Stages of Discovery
Wednesday January 11
Week 11 Physics Lab

Name:_____

Partners' Names:_____

The Spectrum of Light

Goals

- Improve communication and teamwork capacities
- Gain confidence in scientific investigation, including appropriate use of equipment
- Keep careful records of observations
- Produce and interpret graphs
- Learn to use spectrometers to observe and measure the spectra of various light sources
- Measure, compare, and contrast the spectrum from various "white light" sources, gaseous elements, and different colored light emitting diodes (LEDs)

General Outline

Today's activities break up into three broad sections:
1) an orientation to using the spectrometers
2) use the spectrometers to observe and measure spectra at three different Stations
3) producing graphs

1) Orientation to equipment

- You will be oriented to the equipment and data collection during the opening lecture.
- Make sure to take notes and ask clarifying questions.

2) Observations & Measurement

- You may work at the three Stations in any order.
- There are three "White Light Stations" in each room, three "Gas Element Stations" in each room, and two "Light-Emitting Diode Stations" in each room.
- Use the hand-held spectrometers (when possible) to make qualitative observations.
- Use the computer spectrometers to make quantitative measurements.
- Save the data for each measurement using a unique and descriptive file-name in the Workspace or Instrumentation folder in the program file-share.

White Light Station

- This Station has four light sources: an incandescent bulb plugged into a variac; a compact fluorescent light (CFL) bulb plugged into a variac; a standard fluorescent bulb; and a white light-emitting diode (LED) keychain.
- Use the hand-held spectrometer to observe each white light source in turn (the LED might be too difficult to observe with the hand-held spectrometer). Make careful notes of your observations, especially in comparing and contrasting the four sources.
- Use the computer spectrometer to measure and record the spectrum for each white light source.
- Use the computer spectrometer to make three measurements for the incandescent light bulb: one with the variac on a high setting with the light bulb glowing brightly; one at a medium setting; and one at a low setting (but still glowing). Set things so that you can get clear spectra from all three without changing the distance and orientation of the fiber-optic and light source.
- Use the computer spectrometer to make two measurements for the CFL light bulb: one with the variac on a high setting with the light bulb glowing brightly and one at a lower setting (with the bulb still glowing).

Gas Element Station

- This Station has elemental gases in delicate gas tubes mounted in power supplies. When the power supply is turned on, the gas will glow. Be careful: the glass tubes get VERY hot, and remain hot for some time! Make sure not to turn the power on and then off very quickly; leave the power on for at least one minute before turning it off again.
- Use the hand-held spectrometer to observe the spectrum emitted by the hydrogen tube. Make careful notes of your observations. Leave the hydrogen tube on.
- Use the computer spectrometer to measure and record the spectrum for the hydrogen tube. Turn the hydrogen tube off (if it has been one minute).
- Repeat the hand-held observation (taking careful notes of your observations) and also use the computer spectrometer to measure and record the spectrum for three other gases.

Light-Emitting Diode (LED) Station

- This Station should have three light-emitting diode (LED) keychains.
- Use the computer spectrometer to measure and record the spectrum for each LED light source.

(if time and weather permit) Sunlight Station

- CAUTION: Don't look directly at the sun, even through the spectrometer.
- If you have time and the sun is out, use a hand-held spectrometer to observe the spectrum of the indirect sun (look at the bright blue sky or a bright white cloud). Make careful notes of your observations.
- Consult with your instructor to see if you noticed a subtle effect.

3) Producing Graphs

- Produce the following series of graphs, and use each series to tell a relevant story that demonstrates your understanding of physical phenomena/principles.
  Story 1: Spectra of the four white light sources.
  Story 2: Spectra of the three different brightness spectra for the incandescent bulb (on the same graph if you can).
  Story 3: Spectra of the two different brightness spectra for the CFL bulb (on the same graph if you can).
  Story 4: Spectra of your four gases.
  Story 5: Spectra of your three LEDs.

Assignment One:

Due Week 11 Thu. Jan. 12 by 1 pm in class
Briefly address the following questions:

a) What did you know about quantum physics before reading *Quantum*? What has surprised you most so far about the story Kumar is telling?
b) What are you excited or anxious about for your work in any part of our program?

Assignment Two:

Due Week 12 Wed. Jan. 18 in lab
Address relevant material from discussion, lab, and reading from Week 11
Tell stories combining words, graphs, pictures, and equations that address some or all of the following:

a) What is the most useful connection you have made between what you have read/researched, what we have discussed in class, and what you have observed in lab or lecture?
b) What is the most important way in which your understanding of the connection between science and society (consider society as broadly as you like, including culture, history, relationships, power, etc.) has changed?
c) What is the most interesting thing you have learned about the nature of the physical world?
d) What has surprised you most so far about the story Kumar is telling?