# Western Sengineering

Keeping You in Suspension Grade 6-8

# Meet Today's ENG HERO!



Jason Gerhard - Professor with Western Engineering

Dr. Jason Gerhard finished his BSc (Geological Engineering), MSc (Civil Engineering), and PhS (Civil Engineering) at Queen's University. He has nearly 20 years of experience leading research into the fate and remediation of organic contaminants in soils and groundwater. He has received more than \$4.3M in competitively awarded funding and supervised more than 100 research students. Dr. Gerhard is co-inventor of the STAR thermal remediation technology and leads its ongoing emergence. Fun Fact: He came 3<sup>rd</sup> place in the Bill and Melinda Gates Foundation Reinvent the Toilet Challenge (2012). *To learn more about Dr. Gerhard visit:* https://www.eng.uwo.ca/civil/faculty/gerhard\_i/index.html

# Learning Goal:

- Students will about the forces at work in suspension bridges and how the form of suspension bridges affects their function.
- Curriculum Connections: Grade 7 Form and Function: Grade 8 Systems in Action

# Materials Needed:

- 8 Straws
- Tape/Glue
- Wire/String (long pieces)
- Carboard
- Paper
- Popsicle sticks
- Scissors
- 1 Paper clips
- 1 Cup filled with coins or other weight









# Engineering and Science Connections:

Today, we will explore Civil Engineering and the use of suspension bridges.

### What do Civil Engineers do?

Civil engineers conceive, design, build, supervise, operate, construct and maintain infrastructure projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment.

### What is a Beam Bridge?

- They are the simplest structural forms for bridge spans supported by an abutment or pier at each end. No moments are transferred throughout the support, hence their structural type is known as simply supported
- They are used to carry pedestrians, automobiles, trucks, light rail, and heavy rail.

### What is a Suspension Bridge?

- A bridge in which the weight of the deck is supported by vertical cables suspended from larger cables that run between towers and are anchored in abutments at each end.
- The bridge deck: The part of the bridge that supports the *load*, such as cars and their passengers. It hangs from, or is suspended by, massive *cables*. These cables stretch between the bridge's *towers* and are securely anchored at each end.
- The cables are under tension (they are being tightly pulled on) while the bridge towers are under compression (they are being compressed or pressed down on).
- The Akashi-Kaikyo Bridge, shown on the right is the longest suspension bridge.
- The bridge is 3911 meters (m) long overall, with a central span of 1991 m.
- The bridge is in Japan, where it connects the city of Kobe with Iwaya

### Why build a Suspension Bridge?

- The bridge deck, or roadway, is supported from above using tension cables and compression in the towers rather than just from bases. Suspension bridges are less rigid, so they can better withstand outside forces, such as earthquakes.
- For long spans, the suspension bridge is usually the most economical choice, because the amount of material required per unit length is less than for other bridge types.





### What are the advantages of building Suspension Bridges?

- 1. **Cost effective:** There is a very minimal amount of materials needed in order to construct suspension bridges. The only other costs incurred are with the labor involved in building it.
- 2. **Can be build high up**: Suspension bridges can be very high up over waterways. This is essential for any area that needs to be able to allow passing ships to come through.
- 3. **Span great lengths:** The way that suspension bridges are constructed, and the materials that are used, allow them to be able to span a great distance with minimal materials.
- 4. **Has flexibility:** One common reason that the choice to build a suspension bridge is reached is if it is being built in a high earthquake zone. This is because suspension bridges are flexible due to the cable system that holds them. The bridge can move with the wind and during natural disasters such as an earthquake.
- 5. **Simple construction:** No access is needed from below the bridge while it is being constructed, making it a great choice for areas with ships and waterways.

### What are the disadvantages of building Suspension Bridges?

- 1. **Soft ground issues**: If the suspension bridge needs to be built in an area has soft ground, like over water, very extensive foundation work may be needed in order to make it safe for heavy loads.
- 2. **Too flexible:** Flexibility of the suspension bridge design is a major advantage, until conditions become severe. Underneath extreme winds or very heavy loads, the bridge can move so much that the bridge would need to be closed.
- 3. **Cannot Support High Traffic:** Since very little support is needed underneath the deck of the bridge, and the cables are light, the bridges are very light weight. This restricts the amount of traffic and the weight of heavy loads that can use it.

### Video Recommendation: Understanding Suspension Bridges

https://www.youtube.com/watch?time\_continue=256&v=rbrhwTvrxHk

# Challenge Time:

- By only using the materials given above, design and create a bridge that can hold a cup full of coins or other weights
- Did it collapse? Or did it carry the load? If it collapsed, redesign your bridge and test it out again.

# Here is a simple example:

# Build a beam bridge



Add the cables to make it a suspension bridge.



### What Did You Learn?

- What
- What do Civil Engineers do?
  - What are some special features of suspension bridges?
  - What forces act on a suspension bridge?
  - Where would you not want to build a suspension bridge?

# Future Learning

- When you finish building your suspension bridge try thinking of new ways you can make it stronger to carry heavier items (you can use other materials from around your house).
- What extra materials did you use? Is it stronger? Why do you think it is stronger now?
- Research where suspension bridges are most commonly used. Where is there a suspension bridge in Canada?

## Share your creations! We would love to see what you made. Email as at <u>discover@uwo.ca</u> or tag us on social media.

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Thanks for discovering with us!

