How Aquaponics Makes Plants Grow

Adapted from: The American Forest Foundation, 1111 Nineteenth Street, NW, Suite 780. Washington D.C. 20036

Grade Level: Intermediate

Duration: Short sessions (30 minutes) over the course of 2-3 weeks

Setting: Classroom and field

Summary: Students develop their own aquaponics system to explore how ecosystems work.

Objectives: Students will develop an understanding of "waste=food", sustainability, and systems-thinking.

Vocabulary: Ecosystem, nitrogen cycle, sustainability, photosynthesis, carrying capacity, limiting factor, nitrogen cycle, water cycle

Materials (Included in Module:

- Aqua Farm Aquaponics System (Refer to directions on box)

Additional Materials (NOT Included in Module):

- Beta Fish

Academic Standards

English Language Arts Pre K – 5

- 1.2 Reading Informational Text
  - Key Ideas and Details
  - Craft and Structure
  - Integration of Knowledge and Ideas
  - Vocabulary Acquisition and Use
  - Range of Reading
- 1.4 Writing
  - Informative/Explanatory
  - Technology and Publication
  - Conducting Research
  - Credibility, Reliability, and Validity of Sources
- 1.5 Speaking and Listening
  - Comprehension and Collaboration
  - Presentation of Knowledge and Ideas
  - Integration of Knowledge and Ideas

English Language Arts 6 – 12

- 1.2 Reading Informational Text
  - Key Ideas and Details
  - Craft and Structure
  - Integration of Knowledge and Ideas
  - Vocabulary Acquisition and Use
  - Range of Reading
- 1.4 Writing
  - Informative/Explanatory
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- 1.5 Speaking and Listening
  - Comprehension and Collaboration
  - Presentation of Knowledge and Ideas
  - Integration of Knowledge and Ideas

Writing in Science and Technical Subjects 6 – 12

- 3.6 Writing
  - Production and Distribution of Writing
  - Research to Build and Present Knowledge
  - Range of Writing

Reading in Science and Technical Subjects 6 – 12

- 3.5 Reading
  - Key Ideas and Details
  - Craft and Structure
  - Integration of Knowledge and Ideas
  - Range and Level of Complex Texts

Background

A plant is a living system that survives on light, air, water,

and nutrients. Plants get energy from a process called photosynthesis. This is where light (from the sun, lamps, etc.) activates the chlorophyll in the plant leaves, which converts the raw materials from the fish waste and air into food. Water is very essential to the aquaponics system and important for plant health. Water not only helps in photosynthesis but also helps in transporting nutrients from the water (where the fish waste is located) to the plant roots. The fish can also get their food from the plant roots. This creates the idea of a closed-loop system where "waste equals food". It is important in aquaponics that the pH and water quality are at necessary levels, for if not the system could lead to unhealthy fish and plants.

In this system students will be designing and/or building their own aquaponics system to determine the importance of light, air, water, and nutrients (fish waste).

Overview

The class works together to build their own aquaponics set up.

Procedure

Each group will need a basic aquaponics classroom system. This can include many variations and depending on budget can vary greatly. It would be wise to start as soon as possible for there can be many errors in the beginning of this process. Getting down the right plan to show success to students is very important. Once your system is going and can prove that aquaponics does work, split the class into as many groups as possible (based on what supplies are available).

You will also want to create basic spreadsheets for the classroom to collect data. Depending on the knowledge level of the class, and the availability of supplies, you may want to include water quality data.

Discussion

1. Start off asking the students what they think is necessary to make plants grow. This is a great time to discuss the basics and importance of photosynthesis.
2. Ask students what they think of a system of plants not living in soil but rather water. Get their reaction and remember that this could be very cool to students. After (an assumed) lack of realization that plants can survive in just water explain that this is called hydroponics. Consider showing a basic video of hydroponics. Then ask the students what fish could provide to plants. Lead them to the idea of "waste equals food". Then bring up the fact that this process is called aquaponics. Ask them which process they think would be more efficient? Why?
3. Set up the experiments by leaving out all of the available products and have them produce, in groups, their own aquaponics system. They can decorate the tanks with drawings or facts found on the internet.
4. Over the course of the learning experience, have the students collect data and observations from their systems. At the end of the process they should come to their conclusions, which may take the form of a discussion or paper.
5. Some extra questions that may be helpful are the following:
    a. Which plants grew the best?
    b. Whose system worked the best and why?
    c. What do plants need to grow and why?

   d. What are the benefits of aquaponics?
   e. If there was no budget and no barriers, what would you change about your system?
   f. What are the benefits of plants in general?
   g. What importance does water quality have on the system? (ecological balance)
   h. What was the best part of the experiment?
6. If there is more time you can have them create posters, movies, or even teach other students about what they learned. Teaching others and writing down the information can help students to remember these ideas. It would be helpful to take plenty of pictures for this part of the project.

Evaluation

The main component of this activity is participation, so the students should be evaluated based on how the participate during the set up and in the following discussion.

Extensions and Modifications

The activity functions as a stand-alone introduction to aquaponics, but can also be used to help explore a classroom aquaponics setup or the setups displayed in the area.

Notes (Please write any suggestions you have for teachers using this activity in the future)