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**How Is a Star’s Color Related to Its Temperature?**

*Schulman Labs 2011*

On a clear night you have surely noticed that some stars are brighter than others. But stars also have different colors. Rigel is blue, and Betelgeuse is red. Capella and our sun are yellow. In this activity you will make your own Hertzsprung-Russell diagram. You will see how star brightness, color, temperature, and class are related.

**Materials:** Colored pencils, markers, or crayons (red, orange, yellow, blue)

**Procedure:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Star Name** | **Temp (K)** | **Brightness**  **(Luminosity) Sun = 1** |
| 1 | SUN | 5,300 | 1 |
| 2 | ALPHA CENTAURI A | 5,500 | 1.3 |
| 3 | ALPHA CENTAURI B | 3,900 | 0.36 |
| 4 | SIRIUS A | 10,100 | 23 |
| 5 | SIRIUS B | 10,400 | 0.008 |
| 6 | ROSS 248 | 2,400 | 0.0001 |
| 7 | 61 CYGNI A | 3,900 | 0.08 |
| 8 | 61 CYGNI B | 3,600 | 0.04 |
| 9 | PROCYON A | 6,200 | 7.6 |
| 10 | PROCYON B | 7,100 | 0.0005 |
| 11 | CANOPUS | 7,100 | 1,500 |
| 12 | VEGA | 10,400 | 60 |
| 13 | CAPELLA | 5,600 | 150 |
| 14 | BETELGEUSE | 2,900 | 17,000 |
| 15 | ACHERNAR | 14,000 | 200 |
| 16 | BETA CENTAURI | 21,000 | 3,300 |
| 17 | ALDEBARAN | 3,900 | 90 |
| 18 | SPICA | 21,000 | 1,900 |
| 19 | ANTARES | 3,100 | 4,400 |
| 20 | DENEB | 9,900 | 40,000 |
| 21 | BETA CRUCIS | 22,000 | 6,000 |

1. Study the star data to the right. Note that the sun, used as a standard of brightness, is given a value of 1. The brightness given for each other star shows how that star compares with the sun.
2. Plot the temperature and luminosity of each star.

**Hertzsprung - Russell Diagram**

**Spectral Class O B A F G K**  **M**

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| 100,000  75,000  50,000  30,000  10,000  7,500  5,000  3,000  1,000  750  500  300  100  75  50  30  10  7.5  5  3  1  0.7  0.5  0.3  0.1  0.07  0.05  0.03  0.01  0.007  0.005  0.003  0.001  0.0007  0.0005  0.0003  0.0001 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Brightness** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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40,000 20,000 10,000 7,000 6,000 4,500 3,000

**Approximate Temperature (K)**

**Coloring Time!!!**

1. Stars with surface temperatures up to 3,500K are red. Shade a vertical band (up and down) from 0K to 3500K a light red.
2. Color from 3500K up to 5000K orange-red,
3. Color from 5000k to 6000K light yellow,
4. Color from 6000K to 7500K light blue.
5. Color from 7500K to 40,000K blue.

**Questions**

1. What is the general relationship between temperature and star brightness? In other words, what typically happens to the star’s temperature when the brightness goes up/down?
2. What relationship do you see between star color and temperature?
3. List the colors from coolest to hottest:
4. How does the sun compare to the other stars on the main sequence?
5. What spectral class (letter) does our sun belong to? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. If a star is class B, what is its temperature and color?
7. Dwarf stars are smaller than our Sun. Why do you think they are so hot? *Hint: think about what white dwarves were before they were a white dwarf*
8. Using your notes, circle on your graph and label white dwarf stars, red giants, blue giants and main sequence stars.