Real life construction toys

Lesson Plan: Truss Bridge Construction

NZC Level:	3	Class	
Year:	5-6		
Ages:	9-10 years old	Teacher	
Duration:	1-2 Hours		
Class Size:	Up to 24 Students	Date	

Subject:	Key Competencies:
Technology • Technological Practice • Technological Knowledge • Nature of Technology	• Relating to Others • Participating and Contributing • Managing Self

Materials Needed:

- **Constructables Truss Bridge Set**: 1 box per 2-4 children
- **Additional materials**: cars, signs, animals, rocks

Lesson Structure:

Set Up:

- Place all Constructables building parts in a central location.

Form Groups of 4-6:

- Form groups for children to work together. You can do this yourself or allow children to form their own groups.
- Each team to collect:
    - Set of Blueprints
    - Set of Learning Cards

Introduction:

- Talk about different bridge types (see learning card included in sets) and engineering. Choose a few questions

Question	Answer (for teacher)
What are bridges for?	
Who are engineers? What are their jobs?	Engineers are professionals that invent, design, analyse, and build things. Civil Engineers work on infrastructure and construction. Mechanical engineers work on things that move.

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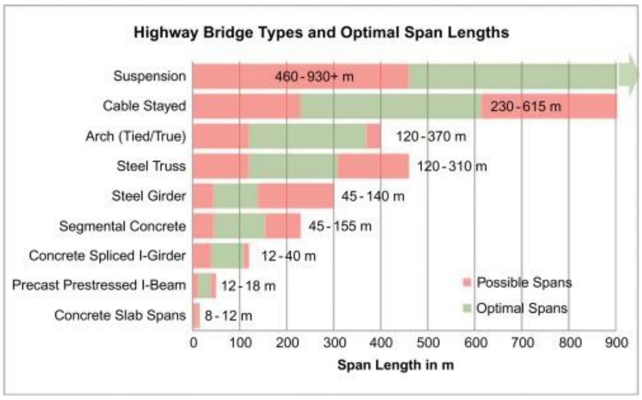
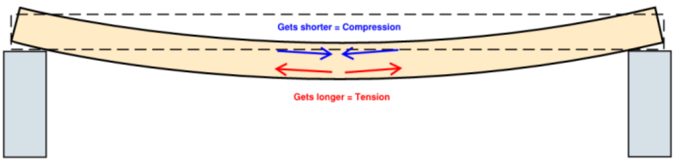
<table>
<tr><td>Which bridge type can span the longest distance?</td><td>Suspension Bridge. The longest one spans nearly 2km!

</td></tr>
<tr><td>What are blueprints?</td><td>These are drawings that engineers created. They show builders how the bridge should be built.</td></tr>
<tr><td>How do bridges work?</td><td>When you put a weight on a bridge, the bridge needs to transfer that weight (or load) through the bridge parts to its supports at the end.
This happens through tension & compression (push & pull)</td></tr>
<tr><td>How do bridges bend? Imagine standing on a wooden plank.</td><td>Bridges bend just like the wooden plank. When the plank bends, you can imagine that the bottom of the plank gets longer. This is why we know that the bottom of the plank is under tension (getting pulled). This is how it transfers the weight in the middle all the way to the outside of the bridge - by pulling forces through the bottom of the plank.


(the top of the plank gets shorter and is in compression)
This concept is used in Truss Bridges. The top of the bridge is being pushed. The bottom of the bridge is being pulled.</td></tr>
</table>

- Talk to the children about the different parts and how they relate to real bridges. Use the photos included in this lesson plan.

Question	Answer
Which direction of the H-Beam is the strongest?	 With the flat side down. The beams are strongest when the most amount of material is the farther from the centre of the beam.
What do connections look like?	Show photo on connection. These are the most complicated parts of the bridge.
What makes Truss Bridges strong?	Triangles

Main Activity:

- Teams will look at the blueprints and make a plan for who does what.
- Teams need to collect the necessary parts from the pile in the centre.
- Teams to build the bridge (teachers to support as necessary).

Teams will need to problem solve as they build. Key things to watch out for are:

- Make sure the H-beams are flat to the ground.
- Make sure that the beams are pushed in far enough. You may want to help with this if they are struggling.

Finishers (optional):

- Make the bridges span across tables to play with.
- Connect bridges together with spare beams (if you have time left over) and see how long you can make the bridge!

Reflection:

- What challenges did they face while building the bridge?
- How did they overcome these challenges?
- What was hard about working in a group?
- What made your group work well?
- How did you solve problems together?

Lesson Goals and Learning Outcomes:

Technology - Technological Practice

Planning for Practice

Objective: Students will describe the outcome they are developing and identify the key stages and resources required to complete it.

In Practice:

- Students plan their bridge using the blueprint as a guide.
- They discuss required materials (e.g., H-Beams, connectors, floor slabs) and estimate time to build.
- They identify who will do what (team roles).

Brief Development

Objective: Students will describe the key attributes of an outcome and develop a brief that includes the intended physical and functional nature of the bridge.

In Practice:

- Students describe what their bridge must do (e.g., span 70 cm, hold weight, use triangles).
- They make decisions to adapt or personalise designs, still meeting the key structural needs.

Outcome Development and Evaluation

Objective: Students will investigate and evaluate design ideas and produce an outcome that meets the specifications and justified design decisions.

In Practice:

- Students test parts of the bridge (e.g., testing truss strength).
- They reflect on what worked or didn’t, modify accordingly.
- They explain why they chose specific shapes (e.g., triangles for strength).

Technology - Technological Knowledge

Technological Modelling

Objective: Students will understand that functional models are used to explore, test, and evaluate design concepts.

In Practice:

- Students build small-scale or trial sections of the bridge to test stability before full assembly.
- They can use different truss patterns (e.g., Warren, Pratt) to compare results.

Technological Products

Objective: Students will understand that materials have performance properties that can affect their use.

In Practice:

- Students notice that some pieces flex under pressure, while others are better for supporting loads.

- They learn why some shapes and materials are stronger under compression or tension.

Technology - Nature of Technology

Characteristics of Technology

Objective: Students will understand how technological outcomes impact society and the environment.

In Practice:

- Students discuss how real bridges help connect communities, support transport, and must be reliable and safe.
- They might look at famous bridges and why certain designs were chosen.

Characteristics of Technological Outcomes

Objective: Students will understand that technological outcomes are products or systems developed for a purpose.

In Practice:

- Students reflect that their bridge is a technological outcome—it solves the problem of crossing a gap.
- They recognise that its design reflects both function (holding weight) and design constraints (material limits).

Core Competencies

Relating to Others

Interacting effectively with a diverse range of people in a variety of contexts.

In Practice:

- Listening to others' ideas for how the bridge should be built.
- Giving feedback in a respectful way (e.g., "Let's try your design.").
- Negotiating roles—who builds, who checks the blueprint, who tests the design.

Participating and Contributing

Being actively involved in communities and making connections with others.

In Practice:

- Taking on roles in the group (builder, planner, tester).
- Encouraging team members and sharing success.
- Reflecting together at the end—what worked well, what would we do differently?

Managing Self

Self-motivation, responsibility, and a can-do attitude.

In Practice:

- Sticking with a tricky part of the build even when it's frustrating.
- Staying on task without needing constant reminders.
- Taking initiative to help others or improve the design or construction.

Questions to extend learning:

- Do you notice the different sizes of the beams? One is longer and one is shorter. Let's measure them beside each other. Practise geometry.
- How will we use these pieces to create something new?
- Where have you seen a bridge before?
- Why do we use H-beams? What is their purpose?

Extensions to the basic Constructables box include:

- Adding a road- using cardboard cut a strip just wide enough to slide across your road. Provide strips of multiple lengths to allow more exploration and thinking.
- Add cars or animals to mass over the bridge.
- Blocks for the bridge to cross over.
- Constructables are very sturdy and could be used outside in a sand pit or garden to allow a more natural connection to the world.
- Building upwards to create buildings.
- Creating different types of bridges (some examples can be seen on our website).
- Build a railroad track across the bridge.

Multimedia

Figure 1 Matapihi Rail Bridge in Tauranga

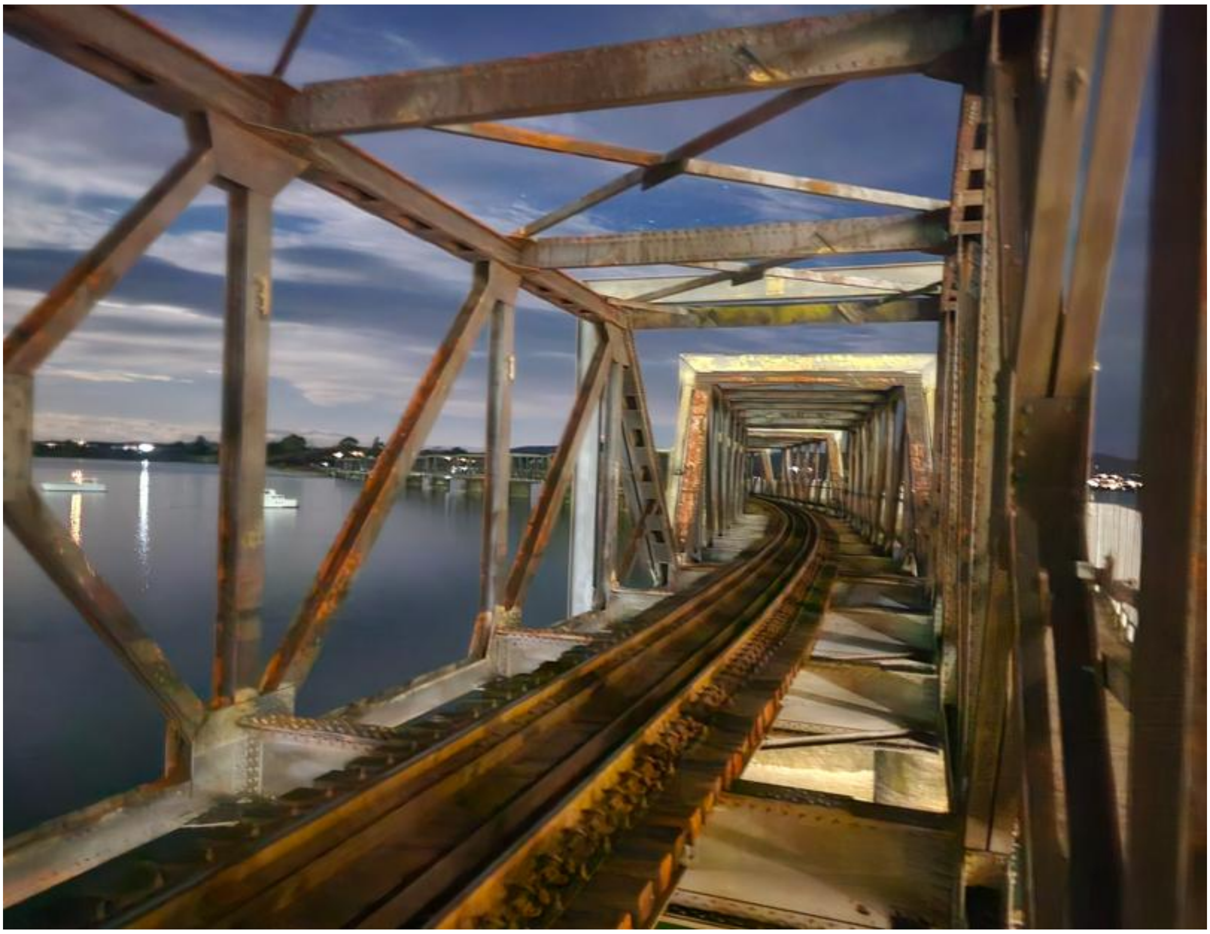


Figure 2 Matapihi Rail Bridge in Tauranga

Figure 3 Route 60 Gauley Bridge, WV, USA

Figure 4 Lifting a truss bridge in its place

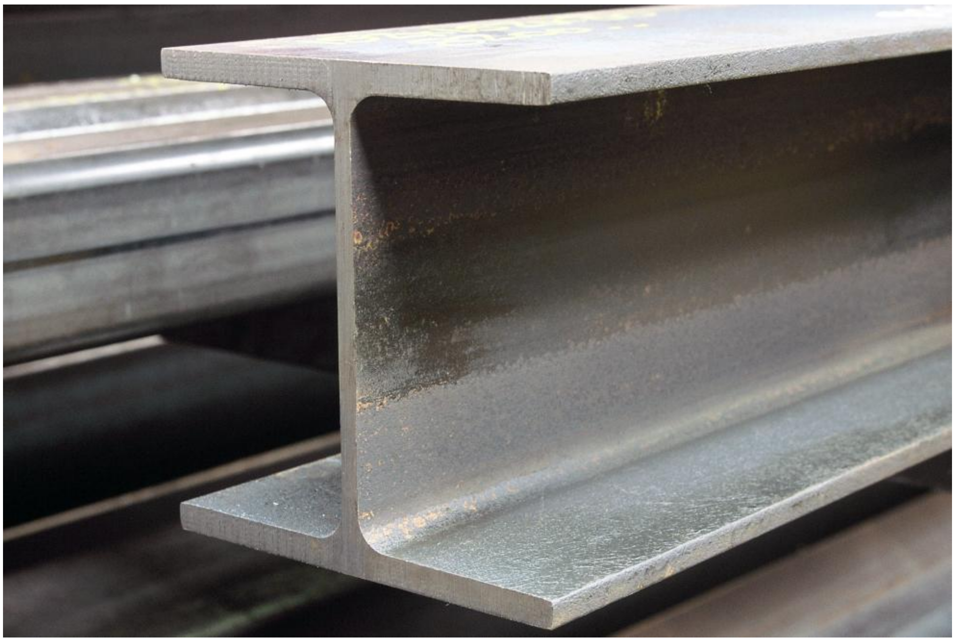


Figure 5 An H-Beam

Figure 6 Matapihi Rail Bridge Beam Connection

Figure 7 H-Beam Connection

Bridge Type	Max Span	Example
Suspension	~2,000 m	Akashi Kaikyō, Japan – 1,991 m
Cable-stayed	~1,000–1,200 m	Russky Bridge, Russia – 1,104 m
Arch	500–600 m	Chaotianmen Bridge, China – 552 m
Cantilever	500–600 m	Quebec Bridge (Canada) – 549 m
Truss	300–400 m	Ikitsuki Bridge (Japan) – 400 m

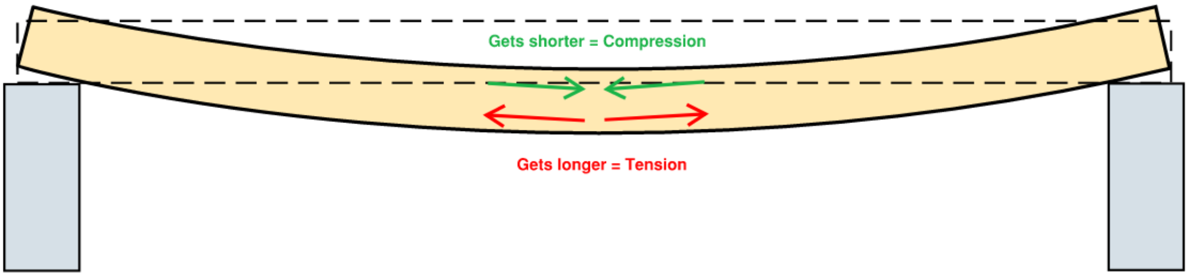


Figure 8 Schematic showing a plank bending. The bottom of the plank is being "pulled" and the top is being "pushed".

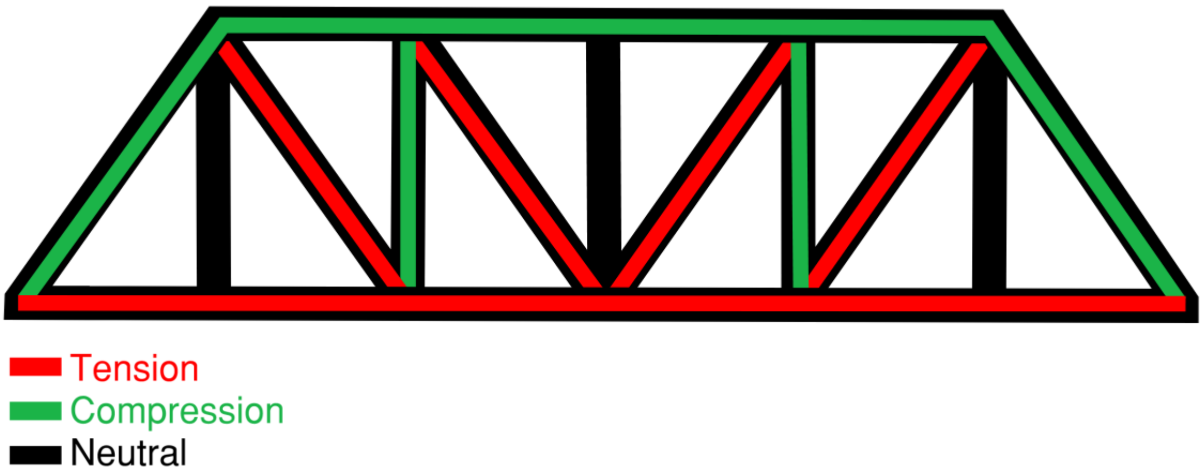


Figure 9 Truss Bridge Push-Pull Model

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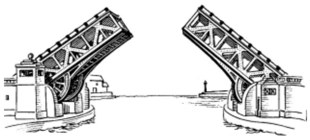
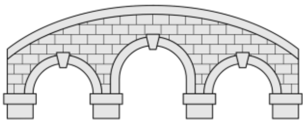
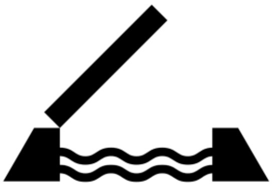
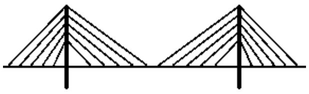
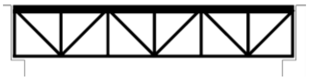
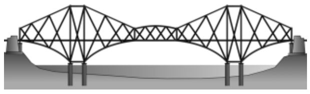
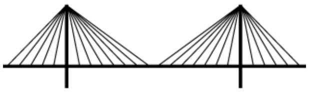
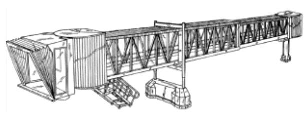
 **Deck Arch Bridge**	 **Bascule Bridge**	 **Truss Bridge**	 **Box Girder Bridge**
 **Suspension Bridge**	 **Three Arch Bridge**	 **Suspension Bridge**	 **Draw Bridge**
 **Harp Cable-Stayed Bridge**	 **Deck Truss Bridge**	 **Tied Arch Bridge**	 **Cantilever Bridge**
 **Arch Bridge**	 **Fan Cable-Stayed Bridge**	 **Truss Bridge**	 **Jet Bridge**