Bridge Engineering

Students Sketch, Test, and Improve a Bridge Design

Grade Level: 4–9 **Time Required:** 60 Minutes
Subject Areas: STEM • Engineering • Physics • Mathematics • Design Thinking

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Project Overview

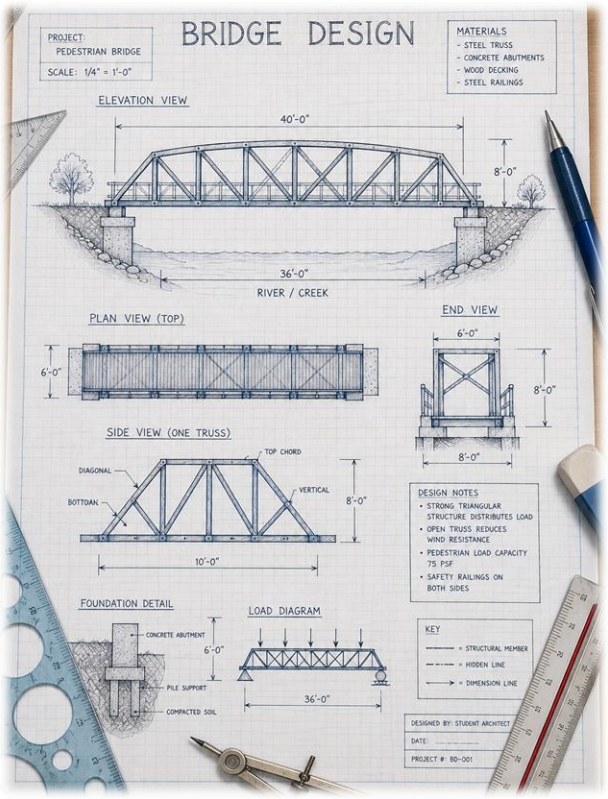
Bridges are some of the most important engineering structures in the world, connecting people, communities, and transportation systems. In this activity, students become civil engineers by designing, sketching, and improving a bridge that is both strong and efficient. Before building a model, students will create a technical drawing that includes measurements, structural supports, and key design features.

Through planning, testing, and redesigning, students will experience the engineering design process while strengthening their understanding of forces, geometry, and structural stability.

Learning Objectives

Students will:

- Create a scaled engineering sketch of a bridge.
- Identify major structural components.
- Apply measurement and geometry skills.
- Explore how forces affect structures.
- Improve designs through testing and redesign.
- Develop engineering problem-solving skills.
- Present and explain engineering decisions.



Materials Needed

- Graph paper
- Drafting pencils
- Ruler
- Triangular scale (optional)
- Eraser
- Colored pencils
- Craft sticks or popsicle sticks
- Glue
- String (optional)
- Small weights (books, washers, or coins)
- Paper clips or binder clips

Vocabulary

- **Bridge** – A structure built to span a gap such as a river, road, or valley.
- **Blueprint** – A detailed engineering drawing used to communicate a design.
- **Load** – The weight or force a structure must support.
- **Span** – The distance between two bridge supports.
- **Truss** – A framework of connected triangles that increases structural strength.
- **Compression** – A force that pushes materials together.
- **Tension** – A force that pulls materials apart.

Project Instructions

Step 1 — Explore Bridge Types

Discuss common bridge designs, including:

- Beam Bridge
- Arch Bridge
- Truss Bridge
- Suspension Bridge
- Cable-Stayed Bridge

Talk about where each type is commonly used and why engineers choose different designs.

Step 2 — Plan Your Design

Students should decide:

- What type of bridge will they build?
- How long will the bridge span?
- What materials would be used in a real bridge?
- How will the bridge support weight?

Encourage students to sketch several ideas before choosing one.

Step 3 — Create a Technical Drawing

Using graph paper, students should include:

- Side view of the bridge
- Top view (optional)
- Support beams
- Trusses or arches
- Roadway or walkway
- Measurements
- Labels for important structural parts

Neat, straight lines and accurate measurements are important.

Step 4 — Build a Prototype

Using classroom materials, construct a small bridge model based on the drawing.

Students should follow their blueprint as closely as possible while making adjustments if needed.

Step 5 — Test and Improve

Place the bridge between two stable supports. Gradually add weight to determine how much the bridge can safely support.

Students should observe:

- Where bending occurs
- Which supports remain strongest
- Where failure begins
- Possible improvements for the next design

Record observations before redesigning.

Extension Activities

Challenge students to improve their bridge by adding:

- Additional trusses
- Reinforced supports
- Wider roadway
- Pedestrian walkway
- Decorative features
- Suspension cables
- Earthquake-resistant supports
- Environmentally friendly materials

Encourage students to compare how different improvements affect strength and stability.

Classroom Discussion

Discuss the following questions:

- Which bridge design supported the most weight?
- Why did your bridge succeed or fail?
- Which structural features made the biggest difference?
- How did your blueprint help during construction?
- What would you change if you built another bridge?
- Why is testing an important part of engineering?

Encourage students to explain how redesigning helped improve their final structure.

Assessment Checklist

☐ Created a neat engineering sketch

☐ Used accurate measurements

☐ Labeled major bridge components

☐ Built a prototype from the drawing

☐ Tested the bridge safely

☐ Recorded observations

☐ Improved the design after testing

☐ Presented engineering decisions clearly

Real-World Connections

Civil engineers design bridges that safely support thousands of vehicles and pedestrians every day. Before construction begins, engineers create detailed technical drawings, calculate loads, test materials, and refine their designs to ensure safety and durability. This project introduces students to the same engineering design process used to build real bridges, helping them develop skills in mathematics, drafting, critical thinking, teamwork, and problem-solving.