Activity Sheet	
Gr 7 - Lesson #3	Medium Motor – Bridge Crossing
Date:	Name(s):

Check That I'm Done ☑		
☐ Commented on my code	☐ Modify it task	☐ Coding Challenge

Learn

In the army exist a mobile bridge laying vehicle. It is capable of carrying a light weight bridge that can support both tanks, armored vehicles, and itself.

The designers of this vehicle had to make some very hard decisions to make sure this worked properly. Many of their decisions centered on their understanding of internal and external forces, form, and function.

The **form** of any object is its physical appearance. Appearance is usually an important design feature. Not so much in a radio tower, but definitely in clothing for example so that it looks good, or army vehicles which are camouflaged. You can't ignore function when thinking about form though also.

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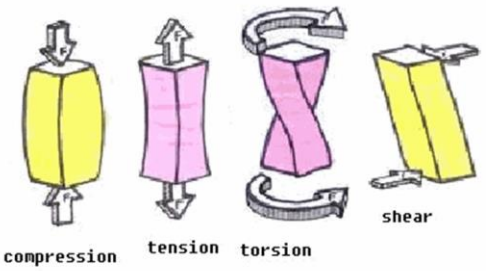
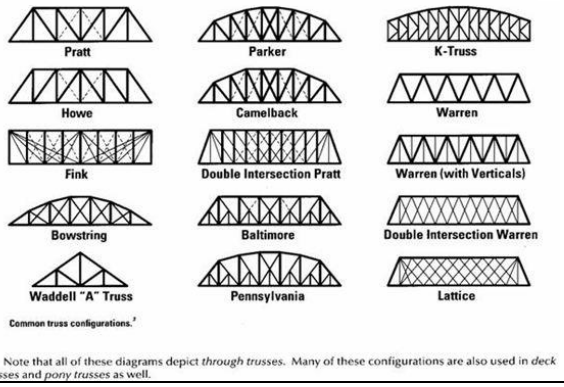
First Lego League Curriculum - Ontario

The **function** of any object is what it is capable of doing. This is determined by its features, materials, geometry and many other factors. The function of a bridge is to support all of the loads it needs to carry and allow vehicles to traverse from one place to another.

In order to create a good design with the desired form and function, you must take careful consideration of the internal forces within the structure itself. The internal forces are put into 5 categories: **tension, compression, torsion,** and **shear**.

To manage these forces affectively engineers have learned some useful tricks. Examples include struts, braces, supports, and stiff materials or flexible materials.





Predict and Plan

What are some of the key features of a portable bridge?

_____

_____

What are some of the biggest challenges in creating such a bridge?

_____

_____

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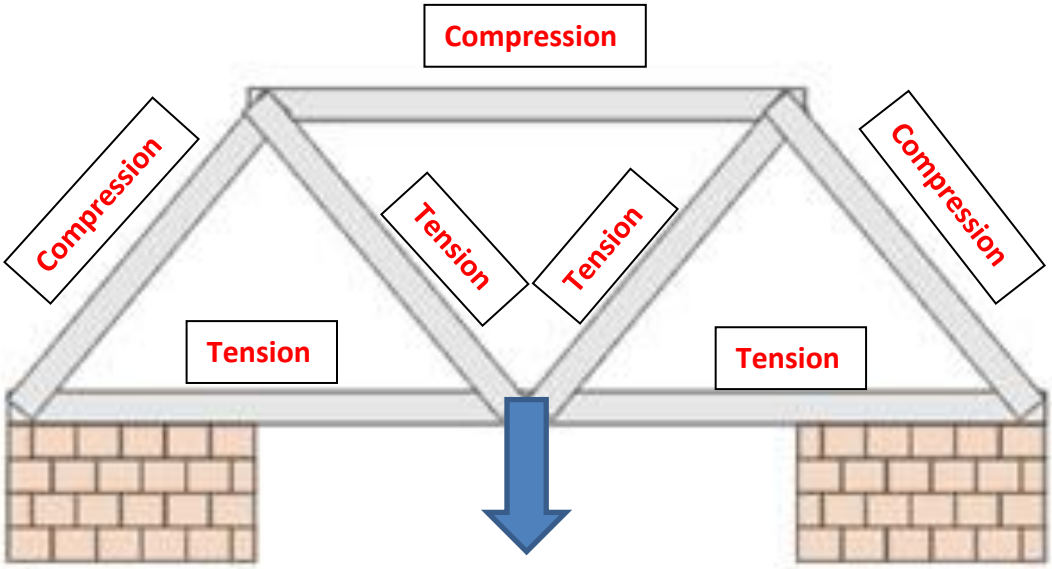
On the bridge below, clearly indicate whether each beam is in tension or compression. It can be helpful to picture pulling where the blue arrow is and imagine the beams being either strings or popsicle sticks, and asking yourself, would it collapse.



Demonstrate/Design/Discover

This challenge consists of three parts. 1) Designing a lifter, 2) Designing a bridge, and finally 3) Programming your sequence that uses that bridge

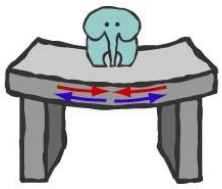
- ✓ Change your front lifter arm so it has two prongs shooting straight out. This can be done with Lego or everyday materials like popsicle sticks and masking tape.

- ✓ Using what you know about forces, structures, braces, and materials, design a light weight bridge that can be carried and laid down by your robot. Your bridge must i) Support the full weight of your robot and carry it without it falling off ii) be able to be carried and laid down by

your robot arm iii) Span a minimum distance of 25cm.

- ✓ Create a program that approaches the gap, lays down your bridge, aligns the robot, and the traverses the gap.

Tips:



#1 The top of a bridge tends to be in compression
As the bending forces the material towards itself.
At the bottom however, the material spreads apart and is in tension.
Select your shape and materials to handle this effect.

#2 Deploying your bridge may take some trial and error. Remember that controlling your motors with seconds will allow a motor to move on after hitting something, where rotations will keep struggling until the motor has completed its turns.

Record
What are the final **dimensions** of your bridge? Length_____cm Width_____cm Height_____cm. (If possible) How much does your bridge weigh? _____Kg

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Sketch your bridge in the 'down' position below. Use a red coloured pen/pencil to signifiy where the bridge is in compression, and a blue line to signifiy where you beieve the bridge is in tension.

Questions	
Question 1 Science	Did the actual forces on the bridge align with your predictions?
Question 2 Science	Which force was your bridges weakest link? Torsion, Shear, Compression, or Tension? (Another way to think of it would be, if your bridge were to fail, which force would be the most responsible).

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Question 3 Science	What aspects of your design worked well? What didn't work well?
Question 4 Science	What were some of the great features of the most effective design? Why did they work so well?
Question 5 Coding	What coding challenges did you have to overcome to make sure the robot could cross the bridge consistently?
Question 6 Science	If your robot was off center going over the bridge, what internal force starts to become much more important?
Torsion. As the robot goes to one side or the other, the bridge may want to twist.	

Extension Coding and Science	Attempt to have your robot pick the bridge once it has crossed over to the other side. This may require changing the other side of your bridge so that it's more symmetrical.