

Unit 5: Engineering Design 1

8th Grade Science

13 Class Meetings

Revised June 2022

Essential Questions

- How can various design solutions be compared and improved?

Enduring Understandings with Unit Goals

EU 1: Bridge construction is a fundamental and essential part of society. Safety is a fundamental issue of building a bridge.

- Investigate which individuals or groups need this problem to be solved
- Determine the needs that must be met by solving the problem.
- Analyze scientific issues that are relevant to the problem.
- Determine potential societal and environmental impacts of solutions.

EU 2: There are many ways to create a solution to a problem.

- Examine how similar problems have been solved in the past.
- Outline possible societal and environmental impacts of each proposed solution.

Standards

Next Generation Science Standards:

- **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet criteria for success.

Common Core State Standards:

- **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- **WHST.6-8.8:** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- **RST.6-8.7:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- **SL.8.5:** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

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- **MP.2:** Reason abstractly and quantitatively.
- **6.RP.A.2:** Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.
- **7.RP.A.2:** Recognize and represent proportional relationships between quantities.

ISAAC Vision of the Graduate Competencies

Competency 1: Write effectively for a variety of purposes.

Competency 2: Speak to diverse audiences in an accountable manner.

Competency 3: Develop the behaviors needed to interact and contribute with others on a team.

Competency 4: Analyze and solve problems independently and collaboratively.

Competency 5: Be responsible, creative, and empathetic members of the community.

Unit Content Overview

1. The History of Bridges

- Relate bridges of the past to present day bridges.

2. Different Types of Bridges

- Compare and contrast beam bridges, arch bridges, cable-stayed bridges, and suspension bridges.

3. Safety Measures and Environmental Impacts

- Analyze the safety measures required to build a stable bridge
- Investigate the impacts that bridges have on the environment

Interdisciplinary Connection:

- Language Arts (**RST.6-8.1**) – Cite textual evidence to support analysis of science and technical texts, attending to the precise details of explanation of description
- Math – Reason abstractly and quantitatively
- Art – Multimedia art

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Daily Learning Objectives with *Do Now Activities*

Students will be able to...

- Critique bridges of the past and modify them to be more like bridges of the present.
 - Think back to BEFORE there were bridges – how did people travel across large bodies of water?
- Create and illustrate a bridge that will be named after them.
 - How do architects know how many supports a bridge will need?
- Evaluate other bridge designs for safety precautions.
 - Where is the oldest bridge that is still intact today and what year was it built? Where is the longest arch bridge and what is the length?
- Compare and contrast the four main types of bridges.
 - How do bridges encourage the trade of goods?
- Analyze the safety measures and environmental impacts of each type of bridge.
 - What does the term, “the balance of forces” mean and how does it pertain to bridges?
- Design a virtual model of each of the types of bridges and test them for safety.
 - Discuss with a partner how you will make your bridge. Write down your partner’s ideas.
- Illustrate or graphically design and outline what their physical bridge will look like.
 - What does the phrase, “golden age” mean and why were the 1800’s a Golden Age for bridges?
- Construct a bridge out of given materials.
 - How were the cables of the Golden Gate bridge lifted up to the tops of the towers?
- Demonstrate content knowledge for success on the unit exam.
 - What have you done to make sure you are ready for this exam?
- Test the effectiveness of their bridge design.
 - Whose bridge will hold the most weight? Why?

Instructional Strategies/Differentiated Instruction

- Whole group instruction
- Guided notes
- Student-led instruction
- Independent problem-solving
- Collaborative problem-solving
- Graphic Organizer
- Accountable Talk
- Homework
- Word walls with visuals
- Small group instruction
- Manipulatives

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Assessments

FORMATIVE ASSESSMENTS:

- Warm-ups
- Whiteboards
- Mid-class check-ins
- Exit Slips
- Accountable Talk Discussions
- Do Now
- Student-led instruction
- Homework
- NGSS Interim Assessments
- Performance Task- Build a Bridge and Get Over It
 - Teamwork Rubric

SUMMATIVE ASSESSMENTS:

- Quiz – EU 1 & EU 2
- Performance Task- Build a Bridge and Get Over It
- Unit 5 Test

Unit Task

Unit Task Name: Build a Bridge and Get Over It

Description: Students will encapsulate what they have learned about bridges throughout this unit by constructing their own bridge design. Students will choose what type of bridge they will build, but their goal is to create a design that is sturdy and safe. They will use spaghetti strands, rubber bands, and hot glue to create their design. When they are finished, they will write a summary about how they have ensured that their bridge is safe and minimizes environmental impacts. Finally, each bridge will be tested with weights to determine its stability.

Evaluation: Summative Assessment and Teamwork Rubric

Unit Resources

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- Khan Academy
- Flipped Google Classroom Videos
- Worksheets
- Laptops
- NGSS Interim Assessments
- Teach Engineering
- PALS
- West Point Bridge Design