



A STUDY ON SHIFTING SCIENCE CURRICULUM TOWARD INQUIRY BASED PRACTICES

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Keene High School Background

KHS recently adopted NGSS. I recognized the need to modify existing recipe-like labs to include more inquiry and science and engineering practices. Earth & Space Science is taught at the freshman level.

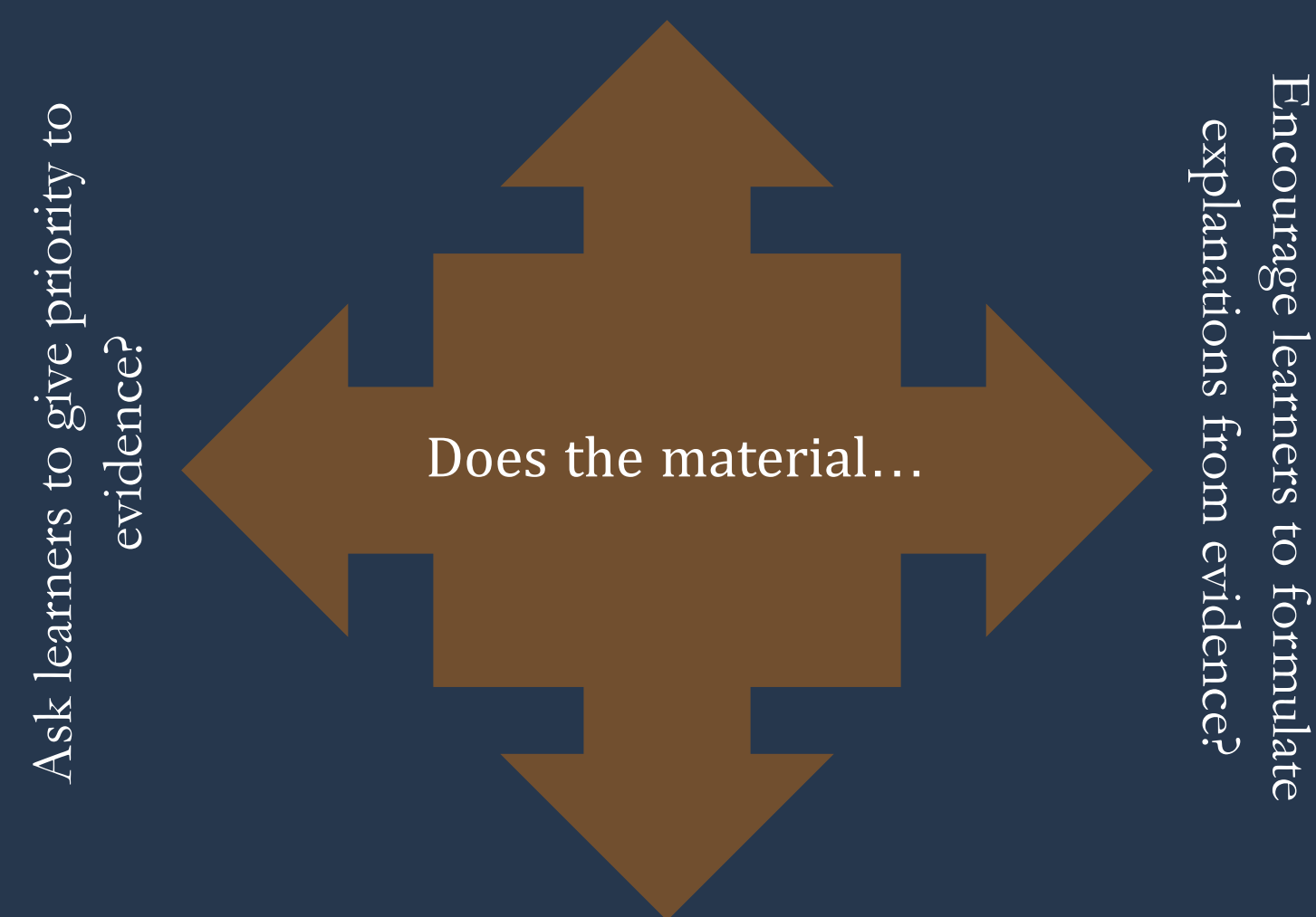
- ◆ As of 2021, 1388 students in grades 9-12th
- ◆ 26% on free and reduced lunch assistance
- ◆ 50% of students come from Keene, the rest from ten rural sending towns
- ◆ 58% attend four-year colleges
- ◆ 19% attend trade-school or 2-year colleges
- ◆ 26% students economically disadvantaged

Methodology

- ◆ Use Volkmann's Inquiry Analysis Tool to improve 3 labs. Use it as a template for ideas and afterwards to analyze the level of inquiry.
- ◆ Use a journal to record what went well and what was challenging after using the modified versions in class. Trouble shoot and reflect on the effectiveness of each lab
- ◆ Use the Student Survey questions midway through the semester for feedback on student preferences.

Inquiry Analysis Tool

Engage Learners in scientifically oriented questions?



Does the material...

Research Questions

Primary Question:

How can I adjust my pedagogical approach in order to increase student opportunities for learning through inquiry-based investigations?

Sub Question:

What are my colleague's opinions of these modified labs?

Sub Question:

How has modifying curriculum affected me as a teacher?

Journal
Student Survey
Inquiry Analysis Tool

Data Triangulation Matrix

Sub Question:

What are the student perceptions of learning through inquiry and using science and engineering practices in my classroom?

Student and teacher quotes

"It was a lot harder than I thought it would be taking an existing lab and modifying it. It took me several days to juggle different ideas of ways to address the issues with the old lab. I ended up modifying not just the original lab but also two different lessons I found online, which I incorporated into the finished product. There was a lot to consider, just like with the creation of any lesson."

"It's fun to figure things out."

"You can decide what you want to learn."

"I learn the material more when I have to figure it out."

Implications to my Teaching

Based on the feedback I got from students, I will continue using the checklist to increase inquiry in the labs. I'll focus on using guided-inquiry, as that was their preference. A couple things I'd like to do in the future are develop lab-based exams as a portion of Summative assessments. I'd also like to develop more misconception probes to strengthen prior knowledge activities, which should support their ability to do inquiry successfully.

Results

Geologic Timeline Lab

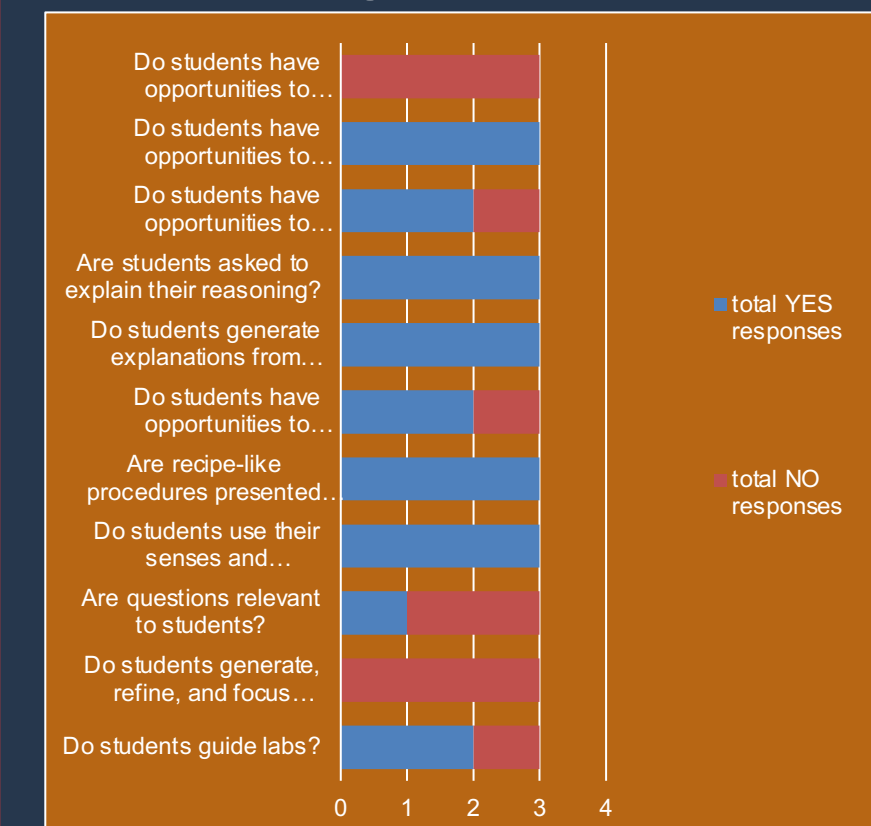


Figure 1. Inquiry analysis checklist results for geologic timeline lab, completed by me and my colleagues. (N=3).

Heat Transfer Lab

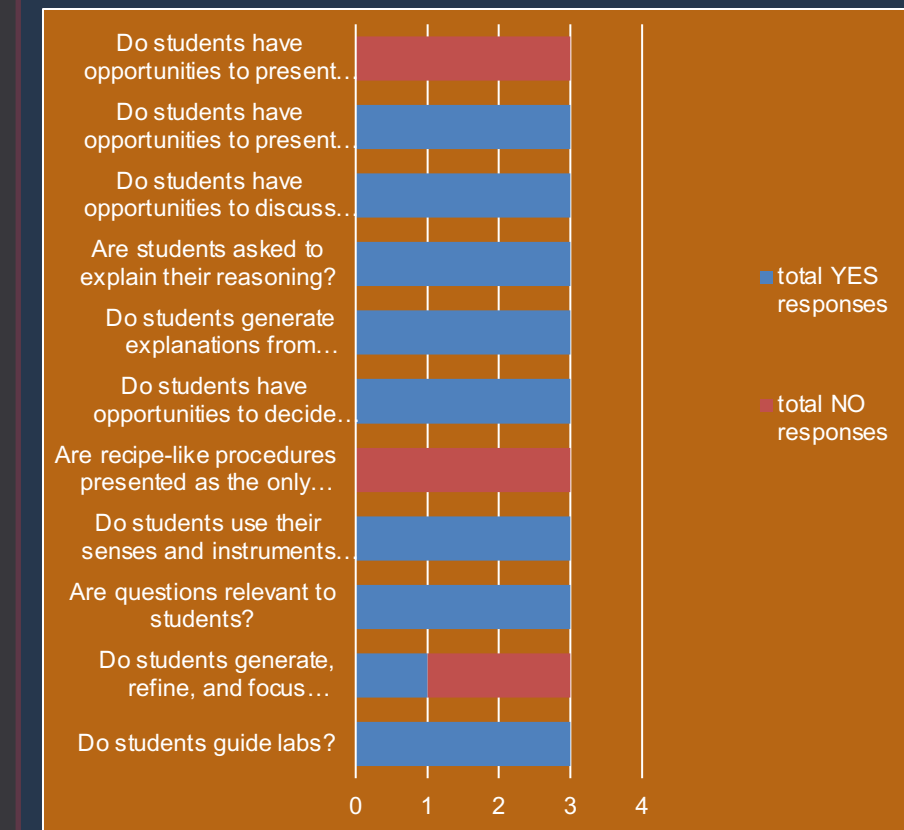


Figure 2. Inquiry analysis checklist results for heat transfer lab completed by me and my colleagues. (N=3).

Rainbow Density Lab

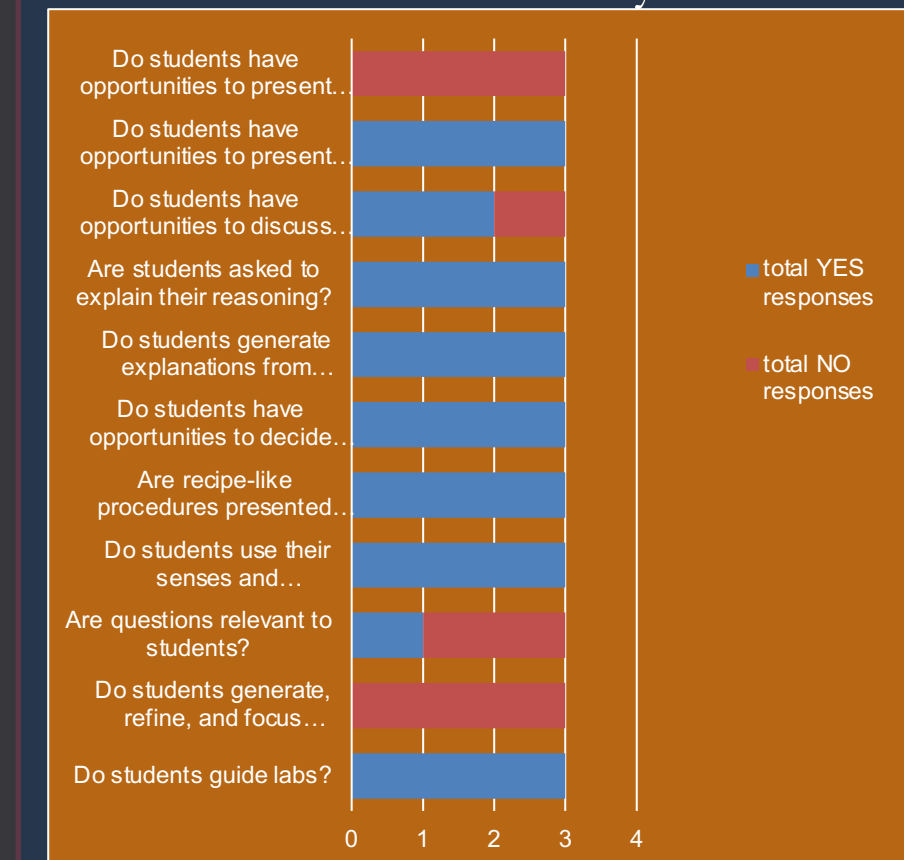
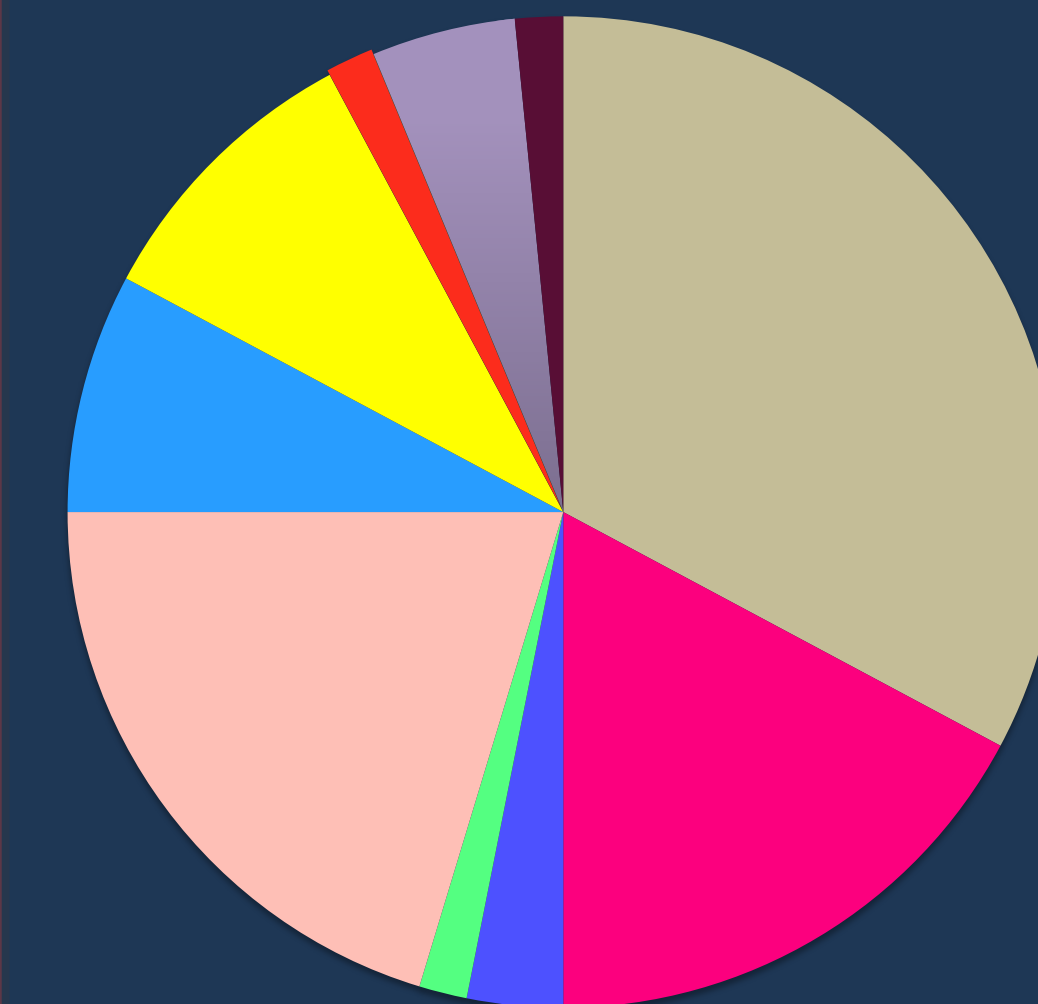


Figure 3. Inquiry analysis checklist results for rainbow density lab completed by me and my colleagues. (N=3).

Student Survey



- I prefer a science class with hands-on activities and labs.
- I learn best by doing labs about the material.
- The material I'm learning in class is not relevant to my life.
- In this class, focus questions guide the labs.
- When I do labs in this class, I get to use equipment and other science instruments often to collect data.
- I prefer recipe-like lab instructions to follow step-by-step.
- I prefer open-ended labs, where I have more freedom to decide how to run the experiment and have fewer directions to follow.
- When I do labs in this class, I get to decide what data to collect or how to collect data.
- When answering an analysis question, I do not know how to explain my reasoning using evidence from my data.
- I am given opportunities to discuss my ideas in small groups.
- I am not given opportunities to present my ideas through writing, drawing, or thinking.

Inquiry Analysis Tool Results

Does the material...	Yes	No	Evidence and Examples
<i>Engage learners in scientifically oriented questions?</i>			
◊ Do questions guide labs?	X		What is the connection between Transformations of Life, Mass Extinctions, and Geologic Changes in earth's history?
◊ Do students generate, refine, and focus questions for investigation?		X	
◊ Are questions relevant to students?	X		Students made a geologic timeline based on earth's history fitting within the length of their arm span
<i>Ask learners to give priority to evidence?</i>			
◊ Do students use their senses and instruments to collect evidence?	X		Student measure their arm span in cm and create a scaled timeline with multiple events after calculating where along the timeline to place each event.
◊ Are recipe-like procedures presented as the only way to address the objective?	X		Students do follow some recipe-like steps, however they use the finished timeline to answer analysis questions which require a higher level of thinking
◊ Do students have opportunities to decide what data to collect or how to collect it?	X		Students are asked to choose several additional events that interest them to place on their timeline
<i>Encourage learners to formulate explanations from evidence?</i>			
◊ Do students generate explanations from evidence?	X		State a Claim to answer the question: <i>What is the connection between Transformations of Life, Mass Extinctions, and Geologic Changes in earth's history? What is your Evidence?</i> Use your timeline and give specific examples to back up your Claim.
◊ Are students asked to explain their reasoning?	X		Explain your Reasoning. How does the Evidence you listed support your Claim?
<i>Expect learners to communicate and justify their proposed explanations?</i>			
◊ Do students have opportunities to discuss their ideas in small groups?	X		Students will be encouraged and given time in order to talk about their ideas together to answer the Claim, Evidence, Reasoning questions
◊ Do students have opportunities to present their ideas through writing, drawing, or thinking?	X		Student will be encouraged to decorate their timeline with drawings. Students will express their ideas by answering the questions. For ex: <i>What has surprised you most about this activity?</i>