

## SORTING SPECTRA

**Ages:**  
Grades 6 and up

**Duration:**  
20 minutes

**Materials:**  
Per group of 2-4  
students

- A color copy of spectra sheet, with individual spectra cut apart and shuffled out of order

### OVERVIEW —

Working in groups, students compare stellar spectra for patterns and sort them accordingly, then report out their observations to the class. This prepares them to understand stellar classification.

### OBJECTIVE —

The students will:

- Analyze stellar spectra for patterns
- Sort stellar spectra into groups based on identified patterns
- Discuss their findings and compare them with other groups

**BEFORE YOU START:** *The students should be familiar with the concept of the spectrum and absorption lines.*

### ACTIVITY —

Print enough color copies of the stellar spectra sheet so that you have one for every 2-4 students. Cut them apart and shuffle them out of order.

Invite the students to discuss the spectrum—what do the different colors of light in a spectrum represent? (*Different wavelengths or frequencies of light.*) When have they seen a spectrum before? What makes a spectrum? (*light split into different colors by a diffraction grating, a prism, or drops of water in the atmosphere*)

1. Organize students into groups of 2-4.
2. Show the students one of the stellar spectra. Share that this is a picture of the visible spectrum of a star. Point out the different colors, as different frequencies of light emitted by the star.
3. Point out some of the dark lines on the spectra and invite the students to speculate what might cause them. Share that these are absorption lines—frequencies in which the light of the star has been absorbed by its atmosphere.
4. Hand out sets of spectra to the students. Ask them to examine the features in their groups, and compare them.
5. Ask the students to organize the spectra into 4 or more groups.
6. Invite each group of students to report out on their categories for spectra. Encourage class discussion on their findings.
7. Share the categories used by astronomers: OBAFGKM, and the relationship between temperature and spectral features.

## **BACKGROUND —**

Detailed background is at <http://stars.astro.illinois.edu/sow/spectra.html>

Because the efficiencies of absorption depend on temperature, so do the appearances of the spectra of the stars. Stellar spectra were first observed in the middle of the 19th century. As an aid to understanding, astronomers began classifying the spectra. In 1890, E.C. Pickering and assistants Annie Jump Cannon, Antonia Maury, and Williamina Fleming categorized the stars, lettering them according to the strengths of their hydrogen lines. As observation improved, astronomers dropped some letters, rearranged others according to different spectral criteria, and added numbers. The result was the seven letter sequence OBAFGKM, representing classes from hottest to coolest. The Sun is class G.

### **THE SPECTRAL SEQUENCE**

<b>Class</b>	<b>Spectrum</b>	<b>Color</b>	<b>Temperature</b>
O	ionized and neutral helium, weakened hydrogen	bluish	31,500-49,000 K
B	neutral helium, stronger hydrogen	blue-white	10,000-31,500 K
A	strong hydrogen, ionized metals	white	7500-10,000 K
F	weaker hydrogen, ionized metals	yellowish white	6000-7500 K
G	still weaker hydrogen, ionized and neutral metals	yellowish	5300-6000 K
K	weak hydrogen, neutral metals	orange	3800-5300 K
M	little or no hydrogen, neutral metals, molecules	reddish	2100-3800 K

## **TIES TO STANDARDS —**

### **NSES Content Standards**

#### **Grades 5-8:**

**DESIGN AND CONDUCT A SCIENTIFIC INVESTIGATION.** Students should develop general abilities, such as systematic observation... Students can learn to formulate questions, design investigations, execute investigations, interpret data, use evidence to generate explanations, propose alternative explanations, and critique explanations and procedures.

#### **TRANSFER OF ENERGY**

Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object—emitted by or scattered from it—must enter the eye.

The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

#### **Grades 9-12:**

#### **THE ORIGIN AND EVOLUTION OF THE UNIVERSE**

Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.

