the diameter of the smaller circle?

$$\frac{\text{Diameter of Larger Circle}}{\text{Diameter of Smaller Circle}} =$$

4. What is the ratio of the area of the larger circle to the area of the smaller circle?

$$\frac{\text{Area of Large Circle}}{\text{Area of Smaller Circle}} =$$

5. Using the idea that **Total Power = Intensity** $\times$ **Area**, explain in a sentence or two why the circle of light on the wall gets larger and fainter as the flashlight gets further from the wall. (*Hint: Is the power the flashlight is outputting changing?*)

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(B) **Intensity and Angle:** Return to where you started the previous set of measurements. Shine the flashlight directly at the wall, and then tilt it so that light hits the wall at an angle.

1. Qualitatively, what happens to the circle of light as you tilt the flashlight? How does its shape change? How does its area change?

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2. Qualitatively, what happens to the intensity of the light hitting the wall? Where is it brightest? Where is it dimmest?

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3. How does your answer to (2) relate to the seasons and the change in temperature between summer and winter?

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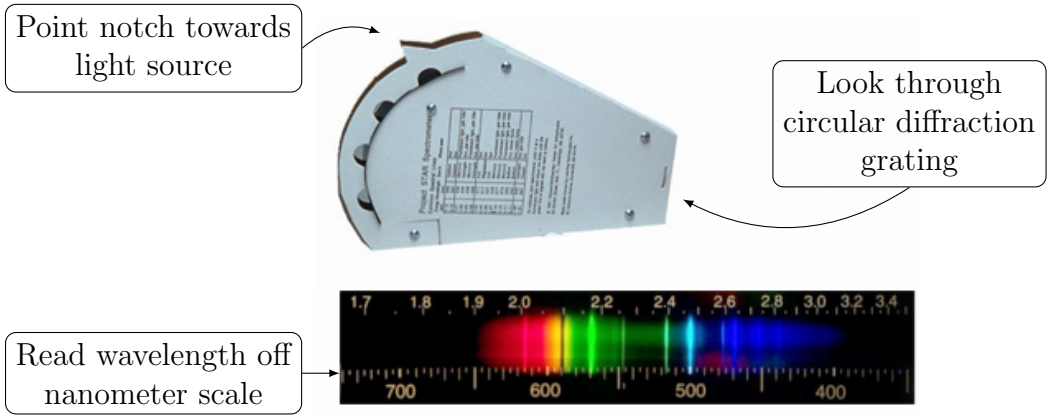
II. **Spectra:**

Taking place in Room 324 and the hallway. You will need a handheld spectrometer for some of these observations.

To use the spectrometer, point the "notch" at the light source you want to observe. This lets a small amount of light from the source through the slit below the notch.

The light is bent by the diffraction grating at the narrow end of the spectrometer, so that as you look through the grating, different wavelengths appear to originate from different points along the spectrometer's scale. You can read the wavelengths in nanometers off the lower scale.



(A) **Fluorescent Lights:** Use a handheld spectrometer (see image for instructions) to look at the fluorescent lights in the hallway or the circular (compact fluorescent) lights around the hearth. What are the wavelengths and colors of the 4 brightest lines you see?

Color	Wavelength

(B) **Power, Color, and Intensity:** The circular light fixtures in Room 324 have incandescent bulbs in them and are dimmable with the slider near the door. Only the circular lights should be on when making these observations.

1. With the lights at full brightness, look at one of the fixtures with the spectrometer. In what ways is the spectrum you see different from the spectrum of the fluorescent bulbs? Do you see individual lines?

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2. With just your eyes, no spectrometer, look at one of the light fixtures while someone slowly dims the light. How does the color of the light you see change as the light gets dimmer?

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3. Repeat the process of (2), but this time look through the handheld spectrometer. How does the spectrum you see change as the light is dimmed?

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4. What do you think is happening to the temperature of the filament in the incandescent bulb as the light is dimmed? How does this relate to our two radiation laws?

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(C) **Gas Tube Spectra:** Four gas tubes are set up in Room 325 and are labeled A,B,C, and D. One contains hydrogen, one contains helium, one contains mercury, and one contains neon.

Look at the lamps through the rainbow glasses (the ones with yellow frames), and use the descriptions of the spectra on the next page to identify which gas is in which lamp.

Lamp	Gas Type
A	
B	
C	
D	

Spectrum Descriptions:

Hydrogen: Two strong lines, one red, one greenish-blue, and a weaker blue-violet line

Helium: Prominent yellow-orange line, fairly strong red and blue-green lines and a number of weaker lines

Mercury: Strong yellow, green, and violet lines, numerous weaker red lines

Neon: Two green lines, and then lots of lines starting at yellow and going to longer wavelengths.