Microteaching; 11-17-2023 (FAST Fellow)

Big Idea(s)

Photosynthesis: is a plant physiological process used to transform sunlight, carbon dioxide, and water into metabolizable carbohydrates, primarily starch and sucrose, which serve as the primary energy source for all other plant processes. Photosynthesis can be divided into two key processes: the light reactions and carbon fixation.

- *Light Reactions*: captured photons drive the extraction of electrons (and protons) from water and transfers them to a system of electron carriers to reduce NADPH (i.e., cellular energy), in the chloroplast. The proton extracted from water generate a gradient that drives the synthesis of ATP (i.e., cellular energy).
- *Carbon Reactions*: The carbon reactions are dependent of gaseous diffusion processes, whereby CO_2 diffuses from the atmosphere to the chloroplast to be fixed by the plant. This carbon fixation occurs via a complex series of enzymatically regulated reactions that transform CO_2, RuBP, and cellular energy (i.e., ATP and NADPH from the light reactions) into carbohydrates.

Stage 1 Desired Results (*focus on Light Reactions*)

ESSENTAL QUESTION

- How do higher plants manage photon fluxes to maintain photosynthetic performance in dynamic environmental conditions?

ESTABLISHED LEARNING GOALS

- … develop a working/integrated knowledge of how the light reactions fit into photosynthesis.

LEARNING OBJECTIVES

- Students will gain a foundational knowledge on the current model electron transport (i.e., the Z-scheme).
- Interpret mechanisms of photosynthesis using real-life measurements and models.
- Understand how dynamic environmental conditions can influences the photosynthesis.

Acquisition

Students will be able to independently use their learning to…

- …construct an accurate model of a photosynthetic membrane.
- …design and collect real-life measurements of photosynthetic processes (i.e., linear electron flow) in different environments.

Meaning

UNDERSTANDINGS

Students will understand that…

- …photosynthesis is a dynamic process that is influenced by numerous physiological and environmental factors.

Transfer

Students will know…	*Students will be skilled at…*
• …how to draw an accurate photosynthetic membrane and be able to use the diagram for hypothesis testing. • …how to collect leaf measurements and interpret the efficiency of plants in context of the light dependent reactions (i.e., parameter: linear electron flow; using a MultspeQ device).	• …analysis and interpretation of photosynthetic (i.e., linear electron flow) measurements using a modified Michaelis-Menten equation. • … hypothesis generation and engagement in argument driven inquiry with peers in photosynthesis-related discipline.

Stage 2 - Evidence

Assessment Evidence/Evaluative Criteria
PERFORMANCE TASK(S):
In collaborative group,
- Work through an in-class quantitative exercise (assess QA, QM, QI).
- Collect measurements at the leaf-level with the MultispeQ and analyze/interpret the differences between plants in different environmental conditions (i.e., high-, medium-, low- light; identify significant features and patterns in data).

OTHER EVIDENCE:
Formative heavy strategies (i.e., general misconception check, whiteboarding, debriefing activities, Socratic dialogue, student reflection) will be used to assess learning goals.
- As a class, we will have each group draw their (hypothesized) photosynthetic membrane on the whiteboard and engage in argument-driven inquiry with the class to support it. After all groups have gone, we will synthesize everyone's ideas and I will guide them to the correct model.
- Using the corrected model of the photosynthetic membrane, have students' conduct thought-exercises about plants in dynamic environments (i.e., cloud cover, shading, bright sunlight).
- How could plants adapt different machinery on their photosynthetic membrane and/or physiology to manage photon fluxes in extreme environments (i.e., plants that thrive in desert environments, ground-floor plants in a canopy, plants in your garden).

Stage 3 – Learning Plan (*for 25-minute microlesson*)

Summary of Key Learning Events and Instruction

5-7 minutes: Introduce class to objectives for today's lesson (what do I want them to take away at the end of the period), and introduction to the topic for today. Form in-class groups and explain why collaboration is necessary in STEM discipline.

5 minutes: Have groups work through an in-class quantitative exercise (assess QA, QM, QI). Focus time on this question: *Using your knowledge of plant physiology, construct a model of a photosynthetic membrane. Then using the diagram, illustrate the process of light energy being absorbed, water breaking, and the movement of electrons to NADPH through the membrane*. Engage in Socratic Dialogue with groups during this time to assist with questions. Do this on whiteboards or pieces of paper.

2-3 minutes: Have different groups talk with one another about their hypothesized model in argument-driven inquiry (i.e., supporting/defending their models). Additionally, this will be a time for groups to update their models.

3-5 minutes: Using a main whiteboard, I will synthesize everyone's ideas and I will guide them to the correct model.

5-7 minutes: As a class, bring the discussion back and demonstrate a tool (i.e., MultispeQ) in front of the class to prep everyone for next weeks class. Show that we can measure Linear Electron Flow and that the collaborative groups will engage in inquiry-based class to develop their own model as it relates to light intensity.