WeTeach_AI

Exploring Star Data with AI

Grade Level: **9-12** | Duration: **60 Minutes** | Subject Area: **Astronomy**

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This lesson was designed for the WeTeach_AI **Advancing AI Literacy Project**. The project supports the development of standards-aligned AI literacy lessons written by teachers for teachers. Additional lesson plan material, such as rubrics, answer keys, activity guides, and instructional considerations can be found here on our website.

The contents of this digital lesson were developed by the Texas Advanced Computing Center (TACC) with the support of Google.org. However, the contents do not necessarily represent the policies of Google.

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"After 15 years in 6th-8th-grade science, I transitioned to CTE in 2021 to teach Computer Science and Robotics. I'm a lifelong learner and PhD candidate in Curriculum and Instruction with a STEM focus at Texas Tech. My goal is to equip students with future-ready skills in critical thinking and problem-solving via real-world connections. This AI lesson is meant to combine my love for science, technology, and AI to bring relevancy and revitalize topics involving stars and the HR diagram."

Lesson Description

Students dive into the practical application of AI by using it to collect and organize data on stars, including temperature, luminosity, and classification. Working in groups, they create HR diagrams using both AI-generated visuals and traditional plotting methods. This dual approach allows students to compare the strengths and limitations of AI-assisted analysis versus manual techniques. Through collaborative discussion, students begin to evaluate the reliability and usefulness of AI in scientific contexts.

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Lesson Objectives
(formatted as "Students will be able to..." statements)

- Utilize AI tools to collect and organize data about stars.
- Create HR diagrams using both manual and AI-assisted methods.
- Compare and evaluate the accuracy of AI-generated data visualizations.
- Justify the choice of method (manual vs AI) for data visualization.
- Classify stars into their appropriate life cycle phase and determine their position on the HR Diagram.

Essential Questions

1. *How can we use AI to collect and visualize astronomical data?*
2. *What patterns emerge when we plot star data on an HR diagram?*
3. *How do AI-generated diagrams compare to manually created ones?*
4. *What are the benefits and drawbacks of using AI in scientific analysis?*

TEKS Alignment (Texas Standards Alignment)

§112.48 Astronomy: *The student understands the characteristics and life cycle of stars. The student is expected to:*

(c)(13)(A): Identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition.

(c)(13)(B): Describe and communicate star formation from nebulae to protostars to the development of main sequence stars.

(c)(13)(C): Evaluate the relationship between mass and fusion on stellar data.

(c)(13)(D): Compare how the mass of a main sequence star will determine its end state as a white dwarf, neutron star, or black hole.

(c)(13)(F): Use the Hertzsprung-Russell diagram to classify stars and plot and examine the life cycle of stars from birth to death.

CSTA/ISTE Alignment (National Standards Alignment)

CSTA	ISTE
2-DA-08: Collect data using computational tools and transform the data to make it more useful and reliable.	**1.5.b**: Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Effective Pedagogical Strategies

Activities that prioritize student questioning and discussion prompts with an emphasis on questions that promote higher order thinking skills (e.g., apply, analyze, evaluate) are selected.	Real-world applications and problems allow students to explore structures of power, assess for bias, and provide thoughtful responses that examine those structures and biases.

AI Literacy Competencies

(based on TeachAI Framework)

Create with AI 2: Visualize, prototype, and combine ideas using different types of AI systems. **Create with AI 3**: Collaborate with generative AI systems to elicit feedback, refine results, and reflect on thought processes.	**Designing AI 2**: Compare the capabilities and limitations of AI systems that follow algorithms created by humans with those that make predictions based on data.

Key Terms	
Term	**Definition**
HR Diagram	A graph that plots stars according to their luminosity and temperature.
Main Sequence	Longest, most stable phase in a star's life.
Nebula	A cloud of gas and dust; a stellar nursery.
Spectral Class	Classification of stars from hottest to coolest (O, B, A, F, G, K, M).
Visualization	A graphical representation of data.

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Launch

Engaging activity or prompt to introduce the lesson. **Estimated time: 15 minutes**

Objective: Students will review HR diagram concepts and stellar properties to prepare for data collection.

Materials:

- HR diagram image (projected or printed), provided in this lesson's resources
- Sticky notes or digital note-taking tool
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)
- Whiteboard or chart paper for group responses

Teacher Instructions	Sample Teacher Remarks
Display an HR diagram on the screen. Ask students to work in pairs for 2 minutes to recall: - What two properties are plotted on the HR diagram? - Where would the Sun be located? Invite volunteers to share answers and clarify misconceptions. Use the following review questions to introduce key concepts and vocabulary: - Where do stars begin their life cycle? (Answer: Nebula) - What does the main sequence represent? (Answer: Longest, most stable phase) - What do spectral classes tell us? (Answer: Temperature and color) - Why do scientists use Kelvin instead of Celsius? (Answer: Absolute zero reference for precision) - What's the difference between luminosity and magnitude? (Answer: Energy output vs apparent brightness)	*"Before we dive into data collection, let's make sure we remember how the HR diagram works. Look at this diagram—what does it show? Where would the Sun be?"* ***(Pause to provide students the chance to work in pairs for 2 minutes to recall and then invite volunteers to share answers.)*** ***(Next, guide students through a quick review via the provided set of review questions.)*** *"Notice the main sequence—that's where most stars spend their longest, most stable phase. Stars start in a nebula, a cloud of gas and dust, and move through stages that we can track on this diagram. See the letters O, B, A, F, G, K, M? Those are spectral classes, which tell us temperature and color.* *Remember, surface temperature is measured in Kelvin, not Celsius, and luminosity shows how much energy per second a star emits. Magnitude tells us brightness from Earth versus actual brightness. These details will guide your work today."*

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Anticipated Student Outcomes

- Students correctly identify temperature and luminosity as HR diagram axes.
- Students recall main sequence placement and stellar properties.
- Students connect vocabulary (nebula, spectral class, Kelvin, luminosity, magnitude) to HR diagram interpretation.
- Students feel prepared to apply this knowledge in data collection and diagram creation.

Exploration

Step-by-step student tasks, experiments, or investigations. **Estimated time: 35 minutes**

Objective: Students will use AI tools to collect stellar data and begin creating HR diagrams using both AI-generated and manual methods.

Materials:

- Blank HR diagram templates (printed or digital)
- Devices with AI access
- Links to HR diagram graph options (provided in this lesson's resources)
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)
- Teacher-provided star list (provided in this lesson's resources)

Teacher Instructions	Sample Teacher Remarks
Explain that students will work in pairs or small groups to collect star data using AI and then create HR diagrams. Divide tasks amongst the students. Half the class will prompt AI to generate an HR diagram; the other half will manually plot data collected from AI. Remind students to record AI prompts, responses, and any adjustments they make on their worksheet. Circulate to check for effective prompting and accurate data collection.	*"Now that we've reviewed the HR diagram and stellar properties, it's time to apply what you know. Your goal is to collect data for specific stars and create an HR diagram.* *Half of you will use AI to generate the diagram, and the other half will plot it manually. Remember, if you're using AI, good prompts matter—be specific about what you need. For example: 'Provide the temperature in Kelvin, luminosity, and spectral class for Betelgeuse.'* *Document your prompts and results. If something looks off, revise your prompt and try again. This is our chance to see how AI compares to traditional methods."*

Anticipated Student Outcomes

- Students successfully collect star data using AI.
- Students create HR diagrams (AI-generated or manual).
- Students practice effective AI prompting and iterative refinement.
- Students begin noticing differences between AI outputs and manual plotting.

Whole Class Discussion

Discussion questions, teacher prompts, and expected student responses. **Estimated time: 15 minutes**

Objective: Students will compare AI-generated HR diagrams with manually plotted diagrams and evaluate the accuracy and limitations of AI outputs.

Materials:

- AI-generated HR diagrams (student work)
- Manually plotted HR diagrams (student work)
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)
- Whiteboard or projector for summarizing observations

Sample Teacher Remarks
"Now that you've created HR diagrams using two different methods—AI and manual plotting—let's analyze what we see. How do these diagrams compare? Are there differences in accuracy or detail? Think about efficiency: Which method was faster? Which was easier? Finally, let's consider limitations—what might AI miss or misinterpret when creating scientific visuals?"

Sample Discussion Questions	Sample Student Responses
1. How do the AI-generated HR diagrams compare to the manually plotted ones?	*"The AI diagrams look polished, but some star positions were slightly off compared to our manual plots."*
2. Which method was more efficient and why?	*"AI was faster because it created the diagram instantly, while manual plotting took more time."*
3. Did you notice any inaccuracies in the AI-generated diagrams?	*"Yes, one diagram placed a star in the wrong spectral class because the prompt wasn't specific enough."*
4. What are some limitations of using AI for scientific visualization?	*"AI depends on the quality of the prompt and its training data—it can't verify accuracy like a scientist."*

5. How could you improve your AI prompts to get better results?	*"Include specific details like temperature range, luminosity scale, and request a labeled HR diagram."*

Assessment

Formative or summative assessment tasks and criteria. **Estimated time: 15 minutes**

Objective: Measure students' ability to compare AI-generated and manually plotted HR diagrams and evaluate accuracy, efficiency, and limitations of AI outputs.

Materials: Student Cosmic Collaborators worksheet and exit ticket or digital form for prompt submission

Assessment Opportunities	Facilitation Tips
Quick Reflection: Comparing AI and Manual HR Diagrams Ask students to respond to two quick prompts: - What is one strength and one weakness of the AI-generated HR diagram compared to the manual version? - How could you improve your AI prompt to get a more accurate diagram? Students share responses with a partner or submit as an exit ticket. Providing the following submission options is recommended: - Written paragraphs (Google Docs, LMS, or sticky notes). - Audio or video response for students who prefer verbal expression. ☑️Use the rubric provided in this lesson's resources to assess student submissions.	Prompt students to write responses on their Cosmic Collaborators worksheet or sticky notes. Circulate to check for understanding and clarify misconceptions. Encourage students to use vocabulary terms (e.g., luminosity, spectral class, main sequence) in their responses. Mastery Indicators: - Students can identify at least one similarity and one difference between AI and manual diagrams. - Students can state one limitation or challenge of using AI for scientific visualization.