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STEM
E-CONTENT
3D VIRTUAL REALTY

The Key To Global Life,
Digital Change Of Nature

Total Duration: 2-3 hours

Student's Age: 12-18 Years

Application Area:
- Recycling,
- Sustainability,
- Resource (water) scarcity, biology,
- Food production

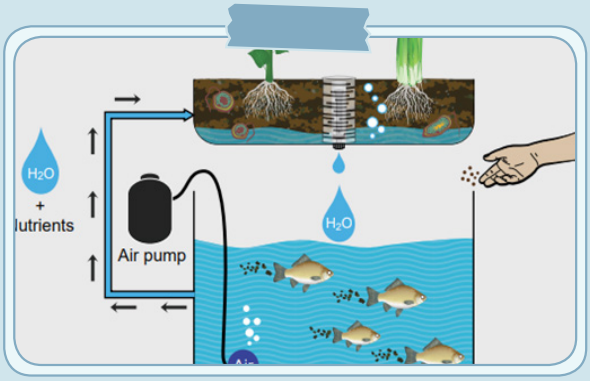
Keywords: **Water, sustainability, resources, recycling, food, production**

W6 - Rooftop Aquaponics

Module
- Water and Healthy Food
- Global Warming

W6 - English Version

Materials:
- **Paper (A3)**
- **(Colored) pencils**
- **Laptop**
- **Beamer**
- **Teacher needs a basic knowledge of Arduino.**



Notes:
- Size of each group: 3-4 students.
- Important is that the students feel free to think out-of-the-box. Don't give them too much information about possible solutions. Let them know that you will evaluate them on the process, not on their solution
- This is only the brainstorming and presentation stage, not making it in real life

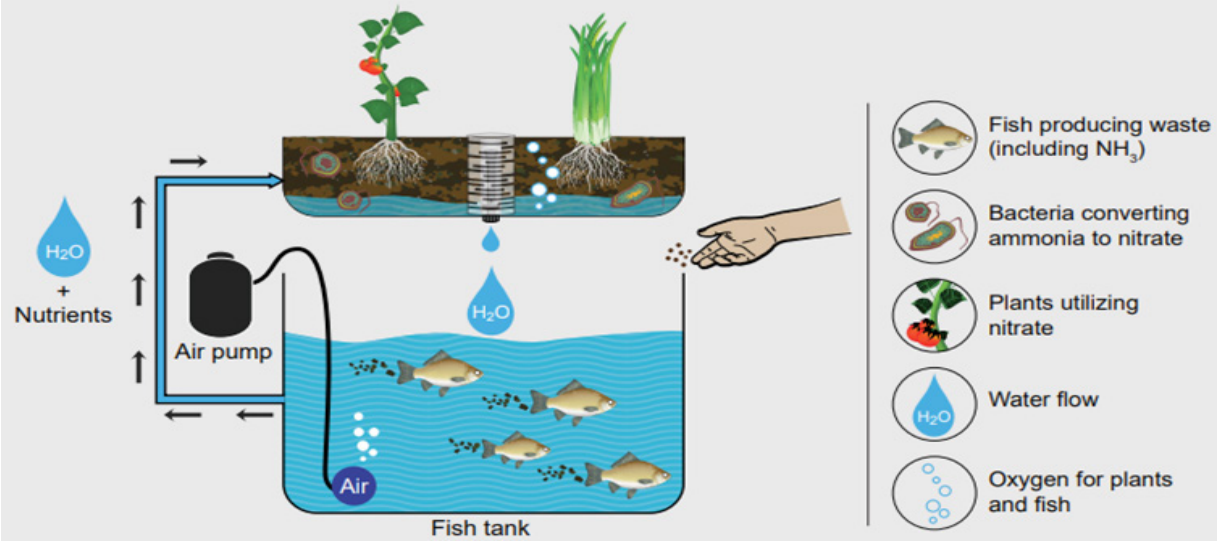
Introduction

In an aquaponics system, nutrients are provided by the fish, their waste contains ammonia which will be converted into nitrites and then nitrates by nitrifying bacteria. The water in the tank is constantly pumped into a grow bed where the plants are located. The plants use the nutrients from this water which is then sent back into the fish tank. Both grow bed and plants act as biofilter. In aquaponics, the fish, plants, and bacteria all depend on each other to live.

Students have to design a feasible, innovative and sustainable aquaponics system for the school's rooftop. After that, they produce a presentation (max. 5 minutes) for the class.

It should include:

1. A detailed building plan of the aquaponics system
2. An overview of the electronics involved



Picture 1. Aquaponics concept

(©Somerville, C., Cohen, M., Pantanella, E., Stankus, A., & Lovatelli, A. (2014). Small-scale aquaponic food production. FAO Fisheries and Aquaculture.)

The story: The school has a flat roof where we grow some strawberries in a rooftop garden; We want to upgrade this garden to a sustainable aquaponics system. Aquaponics combines growing crops with farming of aquatic organisms, usually for human consumption.

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In this activity, the students will work in a group to design a feasible, innovative and sustainable aquaponics system for the school's rooftop, including building plan of growing beds and fish tank, water pump, sensors used and IoT.

At the end of the activity, students will propose their solution to their peers by giving a presentation to the class. The rest of the class ask questions at the end of the presentation.

It is important to stimulate them to think out of the box and find innovative solutions.

Considerations

- Size of each group: 3-4 students.
- Important is that the students feel free to think out-of-the-box. Don't give them too much information about possible solutions. Let them know that you will evaluate them on the process, not on their solution
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Aim of the Activity

- Raising awareness about climate change and how this impacts water availability and food production
- Taking action and work on solutions to tackle these problems
- Focusing on sustainability, using cheap available technology
- Learning clear, structured communication

Activity Process

Before Activity

At this stage, the teacher discuss the following research questions:

1. Explain the assignment: background, aim, time frame for each part
2. Divide the class in groups 3-4 students, each group at their own table. Each group has a laptop, paper and pencils.

Let's Start

Design and build a rooftop aquaponics system. Considerations the students can take in account:

- What equipment do you need for a DIY aquaponics system? Consider location and appropriate size or number for equipment involved (e.g. location and volume fish tank, surface growing beds, number of plants, number of fish)
- Since a dynamic equilibrium among plants, fish and bacteria must be sustained, which parameters need to be monitored? Hence, which sensors are needed?

1 Design

- Are there any 'seasonal' parameters to take into account? (e.g. growing speed of the plant with different amounts of sunlight)
- How could you monitor, store and visualise these parameters on a cloud-based dashboard?

2 Presentation preparation

Once they have designed the aquaponics system, they have to make a presentation (max. 5 minutes for each group). The students choose how to do this themselves. The presentation should include:

- A detailed building plan of the aquaponics system
- An overview of the electronics involved

3 Presentation

Each group will present their solution to the rest of the class. The other students listen to the presentation and in the end they ask questions. Critical thinking and respectful communication has to be encouraged. Aim is by presenting the solution and discussing it with the rest, the quality of the solution will improve.

Assesment

Evaluation

- The design of students can be displayed within the school. Different products can be created by diversifying waste materials used.

If possible the projects can be worked out further in real life in a later phase, maybe downscaled or altered to make it easier to do.

Goals	Must be Improved (1)	Medium (2)	Good (3)	Very Good (4)
Identifying and refining the research question	(.....)	(.....)	(.....)	(.....)
Active participation in the discussion	(.....)	(.....)	(.....)	(.....)
Thinking out of the box	(.....)	(.....)	(.....)	(.....)
Finding multiple solutions and filter out the best	(.....)	(.....)	(.....)	(.....)
Formulating your own opinion in the group	(.....)	(.....)	(.....)	(.....)
Critical thinking	(.....)	(.....)	(.....)	(.....)
Correct presentation (language, clean)	(.....)	(.....)	(.....)	(.....)
Goal oriented presentation	(.....)	(.....)	(.....)	(.....)
Total				

Links

- Somerville, C., Cohen, M., Pantanella, E., Stankus, A., & Lovatelli, A. (2014).
- Small-scale aquaponic food production. FAO Fisheries and Aquaculture.