E-STEAMSEL Project

Erasmus+ KA2- no: 2021-1-NO01-KA220-SCH-000032511

Co-funded by the Erasmus+ Programme of the European Union

E-STEAMSEL Preparing Youth for the Future Labor Market with STEAM and SEL

STEAM LESSON PLANS FOR SECONDARY AND HIGH SCHOOL LEVEL

Partners:

İçindekiler Tablosu

1.WHY DO WE REQUİRE THE E-STEAMSEL PROJECT?

Today, knowledge accumulation is growing very rapidly and overflowing beyond the walls of the classroom. Within the education eco-system; developing analytical, critical thinking and problem solving skills became an important goal in order to become a productive society. We all have a collective responsibility, more than ever, to support the development of today's young people from a holistic perspective for a sustainable economy and society and to prepare them for the 21st century skills-based system. There is a rising momentum all over the world to keep up with the technology revolution.

Today's students will grow to pursue careers that do not yet exist. More than ever, it is necessary to prepare our students today so that they have the confidence to invent the world they want to live in. It is important to equip them with 21st century skills in STEAM (Science, Technology, Engineering, Art and Mathematics) and Social and Emotional

Learning (SEL) (Self-awareness and management, Social Awareness, Relationship Skills, Responsible Decision Making). According to the article of the World Economic Forum titled "New Vision for Education: Promoting Social and Emotional Learning Through Technology":"People who can cooperate, have high communication skills, can produce solutions to problems with rational methods will be able to exist in the business life of the future. This social and emotional competence equips students to succeed in the evolving digital economy."Also, UNESCO recently sent a call to schools to implement SEL practices.By 2027, jobs requiring STEAM skills are expected to increase by 13%.EIGE's economic benefits of gender equality study (2017) show that reducing gender discrimination in STEAM education alone leads to 1.2 million additional jobs in the EU. In this context, our aim is to empower teachers, especially girls and secondary school students with multiple disadvantages, in STEAM and SEL areas and to motivate them to use their skills in a wider way. E-STEAMSEL is to give every student the opportunity to learn about technologies and to help them define themselves as innovators and changers who can take an active role in finding solutions to the problems they care about. In addition, to support them to be individuals who are sensitive to environmental problems and have an aesthetic point of view. It is now a necessity for our youth and girls to have STEAM and SEL learning skills in order to take part and struggle in the challenging business world of the future. STEAM mainly focuses on skill development in the fields of science, technology, engineering, arts and mathematics. SEL provides life skills in the fields of teaching and developing the skills needed tomanage great emotions, build relationships, gain self-awareness, solve problems, make responsible choices, and set goals. These two complement each other. The world of the future needs individuals with mathematics, science and technology literacy, self-actualized in social and affective learning, creative problem solving and aesthetic values. In this context, our project has adopted the STEAM and SEL fields as a whole and develop them at the transnational level with an e-learning Platform as its main objective is to prepare our students for the digital world of the future.

WHAT **ARE THE OBJECTIVES?**

OUR AIMS ARE TO;

* Ensure creative and meaningful participation of girls and young generation with multiple disadvantages in STEAM and SEL education, preparing them for the future labor market

* Raise and spread awareness and sensitivity among teachers, schools and parents in the field of STEAM and SEL learning

* Ensure inclusion, equality and easy access in STEAM and SEL learning areas, and to raise the skills-based literacy of especially disadvantaged youth and girls to higher levels.

* Provide digital content and digital-skills supported transformation in teaching and learning processes

* Develop practical ideas of how to involve students into the learning activities and create environment in which students can study in an innovative way

* Ensure equal access to project result for both genders

OUR GOALS ARE TO;

* Develop a virtual platform as a resource center for practical and innovative learning solutions that complement the curriculum of schools;

* Create a moodle-based e learning platform

* Produce materials for three separate sections on the platform

* Skill-based learning e materials (STEAM)

* Produce Social and Emotional Learning activities

*İnteractive Counseling Services for Parents And Students

The idea of creating and implementing such a tool is the answer to the call for modernity, digitalization, computerization related to every aspect of life.

WHO ARE THE USERS?

The project will target 3 groups:

1. Teachers in Primary, secondary and hıgh school.

2.Students in primary, secondary and high school.

3. DECISION MAKERS, Policy formulators, NGOs, youth workers and public, school directors, EU authorities AND parents.

HOW TO USE THİS BOOK?

Co-funded by the Erasmus+ Programme of the European Union

In this document, there are STEAM lesson designs for secondary and high school students prepared with the problem-based learning method that teachers can use in their classroom practices.
Our teacher colleagues can apply the plan exactly if they wish. Or they can take the plans as an example and tailor them to their class. Whatever you want to do, you are at the helm.
If you're new to STEAM, please take a look at our teacher's guide and training program first.

The Benefits of Teaching STEAM Lessons

Exposes students to the creative process

When students engage in activities that combine different elements of STEAM, they experience guided inquiry in which they must ask thoughtful questions, discover answers, apply what they learn, and problem-solve creatively. Students learning how to make a wire sculpture that lights up must ask questions about how it works, try out different wiring techniques to get the sculpture to light up, think about the meaning behind their artistic creation, and experience the creative process going from a design on paper to a tangible, functional object.

Offers meaningful collaboration

Many STEAM projects involve teamwork and thoughtful dialogue in which students exchange ideas and discuss ways to problem-solve. Through these activities, students learn how to divide up responsibilities, compromise, listen to and encourage each other. Some students might approach STEAM with excitement or curiosity, while others might be more timid or apprehensive.
Strategically placing students together in groups can create powerful teams in which students learn how to help each other and figure out how to use their different strengths and skill sets. If students are learning how to create 3D art depicting sea animals, one student might be knowledgeable about aquatic animals, another might be familiar with optical illusions or excited about constructing 3D glasses. Together, their knowledge, enthusiasm, and skillsets can be utilized to help successfully complete the project as a team.

Increases critical thinking

STEAM projects require students to systematically think through problems, applying the information they learn along the way about technology and engineering to figure out the best solutions. Cross-curricular projects also engage different parts of students' brains so that they are seeing the project through different lenses, focusing on details while also learning to step back and look at the bigger picture.

Provides a unique way to problem-solve

American students don't tend to do as well as students from other countries when it comes to international assessments that measure math, science, and problem-solving skills. STEAM projects give students a chance to problem-solve in unique ways because they're forced to use a variety of methods to solve problems that pop up during these types of activities. By experiencing trial and error, learning how to take risks, and figuring out how to really "think outside the box", students get away from the commonly used approach of applying a known method or formula to solve a set of problems in a step-by-step way. With STEAM, they must solve in more creative, non-linear ways.

Gives all students hands-on learning experiences

While some students grow up in homes in which they are taught how to build and fix things, and are given many manipulatives to do so, others aren't exposed to these important learning opportunities. STEAM projects give students a chance to engage in hands-on, experiential learning. Students are often using different materials and tools in order to discover how something works, how to build it, and how to fix it. This levels the playing field so that all students acquire these crucial skills, regardless of their gender, socioeconomic status, or race.

Encourages girls to explore STEM fields

Since girls and women are underrepresented in the fields of science, technology, engineering, and math, developing STEAM projects helps girls become familiar with these fields at an early age. Early exposure can increase their chances of exploring these fields further as they get older, and high-quality STEAM projects will still benefit boys as well so that all students are able to acquire these 21st-century skills.

Shows them a different way to value the arts

Using art in STEAM projects helps students understand how varied the arts are, and how they're an integral part of products that involve engineering, technology, and mathematics. The arts can help increase engagement in STEAM projects since students can connect artistic mediums that they enjoy (like visual arts and music) with more technical projects that may seem daunting at first, such as building an app or programming a robot. They're able to combine the familiar with the unfamiliar, acquiring new skills, and discovering the world of artistic innovation.

Co-funded by the Erasmus+ Programme of the European Union

E-STEAMSEL Project

Erasmus+ KA2- no: 2021-1-NO01-KA220-SCH-000032511

Lesson Plans for Secondary and High School Level

LESSON PLAN 1 • Matter cycles

LESSON PLAN 1: Matter cycles

Lesson: Science
Subject: Matter cycles
Grade: Secondary (10-12)
Duration: 200 minutes (5 lesson hours)
1. Target Outcomes:

Cognitive Process Outcomes:
The outcomes of the center discipline:
**Explains matter cycles by showing them on the diagram*
**Questions the importance of matter cycles in terms of life.*
**Designs projects for the efficient use of resources.*
**Classifies living things according to their similarities and differences by giving examples.*

Outcomes of other STEAM disciplines:

Biology:
Establishes a relationship between matter cycles and the sustainability of life.
Physics:
Designs and builds a mechanism that will provide ease of work in daily life by using simple machines.
Mathematics:
• Calculates the amount of oxygen and carbon dioxide required for a living thing to survive.
* Collects or selects data related to research questions; shows the data in frequency table and column chart according to their convenience.
Art:
Conveys his ideas through design and drawing.

1.2. Social Product Outcomes:
• Working in a team,
• Communicating,

- Being able to share problem and solution-oriented ideas,
- Fulfilling their duties and responsibilities,
- Being able to defend their ideas,
- Presenting the product effectively,
- Understanding the importance of cooperation and collaboration .

2. Materials Used:

• 2 glass jars • 3 beta fish • Aquatic plants • Engine • 2 batteries • Battery bed • Silicone • Silicone gun • 5 pieces of tile surplus • Pipette or plastic pipe • Pet bottle cap: 2 pieces • Key Minecraft, Mindmeister, tablet, internet connection

3. Resources

• https://www.youtube.com/watch?v=QG6Eo932iC4 • https://www.youtube.com/watch?v=iAVHm7mcHpY • https://www.akvaryum.com/Bitkiler

4.Learning Methods and Techniques

Problem Based Learning Method, Argumentation Based Learning Method Project Based Learning Method techniques; Brainstorming, collaborative work

5. Groups Considered to be Formed During the Activity:

The groups planned to be formed should be included in this section; The following features should be considered in the Groups created. *Groups should consist of 3-5 people. *It should be noted that it is a homogeneous group in terms of level. *It should be ensured that the gender distribution is equal.

6. Implementation Phase;

6.1 Preparation Phase: Create your student groups. Choose your group leader Choose a reporter **6.2: Presenting the problem situation to the student :**

Alice is keeping fish in the aquarium at home. He loves to feed fish. However, there is a shortage of energy in the area where it is located, and there are frequent power cuts. This disables the oxygen engine and the life of the fish is often endangered. Alice is worried about her fish a lot. And she doesn't know what to do.

As you know, the basic components of living things include carbon, hydrogen and oxygen. Fish use oxygen dissolved in water for respiration. Oxygen engine is used to provide this in aquariums. Is there a way to turn this engine off and produce oxygen naturally?

6.3: Obtaining Information (Leading Questions)

In order to find a solution to the problem, the teacher asks the students to think about the following questions, do research and note down the information they have gained. Students do their research on the subject in groups.

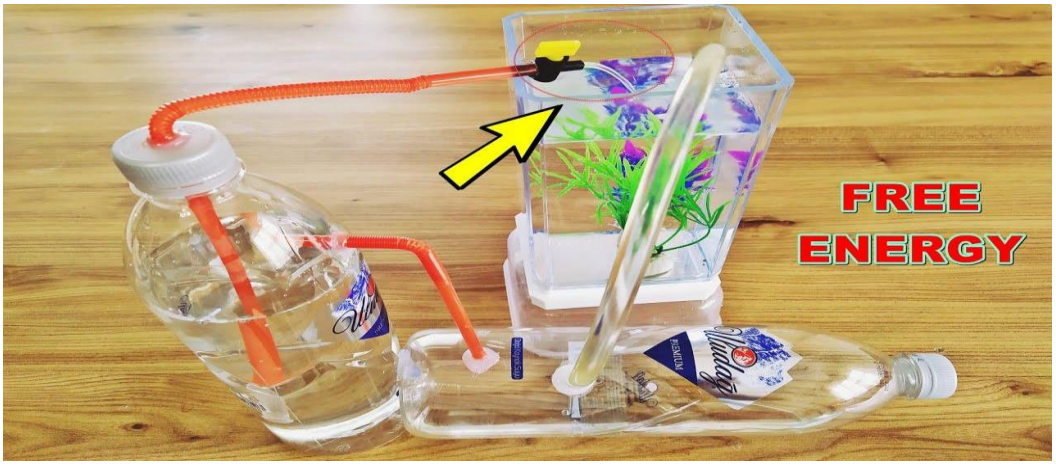
Can living things survive without oxygen gas?
Is there oxygen gas in oceans, seas and lakes?
How is oxygen gas formed in oceans, seas and lakes?
When we buy a fish tank in our house, will the fish live without an air motor?
How would you keep goldfish alive if there were no air motors?

• Videos and animated films are shown to increase students' ideas about the life of fish and the carbon and oxygen cycle.

https://www.youtube.com/watch?v=09vkbA1fDS0
https://www.youtube.com/watch?v=6U2ATMYtyT4&t=12s
https://www.youtube.com/watch?v=BfLRzVA-VE4
https://www.youtube.com/watch?v=Gcr8a_FhvAc

A general exchange of ideas with the class is made on the videos.

The following guiding questions are given to each group. It is ensured that they write their research and answers to the questions by using the collaborative method.



What is the life of betta fish like?

Which aquatic plants are used in aquariums? Which one is more useful?

What is the amount of oxygen the fish will use daily?

How is the water transferred between two aquariums?

What happens when fish are deprived of oxygen?

How can a simple water pump be designed?

Comment on the relationship between the product we will develop and the subject we are working on. Which branches can we integrate with?

6.4: Idea Development

Identifying Needs for the Problem;

Groups move on to the idea development stage. Each group shares their ideas with their group mates in the light of the information they obtained in the previous stage. In this section, they try to find an answer to the question of what they might need to solve the problem.

What kind of mechanism should we set up for the product we are going to make?

How should the water pump be placed in the assembly?

Which aquatic plants should be used? Please search.

How can the quality of life of fish be improved? Groups are often visited and mentored by the teacher.

6.5: Product Development:

Identifying Possible Solutions;

At this stage, student groups identify possible solutions using the brainstorming technique. And the reporter notes.

Choosing the Best Solution:

The solutions proposed in the previous stage are evaluated in terms of their strengths and weaknesses, advantages and disadvantages, and the best solution is

chosen. At this stage, it is recommended to use the argumentation method. The most appropriate solution proposal is chosen by the students through in-group discussions. While choosing the best solution, the teacher can guide the students to consider their time, cost, advantages and disadvantages.

Making the Prototype:

After the solution proposal is selected, the student groups are expected to create a prototype of the proposal.

First, a sketch is made. Guiding questions are asked in order to calculate the materials to be used and the cost.

Attention is paid to the detail of the drawing and to determine what each piece does.

They are asked to draw this sketch drawn on paper in three dimensions using Minecraft. The actual implementation of this design is made. The solution is tested and evaluated. If they are not satisfied with the product, it is recommended that they return to the idea development stage and review everything again. If they need information beyond the necessary theoretical knowledge, the necessary researches are continued and questions are asked and additions are made at the stage of obtaining information.

The teacher is the guide.

6.6. Sharing and Mirroring

The shares envisaged by the students are considered, and the parents of the students are invited to the exhibition of the students' products, short video shoots are taken and necessary social media accounts are opened to inform the people about the activity. From the beginning to this process, feedback is received about at which point they have improved themselves, what they have learned, and the areas they will focus on in line with their interests and abilities.

6.7 Evaluation:

At the stage of presenting the in-class products of each of the groups, they are asked to be evaluated by other groups by answering the questions below.

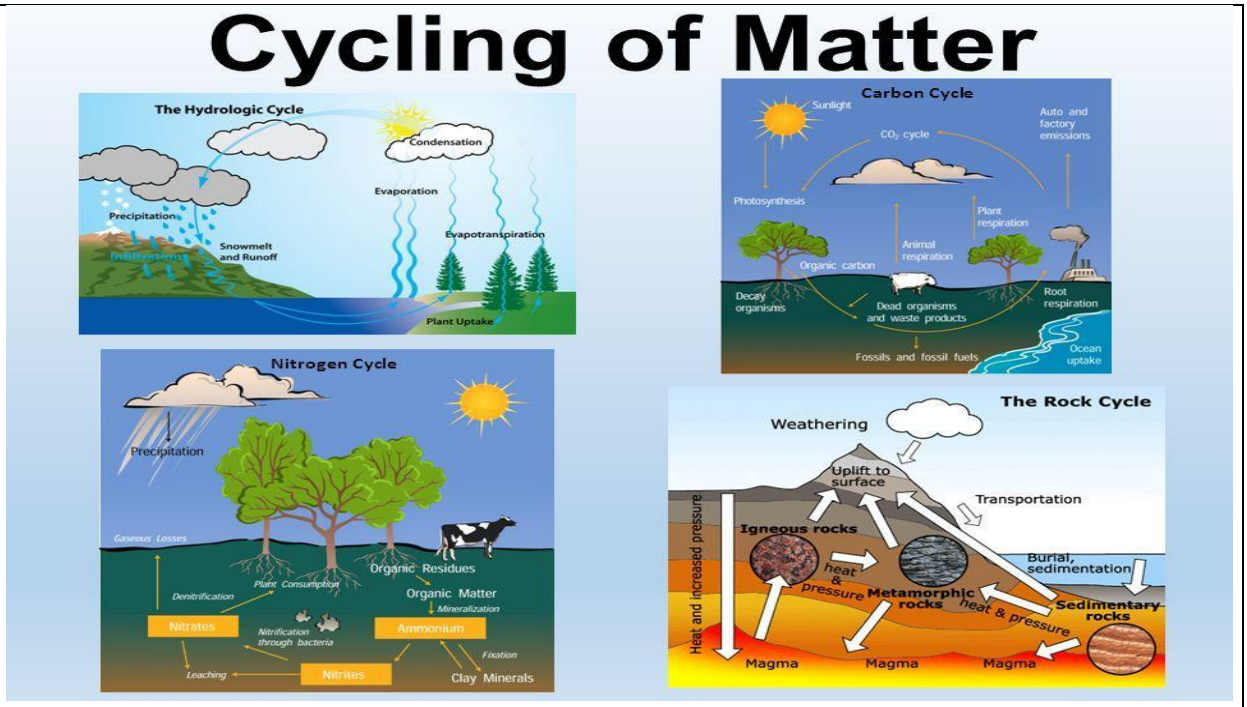
What are the strengths of the offered product?
What are the weaknesses of the offered product?
Evaluate the product in terms of accessibility and cost.
Share your suggestions to strengthen their weaknesses.

The students come together with the groups they worked with at the beginning and use the Mindmeister Web2 tool to prepare a concept map about the matter cycle. This is recommended as a final application. The created concept maps are shared with the whole class by the groups.

Co-funded by the Erasmus+ Programme of the European Union

E-STEAMSEL Project

Erasmus+ KA2- no: 2021-1-NO01-KA220-SCH-000032511



LESSON PLAN 2

- Neutralization Reaction

LESSON PLAN 2: Neutralization Reaction

Lesson: CHEMISTRY

Subject: Neutralization Reaction

Grade: 10th grade (high school)

Duration: 4 Lesson hours

1. Target Outcomes:

Cognitive Process Outcomes:

The outcomes of the center discipline: CHEMISTRY

1. Chemistry Explores reactions between acids and bases

2. Neutralization reactions, mole numbers of acid and base; associates the concept of ph with acidity and alkalinity.

3. Know how to monitor the progress of acid-base reactions

4. Evaluates the benefits and harms of acids and bases in terms of health, industry and environment.

Outcomes of other STEAM disciplines:

Mathematic:

Graphical Representation of Mathematical Data

Interpret data groups reflecting real-life situations by representing them with appropriate graphic types

Explains the scatter plot, shows and interprets the relationship between two quantities with a scatter plot

Interpret data groups reflecting real-life situations by representing them with appropriate graphic types

a. Cases where more than two groups of data are compared are also included

b. Spread and box plots are not included

c. Graphic types are drawn using information and communication technologies

STEAM area Engineering outcomes;

Students identify the processes involved in an engineering project. Students explain the stages such as planning, prototyping, design, execution, quality control and reporting.

The student works by taking care of the materials used and the environment during the project work.

Students will be able to use hazardous materials safely and dispose of waste appropriately.

The student collects qualitative and quantitative data obtained as a result of experiments, records and evaluates observations. Analyzes data using appropriate technology. The student recognizes trends and proportional relationships in the data obtained.

The student uses different mathematical concepts and methods to analyze the problem.

The student realizes the importance of precision in measuring and reading measurements in engineering studies.

The learner uses visual representations of problem statements, structures and data (e.g. graphs, tables, network development graphs, concept maps and flow diagrams).

1.2. Social Product Outcomes:

- Working in a team,
- Communicating,
- Being able to share problem and solution-oriented ideas,
- Fulfilling their duties and responsibilities,
- Being able to defend their ideas,
- Presenting the product effectively,
- Understanding the importance of cooperation and collaboration.

Contributes to the interpretation of different titration curves in the classroom. Knows and applies the meaning of safety signs to be followed in the laboratory and what to do when necessary.

Uses problem solving skills in the classroom.

Demonstrates self-confidence when working independently. Know and apply a series of steps in the production process.

Listen carefully to the ideas of other students and express their own ideas freely.

Apply demonstrated mathematical knowledge or modeling to everyday life.

Use a computer quickly and accurately. Can work in a group.

2. Materials Used:

Information Request Book
Idea Development Notebook
Product Development Notebook
Erlenmayer (1 for each group)
Burette (1 for each group)
Indicator (Phenolphthalein)
Vernier ph sensor
Millimeter Graph Paper
0.2 M HCl
0.2 M NaOH
Active ingredients used in some antacid medicines
Al(OH) 3 Aluminum Hydroxide (Gaviscon Tablets)
MgCO 3 Magnesium Carbonate (Rennie Chewable Tablet)
Mg(OH) 2 Magnesium Hydroxide (Magcine)
CaCO 3 Calcium Carbonate (Magcar Chewable Tablet)
Mg 6Al 2(CO 3)(OH) 16 4(H2O)
Hydrotalcite (Talcid Chewable Tablets)

3. Resources

General Chemistry: The Essential Concepts, 3rd ed.; McGraw-Hill: Boston
Bloom, B.S. (1956). Taxonomy of educational objectives, Vol. 1. New York: McKay. Chang, R. (2011).

4. Learning Methods and Techniques

Problem Based Learning Method,
Project Based Learning Method
techniques; Brainstorming, collaborative work

5. Groups Considered to be formed during the Activity:

The groups planned to be formed should be included in this section;
The following features should be considered in the Groups created.
*Groups should consist of 3-5 people.
*It should be noted that it is a homogeneous group in terms of level.
*It should be ensured that the gender distribution is equal.

6. Implementation Phase;

6.1 Preparation Phase:

Create your student groups.
Choose your group leader
Choose a reporter

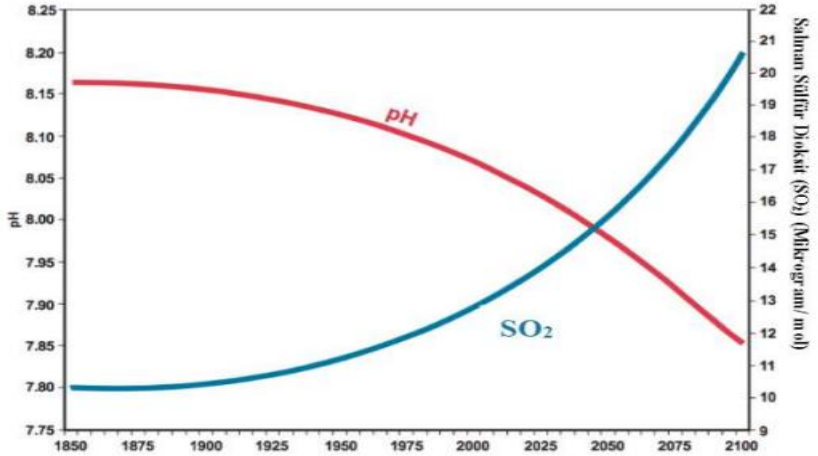
6.2: Presenting the problem situation to the student :

The teacher gives the following problem situation to the students:
You are a "Research and Development Specialist" working in the "Analytical Chemistry Department" of a very famous company. As a result of the recent increase in the number of patients applying to the hospital with heartburn complaints, you want to produce an antacid tablet. For this purpose, first of all, examine the efficacy of the ingredients of the drugs sold as antacids in the market. Determine the main component of the generic antacid tablet planned to be produced.

Limitations
- Conduct your research using scientific literature.
- Examine the chemical structure of the molecules that are the main substance of the anti-acid chewable tablets you will use on the basis of acid-base.
- Do not use chemical substances by mixing them in each other.
- Use the active ingredients you will use in solution with water.
Use a scientific calculator when making your calculations in order to obtain reliable data.

6.3: Obtaining Information (Leading Questions)
In order to find a solution to the problem, the teacher asks the students to think about the following questions, do research and note down the information they have gained. Students do their research on the subject in groups.

In order to create a structure based on inquiry, the following question is directed to attract students' attention and increase their interpretation skills. By means of this question, the students' prior knowledge about the subject is checked. (Students should have prior knowledge about acid-base reactions related to acids and bases and reactions related to the effect of acids or bases on metals in the previous lesson). The following graph was created by Dr. Richard Feely and Dr. Christopher Sabine from California State University by determining the amount of SO2 gas released into the atmosphere in Hawaii in certain years and the resulting pH change in the Hawaiian Ocean.



Co-funded by the Erasmus+ Programme of the European Union

Referans: Feely, Richard A. (2006). *Sulfur Dioxide and Our Ocean Legacy.* https://www.pmel.noaa.gov/pubs/PDF/feel2899/feel2899.pdf

Considering this graph

The following sculpture made of limestone in the region is shown as it looked in 1975 and 1985.

What is the reason for this change in the sculpture? Explain on the basis of acid base

6.4: Idea Development

Identifying Needs for the Problem;

At this stage, students begin the process of acquiring information about the given question. For this, they collect information by analyzing academic publications and published books. While looking for a solution to this problem, they also collect information about how the TITRATION method should be done in relation to the analysis specified in the BTHP and each group determines a prediction within each group about how the experimental setups should be.

In addition, students will investigate the following questions related to the topic. How is pH calculated by titration method? What kind of treatment should be applied in case of honeybee and wasp stings? Explain on the basis of acid base. What is an anti-acid tablet? Which substances are present in its structure? What is the mechanism of action of anti-acids?

6.5: Product Development:

Idea Development: Students present their knowledge acquired in the Acquiring Knowledge section and evaluate the ideas acquired by other groups. This will help to develop ideas and deepen the information learned. For this

purpose, in order for the titration method to be perceived well, the teacher emphasizes the importance of titration and how it should be done and shows a video about the application of the titration method.

Source:
https://www.youtube.com/watch?v=sFpFCPTDv2w&t=9s

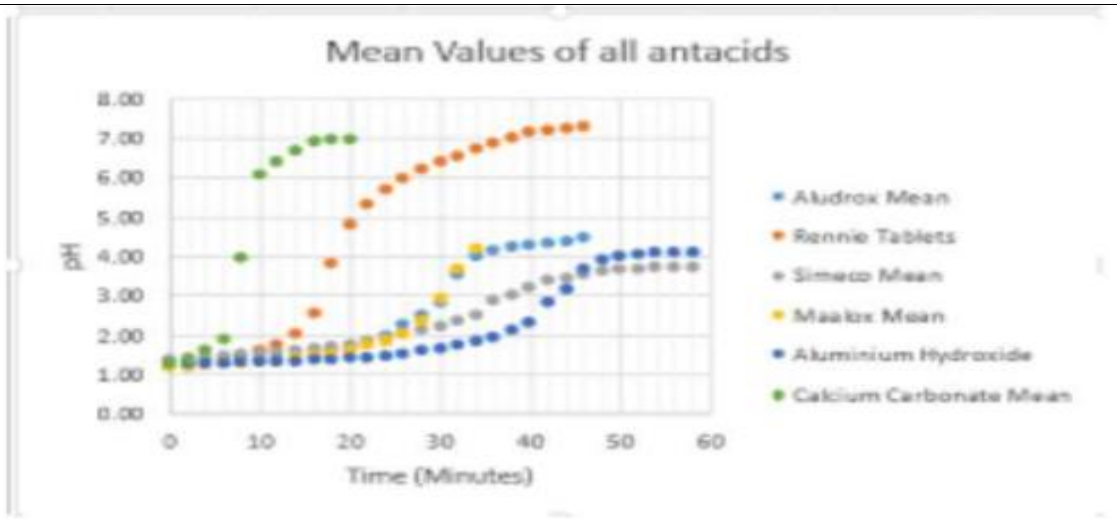
In addition, a Vernier ph sensor will be used for technological visualization of the titration method. In order for the students to be able to use these kits, the students will be given preliminary information about the use of this device by the teacher.

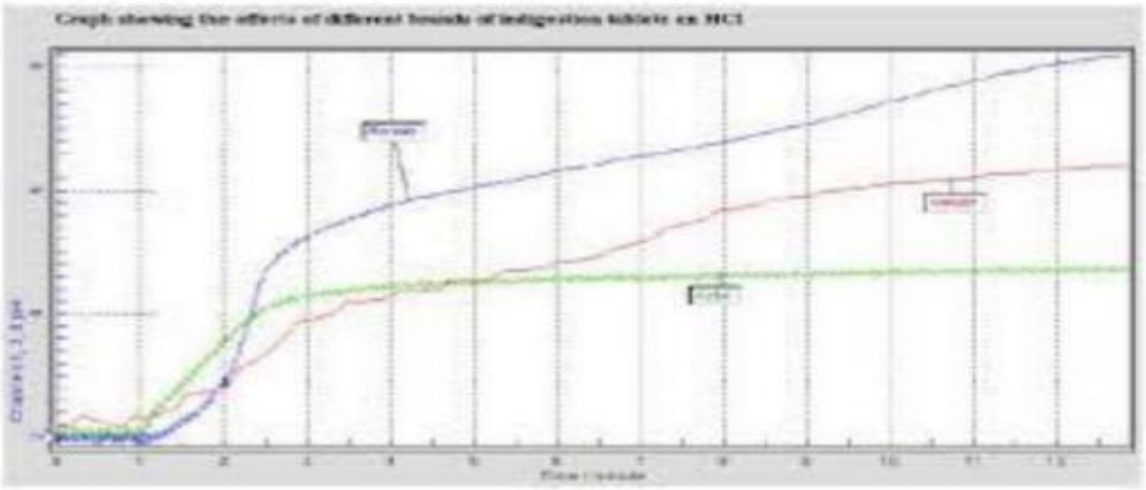
NOTE: Students will be taught how to calculate ph mathematically by teacher-centered instruction. In this step, the questions given to the students in the Information Acquisition section are explained by the teacher so that the students have all the theoretical knowledge about the subject.

Product Development: In this section, students are given samples of antacid drugs from different companies to work on. Students will use these substances to determine the efficacy of antacid tablets using titration method. For this, each group will create the procedural information on how the experiment should be done. In this step, the groups will plan how the qualitative and quantitative analyses of the distributed antacid tablet samples should be done. Testing: Students will graphically observe their designed experimental setups using Vernier kits and interpret the pH changes. Using the volumetric analysis here, they will learn about the efficacy between the anti-acid tablets using the logarithmic definition.

Making the Prototype and Test:

Students will graphically observe their designed experimental setups using Venier kits and interpret the pH changes. Here they will use volumetric analysis to learn about the efficacy between anti-acid tablets using the logarithmic definition.





The graphs that the students will obtain will be like the graphs above. Since the antacid sample that each group works on is different, the graphs they will obtain will be different. When these graphical data are analyzed on a single document with overlapping data, a clearer information about the effect of the antacid tablet will be obtained.

This information will guide the research and development specialist working within the organization on which substance to use for product development. In this way, the active ingredient of the generic drug to be prepared for the market using that active ingredient will be determined, and then they will continue to work on drug release systems.

Research and development specialists will contribute to the production of new drugs using the identified substance. We will be able to observe the effect of technology-based education on students during the experiment

6.6. Sharing and Mirroring and Evaluation:

Students will submit the data obtained as a result of their observations in a report or research paper. Preparing a research report will contribute to the development of students' higher level cognitive skills. In addition, students will present their reports in groups and the data obtained as a result of the experiment using presentation preparation programs such as ppt or prezi and submit their reports on the day of the presentation. Their reporting and presentation skills will

be evaluated using a rubric (graded point system). After all groups finish their presentations, a project poster will be prepared using all the data of the students and we can apply for national or international competitions.

LESSON PLAN 3

- Outside field excursion with mathematics combined with art and engineering.

LESSON PLAN 3: Outside field excursion with mathematics combined with art and engineering.

Topic/Subject: Outside field excursion with mathematics combined with art and engineering.

Target Group: High School students

Objectives:
Objective 1 Learn Math outside using the surroundings and nature as a teaching Arena
Objective 2 Engineering exercise make a ladder
Objective 3 Learn how to use objects in more ways than one.

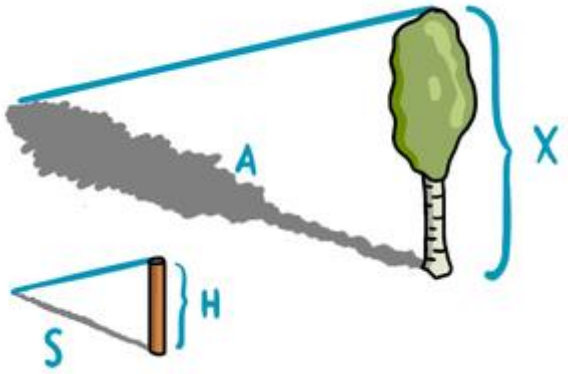
Approach/Methodology used: Social and emotional learning with teamwork and problem-based learning and interdisciplinary teaching with subjects as engineering, art and mathematics**.** To achieve good learning through problem-based learning the teacher needs to address questions which can be leading or open-ended. The questions are mentioned in the plan beneath.

Means/Tools/Educational technology
Calculators, measuring band and folding rule for measuring, rope and knife, a hand saw for cutting tree branches, notebook and pencil for drawing and rope to tie together.

Plan for work

Time	Activities	Methods/ means	Questions
0 9:00-10:00	We are in the woods and see a tree that stands alone. The students must find their way through cross multiplication of how high this	PBL and SEL The group must present a leader to tell	How can we measure the height of a tree with the equipment you have been given?

	tree is. They must use the shadow of the tree and compare it with the shadow to a known length as a person or a stick which is measured. Then they must measure the shadow from the tree and the object they already know the length of. They must compose a plan since they are only equipped with the measuring device and their notebook. The task will be presented like this: How high is this tree? Use only what was handled out to solve the task. The class must be divided into smaller groups of 5-6 in each group.	about their approaches and aid their leader with ideas during the problem solving.	Can someone come up with a plan? Who is the group leader? (The leader must present the plan for the teacher) Be aware to include both male and female students as leader for the group.



Measure the length of the shadow (S) from a log or stick whose height you know (H).

Then measure the length of the shadow cast by the tree (A).

Divide (divide) the length of the tree's shadow by the length of the staff's shadow. You now multiply the number you get by the height of the rod (X = H * A/S). Then you get the height of the tree.

Time	Activities	Methods/ means	Questions
10.30-12.00	After a short summary and reflections from the first task, and a break, the next assignment is to build a wooden ladder made of cutted branches		Safety first! The group must present a plan and a drawing. What do we need to think

	and rope. The main purpose of this task is to use a competitive way of learning through social emotional learning. In order to do this task properly, the leader of the group will be given the assignment and together with the group they must serve a sketch drawing of what they are going to build. The ladder must be steady enough to carry one person vertically and horizontally. One person from the group must climb the ladder and sit on it. The orders given is to create a ladder which is two meters long and fifty centimeters wide. Each step must not exceed 40 centimeters.		about? Weight, steadiness, technic regarding how to tie the branches together. Time control during the task – The students must provide as planned and succeed within the time given. Why did the group use that tree to make the ladder? Are the branches strong enough? After the building, the teacher must credit their work with a critical, but cherish way! The ladder can also be used as a stretcher and one of the participants should be able to sit or lie on it and the others carry it. In this way, this will be perceived as genuine and that they can see the usefulness of what they have built in several ways.

Assessment/Feedback:

Ask the students about the task that was given. It should not be too difficult at their level of education. Though this is a practical approach and perhaps more understandable for the once who are disadvantaged. The feeling of succeeding must also be one of the target goals.

Evaluation:

Look at the assignment and write it down
what knowledge and skills it requires of the students.

Does this match what you want students to learn?

Do you need to adjust the assignment? (Number of leads can regulate the level of difficulty.)

Examine the knowledge and abilities you've recorded:

- What actions must the pupils do in order to obtain these?

- Which activities should be done in the classroom, and which activities should be done outside of the classroom?away from the classroom?

- How will you gain an overview of the pupils' learning through various activities? on the way?

Bibliography:

Practical math from a website of Norwegian Scout – Cross multiplication

Matematikk.org https://www.matematikk.org/oss.html?tid=232017

The ladder and stretcher are only practical examples from the author of this document.

Co-funded by the Erasmus+ Programme of the European Union

E-STEAMSEL Project

Erasmus+ KA2- no: 2021-1-NO01-KA220-SCH-000032511

LESSON PLAN 4

- **Designing a System to Transport Water from a Well to a House**

LESSON PLAN 4: Designing a System to Transport Water from a Well to a House

Lesson: Physics
Subject: Pressure
Grade: 10th grade (High School)
Duration: 80 minutes
STEAM Elements: Science, Technology, Engineering, Art, Mathematics
1. Target Outcomes:
The outcomes of the center discipline:
Pressure concept, solid pressure
*Students are provided with the mathematical model of the relationship between weight and cross-sectional area.
*Students calculate the pressure exerted by more than one weight on the same surface.
*Students calculate the pressure when they put the weights on top of each other or side by side.

- Students will be able to explain the physics concepts of pressure and solid pressure.
- Students will be able to design and build a system to transport water from a well to a house.
- Students will be able to analyze data and use it to make informed decisions about their design.
- Students will be able to communicate their findings and design in a multimedia presentation.

Outcomes of other STEAM disciplines:
Mathematics
Equations and inequalities
*Applications with equations and inequalities
*Computing technologies and software
*Student uses arduino software.
*Student uses the necessary compiler to run the program
The student realizes the project in practice.
*The student presents his/her project effectively by working as a team with his/her friends.
1.2. Social Product Outcomes:
• Working in a team,
• Communicating,
• Being able to share problem and solution-oriented ideas,
• Fulfilling their duties and responsibilities,
• Being able to defend their ideas,
• Presenting the product effectively,

• Understanding the importance of cooperation and collaboration .

2. Materials Used:

- Various materials for building a physical model of the system (such as PVC pipes, valves, and connectors)
- Digital simulation software (such as SolidWorks or AutoCAD)
- Measuring tools (such as pressure gauges and rulers)
- Multimedia presentation software (such as PowerPoint or Prezi)

3. Resources

The videos in the links below can be shown to students
https://youtu.be/jWMsItc25b8
https://youtu.be/pQ0xwoYeWoA

4. Learning Methods and Techniques

Problem Based Learning Method,
Project Based Learning Method
techniques; Brainstorming, collaborative work

5. Groups Considered to be Formed During the Activity:

The groups planned to be formed should be included in this section;
The following features should be considered in the Groups created.
*Groups should consist of 3-5 people.
*It should be noted that it is a homogeneous group in terms of level.
*It should be ensured that the gender distribution is equal.

6. Implementation Phase;

6.1 Preparation Phase:

Create your student groups.
Choose your group leader
Choose a reporter

6.2: Presenting the problem situation to the student :

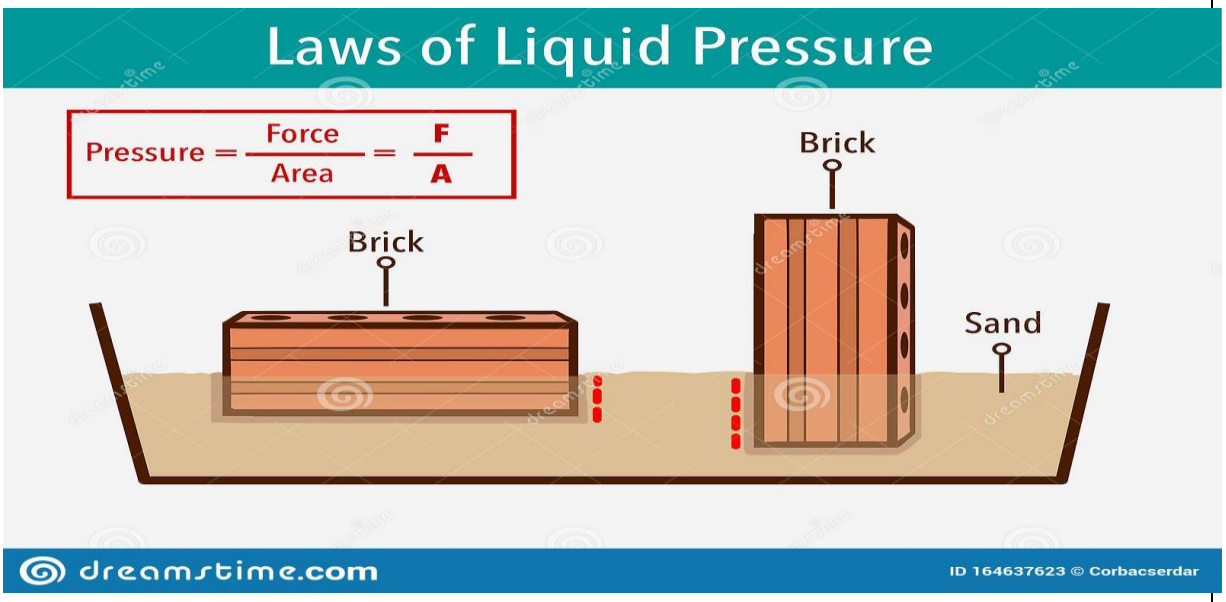
The following real life problem is presented to the students;

Marcus built a new house far away from the city center. Since it is quite costly to bring water from the city, he decides to use well water. But he has to carry the water from the well to the house. Marcus is confused about this. He does not know what to do. Can we develop a project to help Marcus? How?

6.3: Obtaining Information (Leading Questions)

In order to find a solution to the problem, the teacher asks the students to think about the following questions, do research and note down the information they have gained. Students do their research on the subject in groups.

Have students research the problem and analyze the physics concepts related to it. This might include understanding the properties of solids and how they relate to pressure, as well as the ways in which pressure can be measured, calculated, and controlled. Have students work in teams to identify the relevant physics concepts and brainstorm potential solutions.



6.4: Idea Development

Identifying Needs for the Problem;

Explain to students that their task is to design and build a system to transport water from a well to a house. Provide them with some basic information about the well (such as its depth and location) and the house (such as its distance from the well and the number of people living there). Explain that they will need to consider factors such as pressure, solid pressure, and flow rate in order to design an effective system.

6.5: Product Development:

Identifying Possible Solutions;

Encourage your students to work in groups and find possible solutions. Give them time to do this.

Choosing the Best Solution:

Have them decide as a group on the most appropriate one among the possible solutions. You can use the SWOT analysis method for this.

Making the Prototype:

Once students have a solid understanding of the problem and the physics concepts involved, challenge them to develop a prototype of a solution. Provide them with materials for building a physical model of the system, and encourage them to be creative and consider multiple solutions. Have them use measuring tools to test the performance of their prototype and make adjustments as needed.

After developing a prototype, have students test it to see how it performs. Have them measure the pressure and flow rate at various points in the system, and use the data to make informed decisions about their design. Encourage them to think critically and make adjustments based on the data they collect.

6.6. Sharing and Mirroring

Finally, have students communicate their findings and showcase their prototypes. Have them create a multimedia presentation that explains their design and demonstrates how it works. Encourage them to use visual aids and other creative elements to make their presentations engaging and informative.

6.7 Evaluation:

- Students will be assessed on their understanding of the physics concepts of pressure and solid pressure.
- Students will be assessed on the effectiveness of their design and their ability to analyze data and make informed decisions.
- Students will be assessed on their ability to communicate their findings and design in a multimedia presentation.

LESSON PLAN 5 • Water circulation

LESSON PLAN 5: Water circulation

Lesson: Water circulation
Subject: The water – an exhaustible resource
Grade: 7th grade / 8th grade
Teacher: Tudose Mihaela
Duration: 200 minutes (4 lessons)

1. Target Outcomes:

Strengthening knowledge about water.

1.1. Cognitive Process Outcomes:

Collecting and systematizing information on the importance of water.

The outcomes of the center discipline:

Biology:

- Identifing the importance of water for nature and for human body;
- Specifying the factors that lead to water pollution and the effects of water pollution on the environment and the health of living organisms.

Outcomes of other STEAM disciplines:

Physics:

- Specifying the physical and organoleptic properties of water.

Chemistry:

- Studying the chemical structure of the water molecule.

1.2. Social Product Outcomes:

- Developing the ability to work effectively in mixed teams (girls and boys);
- Training the ability to use knowledge to solve the situation-problem;
- Developing the competence to present the results of the project.

2. Materials Used:

Biology:

- Projector - to watch the videos;
- **For experiment „Highlighting the circulation of water in a living organism"**
  - Berzelius glass / tubes
  - Water
  - Colored substance (food coloring / ink)
  - Fresh biological material – flowering plants (snowdrop / daisy / chrysanthemum) - depending on the season;
  - Knife (dissection kit) / scissors
  - Camera / smartphones (to capture the stages of the experiment).
- **To make the filter:**
  - a transparent plastic bottle;
  - scissors;
  - rubber band;
  - stones (< 5 cm);
  - gravel (< 2 cm);
  - leaves (optional);
  - sand;
  - cotton wool;
  - coffee filter, napkin or a piece of cloth.

3. Resources

- Video about the water cycle in nature https://www.youtube.com/watch?v=vZl-WFXVS_g;

- Video about how make a water filter: https://www.twinkl.ro/resource/filtru-pentru-apa-experiment-stiintific-ro-ds-1677310875;

- Silvia Olteanu - Ghid de experimente in biologie (Guide to experiments in biology), Editura LVS CREPUSCUL, 2013;

- Marieta Ghețe, Mariana Florența Grosu – Activități practice de biologie, Editura E.D.P. RA, 2005.

4. Learning Methods and Techniques

- Problem Based Learning Method
- Experiments Based Learning Method
- Techniques: conversation, discovery, explication, brainstorming, collaborative work

4. Groups Considered to be Formed During the Activity:

- 4 groups of 5 students (boys and girls)

5. Implementation Phase

6.1. Preparation Phase:

- Students are organized in groups of 5 (4 groups);
- The working groups are mixed (girls and boys).

6.2. Presenting the problem situation to the student

The problem situation:

– Although the water is considered a universal solvent and a vital biological liquid, it has become an exhaustible resource

6.3. Obtaining Information (Leading Questions)

In order to find a solution to the problem, the teacher asks the students to think about the following questions, do research and note down the information they have gained. Students do their research on the subject in groups.

What is the water?
What importance does water have for nature, but for living organisms?
What is the importance of plants in the water cycle in nature?
What is the current situation of water resources on Earth?
What can we do to have clean water?

6.4 : Idea Development

In a first step, we define and characterize water from a physico-chemical point of view, then we discuss the importance of water in nature. All these discussions are based on the documentation of the students on this topic, documentation made in the previous lesson.

Also, students are asked to watch a short didactic film about the route (cycle) that water makes in nature (https://www.youtube.com/watch?v=vZI-WFXVS_g).

After watching, the students notice that plants are real "stopovers" in water's journey through nature.

6.5. Product Development

To convince themselves that this hypothesis is true, the students are asked to carry out a short experiment on how water circulates through the plant (as part of its cycle in nature). **(Appendix 1)**

After proving the hypothesis and clarifying the theory, students are asked to answer the following question: "How can we make and keep water clean?". This question is a necessary next step in finding solutions to the current global water problem.

Identifying Possible Solutions

To answer the question: How can we make and keep clean water, a 7-minute brainstorming takes place, in which various solutions are specified, such as:

- do not throw waste into the water;
- use as little plastic as possible and recycle it;
- to use filters for water purification (including at industrial level).

Choosing the Best Solution

The best voted solution was the existence of water filters (waste water, industrial water).

To put this into practice, a small-scale filter will be made to observe its importance in keeping water clean.

Making the Prototype: Appendix 2 (the worksheet)

6.6. Sharing and Mirroring

To check the efficiency of the filter, the students are asked to test it using dirty water (from puddles of rain or water mixed with various residues) **(Appendix 3)**

6.7 Evaluation

The assessment is carried out both by assessments made throughout the activity and by assessing the quality of the final product (how well each manufactured filter worked).

Appendix 1

Highlighting the circulation of water in a living organism

Required materials:

- Berzelius glass / test tubes
- Water
- Colored substance (food coloring / ink)
- Fresh biological material – flowering plants (snowdrop / daisy / chrysanthemum) - depending on the season;
- Knife (dissection kit) / scissors
- Camera / smartphones (to capture the stages of the experiment).

Procedure:

Step 1: Prepare colored water with ink of various colors / food coloring; Section the stem of the plant (for faster water absorption);

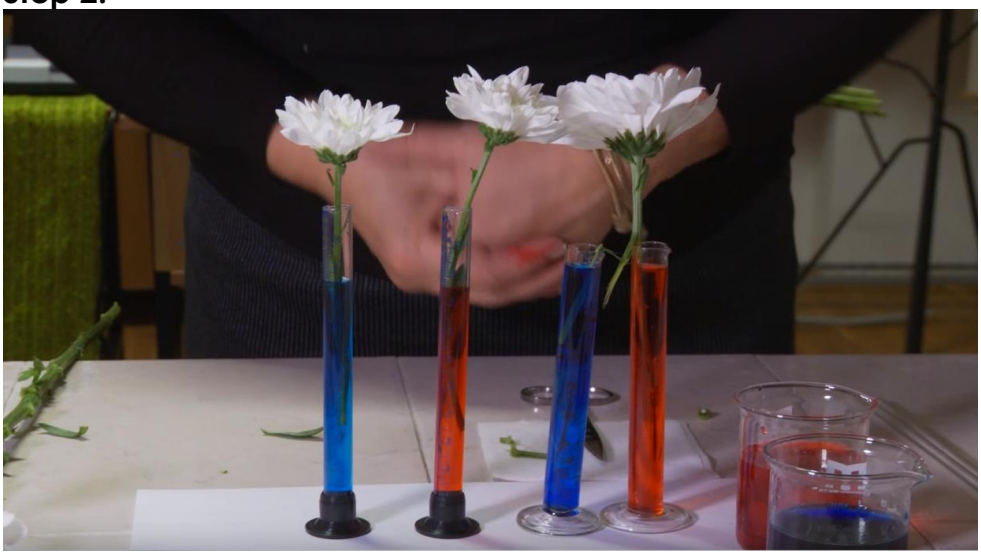
Step 2: Place a flower (ex. chrysanthemum) in each vessel (test tube) with a certain color.

Step 3: What do you notice (final result)?

After a few hours, you will get plants with colored spots.

Step 1:

Step 2:



Step 3: The results

Appendix 2

Build your own **water filter** out of whatever materials you can find home!

Required materials:

- a transparent plastic bottle;
- scissors;
- rubber band;
- stones (< 5 cm);
- gravel (< 2 cm);
- leaves (optional);
- sand;
- cotton wool;
- coffee filter, napkin or a piece of cloth.

Procedure:

Step 1: Use the scissors to carefully cut the plastic bottle in half.

Step 2: Start by covering the mouth of the bottle using the coffee filter, the napkin or piece of fabric and secure it with the rubber band.

Step 3: Turn the cut plastic bottle upside down and place it in the bottom half of the bottle.

Step 4: Now you can start laying the layers of materials that will form the filter. Start by putting the cotton wool. This will form the first layer of the filter.

Step 5: The next layer will be gravel.

Step 6: Then you can add the slightly larger stones.

Step 7: At the end, you can cover the layers with leaves (optional).

Appendix 3

Now is the time to test the filter!

Step 1: Pour the dirty water slowly. The more water it takes to pass through your filter, the more effective it is in cleaning and filtering the water from all dirty things or pollutants found in it!

Step 2: Look at the water that went through filter. Is this cleaner than the water originally poured? It has the same color? Discuss what you notice it happening.

Do you think the filter helped water purification?

LESSON PLAN 6

- **Means/Tools/Educational technology**

- **LESSON PLAN 6: Means/Tools/Educational technology**

Topic/Subject: English

Target Group: High School Students age 15-18 years

Objectives:

Objective number 1 is to show students connection between social science (English) and natural science (Jamaican English words related to natural sciences) in a STEAM-like lesson.

Objective number 2 is to enable students to develop critical thinking and critical media literacy to show that the English language isn't uniform and that there are varieties of English that belong to the so called Pidgin or Creole English which used to be considered pejorative but they are in their own way becoming rich separate languages …

Objective 3 is to see the use of Jamaican English (Jamaican Patois, pronounced patwa) in videos from internet via conversation and music. It will also deal with Rastafarian community in Jamaica featured in video, boosting their immune system during Covid through herbs and organic agriculture.

Approach/Methodology used:

Methodology will be critical thinking and critical media literacy.
Students will search information about the topic on the internet and will later organize the event about various variants of English language.

Students will use the internet, sheets of paper, pens etc. A teacher will use a frontal approach for lecturing and students will work in pairs or do their individual work.

Means/Tools/Educational technology
Students will use the internet, sheets of paper, pens..

Plan for work

Time	Activities	Methods/ means

45 minutes	As stimulus the teacher plays Bob Marley's song Three Little Birds, a famous reggae artist at the beginning of the lesson. Then he plays a video of a musician Macka B Wha Me Eat Wednesdays? Macka B talks about healthy vegetables. The teacher then asks students if they understood all Macka B's words. He divides students into groups and repeats the video. Students have to write words that they didn't understand or didn't find them to be English. The teacher explains there are many variants of English and gives definition of English-based Creole and Pidgin languages that Jamaican Patois belongs to. Students then describe what they imagine under the phrase Jamaica (e.g. sun, beaches, reggae music, ska music, Bob Marley, dreadlocks, Rastafarians etc). The teacher asks them: How did these people arrive to Jamaica? Who lived there before them? How do the Caribbean islands look like? What do they grow or produce? Students individually voice their opinions. The teacher tells them some differences between standard English and the Jamaican one. Students learn that Jamaican Patois has done away with unnecessary bits and pieces of the Standard English (several English-based words in Patois permanently in their plural form such as words related to natural sciences such as ears, teeth,ants, flowers, bees, *dem* as a suffix to make a word deliberately plural, some English words Jamaicans just can't seem to get right such as words related to natural sciences such as flitters instead of fritters, icening instead of icing, plauntin instead of plantain, pingwings instad of penguins, stangerine instead of tangerine,maggage instead of maggots, pongo-nut instead of pomegranate,different meanings of the words in Jamaican Patois such as *salad* (when you kick the ball through another player's legs in football), if you are called *salt, this means you're unlucky etc) blouse and skirt means what the hell,* raw meaning hungry ("*Jah know me raw, me coulda eat a fowl yah now")*.*craven to mean "greedy" (Bwoy, leff de rice and peas. Yuh too craven!)	

	Students take a look at video on Youtube called "Corona Virus" . It is a reggae song by a Jamaican singer Abiyah Yisrael, released in April 2020, which takes a look at COVID-19 from a scriptural perspective as an end-time warning to stay out of Babylon. The lyrics serve as a reminder to eat well and stay healthy , at the same time pressing the need for preventative hygiene. The music video shows how life has changed and will continue to change due to COVID-19. While watching the video and listening to lyrics, they try to remember the words connected with natural sciences. At the end they also watch the video about the Rastafarian community during Covid.	
	In order to encourage students to discuss what they see and think about the video, the teacher tells students to write down what they think about the message of the song. They also try to make few short sentences in Jamaican Patois.	
	For the extra curriculum activity students organize the event connected to various forms of English, including Pidgin and Creole variants of English. They bring the food typical for those areas and play various styles of music such as reggae, reggaeton, ska etc.	

Assessment/Feedback:

At the end of the lesson, students will fill-in the questionnaire prepared by the teacher about the lesson. They will also reflect on the comparison between Standard English and the Jamaican Patois . They will also write what they have learned during the lesson. They will state what they liked or disliked and will suggest improvements for future activities on this topic.

Bibliography:

Alexis Chateau: 10 Words that are Permanently Plural in Jamaican Patois, 24.2.2020, https://alexischateau.com/2020/02/24/10-words-that-are-permanently-plural-in-jamaican-patois/

Alexis Chateau: 5 English Words Jamaicans just can't seem to get right, 9.3.2018, https://alexischateau.com/2018/03/09/5-english-words-jamaicans-just-cant-seem-to-get-right/

Rasta Camp Speaks on COVID-19 : Food Security | Part 2

https://www.youtube.com/watch?v=YsskRixSb60

Abiyah Yisrael: Corona Virus, 2020, https://www.youtube.com/watch?v=IxvkW1WZmZo

Bob Marley: Three Little Birds, https://www.youtube.com/watch?v=zaGUr6wzyT8

Macka B: Wha Me At Wednesdays, 22.3.2017,https://www.youtube.com/watch?v=aS3GjLAnFvE

LESSON PLAN 7 • History

LESSON PLAN 7: History

Topic/Subject: History

Target Group: High School Students age 15-18 years

Objectives:

Objective number 1 is to show the students connection between social science (history) and natural science (ancient Roman technologies) in a STEAM-like lesson.

Objective number 2 is to enable students to develop critical thinking and critical media literacy to show that the advancement of technology doesn't belong to the present only but that in the past there used to be scientists in the ancient world able to create incredibly advanced products for their time. …

Objective 3 is to see the real objects in videos from internet and the museums and to develop appreciation for the protection of the ancient cultural heritage . It will also show the role and the work of natural science experts in history/archaeology such as material analysis, archaeometric methods of dating , ancient technology, geophysical survey, animal and plant remains etc.

Approach/Methodology used:

Methodology will be critical thinking and critical media literacy

The methodology used will be critical thinking and critical media literacy. Students will search information about the topic on the internet and will later visit the museum to see some objects.

Students will use the internet, sheets of paper, pens and a book Rimske zgodbe s stičišča svetov and will visit the Roman collection of the National Museum of Slovenia in Ljubljana and City Museum of Ljubljana.

A teacher will use a frontal approach for lecturing and students will work in pairs or do their individual work.

Means/Tools/Educational technology
Students will use the internet, sheets of paper, pens..

Plan for work

Time	Activities	Methods/ means
45 minutes	As stimulus the teacher divides students in groups or pairs and brings photos of various technological products of the modern era such as of computers, concrete, central heating, surgery equipment, highways, modern farmland etc. The teacher asks: Do you know all these products? Do you think they are all modern inventions? Do you think in the past people were not able to invent some really innovative stuff for their time ? What about ancient Romans? Did they walk on some grassy paths or were they able to build sophisticated roads? What about life in cold weather? Now we have a central heating- what about Romans? And you go to school nowadays- and what about the Romans? How did they get their knowledge? How did they do mathematical tasks if they didn't have computers? Did Romans also travel out of their empire and trade with other faraway nations ? Students individually voice their opinions. The teacher tells them to search for Roman technology on the internet. Students are also given a book Rimske zgodbe s stičišča svetov (about Roman collection in the National Museum of Slovenia). Students find some articles and they also find videos. Parts of one of the video on YouTube are shown to the students - Top ten incredibly advanced Roman technologies that will blow your mind	

	Students take a look at some parts of the video. They concentrate of the following topics connected with natural sciences- Roman concrete (which is more durable and less harmful to environment than modern concrete), Roman central heating system, use of the arches in Roman bridges and aqueducts, Roman industry (watermills, mining), Roman computers (Antikhytera mechanism- the world's oldest surviving analogue computer from the 1 st century BC), Roman ships and trade and Roman surgery	
	In order to encourage students to discuss what they see and think about the video, the teacher tells students to write down what they think about the impact of the Roman scientific achievements on our modern world.	
	For the extra curriculum activity students visit the Roman collections at the National Museum of Slovenia in Ljubljana and the City Museum of Ljubljana. In the later,they are able to see the grave of the female surgeon from the Flavian era with *bronze scalpels with iron handles, tweezers, a needle and other artefacts which are basically no different from tools one might still encounter in a doctor's office even today. They are able to see the remains of the Roman road as well. In the National Museum of Slovenia, students see for example,* the remains of silk from China, a gold ring with beads from Sri Lanka and other imported stuff as well as the remains of the Roman barge etc.	

Assessment/Feedback:

At the end of the lesson, students will fill-in the questionnaire prepared by the teacher about the lesson. They will also reflect on the comparison between Roman era science development and technology and modern era globalization science and technology development and will employ the method of critical thinking and critical reading. They will state what they liked or disliked and will suggest improvements for future activities on this topic.

Bibliography:

Farrell Evans: How The Colloseum Was Built, 15.7, 2022 https://www.history.com/news/how-roman-colosseum-built

Kashyap Vyas: 19 Greatest Innovations of the Roman Empire, 21.3.2021, https://interestingengineering.com/innovation/19-greatest-inventions-of-the-roman-empire-that-helped-shape-the-modern-world

Jennifer Quellette: Noblewoman's Tomb Reveals New Secrets, 1.1.2022, https://arstechnica.com/science/2022/01/noblewomans-tomb-reveals-new-secrets-of-ancient-romes-highly-durable-concrete/

Alexander Donovan: 11 Facts about the 2000-year old Antikhytera Mechanism, 7.7.2022, https://interestingengineering.com/innovation/antikythera-mechanism-2000-year-old-computer

Alice McBride: Reconstructing Roman Industrial Engineering,7.8.2021, https://arstechnica.com/science/2021/07/reconstructing-roman-industrial-engineering/

Janka Istenič: Rimske zgodbe s stičišča svetov, 2014, https://www.nms.si/si/trgovina/izdelek/rimske-zgodbe-s-sticisca-svetov?id=10621

Top ten incredibly advanced Roman technologies that will blow your mind
27.2.2022, https://www.youtube.com/watch?v=DPu9OQpH6uo

Top 10 Genius Advanced Roman Technologies Far Too Advanced For Their Time, 28.6.2022, https://www.youtube.com/watch?v=Ua0ylF2YK7I

LESSON PLAN 8

- ""A wanderer went through the Atom Age" - by Matej Bor

LESSON PLAN 8: ""A wanderer went through the Atom Age" - by Matej Bor

Lesson: Literature
Subject: Slovene language. ""A wanderer went through the Atom Age" - by Matej Bor
Grade: 14 years - 9th grade
Duration: 1 hour
Lesson plan drafted by teacher: Robin Dewa
1. Target Outcomes:
Cognitive Process Outcomes:
The outcomes of the center discipline: enriching the literature with environment topic and the development of critical thinking and critical media literacy skills through an apocalyptic poetic reflection on the environmental disasters.
Social Product Outcomes and outcomes of other STEAM disciplines:

- Developing cooperation and collaboration between students working in a team
- Being able to share problem and solution-oriented ideas
- Being able to stand for their ideas
- Exemplifying ways of expressing attitudes towards an atom age, technology and other challenges that we face nowadays (e.g war)
- Mentioning the importance of protection of environment and peaceful behaviour
- Encouraging students' creativity by using critical thinking and critical media literacy skills by forming pro et contra groups using knowledge acquired in other subjects (biology, geography , citizenship, history etc)

2. Materials Used:

board, Power Point, computer with internet connection, youtube videos, worksheets with printed excerpts of the poem, board with biographical data and the author's portrait

3. Resources

- human resources: students , teachers
- informational resources: educational platforms (youtube)
- ways of organizing the activity: frontal, individual, on groups

Literature and other media:
Matej Bor: A wanderer in the atom age, Državna založba Slovenije, 1970
Kovček / Case Based on a poem »ATOM AGE« by Matej Bor Performers: Suzana Grau & Gašper Jarni,https://www.youtube.com/watch?v=_mCN-BK95KA
Matej Bor: Hej Brigade song, https://www.youtube.com/watch?v=eu_hDrzlpE8

4. Learning Methods and Techniques

Reading, watching videos, conversation, explanation, work with worksheets, pro et contra debate techniques for developing critical thinking and critical media literacy skills

5. Groups Considered to be Formed During the Activity:

Two mixed groups of about 10 students each

6. Implementation Phase;

6.1 Preparation Phase:

Students are divided into two groups, about 10 students per each group depending on the size of the class
Each group chooses a group leader who will present the solutions of the tasks in face of the classroom . At the level of each group, an editor is selected to mark the completion of all tasks.

6.2: Presenting the problem situation to the student:

- based on a Power Point material material, students are presented with a life story about Slovenian poet Matej Bor with a focus on his poems (his poem Hey , Brigades, was the unofficial anthem of Slovene partisan forces during the WW II, he wrote a poem AWanderer in the Atom Age in 1957), , translations of Shakespeare's works into Slovene language his role for Slovenian cinematography (he wrote the screenplay for the movie Vesna in 1954) his work for environment (he founded first Slovenian environmental movement in 1970s) and his work on the

ancient Veneti, hypothetical ancestors of present day Slovenes (his book Veneti: First Builders of European Community, 1996)

A student reads the excerpt of the poem text " A Wanderer in the Atom Age".

The following passage of the poem is read:

A wanderer went through the atom age
and watched,
how the trees were flying away from it.
He hurried after them:
Don't go, trees!
If you go,
your shadows too will go,
and if they go,
where would I, a wanderer, rest,
weary of walking
through the atom age?«
But the trees with their shadows
fled and fled.
-Don't go, don't go!«
the wanderer called after them,
-If you go
the gardens too will go,
since they will long for you;
and if the gardens go
the birds will also go,
since they will long for them;
and if trees, gardens and birds go
love too will go;
and if love goes
Still the trees did not listen;
they fled and fled
abandoning the atom age.
A wanderer went through the atom age
and once he was fairly high up
he looked down
where the atom age lay:
everywhere,
As far as the eye could reach,
concrete and iron,
iron and concrete
in all sorts of shapes,
which in the neon lights were casting
long immovable shadows across time.

The wanderer was watching all this
and when he thought how
useless his heart was
amid it all
he shed a tear.
It fell upon the ground
and a bird which stood there drank it.
And having drunk it, said: -Bitter is your tear.
Why is it so bitter?
And before the wanderer could say
his usual -don't know* —
the bird was dead.
He took it in his hand
and carried it down where the atom age lay
to bury it.
But all in vain:
everywhere concrete and iron,
only iron and concrete,
and not enough earth breeding flowers and birds
to make a bird's grave
and plant a flower upon it.

6.3: Obtaining Information (Leading Questions)

Draws attention to active and interested participation in the lesson for working on the fragment from the poem "A Wanderer Went Through An Atom Age".

6.4: Idea Development

The students are asked to find an explanation for the title the poem and tell their opinion about an atom age

6.5: Product Development:

* Students are requested to take a look at the video connected with the poem:

Kovček / Case Based on a poem »ATOM AGE« by Matej Bor Performers: Suzana Grau & Gašper Jarni,https://www.youtube.com/watch?v=_mCN-BK95KA

1. They are tasked to identify needs for the problem, namely to be split into pro et contra groups to advocate their views about the poem.

6.6: Product Development:

1. Each student will participate in reading the excerpt of the poem again to help develop reading skills.
2. Each student will join one of the two teams formed on the pro et contra basis.
3. Each student will become aware of the importance of the environment and war challenges
4. Each student will contribute their own ideas to the leader of their respective teams for pro et contra debate.

Identifying Possible Solutions;

Students are asked to solve the poet's dilemma by voicing their opinions on the topic.

The students, divided into groups, will present the ways in which they can express their opinions. At the moment of the debate, the two sides, pro and con, will face each other. The teams will take turns introducing themselves and their position on the topic. Each side will provide a major counterargument. Finally, each side provides some additional comments, summarizes, and closes the debate.

Choosing the Best Solution:

The moral lessons derived from the lesson are stated:

- In the end, there is fateful unity between humankind and nature
- beware of the technological advancement which can destroy humankind and nature
-work for peace as in a nuclear war there is no winner.

6.7. Sharing and Mirroring

1. Students will work in groups to fill in the worksheets on the topic of the poem

6.8. Evaluation:

Students will work to fill-in the Google Form for evaluation.

LESSON PLAN 9 • Medicine

LESSON PLAN 9: Medicine

Topic/Subject: Medicine

Target Group: Middle School Students

Objectives:

Objective number 1 is to show the students connection between pandemics/epidemics that happened in history and now (social science-History) and medicine in a STEAM-like lesson.

Objective number 2 is to enable students to develop critical thinking, critical media literacy and empathy in order to be better equipped for potential future pandemics/epidemics

Approach/Methodology used:

Methodology will be critical thinking and critical media literacy

The methodology used will be critical thinking and critical media literacy Students will also search for information about the topic on the internet, through youtube videos and will learn how informed knowledge of the past and present can prevent wrong approach in future.

A teacher will use a frontal approach for lecturing and students will work in pairs or do their individual work.

Means/Tools/Educational technology

Students will use the internet, sheets of paper, pens. They will use the method of the interview and also Online Classroom application

Plan for work

Time	**Activities**	**Methods/ means**
45 minutes	As stimulus the teacher divides students in groups or pairs and shows them a video excerpt from Justinian Plague from Youtube and a video excerpt from Arena on TV Slovenia about Covid with medical experts (in Slovene language)	

	The teacher asks students: How did ancient people cope with pandemics? What kind of measures did they take? Did they know about viruses and bacteria as much as we know now? Did the ancient people deal with pandemics/epidemics in a right way? What about us? How did we treat the recent Covid pandemic and what measures were taken? Did those measures affect young people too? Were the measures taken too harsh and did they have only positive and no negative effects? What can each of students tell about her/his experiences? Students brainstorm their knowledge and opinions. The teacher leads them to develop their ideas by actively exploring real-world problems in the past and now and by identifying key issues that clarify different perspectives and lead to better solutions. Students work in the group in order to develop team skills and competencies as well as communication. They use ability to share problem and solution-oriented ideas, fulfilling their duties and responsibilities. Working in two groups, they are able to defend their ideas, understand the importance of cooperation and approach problems from new perspectives. The Social and emotional learning is used as they develop empathy, activism , out-of-the-box thinking and other aspects of social and emotional learning (SEL)	
	Students take a look at some parts videos. Divided in two groups with different ideas and solutions how to tackle pandemics. Groups are made up of same number of participants . They are homogenous from the point of view of knowledge and equal gender distribution is ensured. people. *It was noted that there was a homogeneous group in terms of level.	

	*Equal gender distribution was ensured.	
	In order to encourage students to discuss what they think about it, One of the student is chosen as a scientist. He/she researches cholera and works on hypotheses which will be published in the forum in the online classroom. As a scientist he/she is a part of the government team. Some other students are also a part of the government team as ministers What kind of measures are they going to take at the outbreak of pandemics? The other students have prepared themselves about the topic by reading the article about pandemics in the past by a historian. They have prepared questions both to the historian and to the experts for epidemics/pandemics. Questions are written in the word document and posted in the Online Classroom as a task.	
	Some examples of questions for a historian: When were epidemics/pandemics in the past? Which ones were the longest or the hardest? How many people died of each pandemics in the past? How did epidemic develop and how did it affect the societies? Why did you decide to research this area as a historian? What were your resources? What were the ways to protect against pandemics in the past? Was there any pandemic in the past similar to Covid 19?	
	Some examples of questions for pandemics expert How did some disease evolve? How fast does it spread? How long did it take in the past to invent vaccine for it and how long does it take nowadays? Did they know in the past how viruses spread?	

	Are there going to be new waves of epidemics/pandemics in future and how often will they appear? How are transmittable diseases created and how to protect ourselves against them? What is the difference between isolation and quarantine How do epidemiologists fight epidemics/pandemics? How do we recognize the peak of epidemics/pandemics? Is Covid 19 natural or man-made? Are Covid vaccines safe or are there any side effects due to Covid vaccines? Do masks protect us from viruses? How many boosters should we have? Are there any alternatives to Covid vaccines (Ivermectin etc)?	
	Obtaining Information (Leading Questions) In order to find a solution to the problem, the educator asks the students to think about questions, do research and write down the information they have learned. Students do their research on the subject in groups.	
	Idea Development **Determining the Requirements of the Problem;** Groups move on to the idea development stage. Each group shares their ideas with their groupmates in the light of the information they have acquired in the previous stage. In this section, they try to answer the question of what they might need to solve the problem. **Sharing and Reflections** From the beginning of this process, feedback is received on the areas where they have developed themselves, learned and focused in line with their interests and abilities.	

	Evaluation: The teacher observes the students throughout the process, and prepares questions to evaluate the students' understanding of the subject.	

Assessment/Feedback:

At the end of the lesson, students will fill-in the questionnaire prepared by the teacher about the lesson. They will also reflect on the comparison between past and current pandemics. They will state what they liked or disliked and will suggest improvements for future activities on this topic.

Bibliography:

https://www.youtube.com/watch?v=kWhn0rXlzeI Justinian Plague

https://365.rtvslo.si/arhiv/arena/174937465, TV Slovenia video about Covid (in Slovenian language)

https://casnik.si/tri-velike-kuge-anticne-dobe/ (3 epidemics during the Roman Empire, in Slovene language)

LESSON PLAN 10

- Medicine

LESSON PLAN 10: MEDİCİNE

Topic/Subject: Medicine

Target Group: Middle School Students

Objectives:

Objective number 1 is to show the students connection between pandemics/epidemics that happened in history and now (social science-History) and medicine in a STEAM-like lesson.

Objective number 2 is to enable students to develop critical thinking, critical media literacy and empathy in order to be better equipped for potential future pandemics/epidemics

Approach/Methodology used:

Methodology will be critical thinking and critical media literacy

The methodology used will be critical thinking and critical media literacy Students will also search for information about the topic on the internet, through youtube videos and will learn how informed knowledge of the past and present can prevent wrong approach in future.

A teacher will use a frontal approach for lecturing and students will work in pairs or do their individual work.

Means/Tools/Educational technology

Students will use the internet, sheets of paper, pens. They will use the method of the interview and also Online Classroom application

Plan for work

Time	Activities	Methods/ means
45 minutes	As stimulus the teacher divides students in groups or pairs and shows them a video excerpt from Justinian Plague from Youtube and a video excerpt from Arena on TV Slovenia about Covid with medical experts (in Slovene language) The teacher asks students: How did ancient people cope with pandemics? What kind of measures did they take? Did they know about viruses and bacteria as much as we know now? Did the ancient people deal with pandemics/epidemics in a right way? What about	

	us? How did we treat the recent Covid pandemic and what measures were taken? Did those measures affect young people too? Were the measures taken too harsh and did they have only positive and no negative effects? What can each of students tell about her/his experiences? Students brainstorm their knowledge and opinions. The teacher leads them to develop their ideas by actively exploring real-world problems in the past and now and by identifying key issues that clarify different perspectives and lead to better solutions. Students work in the group in order to develop team skills and competencies as well as communication. They use ability to share problem and solution-oriented ideas, fulfilling their duties and responsibilities. Working in two groups, they are able to defend their ideas, understand the importance of cooperation and approach problems from new perspectives. The Social and emotional learning is used as they develop empathy, activism , out-of-the-box thinking and other aspects of social and emotional learning (SEL)	
	Students take a look at some parts videos. Divided in two groups with different ideas and solutions how to tackle pandemics. Groups are made up of same number of participants . They are homogenous from the point of view of knowledge and equal gender distribution is ensured. people. *It was noted that there was a homogeneous group in terms of level. *Equal gender distribution was ensured.	
	In order to encourage students to discuss what they think about it, One of the student is chosen as a scientist. He/she researches cholera and works on hypotheses which will be published in	

	the forum in the online classroom. As a scientist he/she is a part of the government team. Some other students are also a part of the government team as ministers What kind of measures are they going to take at the outbreak of pandemics? The other students have prepared themselves about the topic by reading the article about pandemics in the past by a historian. They have prepared questions both to the historian and to the experts for epidemics/pandemics. Questions are written in the word document and posted in the Online Classroom as a task.	
	Some examples of questions for a historian: When were epidemics/pandemics in the past? Which ones were the longest or the hardest? How many people died of each pandemics in the past? How did epidemic develop and how did it affect the societies? Why did you decide to research this area as a historian? What were your resources? What were the ways to protect against pandemics in the past? Was there any pandemic in the past similar to Covid 19?	
	Some examples of questions for pandemics expert How did some disease evolve? How fast does it spread? How long did it take in the past to invent vaccine for it and how long does it take nowadays? Did they know in the past how viruses spread? Are there going to be new waves of epidemics/pandemics in future and how often will they appear? How are transmittable diseases created and how to protect ourselves against them?	

	What is the difference between isolation and quarantine How do epidemiologists fight epidemics/pandemics? How do we recognize the peak of epidemics/pandemics? Is Covid 19 natural or man-made? Are Covid vaccines safe or are there any side effects due to Covid vaccines? Do masks protect us from viruses? How many boosters should we have? Are there any alternatives to Covid vaccines (Ivermectin etc)?	
	Obtaining Information (Leading Questions) In order to find a solution to the problem, the educator asks the students to think about questions, do research and write down the information they have learned. Students do their research on the subject in groups.	
	Idea Development **Determining the Requirements of the Problem;** Groups move on to the idea development stage. Each group shares their ideas with their groupmates in the light of the information they have acquired in the previous stage. In this section, they try to answer the question of what they might need to solve the problem. **Sharing and Reflections** From the beginning of this process, feedback is received on the areas where they have developed themselves, learned and focused in line with their interests and abilities. **Evaluation:** The teacher observes the students throughout the process, and prepares questions to	

	evaluate the students' understanding of the subject.	

Assessment/Feedback:

At the end of the lesson, students will fill-in the questionnaire prepared by the teacher about the lesson. They will also reflect on the comparison between past and current pandemics. They will state what they liked or disliked and will suggest improvements for future activities on this topic.

Bibliography:

https://www.youtube.com/watch?v=kWhn0rXlzeI Justinian Plague

https://365.rtvslo.si/arhiv/arena/174937465, TV Slovenia video about Covid (in Slovenian language)

https://casnik.si/tri-velike-kuge-anticne-dobe/ (3 epidemics during the Roman Empire, in Slovene language)

LESSON PLAN 11

- Learning Maths Through Sport

LESSON PLAN 11: Learning Maths Through Sport

(Društvo Bodi svetloba, Slovenia)

Topic/Subject: Maths

Target Group: Middle School Students

Objectives:

Objective number 1 is to show the students connection between natural science (maths) and sport (football) in a STEAM-like lesson.

Objective number 2 is to enable students to develop critical thinking and creative solution finding through the football match by using alternative ways to result and by using application

Approach/Methodology used:

Methodology will be critical thinking and critical media literacy

The methodology used will be critical thinking and creative solution finding Students will also information about the topic on the internet through youtube and will learn about how physics and mathematics can be applied in sports such as handball, football, etc.

A teacher will use a frontal approach for lecturing and students will work in pairs or do their individual work.

Means/Tools/Educational technology

Students will use the internet, sheets of paper, pens and Photomath application..

Plan for work

Time	**Activities**	***Methods/ means***
45 minutes	As stimulus the teacher divides students in groups or pairs and shows them a video excerpt of a female handball match	

	.The teacher also shows them a football video connected with physics. Then he takes the students to the problem. The teacher says: In a very tight ending to a handball game, the two teams are tied. A second before the final whistle, the goalkeeper blocks the ball, catches the ball, and has no time to pass it to a player of her team. All the other players, including the opponents' goalkeeper are on her side of the court, so she decides to shoot the opponents' goal. In the moment she shoots, the goalkeeper is 6 meters away from her goal line, and she shoots the ball from a height of 2.26 meters. The ball's trajectory is a parabola. At the height of 5.1 meters, the ball flies over a player who is 16 meters away from the goalkeeper. Finally, at the height of 4.2 meters, it flies over a player who is 9 meters from the goal line of the goal the ball is flying towards. If the handball court is 40 meters long, and the goal is 2 meters tall, will the goalkeeper score the goal and bring victory to her team? The teacher then asks: What is parabola here? How is the format of the equation followed? Can you guess what x represents and what f(x) represents? Students then do equation and bring about the following result: $f(x)=ax^2+bx+c$ Students realize that x represents the distance to the goal line of the shooting goalkeeper and that f(x) represents the height of the ball. Next, students have the task to find the values of a, b, and c, using the information in the question. The teacher asks the questions: How many metres from the first goal line? What is the height of the ball? How can you find values for a, b, c based on those information? Students solve the system of equation using elimination method. The other group of students puts the simultaneous equations into Photomath, to calculate values of a, b, and c.	

	The end result is that the ball crosses the goal line at a height of 1.5018 meters, so the goalkeeper will score and the team wins!	
	Students take a look at some parts of the video. They concentrate on how goals are scored in football and what they can learn from mathematicalm or physical knowledge applied in sport (football, handball)	
	In order to encourage students to discuss what they see and think about the use of Photomath, the teacher tells students to write down what they think about the impact of apps in the school subjects, especially in natural sciences like maths. achievements on our modern world.	
	For homework students use Photomath for another type of tasks and exercises.	

Assessment/Feedback:

At the end of the lesson, students will fill-in the questionnaire prepared by the teacher about the lesson. They will also reflect on the comparison between using equation by hand or using Photomath application . They will state what they liked or disliked and will suggest improvements for future activities on this topic.

Bibliography:

Photomath application download: https://play.google.com/store/apps/details?id=com.microblink.photomath&hl=en_GB&gl=US&pli=1

https://www.youtube.com/watch?v=m57cimnJ7fc How physics is used in football

LESSON PLAN 12

- Simple Harmonic Oscillator

LESSON PLAN 12: **Simple Harmonic Oscillator**

Lesson: Science - Physics
Subject: Simple Harmonic Oscillator
Grade: Secondary (10-12)
Duration: 90 minutes

1. Target Outcomes:
1.1 Cognitive Process Outcomes:

The outcomes of the center discipline:
*Understand the basic principles of a Harmonic Oscillator, study the kinematics and dynamics of the system.
*Predict the values of the physical quantities as well as their variation through time, using a theoretical (mathematical) approach.
*Graphically show the relationship between the displacement of the object with respect to time, and extract values for quantities such as period, frequency, and Amplitude.

Outcomes of other STEAM disciplines:
Mathematics:
*Predict the values of the physical quantities as well as their variation through time, using a theoretical (mathematical) approach.
*Graphically show the relationship between the displacement of the object with respect to time, and extract values for quantities such as period, frequency, and Amplitude.

Technology:
Use sensors to collect data and transfer it to Arduino, which depicts it in the computer, by constructing a real time graph.

1.2. Social Product Outcomes:
Working in a team,
Communicating properly,
Sharing problem and solution-oriented ideas,
Thinking critically and being innovative,
Discussing and defending their ideas in an ethical way,
Presenting the product effectively,
Understanding the importance of cooperation and collaboration.

2. Materials Used

Objects with variant masses Extension spring Microsoft office installed (Excel) Arduino UNO Breadboard

Cables
Supersonic Sensor
Windows based computer, tablet, internet connection, projector.

3. Resources or Bibliography

- Hugh D. Young , Roger A. Freedman. University Physics with Modern Physics with Mastering Physics
- To Master Physics, First Master the Harmonic Oscillator - YouTube (12min)
- Animation of an Harmonic oscillator (mechanics, physics) - YouTube
- Oscillation Lab (thephysicsaviary.com) - Game

4.Learning Methods and Techniques

Problem Based Learning Method,
Argumentation Based Learning Method
Collaborative method
Techniques: Brainstorming, teamwork

5. Groups Considered to be Formed During the Activity

The following features should be considered in the Groups created.
*Groups should consist of 3-5 people chosen by teacher.
*It should be noted that it is a heterogeneous group in terms of level.
*It should be ensured that the gender distribution is equal.

6. Implementation Phase

6.1 Preparation Phase:

Create student groups.
Choose group leaders.
Choose a reporter/speaker.
Write the PBL guide (Problem aims, leading theoretical questions, steps, resources, time, reporting goals)

6.2 Presenting the problem situation to the student:

Introduction (5 minutes):

Begin by asking students if they have heard of or encountered the term "harmonic oscillator" before. Invite them to share their ideas or prior knowledge.
Explain that a harmonic oscillator is a system that exhibits repetitive, oscillatory motion around a stable equilibrium position. Give examples such as a spring-mass system or a swinging pendulum.
Understanding the Basics (15 minutes):

Present the equation of motion for a simple harmonic oscillator: $x(t) = A \cos(\omega t + \varphi)$, where $x(t)$ represents the displacement, A is the amplitude, ω is the angular frequency, t is the time, and φ is the phase constant.

Discuss the meaning of each term and how they relate to the motion of a harmonic oscillator.

Highlight that the motion is sinusoidal, with the displacement and velocity following a periodic pattern.

Experimental Exploration (20 minutes):

Divide students into pairs or small groups and provide them with springs or pendulums.

Instruct students to observe and experiment with the oscillations of the system.

Have them measure and record the period (T) of the oscillations using a stopwatch or timer.

Encourage them to vary the amplitude and observe any changes in the motion.

Analyzing Period and Frequency (15 minutes):

Gather the class together and discuss the relationship between period (T) and frequency (f). Emphasize that frequency is the reciprocal of the period, i.e., $f = 1/T$.

Ask students to calculate the frequency of their oscillating systems based on the measured period.

Reinforce the concept that frequency represents the number of complete oscillations per unit time.

Energy and Amplitude (15 minutes):

Introduce the concept of energy in a harmonic oscillator. Discuss how potential energy is maximum at the extreme positions, while kinetic energy is maximum at the equilibrium position.

Explain that the total mechanical energy of the system remains constant throughout the motion, with energy transferring between potential and kinetic forms.

Relate the amplitude of the oscillations to the energy of the system. Discuss how increasing the amplitude affects the energy distribution.

Graphical Representation (10 minutes):

If available, demonstrate how to plot the displacement-time graph or the velocity-time graph of a harmonic oscillator using graphing paper or graphing software (use the game as example).

Discuss the sinusoidal nature of the graphs and how they relate to the equations and motion of the oscillator.

Conclusion and Application (10 minutes):

Summarize the main concepts covered in the lesson, including the equation of motion, period, frequency, amplitude, and energy in a harmonic oscillator.

Discuss real-life examples of harmonic oscillators, such as musical instruments or electronic circuits.

Encourage students to think about other systems they encounter in their daily lives that exhibit oscillatory motion.

6.2 Product Development:

Assembly the experimental setup, using ARDUINO.

Depict the position as a function of time and compare it with a sine function.

Calculate frequency, period and angular frequency using experimental data.

Compare the experimental data with the theoretical values.

Student groups reporters prepare their presentations.

6.3 Evaluation:

Each group should present the in-class products and at the end students are asked to be evaluated by other groups by explaining differences and discuss between peers and teacher.

Quiz about Harmonic Oscillator – Annex I

There was personal development and acquisition of new knowledge by the teachers and students who participated in the class. Pupils renewed their interest in Physics, mainly through the practical experience, and secondarily from the synthetic works. Through the practical training of laboratory STEM techniques, students gained self-confidence increasing the cooperation between them and strengthening their ability to teamwork, improving communication between the teacher and learners.

Annex I

Quiz about Harmonic Oscillator:

This quiz is designed to evaluate your knowledge about the concept of a harmonic oscillator. Read each question carefully and select the most appropriate answer from the options provided. There is only one correct answer for each question. Good luck!

1. What is a harmonic oscillator? a) A musical instrument that produces harmonic sounds b) An object that moves back and forth around a stable equilibrium position with a restoring force proportional to its displacement c) A device used to measure harmonic frequencies d) A term used to describe a harmonious wave pattern

2. Which of the following properties determine the behavior of a harmonic oscillator? a) Amplitude and frequency b) Wavelength and speed c) Intensity and pitch d) Phase and period

3. True or False: In a harmonic oscillator, the restoring force is directly proportional to the displacement from the equilibrium position. a) True b) False

4. Which of the following describes the relationship between the frequency and period of a harmonic oscillator? a) Frequency and period are inversely proportional. b) Frequency and period are directly proportional. c) Frequency and period are unrelated. d) Frequency and period have a nonlinear relationship.

5. What is the term used to describe the maximum displacement from the equilibrium position in a harmonic oscillator? a) Period b) Frequency c) Wavelength d) Amplitude

6. Which of the following is an example of a harmonic oscillator? a) A pendulum swinging back and forth b) Water waves moving in a pond c) A car accelerating on a straight road d) Birds flying in a flock

7. True or False: The amplitude of a harmonic oscillator affects the energy of the system. a) True b) False

8. What is the equilibrium position in a harmonic oscillator? a) The position where the object is at rest b) The position with the highest displacement c) The position with the lowest displacement d) The position where the object achieves maximum velocity

9. In a harmonic oscillator, if the amplitude is doubled while the frequency remains the same, how does this affect the total energy of the system? a) The total energy doubles. b) The total energy remains the same. c) The total energy quadruples. d) The total energy is halved.

10. Which physical law or principle governs the behavior of a harmonic oscillator? a) Newton's Laws of Motion b) Coulomb's Law c) Ohm's Law d) Hooke's Law

LESSON PLAN 13

- The Pythagoras Theorem

LESSON PLAN 13: **The Pythagoras Theorem**

Lesson: Science - Maths
Subject: The Pythagoras Theorem
Grade: Secondary (Students at Grade 10)

Duration: 50 minutes

1. Target Outcomes:

Cognitive Process Outcomes:

The outcomes of the center discipline:

- To identify the basic constituents of a right-angle triangle to state the Pythagoras theorem.
- To prove, apply and use the Pythagoras theorem
- To explain various visual representations of the theorem and exploit them in the proof of the theorem
- To solve real world problems, using the theorem to state and prove the inverse of the theorem
- To develop motives and positive affective tendencies for mathematics
- To identify/ develop/ create applications of the related concepts and processes in the real world

Outcomes of other STEAM disciplines:

Technology:

To develop digital skills/ through the use/ exploitation of digital resources to support in calculations, visual representations of the concepts, processes involved in handling the theorem.

Art:

Conveys his ideas through design and drawing.

1.2. Social Product Outcomes:

- Working in a team,
- Communicating properly,
- Sharing problem and solution-oriented ideas,
- Thinking critically and being innovative,
- Discussing and defending their ideas in an ethical way,
- Presenting the product effectively,
- Understanding the importance of cooperation and collaboration.

2. Materials Used:

Traditional board and geometrical equipment.
Calculators.
Maths software that can help the students to:

- Draw geometrical figures in the Euclidean plane.
- Have the opportunity to observe the transfer of figures from one position to another position on the plane through isometries (translations, rotations, reflections)
- Do calculations

Windows based computer, tablet, internet connection, projector.

3. Resources

- Pythagorean theorem water demo - YouTube (Int)
- The Best Pythagorean Theorem Rap Ever - YouTube
- http://www.onlinemathlearning.com/pythagorean-theorem.html
- https://www.brainingcamp.com/lessons/pythagorean-theorem
- http://www.glencoe.com/sec/math/t_resources/gamezone/pdfs/mac3_04/class_ch03.pdf
- https://www.pinterest.pt/explore/pythagorean-theorem/?lp=true
- Pythagorean Theorem Game (pleacher.com) – Game
- Unit 5 Pythagorean Theorem Scavenger Hunt - Open the box (wordwall.net) - Game

4.Learning Methods and Techniques

Flipped Classroom Method
Collaborative method
Techniques: Brainstorming, teamwork

5. Groups Considered to be Formed During the Activity:

The following features should be considered in the Groups created.
*Groups should consist of 3-5 people chosen by teacher.
*It should be noted that it is a heterogeneous group in terms of level.
*It should be ensured that the gender distribution is equal.

6. Implementation Phase

6.1 Preparation Phase:

Create student groups.
Choose group leaders.
Choose a reporter/speaker.
Write the Flipped classroom (Choosing the resources to be learnt by students at home, prepare the in-class discussion)
See the video (Int) Pythagorean theorem water demo - YouTube
Provide examples and exercises from the textbook, or other resources, where the theorem is used for

- Practical straightforward calculations
- Real world applications of the theorem
- In implicit use in approaching other problems/ issues in Geometry or other areas of mathematics (e.g. trigonometry, coordinate geometry and so on)

6.2: Presenting the flipped approach to the student:

As a first step, the students are asked to construct at home a puzzle that after proper rearrangements leads to the conclusion that under certain

conditions the sum of the areas of two squares is equal to the area of a third square. The students are then asked to specify what these conditions are.

As a second step, the students are given a figure and are asked to prove at home certain propositions that can lead to the Pythagoras Theorem.

Given a triangle AHD, ask the students to specify its characteristics, insisting particularly on the angle at A and the lengths of the sides. Ask for the relation between the sides.

Explain that this is the Pythagoras theorem

Furthermore, the students are asked to surf on the Internet about Pythagoras and the historical roots of the theorem.

6.3: Idea Development in the classroom

In the classroom each group should present their findings and the whole class proceeds to a systematic discussion of the Pythagoras theorem and the various concepts and processes involved as a review/recapitulation of the work they have done at home.

The teacher generalizes by asking to specify:

What are the conditions and requirements that lead to the theorem?

Ask them to state it and explain it between themselves.

Write the Pythagorean theorem on the board: $a^2 + b^2 = c^2$.

Explain the variables: a and b represent the lengths of the legs of a right-angled triangle, and c represents the length of the hypotenuse.

Discuss the concept of the theorem using diagrams and examples, emphasizing that it applies only to right-angled triangles.

Groups move on to the idea development stage.

Each group shares their ideas with their group mates in the light of the information they obtained in the previous stage.

Groups are often visited and mentored by the teacher.

6.4: Evaluation:

Teacher directly observes student groups working and their presentations in order to a formative evaluation.

Use game links as suggested above to play with students.

Observe students' engagement and participation during the activities.

Assess students' understanding through their ability to correctly apply the Pythagorean theorem to solve problems.

Review and provide feedback on their answers to the guided practice and application questions.

LESSON PLAN 14

- Repetition using cycles

LESSON PLAN 14: Repetition using cycles

Lesson: Technology – Introduction to Programming
Subject: Repetition using cycles
Grade: VET Students (12-15)
Duration: 50 minutes

1. Target Outcomes:
1.1 Cognitive Process Outcomes:
The outcomes of the center discipline:

- To understand the use of programming cycles to implement repetitions
- To explain the difference between a cycle which is used to describe a condition and a cycle which is used to execute a certain set of statements a certain number of times
- To apply cycles in concrete situations

Mathematics**:**

- To use logical conditions in while cycles

1.2. Social Product Outcomes:

- Working in a team,
- Communicating properly,
- Sharing problem and solution-oriented ideas,
- Thinking critically and being innovative,
- Discussing and defending their ideas in an ethical way,
- Presenting the product effectively,
- Understanding the importance of cooperation and collaboration.

2. Materials Used

Arduino UNO Breadboard Cables Programming Language: Java, Python Windows based computer, internet connection, projector.

3. Resources or Bibliography

- https://www.arduino.cc

- Intro to Programming: Loops - YouTube
- Human Resource Machine - Official Trailer #1 - YouTube - Game

4.Learning Methods and Techniques

Problem Based Learning Method,
Argumentation Based Learning Method
Collaborative method
Techniques: Brainstorming, teamwork

5. Groups Considered to be Formed During the Activity

The following features should be considered in the Groups created.
*Groups should consist of 3-5 people chosen by teacher.
*It should be noted that it is a heterogeneous group in terms of level.
*It should be ensured that the gender distribution is equal.

6. Implementation Phase

6.1 Preparation Phase:

Create student groups.
Choose group leaders.
Choose a reporter/speaker.
Write the PBL guide (Problem aims, leading theoretical questions, steps, resources, time, reporting goals)

6.2 Presenting the problem situation to the student:

Theoretical approach of the problem.
Use a PowerPoint presentation to introduce explanation of programming cycles, showing different kind of cycles:

1. Introduce the Concept: Begin by explaining the concept of cycles, emphasizing that many phenomena in nature and technology exhibit cyclical patterns. Examples include the Earth's rotation, the seasons, and the operation of various devices.
2. Arduino Basics: Familiarize students with Arduino, explaining that it is a microcontroller platform used for building interactive projects. Provide an overview of Arduino components, such as the board, input/output pins, and programming environment (IDE).

Present some ARDUINO implementations to understand cycles:

3. Demonstrate LED Blinking: Connect an LED to an Arduino board and demonstrate how to write a simple program to make the LED blink on and off. Emphasize that this blinking behavior represents a basic cycle.

4. Adjusting Blinking Speed: Introduce the concept of cycle frequency by modifying the program to adjust the duration of each LED state (on/off). Students can experiment with different time delays between states, observing how it affects the perceived speed of the LED blinking.
5. Potentiometer Input: Integrate a potentiometer (analog input device) with Arduino. Show students how to read the potentiometer's value using Arduino's analog input pins. Explain that the potentiometer can control the duration of each LED state, allowing them to manually adjust the blinking speed.
6. Mapping Potentiometer Values: Teach students how to use the map() function in Arduino to map the potentiometer's analog values to a desired range. For example, they can map the potentiometer values from 0-1023 to a range of time delays suitable for their project.

6.3 Obtaining Information (Leading Questions)

A general exchange of ideas with the class is made with brainstorming approach.

The guiding questions are given to each group.

It is ensured that they write their research and answers to the questions by using the collaborative method.

6.4 Idea Development

Groups move on to the idea development stage. Each group shares their ideas with their group mates in the light of the information they obtained in the previous stage. In this section, they try to find an answer to the question of what they might need to solve the problem.

Groups are often visited and mentored by the teacher.

6.5 Product Development:

Ask the teams to use Arduino SW to understand cycles (see Annex I with SW examples).

Encourage students to design and build their own projects based on the concept of cycles using Arduino. For instance:

- Motorized Fan: Control the speed of a small DC motor using a potentiometer to simulate the different fan speeds.
- Traffic Light: Create a simulated traffic light system with different durations for green, yellow, and red lights, controlled by a potentiometer.
- Animated Display: Connect multiple LEDs and program them to display various patterns or animations with adjustable timing using a potentiometer.

Supervise and support the teams while they are programming in Arduino SW.

Student groups reporters prepare their presentations.

6.6 Evaluation:

Each group should present the in-class products and at the end students are asked to be evaluated by other groups by explaining differences and discuss between peers and teacher.

Encourage students to document their projects, including circuit diagrams, code explanations, and observations. Have them present their projects to the class, discussing the concept of cycles and how they applied it in their Arduino creations.

By combining theory with hands-on Arduino projects, students can gain a deeper understanding of cycles while developing their programming and electronics skills. Remember to provide guidance and support throughout the process, encouraging creativity and problem-solving.

Annex I – SW examples

Example of programming an Arduino board to create a simple project involving cycles: a color-changing LED.

Components needed:

- Arduino board (e.g., Arduino Uno)
- RGB LED (common cathode)
- Breadboard
- Jumper wires

Code:

```
// Constants for pin assignments
const int redPin = 9;
const int greenPin = 10;
const int bluePin = 11;

// Variables to store RGB values
int redValue = 0;
int greenValue = 0;
int blueValue = 0;

// Variables for cycling through colors
int cycleDelay = 1000; // Delay between color changes in milliseconds
int currentColor = 0; // Current color index

// Arrays to store RGB color values
int colors[][3] = {
  {255, 0, 0},   // Red
  {0, 255, 0},   // Green
  {0, 0, 255}    // Blue
};
int numColors = sizeof(colors) / sizeof(colors[0]);
```

```
void setup() {
  // Set the RGB LED pins as OUTPUT
  pinMode(redPin, OUTPUT);
  pinMode(greenPin, OUTPUT);
  pinMode(bluePin, OUTPUT);
}

void loop() {
  // Set the LED to the current color
  analogWrite(redPin, colors[currentColor][0]);
  analogWrite(greenPin, colors[currentColor][1]);
  analogWrite(bluePin, colors[currentColor][2]);

  // Delay for the specified cycle delay
  delay(cycleDelay);
  // Increment the color index
  currentColor++;
  if (currentColor >= numColors) {
    currentColor = 0;
  }
}
```

Explanation:

1. First, we define the pin assignments for the RGB LED and create variables to store the RGB values.
2. Then, we set the initial values for the RGB pins to 0 (off) and define the cycle delay for color changes.
3. We create a 2D array called "colors" to store the RGB values for different colors (in this case, red, green, and blue).
4. In the **setup()** function, we set the RGB LED pins as OUTPUT.
5. The **loop()** function is where the main logic resides. We use **analogWrite()** to set the intensity of each RGB pin based on the current color in the array.
6. After setting the LED to the current color, we introduce a delay using **delay()** for the specified cycle delay.
7. Finally, we increment the color index, ensuring it wraps back to 0 once it reaches the number of colors in the array.

This program cycles through the defined colors, creating a color-changing effect on the RGB LED. You can modify the array to include additional colors or adjust the cycle delay to change the speed of color transitions.

Remember to upload the code to your Arduino board using the Arduino IDE or compatible software. Connect the RGB LED to the appropriate

pins on the board, and you should see the LED cycling through the defined colors.