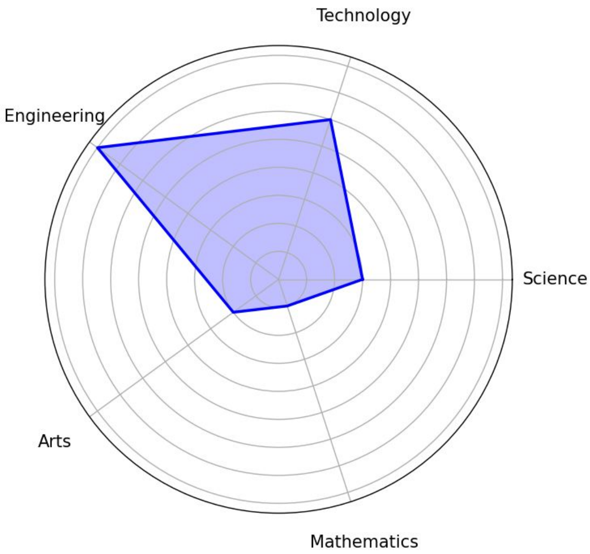
Curricular




# THE GREAT BRIDGE CHALLENGE

| Duration | Age | Difficulty |
|---|---|---|
| 45 min | 11-12 | Medium |
| #BRIDGECHALLENGE #TEAMWORK #ENGINEERING #DESIGNTHINKING | | |

## DESCRIPTION

Students aged 10–12 will explore how engineers design strong and stable bridges.

Using simple materials like spaghetti, straws, or popsicle sticks, students will work in teams to brainstorm, sketch, build, and test their own bridge designs.

They'll learn how shape, balance, and support play a critical role in real-world construction — and how communication and teamwork are just as important as creativity and structure.

## KEY COMPETENCES (EU)

- Personal, social, and learning to learn competence
- Creativity and innovation
- Entrepreneurship competence
- Citizenship (social/environmental awareness)

## ACTIVITY OBJECTIVES

- **Understand structural engineering principles:** Explore how shape, balance, and support contribute to the strength and stability of bridges in real-world design.
- **Apply the engineering design process:** Develop problem-solving skills through sketching, constructing, testing, and refining bridge models based on observed performance.
- **Foster collaborative learning:** Strengthen teamwork and communication by working in groups to solve engineering challenges, share responsibilities, and present outcomes.
- **Encourage creativity and critical thinking:** Promote innovative thinking and decision-making by experimenting with different materials and bridge structures
- **Connect engineering to real-life applications:** Reflect on the role of civil engineering in connecting communities and solving societal infrastructure needs
- **Build scientific and technical confidence:** Support STEAM learning through hands-on experimentation and inquiry-based reflection on structural performance.

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## MATERIALS

- Provided by students
- Provided by the teacher/institution
- Downloadable Elements

Spaghetti sticks, straws, or popsicle sticks

Playdough or marshmallows (for joints)

Tape or glue

String (for suspension bridges)

Paper

Marker pens/pencils

Small toy cars or coins (weights)

Two books, blocks, or chairs (to simulate the river)

## PREVIOUS PREPARATION

- Prepare example images of real bridge types (beam, arch, suspension).
- Print or project visuals for discussion.
- Divide students into small groups before starting.
- Pre-arrange materials at workstations (one set per team).
- Ensure a clear "river gap" space for testing bridges (e.g., between books, blocks, or chairs).
- Set guidelines for safe tool and material usage (e.g., tape, scissors).

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# CONTEXTUALIZATION AND ADAPTATION

Bridges are more than structures — they connect people, places, and ideas. they are vital components of civil infrastructure that support transportation, trade, and access to essential services. In civil engineering, bridges solve complex challenges: they span rivers, valleys, highways, and even oceans, often under extreme environmental and structural constraints.

From the iconic Golden Gate Bridge in San Francisco, to the Millau Viaduct in France, or the Øresund Bridge connecting Denmark and Sweden, these structures showcase the power of engineering to connect people and transform regions. Some cities like Venice depend almost entirely on bridges for daily movement, while others, like New York City, rely on a complex network of bridges to support millions of commuters.

In this activity, students will become mini-engineers, exploring how structure and design work together to make bridges strong and functional. By sketching, building, and testing their own bridges, they'll discover how real-life civil engineers solve problems using shapes, balance, and teamwork.

This challenge also develops soft skills like communication and brainstorming — preparing learners for both technical and collaborative work in the real world.

**Note for the teacher** 📝

The task can be easily adapted for younger or older learners:

• Use building blocks or LEGO for younger students

• Add design constraints like material "cost" or maximum weight for older students

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🔍 **Suggested Guiding Questions:**

- Why do some bridges collapse?
- What causes structural failures, and how can we design to prevent them?
- Which shapes are strongest?
- How do engineers use triangles, arches, or cables to support weight and resist forces?
- How does the environment affect a bridge's design?
- What role do wind, earthquakes, and water levels play in engineering decisions?

💡 **Classroom Starter Activity:**

Start with a discussion:
"Where have you seen a bridge before — in your city or while traveling?
"What makes you feel safe (or unsafe) on a bridge?

Then, show short clips or images of different bridge types (beam, truss, arch, suspension) and ask students to predict which would hold the most weight and why. Encourage them to formulate hypotheses to test during the challenge (write the hypotheses on the board).

Optional enrichment:

- Include a brief story of a famous bridge collapse (e.g., Tacoma Narrows Bridge) to emphasize the importance of engineering principles.
- Explore future bridge innovations, such as solar-powered smart bridges or modular emergency bridges in disaster response zones

**Note for the teacher** 📝

To promote equal participation and leadership opportunities in STEM, highlight the contributions of pioneering women in engineering. These role models show that innovation knows no gender.

🔹 Emily Roebling – Took over as chief engineer of the Brooklyn Bridge after her husband fell ill. She managed construction, communicated with officials, and oversaw technical decisions—breaking gender norms in the 19th century.
🔹 Ellen Swallow Richards – The first woman admitted to MIT and a pioneer in environmental engineering and water sanitation.
🔹 Roma Agrawal – A contemporary structural engineer who worked on The Shard in London and actively promotes diversity in engineering.

🗣️ Discussion Prompt:
"How can we make sure everyone feels empowered to lead and build?"

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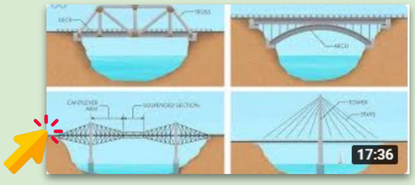
**Watch video 📽️ (optional):**

YouTube: "Every Kind of Bridge Explained in 15 Minutes"




(Or substitute with a short explainer animation about bridge design.)

## ACTIVITY

**STEP 1: Introduction**

- Show real bridge types: beam arch, and suspension
- Encourage students to research bridge design elements from a specific culture or region - "Incorporate a feature inspired by traditional Japanese, Roman, or Incan bridges into your design and explain why."
- Discuss: What makes a bridge strong?
- Talk about shape, balance and support
- Divide into small groups


**STEP 2: Design phase**

- Each group sketches their bridge on paper before building
- Encourage creative ideas – structure matters more than looks!

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**STEP 3: Building time**

- Distribute materials (spaghetti, sticks, marshmallows/playdough, string).
- Each group begins constructing their bridge across the "river gap".
- Encourage experimenting with shapes — especially triangles!
- Offer guidance, but let students build their own way.
- Reinforce teamwork, safety, and clean workspace habits.

**STEP 4: Testing & reflection**

- Each team places their bridge across the "river."
- Test strength using toy cars or coins.
- Observe: Which bridge holds the most weight? Why?

- Teams present their bridge and explain design choices.
- Discuss what worked, what didn't, and ideas for improvement.
- Relate to real bridges — stability, environment, usage.

Reflection questions:

- What made your bridge strong?
- How would you improve your design?
- How does this relate to real-world engineering?

**Note for the teacher** 📝

Bridges also play a critical role in ensuring accessibility and equity. In disaster zones, quickly assembled emergency bridges can reconnect isolated communities. Inclusive bridge design considers people of all ages and abilities—such as ramps for wheelchair users or safety features for pedestrians. Students are encouraged to think about how their bridges can serve everyone, especially in challenging environments or gender-sensitive contexts.

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Ask:
“How might a bridge design change if it needed to be built quickly after an earthquake or flood?”
“Imagine your bridge must be used by someone in a wheelchair, or by someone pushing a stroller or carrying goods. How does that change your design?”

Include a "Design for Impact" rubric where teams explain how their bridge:
• Serves people with different needs
• Could function in difficult environments
• Promotes safety and inclusion

**Classroom activity 💡 (Optional):**

1. Draw one modern and one traditional bridge and explain design differences.
2. Create a comic or timeline showing how bridge building evolved in one culture

## CONCLUSION AND SHARING

Each team presents their bridge to the group.

Ask them to explain:
• What design did you choose and why?
• What worked well? What was difficult?
• How much weight did your bridge hold?

Facilitate a group discussion:
• Which structures were strongest — and why?
• How do these ideas relate to real bridges and engineering challenges?

**Don’t forget to take a photo of your experience and share it with us!**

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