**Modeling the Sun**

**Model:** In science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others.

Create a model of the Sun. Be sure to include the following elements:

What elements are inside the Sun?\*

What happens inside the Sun to give off energy?\*

What is the Sun’s life span?

How is Earth affected by the Sun?

Sun

Earth

\*Note: not to scale

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| **Scoring Elements** | **Beginning** | **Approaching Expectations** | **Meets Expectations** | **Advanced** |
| **Explains Phenomena:** *Does my model explain the energy given off by the Sun?* | Model does not explain the energy given off by the Sun. | Model includes some of the relevant parts of the model to explain what *causes* the energy given off by the Sun. Model might include text and diagrams. | Model connects all relevant components and relationships (observable and unobservable) of the model to explain what *causes* the energy given off by the Sun. Model includes text and diagram(s) to describe the model pieces and processes. | Model includes the relevant parts of the model to explain what causes the energy given off by the Sun (as in Level 3) – as well as additional components and relationships that fit the scientific model. |
| **Fits with Evidence:** *Does my model fit with the evidence collected?* | Evidence is not correctly related to the model. | Model correctly incorporates some of the evidence collected through investigations. | Model refers to a sufficient amount of relevant evidence collected through the investigations to be compelling. | Model fits with all of the evidence collected and additional evidence that could be collected is described. |
| **Clarity of Communication:** *Would someone else be able to understand my model?* | Model is not clearly described. | Model is somewhat clearly described. | Model is clearly explained in a way that allows others to understand how and why the phenomenon happens. Diagram and text include agreed-upon AND personally compelling conventions for representation. | Model is clearly described and additional communication or educational pieces are included for the audience. |

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| **Scoring Elements** | **Beginning** | **Approaching Expectations** | **Meets Expectations** | **Advanced** |
| **Modification of my Model:** *Did I modify my model based on new data and explain those modifications?* | I vaguely explained how I changed my model but did not connect my changes to evidence. Or, I did not revise my model. | I explain how I changed my model to better explain what caused the phenomenon, but only loosely connected my changes to evidence. | I explain how I changed my model to better explain what caused the phenomenon as I gathered new evidence and/or developed new ideas about components or relationships of the model. | I explain how I changed/added to my model to better explain what caused the phenomenon and clearly connected to newly gathered evidence and/or ideas about components or relationships of the model. |
| **Evaluating Limitations of my Model:** *Do I describe the limitations of my model?* | No limitations defined or only cosmetic changes suggested. | Some explanation of limitations. Little connection to the phenomena the model represents. | I explain what simplifications I have made in my model compared to the phenomena from the natural or built world. | I explain the limitations of my model and discuss how this limits its use to explain other related phenomena and suggest improvements and unanswered questions. |
| **Use my Model to Predict a Phenomena:** *Can I use my model to make a prediction about how the relative amounts of hydrogen and helium will change over time?* | I do not use my model to predict how the relative amounts of hydrogen and helium will change over time. | I attempt to use my model to predict how the relative amounts of hydrogen and helium will change over time, but I am missing some connections between my model and the change in amounts of hydrogen and helium. | Model is used to predict and explain how a different relative amounts of hydrogen and helium will change over time. | I identify and predict/explain what will happen as the composition of the Sun continues to change over billions of years. |

**Additional Evidence**

Our Sun:

Surface Temperature: 5,800 K Mass: 2 × 1030 kg Radius: 6.95 × 105 km Luminosity: 3.85 × 1026 W

Spectrum found for the Sun (the majority of elements):





Dwarf Stars

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| Star Type | Color | Surface Temperature (K) | Average Mass ( × 1030 kg) | Average Radius(× 105 km) | Average Luminosity (× 1026 W) | Lifespan (billion years) |
| Yellow Dwarf | White toYellowish White | 5,200 –7,500 | 0.16 – 2.8 | 6.72 – 9.8 | 2.4 – 20 | 4 – 17 |
| Orange Dwarf | Yellow Orange | 3,700 – 5,200 | 0.9 – 0.16 | 4.9 – 6.72  | 0.32 – 2.4 | 17-73 |
| Red Dwarf | Orange Red | Under 3,700  | 0.16 – 0.9 | 0.84 – 4.9 | 0.0004 – 0.32 | 73 - 5500 |

Giant and Supergiant Stars

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| --- | --- | --- | --- | --- | --- | --- |
| Star Type | Color | Surface Temperature (K) | Mass ( × 1030 kg) | Radius(× 105 km) | Luminosity (W) | Lifespan (billion years) |
| Blue Giant | Blueto Blue White | 7,500 – Over 30,000 | 2.8 – 530 | 9.8 – 1750 | 20 – 36,000,000 | 0.003 – 4 |
| Red Giant | Yellow to Orange Red | 3,200 – 5,200 K | 0.6 – 20 | 140 – 700 | 400 – 4000 | 0.1 – 2 |
| Red Supergiant | Yellow to Orange Red | 3,200 – 5,200 K | 20 – 80 | 700 – 11,550 | 4,000 – 3,200,000 | 0.003 – 0.1 |

(adapted from <http://www.enchantedlearning.com/subjects/astronomy/stars/startypes.shtml>, <https://sciencetrends.com/kind-star-sun/>, <https://owlcation.com/stem/Different-Types-of-Stars-in-the-Universe>, and <http://www.phschool.com/atschool/science_activity_library/types_of_stars/diagram.html>)