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STEAME ACADEMY
TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - LEVEL 1
STUDENT TEACHERS: Waves in our life: from X-rays to traffic waves

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1. Overview

Title Driving Question or Topic	*Waves in our life: from X-rays to traffic waves*		
Ages, Grades, …	15-18	9-12 grade level selection	
Duration, Timeline, Activities	*24 learning hours*	*24 lessons by 45 minutes*	*Number of activities:10*
Curriculum Alignment			
Contributors, Partners			
Abstract - Synopsis	*Students discover in what forms waves appear in our everyday life. They study theoretically and experimentally the characteristics of the waves (waveform, frequency, wavelength) and learn how these characteristics effect on the energy carried by a wave. They explore the impact of the waves in everyday life and human health. Students study waves theoretically and experimentally. In Physics they carry out experiments investigating the characteristics of waves and in Mathematics they study these characteristics theoretically. In Mechanical Engineering they build devices that produce waves on a water surface and in Music they study the characteristics of sound waves in relation to notes. In Computer Science they study wave simulations and in Biology they identify the effects of waves on the human body.*		
References, Acknowledgements			

2. STEAME ACADEMY Framework*

Teachers' Cooperation	*Teacher 1: Physics teacher* *Teacher 2: Mathematics teacher* *Teacher 3: Technology teacher* *Teacher 4: Computer science teacher* *Teacher 5: Biology teacher* *Teacher 6: Music teacher*
STEAME in Life (SiL) Organization	*Waves are everywhere in our lives. There are frequent public discussions and controversies about the dangerousness of some forms of waves (eg, electromagnetic radiation from mobile phones). Students should be able to recognize the beneficial uses of waves in our lives, but also the potential dangers of overexposure to some forms of waves.*

Action Plan Formulation	*Reference to the Stages and the Steps of the STEAME ACADEMY Framework for Project-based STEAME learning (Action Plan Formulation)*

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

3. Objectives and Methodologies

Learning Goals and Objectives	*Students should be able* 1. *To design experimental investigations to control variables.* 2. *To understand the characteristic physical quantities of waves.* 3. *Formulate the mathematical equation that describes a wave.* 4. *To understand that the wave carries energy and not matter.* 5. *To understand that the energy of the wave depends on its frequency* 6. *To know in both theoretical and experimental ways how they will investigate the interference of two waves.* 7. *To distinguish between mechanical and electromagnetic waves.* 8. *To distinguish between running and standing waves.* 9. *To know the electromagnetic spectrum and to which region belong the various electromagnetic waves that appear in our daily life.* 10. *To study through simulations the propagation of waves and wave phenomena (diffraction and interference).* 11. *To understand how waves can affect the human body.* 12. *To evaluate information from the internet*
Learning Outcomes and expected Results	*A poster about the waves in everyday life, a ripple tank to investigate the interference of two waves on the surface of water, vibration generator, "music instruments" constructed by students. Presentations about the various waves the students investigated.*
Prior Knowledge and Prerequisites	*Trigonometrical functions, speed, oscillations, frequency and period of an oscillation.*
Motivation, Methodology, Strategies, Scaffolds	*Context-Based Learning, Project-Based Learning, Experimentation, Investigation (Inquiry-Based Learning), Problem Solving Based Learning, Design Thinking Process, Debate and Argumentation, cooperation and collaboration, team working.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*The teacher mainly in charge for the project is the Physics Teacher. In Physics class students in plenary start with a brainstorm about the ways that waves appear in everyday life. The teacher motivates students by asking them hoç these waves effect on human health (e.g. how healthy is sleeping with your mobile phone under your pillow). After that each group chooses a particular wave from everyday life that the group will study further (e.g. microwaves, radio-waves, light, x-rays, sound). Groups are asked to prepare a presentation about the wave they choose. The teacher explains to the class what the other teachers will help them with.*
Resources, Tools, Material, Attachments, Equipment	*School textbooks of Physics and Trigonometry. Physics laboratory, Technology laboratory, resources on the web about biological effects of radiation (e.g. https://www.nrc.gov/reading-rm/basic-ref/students/for-educators/09.pdf , https://www.ncbi.nlm.nih.gov/books/NBK597563/ , https://paidi.com.cy/wp-content/uploads/2023/10/REF_Com-Position-SEPT23.pdf)*
Health and Safety	

5. Implementation

Instructional Activities, Procedures, Reflections	***Activity 1. Waves in our live*** A brainstorm about the forms that waves appear in our everyday life. The Physics teacher guide students to discover all these forms (sound, light, infrared and ultraviolet radiation, x-rays, microwaves, radio waves, seismic waves, traffic waves, football waves, …). Students in groups decide what kind of wave they will investigate in more depth about the effects on human health. ***Activity 2: Measuring the speed of a pulse in a slinky spring*** Students are working in groups to measure the speed of a pulse in a slinky spring. They investigate from what characteristics of the pulse depends on the speed of the pulse. ***Activity 3: Measuring the characteristic physical quantities of a wave*** Students work in groups to measure the characteristic physical quantities of the wave. They use again a slinky spring and produce in it different waves of different amplitude, different frequency and they measure the wavelength, the frequency and the speed of the wave using the video analysis technique. ***Activity 4: Harmonic waves. Mathematical study*** With support from the teacher of Mathematics the students study the equation of the harmonic waves and how the various characteristics of the wave appear in this equation. They also study the addition of two waves (interference) and the special case of standing waves. ***Activity 5: Building a ripple tank*** Students in Physics and in Technology lessons build a ripple tank to study the form of waves produced on water surface and the interference of these waves. ***Activity 6: Making a music instrument*** Students study in Music lessons the way that musical noteç are produced by musical instruments. Each group choose to construct a musical instrument. ***Activity 7: Making a vibrations generator*** Students in Physics and in Technology lessons build a vibration generator to study the standing waves in a chord. **Activity 8: Studying the wave phenomena** Students in physics laboratory study the diffraction and the interference of waves (sound waves, light waves (laser), microwaves, water waves) **Activity 9: Searching the web for evidence** The group of students make a web search about the effects of the particular wave they choose on human health. For example, one of the groups will search for the effects of ultraviolet radiation on human health). **Activity 10: Preparing a presentation and a poster** Each group prepares a presentation about the kind of waves they choose at the beginning focusing on the ways that these waves appear in everyday life and if they are harmful how we can be protected from them. The groups build a poster about their findings, focusing on the protection methods.
Assessment - Evaluation	*Peer assessment of the presentations and the posters. Formative evaluation processes and rubrics to measure the student's ability to perform what was described in the objectives.*

Presentation - Reporting - Sharing *Extensions - Other Information*	*The class prepares a presentation or a poster for the school to inform all the students at the school about the dangers of the waves. Publication on school website.*

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