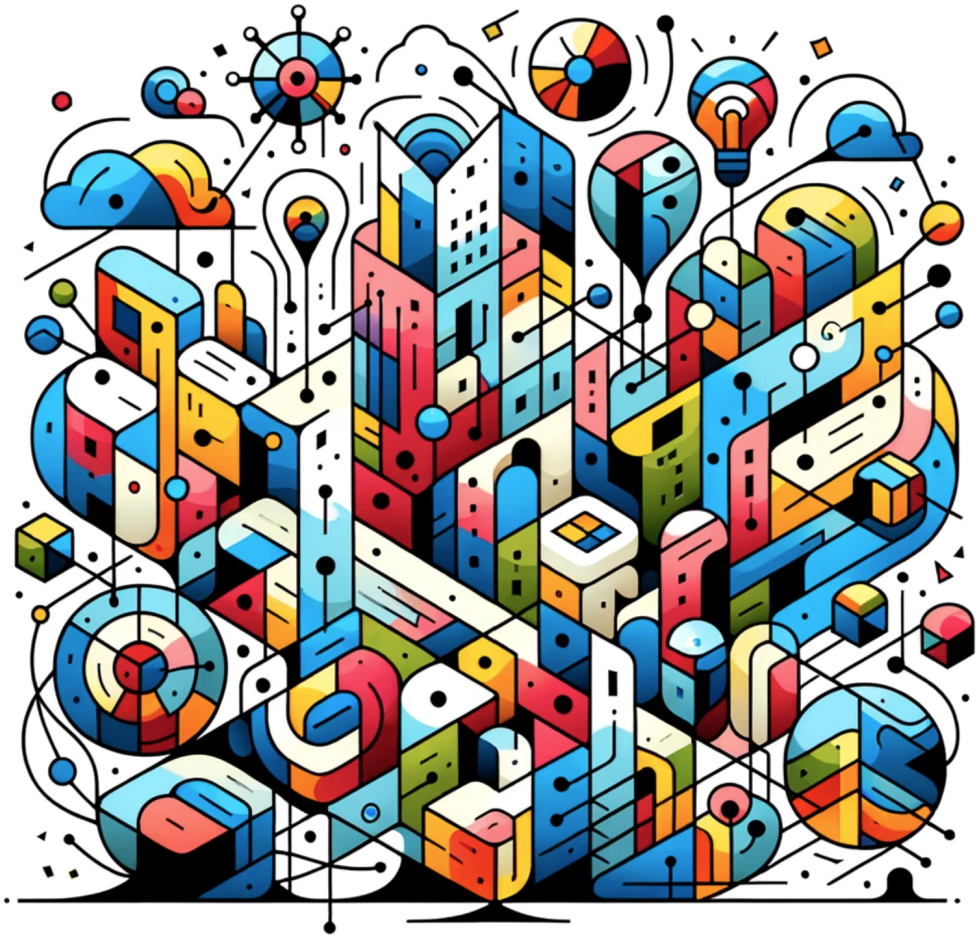

SUMMER SCHOOL MANUAL

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PROJECT NR. 2021-1-PT01-KA220-VET-000034845

No one stays behind

Erasmus+
Enriching lives, opening minds.

Co-funded by the European Union

Title: Summer School Manual

Authorship: Erasmus+ Project n.º 2021-1-PT01-KA220-VET-000034845

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Edition: Amar Terra Verde, Lda

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Design: EPATV's Communication Department

SUMMER SCHOOL MANUAL

TABLE OF CONTENTS

PART I

FOREWORD

The Council of the European Union adopted a recommendation on key competences for lifelong learning in May 2018. The recommendation identifies eight key competences essential to citizens for personal fulfilment, a healthy and sustainable lifestyle, employability, active citizenship and social inclusion:

- Literacy
- Multilingualism
- Mathematics, Science, Technology and Engineering
- Digital
- Personal, Social and learning to learn
- Citizenship
- Entrepreneurship
- Cultural awareness and expression

PART I

The Key Competences for Lifelong Learning European Reference Framework (European Commission, 2019) refers the importance of educational systems to readjust in order to meet nowadays and future challenges. The document identifies and describes key competences for the 21st century and presents successful ways to promote competence development through innovative learning approaches, assessment methods or support to educational staff, pointing out the need to ensure that all children and young people get the opportunities and the education they deserve.

The ***No One Stays behind (NSB)***, Erasmus+ project n°2021-1-PT01-KA220-VET-000034845, grounded its work on these two reference documents, keeping them as a theoretical foundation for our work, believing that everyone should have the opportunity to a quality education, that prepares them to the 21st century challenges, regardless of their background.

Believing that essential skills are highly transferable which almost everyone needs to in any job (Ravenscroft & Baker, 2020), NSB focused their work for the ***Summer School Manual*** (Project Result 3) in creating a set of activities that would mobilize and develop in students' different skills, namely essential skills for the 21st century, in an environment that differed from traditional education settings. Being that this is an activity primarily idealized for a profile of student that struggles with academic achievement, we believe that setting this program in a more non formal educative environment, different from formal school routines, would be more appropriate. To achieve that, we chose a Project-Based Learning (PBL) approach to STEAM (Science, Technology, Engineering, Arts and Mathematics) methodology for considering it a relevant practice, very much in line with current educational trends. We aim at putting the student in the center of the learning process, engaging them in the process of constructing knowledge (Fernandez Morante et al., 2022) and focus on developing skills rather than memorizing content. Working in engaging projects could possible "heal" their relationship with school's more formal activities, hence leaving no one behind.

Scientific literature and current studies indicate that PBL in a STEAM context adds numerous advantages to the learning process, enhancing the development of key competencies for the 21st century. PBL fosters integrated, interdisciplinary, or transdisciplinary learning, offering students the opportunity to recognize the practical applicability of content from various fields of knowledge (Diego-Mantecón et al., 2021). This finding led us to choose these methodologies for application in the context of Vocational Education and Training (VET), although easily adaptable to other training contexts, because:

- It is an effective method for developing competencies for the 21st century.
- It promotes active learning, "learning by doing," which is more effective than just reading or observing.
- It is suitable for any educational level and/or age group.
- It contributes to increased student motivation for learning.

Thus, the use of this methodology becomes particularly relevant for application to VET students in this specific case, contributing to their development and the enhancement of their skills.

The NSB Team

PART II

STEAM ACTIVITIES PROGRAM:

EXPLORING THE CITIES OF THE FUTURE

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PART II

STEAM ACTIVITIES PROGRAM:
EXPLORING THE CITIES OF THE FUTURE

INTRODUCTION

In the educational context of the 21st century, it is crucial to provide students with learning experiences that not only expand their theoretical knowledge but also prepare them for the practical and complex challenges of the real world. To achieve this, we developed an interdisciplinary activity program based on the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics), focused on the theme "Cities of the Future". This initiative is part of our broader "No One Left Behind" program, designed to rekindle motivation and academic achievement among students who face challenges in traditional educational settings.

The program is designed for students between 14 and 16 years old and aims to integrate concepts of science, technology, engineering, arts, and mathematics to explore urban themes in innovative and meaningful ways. The proposed activities are carefully planned to stimulate critical thinking, creativity, problem-solving, and collaboration among students while they engage with current and relevant issues such as sustainability, technology, and urban planning.

- Through ten meticulously developed activities, students will have the opportunity to:
- Model and design sustainable cities.
- Explore the integration of smart technologies in urban environments.
- Evaluate the impact of art in public spaces.
- Apply mathematical concepts in spatial planning.
- Innovate in urban transportation systems.
- Implement renewable energy solutions.
- Create plans for green spaces and urban parks.
- Develop efficient waste management systems.
- Design buildings using sustainable construction practices.
- Apply knowledge of physics and chemistry to optimize energy use in urban environments.

Each activity not only reinforces academic and technical skills but also promotes environmental and social awareness, preparing students to be proactive and conscious citizens in their own urban communities. This program aims to educate and inspire young people to imagine and build a better future for their cities and for the world, leaving No One Behind!

USER'S GUIDE
FOR STEAM ACTIVITIES

OVERVIEW OF PROGRAM STRUCTURE

The STEAM Activities in the “Summer School... Manual” are designed as a series of interconnected activities that guide students through the practical application of Science, Technology, Engineering, Arts, and Mathematics (STEAM) in the context of urban development. The aggregator thematic of all activities is “Exploring the Cities of the Future”. Each activity focuses on a specific aspect of city planning and sustainability, providing a comprehensive learning experience that encompasses both theoretical knowledge and practical skills.

HOW THE ACTIVITIES WORK

- **Interdisciplinary Approach:** Each activity integrates multiple STEAM disciplines, reflecting real-world scenarios where solutions require a blend of skills and knowledge from different fields.
- **Collaborative Projects:** Students are encouraged to work in teams, mimicking real-life work environments where collaboration is key to innovation and problem-solving.

INFORMATION DISPLAYED IN EACH ACTIVITY

Each activity in the program includes the following components:

- **Objective:** Clearly defines what students are expected to learn and achieve with the activity.
- **Skills developed:** Each essential skill developed during the activities is represented by visual icons, facilitating the identification of pedagogical objectives quickly and intuitively.

ICONS FOR KEY COMPETENCES DEVELOPED


CRITICAL THINKING


SOLVING PROBLEMS


COLLABORATION


COLLABORATION


DIGITAL LITERACY


COMMUNICATION


CREATIVITY/INNOVATION


SCIENTIFIC AND TECHNICAL LITERACY


MATHEMATICAL LITERACY


ECOLOGICAL AWARENESS AND SUSTAINABILITY

Necessary Materials: Lists all resources required to complete the activity, from physical materials to software and tools.

Procedures: Step-by-step instructions guide the students through the activity, ensuring they understand the tasks and expected outcomes.

Reflection questions: Proposal of questions to reflect on the activity, encouraging students to reflect on their work and its implications for real-world issues. Group discussions are encouraged in every activity as a way of promoting communication and collaboration skills, as well as to encourage students' self-assessment.

Proposal of Assessment of the Activity: Suggestions of criteria for assessing the learning outcomes is provided.

USING THIS MANUAL

Educators: Should use this manual as a guide to prepare each session, gather materials, and facilitate the activities. It's also a tool to help assess student progress and understanding.

Activities can be adapted for different skill and interest levels. You can also choose to do all the activities or select only a few of them.

Educators/facilitators should guide students in carrying out each step, encouraging discussion, group collaboration and the practical application of theoretical concepts.

Students: Can refer to the manual for guidance on objectives and requirements for each activity, using it as a roadmap through the complex challenges of the program.

Support and Resources

This Manual is one of the resources created by the No One Stays behind (NSB), Erasmus+ project n°2021-1-PT01-KA220-VET-000034845. Other resources complementary to this project result are available at the project's website www.nsb-erasmus.eu.

NSB Project Results:

- R1 – NSB App
- R2 - Mentoring Guide
- R3 – Summer School Manual
- R4 – Evaluation Management Platform

ACTIVITIES

SUMMER SCHOOL MANUAL

	ACTIVITY	OBJECTIVES	DUARTION	PAGE
1	MODELLING SUSTAINABLE CITIES	Provide students with the opportunity to apply science, technology, engineering, and mathematics concepts to develop a city model that responds to the challenges of urban sustainability, encouraging innovative and integrated solutions.	1 DAY*	
2	SMART CITIES AND THE INTERNET OF THINGS (IOT)	Explore the concept of smart cities through the design and simulation of integrated systems using the Internet od Things (IoT), allowing students to understand how technology can improve efficiency and quality of life in urban areas.	1 DAY*	
3	THE ROLE OF ART IN URBAN SPACE	Encourage students to explore and integrate art into the urban context, creating projects that use art as a means of social and aesthetic transformation in cities.	1 DAY*	
4	URBAN PLANNING AND MATHEMATICS: SPACE PLANNING	Apply mathematical concepts to the planning and optimization of urban space, teaching students how mathematics can be used to solve spatial distribution and logistics problems in cities.	1 DAY*	
5	TECHNOLOGY AND URBAN TRANSPORT	Explore how technology can be applied to improve transport systems in urban areas, focusing on efficiency, sustainability, and accessibility.	1 DAY*	
6	RENEWABLE ENERGY IN CITIES	Study and apply renewable energy concepts in the urban context, designing practical solutions for the efficient use of clean energy sources in urban areas.	1 DAY*	
7	GREEN PLANNING: PARKS AND PUBLIC SPACES	Encourage students to design and plan urban green spaces that not only beautify the city, but also offer ecological and social functionalities, promoting biodiversity and the well-being of citizens.	1 DAY*	
8	WASTE MANAGEMENT AND URBAN RECYCLING	Teach students about the importance of effective waste management and recycling practices in urban areas, designing collection and processing systems that are efficient, sustainable, and adaptable to the city's needs.	1 DAY*	
9	GREEN TECHNOLOGY AND SUSTAINABLE CONSTRUCTION	Explore the use of green technologies in construction, encouraging students to design buildings that integrate sustainable solutions to minimize environmental impact and maximize energy efficiency.	1 DAY*	
10	ENERGY AND CHEMISTRY IN URBAN LIFE	Investigate and apply physics and chemistry concepts to solve energy problems in urban environments, with an emphasis on optimizing energy consumption and reducing pollutants.	1 DAY*	
	FINAL ACTIVITY: ESCAPE ROOM STEAM CHALLENGE WITH ROBOTICS	Promote the integration and application of knowledge acquired in previous activities, encouraging creativity, teamwork, and critical thinking. Students will be challenged to create and participate in a digital escape room, combined with a practical robotics challenge.	2 DAYS*	

* The duration of the activities presented is mere suggestive. The duration of each activity should be adapted to the group profile and characteristics.

STEAM ACTIVITIES

SUMMER SCHOOL MANUAL

1

ACTIVITY

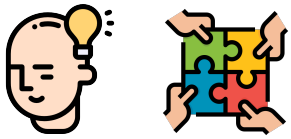
MODELLING SUSTAINABLE CITIES

OBJECTIVE

Provide students with the opportunity to apply science, technology, engineering, and mathematics concepts to develop a city model that responds to the challenges of urban sustainability, encouraging innovative and integrated solutions.

SKILLS DEVELOPED

★ ★ ★ ★ ★

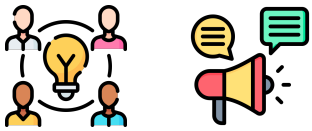


CRITICAL THINKING AND PROBLEM SOLVING

Assessing urban challenges and developing sustainable solutions.

CREATIVITY AND INNOVATION

Using creative techniques to design city models that integrate innovative solutions to real problems.



COLLABORATION AND COMMUNICATION

Teamwork to build models and present solutions, improving communication skills.

NECESSARY MATERIALS

- Graphic design or CAD software (such as AutoCAD or SketchUp)
- Decoration materials such as fabric, coloured paper, and natural elements for detailing
- Cardboard, cardboard, and other recyclable materials
- Glue, scissors, painting supplies and marker pens
- Computers with Internet access for research

TIP:

If you don't have access to graphic design software, reformulate the activity and build only the physical models for parts of the city.

PROCEDURES

1. RESEARCH AND CONCEPTUALIZATION:

- Start with a brainstorming session to identify the main urban problems: pollution, waste management, transport, green infrastructure, among others.

- Discussion about what makes a city sustainable, covering topics such as energy efficiency, sustainable transport systems, and natural resource management.

2. RESEARCH AND PLANNING:

- Students, organized into groups, choose a specific problem to address.

- Conduct detailed research on existing solutions and emerging technologies that can be applied.

- Each group drafts a plan that details how these solutions can be integrated into the city's design.

3. DRAWING AND MODELLING:

- Using CAD software, each group designs their section of the city, focusing on the chosen solutions.

- Projects should reflect practical and aesthetic considerations, integrating the arts into urban design.

4. CONSTRUCTION AND ASSEMBLY:

- Using recyclable materials, each group builds a physical model of their part of the city.

- The parts are assembled into a large model that represents the entire city, highlighting the interconnectivity of the solutions.

5. PRESENTATION AND DEBATE:

- Each group presents their part of the project to the class, explaining the design and technology choices.

- Class discussion about the benefits and possible challenges of the proposed solutions.

REFLECTION QUESTIONS

- *How do the chosen solutions impact the quality of life of urban inhabitants?*

- *How was the interdisciplinarity between STEAM crucial to the development of the project?*

ASSESSMENT

- Originality and sustainability of the proposed urban solutions.
- Coherence and functionality of urban design.
- Clarity and depth of presentation and argumentation.

BOOST THIS ACTIVITY

Real-World Partnerships: Partner with local city planners for workshops on sustainable development.

Community Surveys and Feedback: Involve community feedback in the planning stages to make designs more applicable to real needs.

2

ACTIVITY

SMART CITIES AND THE INTERNET OF THINGS (IOT)

OBJECTIVE

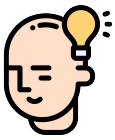
Explore the concept of smart cities through the design and simulation of integrated systems using the Internet of Things (IoT), allowing students to understand how technology can improve efficiency and quality of life in urban areas.

SKILLS DEVELOPED

★ ★ ★ ★ ★

DIGITAL LITERACY

Assessing urban challenges and developing sustainable solutions.



CRITICAL THINKING

Using creative techniques to design city models that integrate innovative solutions to real problems.

SOLVING COMPLEX PROBLEMS

Teamwork to build models and present solutions, improving communication skills.

NECESSARY MATERIALS

- Computers with Internet access
- IoT development kits such as Raspberry Pi or Arduino
- Various sensors (temperature, movement, light, etc.)
- Material for building models (cardboard, cardboard, etc.)
- Programming software (Python, Scratch, etc.)

TIP:

If you don't have access to software proposed and/or wish to keep this activity simpler, skip steps 3 and 4 of the activity, and stick to planning of ideas only.

PROCEDURES

1. THEORETICAL INTRODUCTION

- Discussion about what smart cities are and how IoT can be applied to solve urban problems.
- Presentation of examples of IoT applications in real cities.

2. PLANNING AND DESIGN

- Each group chooses an urban problem to address with IoT solutions (traffic management, smart public lighting, environmental monitoring, etc.).
- Students sketch how their IoT devices will interact within urban infrastructure.

3. DEVELOPMENT AND PROGRAMMING

- Configuration of IoT kits and programming of sensors to collect and send data.
- Implementation of simple algorithms that respond to this data to improve some aspect of urban life.

4. CONSTRUCTION OF THE MODEL

- Construction of a model that represents part of the city, incorporating IoT devices.
- Simulation of how devices interact and benefit the city.

5. PRESENTATION AND ASSESSMENT

- Demonstration of the operation of the model and IoT devices.
- Each group explains the potential impact of their solution on urban life.

REFLECTION QUESTIONS

- *What are the challenges of implementing large-scale IoT solutions in cities?*
- *How can citizens' privacy be affected by these technologies?*

ASSESSMENT

- Innovation and relevance of the proposed IoT solutions.
- Technical functionality of programmed devices.
- Effective presentation and practical demonstration.

BOOST THIS ACTIVITY

Technology Integration: Use Augmented Reality to visualize IoT solutions in a virtual smart city.

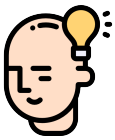
ACTIVITY

THE ROLE OF ART IN URBAN SPACE

OBJECTIVE

Encourage students to explore and integrate art into the urban context, creating projects that use art as a means of social and aesthetic transformation in cities.

SKILLS DEVELOPED

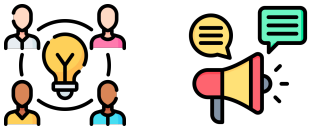


CRITICAL THINKING

Reflection on the impact of art on the environment and society.

CREATIVITY AND INNOVATION

Exploration of art as a means of expression and social transformation in urban environments.



COLLABORATION AND COMMUNICATION

Presentation of artistic projects and collaboration with colleagues for feedback and improvement of ideas.

NECESSARY MATERIALS

- Various art materials (paints, brushes, spray, canvas, paper, etc.)
- Cameras or smartphones for capturing images
- Suitable space for artistic installations
- Computers with image and video editing software
- Glue, scissors, painting supplies and marker pens

PROCEDURES

1. EXPLORATION AND RESEARCH

- Introduction to the role of urban art (muralism, sculptures, installations, etc.) and how it can influence the perception of urban space.
- Virtual visit to cities known for their urban art for inspiration.

2. CONCEPTUALIZATION AND DESIGN

- Group discussion to choose a topic or social problem to address through art.
- Creation of sketches and plans for the works of art that will be produced.

3. ARTISTIC CREATION

- Execution of works of art, which can be murals, interactive installations, or performances.
- Documentation of the creative process through photographs and videos.

4. ASSEMBLY AND EXHIBITION

- Preparation of a space at the school or virtually to display the works.
- Assembly of works of art, considering interaction with the public and visual impact.

5. PRESENTATION AND REFLECTION

- Presentation of works to colleagues and the school community.
- Discussion about how works can contribute to social changes or improvements in the urban environment.

REFLECTION QUESTIONS

- *How can art be used to provoke dialogue and reflection on urban issues?*
- *How is art in public space different from art in closed spaces, like galleries?*

ASSESSMENT

- Creativity and originality of the works of art produced.
- Ability to communicate a message or theme clearly through art
- Public engagement with the works during the exhibition.

BOOST THIS ACTIVITY

Public Art Projects: Collaborate with local artists to create public installations that address urban challenges.

Digital Storytelling and Film: Document the creation and impact of art installations through digital media.

4 ACTIVITY

URBAN PLANNING AND MATHEMATICS: SPACE PLANNING

OBJECTIVE

Apply mathematical concepts to the planning and optimization of urban space, teaching students how mathematics can be used to solve spatial distribution and logistics problems in cities.

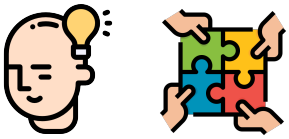
SKILLS DEVELOPED

MATHEMATICAL LITERACY AND ANALYSIS

Use of mathematics to solve space planning and optimization problems.

CREATIVITY

Space layout design that is both functional and aesthetically pleasing.



CRITICAL THINKING AND PROBLEM SOLVING

Application of mathematical concepts to create practical and functional solutions for the use of urban space.

NECESSARY MATERIALS

- Graph paper and pencil
- Ruler, compass, and protractor
- Computers with 3D modelling software (such as Geogebra 3D)
- Calculators

PROCEDURES

1. MATHEMATICAL THEORY

• Introduction to mathematical concepts such as geometry, trigonometry, and calculus, explaining how they can be applied in urban planning.

• Case studies where mathematics was fundamental in efficient urban design.

2. SPACE ANALYSIS

• Observation and analysis of maps of urban areas, identifying space problems such as congested or poorly used areas.

• Calculation of areas and perimeters required for different urban facilities (parks, commercial, residential areas, etc.).

3. MODELLING AND SIMULATION

• Use of 3D modelling software to create virtual models of the areas studied.

• Simulation of different layouts and their spatial efficiency, applying the mathematical concepts discussed.

4. PROPOSAL DEVELOPMENT

• Creation of reorganization proposals or new designs for the analysed spaces.

• Presentation of proposals in project format, with drawings and calculations that justify the decisions.

5. PRESENTATION AND DEBATE

• Each group presents their part of the project to the class, explaining the design and technology choices.

• Class discussion about the benefits and possible challenges of the proposed solutions.

REFLECTION QUESTIONS

• What are the challenges of implementing large-scale IoT solutions in cities?

• How can citizens' privacy be affected by these technologies?

ASSESSMENT

• Innovation and relevance of the proposed IoT solutions.
• Technical functionality of programmed devices.
• Effective presentation and practical demonstration.

BOOST THIS ACTIVITY

Mathematics and Practical Application: Apply data science techniques to analyse traffic patterns and optimize urban layouts.

Economic Models: Develop simple economic models to understand the costs and benefits of different urban planning decisions.

5

ACTIVITY

TECHNOLOGY AND URBAN TRANSPORT

OBJECTIVE

Explore how technology can be applied to improve transport systems in urban areas, focusing on efficiency, sustainability, and accessibility.

SKILLS DEVELOPED

★ ★ ★ ★ ★

DIGITAL LITERACY

Skills with simulation software to analyse and improve transportation systems.

COLLABORATION

Teamwork to develop solutions that integrate technology and transportation.

CRITICAL THINKING

Understanding how improvements in one part of the transport system can affect the entire urban system.

NECESSARY MATERIALS

- Computers with Internet access
- Free traffic simulation software, such as SUMO (Simulation of Urban MObility)
- Graph paper, pencil and drawing material
- Articles and case studies on innovations in urban transport

PROCEDURES

1. INTRODUCTION TO URBAN TRANSPORT

- Discussion on the current challenges of transport systems in large cities.

- Analysis of examples of technological innovations in transport, such as autonomous vehicles, electronic ticketing systems and non-polluting public transport.

2. RESEARCH AND ANALYSIS

- Each group selects an aspect of urban transport to improve (reducing travel time, increasing capacity, reducing environmental impact, etc.).

- Research into existing and emerging technologies that can be applied to the chosen problem.

3. SIMULATION AND MODELLING

- Use of the free SUMO software to model the identified problem and test different technological solutions.

- Analysis of simulation results to determine the effectiveness of solutions.

4. PROPOSAL DEVELOPMENT

- Preparation of an implementation proposal that includes the technologies studied, justifying the choice with simulation data.

- Preparation of a visual presentation that illustrates the expected impact of the proposal.

5. PRESENTATION AND CRITICISM

- Presentation of proposals to the class, highlighting how technology can solve the chosen problem.

- Discussion and feedback from colleagues and the teacher on the feasibility and potential challenges of the proposals.

REFLECTION QUESTIONS

- How would the proposed technological solutions affect citizens' daily lives?

- What ethical and social considerations are important when implementing new technologies in public transport?

ASSESSMENT

- Clarity and technical basis of the proposed solutions.
- Originality and impact of proposals in the urban context.
- Quality of presentation and ability to argue.

BOOST THIS ACTIVITY

Technology Integration: Utilize VR to simulate transportation improvements and their effects on urban flow.

Real-World Partnerships: Engage with local transport authorities to gain insights and real data for simulation.

6 ACTIVITY

RENEWABLE ENERGY IN CITIES

OBJECTIVE

Study and apply renewable energy concepts in the urban context, designing practical solutions for the efficient use of clean energy sources in urban areas.

SKILLS DEVELOPED

ECOLOGICAL AWARENESS AND SUSTAINABILITY

Understanding the importance of renewable energy and developing projects that use these sources.

CREATIVITY AND INNOVATION

Design innovative energy systems that are efficient and sustainable.

PROBLEM SOLVING

Identification and solution of technical challenges in the implementation of renewable energy in urban contexts.

NECESSARY MATERIALS

- Computers with Internet access
- Solar energy kits or mini wind turbines for experiments
- Writing and drawing material for projects
- Multimeters and other energy measuring equipment

TIP:

Dare yourself and do the presentation of your work in a foreign language, for instance, English.

PROCEDURES

1. INTRODUCTION TO RENEWABLE ENERGY

- Discussion about different types of renewable energy (solar, wind, hydro, etc.) and how they can be integrated in cities.

- Analysis of case studies of cities that have successfully implemented renewable energy solutions.

2. PLANNING AND DESIGN

- Divide students into groups, where each one chooses a form of energy to explore.

- Design of a small system that uses the chosen energy to supply electricity to a part of a city model.

3. CONSTRUCTION AND EXPERIMENTATION

- Assembling energy kits, such as solar panels or wind turbines, to capture energy.

- Measurement and recording of the amount of energy generated and analysis of its viability for urban applications.

4. PROPOSAL DEVELOPMENT

- Creation of proposals on how to integrate energy solutions into urban spaces, considering aspects such as cost, efficiency, and environmental impact.

- Preparation of presentations that detail the operation and benefits of the proposals.

5. PRESENTATION AND DISCUSSION

- Presentation of proposals to the class, with practical demonstrations of energy kits.

- Discussion on the challenges and opportunities of implementing renewable energy in cities.

REFLECTION QUESTIONS

- *What challenges do cities face when integrating renewable energy on a large scale?*

- *How can the proposed solutions be adapted to different urban contexts?*

ASSESSMENT

- Creativity and innovation in the use of renewable energy.
- Technical precision and viability of energy solutions.
- Quality of presentation and clarity in communicating ideas.

BOOST THIS ACTIVITY

Sustainability Challenges: Implement a competition to design the most efficient solar-powered system.

ACTIVITY

GREEN PLANNING: PARKS AND PUBLIC SPACES

OBJECTIVE

Encourage students to design and plan urban green spaces that not only beautify the city, but also offer ecological and social functionalities, promoting biodiversity and the well-being of citizens.

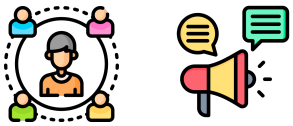
SKILLS DEVELOPED

ECOLOGICAL THINKING

Design of green spaces that contribute to biodiversity and community well-being.

CREATIVITY AND INNOVATION

Creation of green areas that are unique and functional.



SOCIAL SKILLS AND COMMUNICATION

Development of projects that promote community interaction and improve the quality of urban life.

NECESSARY MATERIALS

- Graph paper, pencils, coloured pens
- Computers with landscape design software (such as SketchUp)
- Various materials for models (cardboard, fabrics, plastics, etc.)
- Books and articles on ecological urbanism and green space design

TIP:

Conduct surveys in your community to get feedback on their needs and desires for green spaces.

PROCEDURES

1. THEORY AND INSPIRATION

- Introduction to the concepts of green urbanism, discussing the importance of green spaces in urban areas.

- Exploration of famous examples of successful urban parks and public spaces around the world.

2. RESEARCH AND DESIGN

- Each group of students chooses an area in their community or city model where a green space could be designed.

- Detailed design of the space, considering aspects such as variety of plants, paths, rest areas, and recreational equipment.

3. MODELLING AND VISUALIZATION

- Using design software to create visual representations of designed spaces.

- Construction of a physical model that reflects the proposed design, using materials that simulate different natural and built elements.

4. PRESENTATION AND FEEDBACK

- Presentation of the projects to the class, explaining how each design element contributes to the functionality and aesthetics of the space.

- Group discussion on the proposals, receiving feedback from colleagues and teachers.

5. REFLECTION AND REVIEW

- Reflection on the potential impact of green spaces on the urban environment and the quality of life of inhabitants.

- Review projects based on feedback received, adjusting, and improving designs.

REFLECTION QUESTIONS

- How can green spaces contribute to urban resilience?

- What are the main challenges in maintaining urban parks?

ASSESSMENT

- Originality and functionality of the green space design.
- Technical and aesthetic quality of the model and digital representations.
- Ability to articulate ideas during presentation and respond to feedback.

BOOST THIS ACTIVITY

Art and Cultural Expression: Integrate cultural elements into park designs, reflecting the history and identity of the local community.

8

ACTIVITY

WASTE MANAGEMENT AND URBAN RECYCLING

OBJECTIVE

Teach students about the importance of effective waste management and recycling practices in urban areas, designing collection and processing systems that are efficient, sustainable, and adaptable to the city's needs.

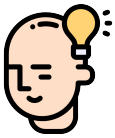
SKILLS DEVELOPED

ECOLOGICAL AWARENESS AND SUSTAINABILITY

Development of a deep understanding of the environmental impacts of urban waste and the importance of recycling.

CREATIVITY AND INNOVATION

Creation of new solutions for processing and reducing waste.



CRITICAL THINKING

Analysis of how different waste management systems interact within an urban environment.

NECESSARY MATERIALS

- Computers with Internet access for research
- Paper, pencils, and drawing supplies for sketching
- Recyclable materials for model construction
- 3D modelling software (such as SketchUp)

PROCEDURES

1. THEORETICAL STUDY

· Introduction to the environmental impact of urban waste and the importance of recycling.

· Study of different waste collection and processing methods used around the world.

2. RESEARCH AND PLANNING

· Each group of students chooses a type of waste (organic, plastic, paper, glass, electronics, etc.) to develop.

· Development of an integrated collection, separation, and recycling system for this type of waste.

3. DESIGN AND MODELLING:

· Creation of sketches and, subsequently, 3D models of the proposed waste management systems.

· Construction of models that demonstrate the functionality of the collection and processing system.

4. SIMULATED IMPLEMENTATION

· Simulation of how the system would work in an urban area, using the model and digital presentations.

· Analysis of the strengths and limitations of the proposed system.

5. PRESENTATION AND DISCUSSION

· Presentation of waste management systems to the class, highlighting the innovation and sustainability of the solutions.

· Discussion of the practical feasibility and environmental challenges of the proposed systems.

REFLECTION QUESTIONS

· What are the biggest barriers to implementing efficient recycling systems in cities?

· How can the proposed solutions be adapted to different urban contexts?

ASSESSMENT

· Innovation and sustainability of the proposed waste management system.

· Clarity and technical detail in mock-ups and 3D models.

· Efficiency in presentation and ability to argue about the advantages of the system.

BOOST THIS ACTIVITY

Sustainability Challenges: Design a zero-waste system for a section of the city modelled by students.

Real-World Partnerships: Partner with local recycling facilities and do field trips to understand and integrate real-world waste management systems.

9

ACTIVITY

GREEN TECHNOLOGY AND SUSTAINABLE CONSTRUCTION

OBJECTIVE

Explore the use of green technologies in construction, encouraging students to design buildings that integrate sustainable solutions to minimize environmental impact and maximize energy efficiency.

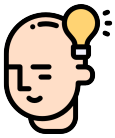
SKILLS DEVELOPED

INNOVATION AND PROBLEM SOLVING

Design buildings that incorporate sustainable technologies to solve environmental problems.

COMMUNICATION AND COLLABORATION

Work as a team to develop projects and effectively communicate their advantages and challenges.



CRITICAL THINKING

Evaluate the feasibility and effectiveness of sustainable technologies and materials.

NECESSARY MATERIALS

- Computers with Internet access
- Architectural design software such as SketchUp
- Materials for models (cardboard, glue, scissors, etc.)
- Case studies on sustainable buildings

PROCEDURES

1. INTRODUCTION TO SUSTAINABLE CONSTRUCTION

- Discussion on the principles of sustainable construction, such as energy efficiency, eco-friendly materials, and integration with the natural environment.

- Analysis of examples of buildings that exemplify these principles.

2. DESIGN AND PLANNING

- Each group of students chooses a type of building to design (residential, commercial, educational, etc.) with a focus on sustainability.

- Layout planning, choice of materials and definition of green technologies to be incorporated.

3. MODELLING AND SIMULATION

- Use of design software to create digital models of buildings.

- Simulation of aspects such as energy consumption and environmental impact.

4. CONSTRUCTION OF MODELS

- Construction of physical models of the projects, using materials that simulate the properties of the proposed sustainable materials.

- Detail of incorporated technological solutions, such as solar panels or rainwater collection systems.

5. PRESENTATION AND ASSESSMENT

- Presentation of the projects to the class, explaining how each design decision contributes to the sustainability of the building.

- Discussion on the feasibility of the technologies used and the potential impact on the urban environment.

REFLECTION QUESTIONS

- *How can buildings contribute to the sustainability of a city?*

- *What are the challenges of implementing green technologies in current construction?*

ASSESSMENT

- Innovation and effectiveness of the sustainable solutions adopted.
- Technical quality of digital models and mock-ups.
- Clarity and depth in the presentation and justification of design choices.

BOOST THIS ACTIVITY

Public Art Projects: Integrate sustainable materials into artistic features of the buildings.

10

ACTIVITY

ENERGY AND CHEMISTRY IN URBAN LIFE

OBJECTIVE

Investigate and apply physics and chemistry concepts to solve energy problems in urban environments, with an emphasis on optimizing energy consumption and reducing pollutants.

SKILLS DEVELOPED

SCIENTIFIC AND TECHNICAL LITERACY

Application of physics and chemistry knowledge to explore and resolve energy issues.

INNOVATIVE AND CREATIVE THINKING

Development of energy solutions that are sustainable and efficient.

DATA ANALYSIS AND PROBLEM SOLVING

Using experimentation and analysis to test the effectiveness of different energy solutions and their applicability in urban contexts.

NECESSARY MATERIALS

- Computers with Internet access for research
- Physics and chemistry educational kits (such as energy kits, thermometers, pH meters, etc.)
- Materials for building models and experiments (batteries, LED lamps, small motors, etc.)
- Adequate space for safe experimentation

PROCEDURES

1. INTRODUCTION TO APPLIED PHYSICS AND CHEMISTRY

- Exploration of how physics and chemistry impact energy use and the urban environment.

- Study of concepts such as thermodynamics, chemical reactions, and their applications in clean and efficient technologies.

2. EXPERIMENTATION WITH ENERGY

- Experiments to explore energy efficiency using different light sources (incandescent, fluorescent, LED) and measuring their energy consumption.

- Experiments with solar cells to understand the conversion of solar energy into electrical energy.

3. ENVIRONMENTAL CHEMISTRY

- Chemical analysis of air and water samples to identify common pollutants in urban environments.

- Experiments to test purification and treatment methods using simple chemical principles (such as filtration, distillation, and neutralization).

4. DEVELOPMENT OF SUSTAINABLE SOLUTIONS

- Design of simple systems that use physics and chemistry principles to improve energy efficiency or reduce pollution.

- Construction of models or prototypes that demonstrate the proposed solutions.

5. PRESENTATION AND DISCUSSION

- Presentation of experiments and solutions developed for the class.

- Discussion about how these solutions can be implemented on a real scale in the city and what the impacts would be.

REFLECTION QUESTIONS

- *How can the principles of physics and chemistry contribute to more sustainable cities?*

- *What are the challenges of applying these solutions on a large scale?*

ASSESSMENT

- Creativity and innovation in proposed solutions.
- Scientific rigor and precision in the experiments carried out.
- Clarity and depth in the presentation of results and solutions.

FINAL ACTIVITY

ESCAPE ROOM STEAM CHALLENGE WITH ROBOTICS

OBJECTIVE

Promote the integration and application of knowledge acquired in previous activities, encouraging creativity, teamwork, and critical thinking.

Students will be challenged to create and participate in a digital escape room, combined with a practical robotics challenge.

NECESSARY MATERIALS

- Computers with Internet access and Genially software or similar to create digital escape rooms.
- Robots follow programmable lines.
- Various materials to create physical challenges (cards, track, etc.).
- Programming tools for robots.

PROCEDURES

DAY 1

CREATING CHALLENGES

1. CONTENT REVIEW

Students review the concepts and skills developed in Activities 1 (Modelling Sustainable Cities) and 10 (Energy and Chemistry in Urban Life) to integrate this knowledge into the escape room challenges.

2. DEVELOPMENT OF THE DIGITAL ESCAPE ROOM

In groups, students use Genially to create interactive challenges that reflect the themes of urban sustainability and physics and chemistry applications. Challenges must be logical, educational and require solutions based on acquired knowledge.

3. INTEGRATION WITH ROBOTICS

Each digital challenge corresponds to a physical station that the robot must reach. Students program the robots to navigate a route that connects these stations.

Physical challenges may include manipulating objects, responding to sensors, or adjusting trajectory based on correct responses in the digital escape room.

DAY 2

COMPETITION BETWEEN GROUPS

1. CHALLENGE SETUP

Groups set up the course and prepare the robots at the starting line.

Each team will have a tablet or computer to access the corresponding digital escape room.

2. COMPLETION OF THE CHALLENGE

Groups compete against each other to complete the circuit. Each team must solve the challenges in the escape room to advance the robot to the next station.

Time is measured from the beginning until the robot completes the route.

3. RATING AND FEEDBACK

After the competition, students discuss solutions to the challenges, explore different team approaches and receive feedback from teachers.

Discussion on how the integration of STEAM knowledge helped in solving challenges and programming robots.

TIP:

You don't have access to robots and programming tools.

Don't worry! Stick only to the creation of the Digital Escape Room.

REFLECTION QUESTIONS

- *How were critical thinking and problem-solving skills essential to success in challenges?*

- *How did collaboration and communication influence the team's performance during the competition?*

ASSESSMENT

- Creativity and innovation in proposed solutions.

- Scientific rigor and precision in the experiments carried out.

- Clarity and depth in the presentation of results and solutions.

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