

Name: _____

Three Views Spectrum Simulation

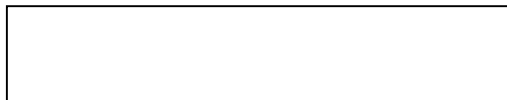
This simulation uses the Three Views Spectrum Demonstrator from the NAAP group: <http://astro.unl.edu/classaction/animations/light/threeviewsspectra.html> Further, this simulation assumes that students understand the Bohr model of the atom along with the terms electrons, protons, nucleus, and transition as they relate to the production of light.

Because astronomers cannot bring a star into a laboratory for analysis, they have learned to use starlight to determine a star's chemical composition, luminosity class (size), surface pressure, rotation, and so on. In order to make these determinations, astronomers use a spectroscope that breaks starlight down into its component colors - a spectrum.

During this simulation you will learn three spectral laws first discovered by a German scientist named Kirchhoff during the 19th century. The goal of this activity is to help you understand how spectra can be used to determine the chemical composition of a star and draw other conclusions as well. At the end of this exercise you should be able to:

- state the source of a CONTINUOUS spectrum in a star,
- state the cause of a bright-line EMISSION spectrum, and
- explain how a star's dark-line ABSORPTION spectrum can be used to identify gases.

- A. Start the Three Views Spectrum Demonstration found at the web address above.
- B. Read the instructions contained within the simulation's black box. Give it a try.
- C. Note that the spectroscope produces a spectrum that is exhibited in the gray box labeled with the word SPECTROMETER.
- D. First, drag the spectroscope to a point above the light bulb so that it produces a spectrum of its light. Using colored pencils, recreate in the box below the CONTINUOUS spectrum shown in the spectrometer. Note that hot glowing solids, liquids, or high-density gases (such as found on the surface of a star) will produce a spectrum that contains all the ROY G. BIV colors and everything in between.



CONTINUOUS SPECTRUM

The CONTINUOUS spectrum is caused by gas particles (atoms and even molecules) moving at high speeds bumping into one another near the star's surface. In colliding, the orbits of the electrons are bent out of shape or disturbed. A spectrum containing every color (and some we can't see like ultraviolet and infrared) is therefore produced.

- E. Next, drag the spectroscope to a point above the cloud of low-density glowing gas. This low-pressure, "thin" cloud of gas is somewhat like the rarified atmosphere above the

visible surface of a star. Using colored pencils, recreate in the box below the bright-line EMISSION spectrum shown in the spectrometer that arises from a glowing cloud of gas.

EMISSION SPECTRUM

The EMISSION spectrum is produced in a thin gas where the collisions between atoms are relatively rare. As a result, spectral lines can be easily associated with certain jumps of electrons between atomic orbits. Because each type of atom or molecule will produce its own spectrum, one can identify glowing gases in a space cloud by comparing its bright spectral lines with standard sources studied in a laboratory.

F. Lastly, drag the spectroscope to the left of the cloud of glowing gas so that light from the bulb (star's surface) can be observed after it passes through the cloud of gas (star's atmosphere). Using colored pencils, recreate in the box below the dark-line ABSORPTION spectrum shown in the spectrometer.

ABSORPTION SPECTRUM

The ABSORPTION spectrum results from a low-pressure gas cloud "robbing" light from a continuous spectrum. That is, all the colors from the light bulb pass through the gas cloud but certain colors do not make it through because atoms or molecules within the gas cloud absorb them. It is interesting to note that a cloud of low-pressure gas will absorb the same colors of light that it would emit if it were glowing and observed against the dark background of space. The dark spectral lines in a star's absorption spectrum match precisely those in the cloud's emission spectrum.

Now, answer the following questions referring to the provided information as well as the data about the three different types of spectra you have just recorded. Be certain when referring to types of spectra to use the words CONTINUOUS, EMISSION, and ABSORPTION. You will have to think deeply about some of these questions before answering.

1. Street lights such as "mercury vapor" and "low-pressure sodium" glow brightly at night. Why type of spectrum would they exhibit? _____
2. What type of spectrum does the visible surface of a star produce? _____
3. What type of spectrum will the atmosphere of a star produce when observed against the bright glow of the star's visible surface? _____

4. If the stellar atmosphere mentioned in question 3 is forced to glow and then viewed against the dark background of space, what sort of spectrum would it produce?

5. Which part of a star produces a continuous spectrum? _____

6. Which part of a star is responsible for "robbing" light from its continuous spectrum thereby producing the absorption spectrum? _____

7. In a situation unrelated to the above star, a cloud of warm gas produces a faint emission spectrum of red, yellow and green. The cloud drifts in front of a star. What colors of the star's spectrum will be no longer be seen in its spectrum? _____

8. Why would the absorption phenomenon described question 7 occur? That is, what is the relationship between emission and absorption in the cloud of gas? _____

9. On our sun, huge loops of glowing gas sometimes can be seen just beyond the edge of the sun's visible disk. These are called prominences. When prominences fall back onto the sun's visible disk, they appear different. Would they appear brighter still or dimmer? _____

10. Explain the reasoning behind your answer to question 9. _____
