

# Bridges

## *Bridging gaps with strength and stability*

Bridges are important structures. They make journeys shorter, safer and easier. Bridges have to be light so that they do not sag under their own weight or waste materials and resources. They have to be as strong as possible so that they can carry heavy loads. There are four basic kinds of bridge: beam, cantilever, arch and suspension bridge. Find out about bridges by making these:



Humber Bridge, Yorkshire

### **Beam bridges**

Beam bridges can be single span (one beam) or multi-span (several beams).

Frameworks called trusses are often used to make bridges that are strong but light.

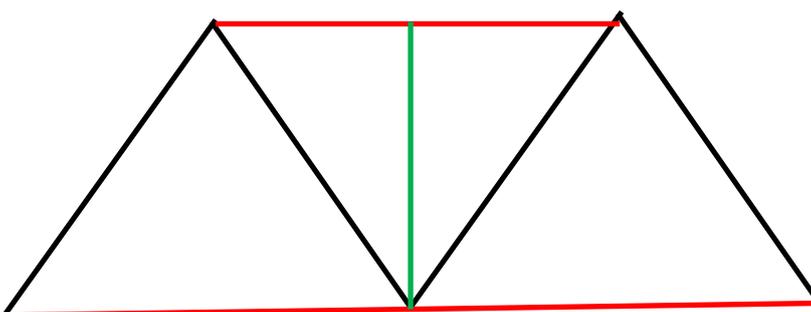
#### ***You will need***

- Art Straws
- Card

#### ***What to do***

Make your own bridges using art straws to bridge a gap of your choosing.

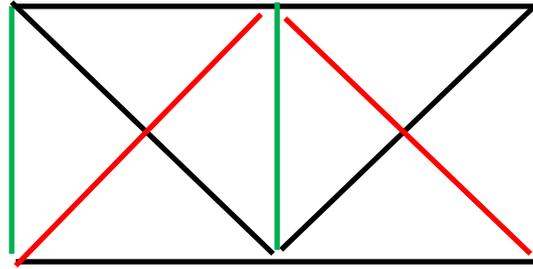
1. Draw the plan on this page full size and build your bridges sides on it. Hold parts still while you glue the edges together. You may wish to use cardboard triangles for this.
2. Turn the frame over carefully and glue triangles on the other side.
3. Let the sides of your bridge dry before joining them to each other. Don't use too much glue and let it dry well. Glue on a thin card deck (like a roadway) to hold the load.
4. Add a little weight at a time to see how much your bridge can carry. Try different designs and compare yours with others made by friends.



Plan

Ensure all straws are the same length before gluing

Here is an alternative truss design.  
Remember to make full-sized plans.



The Fourth Railway Bridge, Scotland

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### **Cantilever bridges**

Cantilever bridges are made up of beams that are only supported at one end. Trap one end of a ruler between heavy books to make a quick cantilever. Often two cantilevers are used with a short beam between them.

### **Lifting bridges**

Lifting bridges are supported at one end so that they can be raised to let ships pass.



Tower Bridge, London

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Akashi-Kaikyo, Japan

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### **Suspension bridges**

For wide or deep channels, a suspension bridge, with a span of up to 1200m, is often used. The deck (such as a roadway) is held up by steel cables hanging between tall towers. These cables are held in concrete blocks at both ends of the bridge. The deck may be supported by a framework to stop it swaying too much in the wind. The weight of the deck is transferred to the vertical cables, over the towers and to the concrete blocks at either end.

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Bridges are vital links, carrying traffic—people, animals and vehicles - over rivers, roads, railways or ravines. To be safe, a bridge must be strong enough to bear the weight not only of the load moving across it, but also its own weight. This strength can be achieved in a number of ways, but every bridge has massive supports at either end called abutments that are embedded in solid ground. In between there are often extra supports called piers, linked by short sections of the bridge called spans. There is usually a long, middle span over the deepest water.



Yangtze River Bridge, China

### **Types of bridges**

Traditionally, bridges were simple wooden or stone arches. Modern bridges are built of concrete and steel, and the type of construction depends on the heaviest load it has to carry and the nature of the place where it has to be built. For example, for wide spans over water, suspension or cable-stayed bridges are usually best. To carry a very heavy load over a short distance, a beam bridge may be built. To carry a heavy load over a greater distance, a cantilever bridge is often used.

### **Longest Suspension Bridges**

| Bridge, Country      | Length |
|----------------------|--------|
| Akaishi-Kaiko, Japan | 1990m  |
| Great Belt, Denmark  | 1624m  |
| Humber Estuary, UK   | 1410m  |
| Jiangyin, China      | 1385m  |
| Tsing Ma, China      | 1377m  |

### **Building Bridges**

The first step in bridge building is to build the piers and abutments. To erect piers in the water, a steel wall or shuttering is built on the riverbed. The water is then pumped out while the pier is built, before the walls can be removed, and the spans laid between the piers.



The building of a bridge

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## ***Make it WORK!***

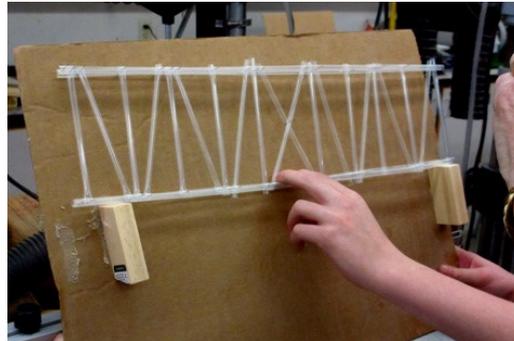
*Bowstring bridges are named after the string of an archer's bow. Tension in the bridge's bottom order - the bowstring - holds the arch in place, just as tension in the string curves a bow. Find out how the ties carry the strength of the arch of the deck by building your own bridge.*

## ***You will need***

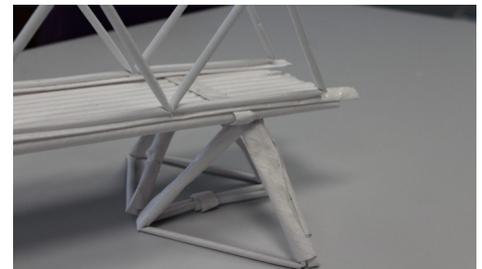
- Art Straws
- Card
- Scissors
- Glue
- Card



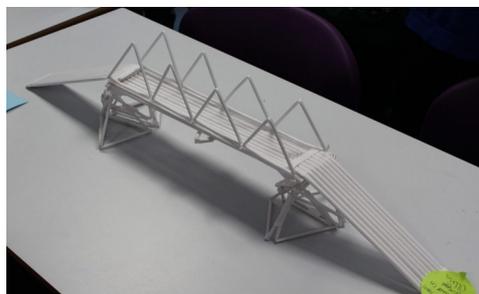
1. First make the bow shaped sides of the bridge using lengths of straw. The piece which you bend to make the bridge's arch should be about one and a half times as long as the girder (the bowstring) that runs along the bottom.



2. You can join pieces of straw by putting a drop of glue on the end of one piece and pushing it into the end of another. You may have to split the end of one straw a little way.



3. To fix the bowstring girder across the arch, split the ends of the bowstring straws. Open out the ends to make small flaps, then cut one of the flaps off each end. Glue the remaining flaps to the ends of the arch. Use this method to fix the ties between the arch and bowstring.



4. Join the two sides of the bridge with straws of equal length. Make flaps in the ends of the cross-piece straws and glue them to the arches.

5. Make your bridge more rigid by adding extra ties to make triangular shapes on each side.

6. Cut a strip of thin card to make the bridge deck and glue it in place. Your bridge is now complete.