CONTENT

3 TOPIC. CREATIVE AND CRITICAL THINKING IN ECOSTEAM EDUCATION

3.1. SUBTOPIC. PROBLEM-SOLVING IN ENVIRONMENTAL CONTEXTS

3.1.1. ACTIVITY PLAN: GREENHOUSE EFFECT MODELING	
Introduction part (or activity overview)	The goal of the activity is to create an organic farm according to a chosen specialization direction, which would be fully self-sufficient and explain in which economic system the farm would operate. Students are divided into groups of 4-5, walking by the sea (in the forest, park, or another natural space), collecting various materials found in nature to create an organic farm and present in which economic system (traditional, command, or market) it will operate, explaining why. Students will delve into the structures and operating principles of different economic systems, such as market, command (planned), or traditional. This will help understand how an organic farm can be integrated with each of them. After creating an organic farm that aims to be completely self-sufficient, it's important to consider how this farm could operate in different economic systems. Each economic system has its advantages and challenges, which could affect such a farm. Students need to consider how this organic farm could operate in market, traditional, and command (planned) economic systems. Each of these economic systems has its peculiarities and can offer different opportunities. The market economy can ensure freedom of choice and profitability, the traditional economy - community support, and the planned economy - government backing and regulation. It's important to properly adapt the organic farm to the chosen economic system and the needs of the local community.
Setting	The activity takes place by the sea, in a park, in a forest, or in another natural space. The educational context - group work.
Materials Needed	Textbook and/or computer and internet (for finding information about economic systems). Materials found in nature.
Learning Outcomes	● Create a model of organic farming that takes into account aspects of economic efficiency and environmental protection. This will allow students to gain practical skills in planning and ● developing an organic farm. ● Examine and evaluate the impact of organic farming on economic systems and the ● environment. This will enable students to critically assess the advantages and challenges of organic farming. ● Analyze the possibilities of applying the created organic farm model in different economic systems and identify potential obstacles or challenges associated with such application. ● Present their created models of organic farming and introduce them. This will help students express thoughts and propose interesting solutions. ● Encourage students not only to create an organic farm but also to look for ways to successfully integrate it into existing economic systems, aiming for sustainability and long-term efficiency.
Activity Contents	Activity 1: Ecology in Economic Systems Theoretical Part (Duration: 45 minutes): Students are introduced to economic systems. The teacher explains, and then students either read about it in economics textbooks, watch videos, or read articles online. Videos: "What is an Economic System?" https://www.youtube.com/watch?v=AHJSSr_wrJY Overview: An educational video about what an economic system is, how they are classified, and what kinds of economic systems exist. Duration: Approximately 3 minutes.

"The Purpose of Mixed Economies" https://www.youtube.com/watch?v=9S85CypctJI
Overview: An educational video explaining that almost all countries on Earth use a mixed economy, which merges aspects of various economic types. It discusses why a mix of free market aspects and some government control is used, the purpose of this approach, why the government should intervene in the economy, and why this model is successful.
Duration: Approximately 6 minutes.

About Traditional Economic System:
In a traditional economic system, agriculture and manual labour are common. Creative thinking might be valued as a way to improve traditional technologies and farming methods, aiming for efficiency and productivity increases. Critical thinking could be directed towards understanding how the traditional economy affects the environment and how new ideas can contribute to the development of a sustainable farm model.
Texts: What is a Traditional Economy? Countries, Characteristics and Examples
https://www.geeksforgeeks.org/traditional-economy-definition-examples-pros-cons/
What Is a Traditional Economy?
https://www.thebalancemoney.com/traditional-economy-definition-examples-pros-cons-3305587

Videos:

What is a Traditional Economy? https://www.youtube.com/watch?v=IQwU7NKf02g

Overview: This video looks at a traditional economy. It analyzes the different advantages and disadvantages of the economy and explains how life is in this economy.

Duration: Approx. 4 minutes

About Market Economic System: In a market economy, individual initiative and competition are crucial. Creative thinking can be used for creating new products and services aimed at meeting environmental and technological standards. Critical thinking could be aimed at evaluating the consequences of the market economy system on the environment, identifying social inequalities, and seeking ways to make the economy more sustainable.

Text: What Is a Market Economy?
https://www.thebalancemoney.com/market-economy-characteristics-examples-pros-cons-3305586

Videos:
What is a Market Economy? https://www.youtube.com/watch?v=DKVEOefidjQ
Overview: This video examines a market economy. It analyzes its advantages and disadvantages and explains how life is in this economy.
Duration: Approx. 6 minutes

What is Capitalism? Capitalism Explained | Pros and Cons of Capitalism? Who is Adam Smith?
https://www.youtube.com/watch?v=uLsAhwJzQoI
Overview: In this video, we're going to look at a simple explanation of Capitalism as well as the pros and cons.
Duration: Approx. 4 minutes

About Command (Planned) Economic System:In a command (planned) economy, collective work and resource distribution are typical. Creative thinking in this system could be used to create an organic farm that integrates environmental protection and science disciplines. Critical thinking could be directed towards analyzing how the command economy affects nature and how various solutions can have social and ecological consequences.

Text: What Is a Command Economy?

https://www.thebalancemoney.com/command-economy-characteristics-pros-cons-and-examples-3305585

Videos:

What is a Command Economy? https://www.youtube.com/watch?v=lIHfNDNRQKs

Overview:This video looks at a command economy. It analyzes the different advantages and disadvantages of the economy and explains how life is in this economy.

Duration: Approx. 4 minutes

Task (Duration: 20 minutes): Students are divided into groups of 4-5 and choose in which economic system their farm will operate, prepare a short presentation (oral) on what ecological aspects will be reflected in the chosen economic system.

Activity 2: Trade in Organic Farming

Students will have to create an organic farm that reflects the chosen economic system and creates an item for sale from materials collected in nature.

Theoretical Part (Duration: 15 minutes):

Students are introduced to the concept of organic farming, its benefits. Organic farming is not just a place where organic food products are grown. It's a living system where nature's balance is respected, biological diversity is nurtured, and sustainable use of resources is encouraged. The essence of organic farming is to avoid using synthetic fertilizers, pesticides, genetically modified organisms (GMOs), and certain veterinary medicines. Instead, it relies on ecologically balanced agricultural principles, such as crop rotation, green manure, compost, and biological pest control.

Benefits of Organic Farms:

Environmental Sustainability. Organic farms contribute to environmental sustainability because they reduce pollution from synthetic chemicals, decrease soil erosion, promote biological diversity, and use less energy.

Health Benefits. Organic products, which do not contain harmful synthetic chemical substances, are often healthier. Some studies suggest that organic food products might be more nutritious than those grown using conventional methods.

Animal Welfare. Organic farming also demands high standards of animal welfare, providing animals with organic feed and keeping them in conditions that match their natural behavior.

Soil Health. Practices in organic farming improve soil health by enhancing soil structure, conserving water, and fostering beneficial soil organisms.

Resilience. Organic farms are often more resilient to environmental factors such as climate change due to their greater biological diversity and healthier, more robust soil.

https://www.vilkijoszum.lt/kas-yra-ekologinis-ukis-sveikesniu-ekosistemu-ir-bendruomeniu-puoselejimas/

Task 1 (Duration: 2 hours): Create an Organic Farm.

Step 1: Students walk in natural spaces and collect various materials, e.g., branches, leaves, pebbles, which they will use to create an organic farm. (1 hour)

Step 2: Group members use the collected materials to create an organic farm that has all the necessary elements for self-sufficient living. (30 minutes)

Step 3: Each group creates and presents their organic farm and explains in which economic

	system it will operate (traditional, command, or market). Students justify their decisions. (30 minutes) **Task 2 (Duration: 45 minutes):** Produce one item within the selected economic system and sell it. The item must serve a purpose. The goal is to generate as much revenue as possible. Resources for manufacturing the item are gathered from nature, so only labor costs are incurred. Each team can set the price for their product themselves. Step 1: Make an item from the collected resources. Think of a name for the product and prepare a presentation/advertisement lasting up to 30 seconds. Step 2: Present/advertise the created product. Team members show the item to all participants, share its name, and explain its purpose and how to use it. The goal is to convince other team members to choose your item. Step 3: Each student "buys" an item from another team. You can't buy your product. Each student writes down which item they are buying (Appendix 1). Step 4: The teacher records the product name, purchases, and everything else in a table (Appendix 2) and announces which team earned the most revenue
Assessments	The final result is assessed with a grade. (Appendix 3. Assessment Table) The assessment is based on several criteria: originality and creativity in creating the organic farm, application of knowledge in the STEAM area, accuracy of information - the ability to explain in which economic system the farm will operate, teamwork and collaboration, use of visual aids in the presentation, quality of the presentation, and revenue earned. After the presentations, students perform an oral reflection.
Key Competences	● Creativity competence ● Cognitive competence ● Communication competence ● Social, emotional and healthy living competencies ● Digital competence ● Cultural competence
Connections with Eco STEAM	Eco - understanding the connections between organic farming and economic systems. Science - knowledge in economics, biology, chemistry, physics, and the arts. Technology- understanding how to improve technologies in different economic systems. Engineering – engineering solutions for farms that produce everything themselves. Art - creating visually appealing models of organic farms. Math- optimizing the operation of economic systems, and calculating revenue. This could involve optimizing production efficiency, resource distribution, or profitability.
References	https://www.youtube.com/watch?v=AHJSSr_wrJY https://www.youtube.com/watch?v=9S85CypctJI https://www.geeksforgeeks.org/traditional-economy-definition-examples-pros-cons/ https://www.thebalancemoney.com/traditional-economy-definition-examples-pros-cons-3305587 https://www.youtube.com/watch?v=IQwU7NKf02g https://www.thebalancemoney.com/market-economy-characteristics-examples-pros-cons-3305586 https://www.youtube.com/watch?v=DKVEOefidjQ https://www.youtube.com/watch?v=uLsAhwJzQoI

	https://www.thebalancemoney.com/command-economy-characteristics-pros-cons-and-examples- 3305585 https://www.youtube.com/watch?v=lIHfNDNRQKs https://agriculture.ec.europa.eu/farming/organic-farming/organics-glance_lt https://www.vilkijoszum.lt/kas-yra-ekologinis-ukis-sveikesniu-ekosistemu-ir-bendruomeniu-puoselejimas/
Notes	-

APPENDIX 1 "PURCHASING" CARD.

"Purchasing" card
I, ..., ,,purchase“ ..... (product name)

APPENDIX 2 PRODUCTS TABLE.

Products table			
Product name (1)	**Product price (2)**	**Quantity purchased (3)**	**Revenue earned (2) × (3)**

APPENDIX 3. EVALUATION TABLE FOR ACTIVITY 2.

Evaluation criteria	Points	Comments
Originality and creativity in creating the organic farm	_/5	
Application of knowledge in the STEAM area	_/5	
Accuracy of information - the ability to explain in which economic system the farm will operate	_/5	
Quality of Presentation	_/5	
Teamwork and Collaboration	_/5	
Use of Visual Aids in Presentation	_/5	
Quality of Presentation	_/5	
Earned revenue	_/5	

3.1.2. ACTIVITY PLAN: GREEN INNOVATION CHALLENGE	
Introduction part (or activity overview)	This activity involves students participating in a Green Innovation Challenge where they design and prototype eco-friendly products or practices. The focus is on assessing the economic impacts of their innovations, including cost-effectiveness, market potential, and sustainability.
Setting	Location: Classroom for planning and prototyping, online resources for research. Educational Context: Collaborative group work.
Materials Needed	Research materials (books, articles, internet access) Prototyping materials (recycled materials, craft supplies, basic tools) Economic analysis tools (spreadsheets, cost-benefit analysis templates) Presentation tools (e.g., PowerPoint, poster boards) Whiteboard and markers
Learning Outcomes	● Develop innovative thinking and prototyping skills. ● Enhance understanding of the economic impacts of eco-friendly products and practices. ● Improve abilities in market analysis, economic assessment, and presentation.
Activity Contents	**Theoretical Part (Duration: 60 minutes)**: Begin with a detailed introduction to green innovation and the economic impacts of eco-friendly products and practices. ● **Introduction to Green Innovation**: o Green innovation refers to the development of new products, services, or processes that reduce environmental impacts, enhance resource efficiency, and contribute to sustainable development. Examples include renewable energy technologies, sustainable agricultural practices, and eco-friendly consumer products. ▪ Discuss the growing importance of green innovation in today's world, driven by increasing environmental awareness, regulatory pressures, and market demand for sustainable solutions. ▪ Explain how green innovation can drive economic growth by creating new markets, reducing costs through efficiency improvements, and enhancing competitiveness. o **Case Studies of Successful Green Innovations**: ▪ Discuss how Tesla's electric cars have revolutionized the automotive industry by offering a sustainable alternative to traditional gasoline-powered vehicles. Highlight the economic benefits, including cost savings on fuel and maintenance, job creation in the green technology sector, and market growth. ▪ Explain the economic impacts of solar energy adoption, such as reduced energy costs for consumers, job creation in the solar installation and manufacturing industries, and long-term environmental benefits that translate into economic savings. ▪ Explore how sustainable farming practices, such as organic farming and permaculture, can increase crop yields, reduce input costs, and enhance soil health, leading to long-term economic and

environmental benefits.

- **Economic Impacts of Green Innovations**:
    - Explain the concept of cost-benefit analysis (CBA) as a tool for evaluating the economic viability of green innovations. Discuss how CBA involves comparing the costs of implementing a green innovation (e.g., initial investment, operational costs) with the expected benefits (e.g., cost savings, revenue generation, environmental improvements).
        - Provide a detailed example of a cost-benefit analysis for a hypothetical green innovation, such as installing solar panels on a commercial building. Outline the steps involved in conducting the analysis, including identifying costs and benefits, quantifying them in monetary terms, and calculating key metrics such as net present value (NPV) and return on investment (ROI).
        - Discuss the market potential of green innovations and their economic benefits. Explain how green innovations can create new business opportunities, attract investment, and generate revenue. Highlight the role of government policies, subsidies, and incentives in supporting the adoption and commercialization of green innovations.

Discussion Prompts:

- What are some examples of green innovations that have had a significant economic impact?
- How can eco-friendly products be made cost-effective and marketable?
- What challenges do innovators face when developing sustainable products

Task 1: Green Innovation Design (Duration: 90 minutes) Objective: To design and prototype eco-friendly products or practices.

Steps:

1. Divide students into groups, each tasked with designing an innovative eco-friendly product or practice.
2. Conduct a brainstorming session to generate ideas for green innovations. Use mind maps or idea boards to visualize concepts.
3. Develop detailed designs and create prototypes using recycled materials and basic tools. Consider factors such as functionality, sustainability, and cost.

Task 2: Economic Analysis and Market Potential (Duration: 120 minutes) Objective: To analyze the economic impacts and market potential of the designed innovations.

Steps:

1. Research the potential market for the designed product or practice, including target audience, competitors, and market trends.
2. Use economic analysis tools (e.g., cost-benefit analysis templates) to assess the innovation's cost-effectiveness, pricing, and potential economic benefits.
3. Develop a market plan that includes pricing strategies, marketing approaches, and distribution channels.

Task 3: Presentation and Feedback (Duration: 60 minutes)
Objective: To present the innovations and receive feedback from peers and instructors.

Steps:

1. Each group creates a presentation that showcases their innovation, economic analysis, and market plan. Use visual aids such as slides, posters, or prototypes.
2. Present the innovations to the class, highlighting key features, economic impacts,

	and market potential. 3. Engage in a Q&A session where peers and instructors provide feedback and ask questions. Discuss potential improvements based on the feedback received
Assessments	Creativity and innovation in the design and prototype. Thoroughness of economic analysis and market potential assessment. Clarity and effectiveness of the presentation. Ability to defend innovations during the Q&A session. Team collaboration and participation.
Key Competences	Creative thinking and innovation Research and market analysis skills Economic assessment and data interpretation Effective communication and presentation skills Teamwork and collaboration
Connections with Eco STEAM	Eco: Designing and assessing eco-friendly products and practices. Science: Applying scientific principles to develop sustainable innovations. Technology: Utilizing digital tools for research and prototyping. Engineering: Creating functional and sustainable prototypes. Arts: Creatively presenting innovations and market plans. Math: Conducting economic assessments and market analysis.
References	https://www.velocityokc.com/blog/member-news/the-economic-benefits-of-implementing-green- practices-in-the-workplace/
Notes	This activity can be extended into a longer-term project, where students further develop and test their prototypes and market plans. Encourage students to engage with local businesses or environmental organizations for real-world insights and feedback.

Evaluation Criteria Table for Green Innovation Challenge

Evaluation Criteria	Points Available	Comments
1. Creativity and Innovation in Design and Prototype	20	Assess the originality and creativity of the designed product or practice.
2. Thoroughness of Economic Analysis and Market Potential Assessment	20	Evaluate the depth and accuracy of the economic analysis and market potential assessment.
3. Clarity and Persuasiveness of the Presentation	20	Rate the clarity, persuasiveness, and engagement level of the presentation given by each group.
4. Ability to Defend Innovations During Q&A Session	20	Assess the quality and relevance of responses during the Q&A session and the ability to defend innovations.
5. Team Collaboration and Participation	20	Evaluate the level of teamwork, communication, and participation among group members throughout the activity.

Total Points: 100	

3.1.3. ACTIVITY PLAN: PLANNING AN ORGANIC FARMING	
Introduction part (or activity overview)	Students, having familiarized themselves with the benefits and principles of organic farming, will plan an organic farm for the selected agricultural sector, which could operate independently, guided by these principles.
Setting	Classroom
Materials Needed	Computers, phones, interactive whiteboard, student activity sheet, colored paper, white sheet of paper, glue, and scissors.
Learning Outcomes	● Improve digital skills in searching for information in various sources and presenting it. ● Deepen knowledge about organic farming and be able to explain it's conserving effect on the environment with reasoned arguments. ● Improve group work skills and the ability to make collective decisions.
Activity Contents	**Activity 1: Organic Farming** **Theoretical part (Duration: 15 minutes):** Introductory conversation. The teacher explains the relevance of the topic, emphasizing that with increasing environmental pollution and the growing number of people's illnesses, there has been a move away from food grown with chemicals. Organic farming is spreading very rapidly in the European Union, and the popularity and demand for organic food are increasing. The discussion covers the negative impact of traditional farming on the environment, highlighting the most important principle of traditional agriculture – to increase yield per unit area. It contributes to climate change, increases soil and water pollution, and negatively affects biodiversity and landscapes. An alternative – organic farming – is discussed. The advantages of organic farming are emphasized: prioritizing natural soil fertility by returning all organic waste to the soil and protecting it from erosion as much as possible; weed and pest control through mechanical means, crop rotation, and biological control measures; preservation of biological diversity and the natural landscape; production of organic food. The discussion also addresses the problems faced by owners of organic farms: higher labour and machinery costs, lower yields, high production expenses, and poorer commercial appearance of products. **Material for Teacher** Principles of Organic Farming: ● Minimal soil tillage (use of light machinery, infrequent use, no-till conservation agriculture). ● Increasing soil fertility without using synthetic mineral fertilizers (natural mineral fertilizers, organic waste, sowing legumes, and mulching). ● Reduction of soil erosion (proper ploughing, avoiding leaving soil bare, planting protective strips of trees and shrubs). ● Weed and pest elimination using natural organic materials and methods (soil aeration, crop rotation, use of living organisms or their extracts, activating natural enemies of pests). ● Ensuring the safety of food products (chemical and biological safety). ● Energy conservation (reducing energy consumption, incorporating sustainable energy sources: solar, hydro energy). **Task (Duration: 45 minutes):** Work individually. Using digital sources, describe the

	principles of organic farming. Fill in the individual activity sheet (Appendix 1). **Activity 2: Planning of an Organic Farm** **Theoretical Part (Duration: 15 minutes):** The activity begins with an introduction to the goals of agriculture and its branches. It is concluded that agriculture is the most important sector of the economy aimed at providing food for people, feed for livestock, and raw materials for the food, textile, perfume, and pharmaceutical industries. The teacher outlines its branches (crop farming, horticulture, gardening, forestry, grass farming, fodder production, floriculture, seed growing, flax cultivation, and viticulture). It is emphasized that when creating an organic farm, it is important to choose a direction of specialization and plan it considering the specifics of the agricultural branch. The structural elements of an organic farm are indicated: ● Farm buildings (for machinery, product storage, and processing) ● Water bodies ● Cultivated crop areas ● Power plants ● Composting facilities ● Green spaces **Task (Duration: 60 minutes): Choose an agricultural branch.** Based on the knowledge acquired, create a sketch of an organic farming enterprise in the chosen branch that could survive independently, using coloured paper cards, the Paint digital program, or an interactive board, and presenting it to the class.
Assessments	Points are given separately for individual activity and group work. Individual activity is evaluated based on the comprehensiveness, reliability, and diversity of information sources (10 points). Group work (10 points) is assessed considering: ● The choice and layout of farm objects, ● The presentation of the work. After the presentation, a reflection is conducted (Appendix 2).
Key Competences	● Cognitive competence ● Creativity competence ● Communication competence ● Social, emotional and healthy living competencies ● Digital competence
Connections with Eco STEAM	Eco – ecological knowledge on ways to reduce the negative impact of agriculture on the environment. Science - link knowledge of chemistry, physics, and biology. Technology - use digital technologies cleverly and creatively. Engineering - design of an ecological farm. Art - develop skills in the art of visualization.
References	● https://www.dotnuvabaltic.lt/booklets/zTjoC5wBrtKaFhEZoJVUeFL3fCUZlTGr201104_BIO_1x1_LT_ Mail.pdf ● https://www.europarl.europa.eu/news/lt/headlines/society/20180404STO00909/ekologinis- ukininkavimas-es-faktai-ir-skaiciai

Notes	It is possible to construct miniature ecological farms using natural materials based on the layouts of ecological farms in coastal or forest areas. It is also possible to create layouts using a 3D printer.

APPENDIX 1. STUDENT'S INDIVIDUAL ACTIVITY SHEET

Principles of Organic Farming	Implementation Methods
Minimal Soil Tillage	
Increasing soil fertility without using synthetic mineral fertilizers	
Reducing soil erosion	
Eliminating weeds and pests using natural organic materials and methods	
Ensuring the safety of food products	
Saving energy	

Information sources:
Assessment (10 points)
……
Teacher's comment……
……
……

APPENDIX 2. SELF-ASSESSMENT

Self-assessment criteria	Points
I am skilled at using digital technologies for information search.	_/5
I am skilled at using digital technologies to present information.	_/5
I am skilled at working in a group (discussing, listening to different opinions).	_/5
I am skilled at generating ideas, proposing solutions.	_/5

3.1.4. ACTIVITY PLAN: ORGANIC FERTILISERS

Introduction part (or activity overview)	Students will conduct experiments to illustrate pollution sources and effects, develop a model for describing the motion of matter among plants, animals, decomposers and the environment. They will collect dried plant material, sand, small stones and will connect with

	food and nutrition chains networks talking about decomposers and their roles in the environment. Their production and use in monitoring test plants, and the application of organic fertilizers in "friendly" agriculture or horticulture, source of potassium, magnesium, phosphorus, vitamins for use organic fertilizers and minimize the negative impact on the environment.
Setting	The activity takes place in a park or in another natural space, classroom to demonstrate the experimental activity. The educational context - group work.
Materials Needed	• Clear compost container • Soil • Rocks • Gravel/pebbles • Sand • Gloves • Safety glasses • Dried plant material • Samples to place in landfills: Styrofoam, apple cores or bread, and small paper plates
Learning Outcomes	● Developing skills and abilities for critical thinking about the negative consequences of any type of waste impact and different types of waste on the environment. ● Design a method for monitoring and minimizing a human impact on the environment. ● Encourage collaboration and consensus-building as students develop a waste reduction plan and to advocate for sustainable practices in their communities. ● Fostering creativity and collaboration skills with a comprehensive understanding of pollution and waste management. ● Examine different types of pollution (air, water, soil, noise) and their sources, effects, and potential solutions. ● Teach about the principles of reduce, reuse, recycle and strategies for waste reduction and proper disposal. ● Conduct experiments or projects to illustrate pollution sources and effects. ● Analyze the possibilities of implementing waste reduction strategies for profitability model.
Activity Contents	**Activity 1: Generation of possible solutions** Introduction discussion: Students synthesize the obtained information in order to generate more possible solutions. **Theoretical Part (Duration: 45 minutes): Waste and its Impact of the Environment** Students review definitions of organic waste, inorganic waste, full-loop life cycle, linear life cycle**,** compost, and decompose**.** **Videos:** https://www.youtube.com/watch?v=XfuJJNGuS0Q (composting with anaerobic process, duration: 6min 37 sec) https://www.youtube.com/watch?v=u8MQwOR2og8 (a variety of ways through which students can reduce waste, reuse household items and recycle materials, duration: 3min) https://www.youtube.com/watch?v=DmFGsxLcT6k (waste generation management - finding opportunities how to remove plastic from food waste compost, duration: 4min 22 sec)

	https://www.youtube.com/watch?v=GwiiWWEQyQQ (removing plastic at small food waste compost facilities, duration: 3 min 04sec) https://www.youtube.com/watch?v=mcsf3Lj7xxo (how to start a fertilizer business, duration: 5min 29 sec) **Task (Duration: 20 minutes): Testing the plants** Students form groups of 4-5, testing the plants and the application of organic fertilizers in "friendly" agriculture or horticulture. **Activity 2: Research and conduct laboratory analysis with the specified chemicals and laboratory equipment.** **Theoretical Part (Duration: 15 minutes): Group discussion about waste reduction strategies** Students discuss the implementation of waste reduction strategies in their school or community. They encourage collaboration and consensus-building as students develop a waste reduction plan, Assign specific roles and responsibilities to each student group (e.g., organizing recycling bins, promoting waste reduction initiatives), and develop a timeline and action plan for implementing the waste reduction plan. **Task 1 (Duration: 2 hours): Create an organic fertilizer** Students create a model of natural fertilizer with materials collected in our homes or in nature. Step 1: Students walk in natural spaces and collect various materials, e.g. dried plant materials, rocks, apple cores or breads, which they will use to create a natural fertilizer (1 hour) Step 2: Group members use the collected materials to create a natural fertilizer with all the necessary elements. (30 minutes) Step 3: Each group creates and presents its benefits for soil fertility and plant growth. Discuss the environmental advantages of using natural fertilizers over synthetic ones, such as reduced chemical runoff and improved soil health (30 minutes) **Task 2 (Duration: 45 minutes): Preparation of laboratory equipment and reagents** Step 1: Prepare a lab station for each group that includes a compost container, organic soil, gravel, sand, dried plant material, a styrofoam cup, an apple core or piece of bread, a small paper plate, safety glasses, and gloves. Step 2: Assemble the composting chambers, each chamber with the same layers and amounts of soil. We recommend 2–3 inches of rocks and/or gravel for a foundation, 3–5 inches of sand to help with drainage, and 4–6 inches of soil with organic materials. If room allows, you can repeat these layers. Avoid direct sunlight and make sure to water the compost pile to keep it moist (not soaking wet). Make sure gloves are worn when investigating if there are odours or signs of pests. Step 3: Control the experiment, all three chambers should be filled with the same materials and layering. The only thing that needs to change isthe sample material. Students use the same amounts of material to fill each chamber. 1-2 ounces of water can also be added to each chamber after all layers in the chambers, to keep the soil moist. Apply a process of observation, partly obtaining appropriate experimental results.
Assessments	The final product will be evaluated through the self-evaluation method.

	The evaluation segments are contained in the evaluation table. All students in the class can be included in the evaluation. After the presentations, students perform an oral reflection.
Key Competences	• Creativity competence • Cognitive competence • Communication competence • Social, emotional and healthy living competence • Digital competence • Cultural competence
Connections with Eco STEAM	Eco - Understanding the connections between organic fertilizer and production Science - Students will be able to develop scientific principles for a method to reduce human pollution of the environment Technology - Implementing Waste Reduction Strategies in production Engineering - Students can design a model for describe the motion of matter Art - Students can draw the charts and show the circular cycle of the food chain Math - Students have mathematical calculations for calculating revenue and profitability
References	https://www.youtube.com/watch?v=XfuJJNGuS0Q https://www.youtube.com/watch?v=u8MQwOR2og8 https://www.youtube.com/watch?v=DmFGsxLcT6k https://www.youtube.com/watch?v=GwiiWWEQyQQ https://www.youtube.com/watch?v=mcsf3Lj7xxo
Notes	• Students should demonstrate carefully, to wear safety glasses when pouring sand or stones in case of waste. • When handling food samples, gloves should be worn during assembly and all samples during cleaning.

APPENDIX 3. EVALUATION TABLE FOR ACTIVITY 2.

Evaluation criteria	Points	Comments
Quality of the organic fertilizer	_/5	
Application of knowledge in the STEAM area	_/5	
Accuracy of information - the ability to explain profitability	_/5	
Skills in presenting	_/5	
Teamwork and Collaboration	_/5	

3.1.5. ACTIVITY PLAN: ECO ELLIPSES: CONSTRUCTING AND APPLYING ELLIPSES TO ENVIRONMENTAL SOLUTIONS

Introduction part (or activity overview)	Students, after learning what an ellipse is and how to independently construct an ellipse using the garden method, will be able to apply their knowledge in designing environmentally. They will solve problems related to the construction and layout of ellipses in real life taking into

	account environmental factors.
Setting	Classroom
Materials Needed	A computer (phone or tablet for interactive applets in GeoGebra), styrofoam, cardboard or drawing paper, video presentation equipment, markers**,** and flip charts are also needed.
Learning Outcomes	● Understanding the definition and properties of the ellipse ● Identifying different methods of ellipse construction ● Understanding and improvement of using computer programs for drawing mathematical objects ● Constructing ellipses with the garden method ● Develop problem-solving skills by tackling real-world challenges related to ellipse layout and environmental considerations
Activity Contents	**ACTIVITY 1 (50 min): Ellipse construction by gardener's method** **Theoretical part 1** (*10 minutes)* ● Through questions, the teacher initiates the students' prior knowledge of an ellipse as a mathematical curve and its application. Students then watch an educational video. Video: **"What is Ellipse?"** https://www.youtube.com/watch?v=nzwCInIMlU4 (duration 5minutes 49 seconds) Overview: An educational video designed to provide basic knowledge and understanding of the ellipse as a mathematical curve and its real-world application *Material for Teacher:* After the students watch the video, the teacher highlights the definition and properties of the ellipse: ● An ellipse is the set of all points in a plane such that the sum of their distances from two fixed points is a constant. Each fixed point is called a focus (plural: foci) of the ellipse. ● Every ellipse has two axes of symmetry. The longer axis is called the major axis, and the shorter axis is called the minor axis. Each endpoint of the major and minor axis is the vertex of the ellipse. The axis is perpendicular at the centre. The foci always lie on the major axis and the sum of the distances from the foci to any point on the ellipse (the constant sum) is greater than the distance between the foci. ***Theoretical part 2 (****5 min)* There are several methods of constructing an ellipse. Students use a simple one - the gardening method, that has applications outside the classroom. They perform the following experiment: On a flat surface at a certain distance, they stick two nails, and tie the ends of a thread to the nails, the length of which is greater than the distance between the nails. If the thread is stretched with a pencil, when the thread is really stretched, the pencil will write a curved closed line called an ellipse. Video: "How to draw a perfect ellipse?" https://www.youtube.com/shorts/nKqfHrYFne8 (duration 10 s) The French mathematician René Descartes (1596-1650), who is considered the founder of analytical geometry, called the mechanically constructed ellipse a "garden construction". *Task 1 (20 min)* The gardening construction of an ellipse can be perfomed in the computer program GeoGebra. The following link will take you to an interactive applet that simulates the

garden construction of the ellipse. Move point C on the applet and watch what you get!

An interactive applet 1 in GeoGebra: https://www.geogebra.org/m/e5dkn33t

The students are given instructions about the exercise, then they independently explore the applet, complete the question sheet and, finally, self-assess:
The students can change the position of some of the points and observe the changes and record them in the individual work sheet **(Appendix 1).** The questions will help students to explore and draw conclusions, as well as to evaluate their own achievements from this exercise.
As seen in the applet, the length of the string is the distance between points A and B, that is, the length b. We can change it by moving the endpoints. Between points A and B, point C is arbitrarily chosen. Points F1, F2 are the nails from the "garden construction". We can change their mutual distance by moving the points, but that distance must be smaller than the length of the thread.
Think and answer the following questions:

1. Where is the centre and what is the radius of the two circles of the applet?
2. How were points F and G obtained?

By moving point C, which is between points A and B, points F and G will describe an ellipse with their traces. If we want to get a permanent trace, we will call the GMT tool (locus), then we will click on one intersection point, then on point C and on the other intersection point, then on point C.
Explore the applet and answer the following questions:

3. What will happen if the distance between points A and B changes?
4. What if the distance between points A and B is less than the distance between points F1 and F2?
5. What if the distance between the foci is 0? (If F1 and F2 match)

Task 2 (15 min)

Students are shown how an ellipse can be constructed with a tool in GeoGebra if we know its foci and one of its points. In doing so, the equation of the ellipse will be written in the algebraic window. In GeoGebra, tangents to an ellipse can be drawn at a given point on the ellipse or drawn from a point that does not belong to the ellipse, and the equations of the tangents will be displayed in the algebra window. The mutual position of a line and an ellipse can be determined, and the coordinates of the intersection points can be determined. (The teacher shows how the drawing tools in the program work, and the students try on their devices). After students learn how to construct ellipses and their tangents with a tool, they can see another interesting way of constructing an ellipse using its tangents, shown in the following applet:

An interactive applet 2 in GeoGebra: https://www.geogebra.org/m/ufqxt28c

Move point A on the applet and watch what you get! (you can also turn on the animation of point A (on right click))

ACTIVITY 2 (45 minutes): Elliptical Elegance: Applications of Ellipses in real life

Theoretical part 1 (10 min)

Material for Teacher : The teacher asks the students to think about where ellipses have applications in real life. Through a conversation, the students guided by the teacher are reminded that : Athletic tracks and tennis courts are mostly in the shape of an ellipse; Elliptical rooms and halls are often included in architecture to create an interesting and functional use of space; Elliptical shapes can be used in the planning of ecological spaces such as parks and gardens, where the shape of the ellipse can be used to maximize space and enhance environmental design; Antennas on satellite systems are often designed with an ellipse shape to allow the signal to be focused in a specific

	region; Focal lenses in cameras and telescopes are often elliptical in shape for better focusing and detailed view of objects; Ellipses are especially important in astronomy; The orbits of the planets around the Sun are elliptical. The following video explains the importance of ellipses for Kepler's first law: Video: **"Kepler's first law of motion – elliptical orbits (Astrnomy)"** https://www.youtube.com/watch?v=qDHnWptz5Jo (duration 3minutes 18 seconds) Overview: An educational video to learn and understand that with his first law of planetary motion, Kepler rejected circular orbits and showed that an ellipse could better explain the observed motions of Mars. Generalized to all planets, it states that the orbit of a planet follows an ellipse with the Sun at one focus. *Task 1 (30 min)* The teacher divides the students into 4 groups and assigns each group a specific real-life application of the ellipses challenge. 1. The first group works on the problem "Elliptical gears in engineering" 2. The second group works on the problem "Elliptical windows in architecture" 3. The third group works on the problem "Solar panels arranged in elliptical patterns" 4. The fourth group works on the problem "Elliptical pools and garden designs" Students work in groups to gather information using internet research or literature from their school library and prepare a presentation on their assigned topic. Students can use environmental materials to create posters or digital tools for presentations. Finally, each group presents its findings to the class. Other students ask questions and engage in discussions about the various applications. *Discussion and reflection (5 min)* ● Students review the definition of an ellipse and highlight its real-world application. ● Students discuss the challenges they faced during the construction and design process. ● The importance of integrating mathematics, environmental science, and art in understanding and designing sustainable solutions is emphasized
Assessments	Verbal feedback during class; Conversation with/among students; Monitoring of students during group work; Evaluation of the thoroughness and accuracy of individual work; Each student self-assesses his contribution to the work; Assessments the presentation of the work;
Key Competences	● Cognitive competence ● Creativity competence ● Communication competence ● Social, emotional and healthy living competencies ● Digital competence ● Citizenship competence ● Cultural competence
Connections with Eco STEAM	**Eco**- By designing solar panels arranged in elliptical patterns and decorating the ellipses using eco-friendly materials, students will learn valuable skills while promoting environmental awareness.

	Science: Students will understand that the orbits of the planets around the Sun are elliptical. Technology: Students will use various digital programs for ellipse construction and simulations of the changes in the parameters of the ellipses Engineering: Using the Wireframe method to draw ellipses and researching elliptical gears can help engineers accurately represent these shapes in their plans and models. Art: Students will design courtyards and gardens with oval shapes Math: Students will learn to define and construct the mathematical ellipse curve
References	• Mathematics textbook for high school education in the Republic of Nort Macedonia • Master's thesis: "Application of the GeoGebra computer package in the study of analytical geometry" Author: Aleksandra Arsovska, UKIM Skopje • https://www.geogebra.org • https://courses.lumenlearning.com/waymakercollegealgebra/chapter/equations-of-ellipses/
Notes	• Students can construct the ellipses in other computer programs or CAD applications. • Projects that students have to work on in a group can be given as homework for a certain period of time, because it takes more time to think and create a quality design plan. They can make the designs on paper or in a computer drawing program, they can even print them on a 3D printer.

APPENDIX 1. STUDENT'S INDIVIDUAL ACTIVITY SHEET

Explore the applet and answer the following questions:

Name and surname:

1. Where is the centre and what is the radius of the two circles of the applet?	
2. How were points F and G obtained?	
3 . What will happen if the distance between points A and B changes?	
4 . What if the distance between points A and B is less than the distance between points F1 and F2?	
5. What if the distance between the foci is 0? (If F1 and F2 match)	

After answering the questions, compare them with the answers given by the teacher and with the help of the questions that follow, evaluate your achievements in this exercise:

How well did you understand how the applet works?	1	2	3	4	5
How much of the applet did you understand what the definition of an ellipse is?	1	2	3	4	5
How well did you understand how the shape of the ellipse changes as the parameters change?	1	2	3	4	5
How satisfied are you with your own engagement in mastering new material?	1	2	3	4	5

Assessment Table for individual work:

Assessment Criteria	Points	Comments
Understanding the definition of the ellipse	_/5	
Understending the propertiesof the ellipse	_/5	
Constructing an ellipse with the garden method	_/10	
Understanding the applications of the ellipse in real life	_/5	
Digital skills at work in the interactive applet	_/5	
Quality of the aesthetic and artistic constructions	_/5	

Assessment Table for group work:

Assessment Criteria	Points	Comments
Internet research skills	_/5	
Dexterity and creativity in the application of ellipses in the project	/5	
Ellipse construction skills	__/5	
Ecological Interpretations in the project	/5	
Teamwork and Collaboration	__/5	
Skills of presenting the work	/5	

3.2. SUBTOPIC. DESIGN THINKING FOR ECO-FRIENDLY SOLUTIONS

3.2.1. ACTIVITY PLAN: DESIGNING AN ECO-SUSTAINABLE HOUSE	
Introduction part (or activity overview)	This session is designed to engage students in the creative process of designing eco-friendly and sustainable houses, considering environmental impact, energy efficiency, and aesthetic appeal.
Setting	The activities will take place in a classroom equipped with a smart board and computers.
Materials Needed	Drawing paper or sketchbooks; pencils, erasers, rulers, and other drawing tools; colored pencils, markers, or crayons; reference materials or examples of sustainable architecture; information about eco-friendly building materials and techniques; poster boards or large paper for final presentations; presentation materials (optional) - images, diagrams or models.
Learning Outcomes	The specific skills, knowledge, or attitudes that participants are expected to develop or acquire through the activities: ● Learning what eco-friendly building materials are, advantages and disadvantages of eco-friendly materials; ● The contribution of usage of eco-friendly building materials for a cleaner environment; ● Developing creativity and artistic skills; ● Developing the ability to perceive and create and design your own 3D shapes; ● Developing spatial reasoning skills; ● Making a sketch of a model and turn it into a paper model; ● Calculating how much such a real object would cost in everyday life; ● Students will gain a sense of belonging and develop design skills that will be necessary in the future in every society to preserve the environment and live a better quality of life; ● Developing critical thinking and the ability to plan. ● Developing leadership skills, group work, self-assessment and self-evaluation, as well as communication and speaking skills. ● Developing a conscience and sense of environmental protection from local to global level
Activity Contents	**Activity1 (Designing an Eco-sustainable house)** **Theoretical part: (40 minutes)** The teacher makes an Introduction of eco-sustainable design. Students explore the concept of Eco-sustainable design and its importance in mitigating environmental impact, also examples of eco-friendly houses or sustainable architecture. Ecologically and sustainable homes must adapt their design and construction based on the possibilities and advantages that the environment offers them. One of the main strategies for building an ecological home is directly related to weather conditions. Students explore eco-friendly building materials, energy-efficient systems, and sustainable design principles. They sketch out rough floor plans and make notes about key design features and sustainability strategies. Students watch short videos:

	Video1: https://www.youtube.com/watch?v=LB5gzj0bmq0 Duration (8min 52 sec) Overview: The video is about a house without water, power and sewer connection. Video2: https://www.youtube.com/watch?v=K5IGqQmc-90 Duration (8min 02 sec) Overview: This video is about ten examples of Eco-sustainable houses Task 1: (45-60 minutes) The teacher gives a task to students to develop an Eco-sustainable house design. Students start developing their designs, focusing on architectural elements, layout, and aesthetic considerations. They incorporate eco-friendly features such as passive solar design, natural ventilation, energy-efficient appliances, green roofs, rainwater harvesting systems, etc. Teacher should provide guidance and feedback as students work on refining their designs and making decisions about materials and technologies. Task 2: (80 minutes) The students are given instructions to prepare presentations. Students prepare their final presentations, using visual aids such as sketches, diagrams, or models to illustrate their design concepts and sustainability strategies. Students explain their design concepts, sustainability features, and architectural elements. Afterwards, they give their own reflection. Then, they host a discussion session were students provide feedback and ask questions about each other's designs, the effectiveness of different sustainability strategies and the overall impact of eco-friendly design – how they can contribute to a more environmentally conscious future. Students clean up their workspaces and organize their materials. Additional Tips: The teacher should emphasied the importance of balance between environmental sustainability, functionality, and aesthetic appeal in architectural design and considered incorporating interdisciplinary elements into the activity, such as discussions about environmental science, sustainable development, or urban planning. The teacher should help students to showcase the final house designs in a gallery or exhibition to celebrate student's creativity and promote awareness of eco-friendly architecture.
Assessments	The teacher evaluates the students' work and achievements through: Verbal feedback during class; conversation with/among students; monitoring of students during individual and group work; observation the individual contribution of each student when working in groups; evaluation of students' presentations; highlighting the most elegant and ideal solution or Eco-sustainable house. Each student independently evaluates his contribution to the work. The final score is evaluated with a grade. It is possible to involve all students in the class in the assessment. After the presentations, students conduct oral reflection.
Key Competences	● Cognitive competence ● Creativity competence ● Communication competence ● Social, emotional and healthy living competences

	• Citizenship competence • Digital competence • Cultural competence
Connections with Eco STEAM	Eco - Save energy by using renewable energy sources in every household Science - Fuels, renewable energy sources and their conversion into other types of energy. Technology - Students will learn how to apply renewable energy sources for the needs of a household Engineering - Students will learn to design their own model of an Eco-sustainable house. Art - Students will learn to make a sketch of a house and turn it into a paper model. Math - Students perform various mathematical calculations to find out the price of a possible real Eco- sustainable house.
References	• M. A. Rosen, "The Future of SustainableDevelopment: Welcome to the EuropeanJournal of Sustainable Development Research," • Eur. J. Sustain. Dev. Res., vol. 1, no. 1, pp. 1–2,2017 • E. Mulliner and V. Maliene, "EnvironmentalEngineering Criteria for Sustainable HousingAffordability," 8th Int. Conf. Environ. Eng., pp.966–973, 2011. • UN Habitat, Sustainable Housing forSustainable Cities, no. October. 2012 • K. Kankaala, M. Vehiläinen, P. Matilainen, and P. Välimäki, "Smart city actions to supportsustainable city development," Techne, vol.SpecialSer, no. 01, pp. 108–114, 2018.
Notes	• The design activity should be adaptable to different local ecosystems and climatic conditions. • Architectural trends in different countries are different. • Encourage students to reflect on their role in sustainable building.

Assessment Table for Web Quest Reports:

Assessment Criteria	Points	Comments
Depth of Research	_/5	
Understanding of Eco-stainable materials role	_/5	
Accuracy of Information	_/5	
Quality of Presentation	_/5	
Use of Visuals	_/5	

Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Comprehensiveness of Findings	_/5	
Clarity in Presentation of Data	_/5	
Understanding of Ecological Interpretations and Insights	_/5	
Teamwork and Collaboration	_/5	

Use of Visual Aids in Presentation	_/5	

3.2.2. ACTIVITY PLAN: ECO SOAP - LIMONENE SOAP	
Introduction part (or activity overview)	Students will collect waste from oranges, isolate a lemon substance from the peel of oranges, which they will use to obtain soap with a characteristic smell and aroma, learn soap-making procedures, develop creative and critical thinking, design eco-friendly solutions. This activity will contribute to raising environmental awareness by using organic waste that can lead to pollution of nature if not used properly.
Setting	A chemical cabinet with appropriate equipment for conducting physical - chemical processes or a classroom with the necessary equipment and materials. Educational context: teamwork and learning.
Materials Needed	Fat (5 grams), 6 cm^3 sodium hydroxide solution (NaOH), 6 cm^3 96% alcohol – ethanol, table salt (NaCl), oranges, beakers, laboratory beaker, Erlenmeyer flask, cork, bent tube, glass rod, teaspoon, alcohol lamp or Bunzen burner, asbestos netting, tripod, funnel, filter paper, watch glass, red and blue litmus paper, computer or telephone. Precautions: Be careful with sodium hydroxide!
Learning Outcomes	● Develop skills for experimental work; ● Collaborate and develop skills for creative and critical thinking about all polluters of eco systems; ● Learn to prepare materials needed to make soap, calculate the profitability of the production itself; ● Draw conclusions based on experimental results; ● Create thinking about eco friendly solutions;
Activity Contents	**Activity 1: Preparation of the necessary equipment and substances for experimentation** **Theoretical part (Duration: 15 minutes):** Discussion of organic waste and ways to reduce it, consideration of the concept of production, costs and formation of the price of the obtained product https://www.youtube.com/watch?v=FqVNU9eN9DU Discussion around creative ideas for reducing waste and solutions for environmental protection, raising environmental awareness to a higher level, and producing ecological products. **Task 1 (Duration: 10 minutes): Students** observe and collect data on the phenomena and processes that surround us and which they will apply during production, according to the conditions. All team members participate with individual ideas and thoughts. They discuss and think about ecological content and solutions for environmental preservation. **Task 2 (Duration: 20 minutes):** Students research the properties of the substances they will use in experiments on the Internet, consider the necessary equipment, and watch videos that explain the process of obtaining soap. **Videos:** https://www.youtube.com/watch?v=VmQV3Qs9Qzk https://www.youtube.com/watch?v=Tu_sWoHULtY Overview: Videos show the necessary laboratory equipment and chemicals, describe the method of obtaining soap. Duration: Approx. 10 minutes

	https://www.youtube.com/watch?v=KtPbwXolNag Overview: The video will help to demonstrate the saponification reaction, in the reaction of higher fatty acids with a strong base. Duration: Approx. 3min 07sec **Task 3 (Duration: several days):** Collection of orange waste and other materials. The students collect oranges from shops, which instead of being thrown away will be used to flavor the soap, with procedures of crushing, crushing and filtering the peel and isolating the limonene substance. Students set up the laboratory equipment and reagents needed for the experimentation process. **Activity 2: A laboratory procedure based on a chemical reaction and obtaining a final product.** **Task 1 (Duration: 1 hour):** Step 1: Soap making. Put 5 grams of fat, 6 cm^3 96% alcohol and 6 cm^3 20% sodium hydroxide solution into erlenmayer. The Erlenmayer is well shaken, closed with a cork through which a bent glass tube passes, and is dumped into a glass of hot water (15 min). Step 2: Heat for about 20 minutes. Step 3: Add some of the liquid to an Erlenmeyer flask filled with slightly boiling water. If no fat droplets appear, the reaction is complete (5 min). Step 4: The mixture from the first Erlenmeyer flask is poured into a laboratory beaker with a saturated salt solution and stirred. After filtering with filter paper, the soap is separated, and the glycerol and other soluble ingredients remain in the solution (10 min.). Step 5: Calculate the yield of the soap (10 min.). The efficiency of soap production can be assessed by comparing the actual yield to the theoretical yield based on the fat or oil used. High yield indicates efficient conversion. Quality is evaluated through tests like pH measurement, residual base, and lather properties. High-quality soap has near-neutral pH and good foam. **Task 2 (Duration: 30 minutes):** Final Work. Reflection. Students prepare audio-visual material from the laboratory procedures and present the final product, explain the profitability of the process and its environmental significance.
Assessments	The final product will be evaluated through the self-evaluation method. The evaluation segments are contained in the evaluation table, which includes: Proper handling of laboratory equipment and reagents, the quality of the resulting product – soap, skills in presenting eco-friendly solutions and presenting conclusions, and description. All students in the class can be included in the evaluation.
Key Competences	• Cognitive competence • Creativity competence • Socual, emotional and healthy competence • Comunication competence • Digital competence • Citizenship competence • Cultural competence
Connections with Eco STEAM	**Eco** – Application of organic materials and reduction of organic waste Science - Implementation of chemical processes in production Technology - Using a computer during research and cameras during recording of audio-visual material Engineering - Methods and procedures applicable in production

	Art - Creating interesting shapes and forms of soap in molds Math - Calculating the cost and price of the resulting product - soap
References	https://www.youtube.com/watch?v=FqVNU9eN9DU https://www.youtube.com/watch?v=VmQV3Qs9Qzk https://www.youtube.com/watch?v=Tu_sWoHULtY https://www.youtube.com/watch?v=KtPbwXolNag
Notes	• Cavitch, Susan Miller. The Natural Soap Book. Storey Publishing, 1994. • P. 632, chapter 11, Anionic and Related Lime Soap Dispersants, Raymond G. Bistline, Jr. in Anionic surfactants: organic chemistry, Helmut Stache, ed. Volume 56 of Surfactant science series, CRC Press, 1996, ISBN 0-8247-9394-3. **The final product-sopa made in our school the soap production project in our school** **Chemistry cabinet**

Picture 1 Picture 2

Picture 3

Evaluation Table

Evaluation Criteria	Points	Comments
Proper handling of laboratory equipment and reagents	_/5	
The quality of the resulting product - soap	_/5	
Skills in presenting eco-friendly solutions and presenting conclusions	_/5	
Expressing a critical opinion about environmental pollutants	_/5	
Description		

3.2.3. ACTIVITY PLAN: LETS MAKE IT ECO-FRIENDLY

Introduction part (or activity overview)	This activity involves students using design thinking to develop an eco-friendly solution to a common environmental challenge. The focus is on creative and critical thinking, encouraging students to generate innovative ideas and practical solutions through a structured process.
Setting	Location: Classroom for discussion and brainstorming, online resources for research.

	Educational Context: Individual or small group activity.
Materials Needed	Research materials (books, articles, internet access) Design thinking tools (whiteboard, markers, sticky notes) Prototyping materials (optional: craft supplies, recycled materials) Presentation tools (e.g., PowerPoint, poster boards)
Learning Outcomes	● Develop skills in design thinking and creative problem-solving. ● Enhance understanding of the role of creativity in addressing environmental issues. ● Improve abilities in brainstorming, idea generation, and presenting solutions.
Activity Contents	Theoretical Part (Duration: 30 minutes): Provide a detailed introduction to design thinking and its application in creating eco-friendly solutions. ● Introduction to Design Thinking: Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate people's needs, technology's possibilities, and business success requirements. It involves empathizing with users, defining problems, ideating solutions, prototyping, and testing. Designing a reusable shopping bag. By understanding shoppers' needs and the environmental impact of plastic bags, students can create innovative reusable bags that are both functional and eco-friendly. o Stages of Design Thinking: ▪ Understand the users' needs and challenges. For example, interview people to learn about their shopping habits and the difficulties they face with existing reusable bags. ▪ Clearly articulate the problem you want to solve. For instance, "Create a durable, convenient, and eco-friendly reusable shopping bag." ▪ Generate a wide range of ideas and potential solutions. Encourage creativity and think outside the box. For example, brainstorm different materials, designs, and features for the bag. ▪ Develop a simple, tangible representation of one or more of your ideas. This could be a sketch, model, or digital prototype of the bag. ▪ Share your prototype with others to get feedback and refine your solution. For example, have people use the prototype bag and provide feedback on its design and functionality. o Key Principles of Design Thinking: ▪ Focus on the needs and experiences of the users. ▪ Work with others to gain diverse perspectives and ideas. ▪ Create prototypes and test them to learn and improve. ▪ Continuously refine and improve your solution based on feedback. ● Video Resources: o "Introduction to Design Thinking" https://www.youtube.com/watch?v=gHGN6hs2gZY Discussion Prompts: ● How can design thinking be used to solve environmental problems? ● What are the benefits of using a user-centered approach in designing eco-friendly solutions? ● How can feedback and iteration improve the quality of your solution? Task 1: Empathize and Define (Duration: 45 minutes).

	Steps: 1. Conduct interviews or surveys to gather insights about users' needs and experiences related to the chosen environmental challenge (e.g., plastic waste, energy consumption). 2. Analyze the data collected and clearly define the problem. Create a problem statement that reflects the users' needs and the environmental impact. Task 2: Ideate (Duration: 45 minutes) Steps: 1. Conduct a brainstorming session to generate as many ideas as possible. Use techniques like mind mapping or SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Rearrange) to stimulate creativity. 2. Evaluate and select the most promising ideas based on criteria such as feasibility, impact, and user feedback. Task 3: Prototype and Test (Duration: 60 minutes) Steps: 1. Create simple prototypes of the selected ideas. Prototypes can be sketches, models, or digital representations. 2. Share the prototypes with peers or potential users to gather feedback. Use the feedback to refine and improve the solutions. Task 4: Presentation (Duration: 30 minutes) Steps: 1. Create a presentation that showcases the problem, the design thinking process, the prototypes, and the final solution. 2. Present the solution to the class, highlighting the key insights and the impact of the solution. 3. Engage in a Q&A session where peers and instructors provide feedback and ask questions.
Assessments	Effectiveness of applying design thinking to solve the environmental problem. Creativity and innovation of the developed solution. Clarity and persuasiveness of the presentation. Ability to incorporate feedback and improve the solution. Individual or team participation and collaboration.
Key Competences	Design thinking and creative problem-solving skills Empathy and user-centered design Research and data analysis Prototyping and testing Effective communication and presentation skills
Connections with Eco STEAM	Eco: Developing eco-friendly solutions through design thinking. Science: Applying scientific principles to understand the environmental impact. Technology: Utilizing design tools and techniques. Engineering: Creating and refining prototypes. Arts: Creatively presenting solutions. Math: Analyzing data and evaluating solutions.
References	https://www.interaction-design.org/literature/topics/design-thinking#:~:text=Design%20thinking%20is%20a%20non,%2C%20Ideate%2C%20Prototype%20and%20T est.
Notes	Encourage students to think creatively and consider unconventional ideas. Provide support and guidance throughout the design thinking process. Use the feedback to continuously improve the activity.

Evaluation Criteria Table for Using Design Thinking for an Eco-Friendly Solution

Evaluation Criteria	Points Available	Comments

1. Effectiveness of Applying Design Thinking	20	Assess how well the student applied the design thinking process to develop the solution.
2. Creativity and Innovation of the Developed Solution	20	Evaluate the creativity and innovation demonstrated in the developed solution.
3. Clarity and Persuasiveness of the Presentation	20	Rate the clarity, persuasiveness, and engagement level of the presentation given by the student.
4. Ability to Incorporate Feedback and Improve Solution	20	Assess the student's ability to incorporate feedback and improve the solution.
5. Individual or Team Participation and Collaboration	20	Evaluate the level of individual or team participation and collaboration throughout the activity.

Total Points: 100

Interview Guide for Insights on Environmental Challenges
Objective: To explore user needs and experiences related to plastic waste.

Introduction

1. Introduce yourself and the purpose of the interview.
2. Provide a brief explanation of the environmental challenge (plastic waste).
3. Assure confidentiality and explain that responses will only be used for educational purposes.
4. Obtain consent to record the interview (if applicable).

General Background

5. Can you tell me a little about yourself? *(e.g., age, occupation, hobbies)*
6. How aware are you of the environmental issues related to plastic waste? *(e.g., very aware, somewhat aware, not aware)*
7. How important do you think it is to address the issue of plastic waste? *(e.g., very important, somewhat important, not important)*

Current Practices and Experiences

8. How often do you use plastic products in your daily life? *(e.g., daily, weekly, occasionally)*
9. What types of plastic products do you use most frequently? *(e.g., plastic bags, bottles, packaging)*
10. Have you ever tried to reduce your use of plastic? If so, how? *(e.g., using reusable bags, avoiding single-use plastics)*
11. What challenges have you faced in reducing your plastic use? *(e.g., convenience, availability of alternatives, cost)*
12. Have you participated in any initiatives or programs to reduce plastic waste? If so, what were they? *(e.g., recycling programs, community clean-ups)*

User Needs and Preferences

13. What features would you like to see in alternatives to single-use plastic products? *(e.g.,*

durability, affordability, convenience)

14. What would motivate you to switch to eco-friendly alternatives to plastic? *(e.g., incentives, awareness campaigns, availability of products)*
15. How do you think businesses and governments can support individuals in reducing plastic waste? *(e.g., policies, providing alternatives, education)*
16. What role do you think technology can play in addressing plastic waste issues? *(e.g., developing new materials, improving recycling processes)*

Closing Questions

17. Is there anything else you would like to share about your experiences or views on plastic waste?
18. Would you be interested in participating in future discussions or projects related to environmental sustainability?

3.2.4. ACTIVITY PLAN: SUSTAINABLE FURNITURE	
Introduction part (or activity overview)	During the manufacturing process of a piece of furniture, we must take into account the maximum respect for the environment and the lowest possible environmental impact: in this way, we contribute significantly to the care of our planet. Whether a piece of furniture is sustainable or not depends on its life cycle, its duration and the subsequent management of its waste, as well as the materials it is made of. The main difference between an ecological furniture and a conventional one is that during the manufacture of the ecological furniture the circular economy model is taken into account. The circular economy is based on the use of resources, trying to reduce the use of raw materials as much as possible, as well as the generation of waste. Therefore, the aim is to reuse and recycle the materials of a piece of furniture as much as possible so that, at the end of its useful life, the materials can continue to be used for the manufacture of other furniture.
Setting	Classroom with computers, mechanical tools and equipment for making the tables and the chairs.
Materials Needed	Computer (phone or tablet can be used to collect information), projector (to present works), old tires and recycling materials which can be reused, tools, paint and laurel.
Learning Outcomes	What is expected from the activities is: ● Students gain a deeper understanding of different eco-friendly materials; ● Students develop critical thinking and working skills; ● Students learn to search, investigate and calculate for the amount of materials needed for this project; ● Students develop creativity; ● Students acquire interdisciplinary knowledge; ● Students increase the ecological awarenes; ● An incentive for a new business idea with sustainable furniture; ● Students will gain a sense of sustainability in the community;
Activity Contents	**Activity: Sustainable furniture** **Theoretical Part (Duration: 20 minutes)**: Introduction discussion: What is sustainable furniture? What type of furniture is most sustainable? How to make sustainable furniture? How do you know if furniture is sustainable?

	Information about the principles for sustainable furniture on the link: https://www.satinandslateinteriors.com/4-key-principles-of-sustainable-furniture-and-interior-design/ **Task 1 (Duration: 30 minutes)** Research on eco-friendly materials for tables and chairs Schoolchildren, working in groups, will have to make sustainable furniture for the hall of the school or the school yard. (If the furniture is made for the school's yard the students will have to take in account all the weather condition through the year): ● Each group must examine one type of materials used for the furniture (e.g. wood, vegetable fibers, animal fibers, natural fabrics etc.). ● Each student in the group has an assigned role (e.g., group leader and supervisor, data collector, data analyst, environmental impact predictor, speaker and presenter, everyone works on the product etc.). For the choice of eco-friendly materials https://ecobnb.com/blog/2023/11/eco-sustainable-materials-furniture/ **Task 2 (Duration: 60 minutes)** Design of the furniture using old tires - Students start developing their designs, focusing on important elements for the furniture, layout, and aesthetic considerations and its stability. For software design: https://www.smartdraw.com/ https://www.coreldraw.com/ https://www.adobe.com/products/photoshop **Task 3. Presentation, discussion, creation of the furniture and cleanup (60 minutes):** - Students prepare their final presentations, using visual aids such as sketches, diagrams, or models to illustrate their design of comfortable chair and table. - Students explain their sustainable concepts and designing techniques. Afterwards, they give their own reflection. Then, they host a discussion session for students to provide feedback and ask questions about each other's designs, the effectiveness of different sustainability strategies and the overall impact of eco-friendly design. - Students clean up their workspaces and to store the materials for the next production. **Additional Tips** Questions that will help students with their research: 1. Evaluate the area of the tables and the chairs, and the field necessary for their placement. 2. Calculate the cost for paint and laurel. 3. Analyze the impact on the environment. 4. Evaluate the design and components of the system. 5. Conclusion about the final product and determining the risks of the work. 6. Prepare presentations (posters) and present them to classmates.
Assessments	The teacher evaluates the student's work and achievements through: ● Verbal feedback during class; ● Conversation with/among students; ● Monitoring of students during individual and group work; ● Observationof the individual contribution of each student when working in groups; ● Evaluation of students' presentations; ● Highlighting the most elegant and ideal solution; Each student independently evaluates his contribution to the work.

	The final score is evaluated with a grade. It is possible to involve all students in the class in the assessment. After the presentations, students can make a competition about best-made furniture with online voting and questionnaires.
Key Competences	• Cognitive competence • Cultural competence
Connections with Eco STEAM	**Eco** - The choice of environmentally friendly and sustainable materials for furniture. Science: Knowledge of physics, chemistry and environmental sciences. Technology: Through innovation, creativity and change, to ensure the safety, comfort, health and safety of the students by using this furniture. Engineering: Students will learn to design their own model of an Eco-sustainable house. Art: Visually interesting and comfortable furniture for everyone. Math: Calculation of the amount of materials, assessment of cost-effectiveness, mathematical models and formulas about area.
References	Bumgardner S. M., Nicholls L. D. 2020. 11(12), 1277 Sustainable practices in furniture design: A literature study on customization, biomimicry, competitiveness, and product communication.
Notes	It is very important to leave this activity to the student's imagination and creativity. Also, regarding the materials used in the activity, it is left up to the students. Cultural differences and specifications in different European countries can only lead to different products to this activity

Assessment Table for Web Quest Reports:

Assessment Criteria	Points	Comments
Depth of Research	_/5	
Understanding of Eco-stainable materials role	_/5	
Accuracy of Information	_/5	
Quality of Presentation	_/5	
Use of Visuals	_/5	

Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Comprehensiveness of Findings	_/5	
Clarity in Presentation of Data	_/5	
Understanding of Ecological Interpretations and Insights	_/5	
Teamwork and Collaboration	_/5	
Use of Visual Aids in Presentation	_/5	

3.2.5. ACTIVITY PLAN: MAKING ECO FERTILISERS & TESTING PLANTS	
Introduction part (or activity overview)	In this subtopic, we will discuss a project related to ecological fertilizers, their production, and use in monitoring the tested plants. We will also discuss the application of eco-friendly fertilizers in "friendly" agriculture or gardening. The goal of this project, guided by critical thinking, is to create an effective and innovative system that would allow the conscious and efficient use of ecological fertilizers, reducing the negative impact on the environment.
Setting	A classroom equipped with a projector and computers. Chemistry classroom - a laboratory with the necessary equipment. This is a long-term project-based - teamwork carried out by groups of 3-4 students.
Materials Needed	**Materials:** Prepared ecological fertilizers made from ashes, coffee grounds, yeast, banana peels (their preparation is described in the activity content), test plants can be; garden cress (Lepidium sativum L.), spinach (Spinacia oleracea), and others, distilled water or clean tap water (the pH of the water should be 6.0–7.5). **Tools:** Petri dishes or shallow disposable packaging containers 1.5-2 cm in height, filter paper (Paper towels are also suitable), a millimeter ruler, tweezers or a stick for arranging seeds in Petri dishes, and a special marker for labeling Petri dishes.
Learning Outcomes	● Critically evaluate information about ecological fertilizers, analyze various sources, and make reasoned decisions regarding their use. ● Expand understanding of the importance of ecological fertilizers for plant growth and development, their impact on the environment, and human health. ● Enhance practical skills in how to properly use ecological fertilizers for plant nourishment. ● Encourage interest in sustainable development principles and contribute to environmental protection.
Activity Contents	**Information for the Teacher** Plants require three main components for growth: nitrogen, phosphorus, and potassium. Nitrogen is needed for leaf growth, phosphorus is necessary for the development of flowers and fruits, and potassium is responsible for overall plant health. Besides these primary elements, plants also need many other substances, known as micronutrients, such as magnesium, calcium, and sulfur. There's no need to buy fertilizers – you can produce all the nutrients needed for every stage of your garden plants' life cycle at home. This can significantly reduce the costs of garden maintenance and help you grow organically clean products. Vegetable growers and gardeners identify several of the most effective biological additives that increase fertility, such as organic fertilizers like compost, manure, chicken manure, liquid fertilizers from weeds, fertilizers from yeast, growing green manures, fertilizers from ashes, coffee grounds, and banana peels. You can experiment with these fertilizers, changing the composition, proportions, and fertilization timing. **Activity 1: Observation and fertilization of a control plant with ash fertilizers.** **Theoretical Part (Duration: 10 min.):** Introductory talk. It is discussed that ashes are left

from the burning of plant residues. They contain 74 elements from the periodic table of chemical elements, i.e., more than half of all the elements in the Earth's crust. Due to their composition, ashes are an excellent alternative to mineral fertilizers. There's just one downside – ashes completely lack nitrogen, which is quite necessary for plants in spring and early summer. Phosphorus from ash fertilizers is better absorbed than from chemical fertilizer - superphosphate.

Furthermore, ash fertilizers help solve the disposal issue of hard household waste generated in a homestead or home garden.

Task (duration 35 min., plant observation for 1-15 days):
Step 1: Students are divided into groups
of 3-4. Step 2: Make fertilizers from ashes:

Dry ashes can be added directly to the soil while digging it over.
Create a solution by dissolving 10-15 g of ashes in 1 L of distilled water.
Step 3: Students read the work description (Appendix 1) and conduct the experiment. Step 4: Observe, analyze, and record the results.

Activity 2: Observation and fertilization of a control plant with yeast fertilizers.
Theoretical Part (Duration: 10 min.):
Introductory talk. Yeast is a well-known product to all. We constantly consume it with food, eating bread, various baked goods, and many other food products, drinking kvass. Its biomass primarily consists of fungi rich in proteins and other beneficial substances such as organic iron, amino acids, various micro and macro elements. Yeast also contains B vitamins, calcium, iron, magnesium, manganese, phosphorus, zinc, etc

How do yeast work as fertilizer? Since yeast contains fungi, they productively alter the soil composition. They activate the activity of microorganisms, creating a favorable environment, which accelerates the process of organic matter decomposition and releases nitrogen and potassium into the soil.

Task (duration 35 min., plant observation 1-15 days):

Step 1: Students are divided into groups of 3-4. Step 2: Make fertilizers from yeast:
Yeast infusion can be made from stale bread, breadcrumbs, or other flour products containing microbial decomposition products.
Various types of yeast can be used: both wet yeast sold in blocks and dry yeast. Dissolve 20 g of fresh yeast in 1 L of water, or 1 g of dry yeast in 1 L of water, let it sit for 2-3 hours, and water the plants. Step 3: Students read the work description (Appendix 1) and perform the experiment.
Step 4: Observe, analyze, and record the results.

Activity 3: Observation and fertilization of a control plant with coffee grounds.

Theoretical Part (Duration 10 min.): Introductory talk. It's discussed that useful substances in ground coffee help plants stay healthy. Such fertilizer improves soil composition and even helps repel pests like snails, slugs, and insects. Natural coffee grounds are an excellent fertilizer for both outdoor and indoor plants. Coffee enriches the soil with nitrogen, phosphorus, minerals, and potassium (elements that plants often lack), making it lighter. Such fertilizer is very suitable for plants that prefer acidic soil.
Task (duration 35 min., plant observation 1-15 days):

	Step 1: Students are divided into groups of 3-4. Step 2: Make fertilizers from coffee grounds: First, dry them out; Mix the coffee grounds with soil at a ratio of 1:4, then pour the mixture into the soil near the plant stems. Step 3: Students read the work description (Appendix 1) and perform the experiment. Step 4: Observe, analyze, and record the results. **Activity 4: Observation and fertilization of a control plant with banana peel fertilizers.** **Theoretical Part (Duration 10 min.): Introductory talk.** It's discussed that banana peels contain plenty of nutrients, starting with potassium and magnesium, ending with sodium and phosphorus. Plants respond very well to such fertilization because there are practically no allergic reactions to bananas. **Task (duration 35 min., plant observation 1-15 days):** Step 1: Students are divided into groups of 3-4. Step 2: Make fertilizers from banana peels: Soak banana peel in 200 mL of water and leave it for a day. The next day, you'll have fertilizer. Discard the peel, and mix the liquid with 1 L of water. Use this liquid to water plants. You can also use the banana pulp. Mash it with a fork, pour 100 mL of room temperature water. Before watering, dilute the obtained solution with 1 L of water. For preparing fertilizers, you can use dried banana peels. Banana peels can be dried in the oven or simply in the sun. After drying, grind them into powder and pour boiling water over them. Keep the solution in a dark place for two days. Step 3: Students read the work description (Appendix 1) and perform the experiment. Step 4: Observe, analyze, and record the results.
Assessments	Each student evaluates their work according to the provided Appendix No. 2. Each group presents the results of their work, assesses successes and failures, their contribution to the group work, and conducts an oral reflection. The final result is graded. All students in the class are included in the evaluation.
Key Competences	• Cognitive competence • Creativity competence • Communication competence • Social, emotional and healthy living competences • Citizenship competence • Digital competence • Cultural competence
Connections with Eco STEAM	Eco - choosing eco-friendly and biodegradable fertilizers. Science - knowledge in biology, chemistry, economics, and environmental sciences. Technology - the use of biodegradable fertilizers. Engineering – the production of organic fertilizers from household waste is one of the innovative engineering solutions aimed at reducing waste quantity while simultaneously benefiting agriculture. Art - familiarization with nature and its cycles, which can be utilized in the production of eco-friendly fertilizers. Math - application of mathematical calculations.
References	https://www.delfi.lt/agro/sodinu-auginu/pelenai-puiki-trasa-taciau-viena-klaida-gali-pridaryti-daug- zalos-89607355 https://www.delfi.lt/gyvenimas/namai/7-trasos-darzui-kurias-gali-pasigaminti-pats-taip-aisku-dar- nebuvo-84822701

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Notes	

APPENDIX 1. WORK DESCRIPTION

Work description	
1.	Garden cress (Lepidium sativum) seeds or seeds of another test plant. The experiments use healthy, clean, dry, untreated seeds.
2.	An equal number of seeds are placed in Petri dishes or disposable packaging containers. It's important that the seeds are not too close to each other, i.e., there should be enough space for each seed to germinate and grow.
3.	Substrate: filter paper (paper towels are also suitable). The paper must be dry, clean, not contaminated with chemicals, porous, and able to absorb water well enough to provide moisture for the seeds to germinate and the seedlings to grow.
4.	Initially, while the seeds are germinating, the substrate is watered with distilled water. If it's not available, clean tap water can be used (the pH of the water should be 6.0–7.5).
5.	After 7 days, when the seeds have germinated, the substrate is watered with the chosen ecological fertilizer. Organic fertilizers need to be prepared a few days in advance.
6.	The control container is moistened only with distilled water.
7.	We observe the germination and growth of the test plant for about 1-15 days.
8.	Based on the selected data and time, we fill in the table. Appendix No.2
9.	Summarize and present the results.

Appendix 2. Indicators of germination and seedling growth of the test plant on days 12-14 when fertilized with different ecological fertilizers (filled out by each group separately)

	Watering of the test plant with selected fertilizer	Seed germination, %	Average stem height, mm	Average root length, mm	Average total shoot height, mm	Relative shoot height, %	Observations
Control 1	+						
Control 2	+						
Control 3	+						
Control 4	+						

Control 5	Watered only with distilled water						

Appendix 3. Evaluation/Self-Assessment

Skills in performing theoretical and practical questions	I know very well, excellently	I know well	I know satisfactorily	What I didn't understand/could not do and what I would need to learn more about
1. Formulate the research work hypothesis, objectives, and tasks				
2. Create a plan for the research work				
3. Independently conduct the research work				
4. Calculate the amount of fertilizer needed for fertilization				
5. Independently describe the experiments				
6. Process the obtained results				
7. Formulate conclusions and present the work				

3.3. SUBTOPIC. ENVIRONMENTAL ART AND EXPRESSION

3.3.1. ACTIVITY PLAN: ECO-FRIENDLY MATH FORMULAS AND MODELS

Introduction part (or activity overview)	The focus of the activity is on very important mathematical properties: symmetry in mathematics in any aspect, formulas, 2D or 3D models. The main objective is to inspire students to reuse materials or to use eco-friendly building materials into inventive and productive works and models. The idea is not only to provoke the students to be more original in exploring symmetry and creating a model that will have an impact on others, but also to leave something behind that the next generations could develop furthermore. By following this activity plan, you can qualify your students to search for eco-friendly materials, how to reuse the ones they have at the moment and to make advantageous changes to the environment.
Setting	Classroom equipped with digital equipment (computers, laptops, tablets or smart phones)
Materials Needed	• Various recyclable or reusable materials or eco-friendly materials. • Supplies like scissors, glue, tape, paint, markers, etc. • Tools for upcycling (e.g., utility knives, hole punchers, hot glue guns, etc.) • Workspaces (inside or outside).
Learning Outcomes	• Develop deep understanding about the need to recycle certain materials.

	● Improve knowledge about the possible use of various recycling materials. ● Enhance skills in digital research and data analysis. ● Improve creativity and develop awareness about the many possibilities for recycling.
Activity Contents	**Activity: Eco-friendly math formulas and models** **Theoretical part:** (Duration: 15 minutes) - Teachers provide examples of some of the mentioned formulas in the students' educational process like $(A \pm B)^2 = A^2 \pm 2AB + B^2$ or more complex binomial formula, palindromic numbers or palindromic sequence in biology, congruence properties, symmetrical functions, symmetrical surfaces, axes and points of symmetry in geometry etc. **Activity Steps** (Duration: 1-3 hours per session, depending on the difficulty and entanglement of projects, and students can finish it in several classes). **Task 1. Introduction to symmetry in formulas or models, selection of materials, design planning (60 minutes):** - Students explore possibilities for the eco-friendly materials on the following link: https://www.barbuliannodesign.com/post/eco-friendly-building-materials-list - Discuss the concept of reusing and its importance in reducing waste and contributing to sustainability, explore examples of projects or models that impart symmetry. Videos: https://www.youtube.com/watch?v=Uzpkj68wfng (Duration: 10:15) https://www.youtube.com/watch?v=25BDnWILV9I (Duration: 13:37) https://www.youtube.com/watch?v=Yhpe_R7eHTI (Duration: 6:16) - Students select materials based on their interests and ideas for their models. - Students entertain the idea of symmetrical math formulas/geometric figures in a plane/space. **Task 2. Creation, cooperation, implementation and presentation (60-90 minutes):** - Students create the design for the model, start implementing different techniques and combinations of materials to achieve the desired results, become more aware of the use of recycled materials to make these models. - Students work together and exchange ideas with their peers, supplying information for and support to one another. They discuss and share their progress, challenges, and successes. - Students accomplish the products, compose their projects as models for presentation. - Students present their projects to the class, describe the process, materials used during the task and the idea for the originality and the artistry. - Students review how their projects are valuable for the environment applying the materials ingeniously. Students debate the advantages of creating these math models for symmetry, the challenges encountered, and the concepts and formulas revised during this activity.
Assessments	● Assessment of Web Quest reports for depth of research and understanding. ● Personal presentations synthesizing the benefits of reusing and recycling, the challenges encountered, and the concepts learned through this creative process. ● Reflection on how their models contribute to environmental sustainability and inspire others to learn about ecological awareness.
Key Competences	● Cognitive competence ● Creativity competence

	• Communication competence • Social, emotional and healthy living competence • Citizenship competence • Digital competence • cultural competence
Connections with Eco STEAM	Eco – Eco-friendly models from the students for the students. Science – Connections with concepts from physics, geography, chemistry and biology. Technology - Use of digital tools for research and use of different software to sketch the models. Engineering - Creation of innovative symmetrical models and products with math formulas that will increase students interest in mathematics. Arts – Artistic approach for creating models and projects with symmetrical formulas. Math – Measurement and use of different math concepts applied in daily life.
References	• Online resources for design examples with reusable materials.
Notes	• The activity should be adaptable to different local upcycling materials. • Emphasize safety and ethical conduct during practical work. • Encourage students to reflect on their role in the usage of recycling/reusing materials and the importance of sustainable practices.

Assessment Table for Web Quest Reports:

Assessment Criteria	Points	Comments
Depth of Research	_/5	
Understanding of the concept of symmetry	_/5	
Accuracy of Information	_/5	
Quality of Presentation	_/5	
Use of Visuals	_/5	

Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Comprehensiveness of Findings	_/5	
Clarity in Presentation of Data	_/5	
Understanding of recycling/reusing processes	_/5	
Ecological Interpretations and Insights	_/5	
Teamwork and Collaboration	_/5	

Use of Visual Aids in Presentation	_/5	

3.3.2. ACTIVITY PLAN: SUSTAINABLE SHOPPING BAG DECORATION WITH AN ENVIRONMENTAL THEME	
Introduction part (or activity overview)	To conserve the environment we live in, it is recommended to change our habits and reduce the use of plastic bags. By decorating a fabric shopping bag with an environmental theme, students will understand the connection between nature and humans, discover their essence, beauty, feeling, and find the answer to what sustainable living with nature is. Their creations will convey a certain environmental message to consumers. ● Pictogram - (Latin pictus – painted, drawn + Greek gramma – written sign, stroke, line), a graphic information sign; a small picture on the monitor that marks, for example, a folder, program, and more. ● Sustainability - a long-term process aimed at achieving a level of welfare and development that would meet the needs of the current generation without harming future generations.
Setting	Technology (textile) classroom.
Materials Needed	Computer, internet, textile shopping bags (used or sewn from recycled materials), A4 size paper, pencil, textile markers.
Learning Outcomes	• Develop creative and artistic expression skills. • Delve into environmental themes such as recycling, sustainability, and responsible consumption; • Cultivate practical technological decoration skills, which can be useful in their daily lives and future projects. • Understand that the consumption of textile products and the amount of waste generated depend solely on human consumption habits.
Activity Contents	**Activity 1: Decorating a Sustainable Shopping Bag with an Environmental Theme.** **Theoretical Part** (Duration: 20 min): Introductory Conversation. An invitation to share personal experiences on how many plastic bags their family consumes. Is it possible to reduce their usage? Discussing responsible consumption: rational use of materials (including secondary textile raw materials) in creative works. Problematic questions: Can old become new? What benefit/value is there to creativity in using items that no longer serve their direct purpose? **Material for the teacher.** As the world becomes increasingly aware of the negative impact of disposable plastic bags on the environment, more people are choosing environmentally friendly alternatives while shopping. By choosing fabric bags, biodegradable packaging, and other environmentally friendly options, consumers can help fight plastic pollution and contribute to a cleaner and healthier world for future generations. Why? • Fabric bags, made from cotton or canvas, save the environment because they use a minimal amount of waste and chemicals in production, making them a sustainable choice for consumers. • Apart from fabric bags, there are many other environmentally friendly

	packaging options. For example, some companies use innovative materials such as seaweed or mushrooms to create edible packaging that can be consumed along with the product. • Other companies use biodegradable materials such as corn starch or bamboo to create compostable packaging that can be safely returned to the earth. Overall, moving towards reusable and sustainable packaging is a positive step in reducing waste and protecting the planet. Read more here https://lt.scecolife.com/news/use-green-bags-to-protect-the- earth-73472614.html **Task (Duration: 2-3 hours):** Decorating a textile shopping bag with an environmental theme. Video review. Technique of decorating a textile bag with textile markers (2 minutes). https://www.youtube.com/watch?v=UwTCetBAUHI After watching the video, the most important decorating rules are emphasized. STEP 1: Idea search, selection, systematization. • Searching for pictograms. Using IT to find environmental pictograms related to their chosen theme (e.g., recycling, sustainability, eco-products, ECO, reducing plastic waste). Capturing found pictograms. • Searching, selecting, and systematizing analogs. STEP 2: Individually create 4 sketches on the chosen theme for decorating fabric bags, using both images and texts (environmental slogans or short message fragments that complement the pictograms). STEP 3: Discussion and sharing: After creating the sketches, a discussion is organized where students share their creative ideas and explain why they chose specific pictograms or text fragments. This is a great opportunity to express thoughts on the importance of environmental protection and to create sustainable design; STEP 4: After discussing with the teacher, choose the sketch that best matches the task. STEP 5: Based on the chosen sketch, draw the design of the discussed size on paper. STEP 6: Systematically, with quality and resource efficiency, decorate the textile bag with the chosen technique, tidy up the workspace at the end of the lesson. STEP 7: Calculate the product's cost and compare it with similar products for sale. Presentation of work, self-assessment. State the value and benefit of the work to the individual, society, and the environment.
Assessments	Assessment and Self-assessment Criteria (Appendix 1)
Key Competences	• Creativity competence • Digital competence • Cognitive competence • Communication competence • Citizenship competence
Connections with Eco STEAM	Eco - Sustainable use of materials, cultivating consumer culture. Science - The creative process encourages interdisciplinary learning (biology, art, or

	chemistry). Technology - Searching for new recycled materials, waste reduction, decoration technology. Engineering - Emphasizing the importance of a sustainable lifestyle and implementing environmental protection practices in daily life. Creating design sketches, considering technical aspects such as bag size, material selection, and sustainable design. Art - Sketching with digital tools, decorating the product encourages creativity and self-expression. Math - Students incorporate mathematical elements into their product design, for example, proportionally harmonizing elements or creating a symmetrical design, calculating the product's cost price.
References	https://lt.wikipedia.org/wiki/Atliek%C5%B3_tvarkymas Green Book II design from secondary materials. https://kita-forma.lt/leidiniai/ Decorating farbic bags with edding textile markers and pens. https://www.youtube.com/watch?v=UwTCetBAUHI&t=30s https://www.youtube.com/shorts/3OMDcqoaVXc
Notes	A reusable shopping bag can also be decorated with natural dyes.

Appendix 1. Assessment and Self-assessment Criteria

CONVERSION OF CUMULATIVE ASSESSMENT INTO A GRADE										
RESULT	Points	ASSESSMENT		Grade						
		Student	Teacher							
Draw 4 composition sketches on paper.	max 4									
A handicraft composition drawn on paper.	max 4									
Inclusion of environmental themes.	max 4									
Aesthetics and visual appeal.	max 4									
Mastery of decorating techniques.	max 4			**4**	**5**	**6**	**7**	**8**	**9**	**10**
Calculated product cost.	max 2									
Assessed processes, formulated conclusions.	max 2									
TOTAL:				4–6	7–9	10–12	13–15	16–18	19–21	22–24

3.3.3. ACTIVITY PLAN: ENERGY SOURCES FOR WATER HEATING

Introduction part (or	This activity is designed to deepen knowledge about the use of fuel (natural gas, electricity,

activity overview)	wood, etc.) or solar energy for heating water in the heating system of an individual house or apartment, to develop critical thinking by examining the efficiency, costs, and environmental impact of different fuel and heating systems.
Setting	Clasroom / computer classroom
Materials Needed	Digital Devices (tablets / laptops / mobile phones) Projector (for presenting works)
Learning Outcomes	● Deepen understanding of various energy systems and their use for water heating in residential spaces. ● Develop critical thinking skills by analyzing the efficiency, costs, and environmental impact of different fuels and heating systems. ● Learn to collect and analyze data, including market prices, energy quantities, and environmental indicators, using relevant tools and methods.
Activity Contents	**Theoretical part (Duration: 20 minutes):** Initially, it is clarified which types of fuel can be used for water heating in the heating system of an individual house or apartment. Here are some common types of fuel used for heating water: Natural gas: Widely used and relatively clean-burning fuel. It is often accessible through pipelines in cities. Electricity: Electric water heaters are common and easy to install. Wood: Wood can be used as solid fuel, often in the form of logs or pellets, in stoves or boilers. Solar energy: Solar water heaters use solar energy to heat water. It can be an auxiliary or primary source of hot water. Biomass: Biomass boilers use organic materials, such as wood pellets, agricultural residues, or other biofuels, to generate heat. Geothermal energy: In some areas, geothermal heat pumps can be used to extract heat from the ground for water heating. Recalled is how the heat quantity released by burning fuel is calculated: Q=qm, where Q - heat quantity, q - specific combustion heat, m – mass. https://neutrium.net/heat-transfer/heat-of-combustion/ Table of Specific Fuel Combustion Heats: https://www.researchgate.net/figure/Fuel-heating-value-to-calculate-furnace-Watt-power_tbl1_236985748 Carbon footprint calculator: https://www.carbonfootprint.com **Task (Duration: 3 hours):** Students, working in groups, conduct research to determine the efficiency of fuel in terms of costs and environmental impact when heating water in the heating system of an individual house or apartment: Each group must investigate one type of fuel (e.g., natural gas,

	electricity, wood, etc.). Each group member is assigned a role (e.g., group leader, data collector, data analyst, economic analyst, environmental impact analyst, presenter, report writer, etc.). This will ensure that each student contributes meaningfully to the research. Questions to help students conduct the research: ● Assume that a person on average consumes about 1 cubic meter of hot water per month. Heating it requires about 51 kWh or 183.6 kJ of energy. ● Evaluate the combustion heat – determine the theoretical amount of energy released when the fuel burns (if it is a combustible fuel). ● Assess fuel efficiency - how much energy is converted to heat for warming water. (Find the specific efficiency coefficient of the heating device). ● Calculate the cost per unit of energy. Note how it varies and what it depends on. ● Analyze the impact on the environment. Calculate the CO2 footprint. ● Evaluate the system's design and components. ● Make a conclusion. Create a composite index combining energy efficiency, cost per energy unit, design, and environmental impact. ● Prepare presentations and present them to classmates.
Assessments	After the presentations, students perform a written reflection: Reflection Sheet. The final result is graded with a mark: Assessment Table for Group Presentations
Key Competences	● Cognitive competence ● Communication competence ● Social, emotional and healthy living competences ● Citizenship competence ● Digital competence ● Cultural competence
Connections with Eco STEAM	Eco - choosing eco-friendly and sustainable fuel Science - knowledge of physics, chemistry, economics, and environmental sciences. Technology – utilization of advanced heating technologies and renewable energy sources. Engineering - engineering solutions for heating systems, optimizing energy use. Art - visually appealing heating systems. Math - calculation of energy quantities, assessment of economic efficiency, use of mathematical models and statistical tools.
References	https://www.mat.lt/fizikos-formules/siluminiai-reiskiniai/kuro-degimas.html
Notes	Attention is drawn to the fact that fuel availability can vary depending on geographic location, infrastructure, and local regulations.

Reflection Sheet

I will heat the water in my house or apartment heating system with (this fuel) , because.....
Working in a group with others, I learned.....

Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Completeness of data presentation	_/5	
Formulation of conclusions	_/5	
Use of visual aids in presentations	_/5	
Teamwork and collaboration	_/5	
Clarity and interestingness of the presentation	_/5	

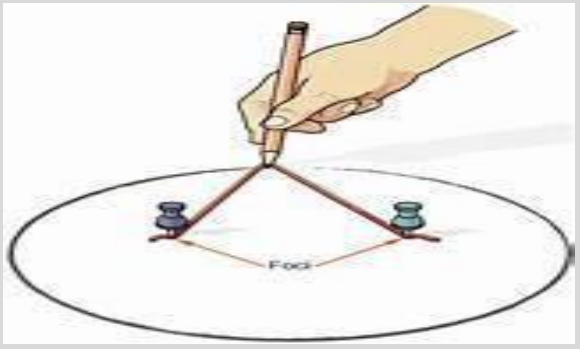
3.3.4. ACTIVITY PLAN: ENERGY SOURCES FOR WATER HEATING	
Introduction part (or activity overview)	Students, after learning what an ellipse and a circle are and how to independently construct an ellipse and a circle using the garden method, will be able to apply their knowledge in designing environmentally – friendly yards. They will solve problems related to the construction and layout of ellipses and oval flower beds in yards and gardens considering environmental factors.
Setting	Classroom, school yards and gardens.
Materials Needed	Computer (phone or tablet for interactive applets in GeoGebra), styrofoam, cardboard or drawing paper, video presentation equipment, markers**,**flip charts,thread and nails(rope and stakes for outdoor activities), images of yards or gardens, handout with ellipse and circle construction step
Learning Outcomes	• Understanding the definition and properties of the circle and ellipse • Identifying different methods of circle and ellipse construction • Constructing circles and ellipses with the garden method in the classroom (on

	paper) and outside (in the environment) ● Develop problem-solving skills by tackling real-world challenges related to circle and ellipse layout and environmental considerations.
Activity Contents	**ACTIVITY 1 (50 min): Marking out an ellipse and creating a tree ring** ***Theoretical part 1*** *(10 minutes)* Through questions, the teacher initiates the students' prior knowledge of circles and ellipses as a mathematical curve and their application. The teacher reminds the students that there are several methods for constructing a circle and an ellipse, and one of the simplest is the garden method, which has applications outside the classroom. Students are reminded how to construct a circle and an ellipse using the gardening method. Gardening construction of a circle and an ellipse can also be drawn in a simple and effective way on a piece of cardboard or styrofoam. In the following video, the students can see how one can draw an ellipse on a piece of wood using thumbs, pencil and string. Video: **"Drawing an ellipse on a piece of wood"** https://www.youtube.com/watch?v=6bw_8McExOs (duration 2min 31 s) *Task 1 (30 min)* Students apply the learned knowledge - they have to draw a circle and an ellipse using a piece of cardboard, two sticks, a pencil and string. The work instructions are given on the individual worksheet (**Appendix 1**). ***Theoretical part 2*** *(10 min)* The simple act of drawing a circle and an ellipse using cardboard, thumbs, pencil and string has practical applications in various areas of life, from design and art to ecology. It shows how mathematics and geometry play a role in understanding and representing our environment, including the natural world. Below are videos in which you can see how elliptical and circular shapes are practically marked using a mathematical construction method. Video: **"Marking out an ellipse" -** how to mark an ellipse on a green surface or ground https://www.youtube.com/watch?v=LRQA7Sx3m0w (duration: 2minute 26 seconds) Video:**"How to create a perfect tree ring"** - how to mark a circle around a tree https://www.youtube.com/watch?v=qW6LzzVbxwI (duration: 2minute 49 seconds) **ACTIVITY 2 (50 minutes): Elliptical and circular elegance in landscape design** *Theoretical part 1 (15 min)* ● Circles and ellipses are fundamental geometric shapes that have numerous applications in everyday life across various fields. Here are some real-life applications of circles and ellipses: Wheels of vehicles like cars, bicycles, and trains are circular to ensure smooth and continuous motion. Athletic tracks and sports fields are mostly in the form of a circle or an ellipse; Circular domes in buildings (e.g. the Pantheon in Rome) and elliptical rooms and halls are often included in architecture to create an interesting and functional use of space and structural stability; Elliptical and circular shapes can be used in the planning of ecological spaces to maximize space and improve environmental design; Circular or semi-circular solar panels to maximize sunlight exposure; The orbits of the planets around the Sun are elliptical. ● The application of circular or elliptical shapes in landscape design is particularly interesting. A circular or elliptical fountain or pond, an elliptical or circular flower bed or

	seating area can make the garden very beautiful. Elliptical hedges or shrubs can be used to divide different areas of the garden, providing privacy or defining specific spaces. Circular planters or raised beds can help organize and structure the garden, creating a sense of order and balance. Below are two videos showing the application of elliptical and circular shapes in landscaping Video: **"Dumbarton oaks gardens: ellipse"** https://www.youtube.com/watch?v=QGTNwGovOtg (duration: 2minute 32 seconds) Video: **"Best tips for landscaping around trees"** https://www.youtube.com/watch?v=rJko1-MAfAI (duration: 3minute 20 seconds) *Task 1 (30 min)* Then the teacher divides the students into groups of 5 students and assigns each group a challenge to design a landscape in their environment. Based on the acquired knowledge, each group should create a sketch of a green area that they want to arrange by applying circular and elliptical shapes. Oval shapes can be flower beds, ovals or rings around trees decorated with pebbles, fountains, etc. Students can make sketches in a computer drawing program or on paper. They can research landscapes online to get ideas. Finally, each group presents its findings to the class. *Discussion and reflection (5 min)* ● Students highlight real-world applications of the circle and ellipse. ● Students discuss the challenges they faced during the construction and design process. ● The importance of considering environmental factors in backyard design is emphasized.
Assessments	Verbal feedback during class; Conversation with/among students; Monitoring of students during group work; Evaluation of the thoroughness and accuracy of individual work; Each student self-assesses his contribution to the work; Aassesments the presentation of the work;
Key Competences	● Cognitive competence ● Creativity competence ● Communication competence ● Social, emotional and healthy living competences ● Citizenship competence ● Digital competence ● Cultural competence
Connections with Eco STEAM	**Eco:** Students will gain a deeper understanding of the interconnectedness of nature and the importance of responsible gardening practices by seeing the application of ellipses and circles in garden design. Science: Students will understand that the orbits of the planets around the Sun are elliptical. Technology - Students will use various digital programs for landscaping design. Engineering - Using the wireframe method to draw circles and ellipses can help engineers accurately represent these shapes in their plans and models. Art - Students will design landscapes and sketch of ellipses and circle. Math - Students will learn how mathematics and geometry play a role in understanding and

	representing our environment.
References	• Mathematics textbook for high school education in the Republic of Nort Macedonia • Master's thesis: "Application of the GeoGebra computer package in the study of analytical geometry" Author: Aleksandra Arsovska, UKIM Skopje • videos with a link given above in the text
Notes	• Encourage creativity and innovation in designing ecological yards and emphasize the importance of sustainability and environmental awareness in landscape design. • A local landscape designer or environmental expert may be invited to discuss sustainable backyard design and provide feedback on student designs.

APPENDIX 1. INSTRUCTIONS FOR STUDENT'S INDIVIDUAL ACTIVITY SHEET

Instructions for constructing an ellipse
Draw a circle and an ellipse using a piece of cardboard, two thumbtacks, a pencil, and string. Place the thumbtacks in the cardboard to form the foci of the ellipse. Cut a piece of string longer than the distance between the two thumbtacks (the length of the string represents the constant in the definition). Tack each end of the string to the cardboard and trace a curve with a pencil held taut against the string. The result is an ellipse. Think about how you will draw a circle.

If you want to get different shapes of the ellipse and circle, change the length of the string or the distance between the foci.
After constructing an ellipse and a circle, make a sketch of this ellipse and circle inserted in your living environment (courtyard, garden, school yard, etc.) as a flowerbed or green area around a tree, etc. Get motivated by the photos and videos you've seen in class or use digital sources to get creative ideas for creating an eco-friendly environment

Assessment Table for individual work:

Assessment Criteria	Points	Comments
Understanding the application of the ellipse and circle in real life	_/5	
Understending the propertiesof the ellipse and circle	_/5	
Constructing an ellipse and a circle with the garden method	_/10	
Understanding the role of mathematics	/5	

in landscape design		

Quality of the aesthetic and artistic constructions	_/5	

Assessment Table for group work:

Assessment Criteria	Points	Comments
Internet research skills	_/5	
Dexterity and creativity in the application of oval shapes in the project	/5	
Ellipse and circle construction skills	__/5	
Ecological Interpretations in the project	/5	
Teamwork and Collaboration	__/5	
Skills of presenting the work	/5	

3.3.5. ACTIVITY PLAN: CREATING UPCYCLING INNOVATIONS	
Introduction part (or activity overview)	This session is designed to deepen students' creativity, resourcefulness and environmental awareness. The main objective of the activity is to encourage students to repurpose discarded materials into creative and innovative artworks, fostering sustainability and creativity. By following this activity plan, you can empower your students to explore their creativity while making a positive impact on the environment through innovative upcycling projects.
Setting	Classroom complemented by digital research.
Materials Needed	● Various discarded or recyclable materials (e.g., cardboard, plastic bottles, old magazines, fabric scraps, bottle caps, broken electronics, etc.) ● Basic art supplies (scissors, glue, tape, paint, markers, etc.) ● Tools for upcycling (e.g., utility knives, hole punchers, hot glue guns, etc.) ● Reference materials or examples of upcycled art projects ● Workspaces with tables and chairs ● Aprons or old clothing to protect against stains
Learning Outcomes	● Developing deep understanding about the need to recycle certain materials. ● Improving knowledge about the possible use of various recycling materials. ● Enhancing skills in digital research and data analysis. ● Improvement of creativity and development of awareness for the huge possibilities for recycling.

Activity Contents	**Activity1 Steps** (Duration:1-2 hours per session, depending on the complexity of projects and available class time) **Activity (Upcycling, selection of materials, design planning) Theoretical part: (40 minutes)** The teacher explanes the concept of upcycling and its importance in reducing waste and promoting sustainability, exploring examples of upcycled art projects or innovations. Students are watching videos: Video 1: https://www.youtube.com/watch?v=4B0zhN7YPVw Duration:(3min 6sec) Overview: the video is about three upcycling ideas. Video 2 :https://www.youtube.com/watch?v=SN9XFS2zMLg Duration: (5min 51sec) Overview: This video is about 15 clever ways to upcycle everything around you. Video 3: https://www.youtube.com/watch?v=M0yZwfiNuUI Duration: (3min 42sec) Overview: this video is about making newspaper gift bags. Students select materials based on their interests and creative vision for their upcycling projects. **Task 1: (15 minutes)** The teacher gives the students a task to draw a sketch of their designs. Students sketch out their designs and plan the steps needed to bring their ideas to life. **Task 2: (60-90 minutes)** The teacher guides students to create upcycling project creations, to collaborate and present. Students start working on their upcycling projects, experimenting with different techniques and combinations of materials to achieve innovative results, aware of the importance of problem- solving and adaptability in the creative process. Students collaborate and exchange ideas with their peers, providing feedback and support to one another. They discuss and share their progress, challenges, and successes. Students add any final touches or details and prepare their projects for presentation. **Task 3: (30 minutes)** The teacher encourages students to present their work. Students present their upcycling projects to the class, explain their creative process, materials used, and the inspiration behind their innovations. They reflect on how their upcycling projects contribute to environmental sustainability and repurposing materials creatively. Students discuss the benefits of upcycling, the challenges encountered, and the lessons learned through the creative process. Students clean up their workspaces and organize their materials. **Additional Tips:** The teacher provides examples of innovative upcycling projects from artists and designers around the world to inspire students and showcase the possibilities of repurposing materials creatively. The teacher encourages students to think critically about the environmental impact of their materials and processes, and to consider ways to minimize waste and maximize resource efficiency in their art projects. The teacher should consider incorporating interdisciplinary elements into the activity, such as discussions about sustainability, environmental science, or product design. The teacher should organise showcase the finished upcycling projects in a display or exhibition to celebrate students' creativity and promote awareness of sustainable art practices.
Assessments	• Assessment of Web Quest reports for depth of research and understanding.

	• Personal presentations synthesizing the benefits of upcycling, the challenges encountered, and the lessons learned through the creative process. • Reflection on how their upcycling projects contribute to environmental sustainability and inspire others to repurpose materials creatively.
Key Competences	• Cognitive competence • Creativity competence • Communication competence • Social, emotional and healthy living competences • Citizenship competence • Digital competence • Cultural competence
Connections with Eco STEAM	Eco - Recycling as base of modern living Science - Ecological science (study of recycling innovations) Technology - Use of digital tools for research Engineering - Creation of finished products for different purposes from materials that can be recycled Arts - Developing creativity and the ability to repurpose and reuse certain creations Math - Data analysis of amounts of waste and ways to repurpose and reus
References	• Academic and scientific literature about designs of recyclable materials • Online databases and resources for design examples with upcycling materials
Notes	• The activity should be adaptable to different local upcycling materials. • Emphasize safety and ethical conduct during practical work. • Encourage students to reflect on their role in the usage of recycling materials and the importance of sustainable practices.

Assessment Table for Web Quest Reports:

Assessment Criteria	Points	Comments
Depth of Research	_/5	
Understanding of Species' Role	_/5	
Accuracy of Information	_/5	
Quality of Presentation	_/5	
Use of Visuals	_/5	

Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Comprehensiveness of Findings	_/5	
Clarity in Presentation of Data	_/5	
Understanding of recycling proceses	_/5	

Ecological Interpretations and Insights	_/5	
Teamwork and Collaboration	_/5	
Use of Visual Aids in Presentation	_/5	

3.3.6. ACTIVITY PLAN: ECOLOGICAL INSTALLATION	
Introduction part (or activity overview)	Environmental art is a unique form of art that uses various artistic styles and expressions to highlight environmental issues, promote awareness of ecological challenges, and inspire actions for a sustainable planet. By integrating art into the learning process, students have the opportunity to express their thoughts, emotions, and ideas regarding environmental conservation. Installation art is an artistic expression characterized by the use of three-dimensional space, where the environment in which it is displayed becomes an integral part of the artwork. An ecological installation is an art form that aims to express or emphasize themes related to environmental conservation, ecology, or sustainability.
Setting	Preparation and the initial creative process can be carried out in the classroom. The partially completed installation is then moved to the chosen space (either within the school or in a pre-planned and selected space outside the school).
Materials Needed	Materials for creating the installations are sorted into groups (paper, plastic, metal) suitable for recycling or naturally decomposable, sustainable materials to emphasize the principles of sorting and sustainability. The materials are not mixed together. Materials: plastic bottles, old metal elements, packaging, old newspapers, advertising brochures, natural materials (branches, moss, stones), and materials needed for assembly (glue, hot glue, thread, wire).
Learning Outcomes	● Improve artistic expression skills. ● Gain understanding of sustainable creation principles. ● Enhance technological skills. ● Develope environmental awareness. ● Improve collaboration and teamwork. ● Self-assess work and analyze its impact on nature. ● Improve drawing and modeling skills. ● Enhance the ability to communicate visually. ● Strengthen sustainable consumption habits. These learning outcomes can have a long-term impact on students' creative, analytical, and practical abilities, as well as promote a responsible attitude towards the environment. (For more details, see Appendix No. 1)
Activity Contents	**Theoretical Part (Duration: 15 minutes):** Installation art is an artistic expression form characterized by the use of three-dimensional space, where the environment in which it is displayed becomes an integral part of the artwork. Video https://www.youtube.com/watch?v=sgKzEw3OFrA Duration: Approx. 8.32 minutes

Ecology is a science that not only helps us understand natural processes but is also crucial in addressing global environmental challenges and creating sustainable ecosystems.
An ecological installation is an art form that aims to express or emphasize themes related to environmental conservation, ecology, or sustainability.
Video
https://www.youtube.com/watch?v=ap9NFCiz4HI
Duration: Approx. 1.58 minutes

Ecological installations serve as a bridge between art and environmental conservation, aiming to highlight the beauty of nature, its vulnerabilities, or to raise awareness about environmental challenges. These installations are created using various secondary materials.
Video https://www.youtube.com/watch?v=vP9YdHXP3Cw
Duration: Approx. 2.47 minutes

Activity 1 (Duration 180 minutes):
An ecological installation will be created from recycled and sorted waste of one selected group (glass, paper, metal). This will demonstrate how creativity can reduce waste (waste management and recycling).
The group work method will be applied to create the installation.

STEP 1. Start with a clear idea that the installation will express. This can be related to ecological or sustainability issues, personal experiences, or concerns.

STEP 2. After selecting the theme, gather information about the materials, colors, shapes, and other elements that will be used in creating the installation. Understand and determine how the installation will convey the desired message.

STEP 3. Create sketches and drawings of the installation. Consider the size, shape, and interaction with the environment.

STEP 4. Choose the materials and tools to be used. Pay attention to sustainability principles, especially how the selected materials are produced and used.

STEP 5. Begin creating the installation based on the chosen sketch. Experiment creatively with shapes, colors, and textures. Pay attention to details and ensure the installation is stable and safe.

STEP 6. If your installation includes light or sound components, integrate them in a way that complements or enhances the main idea or message of the installation.

Activity 2: Exhibiting and Documenting the Installation Duration: 60 minutes

STEP 1. Exhibit the installation in the chosen environment. Photos, videos, or other media recordings can help preserve the artwork long-term. Each installation may have unique stages depending on the theme and the creator's vision. The key is to maintain creativity, openness to experiments, and constantly think about how the installation can convey the chosen message.

STEP 2. Presenting the installation is an important step in sharing creation with others and conveying the theme, message, or emotion of the installation. Presentations can take place in various settings, from art galleries to public spaces or even virtual art platforms.

Presentation Ideas:

- Provide a detailed description explaining the concept, goals, materials used, and key thematic ideas of the installation. This can be presented along with photos of

	the installation or as a separate document. ● Organize an official opening event for the installation, publicly presenting the artwork. This could be an opening exhibition, performance, or special event that draws attention.
Assessments	Installation Evaluation Criteria (For more details, see Appendix No. 2) ● Relevance to the Theme ● Innovation and Creativity ● Use of Materials and Sustainability ● Aesthetics and Visual Appeal ● Interaction with the Viewer ● Technical Execution ● Environmental Sustainability ● Interdisciplinary Approach ● Presentation
Key Competences	Creativity competence Digital competence Cognitive competence Communication competence Citizenship competence
Connections with Eco STEAM	Eco—The installation will be made from easily recyclable and sorted materials to highlight the importance of sustainability in the modern consumer world. Science—The creation process integrates various subjects. For example, it may require biological, physical, or chemical knowledge. Technology - Participants will seek innovative solutions that can be applied in the context of environmental protection and sustainability. This can include new methods of recycling materials, reducing waste, or using energy-saving technologies. Engineering - Students will use engineering principles to design the installation. Art - Participation in creating an ecological installation fosters creativity and self-expression. Math - Mathematical calculations will be involved in creating the installation.
References	What Is Installation Art and How Does It Transform Our Perception? https://www.widewalls.ch/magazine/installation-art Installation art https://ar.pinterest.com/pin/426856870914509171/

Appendix No. 1

Creating an ecological installation can achieve various learning outcomes encompassing artistic, practical, and ecological areas.

1. By creating an ecological installation, students will enhance their artistic expression skills. This includes fostering creative thinking, generating original ideas, and visualizing them.

2. Students will gain an understanding of sustainable creation principles. This includes the ability to choose sustainable materials, use resources wisely, and minimize environmental impact.

3. Students will improve their technological skills.

4. The creation process and interaction with the environment will help students develop environmental

awareness. They will gain knowledge about environmental issues and how art can contribute to sustainability, as well as deepen their understanding of the importance of recycling.

5. Ecological installations will be created in groups. Students will improve collaboration, communication, and collective decision-making skills.

6. Students will learn to reflect and self-assess their work, as well as analyze its impact on the environment. This includes learning from their mistakes and evaluating how the project meets its intended goals.

7. The creation process will enhance practical skills such as drawing, modeling, material handling, and processing.

8. While creating the installation, students can directly interact with nature, use natural materials, or incorporate elements that reflect environmental challenges and beauty.

9. By creating the installation, students will improve their ability to communicate visually. This includes the ability to create impactful and meaningful visual works.

These learning outcomes can have a long-term impact on students' creative, analytical, and practical abilities, as well as promote a responsible attitude towards the environment

Appendix No. 2

When evaluating an installation, it is important to consider not only technical and aesthetic aspects but also how it impacts people, what message it conveys, and how it contributes to the artistic context or environment. The installation evaluation criteria are:

1. Relevance to the Theme (Is the idea clearly visible in the artwork and why is it important?)

2. Innovation and Creativity (Does the installation offer new ideas or use unusual solutions? This can include the use of new material combinations, shapes, or technologies.)

3. Use of Materials and Sustainability (The choice of materials used and how they were used. Were sustainable materials used, or was there an effort to minimize the environmental footprint?)

4. Aesthetics and Visual Appeal (Evaluating the visual attractiveness of the installation. How does it look at first glance and how does it change from different angles? How are colors, shapes, and textures combined?)

5. Interaction with the Viewer (How do people react to the installation? Does it manage to evoke emotions, inspire, or provide new perspectives?)

6. Technical Execution (Is everything stable, safe, and functioning as planned? How well was the installation implemented from a technical standpoint?)

7. Environmental Sustainability (If the installation was exhibited outdoors or in another space, evaluate its impact on the environment. Was it created considering environmental sustainability principles?)

8. Interdisciplinary Approach (If the installation involves multiple artistic disciplines or technologies, assess how successfully they interact and complement each other.)

9. Presentation (The presentation will depend on where and how the installation is exhibited. It is important that the presentation is engaging, informative, and aligns with the artistic idea of the installation.)

ACTIVITY EVALUATION SHEET

Evaluation Criteria	Points	Comments

Relevance to the Theme	_/5	
Innovation and Creativity	_/5	
Use of Materials and Sustainability	_/5	
Aesthetics and Visual Appeal	_/5	
Technical Execution	_/5	
Presentation	_/5	

3.4. SUBTOPIC. EVALUATING AND ANALYSING ENVIRONMENTAL INFORMATION

3.4.1. ACTIVITY PLAN: WATER CONSUMPTION LINE REGRESSION	
Introduction part (or activity overview)	This activity aims to raise awareness among students about the amount of water used in each household or generally in society wherever there is water distribution and consumption. There are significant differences between individual and industrial usage, and there is a direct link between population growth and demand for water supply. Line regression helps to make an analysis, students calculate the percentage of water consumption by creating tables and graphs.
Setting	Classroom complemented by digital research
Materials Needed	• Paper but even better on the computer/laptop (pen tablet) • Pencil, pen, calculator • Data on household water usage (e.g., from water bills or simulated data) • Measuring tools (e.g., flow meters, buckets, stopwatches) • Reference materials and math formulas for calculating • Information about water consumption (weekly or monthly) • Projector or screen (when presenting the results of the activity)
Learning Outcomes	• Developing deep understanding about the impact of individual action on the environment; • Improving proficiency in expressing findings about a certain linear trending through a drawing; • Enhancing skills in digital research and data statistical analysis. • Improving ability to critically analyze and discuss the disadvantages of water pollution and advantages for water saving and consumption and its impact on the quality of life.
Activity Contents	**Activity: Water consumption line regression** (Duration: Approximately 2,5 hours) **Theoretical part:** (Duration:15 minutes) Students debate on climate change related risks such as: urban heat waves, melting glaciers, longer droughts, drying reservoirs, and increased frequency of floods and droughts. Students become more aware of the water demand initiated by the water consumption. Students discuss how water conservation impacts the environment and society, common methods of water conservation and why they are important. Short video about population growth and water demanding equations: https://www.youtube.com/watch?v=gbaCBPxnBtA (Duration: 7:48)

	Short video about water demand calculation in given example: https://www.youtube.com/watch?v=diHzFmtl4dM (Duration: 11:15) Short math literacy video about how to calculate water tariff: https://www.youtube.com/watch?v=hYCYdq33yBE (Duration: 6:15) **Task 1. Concept of linear regression (15 minutes):** - Discuss the concept of linear regression and its importance in explaining some phenomena in daily life and represent scientific information, explore ways and formulas to represent a regression line model for water consumption. **Task 2. Creating the water consumption line regression (30 minutes):** - Students start working on their task, they calculate the total water usage, analyze and compare data: use the collected data to compare the water usage of different methods for the same activity (For example, compare the water usage of hand-washing dishes versus using a dishwasher.) Create graphs to visualize the data (e.g., bar graphs, pie charts etc.) - Students collaborate and exchange ideas with their peers, providing feedback and support to one another. They discuss and share their progress, challenges, and successes. - Students prepare their findings for presentation. **Task 3. Presentation, reflection and social network encouragement (60 minutes):** - Students present their line of regressions to the class, explain their conclusions and tips for saving water, and at the same time they show their digital skills inf front of other students. - They reflect on how water saving contributes to environmental sustainability. Students discuss the benefits of water saving and rational water consumption, the challenges encountered, and the lessons learned through the process. - Students share their research and art models online on social media.
Assessments	● Assessment of Web Quest reports for depth of research and understanding. ● Personal presentations synthesizing the benefits of upcycling, the challenges encountered, and the lessons learned through the creative process. ● Reflection on how precisely the students made the line of regression and what conclusions are drawn from that analysis.
Key Competences	● Cognitive competence ● Creativity competence ● Communication competence ● Social, emotional and healthy living competences ● Citizenship competence ● Digital competence ● Cultural competence
Connections with Eco STEAM	**Eco** – Save water Science – Additional research of water consumption in agriculture, industry etc. Technology - Use of digital tools for research, MS Excel, R and GeoGebra for visual representation of the line of regression. Engineering – An attempt to create a mechanism that leads to minimal water consumption. Arts – Possibility of art sketch about the water consumtion and waste of water every day, pop art exibition with messages that stimulate quality of water saving, put digital posters and brochures on the social media to promote water-saving practices. Math - Data statistical analysis of amounts of water consuption, proportions, tables, graphs and functions.

References	• Academic and scientific literature about math formulas used for the calculations. • Online databases and resources for line of regression and models for water demanding equations.
Notes	• The activity should be adaptable to students who listen advantage level of mathematical statistics

Assessment Table for Web Quest Reports:

Assessment Criteria	Points	Comments
Depth of Research	_/5	
Understanding the concept: Line regression	_/5	
Accuracy of Information	_/5	
Quality of Presentation	_/5	
Use of Visuals	_/5	

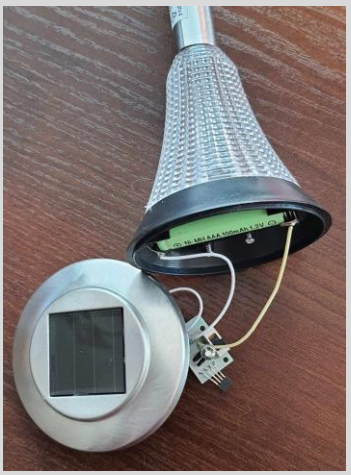
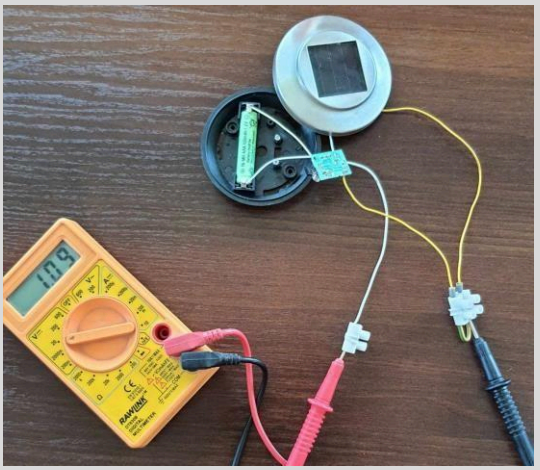
Assessment Table for Group Presentations:

Assessment Criteria	Points	Comments
Comprehensiveness of Findings	_/5	

Clarity in Presentation of Data	_/5	
Understanding of ICT tools for statistical data research	_/5	
Ecological Interpretations and Insights	_/5	
Teamwork and Collaboration	_/5	
Use of Visual Aids in Presentation	_/5	

3.4.2. ACTIVITY PLAN: STUDY OF EFFICIENCY OF SOLAR LAMPS UNDER VARIOUS LIGHTING CONDITIONS	
Introduction part (or activity overview)	There is increasing concern worldwide about energy sustainability and environmental impact, making solar energy a promising solution. Solar lamps are a simple yet effective application of solar energy technology, providing lighting in areas without access to the electrical grid. To maximize the potential of solar lamps, it is crucial to understand how lighting conditions affect their efficiency
Setting	Classroom and outdoor
Materials Needed	Solar lamps Lux meter / phone with an app Ammeter, voltmeter / multimeter Connection terminal blocks Additional wires soldered for measuring voltage Data recording sheets or computer/tablet
Learning Outcomes	● Deepen knowledge about solar energy technologies and how solar lamps utilise sunlight to generate electricity. ● Understand the interrelationship between renewable energy systems and environmental factors, such as the impact of sunlight and ambient light levels. ● Improve data collection and analysis skills. ● Enhance critical thinking skills by analysing experimental results and identifying patterns, correlations, and possible sources of variability. ● Improve abilities to collaborate effectively and communicate findings to others. ● Have the opportunity to practically explore renewable energy technologies and contribute to sustainable solutions.
Activity Contents	**Activity1: Study of the Efficiency of Solar Lamps Under Various Lighting** **Conditions Theoretical Part (Duration: 25 minutes):** If students are not yet familiar with the operation of solar cells, they should be introduced to it. **Videos:** **How do solar panels work?** https://www.youtube.com/watch?v=xKxrkht7CpY&t=10s Overview: An educational video How do solar cells work? Duration: Approx.5 minutes

	Examine the structure and operation of a solar lamp. The solar cells installed in the lamps absorb solar energy during the day and store it in a rechargeable battery, automatically turning on the lamps after sunset. **Videos:** https://www.youtube.com/watch?v=DQX3bKcl6N4 Overview: This video examines how solar lamps work. Duration: Approx.8.36 minutes Remind students how to connect an ammeter and a voltmeter in a circuit. If using a multimeter, review this **video**: https://www.youtube.com/watch?v=DQX3bKcl6N4 Overview: This video examines how to use a multimeter. Duration: Approx.4.35 minutes If you don't have a lux meter, you can use a mobile phone sensor. **Task (Duration: 90 minutes)** **Step 1.** Students are divided into groups (4-5 students per group). Within the groups, they assign roles. **Step 2.** Each group receives materials: a tablet or a sheet of paper with the task (Appendix No. 1), a lux meter or a mobile phone, and a disassembled and prepared solar lamp for measuring voltage and current. To facilitate students' measurements, the teacher should prepare measuring clamps for current measurement by cutting the wire from the solar cell and attaching a connection terminal block. For voltage measurement, a wire with a terminal block can be soldered. **Step 3.** Students take measurements outside the school, walking around the school from all sides, i.e., in the sun and in the shade (this activity should be planned on a sunny day). **Step 4.** Students take measurements in the classroom at various distances from the window. **Step 5.** They analyse the results, summarise them, and draw conclusions. **Step 6.** They present their work. A discussion about the use of solar cells in other areas follows.
Assessments	Evaluation Table (Appendix No. 2)
Key Competences	Cognitive competence Creativity competence Communication competence
Connections with Eco STEAM	Eco - Solar energy used to power lamps is a renewable energy source that reduces environmental impact. Science – Physics knowledge. Technology – Solar energy technologies for sustainable lighting solutions. Engineering – Integration of engineering principles for practical application. Art – The aesthetics of solar lamps combine functionality and visual appeal. Math- data analysis
References	https://ez.analog.com/adieducation/university-program/b/blogs/posts/hacking-an-led-solar-garden-light https://www.youtube.com/watch?v=7TRyD_EXCbA&t=3s

Notes	Solar lantern disassembled :	Solar lantern is ready for examination:
		

APPENDIX NO. 1. ACTIVITY RESEARCH SHEET

Study of the Efficiency of Solar Lamps Under Various Lighting Conditions			
Objective: To investigate the dependence of the current and voltage output from the solar cell of solar lamps on illumination.			
Hypothesis:			
Materials:			
Environment	**Illumination, Lx**	**Current amlifier, A**	**Voltage, V**
Results Analysis and Summary			
Conclusions			
Reflection: How did the work go? What contribution did each group member make? What did you learn? Where ca solar cells be used?			

APPENDIX NO. 2. EVALUATION TABLE

Evaluation Criteria	Points	Comments
Hypothesis Formulation	_/1	
Data Collection	_/2	
Data Analysis	_/2	
Conclusion Formulation	_/2	
Reflection	_/1	
Work Presentation	_/2	

3.4.3. ACTIVITY PLAN: CRITICAL ANALYSIS OF ENVIRONMENTAL DATA	
Introduction part (or activity overview)	This activity focuses on developing students' critical thinking and analytical skills by evaluating and interpreting environmental information. Students will gather data from various sources, analyze it critically, and present their findings and recommendations.
Setting	Location: Classroom and computer lab for research and analysis. Educational Context: Collaborative group work (4-5 students per group).
Materials Needed	Computers with internet access and relevant software (e.g., spreadsheets, data visualization tools) Access to online data sources for environmental statistics Projector for presentations Graph paper, calculators, and other analytical tools
Learning Outcomes	● Develop skills in critical thinking and data analysis. ● Learn to evaluate and interpret environmental information from multiple sources. ● Enhance abilities in research, project development, and presentation
Activity Contents	Theoretical Part (Duration: 60 minutes): Begin with an introduction to the importance of evaluating and analysing environmental information. Highlight various methods and tools used in critical analysis. ● **Introduction to Critical Thinking in Environmental Analysis**: o Explain what critical thinking is and why it is essential in evaluating environmental information. Discuss how critical analysis helps in making informed decisions and solving complex environmental problems. o Break down the key components of critical analysis, including identifying biases, evaluating sources, interpreting data, and making evidence-based conclusions. ● **Methods for Evaluating Environmental Information**: o Discuss how to evaluate the credibility and reliability of different sources of environmental information. Highlight the importance of peer-reviewed studies, government reports, and reputable organizations. o Explain various methods for interpreting environmental data, including statistical analysis, trend analysis, and comparative analysis. o Introduce the concept of critical questioning and how it can be used to probe deeper into environmental issues. Provide examples of critical questions that can guide the analysis process. o Discuss the role of data visualization in making complex data more understandable. Introduce tools and techniques for creating effective visualizations. ● **Case Studies**: o **Case Study 1: Climate Change Data Analysis**: Present a case study on analyzing climate change data. Discuss the sources of data, methods used for analysis, and the conclusions drawn from the study. o **Case Study 2: Air Quality Evaluation**: Share a case study on evaluating air quality information in an urban area. Highlight the data collection process, analysis methods, and the implications of the findings. ● **Video Resources**: o " Math and Critical Thinking in Environmental Ed " https://www.youtube.com/watch?v=Ey-E0Uz-_Qs – A video showcasing the role of critical thinking in environmental science. o " Data science for the environment "

	https://www.youtube.com/watch?v=ph439t-kTIE – An overview of methods and tools for analyzing environmental data. **Discussion Prompts**: ● How can critical thinking help in identifying biases in environmental information? ● What are the key factors to consider when evaluating the credibility of a data source? ● How can data visualization enhance the interpretation and communication of environmental data? **Task 1: Data Collection and Evaluation (Duration: 45 minutes) Objective**: To collect and critically evaluate environmental data from multiple sources. ● **Step 1**: Form groups and assign each group a specific environmental issue to study (e.g., climate change, air quality, water pollution). ● **Step 2**: Use online data sources to collect information on the assigned issue. Ensure that data is gathered from multiple reputable sources. ● **Step 3**: Critically evaluate the credibility and reliability of the sources. Identify any potential biases or limitations. ● **Step 4**: Compile the data and prepare it for analysis. **Task 2: Data Analysis and Interpretation (Duration: 90 minutes) Objective**: To analyze the collected data and interpret the findings critically. ● **Step 1**: Use statistical methods and data visualization tools to analyze the collected data. Look for trends, patterns, and anomalies. ● **Step 2**: Interpret the data to draw meaningful conclusions. Consider the broader context and potential implications of the findings. ● **Step 3**: Based on the analysis, develop recommendations. Identify possible solutions or actions that can address the environmental issue. ● **Step 4**: Prepare a presentation summarising the data analysis, interpretation, and recommendations. **Task 3: Presentation and Feedback (Duration: 45 minutes) Objective**: Present the analysis and recommendations to the class and receive feedback. ● **Step 1**: Each group presents their data analysis, interpretation, and recommendations to the class. ● **Step 2**: Conduct a Q&A session where other students and the instructor can provide feedback and ask challenging questions. ● **Step 3**: Groups reflect on the feedback received and discuss potential improvements.
Assessments	Accuracy and thoroughness in data collection and evaluation. Critical thinking and analytical skills demonstrated in data interpretation. Quality and feasibility of recommendations based on the analysis. Clarity and persuasiveness of the presentation. Team collaboration and dynamics.
Key Competences	Research and analytical skills Critical thinking and evaluation Strategic planning and project management Effective communication and presentation skills Teamwork and collaboration
Connections with Eco STEAM	Eco: Understanding and addressing environmental issues through critical analysis. Science: Applying scientific principles to analyse and interpret environmental data. Technology: Utilizing digital tools and software for data analysis and visualisation. Engineering: Developing solutions based on critical evaluation and analysis. Arts: Creating engaging presentations and visualisations to communicate findings.

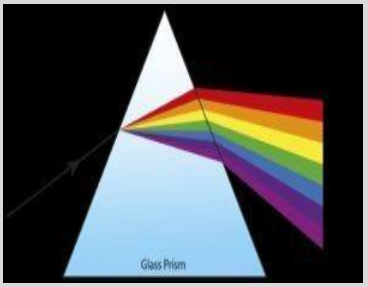
	Math: Using statistical methods and data analysis to support critical evaluations.
References	https://www.tomorrow.bio/post/the-role-of-critical-thinking-in-environmental-sustainability-a-holistic- approach-2023-10-5370564201-rationality
Notes	This activity can be extended into a longer-term project, where students continuously evaluate and analyse new environmental data based on ongoing research and feedback.

Evaluation Criteria Table for Critical Analysis of Environmental Data Activity

Evaluation Criteria	Points Available	Comments
1. Accuracy and Thoroughness in Data Collection and Evaluation	20	Assess the precision and comprehensiveness of the data collected and evaluated.
2. Critical Thinking and Analytical Skills	20	Evaluate the demonstration of critical thinking and analytica skills in interpreting the data.
3. Quality and Feasibility of Recommendations	20	Rate the reliability and practicality of the recommendations based on the analysis.
4. Clarity and Persuasiveness of Presentation	20	Rate the clarity, persuasiveness, and professionalism of the presentation.
5. Team Collaboration and Dynamics	20	Assess the level of teamwork, including communication, cooperation, and mutual support among team members.

Total Points: 100

3.4.4. ACTIVITY PLAN: HOW DIFFERENT COLOURED LIGHT INFLUENCES PLANT GROWTH

Introduction part (or activity overview)	Students discuss wavelength of white light – the visible spectrum of colours which make up the colours of the rainbow: this is why when you pass white light through a prism, the ray of light splits up to reveal these colours. A picture can be used showing this phenomenon, also any previous knowledge from physics.  They further analyse possible applications in biology – questions: Why are plants green? What is chlorophyll? What is photosynthesis? Finally, what is the effect of the colours of the spectrum on bean plant growth?
Setting	In this experiment you will observe the effects of different coloured light on plant growth.
Materials Needed	Different coloured cellophane, around 4 will do (such as green, red, blue, yellow, violet), 5

	plastic cups, 5 shoe boxes, 5 bean plant seeds or any other type of plant seeds that are easy to grow. Soil, Water, Ruler, Tape, Scissors.
Learning Outcomes	● Investigating the effects of different coloured lights on plant growth. ● Observing whether any specific colours of light encourage more growth compared to other colours, or whether they have no influence at all
Activity Contents	**Activity 1: Realization of the experiment (Duration: 90 minutes)** *Introduction discussion*: (10 minutes) **Theoretical part:** **The teacher gives them directions regarding the experiment:** Students want to produce the best bean plants possible. They experiment using multiple coloured filters in order to work out which colour of light is best. Step 1: Start off the experiment by filling the 5 plastic cups at least ¾ full of soil. Step 2: Place your thumb on the surface of the soil present in the cups and press down gently to make a small hole. Step 3: Place the seeds in the hole and cover with soil. Step 4: Repeat steps 2 and 3 for all the plastic cups containing the soil. Step 5: Get the shoe boxes, remove their lids and using the scissors cut out one side of each box. Step 6: Cut a hole in the bottom of the shoe box. Make the hole as big as possible without cutting the corners of the box. Pierce 5-10 small holes in the remaining sides of the box. Step 7: Now tape the coloured cellophane over the side that has been removed and side over the hole in the bottom of the box. Step 8: Repeat steps 5 and 7 three more times using a different colour cellophane for each shoe box. Step 9: It is important to keep one box that is not taped with cellophane to be used as a control. Step 10: Place one of the boxes over each cup. Step 11: Place the boxes in an area which is well lit such as next to a window, with the opening in the box facing the light. Step 12: Water the plant each day for 3-5 weeks (until the plant grows to a sufficient height). Step 13: Use the ruler to see which plant grew the tallest. Also take notice of the leaf colours, their size, time taken for the seeds to germinate etc. Act like a detective and note down every observation you make. **Activity 2: Discussion (Duration: 40 minutes)** The teacher discusses and analyzes connected topics: different wavelengths of light are responsible for the different growth responses, leaf cells possess chlorophylls and carotenoids, organelles which can only absorb specific wavelengths of light, photosynthesis but also: hydroponics, biofuel cells, acoustic analysis of growth, greenhouse control of received light etc. Students discuss what they witnessed, what they produced, and how it was achieved. They share possible solutions to environmental issues, analyse sustainability in terms of plant growth. **Example questions (reflection):** **Which light colour caused the greatest plant growth?** Red and blue light, colours which are furthest away from green in the light spectrum. **Name a pigment that absorbs light.** Chlorophyll, carotene. **What is the function of chlorophyll?** Converts light energy into chemical energy which the plant can use. **What colour filter will be/was the most detrimental towards plant growth?**

	Green since it is reflected rather than absorbed by the plant. **Why are plants green?** Chlorophyll reflects green light and absorbs all other light. **Why are carrots orange?** Carotene reflects orange light and absorbs all other light. **Additional tips:** Be creative and try experimenting with different plant seeds. See if the same results are obtained. You could also try out this experiment during different seasons, which may influence plant growth due to factors such as air temperature and humidity. Try the experiment in summer and in winter and compare results.
Assessments	The final result is evaluated with a grade. All students in the class can be included in the evaluation. Each student independently evaluates his contribution to the work. Students can compete for a correctly conducted experiment. During the assessment, the following are taken into account: The speed of work and correct implementation of all steps of the experiment.
Key Competences	Communication competence Cognitive competence Competence for creativity artistic competence
Connections with Eco STEAM	Eco - Organic plants. Science - Knowledge of chemistry, biology and physics; environmental sciences – fostering sustainability thinking. Technology - Using a computer in the research process, color spectrum prism Engineering - Constructing a greenhouse. Art - Arranging the greenhouse with plants. Mathematics – Calculations.
References	http://www.epicgardening.com/types-of-hydroponic-lighting/ http://www.nature.com/articles/srep44526 https://www.sciencedaily.com/releases/2010/02/100218092846.htm
Notes	**Photosynthesis** can be represented by the following equation: 6 CO2 + 6 H2O ⟶ C6H12O6 + 6 O2

Assessment Table for individual work:

Evaluation Criteria	Points	Comments
Understanding pigments that absorb light	_/5	
Understanding what photosynthesis is	_/5	
Understanding what the function of chlorophyll is	_/5	
Communication competence	_/5	
Cognitive competence	_/5	
Competence for creativity	_/5	
Answered questions correctly	_/10	
Completed homework	_/10	

Assessment Table for group work:

Assessment Criteria	Points	Comments
Internet research skills	_/5	
Height of produced plant	_/10	
Calculation of cost price	_/5	
Ecological Interpretations in the project	_/5	
Teamwork and Collaboration	_/5	
Skills of presenting the work	_/5	