NewTechAqua

New technologies, Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture

The NewTechAqua-IRTA Aquaponic Kit for Schools

- Assembly kit for secondary schools to provide students with basic knowledge (hydraulics and biology) of aquaponics systems.
- The kit is designed to help students learn by designing and setting up their own cheap and simple aquaponics kit.
- The kit contains instructions (diagram, modules and parts) to design two systems of different sizes for freshwater and seawater.

This Kit has been produced in the framework of **NewTechAqua** project (*New Technologies Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture*), funded by European Union's Horizon 2020 under grant agreement No 862658. NewTechAqua aims to expand and diversify European aquaculture production of finfish, molluscs, and microalgae by developing and validating technologically advanced, resilient, and sustainable applications. The concepts, design and instructions have been developed by Ricard Carbó from IRTA La Ràpita. Bernardo Basurco from CIHEAM Zaragoza has collaborated in the concept development and in the preparation of this document.

Aquaponics is an example of an integrated agriculture and aquaculture system. It combines aquaculture (fish culture) and hydroponics (soil-less plant culture) in a single system with a constant flow of water between the aquaculture tanks and the hydroponic crop beds. The fish waste feeds the plants that in turn clean the water for the fish.

The **NewTechAqua-IRTA Aquaponic Kit** is designed to be very economical, based on material purchased locally (budget store, DIY shop, aquarist shop or garden centre), or online. It has a simple design so that teachers and students alike can enjoy learning concepts such as:

- What is an integrated aquaponics system?
- Aquaculture subsystem
  - The nitrogen cycle and nitrification process
  - Biofiltering and water purification for aquariums
  - Physical and chemical water parameters (oxygen, temperature, pH…)
  - The concept of specific surfaces for biofilters.
- Hydroponic subsystem for plants
  - Floating root model
  - Substrate bed model

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

- Benefits of fish for plants
- Benefits of plants for fish
- How does a trap work?
- How to look after fish and plants in an integrated system
- What is a circular economy?
- What is a sustainable system?

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

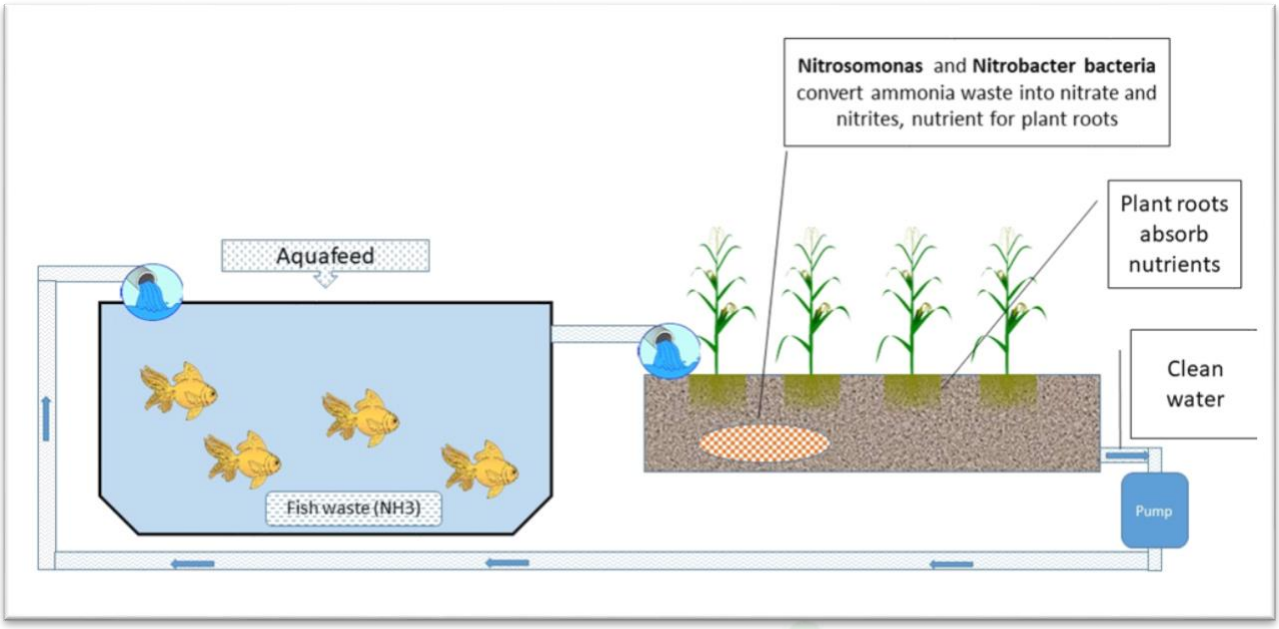
Table of Contents

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Introduction

Aquaponic + Hydroponic = Aquaponic

Diagram showing how an aquaponics system works:



Advantages

- Can produce healthy food (fish and plants), with a Low Carbon Foodprint
- Plants use the metabolic excretions of fish as nutrients
- Plants act as a biofilter
- Very low use of water and share infrastructure/operational costs
  - Minimize effluents
  - Improves water quality

Disadvantages

- Require management knowledge and skills
  - Fish
  - Plants
  - Water chemistry
- Operation requires
  - Commercial fish diets
  - Reliable source of energy
- Investments
  - Moderate initial capital costs for system construction

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

MODEL A. FRESHWATER 127 L AQUAPONICS SYSTEM (advance option)

This system has been designed to be easy and cheap to set up. It has been designed for teachers and students to learn by designing and setting up a cheap and simple aquaponics kit. You can purchase all the corrosion-proof components or similar parts in a local budget store.

Figure 1. General view of the 127 L system

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

1. Where to set it up

The best place to set up your aquaponics system is somewhere readily visible where you can check regularly on the state of the plants and fish. Make sure it is near a wall socket and far from draughts and heaters.

Aquariums are very heavy when they are full! Make sure that the bench or table that you put the system on is flat, sturdy and stable.

The system should be well lit and if possible have natural light to support the plants' photosynthesis but avoid exposure to direct light to prevent the water from overheating.

2. Materials

1) A compact box (80 x 60 x 43 cm, 127 litres) with a lid for transportation. Opaque boxes are most suitable but you can also use transparent or translucent boxes.

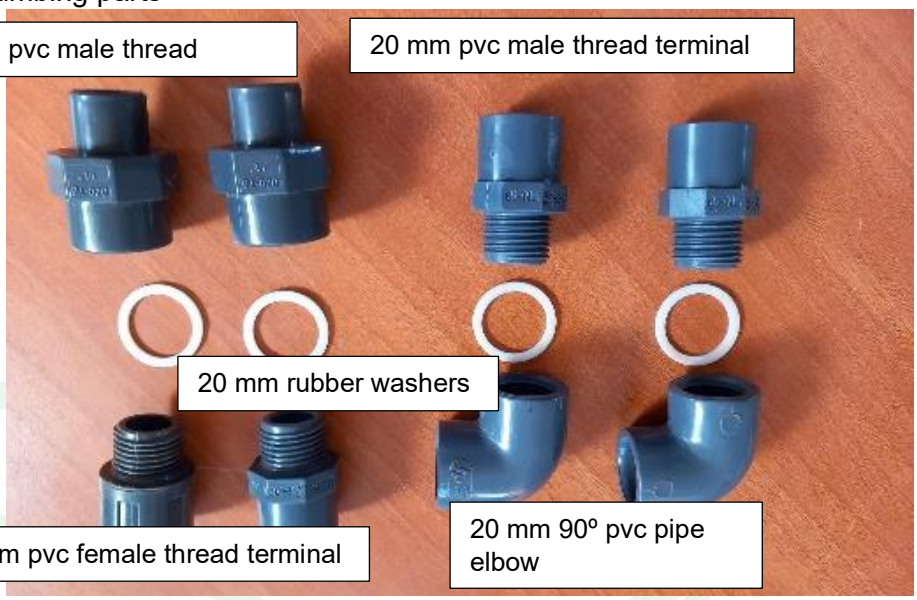

2) Three planters (64 x 24 x 15 cm) without holes. Make holes in the bottom of the planters that you are going to put on the outside, and make holes in the sides of the planter that you will put in the centre.

3) Base for the upper container (or similar rectangular base)

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

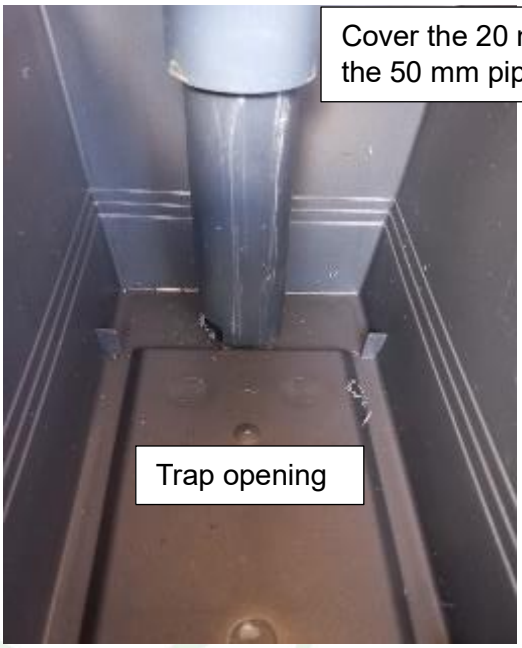
4) An aquarium pump (1150 l/h). Or 2 pumps of (650 l/h) If you can't find one locally, you can buy one online (eBay, Amazon, etc.).

5) Plastic plumbing parts



NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

6) Parts of the trap



7) Dip net to handle fish, and fish feed (on sale at aquarist shops).

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

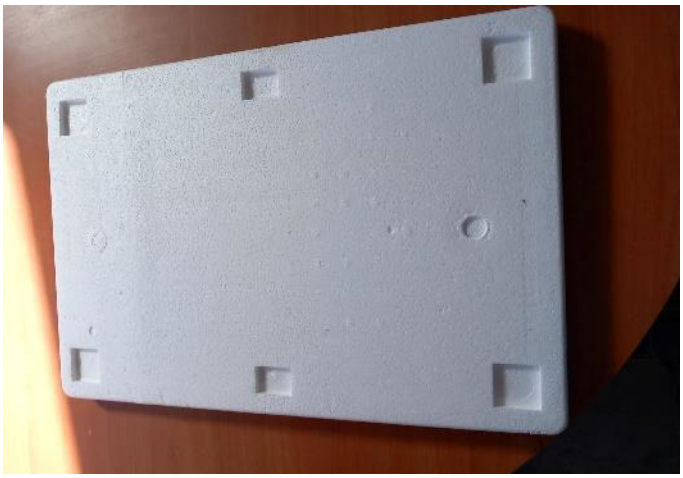
8) Air flow system with distributor hose and air pump. If you can't find one locally, you can buy one online (eBay, Amazon, AliExpres, etc.). The example in the photo is 3w, 220 v 50 Hz, 3l/min

9) Water heater with thermostat. This equipment is optional and is normally used with warm-water fish in places where temperatures may drop to below 15ºC.

10) Dual-purpose biofilter and inert substrate gardening material for plants. The material in the photo is Arlite, also known as expanded clay or LECA. It is a light-weight ceramic substrate, that has multiple uses in gardening and construction work. RINSE WITH WATER BEFORE USE IN ORDER TO ELIMINATE DUST.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

11) Foam base (expanded polystyrene) for the plants in the top container. Cut to fit the plant container.



Freshwater aquaponics system

12) Water. You can use cold tap water. Run the tap for a couple of minutes before filling the aquarium and leave it to settle for 24 h. As some of the water will evaporate, add water from time to time. Have bottles and cannisters at hand with water that has already settled.
13) Plants. It is better to use aromatic plants that need a lot of water (mint, basil, parsley, corinader, etc.). You can also use edible plants (horticulture plants), but they are less suitable for amateurs.
14) Fish. Use resistent, freshwater species such as goldfish *Carassius auratus,* that are economical (1€/fish approx.) and easy to find in aquarist shops. You can also use other fish such as guppies (Poeciliidae), tetras (Characidae) or ramirezi (Cichlidae), but they are more delicate.

Seawater aquaponics system

15) Seawater is normally prepared by adding sea salt to tap water. The best thing is to buy the salt in aquarist shops where they will also give you recommendations on how to prepare it. As rule of thumb use about 33-34 grams of salt per litre of water. As with the freshwater, use a pump for 24 hours so that the salt water can circulate and aireate well.
16) Plants. We recommend working with salicornia (Salicornia sp.) as it is very resistant to salinity and is also edible (perfect for salads or dressings).
17) Fish. Use species that adapt well to salinity. You can find them in aquarist shops (i.e. damselfish, clownfish, or gudgeon…) or you can use aquaculture species or fish that are common in ports or estuaries such as mullet (*Mugil cephalus*).

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Helpful tips

- Place your aquaponics system somewhere readily visible, where you can check regularly on the state of the plants and fish. Avoid places which can be too hot or too cold. Make sure it is near a wall socket and far from draughts and heaters.

- Do not fill the aquarium with fish at the beginning. Check that all the equipment works before, and let the water become clean. Do not feed the fish on the first day.

- Start with few fish and gradually add more over the following weeks so that the filter system can adapt gradually. Do not feed the fish on the first day. Do not crowd the aquarium straight away under any circumstances.

- Feed the fish little and often. Do not overfeed fish, as that will reduce O2 and increasy NH4. Whatever they don't eat in the first 2-3 minutes may deteriorate the quality of the water.

- The aquarium is your fishes' home. Keep it clean and in good condition to make sure your fish stay healthy.

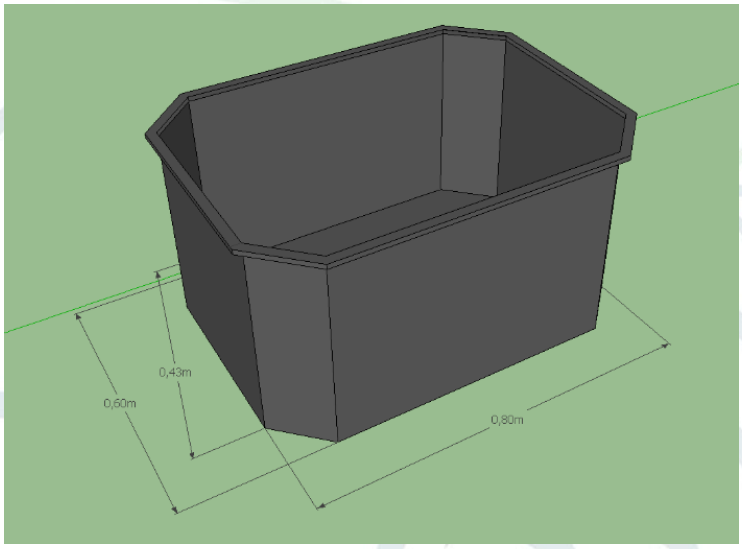
- Establish a routine to clean the aquaponics system regularly. Cleaning an aquarium has its own technique, before you start cleaning it, remove the fish and keep them in clean water. Clean the aquarium well and let the water circulate until you are sure it is clean enough to put the fish back.

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

3. How to assemble

Let's start with the components. The whole system has been designed to be easy and cheap to set up. You can find all the corrosion-proof components or similar parts in a local budget store.

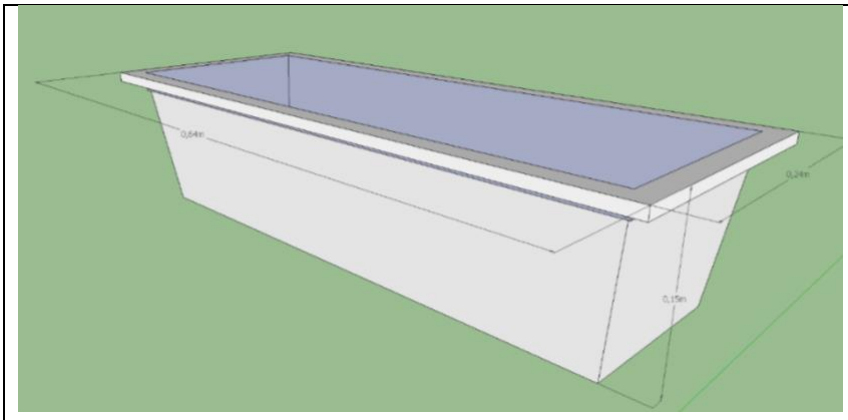
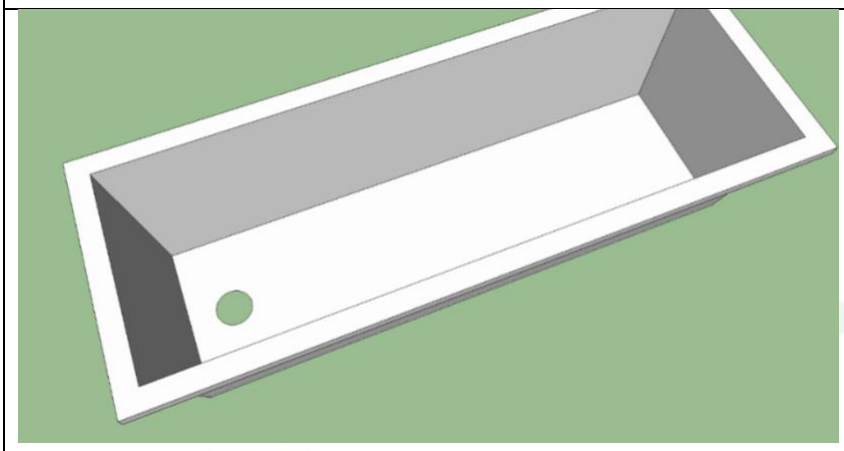
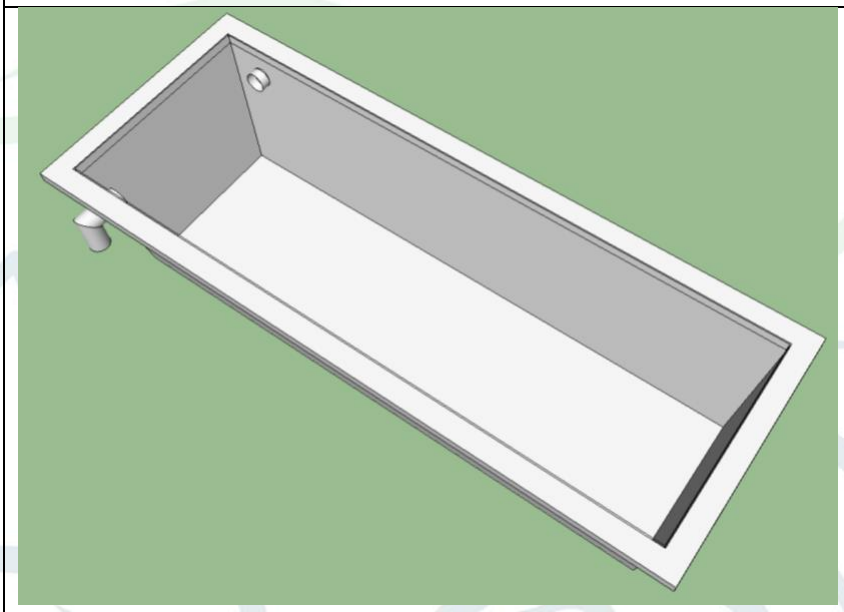
Parts



Plastic bucket for the fish

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

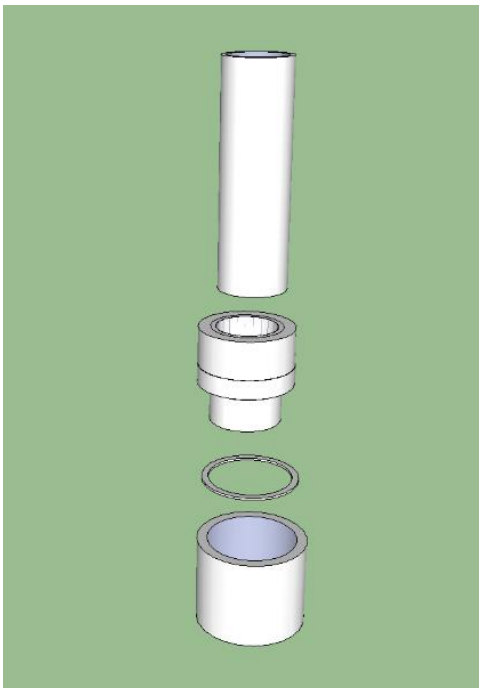
3 Rectangular planters. Make holes in the base of the bottom two planters and make overflow holes on the side of the top planter.

	Two low-lateral planters. 1 hole on the bottom
	
	One top planter. 2 holes on the sides (1 on either side)

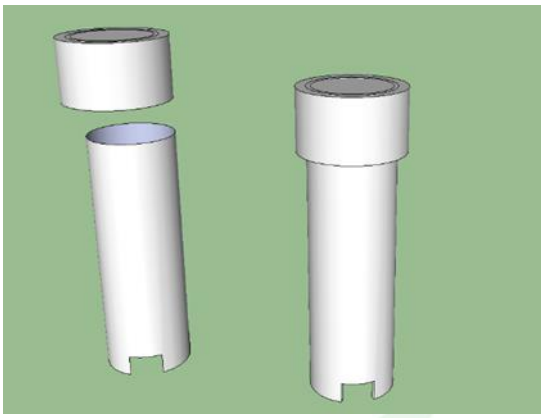
NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

TRAP

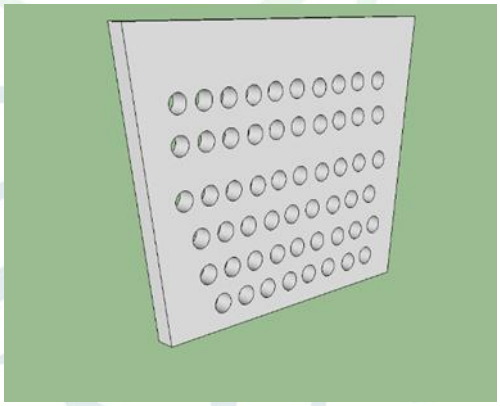
pvc parts, pipe, hose, O-ring



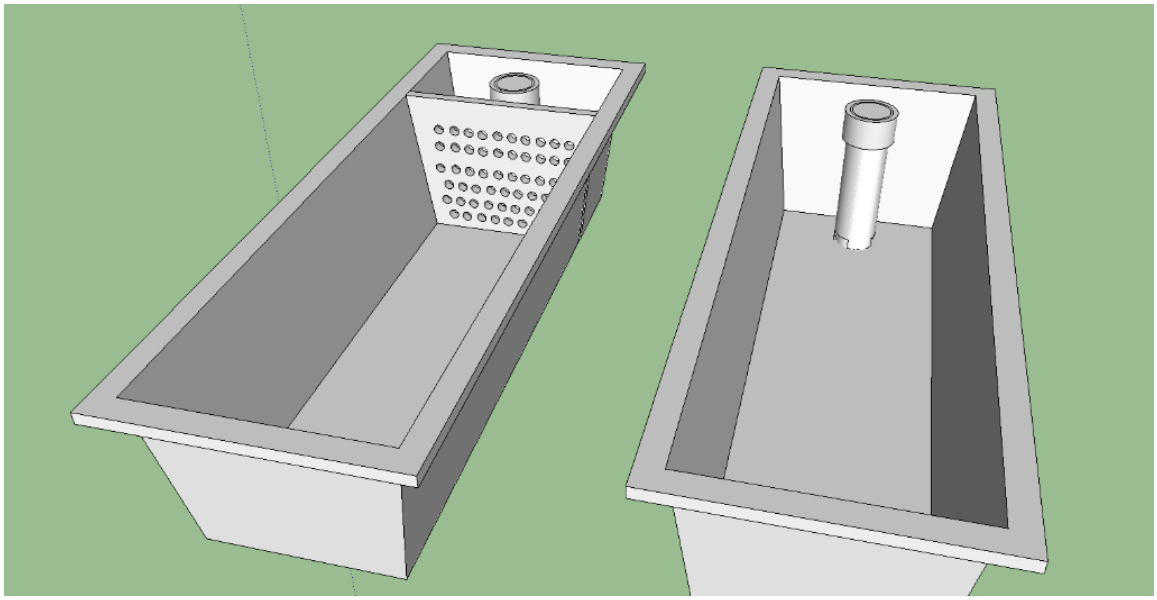
pvc parts, end caps



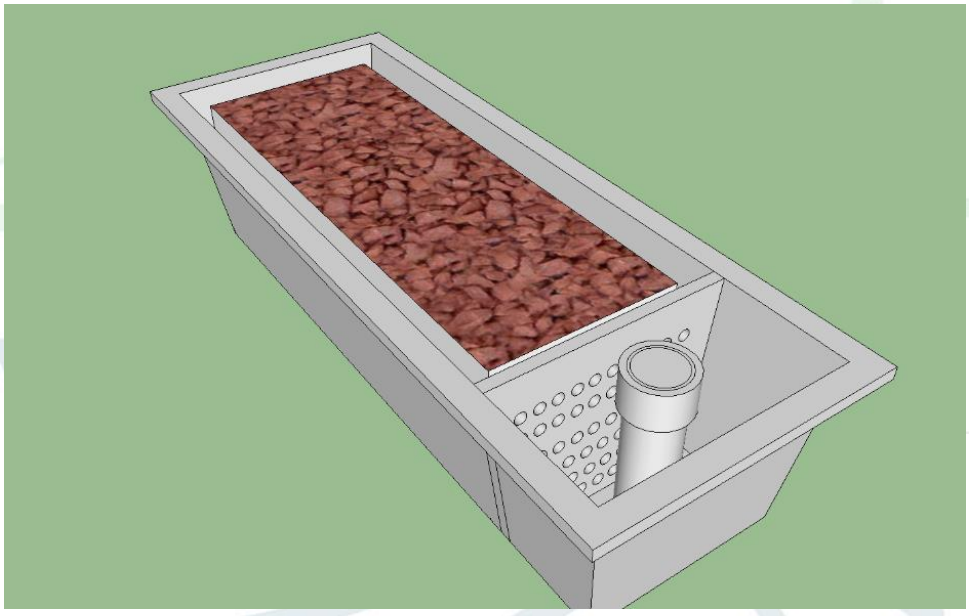
pvc partition with holes



NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

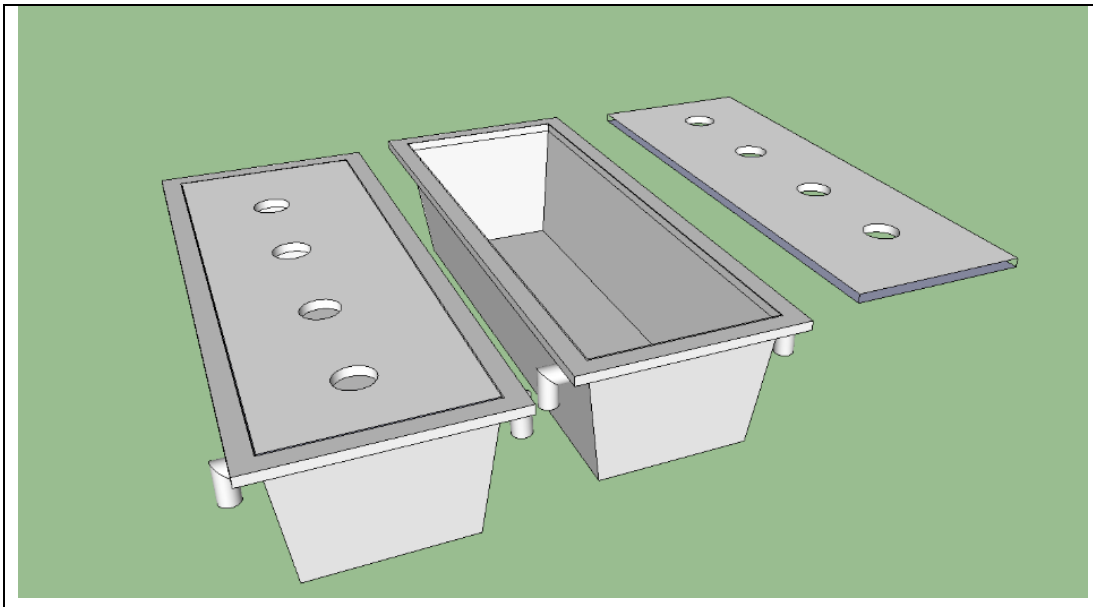


Set up the trap. The water can be drained automatically thanks to the trap effect. Once the planter is full, the water will be filling up and emptying all the time. That will serve a dual purpose because on one hand the roots will be in contact with the water but sometimes they will be in contact with the air so they are well aireated. Also, thanks to the automatic air flow, there will be enough oxygen for the nitrifying bacteria to fix naturally to the substrate (perlite).

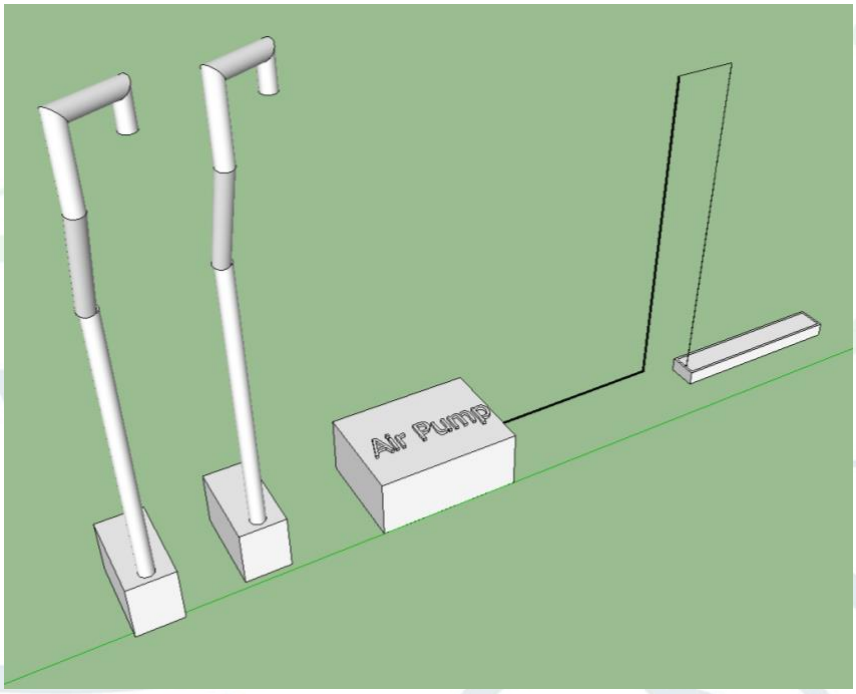


Planter filled with perlite

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.



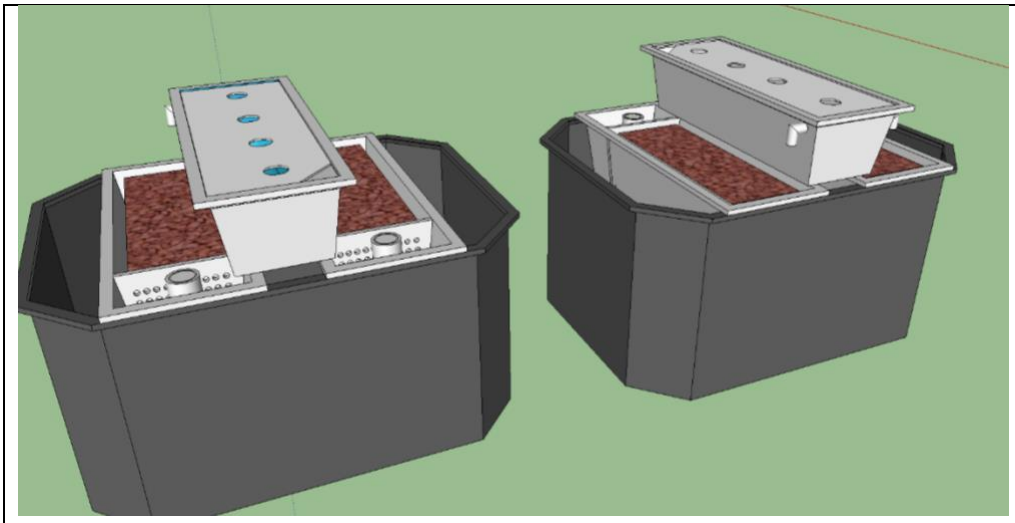
Top planter. System with a float, use an expanded polyurethane sheet with holes to insert the seedlings: Make an drain hole at each end or overflow outlets on the side of the planters so that any excess water can flow down to the two planters below.



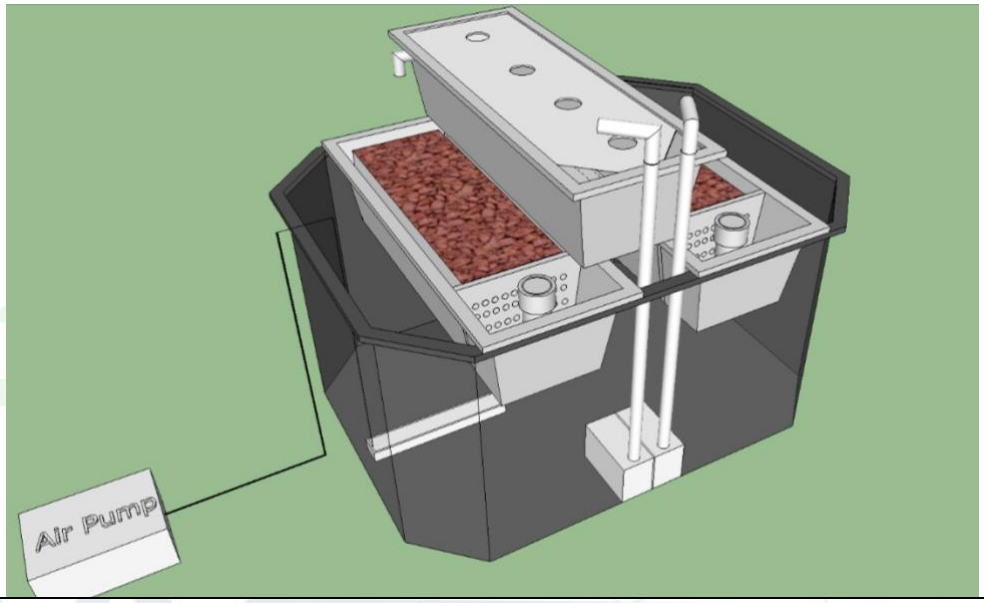
2 Pumps to provide water from the fish (aquarium) to the plants in the top planter.

Air flow pump and macaroni tubing to aireate the water in the aquarium (for the fish).

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.



Front and back view of IRTAponic



Close-up view of the parts

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

MODEL B. DESKTOP AQUAPONICS SYSTEM (basic option)

This system is easy and cheap to set up and has been designed for anyone interested in learning about aquaponics by designing and setting up a cheap and simple desktop kit. You can purchase all components or similar parts from a local budget store.

As this proposed aquarium is of low volume (13 l), use few fish, and feed them very little. Do not overfeed fish, as that will reduce O2 and increasy NH4. Note that water quality in small volumes may deteriorate easily and fast.

1. What you need to set up a desktop aquaponics system

Figure 1. General view of a desktop system

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Components:

Air flow pump with Led lamps (BPS or similar)

Submersible pump

RESTAR 4 l/min air pump or similar

3.25 l Tupperware box

Plastic plant pots for biofilter/substrate and plants

Led lamp to illuminate the plants. Only for systems with little natural light

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.

Plastic aquarium of 31x18x24 cm = 13 litres

2. Steps to set up

NewTechAqua is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 862658.