

## **Basic Building Techniques for LEGO Robots**

By Sanjay and Arvind Seshan



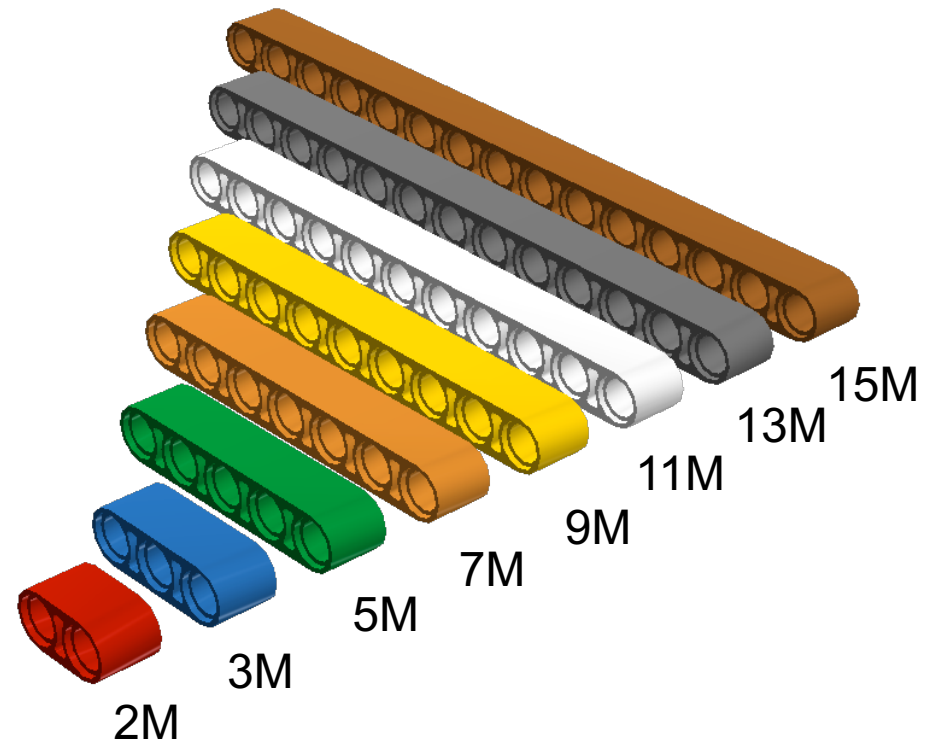
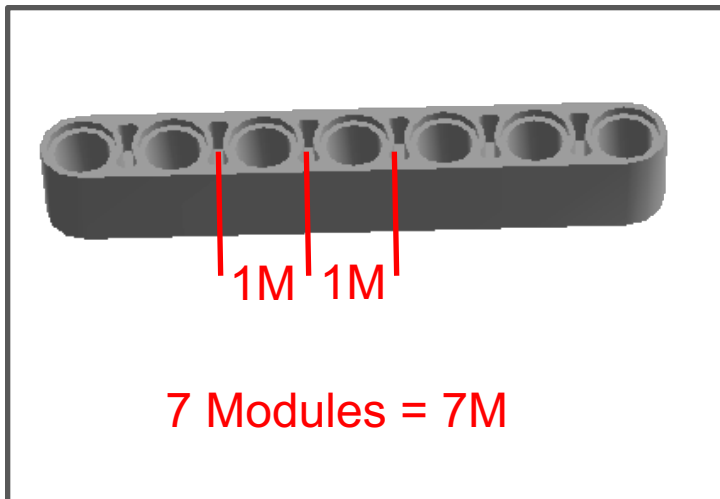
# **ROBOT DESIGN LESSON**

# ARE YOU NEW TO TECHNIC?

- **This lesson is an introductory lesson to common technic pieces**
- **This lessons does not cover every Technic part. It is just an introduction to commonly used parts in MINDSTORMS robots**

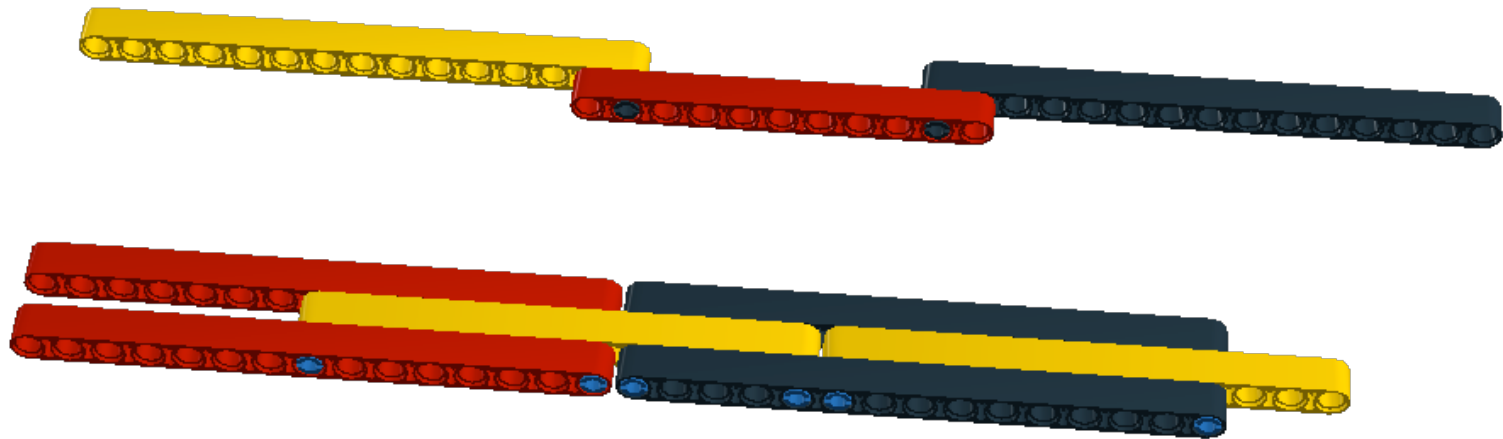
# LIFTARMS

- Liftarms come in various sizes from 2M to 15M length
- Technic is measured in Modules (M)
- The number of holes corresponds to the Modules



# TEST: MAKING SOMETHING LONG

- What if you want to build something long
- Build both models below. Which one is stronger?



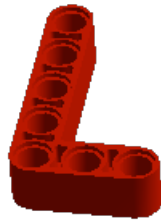
# LIFTARMS – ANGLES



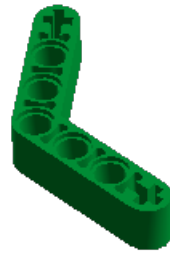
T-beam  
3X3



4X2  
90 degrees



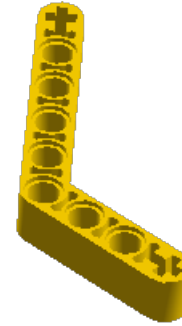
4X3  
90 degrees



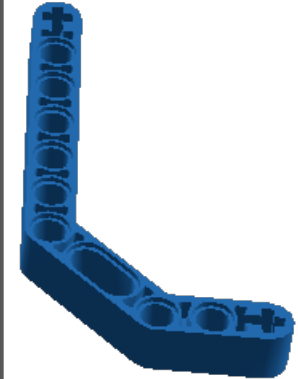
Angle  
4X4



Angle  
4X2



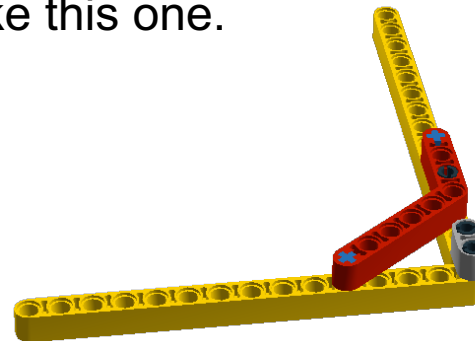
Angle  
3X7



Double  
Angle  
3X7

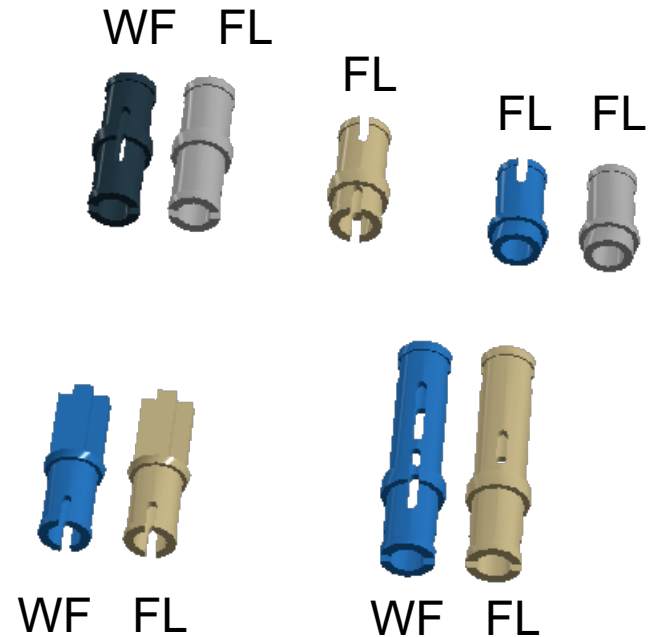
- Don't force LEGO into angles they are not meant for. You will put stress on the liftarms and the pegs

These beams all have a  $53.1^\circ$  angle. This angle makes 3:4:5 right triangles like this one.



# TECHNIC PEGS

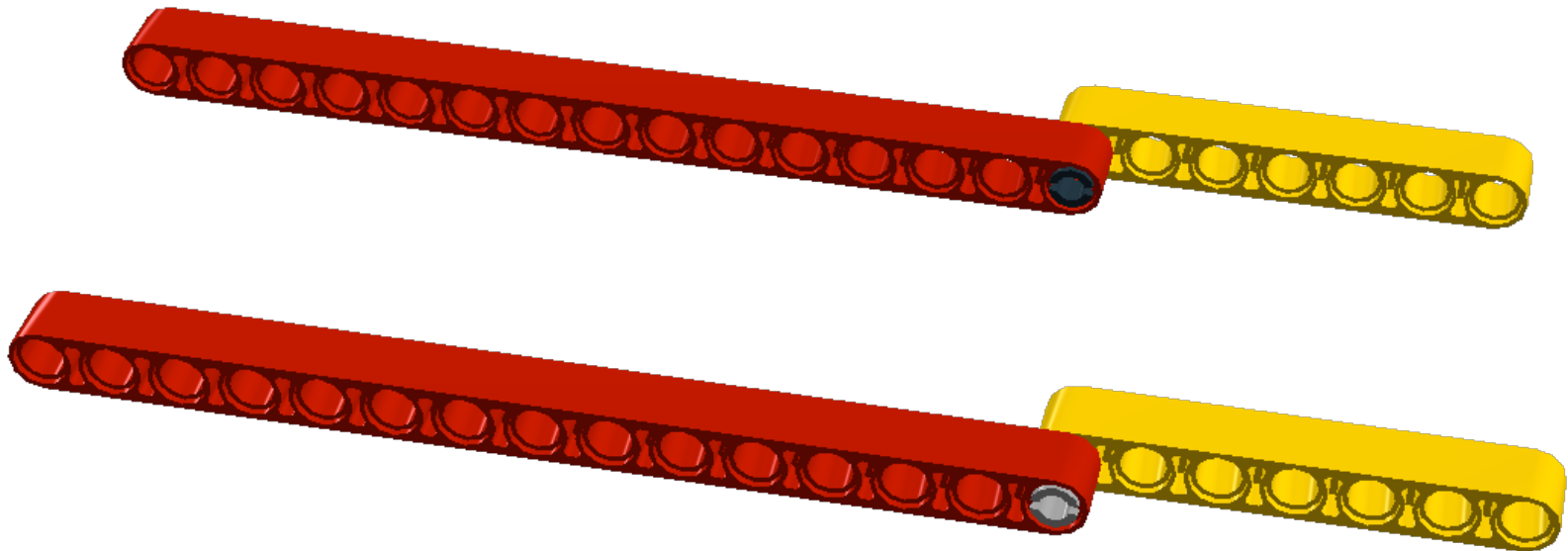
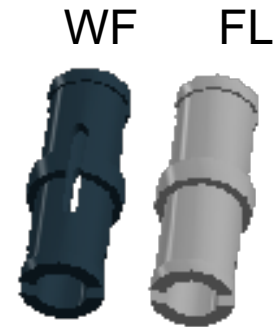
- LEGO makes two type of pegs:  
With Friction and Frictionless  
pegs
- A common mistake is to use  
either peg in builds
- However, which peg you use  
does matter!



FL – Frictionless  
WF- Friction

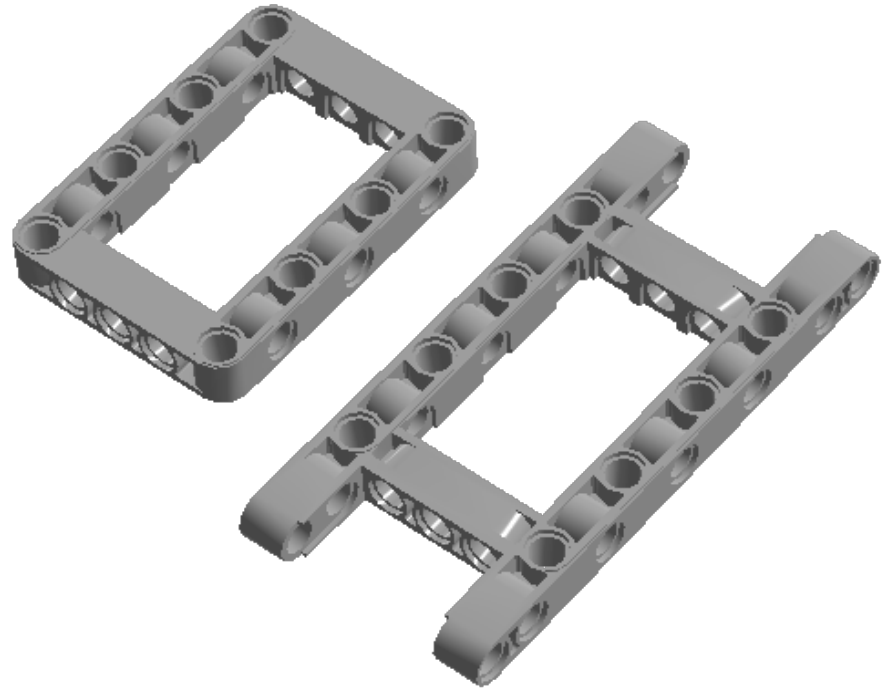
# TECHNIC PEG TEST

- Build both these models. One uses a black peg with friction and the other uses the grey frictionless peg
- What is different?



# FRAMES

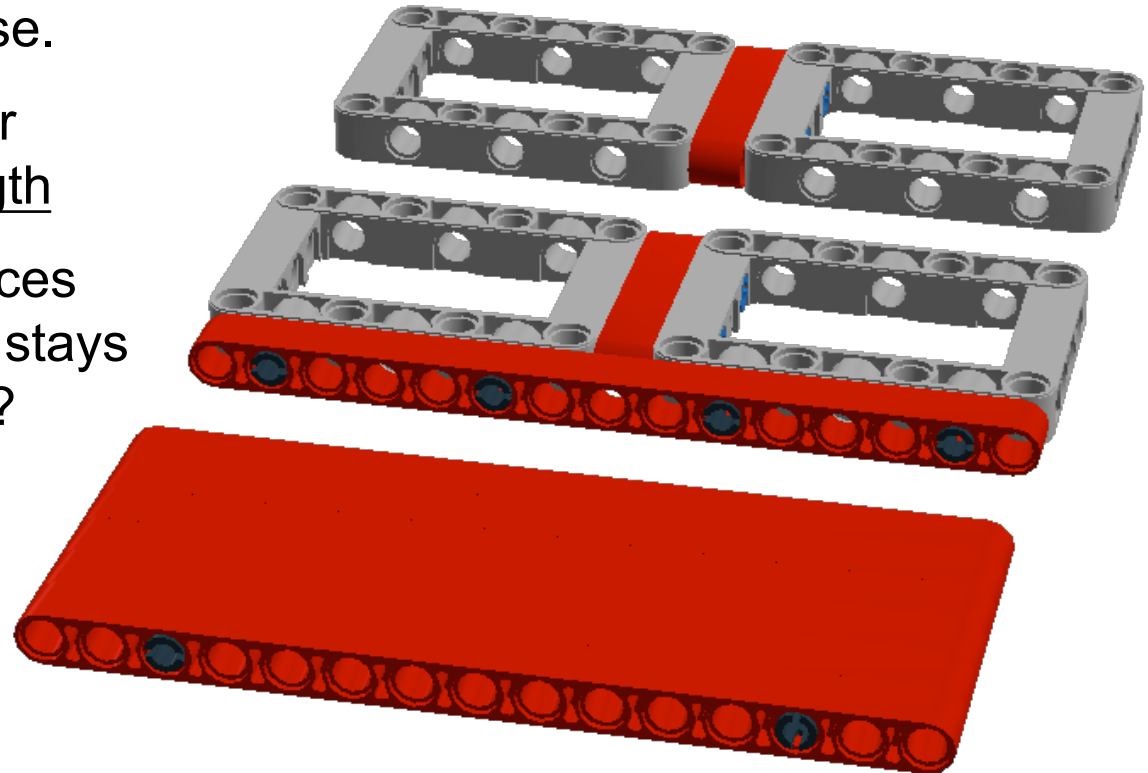
- Open frames and H-frames can add strength to your builds without as much weight





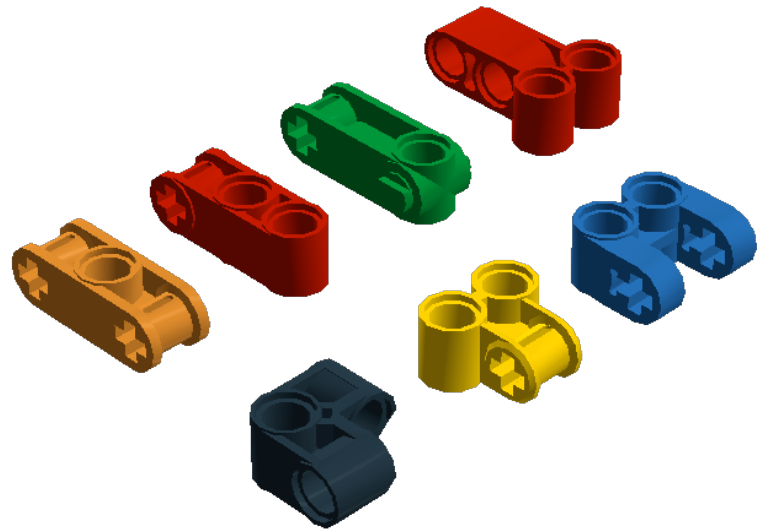
# FRAMES TEST

- Build each of these.
- Compare them for weight and strength
- Try to pull the pieces apart. Which one stays together the best?



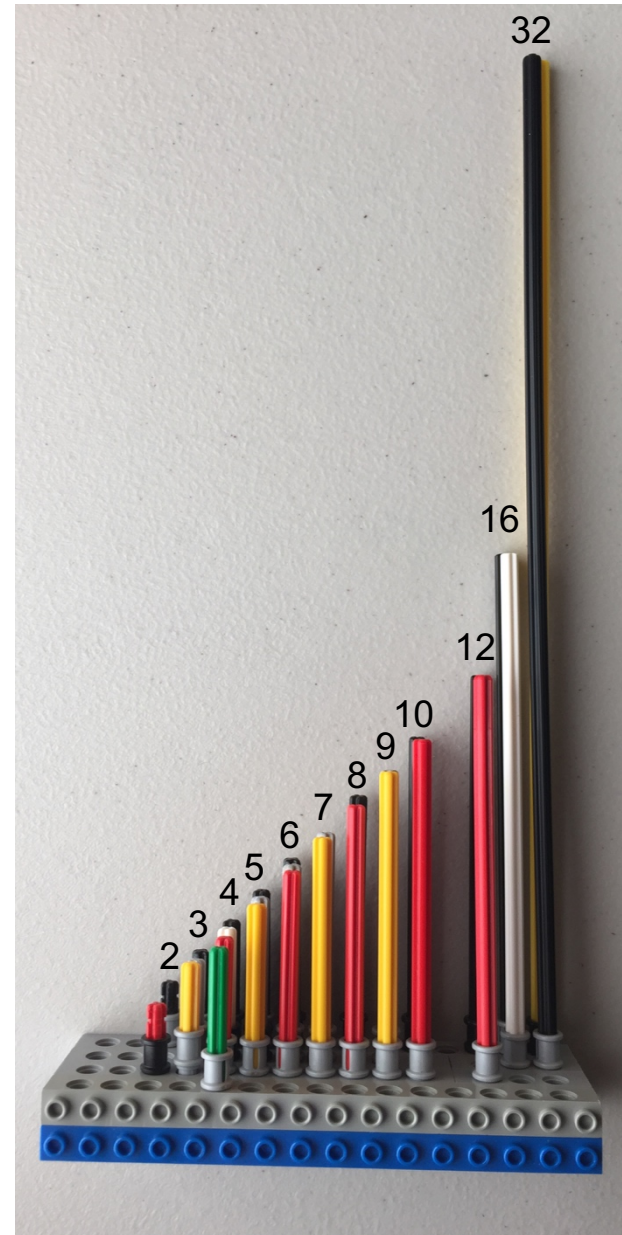
# CHANGING DIRECTIONS

- These connectors can be used to change directions
- You might sometimes need to be a  $\frac{1}{2}$  module off. Some of these connectors can come in handy for this.



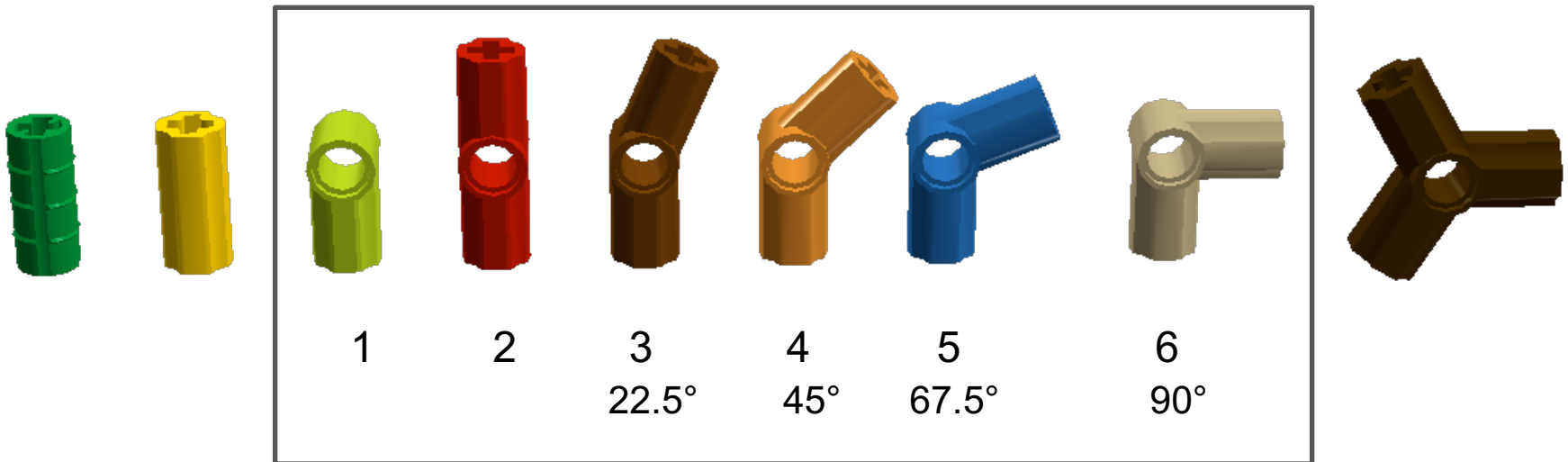
# AXLES

- Axles come in lengths of 2M to 32M in various colors
- The MINDSTORMS set generally has black, red (2 length), and grey axles, but newer technic sets are changing to all red and yellow



# AXLE CONNECTORS

- Axle connectors come in various angles. Many of them are labeled with a number
- Don't force LEGO into angles they are not meant for. You will put stress on the axles and connectors



# AXLE TEST

- Sometimes, shorter axles with connectors are a lot stronger than one long axle
- Construct both builds below. Try bending/twisting them. Which one is stronger?

Three length axles with connectors

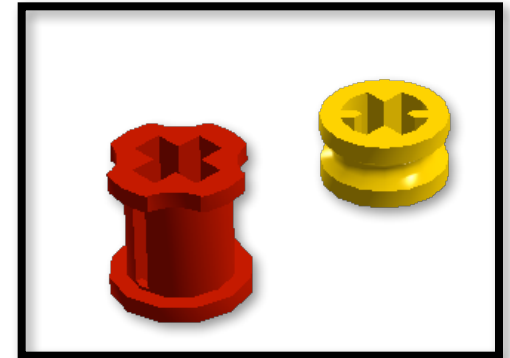
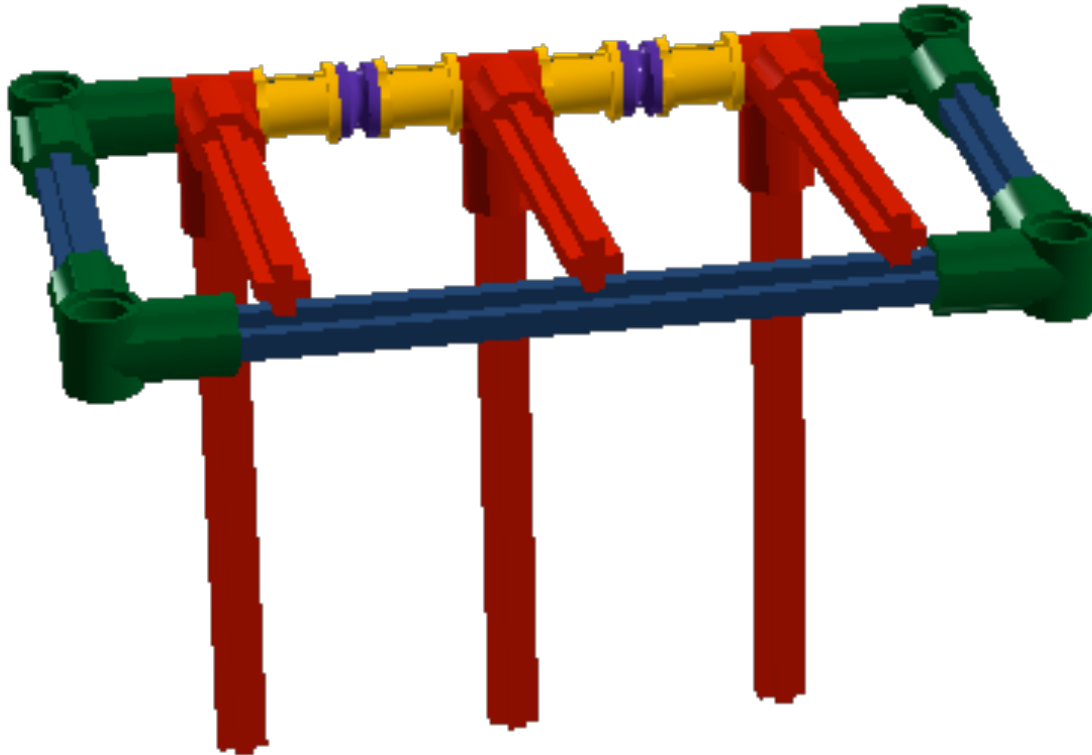


12 length axle



# BUSHINGS

- Bushings can come in very handy
- They are used in axles like a space holder



# CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at [www.ev3lessons.com](http://www.ev3lessons.com)



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