

Co-Designing A Space Weather Curriculum That Responds to High School Students' Interests



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BACKGROUND

When classroom spaces are created to foster students' sense of belonging and recognize their multifaceted cultural, community, and familial knowledge, they are positioned with agency over their voice, empowered in their education, and make space for their sense-making:

CULTURALLY RESPONSIVE PEDAGOGICAL FRAMEWORK (CRP)

- Pedagogy that empowers students by aligning with their cultural means of communicating, imparting knowledge, and their experiences.
- Culture is not a reference dictionary to translate into the dominant monolingual discourse (Ladson-Billings, 1995)
- Our framework focuses on cultural identity, assets, student engagement, relationships, and rigor (Evans, 2023).

COHERENCE FROM THE STUDENTS' PERSPECTIVE

- Science curriculum normally organized through thought process of a disciplinary expert, where the end learning objective is only known to the person who made the materials (the expert)
- Students are co-investigators, creating activities based on their questions and ideas about a phenomenon.
- This fosters a complete contextual picture and investment in their learning (Reiser et al., 2021).

RESEARCH QUESTIONS

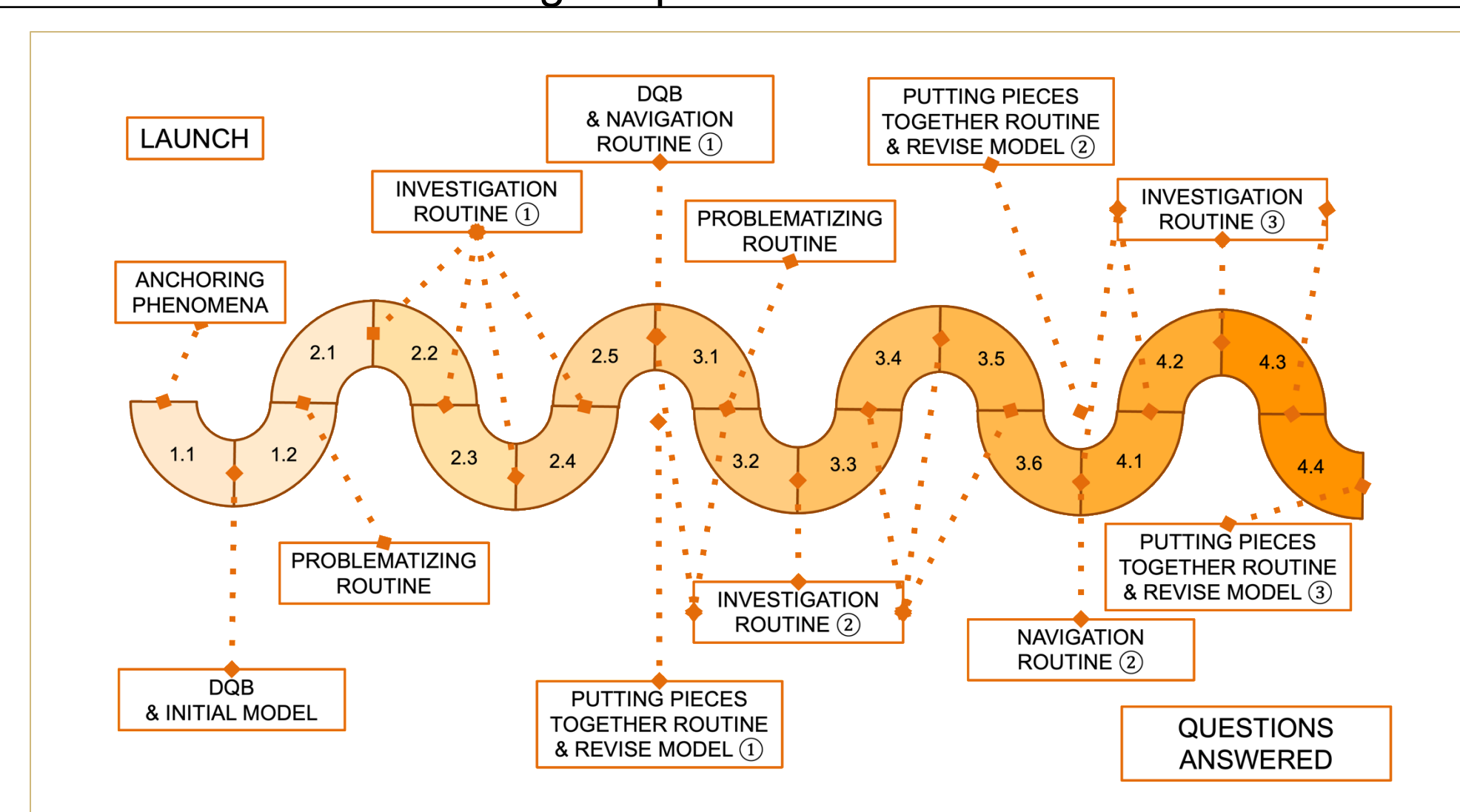
1. How can we design a curriculum for space weather based on culturally responsive principles?
2. To what degree are students interested in the curriculum? How is this sustained through the unit?

RESEARCH GOALS

Co-design a high school space weather curriculum with physics teachers, educational researchers, and scientists specializing in satellite surface charging in ways that build on and respond to students' interests.

Table 1
Culturally Responsive Curriculum Framework

Code	Description
Cultural Identity	Students are encouraged to draw upon their social & cultural background. Family, elders, friends, neighbors, community, etc. Encourage multiple ways to solve / multiple ways of knowing
Assets	Encourage student voice/choice/agency
Student Engagement	Encourage multiple ways to explain/express knowledge
Relationships	Encourage collaboration to deepen knowledge
Rigor	Cognitively challenging High order thinking skills Transfer newly acquired knowledge to solve in new scenarios
Vulnerability	Students encouraged to engage in risk taking without fear of being "wrong" Encourage students to draw upon prior knowledge/experience



STUDY POPULATION & SETTING

- Culturally, linguistically, and racially diverse school district near a large Western U.S. city.
- Almost half population identifies as second-language learners
- Over three-fourths identifying as Spanish speakers.
- Co-design team: physics, Earth, space science, and engineering teachers, educational researchers, astrophysicists, and district curriculum leaders.

Lesson Question	Phenomena or Design Problem	What we do and figure out	How we represent it
LESSON 1.2 Lesson Set 1 1 day How can we represent/model satellites in the Earth-Sun system? Anchoring Phenomenon	 Satellites are located in space outside the Earth, and communicate information back to Earth to perform a variety of functions that are useful in our daily lives.	We draw initial models representing our current understandings of where satellites are in relation to the Earth and Sun. We use these models, as well as our conversations about the resource sets from lesson 1, to surface questions that we have about these scenarios and collect questions for our Driving Question Board. We learn where we are headed in this unit, and how we will be expected to show what we learn and can do in a performance task at the end of the unit. Navigation to Next Lesson: We figured out there are a lot of different kinds of satellites, and we made models of how we think these are related to each other in space. We recognize we need to learn more about how satellites work, and what the conditions are in space that might affect them.	

FINDINGS

The three sources of data for the analysis — the Student Exit Ticket, Curriculum Material Analysis, and Teacher Interviews — suggest that the curriculum materials support the CRP framework in terms of Student Engagement, Relationships, and Rigor.

(RQ1) Our co-design team successfully developed a curriculum that aligns with our culturally responsive principles. Improvements are ongoing for areas for Student Cultural Identity & Assets.

(RQ2) Additionally, the study has found that the importance of student voice in identifying questions for the unit is reflected in their overall interest and engagement.

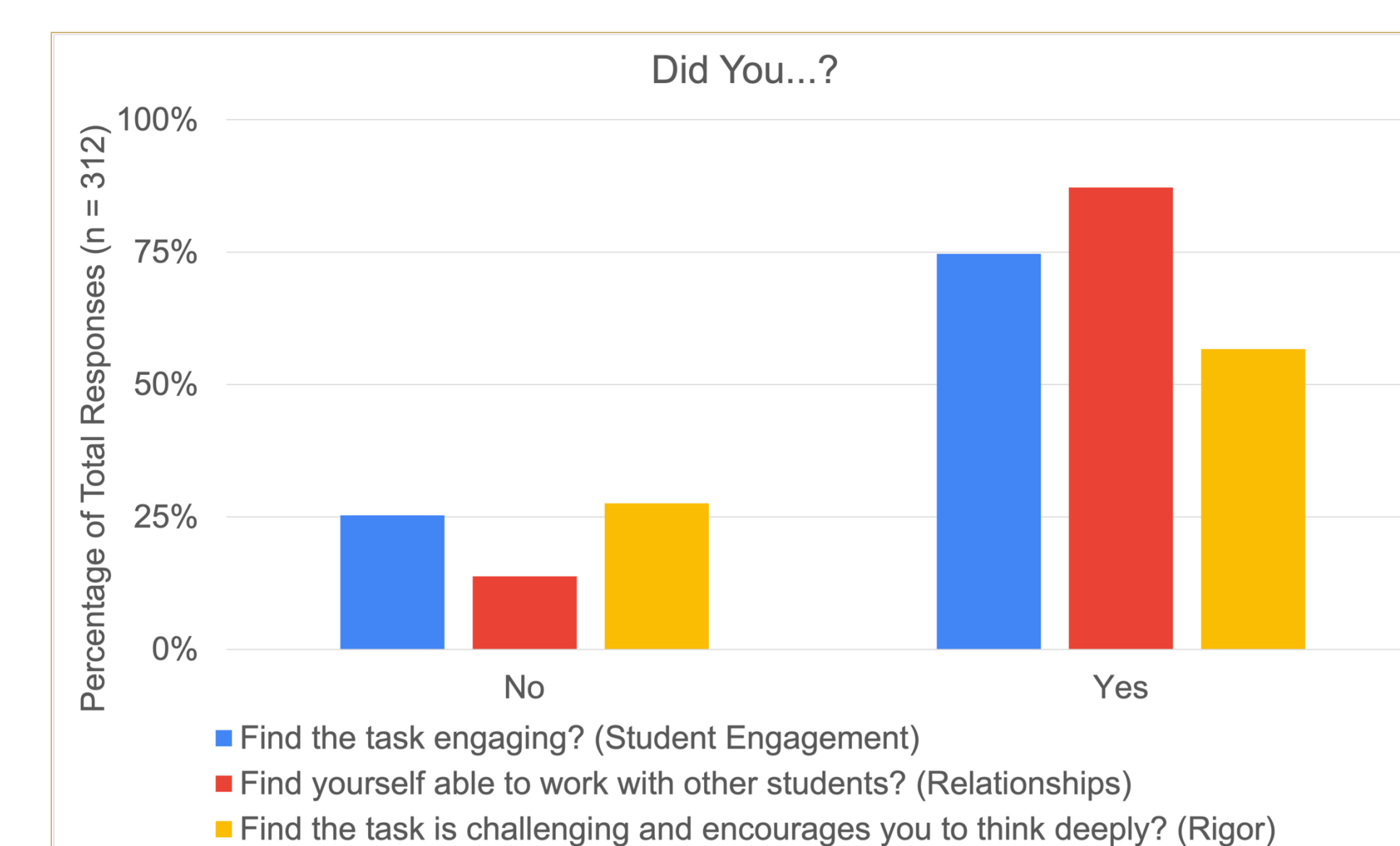
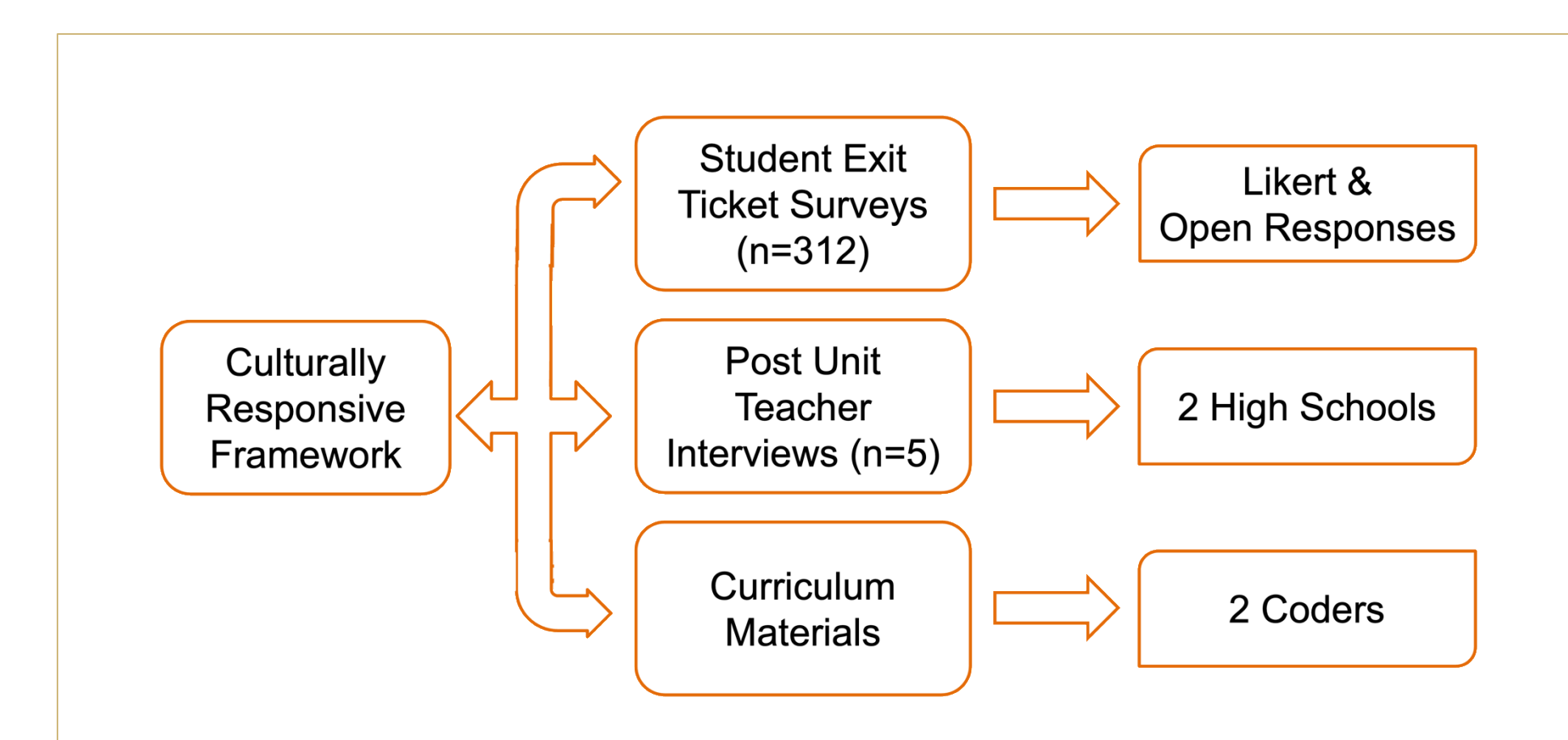


Table 2
Student Quotes in Response to Open-Ended Questions

Code	Open Ended Question	Student Quote
Student Engagement	Did you find the task engaging (like you wanted to keep working on it)? Explain.	What I found engaging was looking at all the different satellites that NASA currently owns and has up in orbit and seeing the functions and designs of each one.
Relationships	Are you able to work with other students to complete this task? Explain.	I am able to work with other people, we all have different levels of knowledge in this subject so we can share different ideas and thought.
Rigor	Do you think the task is challenging and encourages you to think deeply? Explain.	I think it does because it makes me ask questions I would never thought about and gets me more interested in the topic.

Table 3
Teacher Interview Responses to How Curriculum Supported Students

Code	Quote
Student Engagement	"...where kids are taking real data . And this data actually has some kind of meaning to it . Incredibly powerful because you watch their engagement just go through the roof."
Student Engagement	"So the storyboarding was really cool and it really helped bring all of their learning together ... We're telling a story like we have a satellite that's orbiting the sun. Something happens in the sun. It's now coming towards the satellite, and now it affects our satellite and them "
Rigor	"It's the same thing. You're just writing a little bit more text [on the scientific model] and having them start to realize, like, you know so much about this . You just have to include it... So quick! Draw! Put that in there like that. You already have all this information. Now we're trying to condense it into this kind of one cohesive piece . And they're reviewing a lot in the, in a very passive way. They were picking up on stuff, and it was a great way to kind of summarize everything... "

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