

**SUBJECT:** Agricultural Science  
**LEVEL:** Forms 4 & 5  
**TOPIC:** AQUAPONICS

**CSEC Agricultural Science Syllabus**  
**SECTION A: Introduction to Agriculture**  
**1. Agricultural Science and Agriculture**

*Specific objectives:*

- 1.3 Describe conventional and non-conventional crops and livestock farming systems (aquaponics, hydroponics, grow box, trough culture, urban and peri-urban farming)**

## **AQUAPONICS**

This is a system that combines both aquaculture (rearing on fish inland) and hydroponics (growing of plants in water).

***Aquaponics = Aquaculture + Hydroponics***

A farmer can get two products from an aquaponics system:

- Primary or main products are crops/ plants
- Secondary product is the fish

### **Parts of an Aquaponics System**

The main parts (components) of an aquaponics system are:

1. Rearing Tank – where the fishes grow
2. Growing Bed – where the plants are located
3. Water Pump and tubing – Pump is located at the lowest point of the system and used to push water back to the upper level.
4. Aeration system (air pump, air stone, filter, tubing) – to provide oxygen
5. Solid Removal/ sedimentation tank – to remove solid particles which the plant cannot absorb and may block the tubing etc.
6. Bio-filter – the location at which the nitrification bacteria can grow and convert ammonia to nitrates.
7. Sump – lowest point in the system to catch water. The pump can be placed here.

### **Lifeforms in an Aquaponics system**

- Fishes
- Plants
- Bacteria

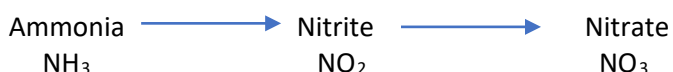
These three living entities each rely on the other to live.

### **Fishes**

Fishes are used in an aquaponics system to provide nutrients for the plants. These nutrients come from their fecal matter and urine (which contains ammonia) and other waste from their bodies. It is critical to control the amount of ammonia in the system; therefore, the pH, oxygen and temperature must be properly managed.

### **Conversion of Ammonia by Bacteria**

Beneficial bacteria convert ammonia to nitrate. The fecal matter and urine of fish contain ammonia. However, the plants are unable to use the nitrogen in ammonia in this form because it is toxic to the plants. Therefore, the ammonia must be converted to a non-toxic form which is the nitrate form. This conversion is done by bacteria. The bacterial is called nitrifying bacteria and they live in the tank walls, underside of the growing medium, rafts which hold the plants etc. These bacteria are natural and will start living in a system when ammonia is present. Nitrifying bacteria naturally live in the soil, water or air. These bacteria convert ammonia first to nitrite and then to nitrate which plants consume.



### Conversion of wastewater to clean water by Plants

1. Bacteria remove ammonia from the wastewater by converting it to nitrate, which is then used by the plants. This is one way of cleaning the water.
2. Plants use the nitrates in the water for growth, thereby removing the nitrates from the water and in so doing, clean up the water in which the fish live.

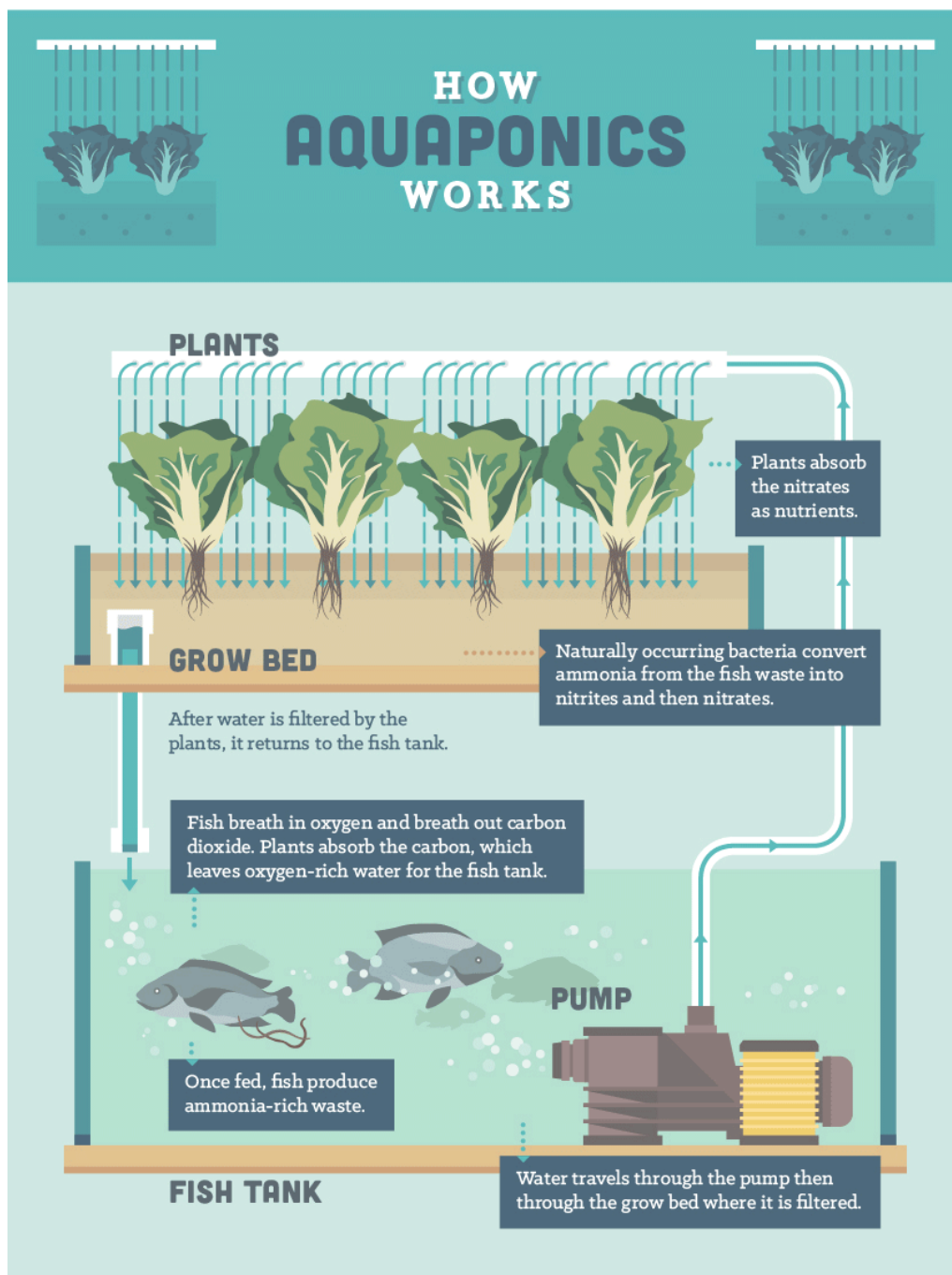
### Benefits of an Aquaponics System

1. Decrease in the use of water since it is recycled and only topped up when required.
2. Lower cost of production since there is no expenditure on artificial fertilizers.
3. Less labour is required when compared to the traditional growing of crops on land.
4. More plants can be grown at the same time because of the density (the number of plants in a specific area)
5. Two sources of revenue (income) at the same time

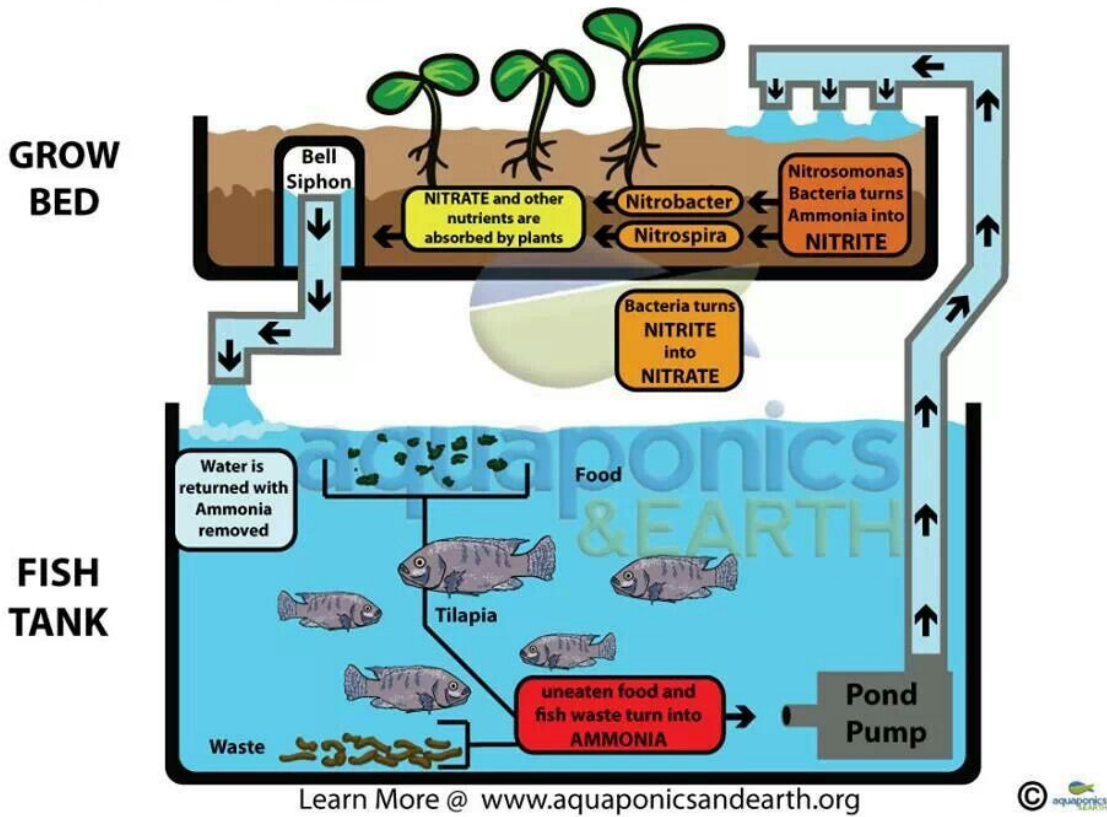
### Disadvantages of an Aquaponics System

1. The system is dependent on electrical energy to work.
2. The fish food has a cost which is added to the cost of production
3. The initial cost to start this system (startup cost) is high
4. Only certain types of crops can be grown in this system (root crops with deep root systems cannot be grown)

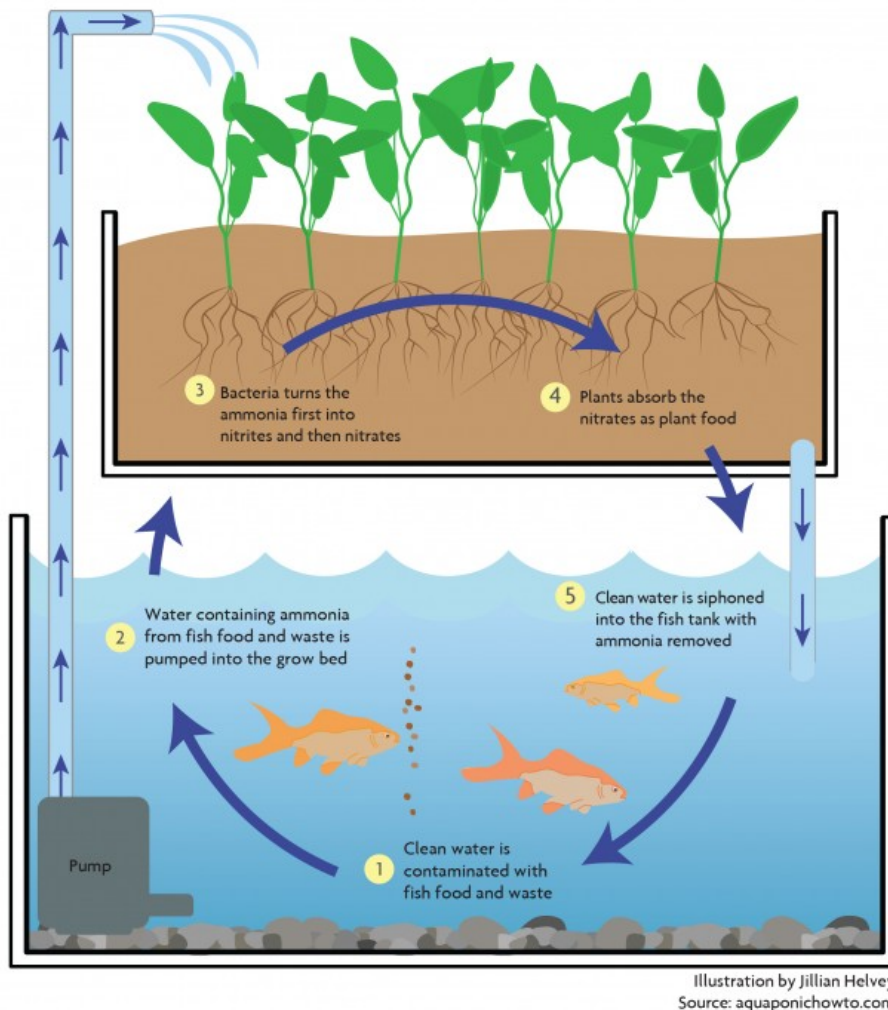
### Diagrams showing Aquaponic Systems



# AQUAPONICS BASIC DIAGRAM

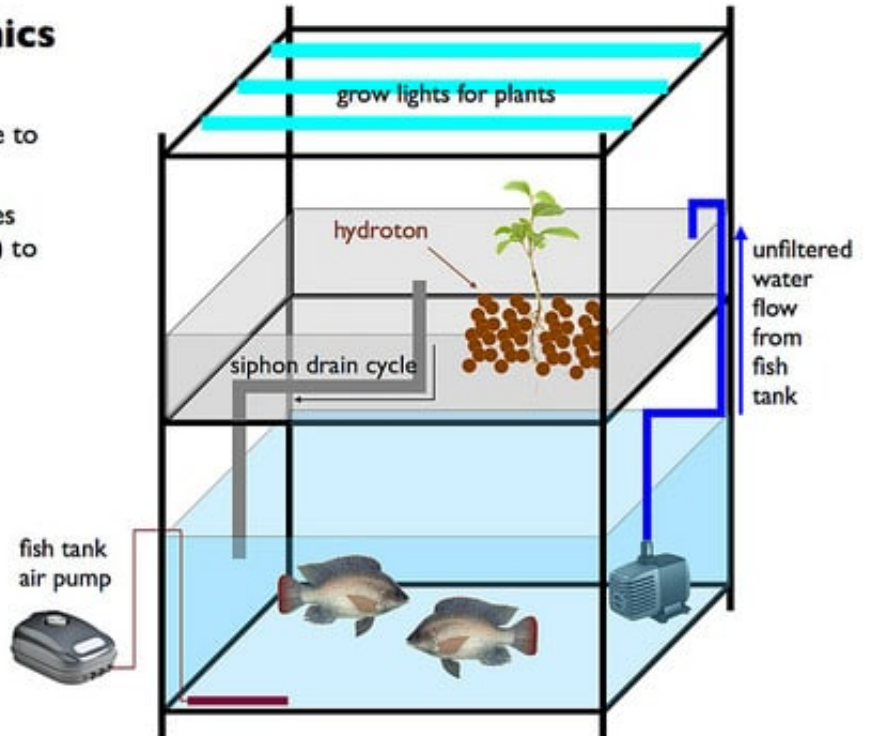


# THE AQUAPONICS CYCLE



## Project: Home Aquaponics

1. Fish eat food and produce waste.
2. Water pump carries water with waste to the plants.
3. Bacteria living on the hydroton pebbles convert fish waste (ammonia+nitrites) to fertilizer (nitrates).
4. Plants feed on nitrates & purify the water.
5. Clean water siphons back to fish.



## References

- Alzuhair, W. (2013, February 22). *Home Economics Project*. Retrieved from <https://fo2oz.com/aquaponics/2013/2/22/home-aquaponics-project>
- Laylin, T. (2016, January 26). Retrieved from *Aquaponics: The Cost-Effective, Cyclical Way to Raise Fish and Grow Plants at the Same Time*: <https://www.fix.com/blog/a-guide-to-aquaponics/>
- Ragoonanan, S. (2017). *Agriculture for CSEC - New Edition Revision Course*. La Romaine: Caribbean Educational Publishers (2003) Ltd.

**Review Questions:**

1. What TWO systems are combined to produce an aquaponics system?
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2. List TWO products farmers can obtain from an aquaponics system?
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3. Describe how the bacteria and plants purify the water in an aquaponics system
  - Bacteria -
  - Plants –

4. Describe the MAIN parts of an aquaponics system.

Part	Description

5. There are mixed opinions on whether home gardeners should be encouraged to establish aquaponics systems in their yards. Suggest TWO advantages and TWO disadvantages of having an aquaponics system
  - Two Advantages:
    - 1.
    - 2.
  - Two Disadvantages:
    - 1.
    - 2.