Western Engineering Outreach

Pasta Bridge Design Challenge

Grade 6-8

Meet Today's ENG HERO!

Michael Bartlett - Professor with Western Engineering

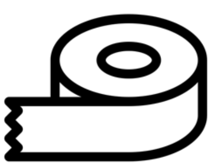
Michael Bartlett completed his BSc in Civil Engineering at Queen's University. He completed his MSc at Waterloo University and his PhD at University of Alberta. He is now a professor in the Civil and Environmental Engineering Department at Western University. Some of his research has focused on bridge and structural engineering.
To learn more about Dr. Bartlett visit:
https://www.eng.uwo.ca/civil/faculty/bartlett_m/index.html

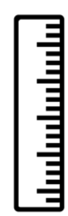
Learning Goal:

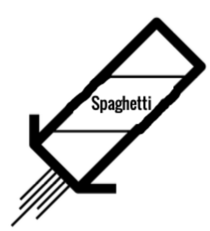
- Students will explore civil engineering as they learn about different types of bridges and create their own using pasta.
- Students will consider form and function and reflect on how the location of a bridge helps determine what kind of bridge is built.
- Curriculum Connections: Grade 7 - Form and Functions; Grade 8 - Systems in Action

Materials Needed:

- Dry spaghetti
- Rubber bands
- Ruler
- Tape
- Scissors
- Piece of paper
- Pencil





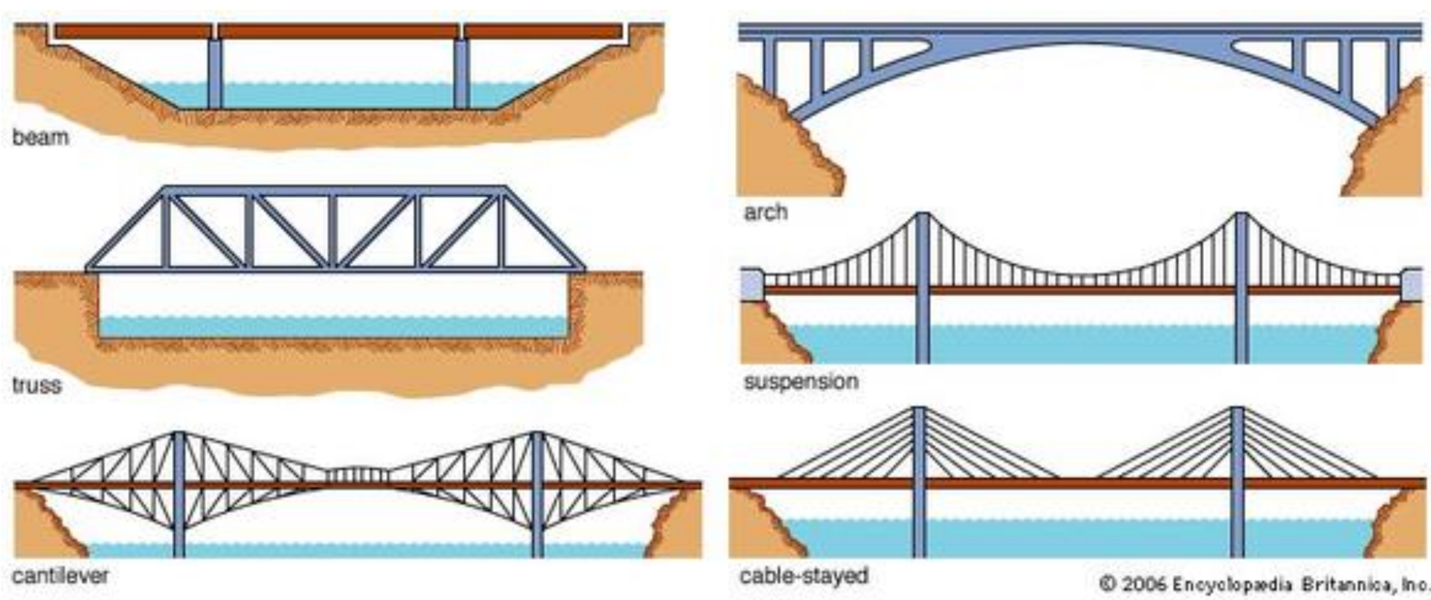


Engineering and Science Connections:

Civil engineering includes the design and construction of buildings, roads, bridges and dams. It is one of the oldest forms of engineering and involves further specialist areas such as transportation, water resources, surveying and construction.

Civil engineers need to consider not only the shape of their structure, but how it will function in relation to the environment as well as the community. Details such as the type of materials used, where the structure is located, what the structure is going to be used for are all important aspects that a civil engineer must take into consideration.

Today's activity deals with bridges. There are a variety of bridges throughout the world. Six common types of bridges include beam, arch, truss, suspension, cantilever, and cable-stayed.



Beam:
The beam bridge is the oldest and most common type of bridge. A beam bridge is a horizontal structure. It has a support on each end. Other supports, called piers, may also hold up the bridge between the two ends. A log that crosses a stream is a beam bridge in its most basic form. This bridge is for a short distance.

Truss:
The truss bridge has a support at each end. It may also rest on piers in between. But its structure gives it more strength than a simple beam bridge. A framework of metal or wood bars connects the two ends of the bridge. They often form a sort of tunnel through which the roadway passes. Trusses use many triangles because this shape is very strong.

Cantilever:
Made up of structures called cantilevers. A cantilever is a beam that has a pier at only one end, like a diving board. A framework of many bars adds strength to the beam, as in a truss bridge. At least two of these beams stretch toward each other to form a cantilever bridge.

Suspension:
The roadway hangs from strong wires called cables. The main cables hang between two or more towers. Smaller cables hang down from the curving main cables. Suspension bridges can span longer distances than any other type of modern bridge. Suspension bridges have a lot of tension.

Cable-Stayed:
Uses cables to support the roadway. Its cables run directly between the towers and the roadway. They attach to the roadway in straight, diagonal lines.

No matter what type of bridge or structure you choose, there are forces that will act on them. Some of these forces are listed below:

- **TENSION**: the stretching of an object by strings, cables, or a chain
- **COMPRESSION**: a pushing force that "squishes"
- **STRESS**: the internal (inside) pressure acting on a structure
- **TORQUE**: the force that an object creates as it rotates on an axis or a pivot
- **LOAD**: can be the weight of something that works with gravity to decrease structural reliability; too much load can create stress and structural issues

Video Recommendation:

Tacoma Bridge Collapse 1940
https://www.youtube.com/watch?v=XggxeuFDaDU

Why the Tacoma Narrows Bridge Collapsed
https://www.youtube.com/watch?v=mXTSnZgrfxM

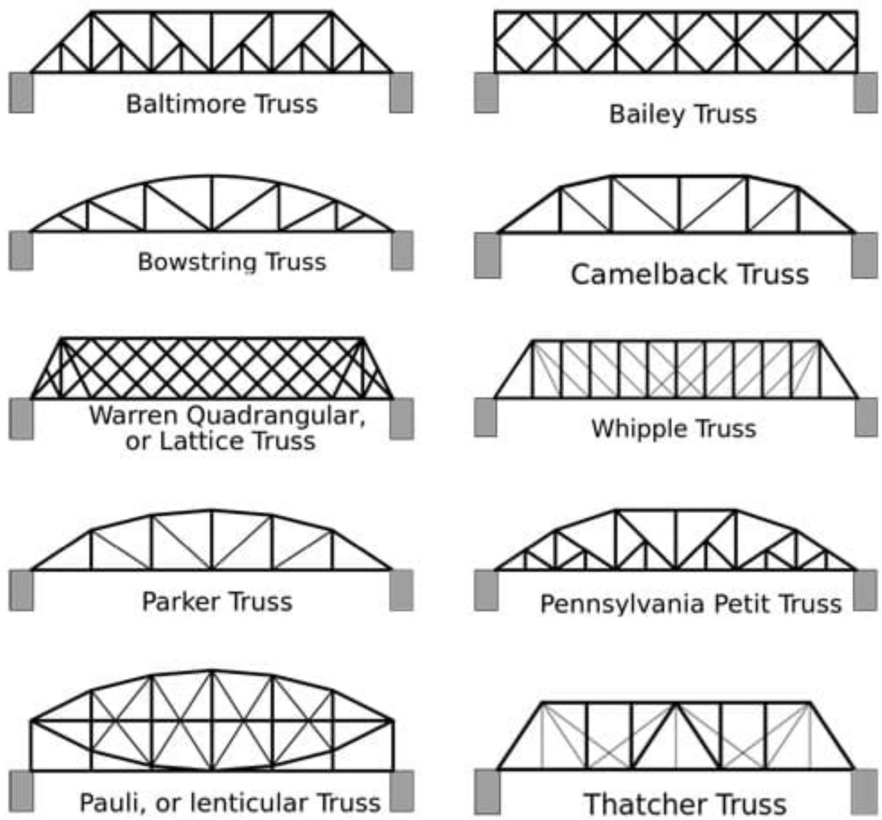
Activity:

Before beginning, think about the following questions:

- Why do we use bridges?
- Why would a bridge break or collapse?
- What are some different types of bridges? Why would you choose one over another?

The City of London is looking to build a new bridge over the Thames River. You and your civil engineering firm have been hired to design and build the bridge. Your bridge must span at least one foot. You need to make sure the bridge is structurally stable and will allow both vehicular and pedestrian traffic to cross it. The City has suggested a truss bridge, but the decision is up to you! Consider the different kinds of truss bridges pictured here.

Before you start building, make sure you draw your design. Using precise measurements in your design may help you with your build.



Use dry spaghetti and tape to create your bridge. Remember, in order to minimize costs, you should minimize materials. Hint: multiple strands of spaghetti will help strength your bridge. To cut multiple strands of spaghetti at the same time, use rubber bands to hold them in place.

Once your bridge is constructed, it is time to test! Place two chairs facing each other, about one foot apart, and place your bridge to span between them. Add objects for weight to test your bridge. How much can it withstand before collapsing? How can you make your bridge stronger?

What Did You Learn?

- What are 6 different types of bridges?
- What forces acted on your bridge?
- Why is it important to test bridges with models before building them in real life?

Future Learning

- Turn your bridge building into an experiment! Consider other types of bridges you might build or other materials you might use. Make predicitions about which type and material you think would work best. Build them and test to see which can hold the most weight! Don't forget to write it down, because writing it down makes it science.

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

Instagram: @westernueng
Twitter: @westernueng
Facebook: @westernueng

Thanks for discovering with us!