Name _____

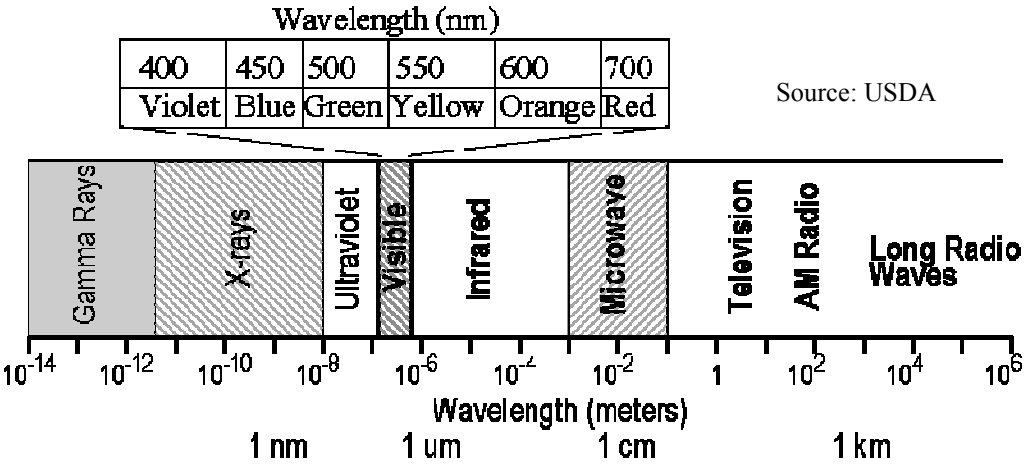
SPECTROSCOPY: STARLIGHT, STAR BRIGHT

(Slightly modified from “All About the Sun", Stanford Solar Center)

Part A. The Electromagnetic spectrum

Scientists use different forms of light to learn more about the sun and stars. There is more to light than what is visible. We think of light as the visible spectrum, which is white light and its colors caused by refraction (red, orange, yellow, green, blue, indigo, and violet). There is also light that is invisible: radio waves, microwaves, x-rays, infrared rays, ultraviolet rays, and gamma rays.

Scientists organize the different forms of light by wavelength (the distance between two successive wave crests). Take a look at the electromagnetic spectrum below to see the relative wavelengths of different kinds of radiation.



Note: 1 nanometer (nm) = 1 x 10^{-9} meter = 1/billionth of a meter.

1. What is the range of wavelengths of visible light? _____
2. Which has a shorter wavelength, violet light or red light? _____
3. Which has a longer wavelength, radio waves or visible light? _____
4. What type of radiation has the shorter wavelength, visible light or ultraviolet light ?

   _____
5. What color is light with a wavelength of 500 nm? _____

Scientists use the full electromagnetic spectrum to learn more about the sun and the stars. For example, radio waves tell scientists about the gases in our galaxy and give details about magnetic fields in space, and ultraviolet light studies have mapped the hot gases found throughout the universe.

Part B. Spectroscopy

Spectroscopes are important tools for astronomy. One of the important applications of spectroscopes is their use for identifying chemical elements. Each element radiates light in specific wavelength combinations that are as distinctive as fingerprints. Knowing the "spectral fingerprint" of each element enables astronomers to identify the elements present in distant stars by analyzing their spectra.

There are 3 kinds of spectra: continuous, absorption, and emission.

- When observed through a spectroscope, the continuous spectrum appears as a continuous band of color ranging from red to violet.
- An absorption spectrum happens when the light from a star passed through a cloud of gas before reaching the spectroscope. For example, let's say that light from a star passes through a cloud of hydrogen gas before reaching the spectroscope. Some of the wavelengths of light will be absorbed by the hydrogen atoms. This absorption will produce a spectrum that has a broad band of color interrupted by dark lines. These dark lines represent the certain wavelengths of light that were absorbed by the hydrogen cloud.
- An emission spectrum is observed when the energy is absorbed by the gas atoms in a nebula and is re-radiated by those atoms as specific wavelengths. This spectrum consists of bright lines against a black background. The light from fluorescent tubes and neon lights produces emission spectra.

Directions

1. Use your spectroscope to observe the spectra for 4 different light sources: the fluorescent lights in this classroom, a soft white lightbulb or light from the overhead projector, and two light tubes containing “mystery gases”. Use the form on the next page to record your observations. Next to each record, indicate whether what you observed was a continuous spectrum, an absorption spectrum, or an emission spectrum,

2. Use your recordings and the spectra of known elements to identify the “mystery gases”.