

**Science Unit: Structures****Lesson 4: Building Bridges – Part 1**

School year: 2008/2009

Developed for: Britannia Elementary School, Vancouver School District

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Grade level: Presented to grades 3 and 4; appropriate for grades 3 – 7 with age appropriate modifications.

Duration of lesson: 1 hour and 15 minutes

**Objectives**

1. To learn about beam, truss, simple suspension, suspension, cantilever and arch bridges.
2. To build bridges.

**Background Information**

This is the fourth in a six-part series of lessons on “Structures.”

**Vocabulary**

<u>Word:</u>	Brief definition.
bridge	a structure that spans a distance (such as a river or a road) to allow people or vehicles to pass over that distance
bridge deck	the part of the bridge that beams the load (i.e., the part you walk or drive over)
pier	support structures of a bridge
truss	the part of a structure that is build of straight bars arranged as a triangle; used to add support to a structure

(See also below for different bridge types)

**Materials**

- |              |              |                   |
|--------------|--------------|-------------------|
| • cardboard  | • tape       | • Popsicle sticks |
| • string     | • plasticine | • worksheet       |
| • white glue |              |                   |

**In the Classroom****Introductory Discussion**

1. Review what the class has covered over the past three weeks.
  - We've learned about structures and fasteners and we've built towers.
2. Short description of other items to discuss or review.



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### Different types of bridges:

- A **beam bridge** is a bridge made of a horizontal beam supported at each end by piers. The further apart the piers are, the weaker the bridge will be, so beam bridges are usually not more than 250 ft (76 m) long. If you've ever crossed a river or stream by walking on a log that sat

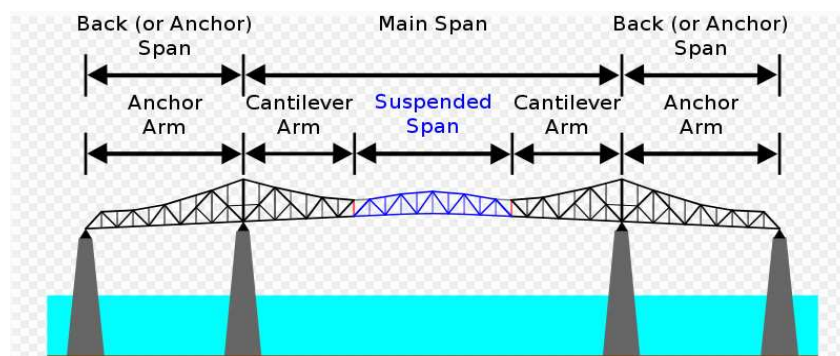


across it, you've crossed a beam bridge!

- A **truss bridge** is a bridge made of connected elements (usually straight bars) which are arranged in triangle configurations, as triangles help to make the bridge strong.



- A **cantilever bridge** is made of horizontal beams that are supported only at one end. They can span distances of more than 1,500 ft (460 m).

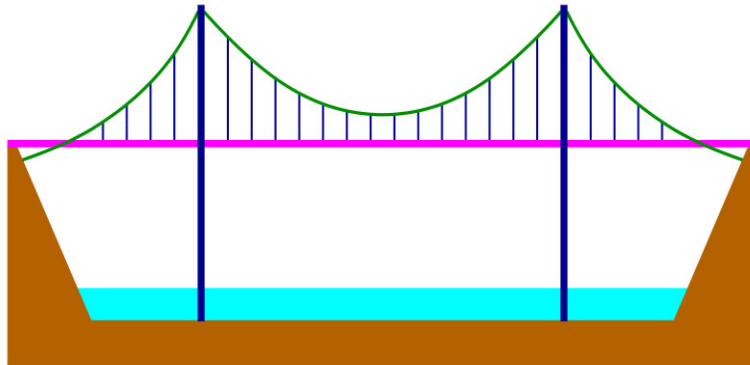


- An **arch bridge** are arch-shaped and have abutments (end supports) at each end.



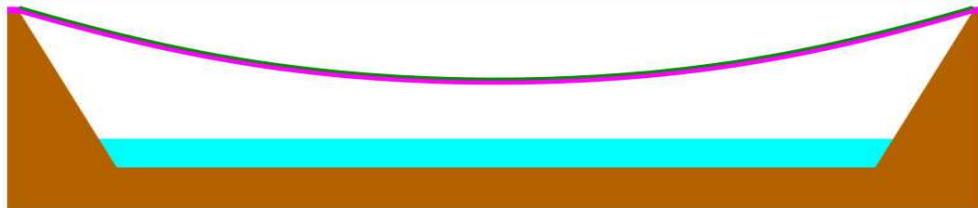
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- A **suspension bridge** is made up of a bridge deck that is suspended by cables that hang from towers/supports. When weight is applied to the bridge deck (such as a car driving over it), the



weight is transferred to the cables in the form of tension.

- A **simple suspension bridge** doesn't have the towers, but instead the cables/ropes are attached to "anchors" at either end of the bridge. The Capilano Suspension Bridge in North Vancouver is an example of a suspension bridge. It is 450 ft (140 m) long.



### 3. Description of the activity:

- Today, we are going to build our very bridges. Our goal is to build the strongest bridge we can build.
  - Once we have all built our bridges, we are going to see which one is the strongest! Over the next week, you will have the opportunity to build stronger bridges and next week we will again test them for strength.
4. Creating a plan before you begin to build is very important. A person who draws up plans for building a structure is known as an "architect." After the architect creates the plan, the "engineers" build the structure. Today we will be acting as architects by drawing a plan and as engineers by building our bridges. (Note that once you start to build your bridge, you may find that something in your plan does not work; that's OK, you can change your plan as you learn what works and what doesn't). As well we will be recording our plans on a worksheet.

### Science Activities

Activity Title: Building Bridges

Purpose of Activity: To build the strongest bridge you can build..

Methods and Instructions:

Set-up prior to experiment: Gather materials.



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Brief description of how students will work in groups or pairs.

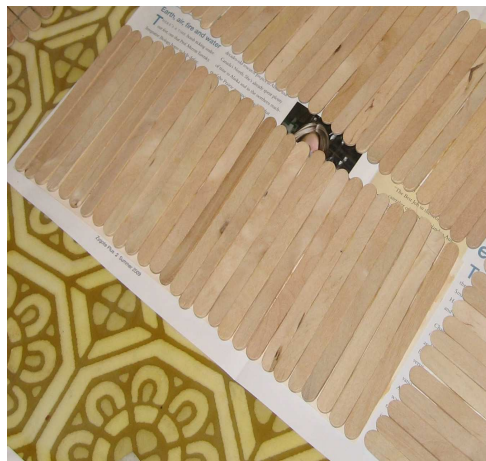
1. Students will be split into groups and each group will be told to make a different type of bridge (simple suspension, truss, arch, suspension, or beam).
2. Students are instructed to build decide on a plan for their bridge and draw and label a picture of this plan. They must present their plan to a teacher or the scientist before they can take any materials and start building their bridge.
3. Once they receive approval from a teacher or the scientist, they will be allowed to access the materials to build their bridge based on their plan.
4. Students will draw a picture of the bridge that they built on the attached worksheet.

Some examples of bridges that student can try building:

- Note: students are to come up with their own designs for building the bridges, but here are some possible ways of building some types of bridges.

Beam Bridge:

- Cut out a piece of paper the size of the bridge deck you want to make.
- Glue Popsicle sticks side-by-side to make a bridge deck.
- Glue a few Popsicle sticks along the bottom of the bridge deck, perpendicular to the Popsicle sticks in the bridge deck for reinforcements.
- Any solid objects can be used as piers (e.g., two chairs; blocks)



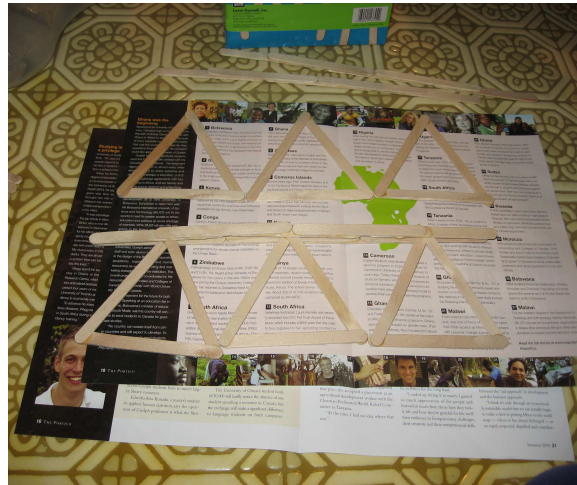
Truss Bridge

- Build the bridge deck as above for the beam bridge.
- Build two trusses (one for each side) by making triangles out of Popsicle sticks and gluing them together with more Popsicle sticks to create the truss (see photo below).
- Glue the the trusses to the bridge deck. Use more Popsicle sticks to make bracing on the top, holding the two trusses together (see diagram below)

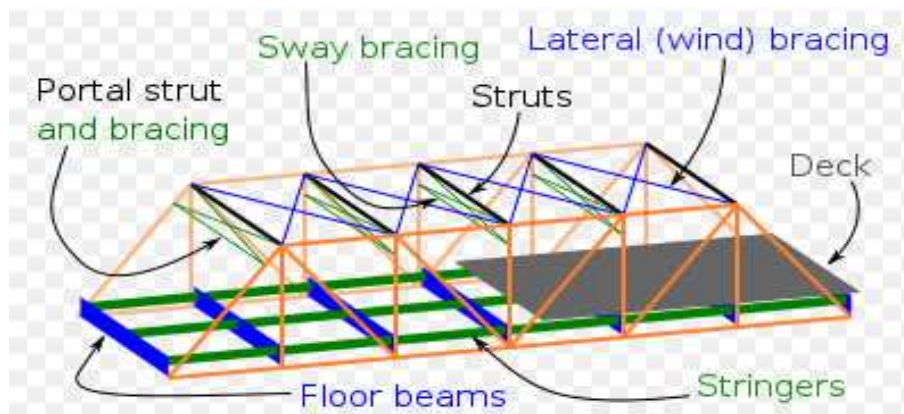


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Popsicle stick trusses being built for a truss bridge:



Advanced model for a truss bridge:



### Popsicle stick simple suspension bridge

- Cut a piece of string three times the length of the bridge you want to build.
- Leaving room for string to be used as an anchor, loop string around the end of a Popsicle stick.
- Repeat this looping procedure with more Popsicle sticks to form the bridge deck. Ensure you leave sufficient string at the other end to be used as an anchor on that end.
- Repeat this procedure with another piece of string on the other end of the Popsicle sticks.
- See photo below for an example.





- Tie ends of strings to anchor the bridge.

## Closure Discussion

1. What did you learn about building bridges?
2. What things did you do to make your bridge strong? What other things can you try to make your bridge strong?

**Simple suspension bridge**

**String**

**Popsicle sticks**

## Image References

1. Diagram of beam bridge. Created by Dr. Beth Snow and placed in the public domain.
2. Source of image "Parts of a Truss Bridge": Public domain image downloaded from [http://en.wikipedia.org/wiki/File:Parts\\_of\\_a\\_truss\\_bridge.svg](http://en.wikipedia.org/wiki/File:Parts_of_a_truss_bridge.svg) on May 18, 2009.
3. Source of image "Photo of a Truss Bridge": Creative Commons licensed image downloaded from <http://en.wikipedia.org/wiki/File:RRTrussBridgeSideView.jpg> on May 18, 2009.
4. Source of image "Suspended Span Cantilever bridge": Public domain image downloaded from <http://en.wikipedia.org/wiki/File:CooperRiverBridge.svg> on May 18, 2009.
5. Source of image "Simple Suspension Bridge": Public domain image downloaded from <http://en.wikipedia.org/wiki/File:Bridge-suspension-simple.svg> on May 18, 2009.
6. Source of image "Nonsimple Suspension Bridge": Public domain image downloaded from <http://en.wikipedia.org/wiki/File:Bridge-suspension-nonsimple.svg> on May 18, 2009.
7. Photo of a Popsicle stick bridge deck. Taken by Dr. Beth Snow and released into the public domain.
8. Photo of a Popsicle stick simple suspension bridge. Taken by Dr. Beth Snow and released into the public domain.

**Bridge decks (built for other bridges)**



### References

1. <<http://en.wikipedia.org/wiki/Bridge>> Wikipedia entry on Bridges.[Source of basic information on bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.
2. <[http://en.wikipedia.org/wiki/Truss\\_bridge](http://en.wikipedia.org/wiki/Truss_bridge)> Wikipedia entry on Cantilever Bridges.[Source of basic information on bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.
3. <[http://en.wikipedia.org/wiki/Cantilever\\_bridges](http://en.wikipedia.org/wiki/Cantilever_bridges)> Wikipedia entry on Cantilever Bridges.[Source of basic information on bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.
4. <[http://en.wikipedia.org/wiki/Arch\\_bridge](http://en.wikipedia.org/wiki/Arch_bridge)> Wikipedia entry on Arch Bridges.[Source of basic information on arch bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.
5. <[http://en.wikipedia.org/wiki/Suspension\\_bridge](http://en.wikipedia.org/wiki/Suspension_bridge)> Wikipedia entry on Suspension Bridges.[Source of basic information on suspension bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.
6. <[http://en.wikipedia.org/wiki/Simple\\_suspension\\_bridge](http://en.wikipedia.org/wiki/Simple_suspension_bridge)> Wikipedia entry on Suspension Bridges.[Source of basic information on simple suspension bridges, as well as access to photos/diagrams which can be used for free]. Accessed 17 May 2009.

### Extension of Lesson Plan

Advanced information about different types of cantilever bridges:

- Usually cantilever bridges have two beams, one from each side, that meet in the middle of the bridge.
- A **balanced cantilever** bridge has two cantilever arms, each of which are counterbalanced by another cantilever arm (called **anchor arms**) which projects in the opposite direction and attach to a solid support.
- A **suspended span** cantilever bridge has two cantilever arms which, instead of meeting in the middle, support a truss bridge in the middle.

# Bridges Worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Draw a picture of the bridge that you plan to build:

What type of bridge is this? \_\_\_\_\_