Spectroscopy

Setup:

Note: I've had students complain that this lab gives them (literal) headaches or triggers migraines. If they are having trouble, tell them it's ok to stop and let labmates measure.

Incandescent lights (around the room for help seeing the numbers in the spectroscopes as well as measuring the spectrum)
Fluorescent light (or they can use the overhead / hallway lights)

Supplies per table: carousel key and comparison spectra (3 laminated sheets)

Spectra tubes carousels	colored pencils
4 spectroscopes	calculator

Teaching points:

- Demonstrate using the spectroscopes. If calibration is required tell them to have you help or they can mess up the spectroscopes, which are surprisingly expensive.
- Blackbody curve: Draw and explain how temperature and size change parameters
- Emission and Absorption lines: Explain the physics (Bohr model atom is fine)
- Wein's Law
- The intensity (luminosity, magnitude, brightness) vs. wavelength (color, temperature, frequency) graph is a difficult concept for them. This bears repeating often.
- Most of this lab after the mini-lecture is observing time. Sometimes I have them make all the measurements first before doing the calculations for table 2.
- When calculating frequencies, students may forget to convert their observation in nanometers to meters.
- When trying to figure out what gases might be in the fluorescent lights, students will not realize that if a gas is present **all** of its lines must be. So they will find something that is "close" but might have an extra line that they do not see (e.g. something with yellow when no yellow is present). However, once you get them to realize that can't be in there, they will not make the jump to it being possible if the fluorescents have **more** lines than the gas, because the fluorescent is a mix of gases. This bears checking with each group.
- The stellar observations are in Angstroms, rather than nanometers. Tell them they can just chop off a zero to get to nanometers (4100 Å = 410 nm).
- Star 6 has a peak wavelength off the graph; this is a good talking point about detectors and how detection limits can impact observations if there is time. All peak wavelengths are going to be estimates. These are real stars!

Demo: *optional, if you feel like it but it's a nice illustration of the points*

- Laptop
- Fancy spectrometer from modern lab (use Spectra Suite software)
- Frosted incandescent bulb (white): shows a nice blackbody spectrum
- Frosted incandescent bulb (blue): shows a blackbody with absorption lines (show 2nd) (talk about why they are not as sharp/spikey as the emission lines)
- One of the carousels: any of the atomic gases, show the emission lines