# Calibrated Spectrometer

Student Worksheet

**Name**_____

**Overview:** Today you are a scientist and an architect, building your very own spectrometer to detect light wavelengths. You'll discover just how different the lights around you are!

**What to Learn:** You should understand the basics of how a spectrometer works and how to calibrate your new instrument.

**Materials**

- cardboard box (approximately 10″ x 5″ x 5″, but anything close to this will work fine)
- diffraction grating
- razor
- 2 spare razor blades
- masking tape
- scissors
- ruler
- photocopy of a ruler
- graph paper

**Lab Time**

1. Using the ruler, measure 4.5 cm from the edge of the box. Make a mark.
2. Go to the mark and measure another 1.5 cm. Make another mark.
3. Use a ruler to extend the lines vertically.
4. Within the two lines, draw a small box 1.5 cm wide and 3 cm tall. Cut out with a razor.
5. Very carefully line up the two spare razor blades edge-to-edge on either side of this small box, leaving a 1 mm slit between the sharp edges. Securely tape into place.
6. From the other edge (on the same side), measure 5 cm from the edge and make a mark. Measure over 11 cm and put another mark (if your box is smaller, you may measure less).
7. Use a ruler to extend the lines vertically.
8. Within the two lines, make a box 4 cm tall. Cut out box.
9. Cut out the ruler photocopy and attach it to the edge of this box, making sure the ruler markings may be seen from within the box.
10. On the opposite side of the box, measure over 3 cm and cut a hole for the diffraction grating that is 4 cm wide and 3 cm tall. This should be directly opposite the razor blades.
11. Tape your diffraction grating over the hole.
12. Tape box closed to make it as dark as possible.
13. Aim the razor slit at a light source such as a fluorescent light, neon sign, sunset, light bulb, computer screen, television, night light, candle, fireplace … any light source you can find. Put the diffraction grating up to your eye and look at the inner scale. Move the spectrometer around until you can get the rainbow to be on the scale inside the box.

How to Find the Wavelength from your Spectroscope

1. To calibrate, first find a fluorescent light (ex: a street light). Aim the slit at the light and look through the diffraction grating. Notice where on the ruler each line falls.
   *For example (NOTE: your values will be different!)*:
   a. orange/yellow light: 6.4 cm
   b. green light: 7.2 cm
   c. blue/violet light: 8.8 cm
2. Make a graph with the x axis (the horizontal line) titled "wavelength (nm, or nanometers)" and y axis (the vertical line) titled "spectrometer scale (cm)." You will need the following information:
   *Wavelengths of Fluorescent Light*:
   a. Blue: 435 nm
   b. Green: 546 nm
   c. Yellow/orange/red: 579 nm
3. Make the scale based on your numbers. For the sample numbers above, the scale for the x axis may be from 0-10 cm, and the y-axis from 400-600 nm.
4. Plot points for the three colors, and draw a best fit line between them. This is the primary line to find other values and is only valid for this particular spectroscope. If you make any changes to it, you must recalibrate.
5. Look at a different light source (ex: a candle). You will see a totally different set of spectral lines on the scale inside. Try to determine the wavelength of each!
   a. If a line in the spectroscope falls on 6.8 cm, look on the graph and go up 6.8 cm on the y axis. Draw a line straight over to the best fit line previously drawn. From there, draw a line straight down to the x axis. This will show the wavelength.

# Calibrated Spectrometer Data Table

**(Note: only the fluorescent wavelength values are given. All other wavelengths must be discovered using your graph!)**

| Light Source | Colors Observed and Measurement from Spectroscope (cm) | Wavelength (nm) |
|---|---|---|
| Fluorescent Light | Blue:_____<br>Green:_____<br>Yellow: _____ | Blue: 435 nm<br>Green: 546 nm<br>Yellow: 579 nm |
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**Exercises** Answer the questions below:

1. How does a spectrometer work?

2. Using your spectrometer graph, if a spectral line was at 7.6 cm, what wavelength would it correspond to? How do you know?

3. Why do different lights have lines at different numbers on the spectrometer?

**Exercises**

1. How does a spectrometer work? (When light passes through it, the diffraction grating separates the light into its different wavelengths, seen as different colors.)
2. Using your spectrometer graph, if a spectral line was at 7.6 cm, what wavelength would it correspond to? How do you know? (Answers will vary but should include the idea that if they go up 7.6 cm on the y axis, then go over until hitting the best fit line, the wavelength may be discovered by drawing a line straight down to the x axis.)
3. Why do different lights have lines at different numbers on the spectrometer? (Different types of lights have different colors in them.)

**Closure:** Before moving on, ask your students if they have any recommendations or unanswered questions that they can work out on their own. Brainstorming extension ideas is a great way to add more science studies to your class time.