

Stellar Spectra Classification

Introduction: Classifying stars based on brightness is somewhat problematic. A star's apparent brightness can be affected by its distance from the observer, its size, or by the presence of interstellar dust. Instead, astronomers classify stars based on the major components of their spectra. Much like bar codes on grocery store items, stellar spectra are each slightly different but have many characteristics in common. The current classification system used by astronomers was created by Annie Jump Cannon and Henrietta Leavitt working at Harvard in the early 20th Century. The study of spectra provides scientists with important information about stars that is otherwise inaccessible. This information includes composition and temperature.

Part I: Classifying Stellar Spectra

Included in this activity is a table of simulated stellar spectra on page 5. Your first task is to sort the spectra by creating a classification scheme. As with real stellar spectra, you will never find two exactly the same. The thickness of each line represents how much light is received at a particular wavelength, so the both the thickness and the position of the lines are very important. Astronomers usually focus on the broadest lines first. Record your results in the table on the next page.

Note: The table contains five rows but you do not need to use them all. Also, there is no requirement that your classification scheme results in the same number of stars in each category.

Hint: Imagine that the sixteen bar codes represent food items from four departments—meat, dairy, produce, and groceries. You might expect that all the bar codes from the same department look similar, but not identical. Your task would be to sort them into groups representing the four departments.

** This activity is adapted from the Stellar Bar Code Activity developed by Tim Slater at the University of Montana at Bozeman. The activity was published in the Physics Teacher magazine in January, 2000.

	Spectra ID Numbers	Defining Characteristics (provide enough detail so that anyone could use your scheme)
Category I		

Category II		
Category III		
Category IV		
Category V		

Reflection: Find a nearby group and compare your classification scheme to theirs. What is the difference between how you chose to classify the spectra and how they did?

Part II: Matching Stellar Spectra

Now, let's try somebody else's scheme. Your task is to match the 16 unknown stellar spectra with the 4 known ones (standard spectra) at the end of this activity on page 6. You should identify four unknown spectra similar to standard A and the same for B, C, and D.

Known Spectra	A	B	C	D
Unknown Spectra Numbers				

Reflection: Describe the specific characteristics that your group used to match the known with the unknown spectra.

Part III: Determining Relative Stellar Temperatures

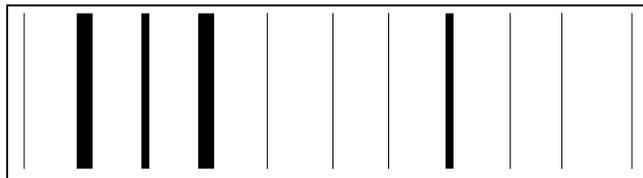
Blackbody radiation curves were acquired for all simulated stars, including the standards, and the results are listed on the Data Sheet at the end of the activity. Remembering that the peak wavelength is a measure of the star's temperature, sort all twenty stars, including stars A, B, C, and D, into four new categories and record the star ID's in the table below. The smaller the wavelength, the hotter the star.

Hot Stars	Medium-Hot Stars	Medium-Cool Stars	Cool Stars

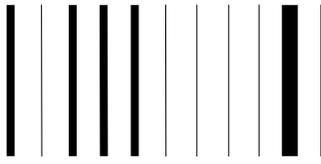
Reflection: Carefully compare and contrast the stellar temperature classification (table above) with the stellar spectra classification scheme used in Part II. How are the two classification schemes related?

Part IV: Determining the Temperature of a Star

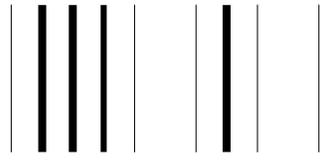
At the bottom of the Data Sheet, you will find a table that relates the peak wavelength of the blackbody spectrum to the surface temperature of the star. Suppose a new star is discovered and its spectrum is shown below. Determine its temperature and justify your answer.



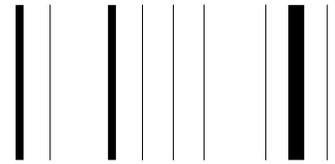
SIMULATED STELLAR SPECTRA



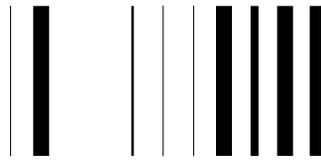
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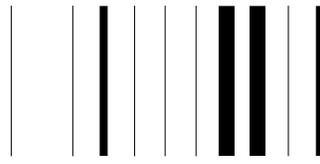
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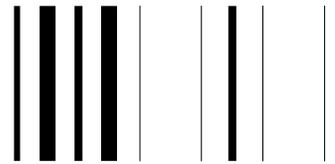
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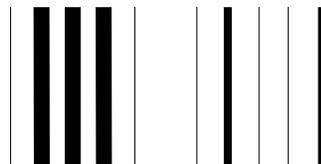
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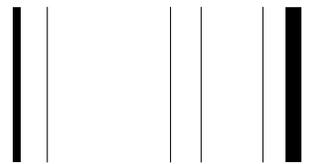
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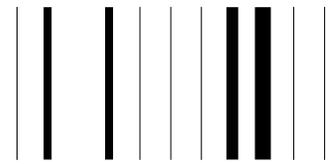
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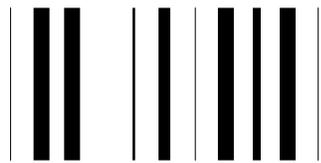
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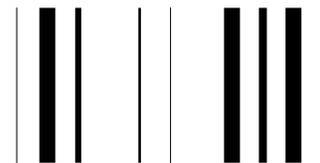
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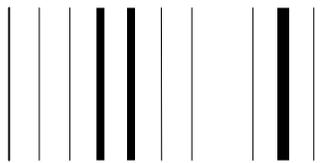
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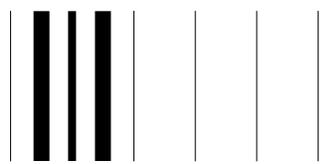
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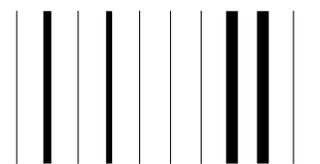
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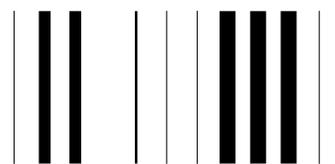
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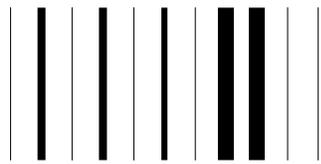
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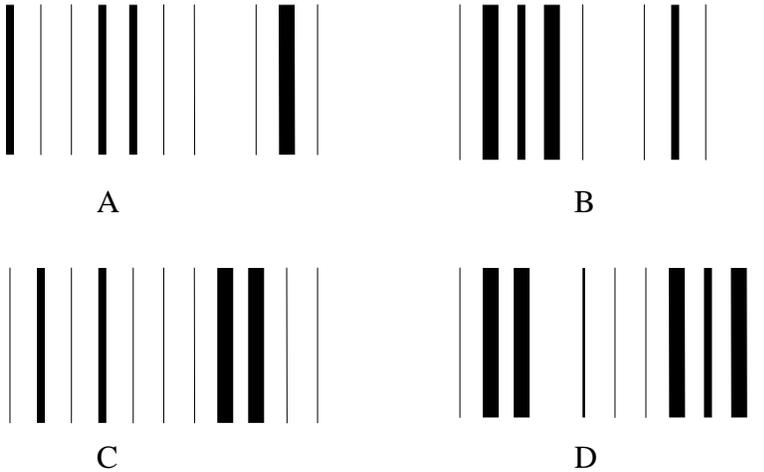


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Stellar Spectra Classification Data Sheet

Standard Spectra Classifications



Blackbody Radiation Peak Values

Star ID	Peak Value (angstroms)		Star ID	Peak Value (angstroms)
1	3625		11	7005
2	2810		12	3610
3	3612		13	2805
4	7040		14	5515
5	5470		15	7010
6	2812		16	5555
7	2790		A	3600
8	3595		B	2800
9	5510		C	5500
10	6940		D	7000

Corresponding temperatures for four classes of stars studied.

Standard	Peak blackbody wavelength (angstroms)	Temperature (degrees)
A	3600	8000
B	2800	10,000
C	5500	5000
D	7000	4000