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Natural processes for water recovery and reuse in aquaponic systems



BIOS4YOU
AR 2.0

BIO-INSPIRED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS
THANKS TO THE USE OF AUGMENTED REALITY

Project Number: KA220-BW-23-30-126516

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Introduction

The purpose of this document is to create guidelines to help the project staff that are dealing with school children, 14-19 aged, to create and re-adapt exercises using Augmented Reality technology.

To this end, a series of templates have been created that define exercises from a methodological, pedagogical and technological point of view.

A good written description, along with images, videos or sketches of the exercise is very important for experts to understand the idea. This will be part of the “General Information” template.

On the other hand, it will be important to define what STEM topic/subject each exercise is intended for and how AR technology can help students or staff or people interested in it when they use these exercises. In addition, people interested in the exercise can understand the usefulness of augmented information, and it will be necessary to explain the benefits.

During the process of defining the augmented information that each exercise will offer, staff working with teachers will be able to develop innovative ideas that make it easier

Add headings (Format > Paragraph styles) and they will appear in your table of contents.

to learn teaching concepts in an easier way.

All students will be able to view the contents explained by professionals projected in the real world in the form of text, 3D model, image, video, sound... This will help them focus their attention on exercise and more easily assimilate the associated concepts.

This document consists of the following points:

- Information about AR technology
- How to define AR exercise thanks to the template
 - General information
 - Pedagogical specifications



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IMMERSED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS
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- Technical specifications

General information

In this part it will be necessary to report the generic information of the exercise so that it can be recognised.

Name of the exercise:

Natural processes for water recovery and reuse in aquaponic systems

Description of the exercises:

The activity uses Augmented Reality to virtually transport you inside an aquarium in which the functioning of the aquaponic systems will be explained

Through their mobile devices or tablets, students interact with a virtual guide —diver man— that will show the various explanatory panels. Students must listen to the diver man and interact by swimming with him and clicking on the various panels that show the definitions.

Participants:

The activity is designed to be done **individually**, with optional group reflection afterward. Individual participation ensures that each student makes their own decisions throughout the experience, fostering personal responsibility in sustainability thinking.

Group discussions at the end (optional) allow comparison of results and reasoning behind choices, strengthening collaborative learning and peer feedback.



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Participants' age range:

Minimum age: 17, Maximum age: 19

STEM subject and specific topic:

The exercise presupposes preliminary basic knowledge of the bio architectures of sustainable water management systems and familiarity with the use of smartphones/tablets. Students at this age are cognitively ready to engage in abstract thinking, ethical reasoning, and the real world problem-solving.

Gamification process:

The exercise addresses the challenge of clarifying the concept of natural processes for water recovery and reuse specifically in aquaponic systems. Augmented reality helps simplify this process by showing each step clearly and interactively.

Written or graphic description of Augmented info:

Students navigate through each phase of the product's life — from raw materials to disposal — they are faced with choices that carry real environmental consequences. Each decision either earns or deducts “circular energy points”, a dynamic scoring system that reflects their sustainability awareness.

- Animated character (driver man) who guides students.
- Information overlay: interactive panels, visual feedback effects (setting within an aquarium), and explanatory audio.
- Floating 3D choices: Students select explanatory panels.
- Static AR environments: a 3D aquarium

External (or extra) tools required

The augmented reality experience is based on image recognition or QR markers and does not require any physical movement — it is designed to be used at the desk or classroom table.

Mobile device or tablet with AR capabilities. Internet connection for initial file loading. Printed AR marker sheet (optional) or screen-displayed trigger image.

Links (video, images, text online and so on).

<https://www.ellenmacarthurfoundation.org/>





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Pedagogical specifications

Here we will collect information on how to use the exercise in the learning session and the results and benefits of using it, from a pedagogical perspective.

How can this augmented information be used to address a STEAM topic in a more interesting way for students?

Using a mobile device (tablet or phone), students will scan the QR code that will bring them into the game. Once inside the game they will find themselves immersed in an aquarium where they can explore their surroundings to interact with augmented reality. Through interaction with the driver man character, they will learn in a fun and playful way what natural processes are for water recovery and reuse in aquaponic systems and how they can be used.

Which pedagogical objectives are addressed through this scenario?

The educational objective of this game is to improve students' logical skills. In addition to acquiring new knowledge on the subject matter, students will have to figure out for themselves how to interact with the surrounding space and what order of information will be useful for completing the game.



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Which results are expected to be reached with its use?

Natural processes for water recovery and reuse are a topic that is often not explained in school; many students don't even know about aquaponic systems. The game can improve the understanding of this specific topic, improving the memory and learning skills of the student, who will be more involved in the topic through the game.

Which benefits are expected to be reached with its use?

Students can improve their technical and IT skills through the use of augmented reality. By improving their proprioceptive and spatial skills when interacting with a 3D space projected into the surrounding reality. The game mode will make the educational experience more engaging and interesting, even for students with learning difficulties.



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Technical specifications

In this part it is necessary to specify whether the exercise was designed to be implemented with AR technology. This part is fundamental for the translation process. Please include text, audio text and all the necessary materials.

AR INFORMATION

Technology

<https://edu.delightex.com/Studio/Spaces> Marker

If it's needed a marker, description of the marker



Hardware and software needed:

pc, smartphone, tablet, camera.

Type of Augmented data

Images; Text; 3D models

Written description of the AR data

Students will begin the experience by scanning a marker or accessing an AR app on their mobile device or tablet. Students will find themselves immersed in the interior of the game, which takes place inside an aquarium. The driver man character will appear on their screen, inviting them to follow him by swimming along an interactive path with explanatory panels.



3 GENERATIONS
FALTY

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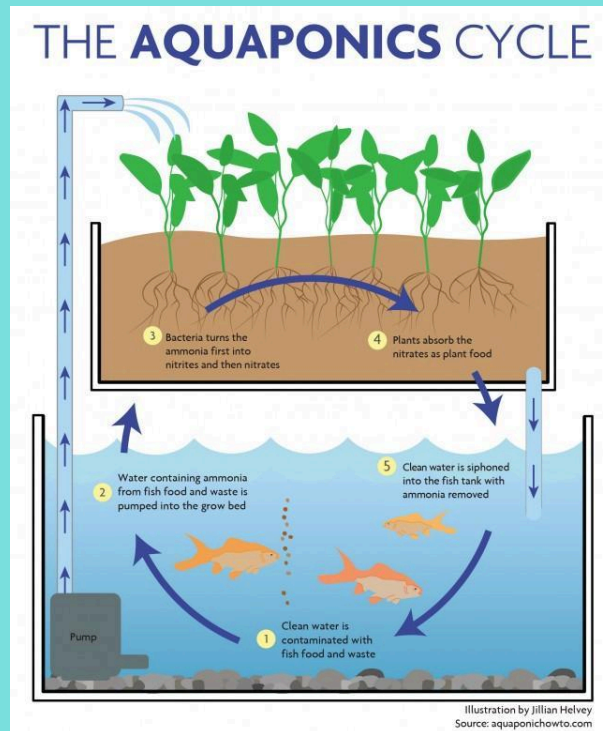
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Students will click on the various panels and the driver man will explain the topic in the meantime.

The activity is carried out in a group and can end with a discussion or reflection in class to compare the results and share ideas.

If Image



If Text

NATURE BASED SOLUTIONS -NBS

- They are nature-inspired solutions to address environmental and social challenges (ex. water security, food, climate change).
- Aquaponics are included in the NBS because they reproduce natural ecosystems in a controlled and efficient way.

What is Aquaponics?



3 GENERATIONS FAULTY

0-126516



- Union of aquaculture (fish farming) and hydroponics (cultivation without soil).
- Nutrient-rich water from fish waste is filtered and used to feed plants.
- The plants, in turn, purify water that can be reused by fish.

Main components of an aquaponic system:

1. Fish aquarium
2. Hydroponic unit
3. Mechanical filter (solids removal)
4. Biofilter (conversion of ammonia to nitrates)

Experiment at the University of Salerno (SEED)

- Period: November 2019 - March 2020
- Species used: Tilapia (fish) and lettuce (plant)
- Objective: To test the effectiveness of the system in removing nitrogen compounds.
- Method: Floating system, use of tanks from 100L (aquarium) and 45L (hydroponics).

Analyses carried out:

- Physical and chemical parameters (pH, DO, salinity, turbidity, nitrogen, etc.)
- Analysis of anions, cations, carbon and bacterial colonies

Results and Criticality

- The system worked but did not completely clean the water.
- Proposal: Integrate the system with filter membranes to improve water quality and nitrification efficiency.

Advantages of an Aquaponic system

- Double production (fish and plants) with the same volume of water.
- Reduction in the use of chemical fertilizers.
- Less environmental impact than traditional farming and aquaculture systems.
- Suitable for urban contexts and areas with limited resources.



3 GENERATIONS
FAULTY

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Conclusion

Aquaponics is a promising sustainable technology, capable of contributing to food safety and reducing environmental pollution, but requires further technical development to improve its efficiency.

If video

-

If audio

-

If 3D model

The formats needed are:.obj,. stl.

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| ☰ Title | |
| 👤 Guests | Person Person Person |
| 🕒 Start time | Date |
| 🕒 End time | Date |
| 📍 Location | Place |
| ☰ Description | |

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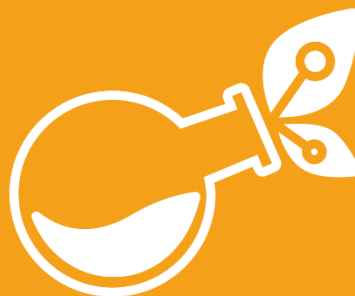
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