William M. Staerkel PLANETARIUM

Teacher's Guide for:

Messages of Starlight

Objectives:

- To discover that "white" light is actually a mixture of other colors.
- To see that different elements emit different colors of light when excited.
- To discover how we know what we do about the stars.

This show conforms to the following Illinois state science standards: 11.A.3f, 12.F.2b, 12.F.2c, 12.F.3c, 12.F.4a, 12.F.5a. Next Generation Science Standards: HS.ESS1.2, 1.ESS1.1

Brief Show Summary:
We have a vast knowledge about the stars but the only information we received from them is from the light they emit. After looking at the current constellations, we ask why red stars are red and, through an "eyes-on" activity, we see that red stars are cool. Then the class examines several discharge tubes (e.g. neon, hydrogen, etc.) with a diffraction grating to see how their spectra are both alike and different. From these spectra we discuss how we can learn about a star's composition. Atomic theory is not covered, though this is an option for the instructor. We finally view a spectrum of the Sun and see how it compares to spectra of the other stars.

Pre-visit Discussion & Activities:

1) Challenge student's knowledge of the stars by asking them questions about the Sun. How hot is it? What is it made of? Then ask how they know this. A book told me won't cut it!
2) Light waves can be demonstrated by using a clear tank (a glass lasagna pan works nicely) on an overhead transparency projector. Poking your finger in the water produces a nice wave front that can be projected on a screen using a transparency projector. Try using two fingers and see if you can achieve interference.
3) Discuss what an atom is with your students and how an atom of, say, hydrogen is different from an atom of helium.

Post-visit Discussion & Activities:

1) Obtain some diffraction grating material from a hobby shop and build a spectroscope out of a shoebox. Try looking at the fluorescent light fixtures that many schools use for lighting classrooms and record its spectra. Next try a sodium vapor streetlight. Can you identify the gases within each? [Hint: The fluorescent lights contain Mercury]
2) You may begin a discussion of light and the relationship between wavelength and frequency (number of waves in a second). You may want to use an analogy of a train moving at the speed of light. If large boxcars are used, then fewer go by in a second (large wavelength means small frequency) and, consequently, small cars mean many go by in a specified time.

3) Light propagation can be demonstrated by using a large slinky. Stretch it across a tile floor and give one end a horizontal yank. Watch the waves travel down the slinky. What happens when two waves meet each other?
4) Closely examine the spectra of different stars, some hotter than others. How are they alike? How are they different? You can learn the spectral classes (O,B,A,F,G,K,M,R,N) and maybe make up a pneumonic to remember their order. Look at a list of the brightest stars. What spectral classes are listed? Are these hot stars? Now look at a list of the nearest stars. How are they different from the brightest stars?
5) Why do different elements have different spectra? You can model the atom after a large city. Poorer families (electrons) live closer to the center. If one family comes into some money (energy) they move to the suburbs (higher energy orbit) but they don't like it there because they have to hire a maid and gardener for their larger house, so they move back to their original house and give their money to charity (the electron gives off its excess energy as light). [Thanks to Dave's high school physics teacher, Mike Scott, for that one!]

Vocabulary

Spectrum	Atom	Absorption
Emission	Temperature	Constellation

Internet resources:

Jim Kaler's spectra page: http://stars.astro.illinois.edu/sow/spectra.html
Physics of the rainbow (java): http://www.phy.ntnu.edu.tw/java/Rainbow/rainbow.html
The SOHO mission: http://sohowww.nascom.nasa.gov/
Northern Lights reports: http://www.spaceweather.com/
Sky & Telescope magazine: http://SkyandTelescope.com
Star spectra: http://casswww.ucsd.edu/archive/public/tutorial/Stars.html