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STEAME TEACHER ACADEMY

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STEAME ACADEMY
TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN)
LEVEL 1 STUDENT TEACHERS:
Understanding the Spread of Infectious Diseases: A Mathematical Perspective

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L1 Teachers

In the case of learners/student teachers the L&C plan that follows should be a document for study and exchange of ideas both among themselves as well as with the trainer. A fruitful approach would be, if possible one where experienced/service teachers are involved as well either in some of the roles of the teachers that are mentioned in the section on the cooperating teachers that follows. In this framework the L&C plan should be the object of consideration and discussion between the trainer and the trainees so that the following aspects would be the object of enrichment at each step of the study and experimental implementation, if possible, by the trainees:

- Provide further opportunities in dealing with the subject matter (e.g. Give them further resources in the area, enrich with a variety of skills with teaching approaches)
- Enrich with ideas for classroom management (e.g. inclusive classroom approaches, flipped classroom activities, PBL methodology)
- Focus on practical teaching skills (e.g. lesson planning, assessment strategies)
- Discuss on Connecting to real world experience.
- Emphasize the need for reflection, communication and discussion/ debate

1. Overview

Title	Understanding the Spread of Infectious Diseases: A Mathematical Perspective
Driving Question or Topic	*What are infectious diseases, what are the sources of such infections and how do we model their spread using mathematical entities?*
Ages, Grades, …	*School students ages 16-18, grades 11-12*
Duration, Timeline, Activities	12 HOURS *5 to 7 activities*
Curriculum Alignment	This learning plan provides a comprehensive approach to introducing students to mathematical models in the context of infectious disease spread. It combines theoretical concepts with practical applications to enhance understanding and

	critical thinking skills. The above questions imply that the whole approach concerns Biology, Chemistry and Mathematics
Contributors, Partners	*In the context of the consideration of this topic and taking in mind the driving questions, it is going to be useful to include the cooperation of a number of experts/ teachers covering a broad spectrum of the realms of meaning. Thus, it is suggested to involve a Biology teacher (T1), a Chemistry teacher(T2) and a Mathematics teacher(T3). Furthermore, it is going to be useful to come in contact with an Epidemiologist for advice but also to connect with the real world. Depending on the activities and the extent that the students are willing to go further on their findings it is going to be useful to involve an Arts teacher (T4) and an IT/Technology teacher (T5) to help the students on artistic presentations/ videos or other expressive developments as well as on managing technological means that may be needed for handling data related to the object of the project* .
Abstract - Synopsis	**Understanding the Spread of Infectious Diseases: A Mathematical Perspective** This topic and the respective L&C Plan are aiming at providing a comprehensive approach to introducing students to mathematical models in the context of infectious disease spread. It combines theoretical concepts with practical applications to enhance understanding and critical thinking skills. In the context of the consideration of this topic, it is suggested the development of an approach that is expected to provide to students a rich and meaningful learning experience that integrates mathematics with real-world applications and critical problem-solving skills. It also promotes a holistic understanding of infectious diseases, including their impact on society and ethical considerations. The students are expected to be involved in project activities that will provide the opportunity for studying and modelling infectious diseases (eg the CIR approach which stands for Compartmental, Infectious, and Recovery) and articulate on the significance, philosophical and ethical implications of such approaches.
References, Acknowledgements	There is ample literature on the topic but the students can give emphasis on: Their textbooks on Biology and Statistics/ Mathematics Information from the Internet for the various issues already mentioned in the guiding questions. Mathematical Modelling and particularly the CIR method

2. STEAME ACADEMY Framework*

Teachers' Cooperation	Teacher T3 (teacher of mathematics) with the main responsibility of identifying and promoting/helping in the development of activities in area of mathematical modelling. This teacher will be responsible for the content that stems out of the guiding questions and it is related to mathematics. T3 will get from T1 and T2 as well as from the epidemiologist the necessary content that is vital in the spread and identify the mathematical entities and processes that provide the paradigms for mathematical development. Teacher T1 (teacher of Biology) and Teacher T2 (teacher of Chemistry) with main responsibility of taking care of elements related to the scientific content and the issues/outcomes of the infectious diseases as they stem out of the guiding questions and provide the necessary information to T3 for considering the mathematical aspects. Furthermore, T1 should provide the context of to T4 and

	T5 for the development of activities in their areas (artistic presentations by T4 and technological handling by T5)
STEAME in Life (SiL) Organization	The teachers should meet at the initial stages and identify the basic aspects that are needed for the study of spreading of infectious diseases and that are expected to have an impact on real and everyday aspects of human life. In this context, they could consider the Driving Questions (above or if they have the opportunity to extend them) as well as the objectives and, based on them, develop a first draft of activities. Based on this they proceed to the Action Plan Formulation
Action Plan Formulation	**Action Plan Formulation** **STAGE I**: Preparation by one or more teachers [STEPS 1-4], and **STAGE II**: Action Plan Formulation [Preparation STEPS 1-3] Refers to the creation of this Learning Plan, by teachers in collaboration. **STAGE II**: Action Plan Formulation [Development STEPS 4-18] Refers to the realization by the students of the five activities of the Learning Plan. The support, feedback and evaluation by the teachers are accompanied throughout the implementation of the activities.

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

3. Objectives and Methodologies

Learning Goals and Objectives	● Know and understand the basic concepts of infectious diseases, including modes of transmission and factors influencing spread. ● Develop a proficiency in using mathematical models to describe and analyze the spread of infectious diseases, including familiarity with key mathematical parameters such as transmission rates, recovery rates, and population sizes. ● Apply critical thinking skills to evaluate the strengths and limitations of mathematical models in the context of infectious disease spread. ● Appreciate the role of epidemiology in understanding patterns of disease transmission and the importance of data collection and analysis. ● Be familiar with different types of mathematical models used in infectious disease spread analysis, including compartmental models, and their components. ● Develop skills for interpreting real-world data related to infectious diseases and use it to validate or adjust mathematical models. ● Recognize the interdisciplinary nature of studying infectious disease spread, connecting mathematics with biology, statistics, and computer science. ● Apply mathematical models to predict and simulate the spread of infectious diseases, using relevant parameters and assumptions. ● Communicate findings and interpretations effectively, both verbally and in writing, using appropriate terminology related to infectious disease modeling. ● Understand and discuss the ethical considerations involved in using mathematical models to inform public health decisions. ● Develop problem-solving skills by applying mathematical concepts to address challenges and uncertainties in infectious disease modeling.

	● Work collaboratively in groups to analyze and discuss infectious disease scenarios, encouraging peer-to-peer learning. ● Utilize technology and simulation tools to enhance understanding and visualization of infectious disease spread.
Learning Outcomes and expected Results	Overall, the project is expected to provide students a rich and meaningful learning experience that integrates mathematics with real-world applications and critical problem-solving skills. It also promotes a holistic understanding of infectious diseases, including their impact on society and ethical considerations.
Prior Knowledge and Prerequisites	When promoting the project on "Understanding the spread of infectious diseases: a mathematical approach" for school students, it is essential to consider their prior knowledge and prerequisites. Tailoring the project to the students' existing understanding ensures that the project is challenging yet achievable. Here are some key considerations: Basic Biology and Chemistry Knowledge as well as Mathematical skills for engaging in the project, Research and Data Handling Skills, Critical thinking and Problem-Solving abilities, technology literacy and Communication competencies. Differentiation strategies may also be employed to accommodate varying levels of prior knowledge and skills within the student group.
Motivation, Methodology, Strategies, Scaffolds	The students are provided with challenging events on spreading of infectious diseases and are called to analyze, mediate and study the issue by considering the need for approaches developing mathematical models that would provide us with the means for prediction and conclusion on their effects in the spirit of the critical driving questions presented earlier, thus forming views on the pros and cons of reaching inferences on the issue of spreading in the context of real world. The basic methodology is the one for project based on Problem-solving based and should provide ample opportunities for discussion. Project work is also an important tool in the methodology of approaching this issue as it can provide the context for creating the background as well as the framework for investigation and consideration of the various issues that step out during the consideration of the driving questions identified in section 1.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	By addressing the following aspects, it can be ensured that the students are well-prepared to promote their project effectively and that the significance of their work is communicated to a wider audience: ● Articulate the importance of the project in understanding and potentially controlling the spread of infectious diseases. ● Emphasize how a mathematical approach can provide insights into the dynamics of disease transmission and help formulate strategies for prevention and control. ● Ensure that students have a solid understanding of the mathematical concepts and models related to infectious disease spread. This should include knowledge of epidemiology, statistics, and mathematical modeling. ● Emphasize the importance of clear and concise communication. The audience may include individuals with varying levels of expertise, so the students should be able to explain their project in a way that is accessible to a general audience. ● Request the use of visuals, such as charts, graphs, and diagrams, to enhance understanding.

	• Discuss how the mathematical models and findings from the project can be applied to real-world situations. Help students connect their work to potential public health strategies or interventions.
Resources, Tools, Material, Attachments, Equipment *Health and Safety*	The following list is a comprehensive entity of such elements that can easily be secured through searching (by the students as one of the activities): Textbooks, online journals, Data sources and Databases connected either to the country or to WHO (World Health Organisation) Statistical and Modelling software Computers and Presentation Equipment

5. Implementation

Instructional Activities, Procedures, Reflections	1. Develop interest by asking the students to consider a recent pandemic due to spreading of a disease and consider the issues arising from it in a mathematical context 2. Suggest to the students to search the website on ideas related or are the outcomes of the guiding questions set in SECTION1 3. Introduce the students to modeling simulations related to infectious diseases. This can include using software to simulate disease spread based on different parameters. 4. Provide material for using the CIR approach for modelling 5. Assign case studies related to historical or recent infectious disease outbreaks. Students can analyze these cases to understand the role of mathematical modeling in predicting and controlling the spread. 6. Ask them to articulate the significance of their research question and the potential impact of their findings. 7. Ask students to reflect on the ethical implications of their research and how they plan to address them.
Assessment - Evaluation	The assessment/ evaluation could be based on the following criteria: 1. The format of the research proposal 2. The extent, depth and use of the literature review 3. The quality and extent of data handling/ analysis and the modelling approach 4. The quality and extent of the Presentation of the outcomes and the skills that are shown by the students 5. The extent of the problem solving and critical thinking skills that were demonstrated in the development of the project 6. The extent of demonstration of communication skills, competences for reflection and consideration of ethical issues, cooperation and teamwork, originality and innovation, documentation.
Presentation - Reporting - Sharing	Provide comments to the specific strengths and areas for improvement observed in the students' presentation and reporting work. By using this constructive and encouraging feedback it is expected that we help students grow and refine their skills for future projects.
Extensions - Other Information	Extensions can involve additional research, practical applications, community engagement, and interdisciplinary connections.

	These extensions and additional information can elevate the impact of the project, providing students with opportunities to deepen their knowledge, engage with real-world applications, and contribute meaningfully to the understanding and prevention of infectious diseases.

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