Europeana Learning Scenario
(Teachers)

Title

Let's Build Bridges!

Author(s)

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Abstract

Our project aims to research and study the basic types of bridge structures, familiarize ourselves with the main bridge constructions, determine the significance of bridges in human life, and identify the main characteristics and details necessary for their construction. We also plan to determine the distribution of compressive and tensile forces in the main types of bridges. As part of the project, we will be building our own bridge using simple materials and experimentally determining the maximum load that our constructed bridge can withstand. Our project will help deepen the understanding of bridge construction and their role in human life.

Keywords

Bridge engineering, Structural engineering, steam, art, Cooperative learning

Table of summary

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Subject	Mathematics, Technology, Engineering, Geography, and History of Technology are involved in our project. Students will learn about the physical principles behind bridge construction, perform calculations for bridge design, study the history of technology and the development of engineering art. They will also work with software such as Tinkercad to design and create their own bridges.
Topic	This educational project is developed by a teacher of computer science and mathematics. Therefore, it can be the final stage in studying the topic of 3D design in computer science classes.
Age of students	13-14
Preparation time	90 min
Teaching time	150 min
Online teaching material	Bridges AR - augmented reality application http://kfk.biz.ht/android/Bridges/images_ukr.html https://en.wikipedia.org/wiki/Tacoma_Narrows_Bridge_(1940) https://www.golabz.eu/lab/suspension-bridge http://www.thephysicsaviary.com/Physics/Programs/Labs/SuspensionBridge/index.html https://www.tinkercad.com/

Funded by the European Union

	https://youtu.be/JIPW_em98UA https://ua.mozaweb.com/uk/search?search=%D0%BC%D0%BE%D1%81%D1%82%D0%B8 https://www.geogebra.org/m/uefuhrdh?fbclid=IwAR0R4hp0XxfuEnuKETVULHvtvZvPc1klJcKMwiqOo6Q4KtSdlcTv6XXtXb8
Offline teaching material	Computer, projector, tracing paper, straws, tape, glue, containers.
Europeana resources used	https://www.europeana.eu/en/galleries/9188-bridges-of-europe https://www.europeana.eu/en/galleries/10678-let's-build-bridges! https://www.europeana.eu/en/collections/topic/1846-bridge https://www.europeana.eu/en/item/90402/RP_T_1968_38_V_ https://www.europeana.eu/en/item/90402/RP_T_1979_103 https://www.europeana.eu/en/item/199/item_U5HSI6PGWFIVHAF45SO3TC643Y3VXKAU *Disclaimer:* Europeana Galleries may content objects in copyright, please remember that to creative reuse these specific items (like download it to paste it in any format, physically display it or transform it in any way for a project) out of the schools premises will need permission of the authors or the providing institution.”

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Integration into the curriculum

During the project, students will learn mathematical concepts such as geometry and trigonometry to calculate various aspects of bridges, such as length, height, angle of inclination, and other parameters. They will also learn to use software for bridge design, developing their skills in the field of computer science.

Students will learn about the geographical features of different regions and various obstacles they may face when designing bridges, enhancing their knowledge in the field of geography.

Studying the physical principles behind bridge construction will allow students to understand how bridge structures work and how they can be improved.

In the process of completing the project, students will also learn computer skills such as using design software to create and modify their bridge designs. They will gain experience in using tools such as Tinkercad and other design software to create 3D models of their bridges, which will develop their skills in the field of computer science.

Thus, the project will help students increase their knowledge in the fields of mathematics, computer science, geography, and physics, as well as develop their creative and analytical skills.

Aim of the lesson

The ultimate goal of the project is to create functional bridges that meet all the necessary criteria that the students have learned during the project. Students will work in teams and apply their knowledge of mathematics, physics, geography, and computer science to design and build bridges that will be evaluated and tested for strength and stability.

In addition, the ultimate goal of the project is to develop students' creative and analytical skills, as well as teamwork and communication skills. Students will learn to collaborate and solve problems together, using their individual knowledge and skills.

When the bridges are built, students will have the opportunity to demonstrate their achievements, share what they have learned and how they have succeeded, and present their projects to their classmates and parents. Students will also be involved in art, learning about design elements and aesthetics necessary for creating effective and attractive bridges. They will have the opportunity to develop their creative abilities by solving complex bridge design tasks that require the interaction of different disciplines, including mathematics, physics, computer science, geography, and art.

The knowledge and skills gained from bridge design will form the basis for students' future professional development in the fields of engineering, architecture, and construction. In addition, this project will improve students' overall competence in important areas that can be applied in various aspects of life, including scientific research, technical, and artistic fields.

During the project, students will also have the opportunity to explore European cultural heritage associated with bridges. They will be able to learn about the history and architecture of these bridges, which will help them increase their cultural level and broaden their horizons. Additionally, students will be able to create artistic reproductions of bridges, which are an important artistic component of the project, and develop their creative and artistic skills.

Outcome of the lesson

This project aimed to develop the creative, analytical, and communicative skills of the students, as well as teamwork skills. The students gained knowledge in mathematics, physics, geography, computer science, and art, which will help them in their future professional development in the fields of engineering, architecture, and design. The project also allowed the students to explore European cultural heritage related to bridges and develop their creative and artistic skills.

Trends

Problem-based learning - the use of real-world problems and tasks that provide opportunities for the application of knowledge and skills in practical situations.
Communicative approach - a focus on developing students' communication skills, which helps them to communicate effectively, collaborate, and solve problems.
Integrated learning - the combination of multiple subjects in the learning process to ensure a deeper understanding of the connections between them.
Balanced learning technologies - the use of various methods and approaches that help ensure the balanced development of different skills and competencies in students.
Project-based learning - learning focused on solving real-world problems and tasks that require active exploration, creative thinking, and collaboration from students.

Developmental learning - learning aimed at developing not only knowledge but also personal qualities of students, such as critical thinking, self-assessment, emotional and social intelligence, etc.
Adaptive learning - learning that adapts to the individual needs and abilities of each student, ensuring a more effective and efficient learning process.

Key competences

Critical thinking: students can develop critical thinking skills by analyzing and evaluating different aspects of the project, investigating problems and seeking solutions.
Communication skills: students can develop communication skills by collaborating with other students and teachers, presenting their thoughts and ideas to a group of people.
Creativity: students can develop creative skills by developing new and unconventional ideas and solutions.
Teamwork: students can learn to work effectively in a team, share responsibilities, and interact with other project participants.
Interdisciplinary knowledge: students can develop interdisciplinary knowledge and skills by using knowledge from different subjects to solve a specific problem.
Independence: students can learn to work independently, researching new materials and finding solutions to specific problems.

Activities

Name of activity	Procedure	Time
First lesson - art and engineering 60 min	1. Introduction by the teacher about the art of bridge building and its impact on our lives. 2. Introduction to the project: presentation of the project and its objectives. Explanation of the lesson topic - exploring bridge types. 3. Video demonstration of different types of bridges and their features. Discussion of the most common bridges in Europe. • What are the most common bridge types in Europe? • What are the features of different bridge types? • What materials are used for building bridges? • How are forces distributed on different types of bridges? • What role do bridges play in people's lives?	1 min 1 min 3 min 20 min

Name of activity	Procedure	Time
	4. Work with Europeana: students research and find images of different types of bridges on the Europeana platform. https://www.europeana.eu/en/galleries/9188-bridges-of-europe 5. Work with augmented reality: students use augmented reality to see types of bridges and their details. 6. "Bridge puzzle game" will help children learn more about the shape and construction of bridges. Children can work in groups or individually, depending on the number of puzzles and the complexity of the task. Using puzzles with images of different types of bridges can also help children learn the names and main characteristics of each bridge type. 7. Filling out bridge cards. The cards are created with questions about different bridge types, their construction, and use. 8. Preparing presentations: students prepare presentations with found images and information about different bridge types. Presentation and discussion of presentations: students demonstrate their presentations and discuss the differences between different types of bridges. • What type of bridge has an arch shape? • What type of bridge is supported by cables that intersect each other? • What type of bridge consists of a single long beam? • What type of bridge is used to cross a river when it is necessary to preserve an open space for ships? • What type of bridge is supported by one or more columns on either side? 9. Drawing competition. Children draw their favorite bridge or city with the most interesting bridges. Children can be divided into groups or offered individual work." https://www.europeana.eu/en/item/90402/RP_T_1979_103 https://www.europeana.eu/en/item/199/item_U5HSI6PGWFIVHAF45SO3TC643Y3VXKAU 10. The teacher's closing speech: summary of the lesson and answers to questions that arose during the lesson. Assessment - rating. For each type of activity	8 min 2 min 4 min 10 min 8 min 3 min
Lesson Two and Three - Math,	1. Students look at an image of a broken and dangerous bridge and discuss how they would feel if they had to walk across it. - https://www.europeana.eu/en/item/900/nbm_bildarkiv_29627	2 min

Name of activity	Procedure	Time
Science, Technology, Design, Engineering 90 min	2. In class, students watch the "Tacoma Bridge" video. https://en.wikipedia.org/wiki/Tacoma_Narrows_Bridge_(1940) The video uses real-time footage of the collapse of the Tacoma bridge due to its poor design and construction. Then students discuss the reasons for the bridge's collapse. 3. Children look at images of the rebuilt Tacoma bridge and explain why its design looks stronger and safer. 4. In small groups, students study the structures of different bridges. https://www.europeana.eu/en/item/90402/RP_T_1968_38_V_ Then they discuss two questions in detail: What is similar about them? How do they differ? Then the class is invited to share their thoughts. In the group, students discuss their initial ideas, then draw a sketch and label their bridge project on a large sheet of paper. They are encouraged to include and label important parts of the bridge system. Annex 1 5. Natural Solution: Determining the Location for Building a Bridge. Children study the physical properties of different terrains, such as river depth, current speed, soil strength, etc., and determine the optimal location for building a bridge, taking these factors into account. Students create a presentation according to the plan: • Choosing a location for building a bridge. We chose locations where bridges were destroyed during military operations in Ukraine. • Determining the physical properties of the terrain: researching information on the Internet about the depth of the river, current speed, soil strength, etc. for different terrains. • Determining the optimal location for building a bridge: children can apply their knowledge of the physical properties of the terrain and conduct an analysis to determine the optimal location for building a bridge. For example, if the river has a high current speed, there may be problems with the strength of the bridge, so children can consider building a bridge where the current is slower. • Confirming the choice of the optimal location: children can use additional resources to verify their choice, such as consulting with experts or conducting additional research. 6. Children are working with a virtual physics laboratory. https://www.golabz.eu/lab/suspension-bridge This lab activity is designed for students to see how the forces required to support a suspension bridge change as an object moves across the bridge. This laboratory is intended to be used as a supplement to a live laboratory with similar equipment	3 min 3 min 8 min 8 min 8 min

Name of activity	Procedure	Time
	http://www.thephysicsaviary.com/Physics/Programs/Labs/SuspensionBridge/index.html 7. Children solve math problems using research results: a. Math problem: Determining the length of a bridge. Children can learn how to measure the length of a bridge using a tape measure or meter and solve a problem to find the length of the bridge using information about its height and slope. b. Math problem: Determining the load on a bridge. Children can investigate factors that affect the load on a bridge, such as the weight of vehicles, the number of crossings, etc., and solve a problem to determine the maximum allowable load on the bridge. The GeoGebra program is used for visualization. https://www.geogebra.org/m/uefuhrdh?fbclid=IwAR0R4hp0XxfuEnuKETVULHvtvZvPc1klJcKMwiqOo6Q4KtSdlcTv6XXtXb8 8. Students receive a group task to build a sturdy bridge. Working together, the students gather their materials and build their bridge. They test and refine their design during construction. The students verify the strength of the bridge they built and respond to the success criteria. Then, they evaluate their work by recording their answers to two questions: • What worked well in your group design? • What didn't work out? Why? Students can be offered to build their own bridges using supports (cardboard tubes), wooden sticks or poster board strips (cardboard), thread or rope. Children experiment with how many candies or coins each bridge holds depending on the placement of supports and the design of the bridge. This activity will help them understand that the longer the bridge, the weaker it is, and if the distance between the supports is too great, the bridge will collapse under its own weight. 9. Next, we will consider the structure of an arch bridge. An arch is one of the oldest architectural elements, developed and used by the Romans in their buildings, bridges, and aqueducts. Ask a couple of volunteers to demonstrate an arch bridge by pressing their hands together high above their heads and leaning forward. Ask the students where the force is applied in this bridge. Ask what will happen if the volunteers stand on a slippery surface. Then ask how they can counteract this movement. 10. The students are divided into groups (five to six students per group). Each group has about 50 plastic straws, one thin skewer (1 cm), a small plastic container, and candies can be used as a load. The students build a bridge structure and then test their structures for strength by carefully filling the containers with candies. Ask the students to count the number of candies that their structures were able to hold. Determine the winner and discuss the features of the strongest structure.	8 min 15 min 3 min 10 min

Name of activity	Procedure	Time
	11. Further discussion: • How do you think engineers and architects use this information during construction? • What kinds of events can push and pull real structures (gravity, water, wind, etc.)? • What factors do engineers consider before building bridges? • How far does a bridge need to span? • Is the location where the bridge is being built a critical factor? Is the ground sturdy enough to support large arch supports? Is there a good foundation where suspension cables can be anchored? • If the bridge needs to cross a river, how can engineers safely submerge supports and towers into the riverbed so that the flowing water doesn't wash them away? • What load should the bridge be able to carry? Can it withstand trains, cars, and pedestrians? • How do architects and engineers decide to have rigid structures? When might they want them to be flexible? • How can engineers increase a building's ability to withstand earthquakes? Pupils work with https://ua.mozaweb.com/uk/search?search=%D0%BC%D0%BE%D1%81%D1%82%D0%B8 . To better imagine what the bridge design should be. 12. Next, students create bridge designs using Tinkercad https://www.tinkercad.com/. For example, https://youtu.be/JIPW_em98UA. 13. Summarizing and evaluating the results.	8 min 10 min 4 min
Assessment		

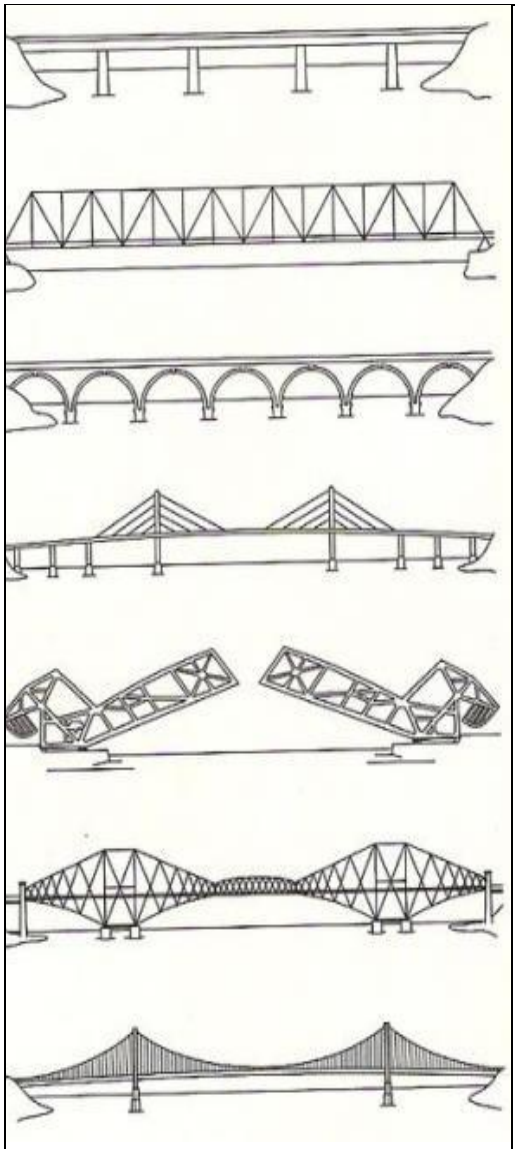
Item	Description
Understanding the task	The student should understand the task well and be able to formulate its purpose and objectives.
Planning	The student should be able to develop a work plan, including stages, deadlines, tools, and materials.
Research	The student should be able to research the project topic, search for information, and select necessary data.
Creativity	The student should demonstrate a creative approach to solving the task and propose new ideas and solutions
Teamwork	The student should be able to collaborate with other students, exchange ideas, and help each other.
Effectiveness	The student should complete the task within the established deadline and achieve the planned results.
Project presentation	Quality and clarity of information presented in the project presentation.
Risk assessment	Ability to identify and assess potential risks in the project.
Self-criticism and self-control	Ability to recognize and correct mistakes in one's own work.

About the Europeana DS project

Europeana is Europe's digital platform for cultural heritage, providing free online access to over millions of digitised items drawn from Europe's museums, archives, libraries, and galleries. The Deployment of a common European data space (DS) for cultural heritage project builds on and expands the existing functionalities and services of the Europeana Digital Service Infrastructure (Europeana DSI).This initiative works towards the development and operation of the data space infrastructure, the integration and of high-quality data in the data space, the capacity building of professionals, the reuse of existing resources and the improvement of the digital services for the public. .

European Schoolnet (EUN) is the network of more than 30 European Ministries of Education, based in Brussels. As a not-for-profit organisation, EUN aims to bring innovation in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers, researchers, and industry partners. European Schoolnet's task in the Europeana DS project is to facilitate the reuse of high-quality data and expand the community of users of Europeana for education.

Annex



1. Beam bridges are often used on highways. The beams rest on supports. These bridges can have a length of 300 meters.
2. Truss bridges are supported by trusses in the form of triangles. These bridges are often used for railways and are built over canyons, rivers, and other obstacles.
3. In an arch bridge, each span forms an arch. This is one of the oldest types of bridges. The Romans built such arches in their aqueducts and viaducts and used keystone to secure the arch. Many of these bridges still stand today.
4. Suspension bridges.
5. Drawbridges can be lifted or opened to allow ships to pass. A good example is the Tower Bridge in London.
6. Cantilever bridges.
7. Cable-stayed bridges are similar to suspension bridges, except that the cables are attached directly to the pylons.