

Sabina Perez
Simon A. Sanchez High School
Guam

Lesson Plan

Topic: Hydroponics, Aquaculture, and Aquaponics

Summary: Students will learn the 1) basics of hydroponics and six types of hydroponics systems, 2) basics of aquaculture, 3) basics of aquaponics, and 4) design and construct one of the systems.

Goals and Objectives: Students will be able to conduct further research on a particular system and to design, construct and maintain it. As the systems are maintained, students will conduct research on optimal conditions for growth of fish and/or plant populations.

Guam Standards: BI.2.2 Explain the chemical reactions that occur in photosynthesis and cellular respiration that result in the cycling of energy. BI.2.4 Describe the flow of matter, nutrients, and energy within ecosystems. BI.2.22 Understand and describe how organisms are influenced by a particular combination of living and nonliving components of the environment. CH.3.16 Know how to use the pH scale to characterize acid and base solutions and to calculate pH from the hydrogen-ion concentration; also, know and explain how buffers stabilize pH in acid-base reactions.

Time Length: Three weeks. A longer period may be needed for the construction of the aquaculture pond.

Prerequisite knowledge: Basic understanding of photosynthesis and ecology

Materials:

- Hydroponics Powerpoint with worksheet
- Permaculture Resource Book
- Aquaponics Explained* Video
- Computer with Internet access
- Aquaculture Training Online Learning Videos (ATOLL) and other online resources
- Materials for hydroponics, aquaculture, or aquaponics systems

Procedures:

I. Hydroponics

- Students will complete interactive notes for the hydroponics basics (see attached Hydroponics Powerpoint and worksheet)
- Students will create a foldable that contains four types of hydroponics systems
- Students will draft a design and construct one of the hydroponics systems

II. Aquaculture

- Students will read and outline key points in the “Aquaculture Module” in the *Permaculture Resource Book*
- Students will design and construct an aquaculture pond for the school garden

III. Aquaponics

- Students will view and take notes on “Aquaponics Explained” Video
- Students will help in the assembly and maintenance of an aquaponics system

Evaluation: See attached rubric

Hydroponics Worksheet

Created by Mary Garvilles

Name: _____ Date: _____ Period: _____ Group: _____

1. What is hydroponics?

 2. Growing plants hydroponically helps _____ and _____ grow more _____ more _____ in smaller areas and to produce food in parts of the world where _____, _____, and/or _____ are limited.

 3. Passive Systems:
 - These systems use _____ energy to move nutrients and water.
 - Passive systems often use a _____ material to draw up the liquid nutrients.
 - Or they simply _____ the plants in the solution with an air space around some of the root zone.
 - pH must remain between _____ and _____.
 - _____ is the process by which plants grow.

 4. _____ is a measure of the acidity and alkalinity on a scale from 0 to 14.
_____ being very acidic
_____ being neutral
_____ being very alkaline

 5. Plants need about _____ different essential elements for optimum growth.

 6. There are _____ and _____ nutrients.

 7. _____, which are ordinarily found in soil, are needed by plants in rather _____ amounts.
Examples include: _____,

 8. Trace elements, or _____, are important to the total well-being of the plant, but in much smaller amounts.
Examples include: _____

 9. Did you know that most plants are composed of about _____ water?
Records show that plants have been grown _____ soil for many thousands of years.
The modern science of _____ began in the _____.
- A large _____ plant, when fruiting, can use up to a _____ of water

Permaculture Design Project Assessment Rubric

Course No.: Permaculture Date: _____

Team/Student: _____ Reviewer: _____

| Topic (Weight) | Unacceptable (0) | Marginal (1) | Acceptable (2) | Exceptional (3) | Points |
|----------------------------------|---|--|---|--|--------------|
| Project Description (1) | No description provided | Includes purpose of project only | Engages the audience. Includes purpose of project, description of materials and procedures. Relates the project to Permaculture principles and overall sustainability. Organized and no grammatical errors. | Captures audience attention. Includes purpose of project, description of materials and procedures, problem-solving, & significance to society. Relates the project to Permaculture principles and overall sustainability. Organized and no grammatical errors. | |
| Permaculture Concepts (2) | No connection is made to Permaculture principles | Relates project to less than 6 Permaculture principles | Relates project to 6-10 principles of Permaculture in a thoughtful manner | Relates to 11 principles of Permaculture in a thoughtful manner | |
| Neatness and Effort (2) | Not assembled properly or not operable. Missing components. | Assembled and operable. | Project is neatly done. Demonstrates care and thought in its construction and operation. | Project is neatly done. Demonstrates care and thought in its construction and operation. Personal expression is evident. | |
| Plant Growth (1) | No germination has occurred. | Seeds have sprouted. | Growth is vibrant. Produce may be ready for harvest. | Different stages of growth are visible. | |
| Research (2) | No citations provided or sources may be questionable. | Less than five APA citations. | Selection of resources shows a progressive line of inquiry. Sources are reputable. At least five APA citations are present. | Selection of resources shows a progressive line of inquiry. Sources are reputable. Five or more APA citations. | |
| OVERALL PERFORMANCE | Unacceptable | Marginal | Acceptable | Exceptional | TOTAL |
| POINTS REQUIRED | 0–14 | 15-18 | 19–21 | 22–24 | |

What, NO SOIL?

Intro to Hydroponics

Created by Mary Garvilles





Hydroponics is growing plants by supplying all necessary nutrients in the plants' water supply rather than through the soil.

Growing plants hydroponically helps gardeners and farmers grow more food more rapidly in smaller areas and to produce food in parts of the world where space, good soil, and/or water are limited.

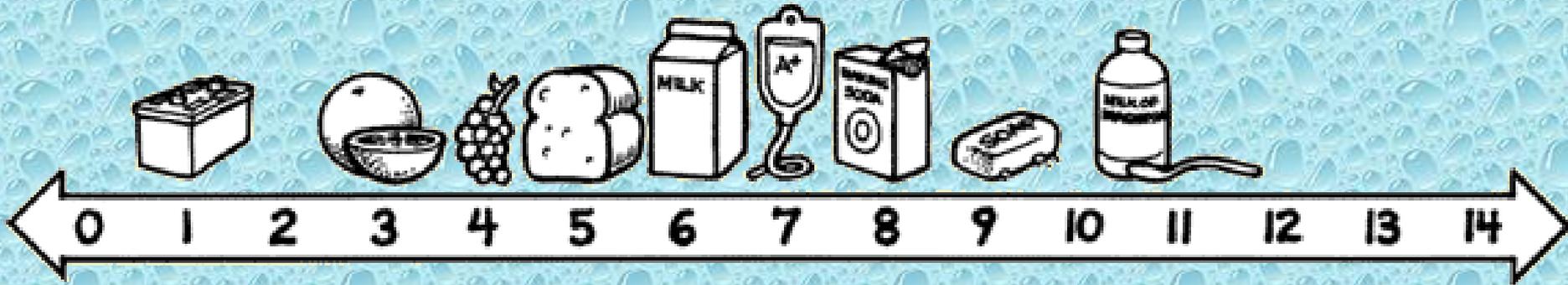


Passive Systems



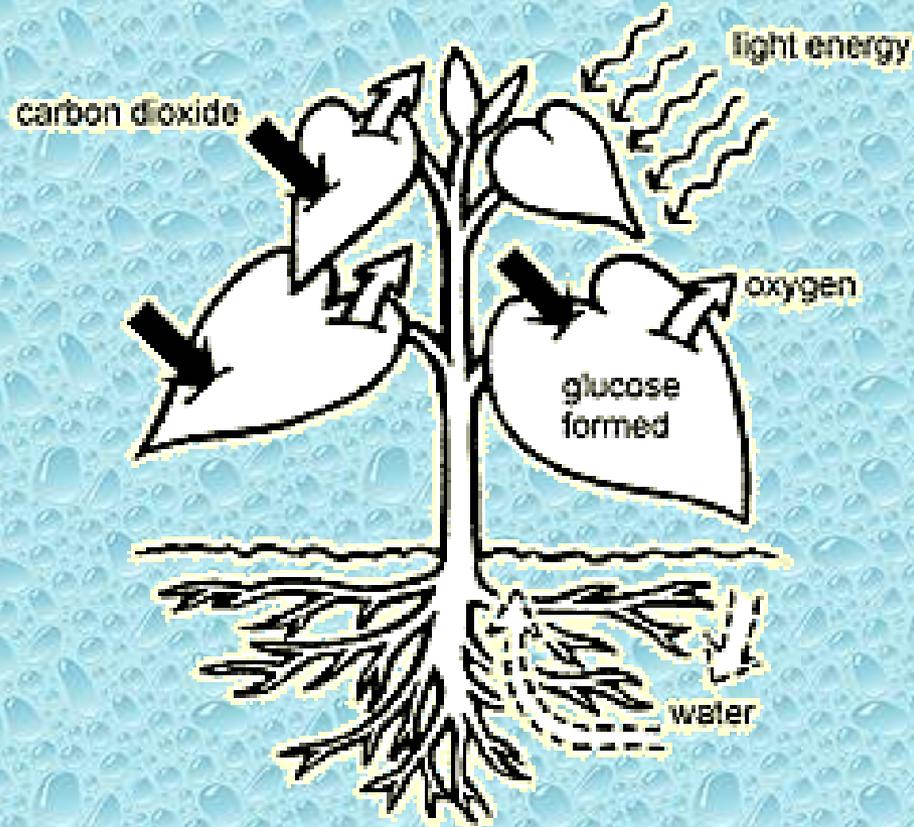
- These systems use no energy to move nutrients and water.
- Passive systems often use a "wicking" material to draw up the liquid nutrients.
- Or they simply suspend the plants in the solution with an air space around some of the root zone.
- pH must remain between 5.8 and 6.5
- Photosynthesis is the process by which plants grow.

pH



pH is a measure of the acidity and alkalinity on a scale from 0 to 14, With 0 being very acidic, 7 being neutral, and 14 being very alkaline.

Photosynthesis



Nutrients

Plants need about 16 different essential elements for optimum growth.

There are Macro and Micro nutrients.



Macro

Macronutrients, which are ordinarily found in soil, are needed by plants in rather large amounts.

- nitrogen (N)–Promotes development of leaves
- phosphorus (P)–Aids in growth of roots
- potassium (K)–Helps plant resist disease
- calcium (Ca)–Helps promote new root and shoot growth
- magnesium (Mg)–Contributes to leaf color and helps absorb sunlight
- sulfur (S)–Contributes leaf color

Micro

Trace elements, or micronutrients, are important to the total well-being of the plant, but in much smaller amounts.

They include manganese, iron, copper, and others...

Did you know?

- **Did you know that most plants are composed of about 90 percent water?**
- **Records show that plants have been grown without soil for many thousands of years.**
- **The modern science of hydroponics began in the 1930s**
- **A large cucumber plant, when fruiting, can use up to a gallon of water a day!**