Title of the STEAM Unit: Build a Bridge

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RELATED SUBJECTS	GRADE RECOMMENDATIONS	TOTAL ACTIVITY TIME	LEARNING OBJECTIVES DURING THE LESSON SUBJECT-SPECIFIC COMPETENCIES	LEARNING OBJECTIVES AFTER THE LESSON
Mathematics and Arts Architecture Physics	15 – 16 years	8 hours	spatial awareness surface and volume pressure - force	How does force work? Why are triangles stronger than squares?

OVERVIEW: TOPIC & PURPOSE

How to build the strongest bridge of the classroom?

Everyone must build a bridge of 1 meter with paper, cartons and a rope (prototype).

ACTIVITY PREREQUISITES

- They know what a bridge is.
- The students know what pressure and force means.
- The students know how to calculate triangles, squares, rectangles, cubes, cylinder and beam.

STEAM ELEMENTS

ELEMENT 1: **context presentation**	Picture of bridges – how do bridges work – architecture
ELEMENT 2: **creative design**	Design your own bridge!
ELEMENT 3: **emotional and social learning**	How to work together?

STEAM SUBJECT ELEMENTS

STEAM SUBJECTS	SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATHEMATICS
SHORT INTRODUCTION TO RELATED SUBJECT ELEMENTS	Relations between force, pressure and weight?	3D – modeling of the bridge	The stability of the bridge. How to create? How do you make couplings?	Architectural construction, that are realistic.	Sizes of cylinders and triangles. Measurement of the bridge (length, heigh)

SYLLABUS

LESSONS (=50 min)	SUBJECTS	TOPIC OF THE UNIT	LEARNING OBJECTIVES DURING THE LESSON: SUBJECT SPECIFIC COMPETENCIES	LEARNING OBJECTIVES AFTER THE LESSON: STEAM COMPETENCIES
1	Introduction	Studying how a real bridge works and examining real and famous bridges in the world. What are bridges? How do they work? Comparing bridges and rank them from "strongest" bridges to the "weakest".	Learn about architecture and how it works in society.	They will see how arts work in combination with architecture. They will see how these bridges became famous (way of architecture).
2 + 3	Learning activities	Design and think about building your own bridge. Starting with a normal paper to brainstorm and draw together on to making a 3D version of a bridge in Tinkercad.	How do I use Tinkercad for designing?	Using Tinkercad in the future.
4 + 5		Build the bridge with the prototype you made in Tinkercad (maybe 3D printed) in real with paper and ropes. Struggling with the limits of paper and rope.	Force – weight – pressure	Are you using the same materials?
6 + 7		Re-evaluate your bridge to see what's wrong with it and improve yourself by applying your knowledge in physics more.	Does it work? Why not? Does our bridge collapse? Why?	Learning from your mistakes!
8	Evaluation	Sharing their experience of the building process. Review the real bridges and compare them to		Summarizing, putting real world relation next to the limits of a

		their bridges to see why building arches is so difficult. Testing who has the strongest bridge by putting weights on it.		building project in school.

INSTRUCTIONAL PLAN BY LESSON

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS
INTRODUCTION and RESEARCH **(50 x minutes = 1h)**	Questions and answers Research how bridges work	Presentation about bridges + Real life bridges Paper and rope Evaluation with rubrics Bridges built by students
LEARNING ACTIVITIES **(300 x minutes = 6h)**	Small groups (designing and building)	
WRAP-UP & EVALUATION **(50 x minutes = 1h)**	Class conversation	

EVALUATION PLAN BY LESSON

Evaluation Criteria and Methods

Lesson 1: Introduction to Bridge Concepts
Group Evaluation: Groups will analyze various bridges and rank them based on strength and architectural design.
Individual Evaluation: Students will participate in a discussion to assess their initial understanding of how bridges work.
Evaluation Methods:
Concept Map (Individual Activity): Students create individual concept maps that illustrate their understanding of bridge dynamics.
Group Discussion (Group Activity): Active participation in discussions about different types of bridges and their functionalities.

Lessons 2 & 3: Design and 3D Modeling
Group Evaluation: Assessment of the bridge designs created using Tinkercad, focusing on creativity, feasibility, and application of architectural principles.
Individual Evaluation: Observation of each student's ability to contribute to the design process and use Tinkercad effectively.
Evaluation Methods:
3D Design Review (Group Activity): Peer and teacher reviews of Tinkercad designs.
Observational Checklist (Individual Activity): Checklist to monitor each student's engagement and proficiency with the software.

Lessons 4 & 5: Prototype Building
Group Evaluation: Evaluation of the constructed paper and rope bridge prototypes for stability and design accuracy.

Individual Evaluation: Assessment of practical skills and problem-solving skills during the construction process.
Evaluation Methods:
Prototype Presentation (Group Activity): Groups present their prototypes, explaining their design choices and construction challenges.
Skill Application Review (Individual Activity): Observation of each student's ability to apply physics concepts in constructing the bridge.

Lessons 6 & 7: Testing and Improvement
Group Evaluation: Re-assessment of the bridge designs based on performance during stress tests.
Individual Evaluation: Reflections on the redesign process and understanding of why certain designs failed or succeeded.
Evaluation Methods:
Stress Test Performance (Group Activity): Observing the bridge's ability to handle weight and identifying structural weaknesses.
Redesign Journal (Individual Activity): Individual logs documenting the thought process behind modifications and enhancements.

Lesson 8: Final Evaluation and Reflection

Group Evaluation: Final presentations comparing student-built bridges to real-world bridges, discussing the challenges and learning points.
Individual Evaluation: Each student submits a reflective essay on what they have learnt about bridge building, the science behind it, and teamwork.
Evaluation Methods:
Bridge Comparison Presentation (Group Activity): Students present their final bridges, highlighting insights gained through comparison with real bridges.
Reflective Essay (Individual Activity): Essays assess individual understanding of architectural principles, physics, and the overall STEAM process.

Final Evaluation
Portfolio Assessment: Students compile a portfolio including their designs, models, test results, and reflective essays to demonstrate their learning process throughout the unit.
Weight Test Challenge: A conclusive test where bridges are subjected to increasing weights to identify the strongest structure, integrating competition to motivate performance.

Additional Components
Continuous Feedback: Regular feedback loops after each session to guide students and rectify misunderstandings.
Peer Review: Students engage in peer assessments to foster critical thinking and improve interpersonal skills through constructive criticism.

NOTES

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ACTIVITY SHEETS TO BE LINKED

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EVALUATION MATERIALS TO BE LINKED

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REFERENCES / SUPPORTING MATERIALS TO BE LINKED

Bridges in the world:

Golden Gate bridge – San Fransisco

Ponte Rialto – Venice

Ponte Vecchio – Florence

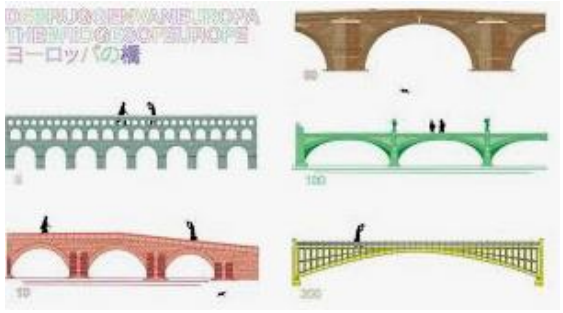
Tower bridge – London

Milau bridge – France

Harbour bridge – Australia

Dom Luis I bridge – Portugal

Øresund bridge – Denmark – Sweden



Euro-bridges – Netherlands

Charles bridge - Prague