

Life of Stars – Week 1 Labwork

Name: _____ Hour _____ Date: _____

Date Packet is due: _____ Why late? _____ Score: _____
Day of Week Date If your project was late, describe why

Driving Question: How long do stars last?

Anchoring Phenomenon: How can the H-R diagram predict the futures of stars?

Deeper Questions

1. How does the mass of a star affect the rate at which it ages?
2. What are the different outcomes for stars as they age?
3. Why do stars change as they age?

Weekly Schedule

Part 1: Introduction

- Initial Ideas – The H-R Diagram
- Discussion & Developing Explanations

Part 2: Core Ideas

- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigation

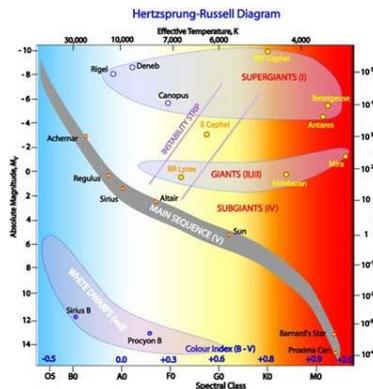
- Biographies of the Stars

Part 4: Review & Assessment

- Critiquing Ideas
- Assessment

Part 5: Side Quest

- Weekly Recap
- Side Quests



Semester Schedule

How the Sun Works

Week 1: What is matter? What is energy?

Week 2: What's inside the sun?

Week 3: How can we measure the sun?

Week 4: Where does the sun's energy come from?

Week 5: Unit Assessment

The Life of Stars

Week 1: How long do stars last?

Week 2: Why do stars die?

Week 3: What happens after stars die?

Week 4: Unit Assessment

How It All Began

Week 1: How can we determine the universe's size?

Week 2: How can expansion determine the universe's age?

Week 3: What can we learn from background radiation?

Week 4: Unit Assessment

Navigating Space

Week 1: How and why do things orbit in space?

Week 2: How can we predict orbits?

Week 3: Unit Assessments

NGSS Standard:

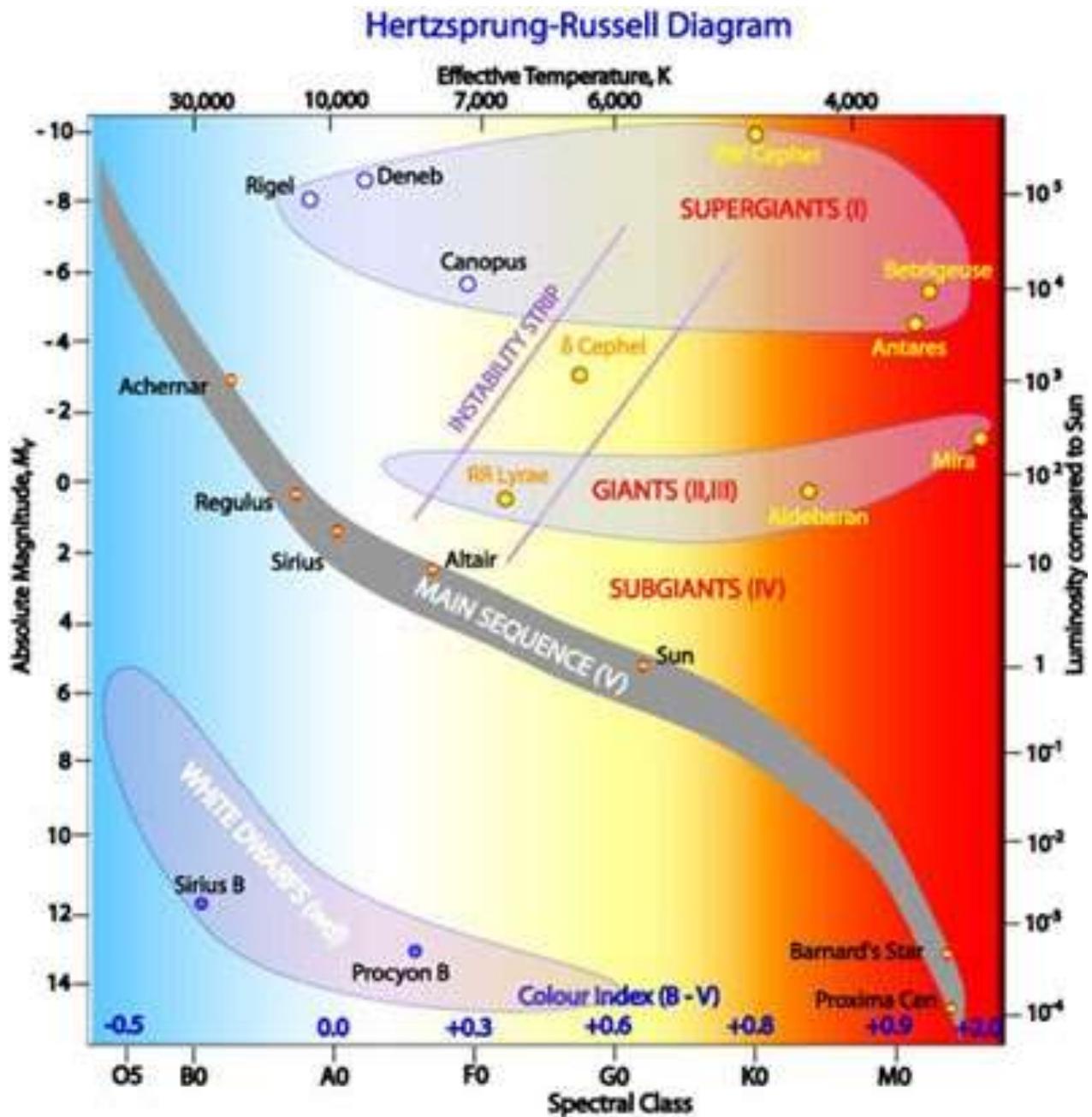
HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.

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Part 1: Initial Ideas About the H-R Diagram

Overview: In this activity, you will analyze the H-R Diagram to develop some initial ideas about the life cycle of stars.

Directions: Begin by answers the first questions on the next page. Try to reach a consensus. Next, individually interpret the graph below. Then work with your group to reach a consensus about the patterns and trends in this data and what conclusions they support.



Background: In the early 1900s, Hertzsprung and Russell graphed stars based on their internal temperature and luminosity. They also graphed stars based on their color (based on blackbody radiation) and their absolute magnitude (a star's standardized measure of size and brightness). Both are shown in the image here.

Questions

1. Three students shared their ideas about what happens to stars over time. **Do you agree or disagree with each student's claim?**
 - a. Mike: "I think that stars stayed essentially the same since the Big Bang." Agree/ Disagree
 - b. Lucia: "I think that all stars go through the same stages over time and that most stars are at different points in the same life cycles." Agree / Disagree
 - c. Oscar: "I think that every star changes in different ways because each star has a unique size and elemental composition." Agree / Disagree
2. **Work in your small groups to discuss your ideas.** Try to identify how your ideas are similar or different. Then work as a team to decide as a group whether each statement is correct or incorrect (and why). Be prepared to present your ideas to the class.

Videos: Next, watch the following videos individually or as a class (based on your teacher's instructions) – <https://youtu.be/gT8WrjBEaHM>

Data Dive: On the previous page, you can see the H-R Diagram, which is an important tool for astronomers. Discuss the questions below as a team and then as a class. Only the last question needs a written response.

3. **Begin by individually attempting to make sense of this image.** What trends or patterns do you notice? How does this relate to any prior knowledge or experience that you have?
4. **Next, work in your teams to discuss your ideas.** Where do you agree? Where do you disagree? Can you use this data to reach agreement? Do others have prior knowledge/experience that could help?
5. **Based on this data, what is one conclusion that would be supported by this data?**
 - a. How is this conclusion supported by this data?
 - b. What specifically suggests that your claim is accurate?
6. **Based on this data, what is a second conclusion that would be supported by this data?**
 - a. How is this conclusion supported by this data?
 - b. What specifically suggests that your claim is accurate?
7. **Would you change any of your responses to the first question above?** (See Question #1 under *Initial Ideas*). Discuss as a team.
8. **What are ideas that most in the class agreed on?** Where did your ideas differ as a class?
9. **What conclusions can we draw from the patterns and trends in this graph? Does this seem to indicate anything about how stars age or how long they last?** Write down your initial explanation in the space below. Don't worry if you aren't completely sure! You will have opportunities to revise.

Part 2: Core Ideas

Overview: In this activity, you will look at a short slideshow presentation. This will provide you with core ideas that will help you clarify your initial ideas. Your instructor will decide on how to implement this portion depending on your previous experience and capabilities with this content.

You will then work in small teams to answer the questions listed below. You should take notes in a notebook, on a dry erase board, or on scratch paper so that you are prepared to deliver your responses during the class discussion that will follow. *Note: your instructor may assign specific questions to your group if time is limited.*

Core Ideas Presentation: <https://bit.ly/WUHS-Astro-StarsW1>

Driving Questions:

1. True or False: all stars go through a predictable life cycle. Explain.
2. How long do stars last? What determines the length of the life of a star?
3. Where do stars come from?
4. What kinds of information are plotted on the H-R Diagram?
5. How information can be determined by observing a star's position on the H-R Diagram?
6. Briefly summarize the three main regions (or evolutionary stages) of stars on the H-R Diagram.
7. What is the Main Sequence stage? For how long do stars stay in this phase?
8. How does a star's internal balance shift while it is in the Main Sequence stage?
9. What changes occur as a star goes from the Main Sequence stage to the Red Giant phase?
10. How do White Dwarfs form?
11. What is a planetary nebula? How is it different from the nebula from which stars form?
12. How is the life cycle of high-mass stars similar and different from that of low-mass stars?
13. In high-mass stars, nuclear fusion will continue until iron is formed. Why?
14. Briefly summarize the events that occur after a high-mass star enters the phase of gravitational collapse.
15. What is a supernova explosion? Why does it occur? How does this event relate to the heaviest elements?
16. Some high-mass stars form neutron stars; others form black holes. Why? What determines this outcome?
17. **Revising Explanations:** How does the H-R Diagram help us to understand how stars age and how long they last?

Part 3: Investigation – Star Biographies

Overview: You will provide a summary of different stars of different masses at different stages in their life cycles as a means to better understand the life cycle of stars.

Directions: Choose a star from each category in the box in the lower right. Then use an internet search engine to acquire information needed to answer the questions below. Create a presentation (such as PowerPoint or Google Slides) to present the information you find. Plan for roughly a slide per question. You should complete this work in teams of 3-4.

Star Biography Questions

1. Where is this star located? How close is it to earth? Is it visible in the night sky? Is it part of a constellation? (If so, explain which one)
2. How old is this star? How much longer will this star exist?
3. What is the size of this star?
4. What kind of fusion is occurring in this star (e.g., hydrogen to helium)? How does this relate to its appearance?
5. What will happen to this star over its lifetime? (e.g., white dwarf, neutron star, or black hole?)

Main Sequence Stars

- Achernar
- Regulus
- Sirius
- Altair
- Sun
- Barnard's Star
- Proxima Centauri

Red Giants

- RR Lyrae
- Alderbaran
- Mira

Supergiants

- Rigel
- Deneb
- Canopus
- Betelgeuse
- Antares

White Dwarfs

- Sirius B
- Procyon B

Part 4: Review & Assessment

Overview: you will begin by reviewing the driving questions below in your small groups. For each objective, rank it as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comfort with that objective. Then work in teams to create responses to the questions (your instructor will determine if you will answer all the questions or only a portion).

Driving Questions:

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2. How long do stars last? What determines the length of the life of a star?
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15. What is a supernova explosion? Why does it occur? How does this event relate to the heaviest elements?
16. Some high-mass stars form neutron stars; others form black holes. Why? What determines this outcome?
17. **Revising Explanations:** How does the H-R Diagram help us to understand how stars age and how long they last?

Part 5: Side Quest

Overview: For this activity, you will begin with a recap of the things that you learned in this packet. You will then identify topics related to astronomy that you personally find interesting to investigate more deeply over the remainder of the semester.

Weekly Recap (use a whiteboard, scratch paper, online document, etc.)

1. Summarize everything that you have learned through this packet within your group. Try to identify the common themes, major ideas, and most important concepts from the content you have learned.
2. Is there anything that anyone still doesn't completely understand? Is there anything that anyone maybe disputes or disagrees with? Did anything seem particularly surprising or noteworthy?
3. What you think are the most important ideas and concepts that you have learned so far. Aim to have at least 5 or 6 ideas written down. It is ok to have more than this.

Side Quest: In this activity, you will begin to identify some topics related to astronomy to investigate more deeply over the course of the semester. Be prepared to discuss the following with your instructor.

1. Summarize the topic that you would like to investigate as your side quest.
2. Why did you choose this topic? Why do you find this topic interesting or intriguing?
3. What is your learning objective for this project? In other words, what do you want to learn and what do you want others to know by the time you finish your presentation?
4. Are you working alone or with a group? If in a group, how will you divide the work?
5. What is your strategy for developing a presentation? How will you effectively teach this topic?
6. Is this topic appropriate for the time available to you?
7. Are you excited about this topic? Is it something that is personally interesting to you?



Life of Stars – Week 1 Assessment

Name: _____ Hour _____ Date: _____ Score: _____ / _____

Directions: This is an open-notes quiz. You should work with your assigned team to complete responses to the questions below. Each person should write the response to at least one question. Write your initials next to the answer(s) you wrote. Those who are not writing should collaborate to create the response that will be written.

1. Briefly summarize astronomers can know a star’s internal structure and evolutionary stage simply by determining its position in the H-R diagram.

Initials:

2. Summarize each of the main regions (stellar evolutionary stages) on the H-R diagram.

Initials:

3. What is a Main Sequence star? How does a main sequence star’s internal structure and outward appearance change as it ages?

Initials:

4. How does the changes during the Main Sequence stage lead to the characteristics of the Red Giant and White Dwarf stages? Use the term *planetary nebula* in your response.

Initials:

5. How does the life cycle of a high-mass star differ from low-mass stars? What are the possible outcomes for high-mass stars as they age?

Initials:

6. What is a supernova explosion and why does it occur? How does this relate to the produce of most of the elements in the periodic table?

Initials:

7. What happens to high-mass stars after a supernova explosion? Summarize the possible outcomes.

Initials: