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STEAME ACADEMY
TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - LEVEL 1
STUDENT TEACHERS: AQUAPONICS SELF-SUSTAINED CLASSROOM ECO-SYSTEM

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1. Overview

Title Driving Question or Topic	Aquaponics self-sustained classroom eco-system *How can we create a self-sustained aquaponics ecosystem in our classroom that models sustainable agricultural practices and addresses real-world environmental challenges?*
Ages, Grades, … Duration, Timeline, Activities	*16-18* *K10-K12* *180 minutes* *4 X 45 Learning hours* *4 activities*
Curriculum Alignment	*The learning activity aligns with most EU countries' curriculum, with the subject of biology and science while it supports the development of environmental awareness among students making them responsible for taking care of plants while at the same moment their classroom becomes "greener".*
Contributors, Partners	
Abstract - Synopsis	
References, Acknowledgements	Aquaponics USA (https://www.aquaponicsusa.com/education/aquaponics-101-part-1.html) Forchino, Andrea & Gennotte, Vincent & Maiolo, Silvia & Brigolin, Daniele & Mélard, Charles & Pastres, Roberto. (2018). Eco-designing Aquaponics: A Case Study of an Experimental Production System in Belgium. Procedia CIRP. 69. 546-550. 10.1016/j.procir.2017.11.064.

2. STEAME ACADEMY Framework*

Teachers' Cooperation	*The cooperation between teachers of science and biology is highly endorsed within the scope of this activity as well as the teachers (if such) that is responsible for developing environmental awareness (e.g., EcoMobility school coordinator, ect.). The biology teacher will provide valuable info on how to set up the hydroponic plants while the science teacher will support the actual arrangement and use of lab equipment.*
STEAME in Life (SiL) Organization	*Meeting with business representatives/Applications in real world Entrepreneurship – STEAME in Life (SiL) Days*

Action Plan Formulation	*STAGE I: The activity encompasses the cooperation of two or more teachers, mainly the biology teacher, with the science teacher that is in charge of the school's laboratory equipment.* *STAGE II: All steps have been considered in formulating the learning activity action plan. The relation with a real life problem is evident through out the activity, introduced by the teacher, explaining the benefits of hydroponic plants and their capabilities of wide implementation.*

[*] *under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	*- Understand the principles of aquaponics and its role in sustainable agriculture.* *- Design and set up a small-scale aquaponics system in the classroom.* *- Monitor and maintain the aquaponics system, including balancing fish, plant, and bacterial needs.* *- Analyze data from the system to understand nutrient cycles, water quality, and ecosystem interdependence.* *- Reflect on the broader implications of aquaponics for food security and environmental sustainability.*
Learning Outcomes and expected Results	*The activity aims to achieve the following learning objectives so that students, upon completion are able to:* *- Comprehend the basic way a hydroponic system function,* *- Monitor the progress and status of the hydroponic plants* *- Understand and analyze the elements of the hydroponic plants (e.g., nutrition cycles, water quality, etc.)*
Prior Knowledge and Prerequisites	*Students participating in this activity should have:* *- basic biology knowledge (K7-K9)* *- basic science knowledge (K7-K9)*
Motivation, Methodology, Strategies, Scaffolds	*This learning activity utilizes a project-based approach by engaging students to work in teams, inquire and explore online information to understand the basics of a hydroponic system. Students will have to explore, plan, implement, and test (through observations) if the system they designed functions properly. This approach would also be considered as experiential learning.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*The teacher/s do not need to prepare a lot, as what is needed is the tools and materials related to this activity and a classroom that has the space to host a hydroponic system. It might be preferable to use a classroom with a water tap or a science laboratory for the same reason.*
Resources, Tools, Material, Attachments, Equipment	*The teacher/s for this activity will need the following:* - *Aquaponics system components (fish tank, grow bed, water pump, tubing, grow lights, etc.)* - *Fish (e.g., tilapia or goldfish)* - *Plants (e.g., lettuce, basil, herbs)* - *Water testing kits (for pH, ammonia, nitrites, nitrates)* - *pH adjusters (if necessary)* - *Grow media (e.g., clay pebbles)* - *Whiteboard/markers for diagramming* - *Computers/tablets for research and data logging* - *Lab notebooks*

Health and Safety	*Health and safety for this activity needs to focus mainly on the plants to be used considering if they are allergy friendly, not to have thorns, etc.) as well as with the use of the laboratory equipment (e.g., glass tank).*

5. Implementation

Instructional Activities, Procedures, Reflections	Phase 1 - Aquaponics and System Design (45 minutes) Introduction: Begin with a discussion on sustainable agriculture, introducing the concept of aquaponics as a method of creating a self-sustained ecosystem that combines aquaculture (raising fish) and hydroponics (growing plants without soil). Discussion Questions: What are the benefits of sustainable agriculture? How does aquaponics work? Video/Presentation: Show a video or presentation explaining the basic principles of aquaponics. Activity: Students break into small groups to brainstorm and design their classroom aquaponics system. Each group will present their design ideas. Activity: Begin the setup of the classroom aquaponics system. Assign roles for each group of students (e.g., fish care, plant care, water testing, etc.). For homework, the teacher may ask students to research the specific needs of the fish and plants they will be using in the system and prepare to present their findings. Phase 2 - Monitor, Maintenance, System Care, and Data Logging (45 minutes) Instruction: Teach students about the nitrogen cycle and its importance in an aquaponics system (ammonia, nitrite, nitrate levels). Activity: Demonstrate how to test water quality using testing kits. Students record baseline water quality data in their lab notebooks. Discussion: Discuss what could happen if water quality is not maintained and brainstorm solutions. Activity: Students rotate through maintenance tasks (feeding fish, checking plant health, monitoring water quality). Emphasize the importance of consistent data logging. Instruction: Introduce students to online tools or software that can be used to track and analyze the data collected from the system. Phase 3 – Troubleshooting, Optimization, Analysis, and Reflection (45 minutes) Discussion: Review common problems in aquaponics systems and how to troubleshoot them. Activity: Students analyze the data collected so far and identify any trends or issues. They then propose adjustments to improve system performance. Instruction: Deep dive into nutrient cycling within the aquaponics system, emphasizing the interdependence of fish, plants, and bacteria. Activity: Students diagram the nutrient cycle in their notebooks, labeling where each organism fits into the system. Group Discussion: How does this small ecosystem relate to larger environmental systems? Phase 4 – Broader exploitation of aquaponics and Final presentation Discussion: Explore the role of aquaponics in global food security, its potential benefits in urban environments, and its role in reducing environmental impact. Activity: Students research case studies of aquaponics systems being used around the world and present their findings. *Activity: Each group prepares a presentation on the operation and outcomes of their aquaponics system. Presentations should include: (1) System design and*

	setup process, (2) Data analysis and trends observed, (3) Challenges faced and how they were overcome, (4) Broader environmental and societal implications
Assessment - Evaluation	*The teacher asks students to write a final reflection on what they learned from the project, including how their perceptions of sustainable agriculture may have changed. The outcome of this reflection along with the observations of the teachers throughout the activity is used to evaluate the degree to which the activity objectives have been accomplished.*
Presentation - Reporting - Sharing	*As described in Phase 4 of the activity students will be asked to prepare short presentations which may be shared with their peers, the school community, and their parents.*
Extensions - Other Information	The teachers may ask student to create and cultivate their own hydroponic plant system at home and observe it over a longer period of time. Furthermore, the teacher may introduce students to the concept of a bio-sphere, which is a “closed” eco-system, that can be monitored and examined similarly (same processes and tools) to the hydroponic plants.

Resources for the development of the STEAME ACADEMY Learning and Creativity Plan Template
In the case of learning through project-based activity

STEAME ACADEMY Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the STEAME learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

4. Background Creation - Search / Gather Information
5. Simplify the issue - Configure the problem with a limited number of requirements
6. Case Making - Designing - identifying materials for building / development / creation
7. Construction - Workflow - Implementation of projects
8. Observation-Experimentation - Initial Conclusions
9. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
10. Gathering of results / information based on points 7, 8, 9
11. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

12. Configure STEAME models to describe / represent / illustrate the results
13. Studying the results in 9 and drawing conclusions, using 12
14. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - SIL Days)

Review (by teachers)

15. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

16. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
17. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions

18. Presentation of Conclusions - Communication Tactics.

STAGE III: STEAME ACADEMY Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (SIL) STEAME in Life	14 Meeting with Business representatives	Organization (SIL) STEAME in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation