Astrobiology

An Integrated Science Approach

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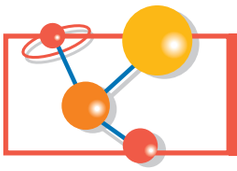

Activity Three

What Types of Stars are in Our Universe?

Purpose

To provide a sense of the abundance of different-colored stars and the relationship between color and temperature, mass, and age

Overview

Students are each given several star circles that include information about individual stars. They place these on a large class chart according to brightness and color (similar to an HR diagram). Discussion about the resulting chart involves trends between mass and color, temperature and color, and expected lifetime and color.

Time: 50 minutes

Context

Students should realize that the sun is only one type of star, and its type is not even the most abundant. Students will question whether the other types of stars could be suitable for supporting life in a solar system.

Key Concepts

- Stars come in many colors.
- A star's color is determined by its temperature.
- Hot stars generally have a shorter lifespan than cool stars.
- The sun is a yellow star, which is in the middle of the color and brightness spectrum, but yellow stars are not the most prevalent type in the universe.

Key Skills

- *Plotting* points on a graph
- *Analyzing* a graph to determine trends

Materials

- Scissors (for teacher)
- Large Poster Paper
- Markers
- Tape
- COLOR—*Star Circles*

Preparation

1. Cut out the *Star Circles* (COLOR).
2. Make a large plot on the classroom wall like the one on the *Star Chart Template*.

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Recommended Procedures

1. Have your students attach the star circles on the wall chart.
   - Give out all the star circles to your students. There are 100 circles, so each student will get about 3-5, depending on the number of students in your class.
   - Have students first examine the star circles, looking at both their own and their neighbors'.
   - One at a time, have students position their circles on the chart, using the temperature and brightness axes to position them correctly. The purpose of this activity is to notice trends, so tell students not to get too bogged down in exact positioning of the stars on the plot, but to be careful that they place the stars in the right range, or else the patterns will get confusing.
   - Have students copy the chart into their journal.
2. Discuss the resulting chart with the class.
   - Describe the general trend between temperature and brightness.
   - What is the color and brightness of the most abundant stars? The rarest stars?
   - What are the characteristics of the stars that do not conform to the graph's trend?
   - In terms of the graph's trend, is our sun typical or exceptional?
   - If you replaced the temperature scale on the graph's x-axis with a color scale, which color would be closest to the graph's origin and which would farthest away?
   - In the stars that fit the general trend (these are often called Main Sequence stars), what relationship do you notice between color and expected lifetime?
3. Have students read *What's the Story? — What Is a Star?* and *What's the Story? — What Determines Habitable Zones Around Stars?* and answer the *Checking In* questions.
4. Have students answer the *Think About It* questions.

Think About It

1. Why might stars of one color be much more abundant than stars of another color?

   Since the red dim stars live the longest, there are many of them still around. The only hot blue stars we see are ones that formed in the past few million years. The others have already died off.

2. Which type(s) of star should we consider first when looking for stars that might have life-supporting worlds around them? Why?

   Since our sun is a yellow star, this is a good place to start, and in fact this is where many extrasolar planet searchers are looking. The blue and white stars are often ruled out because they don't live long enough for planetary life to begin and evolve very far before the star goes supernova. The red dim stars may not give off enough energy to support life easily on planets around them.

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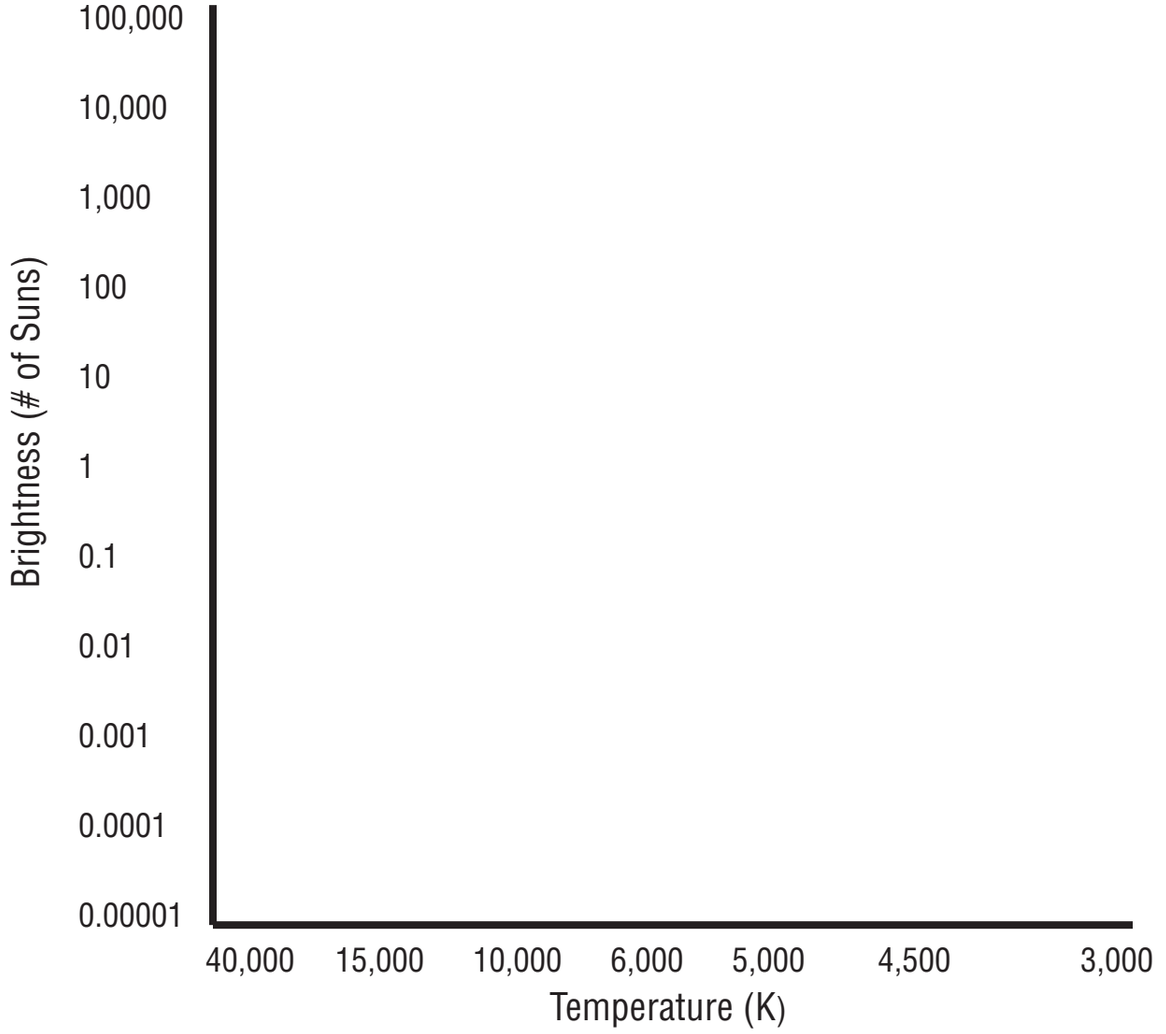
Star Chart Template



Notice that the axes are not scaled linearly. The vertical axis is brightness (in terms of number of times the brightness of our sun), and it is a geometric scale increasing by a factor of 10 each step. The horizontal axis is temperature (on the Kelvin scale) and it is roughly logarithmic. The graph is made this way to ensure that all the values fit within a reasonable area. It makes plotting the points more difficult for students, but they can approximate by doing a rough interpolation between numbers.

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