STE(A)M IT INTEGRATED LESSON PLAN

"Plants - Superheroes"

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INTRODUCTION

In order to inspire students, see the added value of STEM subjects and careers, contributing the same way in tacking unfavourable perceptions and the overall lack of interest in Science, there is a need to reconsider the way STEM subjects are taught. For this purpose, there is a need for an integrated way of teaching. More specifically, there is a need to combine Science classes with other disciplines, ensuring that the integrated STE(A)M education will contextualize STEM teaching is such a way that it becomes more attractive for every student.

Right now, there is no integrated STE(A)M education framework in Europe that will further enhance coherence in STEM education. It is essential to bring together partners from different countries, already working in STE(A)M education, policy, pedagogical innovation and professional development of teachers, educators and school leaders, and engage them in discussions, planning, implementing and the review of new practices. This will ensure that the topic is given new and more intense attention within each country. Therefore, the STE(A)M IT project will lead the way in the creation and testing of the 1st Integrated STE(A)M framework, aiming to strengthen the coherence in STEM education by defining collectively with MoEs and STEM teachers the integrated STE(A)M education framework. The focus group teachers that will create interdisciplinary and innovative teaching and learning scenarios, will be used to test the proposed framework of reference for integrated STE(A)M education.

The creation and implementation of the aforementioned framework is particularly important for students who do not link STEM subjects and their use with their everyday life, but most importantly with their future career paths. The teaching of each STEM subject individually often prevents students from linking those subjects, consequently missing out on a cohesive educational opportunity that might largely affect their study path choice and eventually career.

It is additionally important for teachers of Primary and Secondary schools to work together and fully exploit the benefits of the in-between them collaboration, while contributing to the creation of innovative and cross-disciplinary approaches to STE(A)M teaching in education, each adding their own insight, expertise and knowledge. This collaboration and continuous feedback aim to provide an opportunity for reflection and support a steady and much necessary change in formal education but also career consultancy. This way, schools will assume the additional role of mentorship supporting their students collectively.

A STE(A)M IT Integrated lesson plan is a teacher's detailed description of the course of instruction or "learning trajectory" for a lesson, a guide and a document that will be continuously improved and updated. Each lesson needs to combine three subjects, two of the subjects must be STEM and the third subject can be either STEM or non-STEM. is about designing educational activities that facilitate deep learning to enhance 21st century skills such as critical thinking, collaboration, communication and creativity and divergent thinking. Designing a path based on methodologies such as Problem, Project

and Challenged Based learning allow to incorporate problem-solving, inquiry and design based learning into the teaching activity taking care of real challenges in an authentic context, that of our world.

With this in mind, an integrated STEM approach will develop capable citizens who personally and professionally make informed decisions in their daily lives and have the power to follow STEM careers and guide innovation at any age.

Title

Plants - Superheroes

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Summary

Awareness about importance of ecology and sustainable development are values that need to be nurtured from very young age. Children should learn about symbiosis with nature around us. With various activities students will discover the importance of plants in our lives through scientific research and conclude how an individual can contribute to the salvation of our planet Earth by taking care of plants. Why plants are superheroes, not only they are creating oxygen, clean the air, feed us and give us lots of benefits, but they are also important part of an ecosystem and their existence influence all life on earth. The students will explore what living conditions are important for plants to live, develop and grow, and what can we do to help them thrive.

Licenses

Subject (s)

STEM subjects:

1. Natural sciences
2. Mathematics

Non – STEM subjects:

1. Art

Real- life questions

Are the plants alive and how can we prove our statement?

How are the plants useful?

What can we do to preserve the plants on our planet?

Aims of the lesson

Students will:

• explore life conditions for growing plants

• learn through creative processes of examination and research, creation

• improve their communication skills and collaborative learning

• develop environmentally friendly behavior

• be able to provide solutions on how we can help the future of our environment and planet Earth.

Connection to STEM careers

Ecological caretaker (Natural science)- protects biodiversity by observing nature and taking planned actions about sustainable development

Biologist of the future (Biology) - improving living conditions on Earth as an impact on preserving biodiversity and sustainable agricultural development

Protector geo (Natural science)- planting plants preventing soil erosion and preserving biodiversity

Mathematician and Math)-measurement and calculating data by observing the phenomenon

Research analyst (Natural science, Math)-measuring and analyzing data about phenomenon

Graphic designer (Art)- creating design concepts and drawings to present ideas and concepts

Age of students

5- 8

Time

Preparation time:

2 hours for preparation and planning activities

Teaching time:

- **Preparation:** Presentation of a cartoon on environmental issues and discussion (30 min)
- **STEM Subject 1** Natural Sciences – 120 min
- **STEM Subject 2** Mathematics – 45 min
- **Non-STEM subject 1 :** Art – 90 min

Teaching resources (material & online tools)

Materials:

Transparent plastic cup of half liter, soil, lettuce seedlings, ruler or measuring tape, crayons, Pencils, color markers, Whiteboard/smartboard, Projector Computer, Internet, Graphic poster templates, Evaluation-template

Online tools:

Videos in English language*:*

https://www.youtube.com/watch?v=aOn7ybncP14

Superheroes of Nature - Plants

USES OF PLANTS || SCIENCE EDUCATIONAL VIDEO FOR KIDS

Graphic poster templates:

Growing lettuce; soil+sunlight+water-template:

https://1drv.ms/b/s!Avz-pET_GxbqhB16RRROwdh4Go9a

Growing lettuce in sandy soil-template:

https://1drv.ms/b/s!Avz-pET_GxbqhBqMpr0iZCeBkDl2

Growing lettuce without sunlight-template:

https://1drv.ms/b/s!Avz-pET_GxbqhBuLgusIOShfZtrR

Growing lettuce without water-template:

https://1drv.ms/b/s!Avz-pET_GxbqhBzI7VjShbGaA7S2

Evaluation project-template:

https://1drv.ms/b/s!Avz-pET_GxbqhB4FHPl0BrpeoyNc

21st century skills

This curriculum will improve the following 21st century skills in students:

skills:

1. Critical thinking: Students will reflect and discuss everyday environmental issues
2. Problem solving: Students will define problems that affect the environment, seek and offer solutions
3. Information literacy: Students will receive information about the importance of plants, changes in the environment caused by the reduction of plants, air pollution that will help them think and find solutions
4. Life and career skills

Students will take the initiative to help their environment and the wider community

5. Social skills: Students will develop positive attitudes, communicate

with each other and respect different opinions

6. Creativity: Students will practice their creative thinking skills using available information and reflecions of activities
7. Communication: Students will engage in dialogue and listen to everyone

other people's suggestions and opinions.

Through art work, they will create materials for visual communication.

8. Collaboration: Students will collaborate with each other in solving problems and bring about changes in their local community and the nature around them.

9. Productivity and responsibility: Students will plan and manage time for implementation and collaboration in activities

10. Responsibility: Students will be asked to suggest applicable and realistic solutions and implement them.

STEM Strategy Criteria

Interdisciplinary instruction: in this learning scenario, we will examine and implement a variety of activities in a wide spectrum of subjects, ranging from ethics and philosophy (non-STEM) to biology and maths (STEM).

Lesson Plan

The implementation of integrated STEM teaching and learning is facilitated by the use of specific pedagogical approaches (PBL, IBL, etc). In order to facilitate the research done by the teachers and the design of activities by teachers, a selection of such approaches is presented in Annex 1. Maintaining Annex 1 in the Learning Scenario and citing where necessary is mandatory.

Name of activity	Procedure	Time
1st Lesson		
Brainstorming and discussion	Students will debate real-life questions about plants: -Are the plants alive and how can we prove our statement? -How are the plants useful? -What can we do to preserve the plants on our planet?	10 min
Discussion and preparation for the next lesson	After the debate, children will be introduced to educational videos about plants. After watching educational videos, students will debate about ideas on procedures and on how could be tested if the plants are alive and what conditions are important for plants to grow.	20 min
2nd Lesson		
STEM Subject 1	Natural science	

Name of activity	Procedure	Time
STEM Subject 1	An experiment about living conditions for plant growth. The experiment will consist of a two-week observation of lettuce seedlings with changeable living conditions for each plant. Four samples of lettuce seedlings will be planted in a transparent plastic cup. In three planted cups will be added humus soil. In the fourth planted cup will be added sand and water. Then will be tested the life conditions of each plant. The first plant will have all living conditions: humus soil, water, and sunlight. The second plant will have humus soil and sunlight but no water. The third plant will have humus soil and water but it will be placed in a space with no sunlight (cupboard, or shady place). The fourth plant will have water and sunlight but will have sand with no nutrients instead of humus soil.	100 min
Learning products	Creating samples for observation Data in graphic poster templates, tables attached- part tracking and recording	
3rd Lesson		
STEM Subject 2	Mathematics	
STEM Subject 2	Students will use a ruler or measuring tape to measure the length of the tallest leaf of each plant. They will also count the number of lettuce leaves. They will have all the data recorded on the graphic poster templates, and will also do the drawings of the observation samples.	20 min
Learning products	Data in graphic poster templates- part of mathematics and measurement	
4th Lesson		
STEM Subject 3/non-STEM subject	Art Students use a variety of collected materials to draw or visualize their work. They can use paper, wood, plastic, fabric, or just paints to show how they envision the SUPER HERO PLANT. The paper will be a reminder of how important plants are to us in our lives. Students will exhibit all art works at the project exhibition.	90 min
STEM Subject 3/non-	Artwork: Drawing imaginary “Superhero plant” with “superpowers”.	

Name of activity	Procedure	Time
STEM subject		
Learning products	Arwork, graphic poster by templates, new ideas and concepts about the plants and their sinergy with the world	

Assessment

Assessment will be conducted using a questionnaire on paper adapted to the age of the students, attached: https://1drv.ms/b/s!Avz-pET_GxbqhB4FHPl0BrpeoyNc

Initial assessment

The feedback will be the appearance of the grown plant and the knowledge of how the students will continue to grow in their home. Students will make an exit card of jobs around growing a food plant.

Formative evaluation

Formative follow-up will be conducted orally after measuring and discussing what students have observed.

Final assessment

During the first and second hours initial information about the planet and plants

it will be collected by observing, discussing, and keeping a diary of plant growth.

Student feedback

Each student will complete a satisfaction questionnaire and will be interviewed

TEACHER FEEDBACK

Each student will complete

This way of cooperation between activity leaders requires better communication and cooperation skills. The lesson can be adapted to the age of the students and the environment in which it is conducted by selecting plants that are specific to a particular area. Each part of the lesson part is easily incorporated into NATIONAL AND SUBJECT CURRICULA.

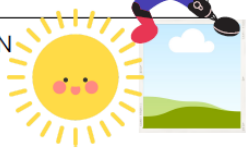
APPENDICES

Name: Teacher:

Grade & Section: Date:

Plants – super heroes

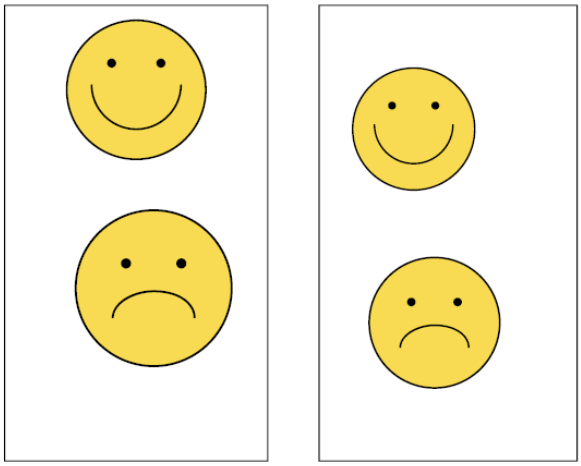
EVALUATION



plants are our superheroes - I know now

circle

I will also grow my own plants to eat



Plants – super heroes

I observe and monitor the growth of the plant

A PLANT WITHOUT SUNLIGHT

DAY	1.	3.	5.	8	10
DRAWING					

How much the plant has grown

DAY	1.	3.	5.	8	10
CM					
NUMBER OF SHEETS					

Plants – super heroes

I observe and monitor the growth of the plant

A PLANT WITHOUT WATER

DAY	1.	3.	5.	8	10
DRAWING					

How much the plant has grown

DAY	1.	3.	5.	8	10
CM					
NUMBER OF SHEETS					

Plants – super heroes

I observe and monitor the growth of the plant

The plant I care about

DAY	1.	3.	5.	8	10
DRAWING					

How much the plant has grown

DAY	1.	3.	5.	8	10
CM					
NUMBER OF SHEETS					

Plants – super heroes

Growing lettuce in sandy soil

I observe and monitor the growth of the plant

DAY	1.	3.	5.	8	10
DRAWING					

How much the plant has grown

DAY	1.	3.	5.	8	10
CM					
NUMBER OF SHEETS					

Annexes

A thorough and complete list of all the materials used will be asked from all teachers. Those materials will be cited as Annexes and they can be further cited in the learning scenario.

Annex 1

PEDAGOGICAL TRENDS IN EDUCATION

Disclaimer: Information presented in this document has been previously partially published in the Scientix Newsletter "Pedagogical trends in education", May 2019: http://files.eun.org/scientix/scx3/newsletter/Scientix-Newsletter-May-19.pdf

Inquiry-based science education

IBSE adopts John Dewey's principle that education begins with curiosity (Savery, 2006), and makes students go through all the steps of scientific research: ask a question, develop a hypothesis, plan how to test this hypothesis, collect data, analyse the results and share it with peers (Pedaste et al. 2015). IBSE is ideal for science education, because it makes teaching more hands-on, and is perfect to learn how scientific research works. Students learn how to formulate questions answerable through experimentation. The teacher has both a facilitator role and an instructor role, making it an in-between method compared to full facilitation in problem-based, and instruction in project-based learning. However, the approach can be gradually made student-directed; students can start an IBSE project with a question provided by the teacher, and then can come up with their own questions to transfer what they learned for deeper learning.

IBSE does not only tap into creativity, problem-solving, and critical and analytical thinking. It also sets the stage for learning about how to collect and interpret data (become science and data-literate), and how to do this ethically and reliably. All these are skills of the 21st century, where data is abundantly available in every part of life.

As mentioned in the recent European Schoolnet publication, while inquiry-based science education (IBSE) has been already around in STEM education for decades, there is still much room for improvement in teachers' development and continued dissemination of innovative pedagogical approaches. To highlight the impact of IBSE, its challenges, and the initiatives addressing these, we published the "Teacher Training and IBSE Practice in Europe, A European Schoolnet overview".

Research shows that IBSE results in greater interest in Science, and motivation for STEM careers. Another important observation from the publication is that the benefits of IBSE are long-term and

maintained, in contrast to the short-term acquisitions of traditional pedagogies that also come with less inclusion of both genders, and less interest in STEM.

One challenge is teacher support: teachers report that they receive little support in implementing IBSE in their classroom. Another challenge to IBSE is standard assessment: PISA tests, as well as end-of-secondary-education exams, are still more focused on recall and repeated-drill exercises, deterring the use of more diverse pedagogies. In order to better integrate inquiry-based methods in school curricula, standardized tests also need to evolve along with traditional pedagogies.

Problem, project and challenge-based learning

Problem-based learning (PBL) is a student-centred multi-disciplinary method that was initially adopted in medical education as a means to put multiple topics in context (Newman, 2003) PBL aims to make students good problem-solvers in the real world: for instance, to put knowledge from multiple disciplines into use, and be able to work with others productively. After all, real-world problems are hardly ever solvable by one single discipline and one single person.

A PBL activity consists of working on an open-ended, even ill-defined question, with no solution provided by the teacher. Students need to work collaboratively and devise a solution to the problem by themselves. The key component is that it is student-centred; students are more motivated when they are responsible for the solution to the problem, and when the whole process rests with them (Savery, 2006). Decades of research has established that although students who went through PBL do not necessarily score better on standardized exams, they are definitely better problem-solvers (Strobel & van Barneveld, 2009).

Project-based learning also involves collaborative learning and finding a solution to a problem. However, the process and the end product are more specified from the beginning. Students work on a project for an extended period of time, a project that will produce a solution to a complex question or solve a complicated problem. The role of the teacher is more active here because multiple obstacles are typically encountered in the production of something like a rocket, or a space habitat, and these obstacles mark the moments for the teacher to instruct specific topics.

Finally, with **challenge-based learning (CBL)** (Johnson et al. 2009), students are again asked to develop a solution to a problem. However, they are only provided with a "big idea", a societal problem that they need to address with a challenge of their choosing (e.g. disinterest in mathematics, low upturn in elections). While the use of technology can be considered optional in other trends, technology needs to be incorporated in every step in CBL. Similar to project-based learning, there is an end product, although this product is determined in the process, not at the beginning. The focus is on the use of ICT in the collection of data and sharing the results.

Design thinking

If IBSE recreates scientific methodology in the classroom, **design thinking (DT)** does the same for design and prototype production. DT helps students develop the skill to identify problems and needs in the society, and entrepreneurship. DT can be implemented within problem or project-based learning; the difference is that the problem is identified by students, and the end product is a prototype to solve the problem. The product is tested and refined in multiple iterations. Students go through a cycle of steps: (1) empathize; (2) define; (3) ideate; (4) prototype; (5) test.

Blended-learning and the flipped classroom

In a classroom where all students are facing the instructor, each moment there will be students drifting from the topic, even if for thinking deeper about a specific point in the lecture. It is challenging to have the undivided attention of the whole classroom because each student has a different way of learning and a different pace. With online content, students can learn the material at home at their own pace. In turn, the teacher can use the classroom to engage students in debates, projects and group assignments. Blended-learning and flipped classroom are instructional strategies that help students learn in their own pace, and deepen their learning with making the most of classroom hours. Although these concepts are used interchangeably, they are slightly different: while blended learning complements online learning with class instruction and support, the flipped classroom requires students to learn the material before coming to class and do assignments and projects during class hours.

Content and Language Integrated Learning (CLIL)

Content and language integrated learning (CLIL) is a well-positioned pedagogical approach that emphasises on the integration of foreign language and thematic content within the context of all school subjects. CLIL is a pedagogical approach that allows to teachers and students use a foreign language as the medium of instruction in non-linguistic subjects, allowing this way the practice and improvement of both the second language and the immersion to subjects that may vary from science subjects to humanities. According to Cenoz et al. (2013) "*the European Commission and the Council of Europe have funded many initiatives in support of CLIL because it responded to a need in Europe for enhancing second-language (L2) education and bilingualism that was well-received*" and research further supports that CLIL is applied successfully in task-based pedagogies. In addition, when it comes specifically to the application of CLIL in the science classroom there are specific advantages including enabling learners to learn a school subject that exists in their curriculum using the respective second language they are learning, provide authentic learning settings while using the resources available at their school and support learners' cognitive skills by equally supporting language practice and the teaching of science context.

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Annex 2

Videos in English language*:*

https://www.youtube.com/watch?v=aOn7ybncP14

Superheroes of Nature - Plants

USES OF PLANTS || SCIENCE EDUCATIONAL VIDEO FOR KIDS

Graphic poster templates:

Growing lettuce; soil+sunlight+water-template:

https://1drv.ms/b/s!Avz-pET_GxbqhB16RRROwdh4Go9a

Growing lettuce in sandy soil-template:

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Growing lettuce without sunlight-template:

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