The Howard School
Aquaponics PBL
Engineering Design Unit Plan

Course Biology: The Garden PBL

Standards (Learning Targets)

CLE 3210.3.1 Analyze energy flow through an ecosystem.
CLE 3210.3.2 Distinguish between aerobic and anaerobic respiration.
CLE 3210.3.3 Investigate the relationship between the processes of photosynthesis and cellular respiration.
CLE 3210.3.4 Describe the events which occur during the major biogeochemical cycles.

Upcoming New Standards

12) Analyze evolutionary relationships among algae and major groups of plants. In this analysis, consider adaptations necessary for survival in terrestrial habitats.
(15) Use a model angiosperm to differentiate plant organs and the tissues from which they are made. Use the model to explain how the plant structures: provide support; regulate gas exchange; obtain and use energy; and, process and distribute nutrients.
16) Design and carry out an investigation examining the function of plant hormones.
17) Develop a model explaining plant tropisms at different scales (cell, tissue, organ, system). Use the model to predict how plants will respond in various environmental conditions.
19) Investigate the role of different plant types in ecosystem building and maintenance (examples: soil formation, inhibition of erosion, oxygen production, carbon sequestration, habitats).

Grade Level	9th grade	Unit Length	2 Weeks
Mini-PBL Overview	This PBL serves to help Howard students develop and implement a better design for the garden. Students will work in teams to collaborate with local experts to design and implement a structure that will balance the nutrient needs of plants. Students will also develop a plan to monitor the design long term and record useful data.		
Mini-PBL Driving Question	How can we, as Hustlin' Tigers, redesign the Howard garden to increase output and include a variety of plants best suited for channel catfish.		
Hook Event	● Video from local company highlighting issues and potential areas of success ● Tour of systems		
Scaffolding Activities	This section should include the scaffolding activities used throughout the Mini-PBL. The activities listed should fall into the following categories: **Class Activities** ● Students will be given a list of plants and must determine which are the best to work with channel catfish		

Station Activities

- Nutrient Cycling Diagrams and Worksheets
- Vernier Probe Stations
- Aerobic and Anaerobic Respiration Diagram and Worksheets

Workshops

- Energy and Nutrient Cycling

Focus Groups

- Vernier Probe Best Practices

Mini-PBL Teams

- Student will work in small groups to research and design a better system for the aquaponics garden with a long term monitoring plan

Digital Resources

- Aquaponics Best Practices
- Aquaponics Research
- Aquaponics Basics Video
- Aquaponics Collection Sheet

Calendar Overview

Monday	Tuesday	Wednesday	Thursday	Friday
Hook Event	Plant/Nutrient Info and Research Begins	Station Activities	Continue Research	Workshops/Focus Groups as needed
Continue Research/Begin Designs	Share progress - Workshops/Focus Groups as needed Continue Research/Design	Continue Design of System and Data Acquisition Plan	Finalize Design and Data Acquisition Plan	Culminating Event

Culminating Event

Product

- Each group will develop and build a small scale model of the new design.

Showcase

- Each group will present their findings to the class and demonstrate their design. One team from each class will go on to a design competition in front of a local company. Ultimately, one team's design will be chosen and implemented in the garden.

Common Assessment

		Mini-PBL: _____ Student: _____

Mini-PBL Rubric

Date: _____

	Advanced	Proficient	Needs Improvement
CLE 3210.3.1 Analyze energy flow through an ecosystem. CLE 3210.3.2 Distinguish between aerobic and anaerobic respiration. CLE 3210.3.3 Investigate the relationship between the processes of photosynthesis and cellular respiration. CLE 3210.3.4 Describe the events which occur during the major biogeochemical cycles.	Students design and diagram a re-imagined aquaponics system. Evaluate and diagram the flow of energy and nutrients through the system. Students devise a robust monitoring plan generating and analyzing data	Students design and diagram a re-imagined aquaponics system. Identify the flow of energy and nutrients through the system. Create a monitoring plan that generates data	
List the Process Skills (21st Century Skills) Collaboration Creativity	Char and summarizet the biogeochemical cycles present in the system. Compare and Contrast anaerobic and aerobic respiration and identify each in the system	Compare and Contrast anaerobic and aerobic respiration. Describe the biogeochemical cycles present in the system.	

Minimum Requirement Components:
Must be included to be graded
	• Completed small scale model or diagram
	• Well developed plan to monitor system
	  ○ must include data acquisition plan
	  ○ must include info on balance of plant and animal nutrients		

Grades	• If the Mini-PBL work is all advanced according to the rubric criteria above, the grade is a 100. • If the work meets all the proficient criteria and not all of the advanced criteria, the grade is an 85. • If the work does not meet all of the proficient criteria, the grade is a 50. • If the grade does not meet the minimum requirements, the grade is a 0.		

Vocabulary

Garden PBL - Biology	1. Nutrient Cycling
	  a. Carbon
	  b. Nitrogen
	  c. Energy
	2. Respiration
	  a. Aerobic
	  b. Anaerobic
	3. Biogeochemical
	4. Photosynthesis