ASTR 1120 (Dr. Hornstein)
Written Homework Set 1
Due <u>at the Beginning of Class</u>: Wednesday, January 27

NAME:_____ STUDENT ID (#):_____

- You may work with your friends but the work you hand in should be your own (in your OWN words!) ***Identical assignments will receive split credit.***
- If you have other sheets (or printed this out), ***PLEASE STAPLE!!***

Do-it-Yourself Exploration-Homework for the
Fiske Planetarium "SEEING THE INVISIBLE" Lobby Exhibit
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THIS HOMEWORK MUST BE DONE ON YOUR OWN TIME AT FISKE PLANETARIUM DURING THEIR REGULAR HOURS (9am-5pm).

The section titles refer to exhibit tables or areas in the Fiske Planetarium Lobby. Prediction questions should be done before doing each experiment and will not be marked wrong for incorrect predictions. Be sure to read the posters at each station, you'll need them for some of the answers.

Two preparatory questions; If you can't answer these before seeing the exhibits you should be able to afterwards:
1. You will be looking at visible, ultraviolet (UV), and infrared (IR) light. Put these wavelengths in the order they are found in the spectrum, <u>lowest</u> to <u>highest</u> energy:

2. Objects of different temperature generally give off different proportions of visible, UV, and IR light. In which spectrum region would you expect lower temperature objects to emit most of their light, and which region for higher temperature objects?

Now follow the footprints in the carpet that lead from exhibit to exhibit…

WHITE LIGHT WALL

1) What are the three primary colors? Note: do not confuse these with the primary pigments, which are known in art world as the "primary colors."

2) Stand in front of the wall, hold out your hand, and make a shadow.
   a. What colors do you think you will see if you cover the blue light? The red light? The green light? Write down your predictions.

   b. Test your predictions. (There is a "paddle" you can hold up to block one of the lights.) Were they right? If not, why?

c. What happens if you mix all three colors together? Why?

d. Is your eye an adequate instrument to tell what colors are in a beam of light? What would let you do better? How do astronomers analyze what colors are present in a beam of light?

ULTRAVIOLET (UV) TABLE

3) What is fluorescence?

4) a. What objects on the table fluoresce?

b. Why do these objects fluoresce (in other words what is contained in these objects to cause them to fluoresce)?

c. What colors do you observe?

5) Why do we study UV light from space instead of from the ground?

6) What is FUSE?

SPECTRUM TABLE

Turn on the big, clear light bulb and adjust it to a comfortable brightness by moving your finger along the dimmer control.

7) *Pick up a "diffraction grating" and hold it <u>up to</u> (right in front of) one of your eyes. Look at the light bulb. You should see the bulb and to the right and left of the bulb a spectrum of colors.* Do you see all the colors of the spectrum? If not, ask someone to show you!

a. Dim the bulb until it is barely glowing. Look at the filament (glowing part) of the bulb as it emits less energy and cools (both with and without the grating). How does the color of the filament change when it is cooler? How does the spectrum change?

- The colors of stars tell you their temperatures the same way the color of the filament indicates temperature. The color of any solid object – no matter what it is made of – only depends on its temperature.

Turn on the two gas emission tubes. (WARNING: please don't leave these on. They get HOT!).

8) a. Use just your eyes. What visible colors do you see coming from each tube? Each tube contains a different gas.

b. Now hold a diffraction grating up to each one. (While looking at each tube, turn off the other tube.) Do you see all the colors of the spectrum, like you did with the ordinary light bulb? If not, describe the pattern that you see. What colors do you observe?

c. Match each of the two spectral patterns to those on the chart. What gas is contained in each tube?

9) *Now look at the image of Orion. The Orion Nebula is found where Orion's sword would be. Hold the diffraction grating over your eyes and look at this region.*

a. What spectral pattern do you see? (The nebula is smaller than the emission tubes, so the emissions will be smaller. It is the pattern of colors you are trying to match.)

b. What element does this pattern represent?

10) How do astronomers use spectra to learn the chemical composition of nebulae?

11) Often more than one type of gas is found in a nebula. How are astronomers able to sort out which gases are present in a nebula?

Every element has its own, distinctive pattern of colors, just like each person has a unique fingerprint. This is how astronomers tell what the universe is made of! This was discovered by two Germans, Kirchoff and Bunsen. Most people have heard of Bunsen. He invented the "Bunsen burner" to heat up elements and study their light. Bunsen burners are still used in Chemistry classes.

FILTERS

12) *At the table, the words RED, GREEN, and BLUE are written with colored crayons.* What do you think will happen if you look at the word RED through a red filter? Why? (Don't try it until you predict!)

Now try it. What did you see? Was your prediction correct? Explain what is happening. (*Hint: What color is the paper it is written on? What does that mean about the colors that paper reflects?)*

What color does the word RED look like through the blue filter? Explain what is happening.

What does a red filter do – what colors does it let through?

What colors does a blue filter let through?

Try looking at some of the astronomical images in the lobby using different colored filters.

Filters are a more accurate way of determining colors than just looking. They are less accurate than using a diffraction grating and making a spectrum, but more efficient: an entire "pictureful" of celestial objects may be studied all at once by taking an image through a colored filter.

Infrared (IR) TABLE

13) a. Look at the image from the mid-infrared camera. What do you see?

b. What do you think the dark areas represent? Why?

c. What do you think the light areas represent? Why?

14) a. What do you think you'd see if you touched a block of ice to your face? Write your prediction BEFORE you try it!

b. Now write what you actually saw. Are your observations consistent with your prediction? Explain what is happening.

15) a. Based on your observations in questions 13 and 14, you've probably realized that infrared light can be an indicator of heat. Is this the only wavelength that indicates heat? Explain your answer.

b. Why do people typically associate IR light with heat?

16) a. Do you think a piece of clear plastic will transmit infrared light? Why or why not?

Test your prediction. What did you actually see?

b. Predict whether black plastic (like a black plastic garbage bag) transmits infrared light.

Test your prediction. <u>Explain your results.</u>