Environmental Science Institute
UNIVERSITY OF TEXAS AT AUSTIN

Creating a Hertzsprung-Russell Diagram

Subject: Science, Math

Grade Level: 6th-8th

Rational or Purpose: This activity introduces concepts of absolute and apparent magnitude of stars. It will help students group similar stars to see the relationship of color and magnitude.

Materials: (For each student)
- Scissors
- Tape or glue
- Colored pencils: red, orange, yellow, blue
- Metric ruler

Documents:
- Stars of Constellation Orion
- H-R Diagram Sheet
- Conclusions Worksheet

Lesson Duration: 45-50 minutes

Sources:
Hertzsprung-Russell diagram. (2007, September 3). In *Wikipedia, The Free Encyclopedia*. Retrieved 01:52, September 20, 2007

Science TEKS:
6th Grade Science: (2B), (2C), (2D), (2E), (3A), (3D), (4A), (4B), (7B), (13A)
7th Grade Science: (2B), (2C), (2D), (2E), (3A), (3D), (4A), (4B)
8th Grade Science: (2B), (2C), (2D), (2E), (3A), (3D), (4A), (4B), (10B), (10C), (13A), (13B)

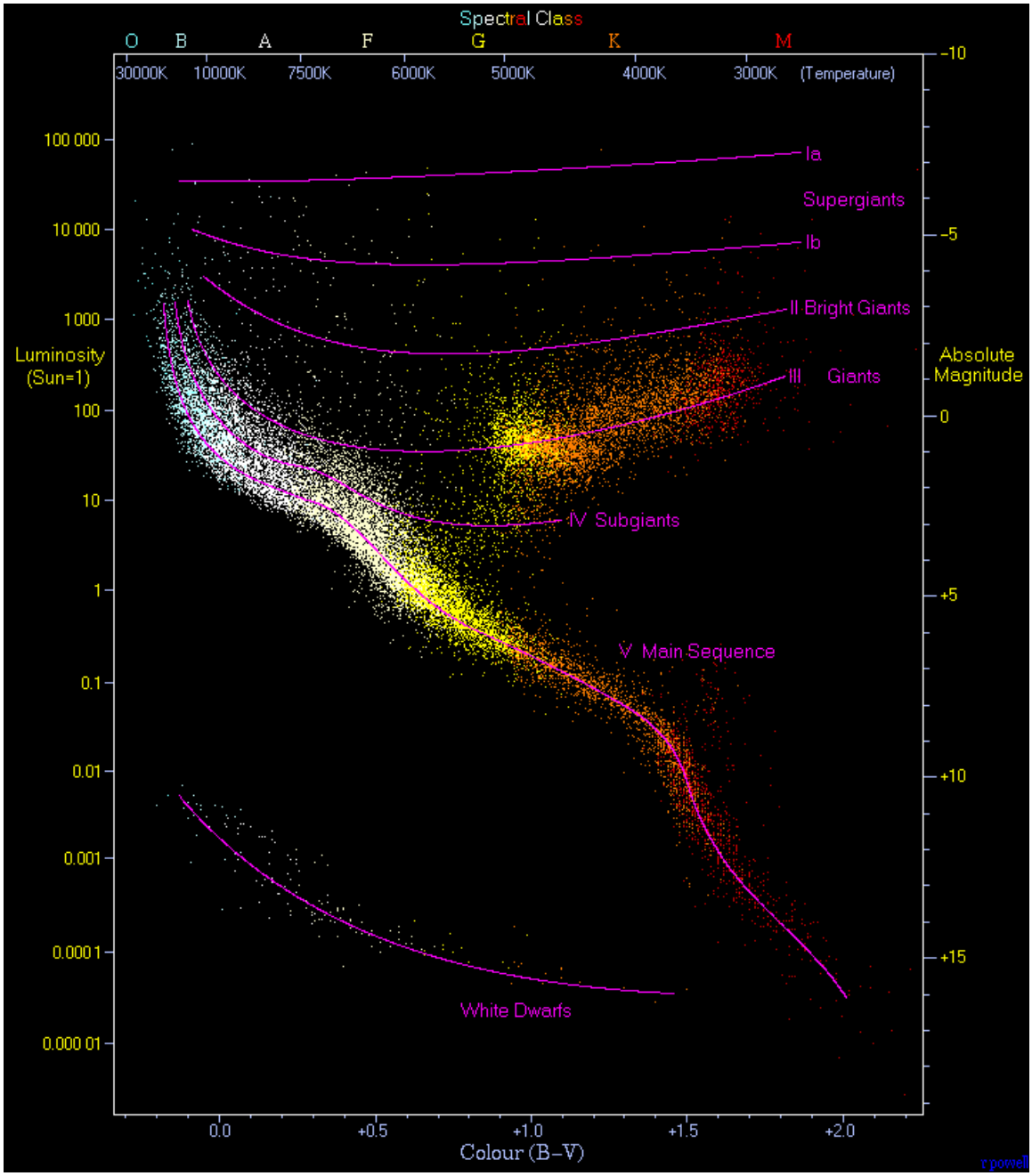
Background Information:
Two major characteristics of stars are their color and their brightness or magnitude. Absolute magnitude is the brightness of the star if it was a set distance away from earth, about 32.6 light years. Apparent magnitude is the brightness of the star as seen from earth. Magnitude is given the value of a number, the smaller the number, the brighter the star. Color depends on and is determined by the star's surface temperature. Hotter temperatures are blue in color while cooler temperatures are red in color. True brightness depends on the star's diameter or size. The larger the star is the brighter it is, and the smaller the star is the less bright it is.

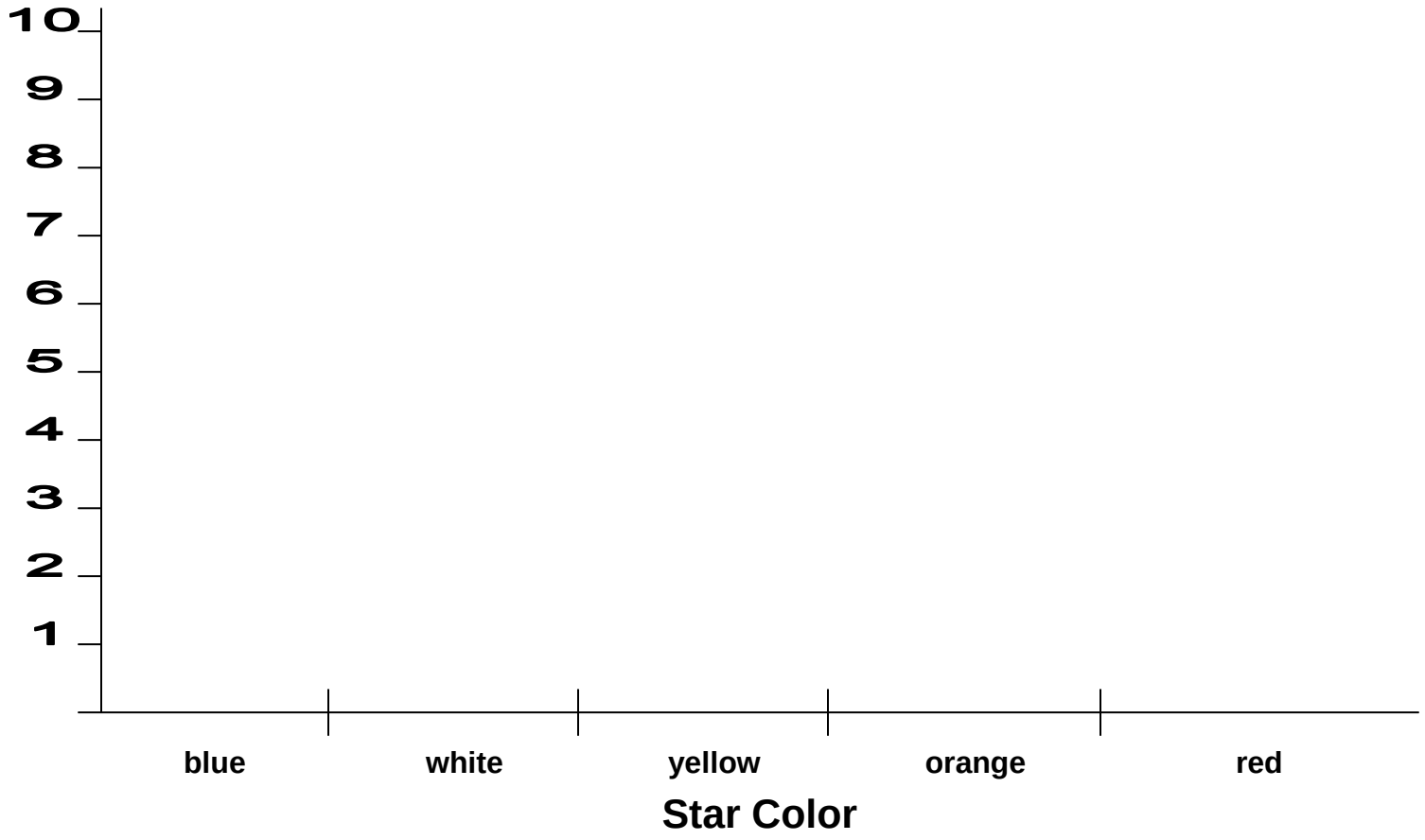
Star color or the temperature is often plotted on a graph against true brightness. Two astronomers used this information and created the Hertzsprung – Russell diagram. Sometimes luminosity is also plotted on the diagram. Luminosity is a measure of how much energy leaves a star in a certain period of time. Generally, the more luminous a star is, the brighter the star is. The luminosity of a star is not only affected by temperature but also by size. The most luminous stars would be those that are large and hot and the least luminous would be small and cool. In some cases, there are exceptions to this rule.

Activity:
Students will be able to practice measurement and graphing skills. They will discover the relationships between different types of stars, and they will create their own Hertzsprung - Russell diagram.

Procedure:

1. Take a look at the figure of the constellation Orion. The circles represent the stars of the constellation Orion. The diameter of the stars represents their magnitude.
2. Trace the stars on another sheet of paper.
3. Color each star with the appropriate color and then cut them out.
4. Measure the diameter of each star and place them in the H-R Diagram Graph according to their size and color.
5. Tape or glue the stars to the diagram.
6. If you have more than one star that looks alike in diameter and color, group them in a small area on the graph.
7. Use the graph to answer the questions.


Spectral Class
O
B
A
F
G
K
M
30000K
10000K
7500K
6000K
5000K
4000K
3000K
(Temperature)
-10
-5
0
+5
+10
+15
Absolute Magnitude
100 000
10 000
1000
100
10
1
0.1
0.01
0.001
0.0001
0.000 01
Luminosity (Sun=1)
Ia
Supergiants
Ib
II Bright Giants
III Giants
IV Subgiants
V Main Sequence
White Dwarfs
0.0
+0.5
+1.0
+1.5
+2.0
Colour (B–V)
rpowell


10
9
8
7
6
5
4
3
2
1
blue
white
yellow
orange
red
Star Color

Name _____ Date: _____

Class Section: _____

The Hertzsprung – Russell Diagram

1. Look at your graph. Do you see a pattern of stars on your graph? This pattern of stars is called the main sequence. Label it on your diagram. Describe the pattern made by the stars on your graph.

2. List all the types (color and size) of stars that are found in the main sequence.

3. Which stars (three groups) on your graph are not part of the main sequence stars?

4. Describe the relationship between star color and true brightness for stars in the main sequence.

5. Is the Sun a main sequence star? Why or why not?

Write in the following temperatures for the corresponding colors on your diagram:

Red	3,500 °K
Orange	5,000 °K
Yellow	6,000 °K
White	11,000 °K
Blue	25,000 °K

6. What is the approximate surface temperature of our yellow sun? Its size?

7. What is the color of the stars shown on the diagram that has the highest surface temperature?

8. What is the color of the stars that have the lowest surface temperature?

9. How is it possible for white dwarfs to have a lower luminosity than the sun even though the sun is much cooler than the white dwarfs?

10. How are red giants and blue giants similar? How are they different?

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