Aquaponics: Sustainability Model

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What is Aquaponics?

Aquaponics is an agricultural system designed to provide complete nutritional production raising fish to provide protein and fruits or vegetables to provide fiber, vitamins and antioxidants.

Aquaponics is the convergence of hydroponics and aquaculture.

HYDROPONICS: In hydroponics plants are grown in a soil less environment using water. Nutrients essential to the growth of the plants are added to the water. The roots of the plants absorb the water, nutrients and oxygen while the stem and leaves of the plant absorb sunlight and carbon dioxide. In hydroponics the nutrients are more readily absorbed by the roots than in a traditional soil system producing rapid growth and generous yields.

AQUACULTURE: In aquaculture fish are raised in a "farm" like setting. Ponds are used to grow fish. The diet of the fish is controlled by the farmer and filtration systems are used to maintain optimum growing conditions.

AQUAPONICS ADVANTAGES:
- Vertical plantings allowing for greater production per square foot of growing space.
- Year round growing season in climate and light controlled greenhouses.
- Organic fertilization through nutrient cycling.
- Conservation and recycling of water through the system.
- Preservation of natural fisheries.
- Control of fish diet.
- Ability to grow fish food.
- Natural "green" filtration of water.

Research Objectives

- Determine feasibility of a classroom aquaponics system.
- Involve students in:
  - Engineering a classroom aquaponics system.
  - Construction of a classroom aquaponics system.
  - Establishing a classroom aquaponics system.
  - Maintaining a classroom aquaponics system.
- Establish classroom routines to include the model.
- Form an Aquaponics club to maintain classroom model.
- Use ion selective probeware to assess water quality.
- To engage students with science based activities.
- Align learning activities with NY Standards.
- Align learning activities with Common Core Standards.
- Align learning activities with Next Generation Science Standards.
- To make learning science fun!

Students Design and Engineer the Model

- Choose Grow Bed & Fish Tank Design

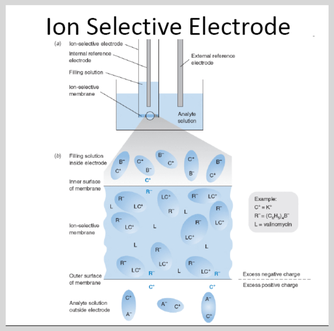
- Design Supply Plumbing

- Engineer Siphon

- Install Siphon

- Install Pump

Probeware (Ion-Selective Electrodes)



Ion-Selective Electrodes Advantages and Disadvantages
- Relatively inexpensive per sample analyzed
- Relatively simple to use
- Not influenced by impurities in the solution
- Relatively easy to make in-situ field measurements
- Need a separate probe for each analyte

Students Maintain the Model

- Clean Filters
- Catch Fish Food
- Establish Plants
- Harvest Plants
- Regulate Light

Incorporating The Standards

Bennett High School Lesson Plan

Teacher: Bish, Date: 2/6
Subject: Living Environment Duration: 40 min.
Lesson/Unit Title/ Theme: Carbon/nitrogen cycle & Photosynthesis
NYS Learning Standard(s) *and* Performance Indicator(s):4:2.1b; 4:2.1c; 4:2.2.c; 4:3.1c, 4:4.1c

Objective(s):
SWBAT understand the cycling of material in the environment.

Warm-up Activity:
~posted on the board
Draw a KWL chart on carbon cycle

Assessment Plan:
*(How do we know when they have learned it?)
~instructional strategies you will use to collect evidence of student progress (observation, group discussion, formative/summative assessments, writing, etc.)
Summative: Students are systematically asked questions and participation is required.
Formative:
End of class wrap up activity labeling the cycles in an aquaponics system.

Instructional Steps:
~agenda posted on the board
KWL on carbon cycle (photosynthesis & cellular respiration)
Aquaponics video
Model based discussion
Observe the model have students describe where water, carbon and nutrients can be found in the model.
TOTD (create a diagram showing the cycling of water, carbon, oxygen, nitrogen and any others in an aquaponics system.)

Intervention:
*(What will we do when they have not learned it?)
Summative assessment mechanism allows for immediate identification of learning gaps and instruction can be modified quickly.

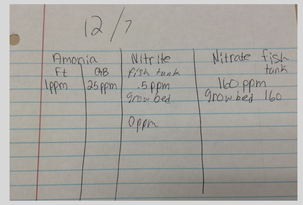
Enrichment:
*(What will we do when they already know it?)
Encourage students to share their knowledge with the rest of the class.
Encourage students to work with mentor program.
Allow student to perform a webquest using the sepup website.

Common Core Alignment:
Standard for literacy in Science #4: "Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics."
Range of Writing #10: "Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes and audiences."

Students Collect Data and Study the Model

- Measure Growth
- Form and test Hypotheses

- Collect Data
- Analyze Longitudinal Data
- Form an Experiment to Test Hypothesis



- Prepare classroom Presentations

Continuing Implantation and Further Research

School Year 2013-2014
- Collaborating with teachers to set up models city wide.
- Aquaponics Club Scholars at Bennett High School will design and engineer a model of their own.
- Use of the model in every Laboratory Class throughout the year.

Further Research 2014
- Increasing productivity of the classroom model.
- Engineering a modular system.
- Feasibility of a grow green school trip to establish systems in West Africa

References / Acknowledgements

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