Name: _____ Date: _____

Hertzsprung-Russell (H-R) Diagram

Science Literacy Article

Stars come in different sizes and temperatures and with different chemical compositions. The **H-R diagram** is a chart that graphs the brightness and temperature of stars so that they can be more easily studied and compared by astronomers. By plotting the brightness and temperature of stars, astronomers can also determine their *color and mass*. The mass of a star determines all of its other characteristics. As a star's *mass changes* throughout its life span so does its *characteristics and placement on the H-R diagram*. It is extremely important to note that the Hertzsprung-Russell diagram is simply a graph of the characteristics of stars and not the actual placement of those stars in the sky.

- **Brightness**, which is also referred to as magnitude or luminosity, is represented on the **y-axis of an H-R diagram**. Brightness *increases as you move toward the top* of the diagram. For example, a star near the top of the diagram will be much brighter than a star near the bottom of the diagram.
- **Temperature** is represented on the **x-axis of an H-R diagram**. *Temperature increases as you move toward the left* of the diagram. For example, a star near the left side of the diagram will be much hotter than a star near the right side of the diagram.

Types of Stars

Since the *color of a star corresponds to its temperature*, the color of stars is often included on an H-R diagram as well. The color of stars, from hottest to coolest, is blue, white, yellow, red-orange, and red. Our Sun is yellow in color, therefore, it has an average temperature when compared to other stars. When plotting stars on the Hertzsprung-Russell diagram, their characteristics will also classify them into one of the four main groups of stars:

1. **Main sequence stars** make up the majority of stars on the H-R diagram. Main sequence stars can range from bright and hot (top-left of an H-R diagram) to dim and cool (bottom-right of an H-R diagram). Approximately 90% of all known stars are in the main sequence stage of their life cycle. Our Sun is an example of a yellow, main sequence star that is average in both brightness and temperature.

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2. **Giant stars** are the stage in a star's life cycle that occurs after the main sequence stage for small to medium mass stars. Giant stars are typically *average in brightness and cooler in temperature*. Giant stars are grouped about half way up and near the right side of an H-R diagram. Arcturus is an example of a red-orange, giant star that is brighter but cooler than the Sun.

3. **Supergiant stars** are the stage in a star's life cycle that occurs after the main sequence stage for high mass to extremely high mass stars. Supergiant stars are *extremely bright*, but they can range from *hot to cool temperatures*. Supergiant stars are grouped near the top of an H-R diagram. Deneb is an example of a white, supergiant star that is both brighter and hotter than the Sun.

4. **White dwarf stars** are the stage in a star's life cycle that occurs after a giant star stage. They are the *dense core that remains when a small to medium mass star has exhausted all of its nuclear fuel* and has lost its outer layers. White dwarf stars are *extremely dim* and typically have *hot to average temperatures*. White dwarf stars are grouped near the bottom of an H-R diagram. Sirius B is an example of a white, white dwarf star that is dimmer but hotter than the Sun.

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