WeTeach_AI

Analyzing & Reflecting on AI's Role in Astronomy

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

(Note: this lesson's duration was calculated excluding time estimates for the assessment)

LESSON TABLE OF CONTENTS

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

In this lesson, students synthesize their learning by presenting and analyzing HR diagrams created through different methods. They engage in a gallery walk and whole-class discussion to identify trends, anomalies, and insights. A mini-lesson on AI bias and limitations encourages critical thinking about the role of AI in scientific research. Students conclude with a Claim-Evidence-Reasoning (CER) writing task, articulating their stance on the value of AI in astronomy based on evidence gathered throughout this lesson series.

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

- Analyze patterns and trends in HR diagrams.
- Identify potential biases or limitations in AI-generated scientific data.
- Construct a CER argument evaluating the usefulness of AI in astronomy.
- Critique the role of AI in scientific research using evidence from the lesson.
- Design a strategy for improving AI prompts to reduce bias.

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
(c)(13)(A): The student understands the characteristics and life cycle of stars. The student is expected to identify the characteristics of main sequence stars, including surface temperature, age, relative size, and composition.

(c)(13)(F): The student understands the characteristics and life cycle of stars. The student is expected to 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.

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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)

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.	**Engaging with AI 2**: Evaluate whether AI outputs should be accepted, revised, or rejected.	**Managing AI 3**: Direct generative AI systems by providing specific instructions, appropriate context, and evaluation criteria.

Key Terms	
Term	**Definition**
AI Bias	A tendency of AI to produce skewed or inaccurate results due to training data or prompt design.
Claim-Evidence-Reasoning (CER)	A structured format for scientific argumentation.
Limitations	Constraints or weaknesses in AI capabilities.
Machine Learning	Technology that helps computers learn from data and make predictions or decisions without being told exactly what to do.
Scientific Analysis	The process of interpreting data to draw conclusions.
Super Giant	The largest and most luminous stars, which can be several hundred times larger than the Sun and many thousand times more luminous.

White Dwarf	Remains of a medium-sized star that has exhausted its energy.

Launch

Engaging activity or prompt to introduce the lesson. **Estimated time: 10 minutes**

Objective: Students will identify differences between AI-generated and manually created HR diagrams and begin considering the implications of AI in scientific research.

Materials:

- AI-generated HR diagrams (from the previous lesson)
- Manually plotted HR diagrams
- Projector or whiteboard for displaying examples
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)

Teacher Instructions	Sample Teacher Remarks
Display one AI-generated HR diagram and one manually plotted diagram side by side. Ask students to silently observe and jot down at least two differences and one similarity. Facilitate a quick share-out to surface observations and set up deeper analysis later.	*"Take a close look at these two HR diagrams—one created by AI and one plotted by hand. What do you notice? What stands out as different? What looks similar? Think about accuracy, detail, and clarity. This is our starting point for today's discussion on how AI influences scientific work.* *Later, we'll explore whether these differences matter and what they tell us about the strengths and limitations of AI."*

Anticipated Student Outcomes

- Students identify visual and data differences between AI and manual diagrams.
- Students begin questioning the reliability and usefulness of AI-generated scientific outputs.
- Students prepare for deeper reflection on AI's role in astronomy.

Exploration

Step-by-step student tasks, experiments, or investigations. **Estimated time: 30 minutes**

Objective: Students will analyze AI bias and limitations in scientific contexts and apply scientific reasoning (CER) to evaluate AI's role in astronomy.

Materials:

- Devices with internet access
- Examples of AI-generated HR diagrams from previous lessons
- Projector screen or display for showing video
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)

Teacher Instructions	Sample Teacher Remarks

Video & Reflection (8 min) Play this video: 3 types of bias in AI | Machine learning Students jot down key ideas: - What is AI bias? - How could it affect astronomy research? Small Group Analysis (12 min) Students review in groups their AI-generated HR diagrams from the previous lesson. They identify any inaccuracies or unexpected results. Have students discuss: *"Were these due to prompt design, data limitations, or AI bias?"* Introduce CER Framework (10 min) Explain **Claim-Evidence-Reasoning** as a tool for scientific argumentation. - **Claim:** Your position. - **Evidence:** Examples from your diagrams and today's discussion. - **Reasoning:** Why your evidence supports your claim. In groups, students begin drafting a claim: *"AI is beneficial for star data analysis"* or *"AI has significant limitations in astronomy."* Encourage students to write their claims in a visual format that can be seen by their peers in the upcoming gallery walk. **Anticipated Student Outcomes** - Students define AI bias and limitations in their own words. - Students identify examples of bias or inaccuracies in AI-generated diagrams. - Students use scientific analysis to interpret findings. - Students begin constructing a CER argument using evidence from their work.	*"Before we dive in, let's clarify something important: AI is a broad term for systems that mimic human intelligence—like reasoning and decision-making. Machine Learning is a subset of AI where systems learn patterns from data instead of following fixed rules. This matters because bias often comes from the data machine learning uses.* *I have a video for us to watch. As you watch, jot down answers to these questions:* - *What is AI bias?* - *How could bias affect astronomy research?* *Think about how incorrect classification of stars—like calling a super giant a main sequence star—could lead to wrong conclusions about stellar evolution."* ***(Pause to show the video.)*** *"Now, look closely at your diagrams. Were any stars placed incorrectly? For example, did AI mislabel a white dwarf, which is the remnant of a medium-sized star, or a super giant, which is a massive star nearing the end of its life cycle? Discuss in your group:* - *Were these errors caused by vague prompts?* - *Could they be due to limitations in AI's training data?* - *Or do they reflect AI bias?* *Record your observations on your worksheet."* ***(Pause for small group analysis. Then, transition into explaining the CER framework.)*** *"Scientists use Claim-Evidence-Reasoning (CER) to make strong arguments. Your claim might be: 'AI is beneficial for star data analysis' or 'AI has significant limitations in astronomy.'* - *Claim: Your position.* - *Evidence: Examples from your diagrams and today's discussion.* - *Reasoning: Why your evidence supports your claim.* *Start drafting your claim with your group now—we'll*

	refine it later."

Whole Class Discussion

Discussion questions, teacher prompts, and expected student responses. **Estimated time: 20 minutes**

Objective: Students will share observations from their analysis of AI-generated HR diagrams, identify examples of bias and limitations, reflect on similarities and differences in CER arguments, and discuss implications for scientific research.

Materials:

- AI-generated HR diagrams (student work)
- Manually plotted HR diagrams (student work)
- Sticky notes for Gallery Walk comments
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)

Students first complete a 10-minute gallery walk, exploring other groups' diagrams and CER arguments. Then, the class convenes for a 10-minute whole class discussion as a reflection on the lesson and exercise.

Sample Teacher Remarks
"Now that you've explored AI bias and limitations in small groups, let's bring our ideas together. During this Gallery Walk, you'll visit other groups' diagrams and CER arguments. Look for differences, inaccuracies, and any signs of bias. Also, pay attention to how your peers structured their CER arguments—what claims did they make? What evidence did they use? Afterward, we'll reflect on what this means for using AI in astronomy and how your own argument could be stronger."

Sample Discussion Questions	Sample Student Responses
1. What similarities and differences did you notice in your peers' CER arguments?	*"Most of us agreed AI is helpful for speed, but some argued it's unreliable for accuracy."*
2. Did you find any examples of AI bias or limitations?	*"Yes, AI assumed all stars were the main sequence because our prompt didn't specify life cycle stages."*

3. How could these inaccuracies affect scientific research?	*"They could lead to incorrect conclusions about star evolution or misclassification of super giants and white dwarfs."*
4. What strategies could improve AI outputs for astronomy tasks?	*"Use precise prompts with temperature ranges, luminosity scales, and request labeled diagrams."*
5. How will you use these observations to strengthen your CER argument?	*"We'll include evidence of AI's speed and convenience but also note its limitations and bias risks."*

Assessment

Formative or summative assessment tasks and criteria.

Objective: Students will construct a CER argument evaluating the usefulness and limitations of AI in astronomy, using evidence from their HR diagram analysis and Gallery Walk observations.

Materials:

- AI-generated and manually plotted HR diagrams
- Notes from Gallery Walk and discussion
- Student Cosmic Collaborators worksheet (provided in this lesson's resources)

⚠️**Note:** The time estimates for the various assessment options vary. If time is a constraint, it is recommended that the assessment be completed outside of the class period.

Assessment Opportunities	Facilitation Tips
Revised CER Arguments Have students revisit the CER structure: - Claim: Your position on AI's role in astronomy (beneficial, limited, or both). - Evidence: Observations from diagrams, Gallery Walk, and discussion. - Reasoning: Why your evidence supports your claim; include concepts like AI bias, limitations, and scientific analysis.	Show an example CER argument on the board (e.g., "AI is beneficial for astronomy because..."). Highlight the claim, evidence, and reasoning separately. Provide sentence starter scaffolds like: - *Claim:* "I believe AI is [beneficial/limited] in astronomy because..." - *Evidence:* "One example from our HR diagram activity is..." - *Reasoning:* "This matters because accurate classification impacts scientific research..."

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Students write CER arguments individually. Encourage use of key terms: AI Bias, Limitations, Scientific Analysis, Super Giant, White Dwarf. ☑️Use the below assessment criteria to assess student submissions. Assessment Criteria (Rubric Outline) • Claim (1 point): Clear position stated. • Evidence (2 points): At least two relevant observations cited (e.g., diagram accuracy, speed, bias). • Reasoning (2 points): Logical explanation connecting evidence to claim; includes key terms. • Use of Vocabulary (1 point): Incorporates terms like AI Bias, Limitations, Scientific Analysis, Super Giant, White Dwarf.	Encourage students to reference specific findings from the Gallery Walk and their own diagrams (e.g., misclassified stars, efficiency differences). Remind students to incorporate vocabulary: AI Bias, Limitations, Scientific Analysis, Super Giant, White Dwarf. Have students swap CER drafts and check for: - Is the claim clear? - Does the evidence support the claim? - Is the reasoning logical and connected to science? Allocate 10–12 minutes for writing and 3–5 minutes for peer review to ensure quality without rushing. Remind students that claims can differ—some may argue AI is helpful, others may focus on its limitations. Both are valid if supported by evidence.