Summer 2022 REU experience (May 23rd, 2022 – July 27th, 2022)

REU Project Aim

Determine the photosynthetic efficiency of *Arabidopsis thaliana* lines expressing more thermotolerant isoforms of catalase (CAT) at room and elevated temperature

Stage 1 - Desired Results

ESTABLISHED RESEARCH AND LEARNING GOALS

- Introduce Faith to the threshold concepts critical for understanding the REU project and interpreting the findings (i.e., rubisco behavior, photosynthesis and photorespiration, MM kinetics, light reactions, gas exchange, etc.)
- Teach Faith the fundamentals of Chlorophyll Fluorescence and Leaf-Level Gas Exchange
- Train Faith on the Dynamic Environmental Photosynthetic Imager (DEPI) and LICOR LI-6800 system
- Additionally, Faith will receive training in basic *A. thaliana* care and management

Acquisition

Faith will be able to independently use her learning to…

- Screen multiple transgenic lines of *A. thaliana* using an established fluorescence protocol to distinguish recovered recombinant CAT lines from wildtype (WT), and mutant lines lacking the foliar expressed CAT (CAT-KO)
- Conduct both post-illumination burst (PIB) and rapid common intersection method investigations to discern changes in net carbon fixation between WT, CAT-KO, recovered recombinant CAT lines
- Identify which *A. thaliana* line has the greatest photorespiratory efficiency (i.e., high net carbon fixation)

Meaning

UNDERSTANDINGS

Faith will understand…

- the fundamentals of chlorophyll fluorescence and gas exchange measurements and how to apply these approaches to investigate leaf-level physiology

Transfer

Faith will know…

- more about photosynthetic research leaving the REU experience than when she entered

Faith will be skilled at…

- Basic *A. thaliana* care
- Operating the DEPI and LI-6800
- Visualizing data in Python/R

Stage 2 – Acceptable Evidence

PERFORMANCE TASK(S):

RESEARCH/LEARNING GOALS

- Plan out and conduct two investigations (i.e., Fluorescence-Based Screens of *A. thaliana* transgenic lines using the DEPI system & In-Depth Gas-Exchange Analysis of the *A. thaliana* transgenic lines using the LI-6800)
- Analyze and interpret the data from each investigation to derive physiological meaning (i.e., using data visualization and statistical analysis to identify significant features and patterns in data)
- Construct an explanation(s) about the differences in photosynthetic efficiency between *A. thaliana* lines and support it using your knowledge of plant physiology/biochemistry (i.e., look at the relationships and patterns within the data)
- Communicate experimental work to the public and engage in argument-driven inquiry (i.e., oral and poster presentations)

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

INSTRUCTIONAL STRATEGY:

- Formative-heavy strategies (i.e., general observations, misconception checks, whiteboarding core concepts, debriefing after activities) will be used to assess learning goals
- Both Dez and Luke will engage with and support Faith in research activities

TENATIVE TIMELINE:

- ***Week 1***: check for comprehension with assigned papers and answer any initial question, introduction to the light reactions and chlorophyll fluorescence (i.e., PPT and whiteboarding), begin training with the DEPI
- ***Week 2***: began safety training, walkthrough of *Arabidopsis* care (cold stratification, repotting, watering), introduction to gas exchange (PPT and whiteboarding), begin training with the LI-6800
- ***Week 3***: site-specific training, misconception check with chlorophyll fluorescence (i.e., PPT and whiteboarding), data analysis with practice DEPI data (i.e., observation/walkthrough with practice data), conduct fluorescence-based screen investigation on first batch (i.e., observation/walkthrough with the first screen), analyze/interpret fluorescence data, setting up gas exchange experimental design (i.e., walkthrough), *Arabidopsis* care
- ***Week 4***: abstract preparation/feedback for MidSure Symposium, misconception check with gas-exchange, train with LI-6800, conduct Post-Illumination Burst (PIB) investigation, analyze/interpret PIB data

- ***Week 5***: abstract feedback/incorporation, submit abstract to MidSure Symposium, 5-minute presentation, conduct PIB investigation, conduct fluorescence-based screen (batch #2), analyze/interpret data
- ***Week 6***: finish conducting the PIB investigation, conduct fluorescence-based screen (batch #3), analyze/interpret fluorescence data with new script, create script for analyzing PIB, plant cold stratified seeds, water *Arabidopsis*.
- ***Week 7***: Collect leaf samples from WT/CAT/Hp lines for Catalase assay, analyze/interpret fluorescence data, pitch unneeded plants in growth chamber #111 and #78, think about and code the analysis for PIB, train Faith on common intersection method, repot *Arabidopsis* batch #4 plants
- ***Week 8***: conducting the common intersection investigation, water and repot *Arabidopsis* (Batch #4)
- ***Week 9***: analyze/interpret PIB data, put together poster and oral presentation, get critical feedback, present at lab meeting on Wednesday, meet with Luke and Dez to go over experimental work (tomorrow), submit poster on the 22nd to get printed
- ***Week 10***: clean out and dispose of *Arabidopsis* in growth chambers, synthesize and construct explanations for the experimental work conducted, communicate work to the public in poster (27$^{th)\ and}$ oral (29th) presentation