Dynamic Strategies for Active Learning in Microbiology

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LAMP
LEARNING ACTIVELY MENTORING PROGRAM

Pedagogical Methods

Be Your Own Bob Ross (BYOBR)
- ⇢ Art supplies provided for students who don't have tablets
- ⇢ Recordings w/captions provided

Team Based Learning
- ⇢ Provide paper copies as needed/preferred

Game (Kahoot!)
- ⇢ Provide option to play anonymously

Muddiest Point
- ⇢ Anonymous via PollEverywhere, option to "upVote"

Self assessment

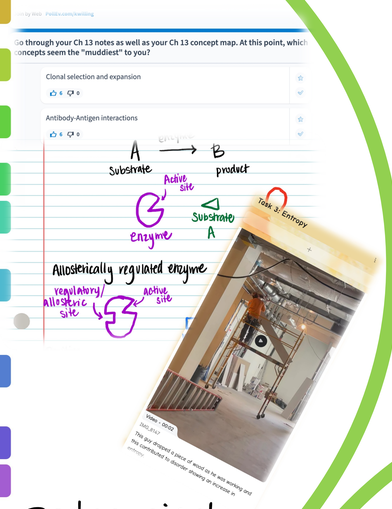
Peer evaluation
- ⇢ Students are encouraged to think about equity vs. equality as they are building their evaluation rubric

Concept mapping
- ⇢ Students are given choice to build their own concept maps vs. building one as a team
- ⇢ Choice of posterboard or electronic

Cooperative learning (Group project)
- ⇢ Students choose topic and medium (podcast, voicecover, etc.)
- ⇢ Scaffolded

Place based learning

Flipped classroom
- ⇢ Large online presence in the course
- ⇢ Materials provided in multiple formats (skeleton notes, filled out notes, PDF, PPT, etc.)
- ⇢ Downloadable weekly agendas



"It's not hard to make decisions when you know what your values are"
-Roy Disney

I believe in the power of affect.
(when students are having fun, they learn on accident!)

I believe that student learning is enhanced when students are made to feel included and shown that their opinions matter.

I believe scientists and nonscientists alike should be well-informed about how science integrates into their world.

I believe that when students are given creative freedom to choose the topics that they learn about, the breadth of information discussed in a class can be deeply enriched.

I believe finding the "why" is essential to information retention.

I believe that when educators/TAs/LAs are approachable and passionate, students are more likely to ask questions and reach deeper learning.

Qualitative Data on Selected Outcomes

(excerpts from student reflections of their Scientific Communication group project)

⇢ "Overall...this whole project taught me the value of collaboration and roles in a group setting. Having other people to correct your work and correcting other's work yourself is very beneficial to me in knowing that I have given the best presentation possible."

⇢ "I really enjoyed the teamwork aspect of this project in conjunction to the autonomy we faced with choosing any type of project we wanted to discuss. I think the freedom of choice in what we wanted to talk and write about really made this project feel fun and enjoyable. I also enjoyed the creative nature of the assignment we were able to present, i.e. we could do a PowerPoint, podcast or anything creative."

⇢ "In the professional field, the knack for collaborative teamwork is a helpful skill to have developed in a college class like this. These skills will prove vital in roles demanding collaboration and exploration of new scientific inquiries."

⇢ "This was probably one of the first positive experiences I have had with a group project, coming from both the people I got to work with and the free reign on the project to research what we wanted to talk about, rather than being given a pre-set topic to research."

⇢ "...teamwork really hasn't been included in any of my classes until this one, and it's refreshing to take a class that includes skills like teamwork...having the freedom to research anything and express it in many different ways improves learning dramatically."

⇢ "I think this project is useful in helping us to figure out how to teach our topic to others, as well as figure out how to work together as a team and communicate effectively, which is really important in the science world."

⇢ "I think this project really helped me understand how much of a gap there is between the scientific community and the everyday person. It became very apparent how difficult it can be to distill these complex scientific conversations into something that everyone can understand. However, I think I started to get an idea of how to do it. I felt like the main thing is to try to get rid of all the jargon that those who are experts understand, then replacing those words with something that everyone can understand."

⇢ "Overall I think this project really enhanced my understanding of how scientific communication works. I used to think that people would only use scientific communication in areas like research papers and journals, but this project has made me realize that it can happen in almost any format like a podcast, ted talk, or even through a tik tok...I really enjoyed working on this project, and overall I think it will help me to remember how fun group projects can be."

⇢ "I also liked learning and then teaching about the concepts that I have learned in class. It made me feel like an expert in something that I couldn't say I was before."

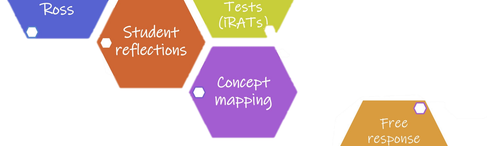
⇢ "I definitely improved on reading scientific research papers and understanding them. I also had the privilege of interviewing one of the world's top biofilm experts. This information could help my understanding of how bacteria work for years to come in my academic career as well as my professional career."

⇢ "This project helped me a lot with improving my ability to read scientific articles and decipher an accurate vs. inaccurate source."

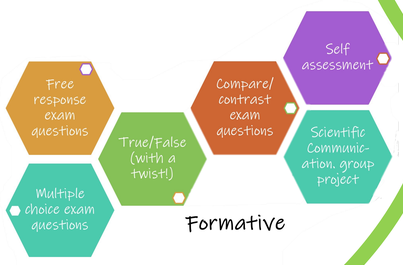
⇢ "Throughout creating this project, I definitely would say I learned better research skills and how to find more credible sources than what most people would typically use."

Assessment Methods

Summative



Formative



Student Learning Outcomes

Students will recognize the broad-ranging implications of microbiology by relating it to clinical medicine, food production and preservation, biotechnology, biogeochemical cycling, our microbiome, and our behavior. Affective: Valuing Cognitive: Apply	Following a concept mapping activity, students will be able to describe the organization and identification of organisms based on their physiological characteristics and their genome. Affective: Valuing Cognitive: Understand	Given a structured prompt, students will be able to use scientific evidence to defend the idea that microbes are our most ancient ancestors and justify how this informs medical and ecological practices. Affective: Organization Cognitive: Understand	Given a creative learning environment with multiple learning modalities, students will combine concepts of nutritional requirements, microbial growth curves, metabolic pathways, and genome replication in a way that shows understanding of microbial life cycles. Cognitive: Analyze	After a class wide discussion, students will correlate how genetic changes impact antimicrobial resistance and vaccine evasion. Affective: Characterization Cognitive: Analyze
Given a rubric and a group presentation assignment, students will explain a complex microbiological concept to a variety of audiences, including their peers, other scientists, and laypeople in a way that shows the value of quality scientific communication. Affective: Valuing Cognitive: Create	When given tangible and specific examples, students will be able to define germ theory, describe how it was developed, and use this information to relate microbes to disease. Cognitive: Apply	Following a series of active learning class sessions, compare and contrast innate and adaptive immunology and differentiate how each arm of the immune system facilitates our relationships with resident and pathogenic microorganisms. Affective: Valuing Cognitive: Understand, Analyze	Given a flipped classroom activity, students will be able to summarize core information from the findings in a peer-reviewed scientific publication. Cognitive: Understand	Given multiple team based-learning activities, students will justify the value of collaborative communication, group-work, peer, and self-assessment. Affective: Characterization

Bloom's Affective Domain
Adapted from https://hawkeseshd.com/2018/06/23/krathwohl-and-blooms-affective-taxonomy/

Bloom's Cognitive Domain
Adapted from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Challenges

Future Directions