Identifying Science Practices in an Upper-Division E&M Activity

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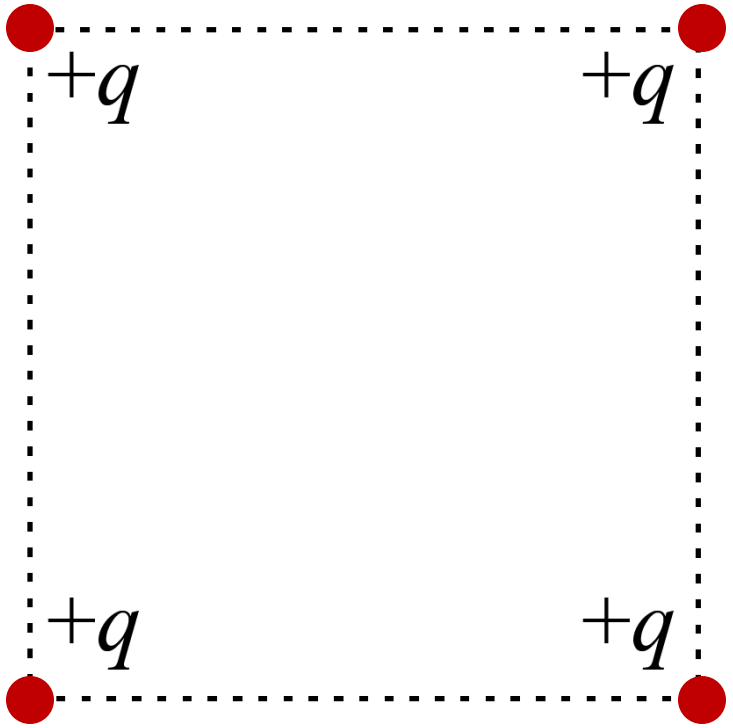
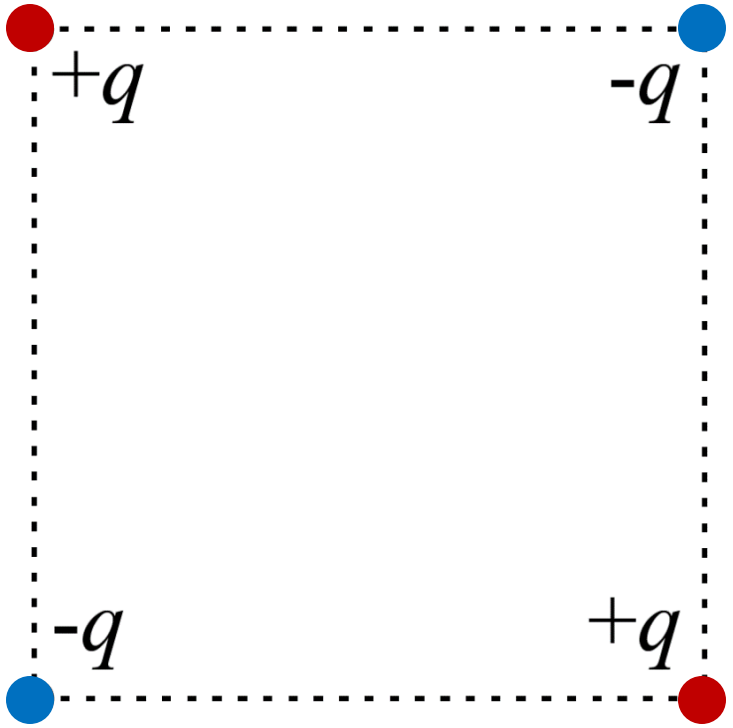
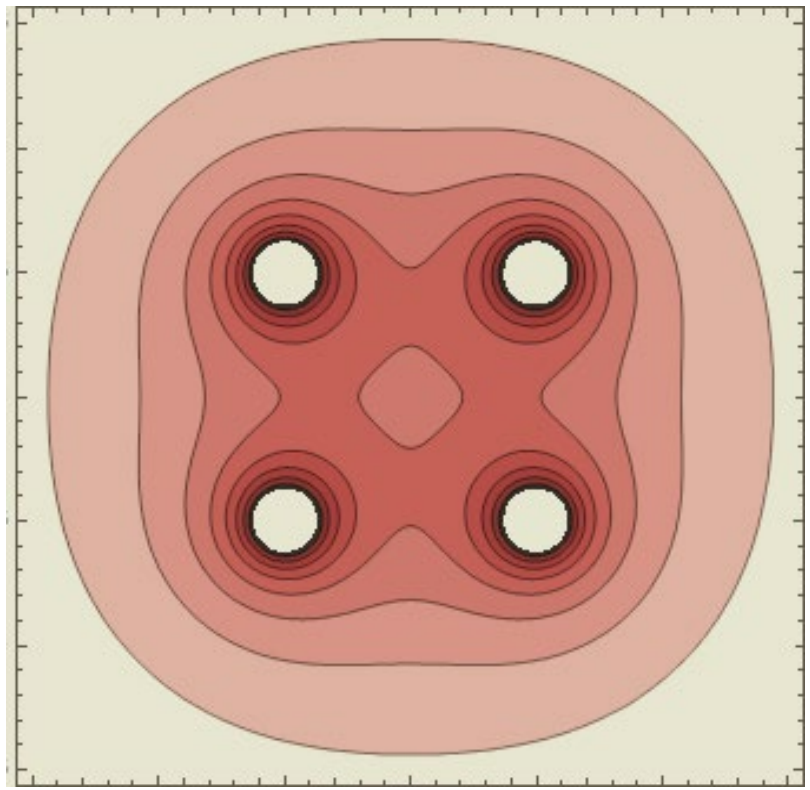
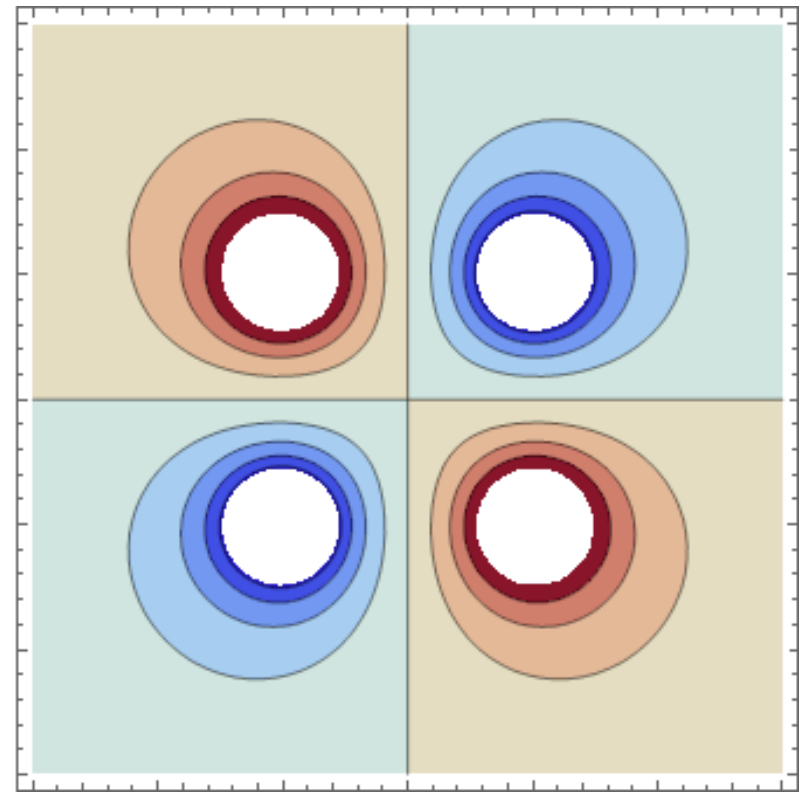
ACTIVITY

“So could you draw a curve that corresponds to the same value of electric potential along that curve?”

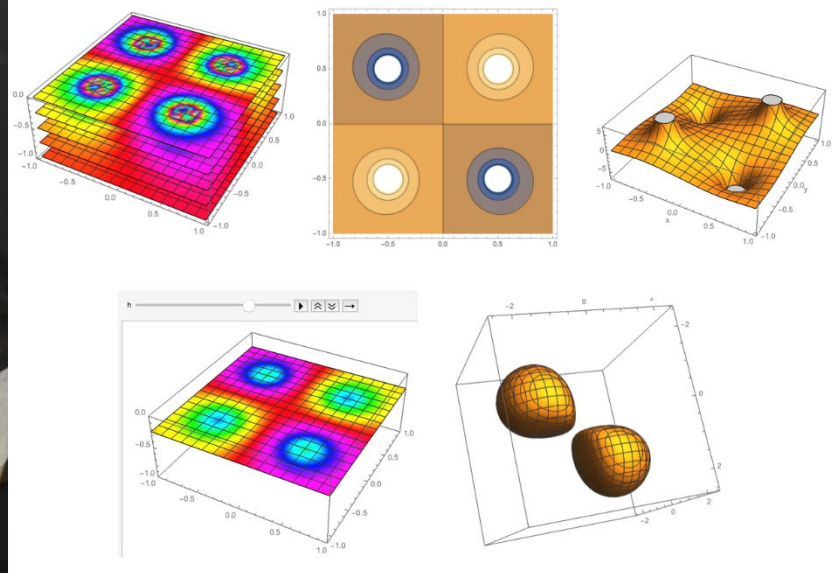








REPRESENTATIONS IN THE ACTIVITY



How do these representations support the students' science practices?

NGSS SCIENCE/ENGINEERING PRACTICES

1. Asking questions (for science) and defining problems (for engineering)

2. Developing and using models

3. Planning and carrying out investigations

4. Analyzing and interpreting data

5. Using mathematics and computational thinking

6. Constructing explanations (for science) and designing solutions (for engineering)

7. Engaging in argument from evidence

8. Obtaining, evaluating, and communicating information

https://www.nextgenscience.org/resources/ngss-appendices

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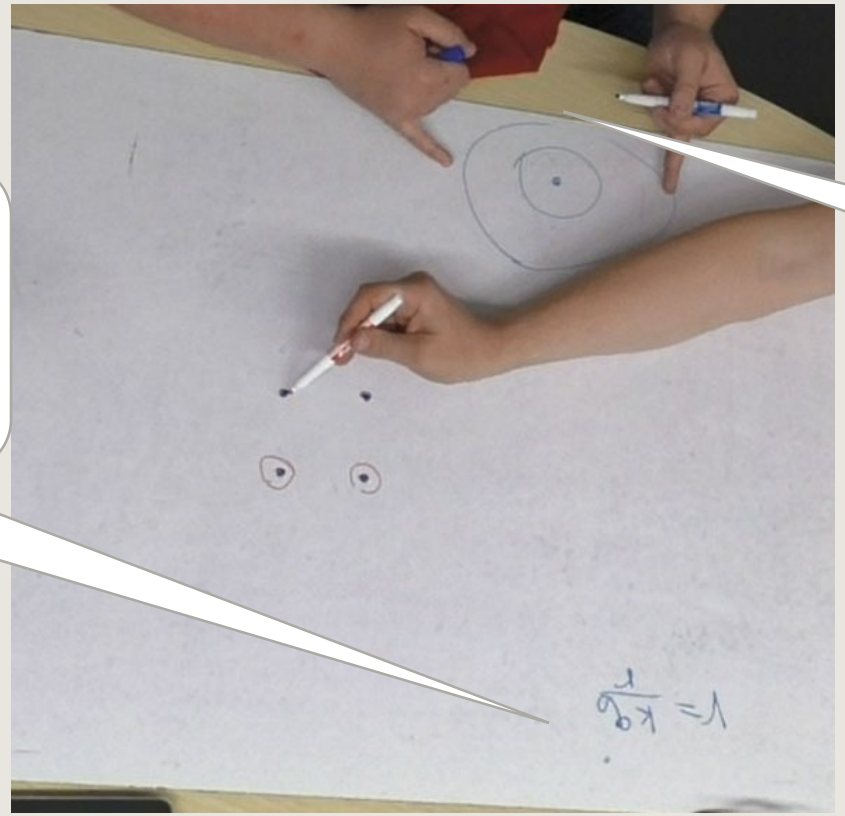
DEVELOPING AND USING MODELS

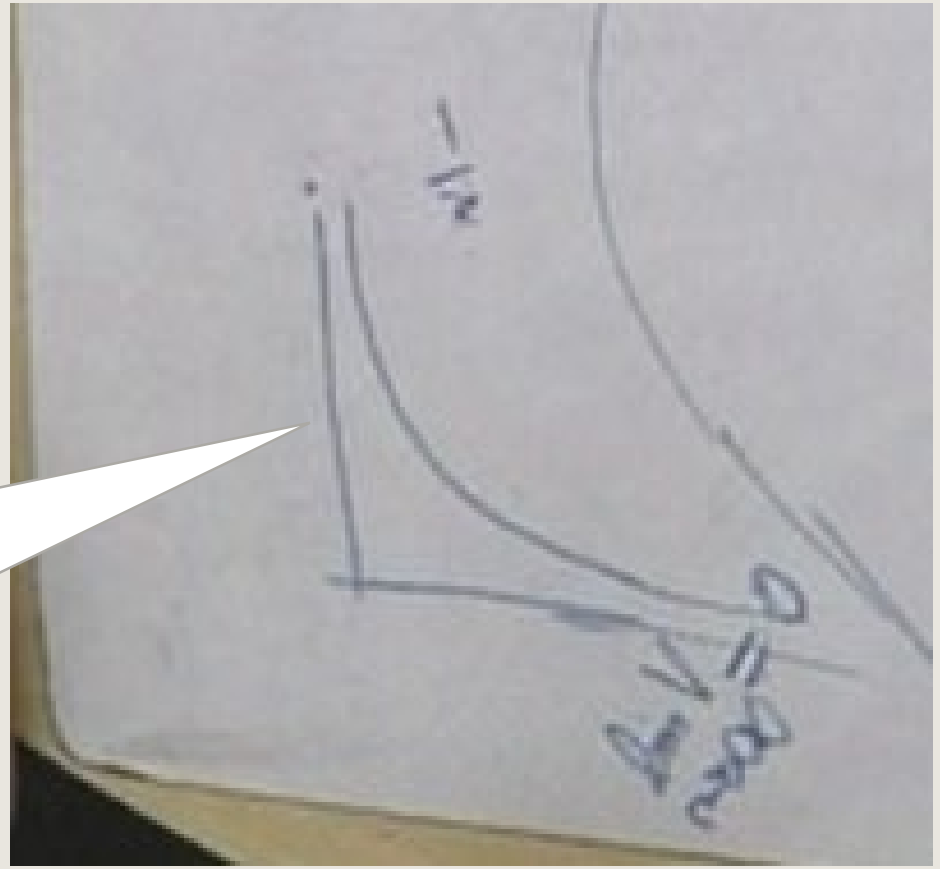
Storing Information:
“I'm just gonna write this up here, so we've got it. Just to think about.”



Simpler Model:
“So a single one’s gonna just be like circles, right?”

USING MATHEMATICS AND COMPUTATIONAL THINKING

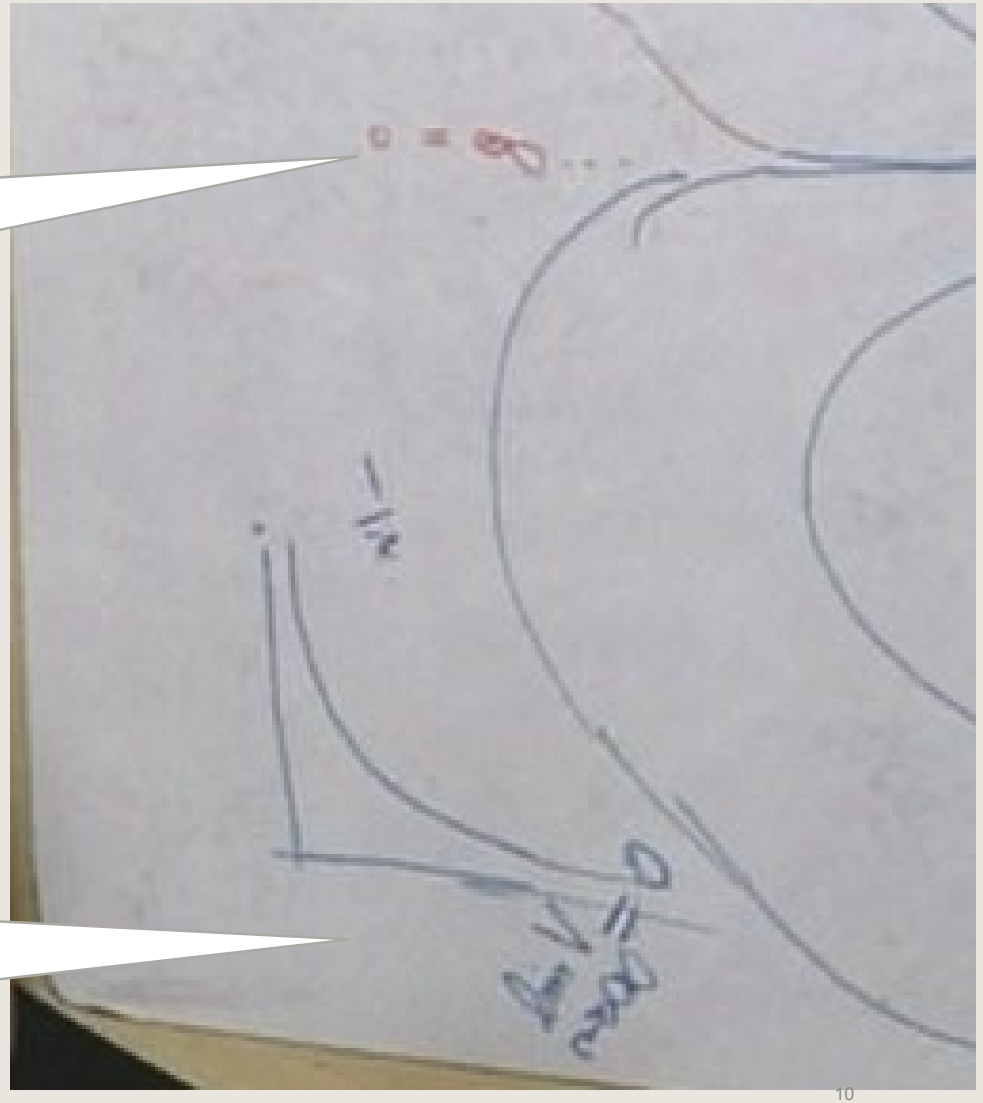
Inverse proportionality:
“if we look at it in this…region right here [Pointing to graph near r=0] if we want to halve the value, right, you only have to move a little bit?...But out here [Pointing to graph far from r=0] if we want to halve the voltage we'd have to move a ton.”



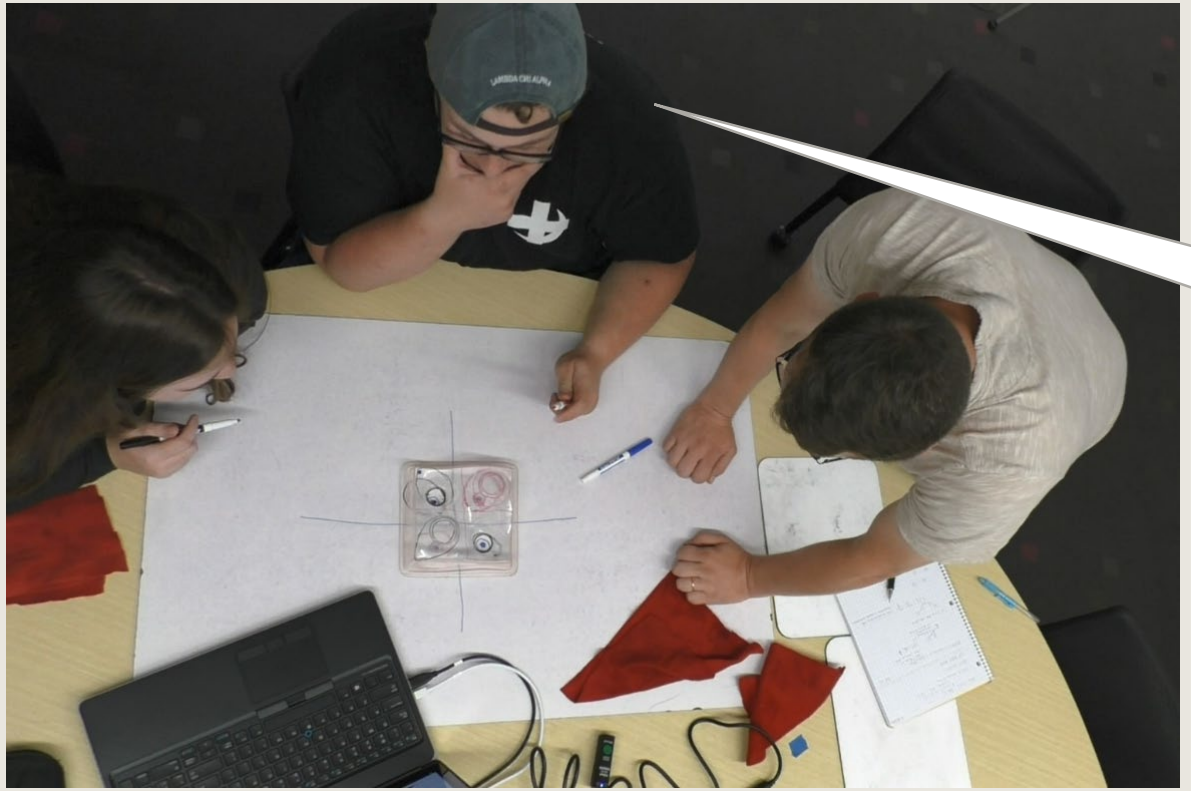
USING MATHEMATICS AND COMPUTATIONAL THINKING

Denoting the zero:
“Yeah, well, it's zero out at infinity anyway, so…”

Describing a limit:
“The limit of V as, what do we wanna say...As r approaches infinity should be equal to zero.”



CONSTRUCTING EXPLANATIONS AND ENGAGING IN ARGUMENT FROM EVIDENCE



Choosing the plastic graph:
“Can we snag one? We’re trying to decide whether or not we think it’ll be fatter this way [near the center] or fatter on the back end [away from center].”

Finding answers:
“So that's clear. And those get fatter out that way.”

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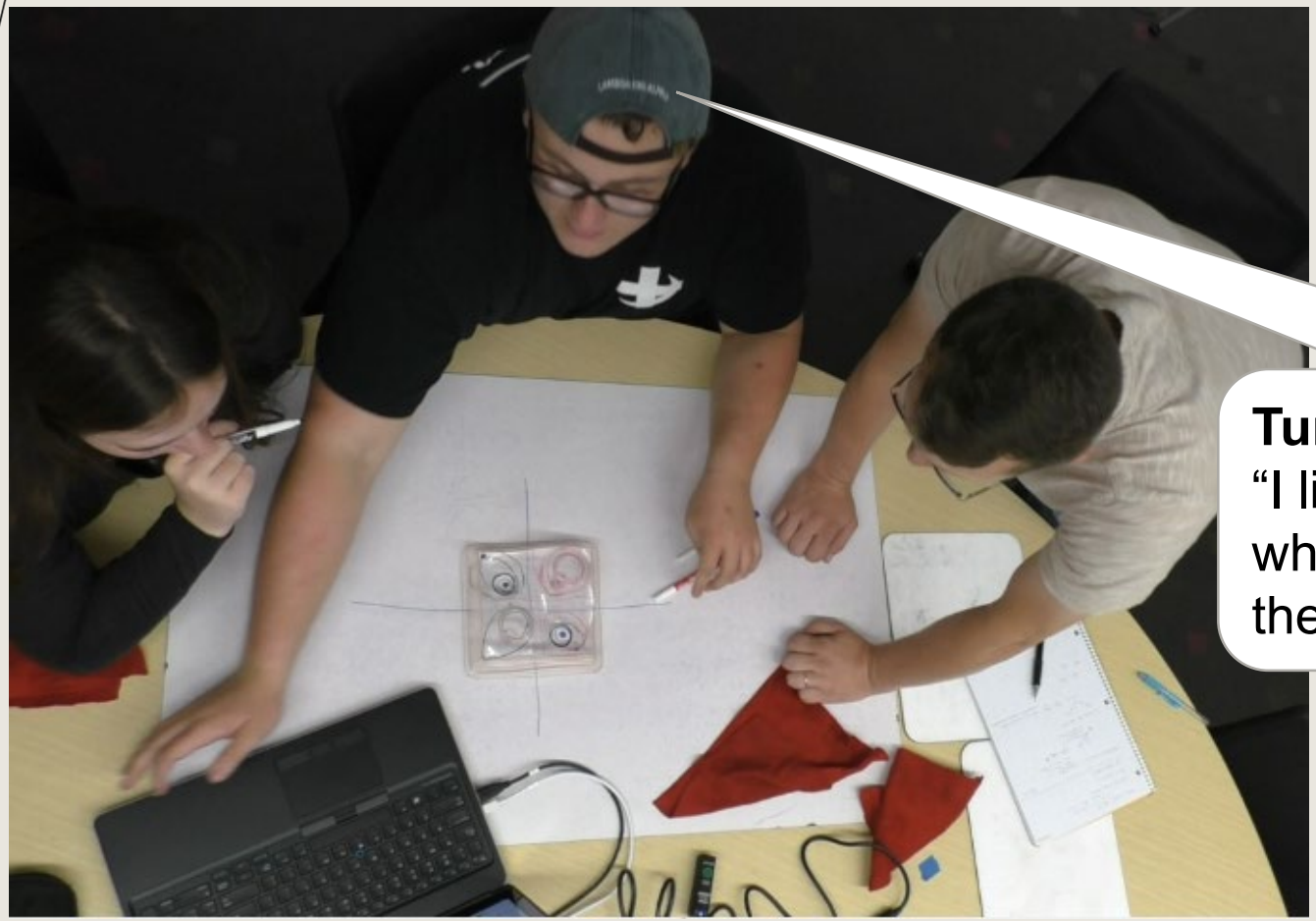

Turning to Mathematica:
“I like our picture. I want to know what these do farther out. . . Is there a way?. . . Let’s do this.”

RESULTS

Students express their own reasoning

- Whiteboard

2) Developing and Using Models

5) Using Mathematics and Computational Thinking

- Mathematica and Plastic Graph

6) Constructing Explanations

7) Engaging in Argument from Evidence

Students engage with evidence

CONCLUSIONS AND IMPLICATIONS

- Difference between representations used for *exploring ideas* and those that *serve as evidence*.
- Expressing their own ideas and generating questions prepares students for representations that can help answer those questions.
- Instructors may support different science practices with different external representations.

https://paradigms.oregonstate.edu/whitepaper/raising-physics-to-the-surface-activities/

DUE-1612480