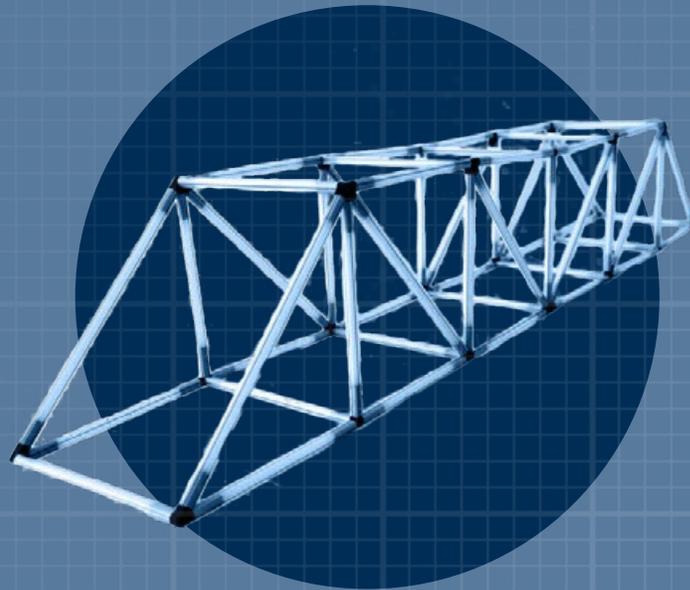


How To **BUILD A STRAW BRIDGE**



STEM Learning Workbook



OVERVIEW

Bridges carry traffic over different obstacles to allow us to move from place to place. Those obstacles can be natural or man-made. Structural bridge engineers use their knowledge to design bridges that safely carry traffic and can last for over 100 years.

Many types of engineers, scientists, and technicians work together to design and build bridges.

- **Traffic Engineer:** studies traffic patterns, traffic volumes, and roadway use to design safe and efficient roadway systems for moving people and products.
- **Roadway/Highway Engineer:** designs the roadway geometry and traffic speed limits to ensure safe travel routes for the public.
- **Hydraulic Engineer:** designs the drainage systems to remove storm water from a bridge and studies stream and river levels to ensure high water levels pass underneath the bridge.
- **Environmental Engineer:** ensures the project is designed to have minimal impact on the surrounding natural environment.
- **Materials Scientist:** studies and tests construction materials that are used to build the roadway and bridge.
- **Geotechnical Engineer:** studies and tests the soil conditions on a project to design the proper foundations.
- **CAD Technician:** uses specialized computer modeling software to create drawings of all components of the project.
- **Structural/Bridge Engineer:** designs the bridge to resist the loads applied to the structure by the component weights, traffic, wind, water, and earthquake.

All these different people work together to create roadways and bridges, and all these different people use STEM (Science, Technology, Engineering, Math) in their work. For this exercise, we'll focus on the role of the **Structural/Bridge Engineer**.

Now let's get ready to design and build your bridge!

BRIDGE TYPES

There are lots of different types of bridges. What type of bridge do you want to build today?

- **Girder Bridge:** uses girders to span between the piers/abutments and support the bridge deck that the vehicles drive on. Girders are usually steel or concrete and act in bending.
- **Truss Bridge:** uses members connected to form panels of triangles. The members are designed to be in compression or tension and are usually made of steel.
- **Arch Bridge:** gets its name from the shape of the structure. It can be made of steel, stone, or concrete and works by “thrusting” horizontally against the abutments.
- **Cable-Stayed Bridge:** uses angled cables called “stays” running directly to vertical towers to support the deck.
- **Suspension Bridge:** uses a series of cables to support the bridge deck. Vertical cables are run up to the main support cable that are supported by central tower and anchored at the abutments.
- **Movable Bridges:** can move to allow ships to pass beneath. There are many types of moveable bridges including Bascule, Swing, and Vertical Lift.



COMMON TYPES OF BRIDGES

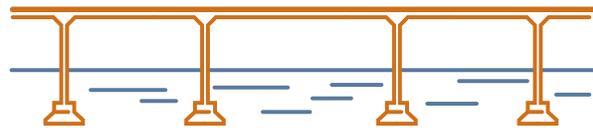
Truss Bridge



Arch Bridge



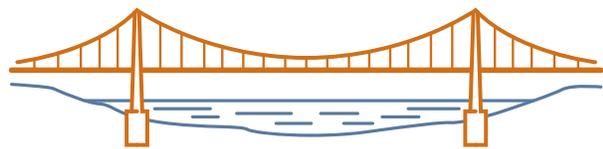
Beam Bridge



Tied Arch Bridge



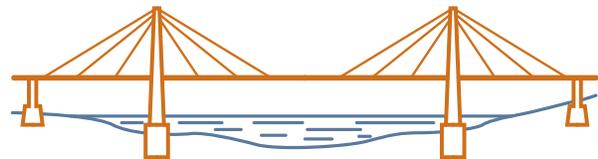
Suspension Bridge



Cantilever Bridge



Cable-Stayed Bridge



MATERIALS

DESIGN/BUILD

25 plastic drinking straws
Scotch tape
Scissors
Ruler
Scratch paper
Pen/pencil

TESTING

Bridge supports
Kitchen scale
Small paper/plastic cup
Loose change (for weights)

INSTRUCTIONS

Your team has been hired to design a bridge. A new highway is being constructed over an existing road. In order to demonstrate your bridge design concept, you have been asked to build a scale model bridge to prove its effectiveness.

Set a timer for 35 minutes. Use only the materials listed above in the “Design/Build” section to design and construct your bridge. At the end of 35 minutes, use the “Testing” materials listed above to see how much weight it can hold.

The bridge must meet the following requirements:

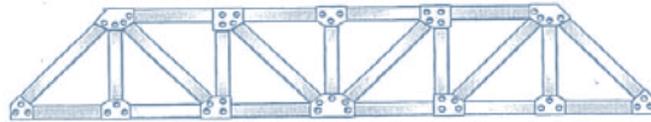
- Clear span length of 10” between supports
- The bridge may not touch the “ground” between the supports
- The bridge must have a place to support at least one small paper/plastic cup
- The bridge may not be taped to the supports
- Only the plastic drinking straws and scotch tape can be used as building materials

First, figure out what type of bridge you want to build. Then, use some scratch paper to draw your ideas. Then, use the tape to connect the straws together for your design. The straws may be modified in any way you want (cut, bent, split, twisted, smushed).

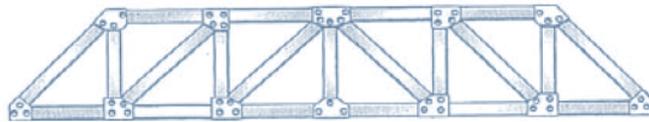
Some questions to consider:

- What type of bridge will support the most weight?
- What type of bridge can you build with the time you have?
- Are the straws solid or bendable? How might bendable straws affect your bridge?
- What does the term “clear span” mean? Should your bridge be longer than the clear span?
- Will your bridge carry more load if you have one weight platform or more than one?

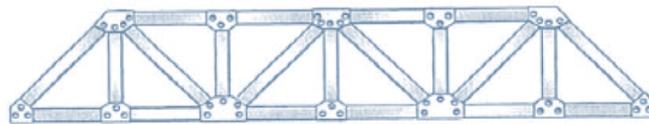
COMMON TYPES OF TRUSSES



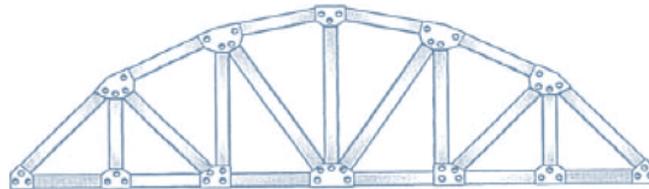
Pratt



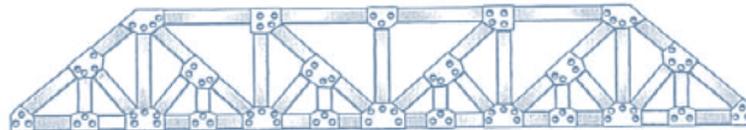
Howe



Warren with Verticals



Parker



Baltimore

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