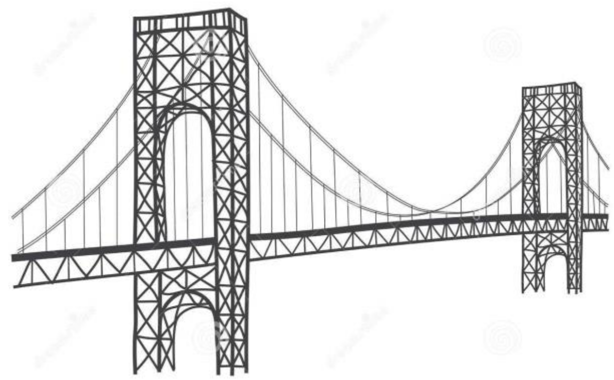
Bridge Over Troubled Water



Big Idea: There is a lot of math that goes into the construction of a bridge. Bridges are just a series of intersecting, parallel, and perpendicular lines and line segments arranged in such a way as to support heavy weights.

Essential Question: How do you build a bridge that can support the weight of objects going across it.

Constraints:

Bridge must be built on a piece of cardboard 1½ feet by 8 inches

Only glue may be used to join the popsicle sticks.

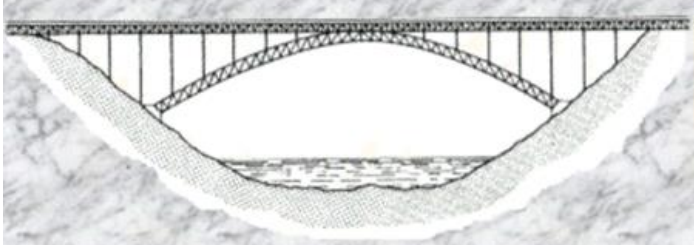
The bridge must at all times touch only the cardboard inside the drawn squares.

Deliverables: You will have the task of building a bridge out of popsicle sticks, designing, buying the materials with your budget, and constructing a final product and seeing how much weight your structure can hold.

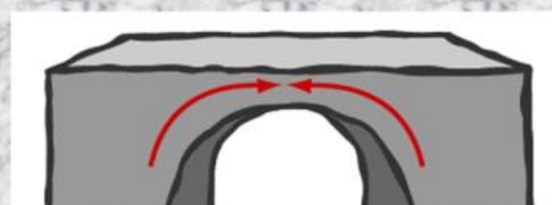
DAY 1 Types of bridges *Ask*	**DAY 2** Introduction of project, going over the rules, breaking into teams and assigning roles *Imagine*	**DAY 3** Begin planning your team's bridge *Imagine*	**DAY 4** Continue planning your team's bridge *Plan*	**DAY 5** Finish planning your team's bridge *Plan*
DAY 6 Begin construction on your team's bridge *Create*	**DAY 7** Continue construction on your team's bridge *Create*	**DAY 8** Continue construction on your team's bridge *Create*	**DAY 9** Test bridge and make improvements based on test *Improve*	**DAY 10** Final test of team's bridge

Lesson 1 – Types of Bridges

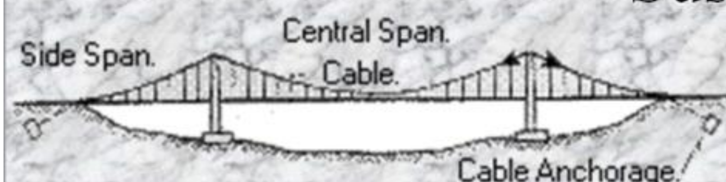
Arch Bridges



A simple arch bridge reaches across in a arch shape rather than straight across. A bridge naturally creates a downward force with weight and gravity but since the



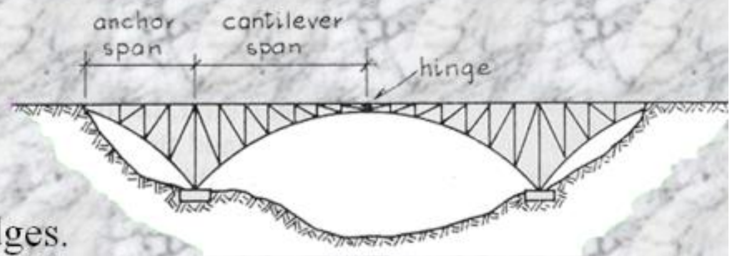
Suspension Bridge



An example of this would be the Brooklyn Bridge in New York.

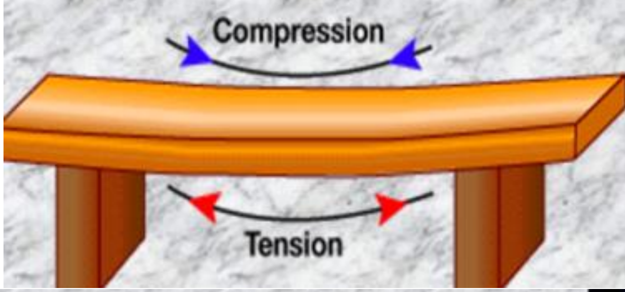
A simple suspension bridge droops down between two ends that hold it up. The droop causes the downward force to go inwards as well.

Beam Bridge



There are 4 types of beam bridges.

1) Clapper bridge
2) Floating pontoon
3) Truss
4) Cantilever



A simple beam bridge is flat and supported at the two ends. The downward forces acting on the beam bridge is spread throughout the bridge either through piers or the like. These upward forces and downward forces balance out.

Cantilever Bridge

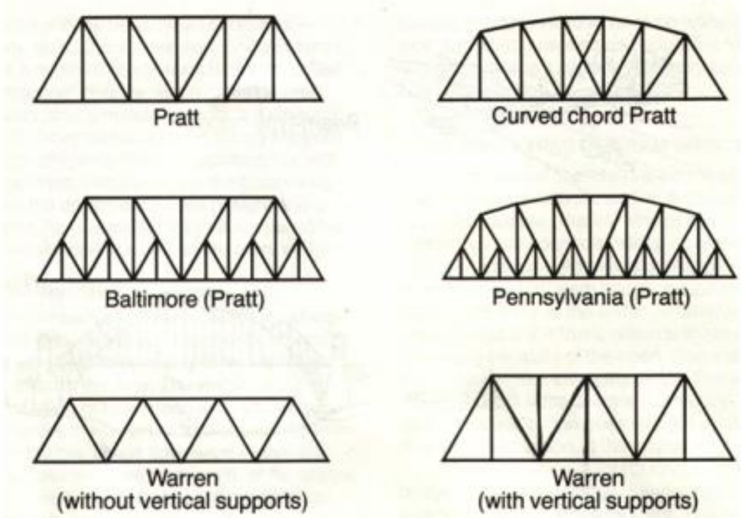
A cantilever is a structure or beam that is unsupported at one end but supported at the other, like diving boards. This configuration made longer spans possible.

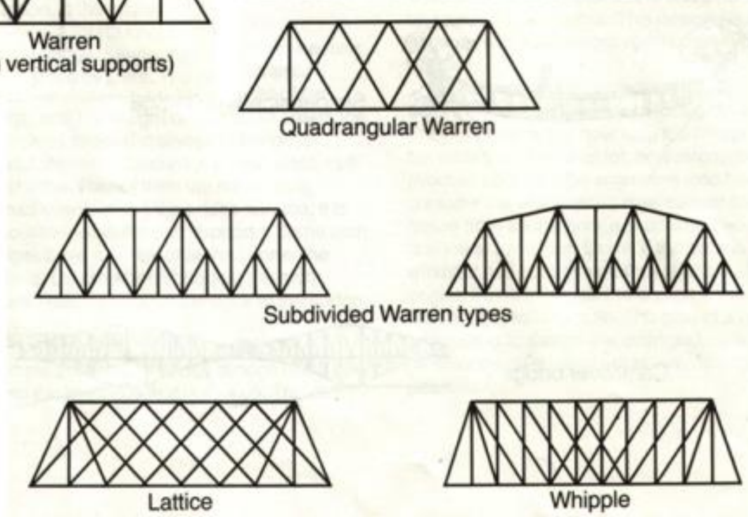
Forth Rail Bridge, Scotland

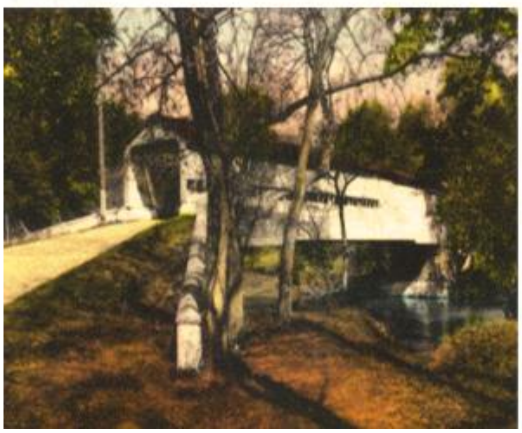
The great tubes take the compression, held up by the narrow top members, with bracing and strutting to keep the forces from buckling them. The spread legs of the towers suggest great stability, though in fact the outer cantilevers have counterweights at the ends to keep the balance. The outer towers could in fact have been hinged at the bottom, but that would have been out of keeping with the middle one, which has to be totally self supporting.

Truss Bridge Designs

Most covered bridges are built on the truss design.







Activity 1 – Imagining, Planning, and Building Your Bridge

During this time as a team you will imagine, plan, and build your bridge, adhering to the constraints of the task.

- Will have a budget of $2 million to spend. Cannot go over this.

- The bridge will be judged on whether it spans at least 12 inches and can hold a toy car.

- The bridge must be built according to code and using only the materials purchased at the Saw Lumber Company.

- Bridge Building Code.
    1. Bridge must be built on a piece of cardboard 1½ feet by 8 inches
    2. Only glue may be used to join the popsicle sticks.
    3. The bridge must at all times touch only the cardboard inside the drawn squares.

The team must imagine and plan for the supplies they are going to need. Every day during the creating phase, the team will come to the lumber company warehouse and purchase the supplies they feel they need to build their bridge.

Bridge Building Rules

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ROLES FOR GROUP MEMBERS

- Accountant
  - Must keep balance sheets and write checks to keep track of expenses. Have to stay under budget.
- Architect
  - Must draw plans for bridge.
- Foreman – appearance/construction of bridge
  - Bridge must match plans and be visually pleasing.
- Safety Inspector – following of building code
  - Make sure all codes are followed and no violations.
- Engineer – strength of bridge
  - See how much weight bridge can hold. Strongest bridge sets the curve.

RULES FOR BUILDERS

- Rulers will be loaned out at no cost to the builders.
- Warehouse will hand out materials at the beginning of class.
- Warehouse closes with 10 minutes left in class.
  - During this time the order forms for the next day need to be filled out.
- If there are bookkeeping problems the company can request an audit at cost.
- Can be fined for numerous infractions.
  - Bothering other builders
  - Leaving messy construction site
  - Not meeting code

SAW LUMBER COMPANY WAREHOUSE PRICE LIST

Land (cardboard)	$500,000
Lumber (popsicle sticks)	$50,000 each
Cable (string)	$500 per cm
Welding Material (glue)	$850 per day
Building Plan Permit (4 sheets of graph paper)	$40,000
Extra Permits	$10,000 per sheet

Daily Order Form

Description	Unit Price	Qty.	Total
		Total Cost	

Balance Sheet

Description	Day Item Ordered	Unit Price	Qty.	Total
			Total	

Bridge Over Troubled Water Rubric

Overall	Plans	Model	Accountant/ Bookkeeping
Excellent	• Correctly labels all dimensions, materials, and parts of the plan, giving someone a good idea of what the finished product will look like. • Plans are neat and look professional, employing a ruler for straight lines.	• Model of the bridge looks exactly like the plan. • Building code was followed correctly without any violations.	• Expenses are all accounted for and comes in under budget. • Balance sheet is mathematically correct and order forms consistently correct during entire project.
Good	• Correctly labels most dimensions, materials, and parts of the plan, but a few are not. • Plans are neat and look professional most of the time but a few places where could look nicer.	• Model of the bridge looks generally like the plan but a couple of instances where they do not match. • Building code was mostly followed correctly with just some minor violations.	• Expenses are all accounted for but is over budget by less than $10,000. • Balance sheet is mathematically correct and order forms mostly correct but a couple had to be reworked.
Needs Improvement	• Does not correctly label most dimensions, materials, and parts of the plan. • Plans are sloppy and do not look professional.	• Model of the bridge looks almost nothing like the plan and/or major differences. • Building code was not always followed resulting in some major violations.	• Either expenses are not all accounted for and/or is over budget by more than $10,000. • Balance sheet is not mathematically correct and/or many order forms were not correct and had to be reworked.