**Star in a Box Worksheet**

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Period <period 3>

[Star in a Box Link](https://starinabox.lco.global/)

Launch the Star in a box and open the lid. The main plot is a Hertzsprung-Russell diagram. On the right, the information panel allows comparisons between the radius, surface temperature, luminosity and mass of the star relative to the Sun. The Starting parameters are for a star like the Sun.

1. Click the play button below the Hertzsprung-Russell Diagram (HR diagram) to show the Sun’s evolution. Once it is complete, you can click on the “Data Table” (upper right) to see the final values for each stage in the life cycle
   1. Describe how the Sun Changes over its lifetime

<the sun starts small and then increases size somewhat slowly during its life time until it quickly shrinks/ dies>

* 1. When will the sun be at its brightest?

<it will be the brightest when the core helium is burning and during the main sequence >

* 1. When will the Sun be at its hottest?

<it will be the hottest in the Thermally-pulsing Asymptotic Giant Branch stage>

* 1. In which stage of its life does the Sun spend the longest time?

<It spends the most time in the Red Giant Branch>

* 1. In what stage of life will the sun undergo the most change?

<it will undergo the most change between the two asymptotic giant branches.>

* 1. What kind of star will the Sun be at the end of its life?

<It will be a white dwarf star>

* 1. How long will the Sun live?

<about 12000 million years>

1. By adjusting the mass of the star in the “Star Properities” you can explore the evolution of different stars.
   1. Where do the different mass stars lie on the main sequence?

<the higher the mass of a star the higher it is on the main sequence>

* 1. List the different final stages of a star’s life?

<Wolf-Rayet star, Neutron Star, carbon/oxygen white dwarf and Helium White Dwarf>

1. Follow the evolution for five stars with different masses (You get to pick!) Complete the table below filling in a row for each mass you’ve selected. Hint #1 (You will need to watch the evolution, not just look at the Data Table Summary) Hint #2 (You will need to focus on this so put your phone away… Nealley Knows things!)

| **Mass of Star (Msun)** | **Time on main sequence**  **(Myr)**  **Millions of years** | **Number of stages** | **Final State** | **Total Life Span**  **(Myr)**  **Millions of years** | **Maximum Radius**  **(Rsun)** | **Maximum luminosity**  **(Lsun)** | **Maximum Temperature (K)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0.2 | 117,900 Myr | 4 | Helium White Dwarf | 1,087,000 Myr | 0.33 | 87.78 | 3,520K |
| 1 | 8992.81 Myr | 7 | carbon/ oxygen White Dwarf | 12000 Myr | 200.26 | 3910.21 | 6,005 K |
| 6 | 65.96 Myr | 7 | carbon/ oxygen White Dwarf | 12000 Myr | 444.02 | 23621.09 | 19,099K |
| 20 | 8.82 Myr | 5 | Neutron star | 12000 Myr | 1507.3 | 191029.31 | 34,056K |
| 40 | 4.87 Myr | 6 | Black Hole | 12000 Myr | 1433.51 | 425402.46 | 123,880K |

1. Compare the data table for a range of stars
   1. Are more massive stars the brightest and hottest types of star for their whole lives?

<No, because even though the more mass a star has the hotter and brighter it gets those stars don't stay as hot and bright for the longest time>

* 1. Which mass star gets the hottest?

<the star with a mass of 40 will get the hottest >

* 1. Which mass star gets the coolest?

<the star with a mass of 0.2 or a stor with 40 mass when it is blackhole>

* 1. Which mass star becomes the most luminous?

<the star with a mass of 40

1. *Deneb* and *Betelgeuse* (names of specific stars) are both 20x the mass of the Sun, but look very different. *Deneb* has 100 time the radius of the Sun and its temperature is about 8000K. *Betelgeuse* has 1000x the radius of the Sun and its temperature is about 3500k. Select a star with 20x the mass of the Sun and run the animation. Use this to answer the following
   1. What stages are the two stars in?

<Deneb is between the main sequence and the Hertzsprung Gap. Betelgeuse is between the Hertzsprung Gap and core helium burning. >

* 1. How long will each star live from its current age?

<Deneb will live about 1 million years, and Betelgeuse has about 400 thousand years to live. Their lives end when they turn supernova.>