

### Motivation

- Students are members of a society that votes, makes personal health choices, and purchases goods and services.<sup>1</sup>
- Scientific literacy is crucial to being an informed citizen.<sup>1</sup>
- 87% of the NDSU student population are considered non-science majors.
- Benefits of inquiry-based instruction and collecting student-generated questions:
  - Assessment tool to identify misconceptions
  - Promote a student-centered, active learning classroom

### Methodology

- Surveys given to BIOL 111L, a Concepts of Biology course for non-biology majors, Spring 2017 (N=195)
- Analyzed questions across all 4 surveys (N=41) and across Pre and Post surveys (N=109)
- Two coders with an average inter-rater reliability as measured by Cohen's Kappa of 0.822
- Limitations:
  - Prompts for pre and post surveys differ from antibiotic resistance part I and II
  - Total submitted questions vary between each survey
  - Lab teaching assistants (TA) had an affect on question complexity

### Investigation Question

- How do non-science majors' participation in an introductory biology lab course change their question complexity over one semester?

### Survey Prompts

**Pre Survey:** What questions about biology do you have?

\*Students submitted responses to prompts after reading required material before lab

**Post Survey:** What new biological questions do you now have after taking the lab course? What questions do you still have about biology?

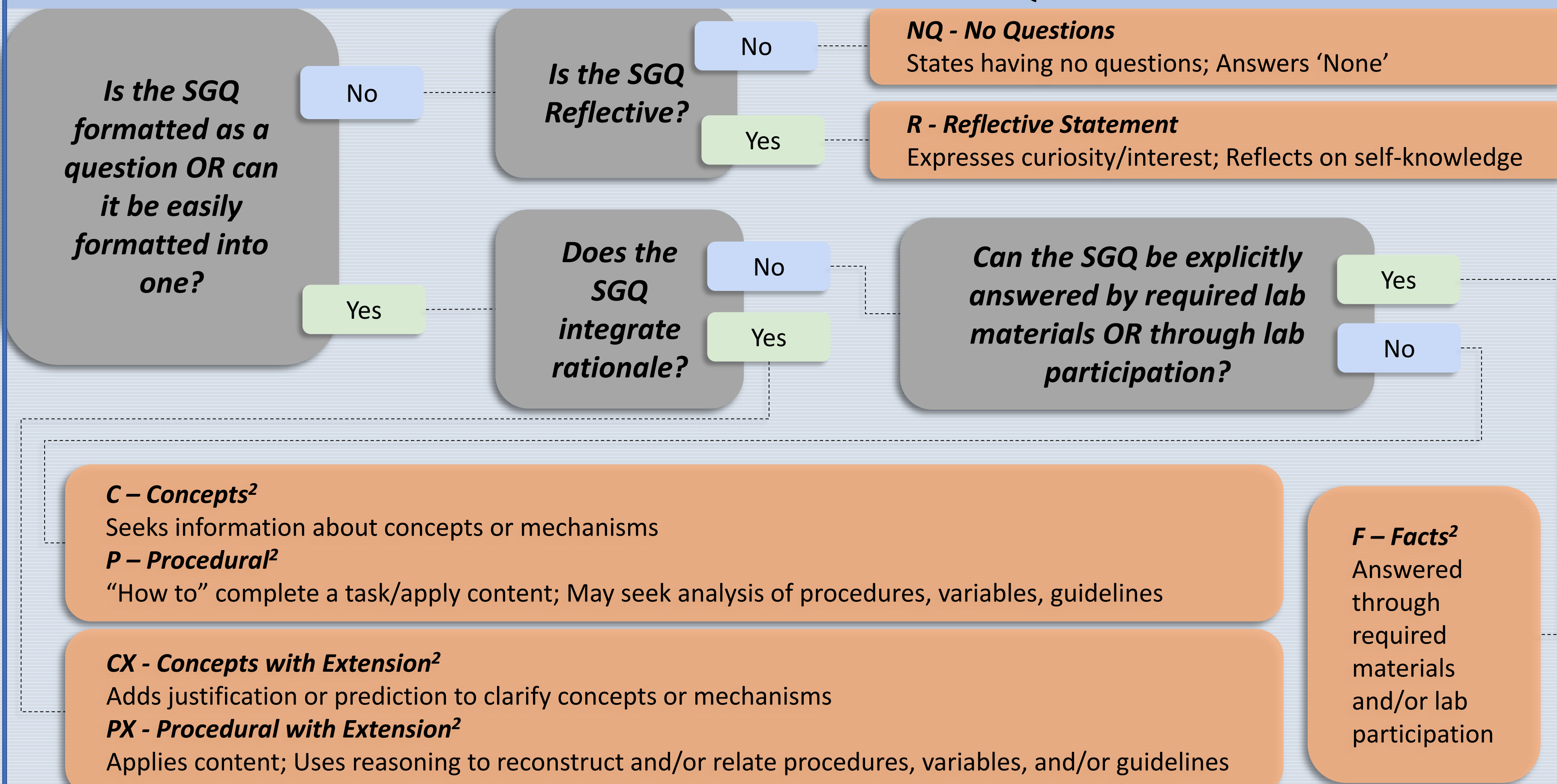
Beginning of semester

Middle of the semester

End of the semester

**Antibiotic Resistance Part I and II:** What question(s) do you have about the previous lab or about the upcoming lab? ("None" is NOT an acceptable answer. You also can't just keep repeating a question all semester long. You can ask something similar, but it may not be the exact same question/question type.)

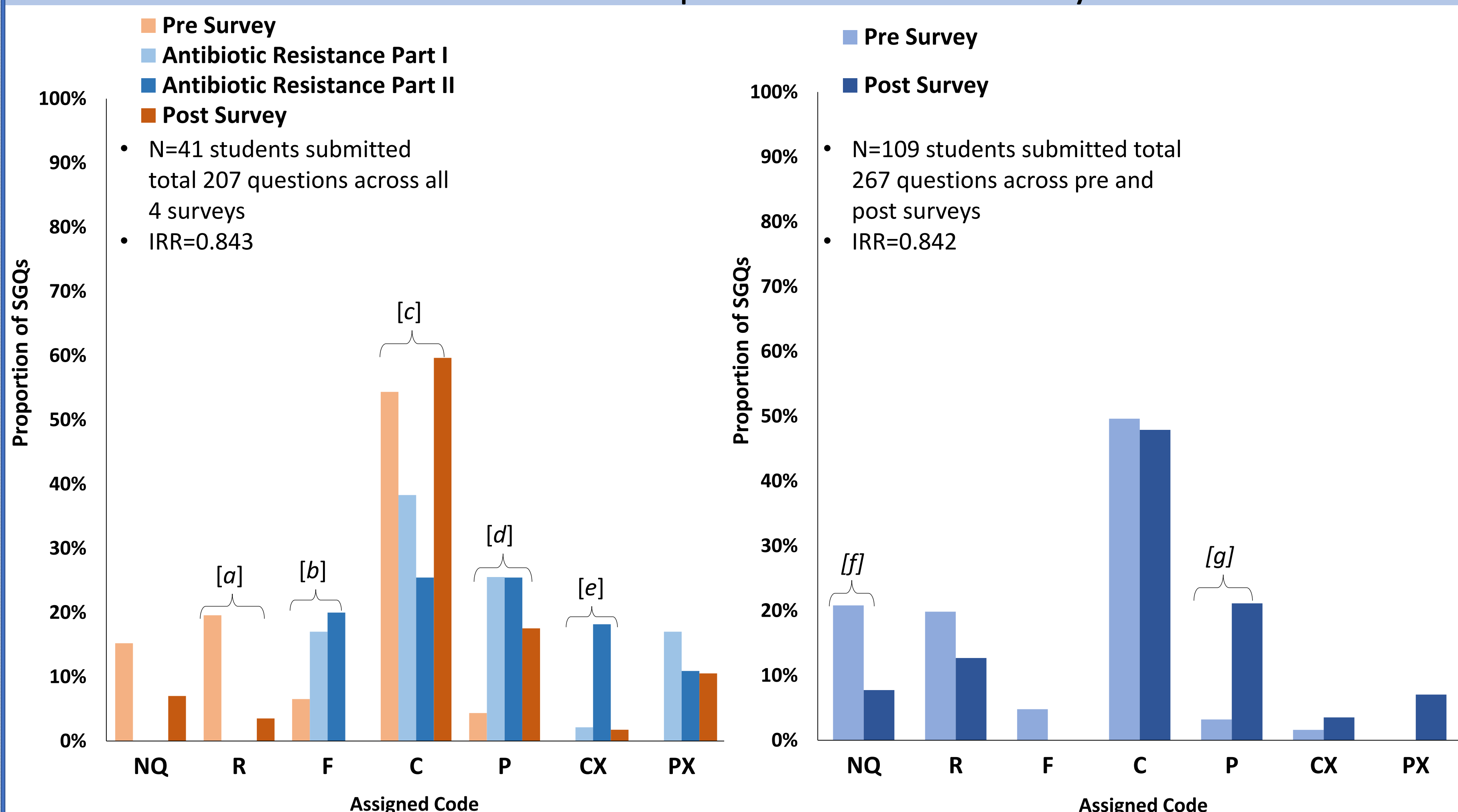
### How to Code Student-Generated Questions



### Example Student-Generated Questions

R	I am curious to see which of our two samples will have the more antibiotic resistance bacteria though I am worried that we may have not gotten a good sample from the carpet and it may skew our results.
F	What will the end outcome of this lab be?
C	How do bacteria build up a resistance to antibiotics?
P	How can the amount of germs in certain locations be measured appropriately?
CX	How many antibiotic resistant germs are left on our hands after they are washed? Would there be a lot of antibiotic resistant bacteria since hands are washed often?
PX	What can we do to defeat bacteria that have gained antibiotic resistance? Are there more antibiotics that we can use or do we need to use other methods?

### Differences in Responses Between Surveys



### Significance in Coded Student-Generated Questions

- [a] Decrease in Reflection codes possibly infers an increase in curiosity
- [b] Increase in Factual codes possibly due to undetailed instructions in lab handouts
- [c] Decrease in Conceptual codes possibly caused by the type of prompt
- [d] Increase in Procedural codes possibly caused by the type of prompt
- [e] Increase in Conceptual with Extension codes possibly induced by familiarity with lab content
- [f] Decrease in No Question codes possibly infers an increase in curiosity
- [g] Increase in Procedural codes possibly caused by participation in lab

### Implications

- Non-Biology Majors' question complexity generally progressed over the course of one semester
- The types of questions instructors ask possibly elicits the types of responses
  - Pre-Post prompts produced ~10% more conceptual responses
  - Antibiotic Resistance prompts produced ~10% more procedural responses

### Future Directions

- Analyze student questions using the same prompt across all surveys
- Analyze student-generated hypothesis-based questions
- Track NQ students for the pre survey throughout the semester
- Provide instruction on generating questions and analyze results

### Acknowledgements

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### References

- [1] Cotner, S., Thompson S., & Wright, R. (2017) Do Biology Majors Really Differ from Non-STEM Majors? *Life Sciences Education*, 16(48), pp. 1-8.
- [2] David R. Krathwohl (2002) A Revision of Bloom's Taxonomy: An Overview, Theory Into Practice, 41(4), pp. 212-218.

