6.1 Levers, Cams & Span

Leverage

I can understand the principals of leverage, cams & span.

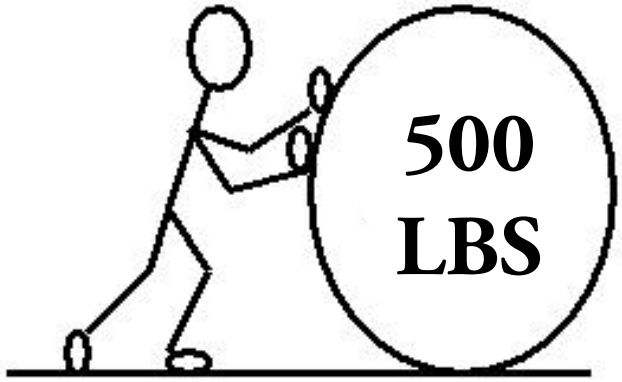
Leverage /'lev(e)rij, 'lev(e)rij/noun

the exertion of force by means of a lever or an object used in the manner of a lever

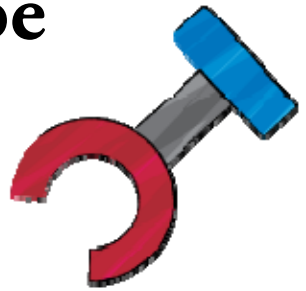
Use of Levers

Levers are used when a mechanical advantage is necessary.

1.)

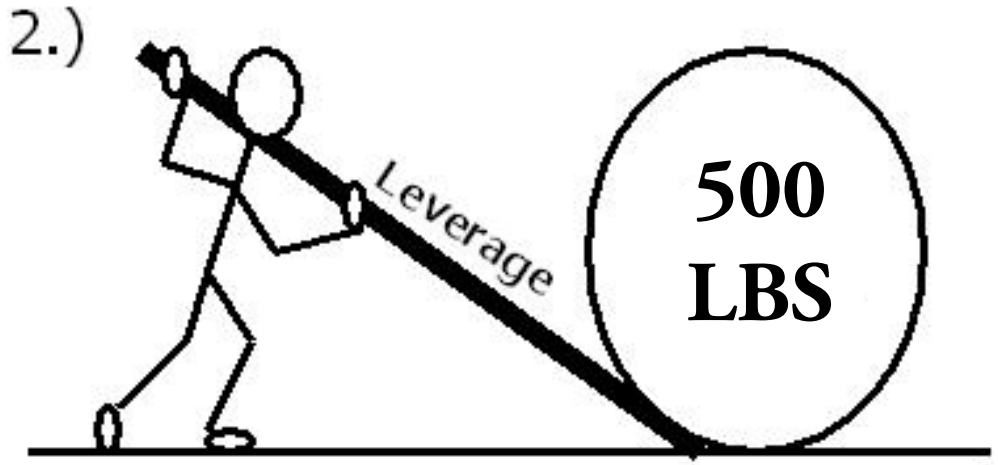


Imagine trying to push a 500 pound rock with just your hands. It would require you to be able to push all 500 pounds.



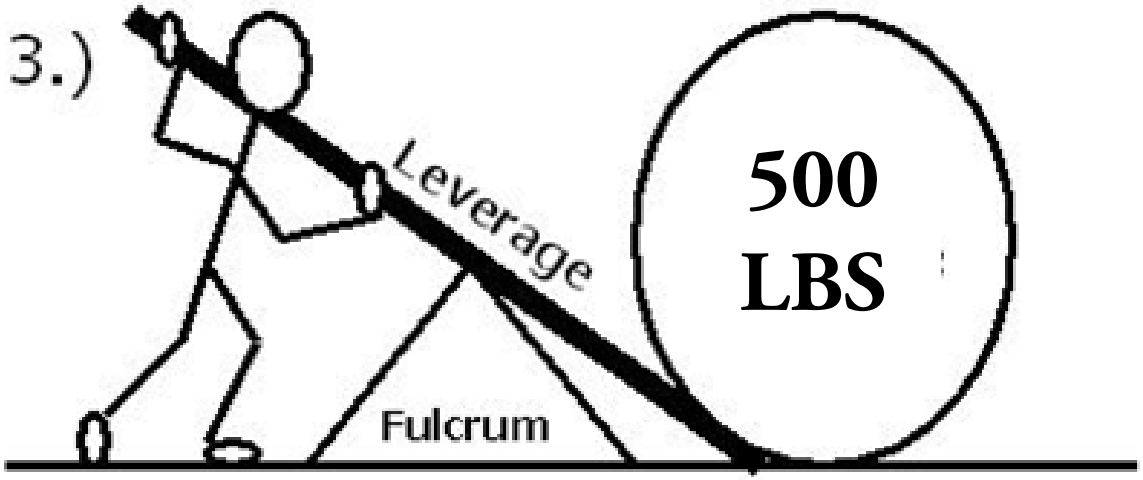
Levers

Now imagine you have a stick (lever) to help you. The amount of force required would be less than the 500 pounds.



Levers

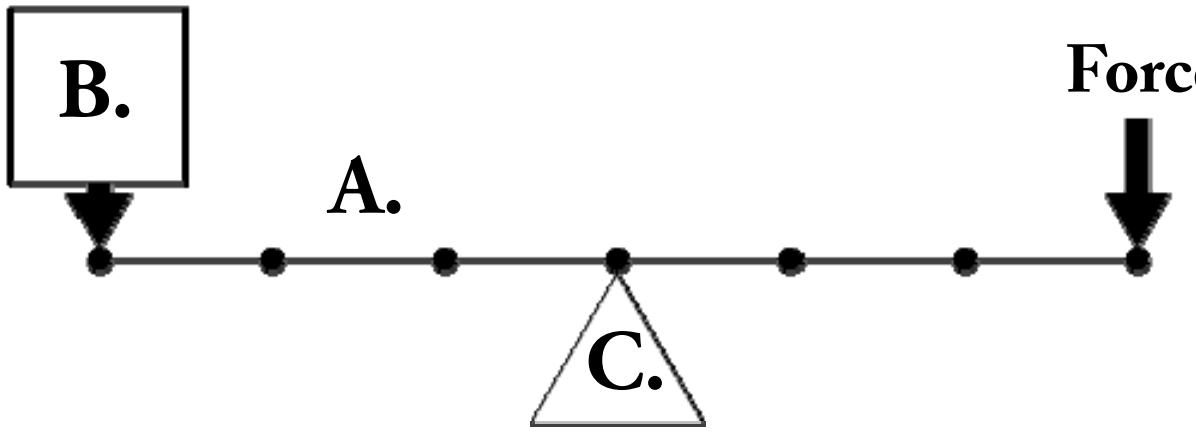
With the addition of a fulcrum the amount of force required can be further reduced.



Calculating Force

When calculating the force needed to move an object using a lever you will need to know a few things,

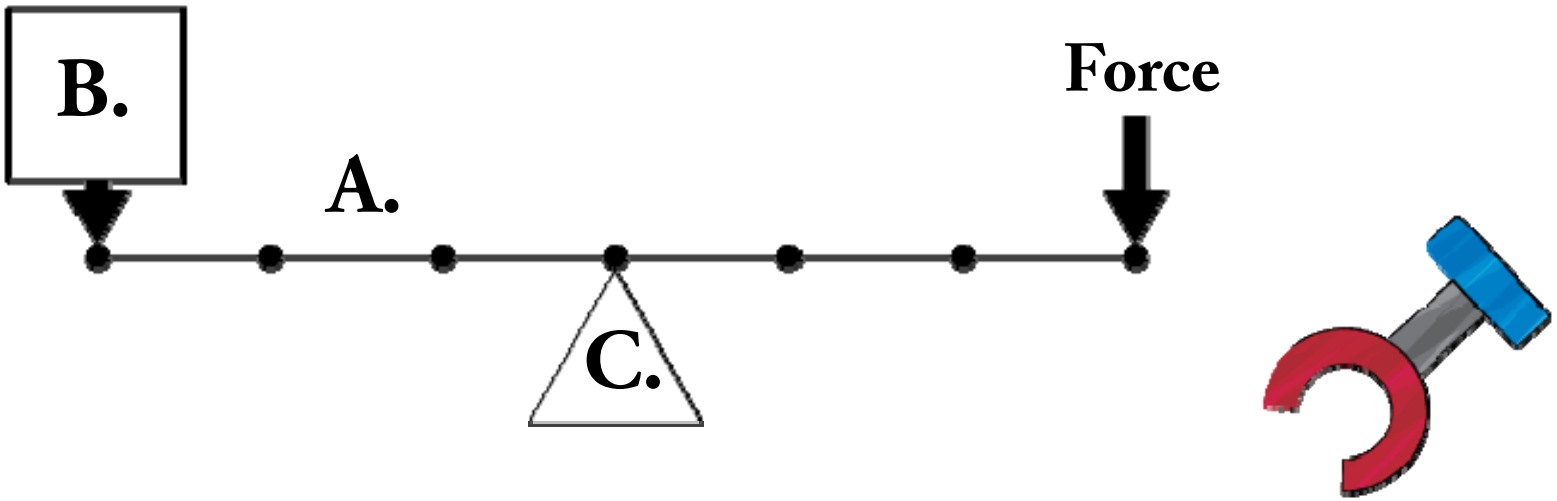
A. Length of the lever arm
B. Weight of the object (load)
C. Position of fulcrum (the ratio between the force and the load)



Calculating Force

If A = 6 Feet
B = 10 Pounds
C = centered (the ratio is a 1:1)

It would require 10 pounds to lift the load.

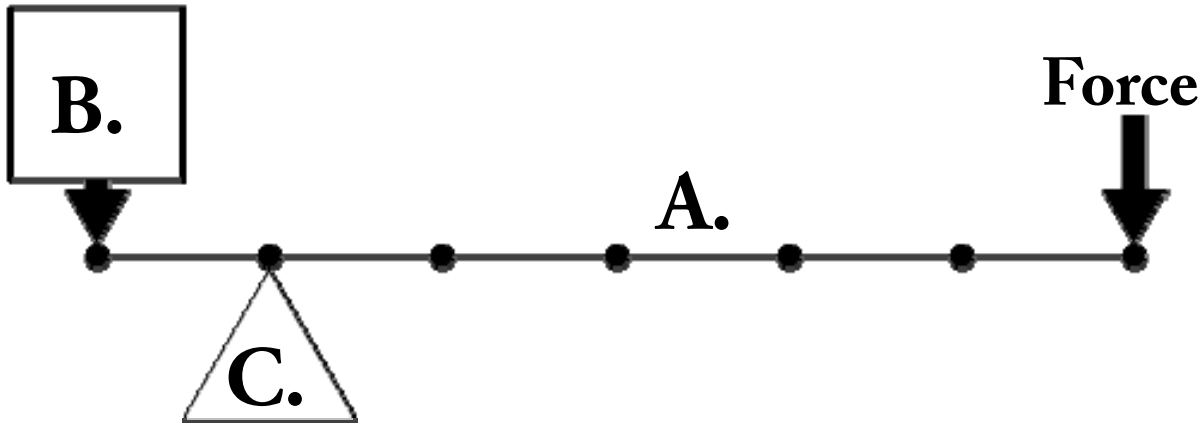


Calculating Force

If we move the fulcrum toward the load it will require less force to lift the load.

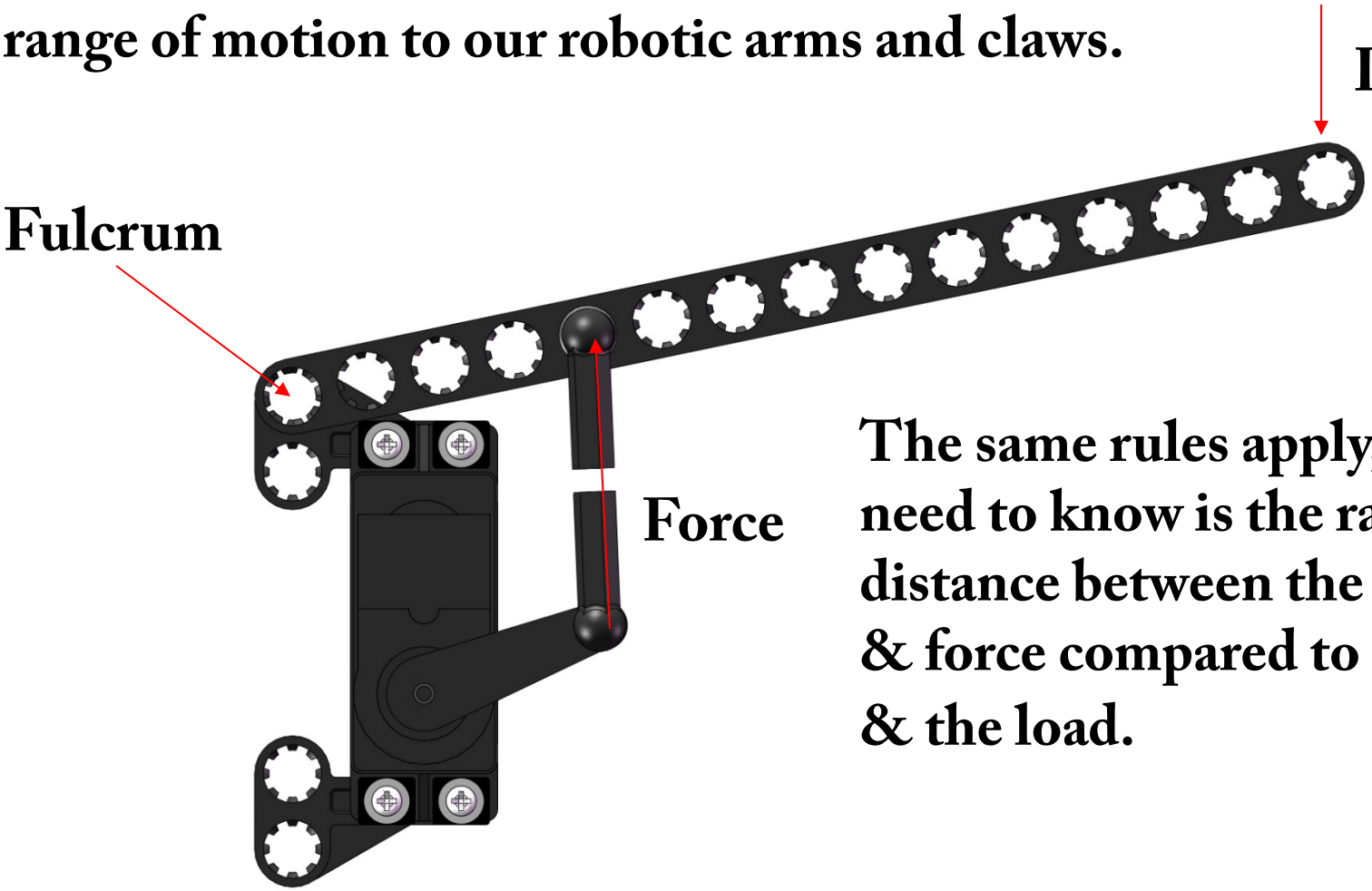
A = 6 Feet
B = 10 Pounds
C = offset toward the load (the ratio is a 5:1)

It now only requires 2 pounds to lift the load.



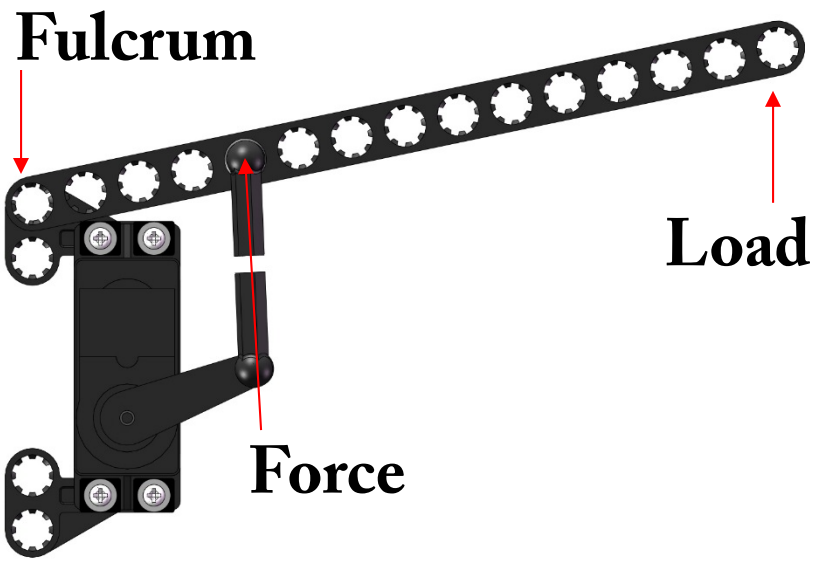
MINDS-i Levers

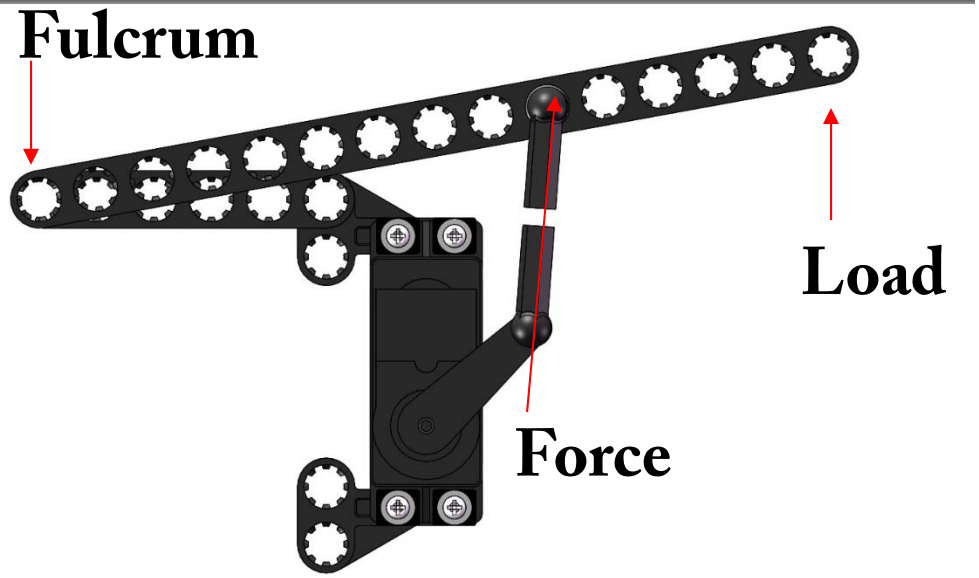
With the MINDS-i system we use levers to provide increased range of motion to our robotic arms and claws.



The same rules apply, all you need to know is the ratio of the distance between the fulcrum & force compared to the force & the load.

MINDS-i Levers





The closer the force is applied to the fulcrum the greater the range of motion on the load end, inversely the force applied to the load end decreases.

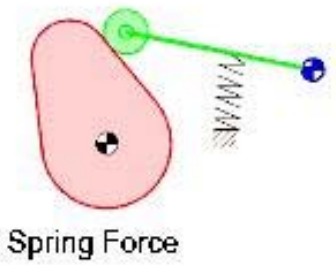
The further away the force is applied the lesser the range of motion on the load end, inversely the force applied to the load end increases.

Cam /kam/noun

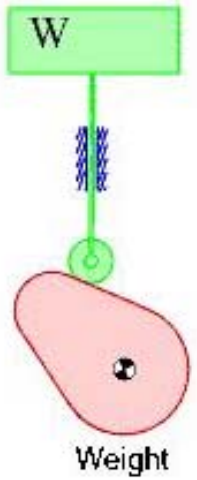
a **projection** on a rotating part in machinery, designed to make **sliding** contact with another part while rotating and to impart **reciprocal** or variable motion

Use of Cams

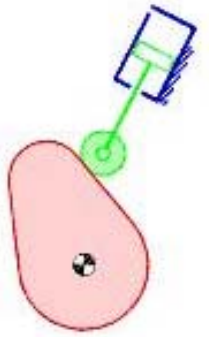
Cams are used to turn rotary motion into linear or sweeping motion.



Spring Force



Weight

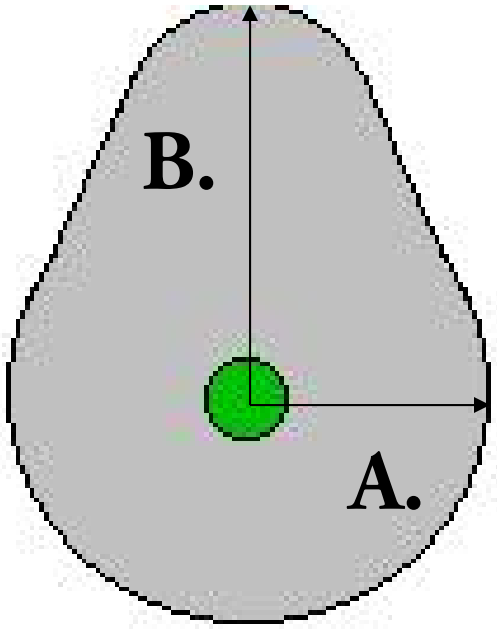


Hydraulic or
Pneumatic Pressure

Calculating Rise

When calculating the rise of the cam you will need to know a few things,

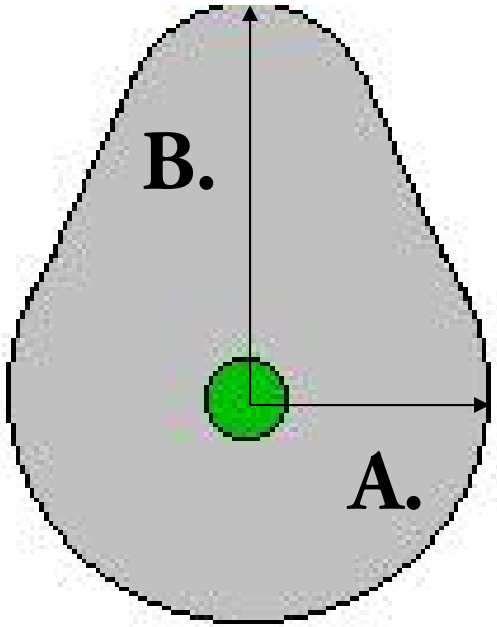
A. Radius of the Low profile
B. Radius of the High profile



Calculating Rise

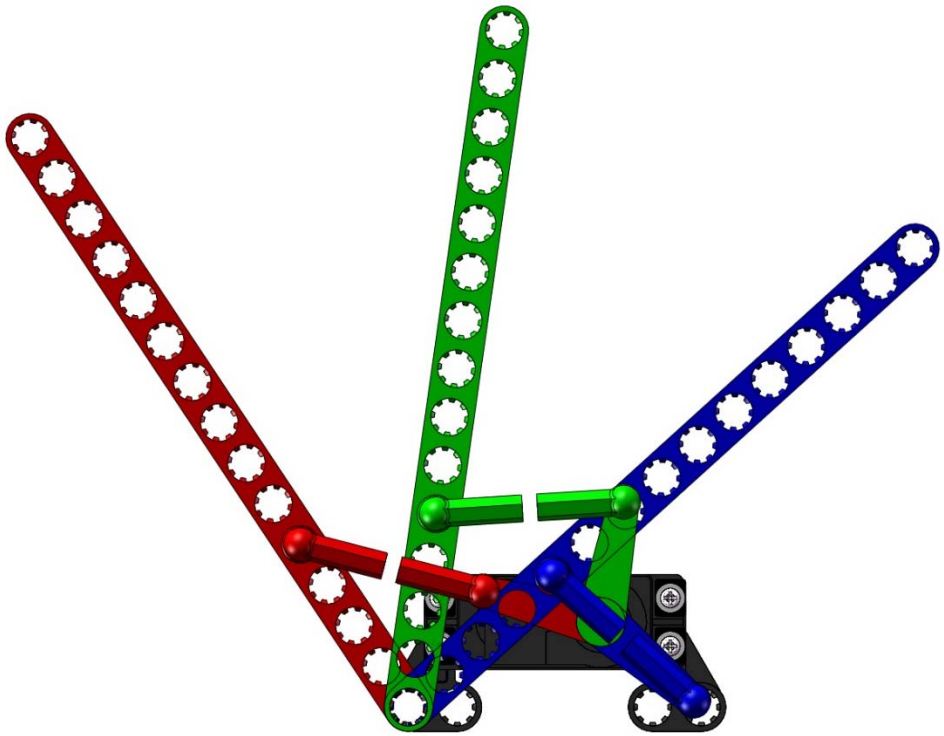
If A= 1.0 inch
B= 1.5 inch

The rise of the cam would be 0.5 inches



MINDS-i Cams

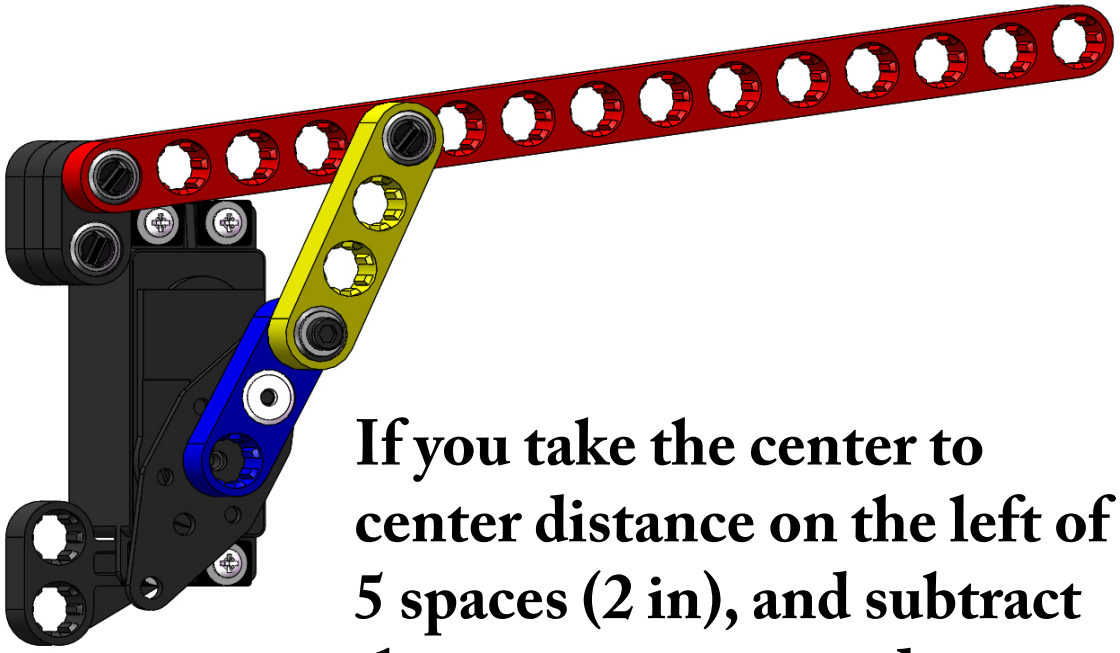
With the MINDS-i system we use cams to turn the rotary motion of our servos into linear motion.



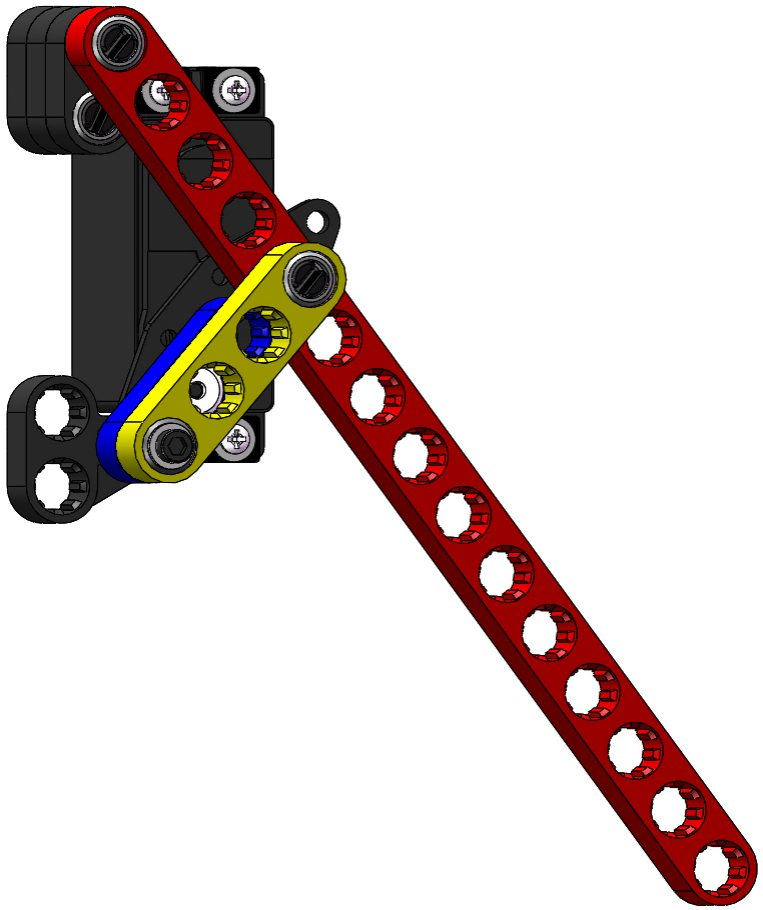
The same rules apply, all you need to know is the difference between the low point and the high point.

MINDS-i Cams

With the MINDS-i system we use cams to turn the rotary motion of our servos into linear motion.



If you take the center to center distance on the left of 5 spaces (2 in), and subtract the center to center distance on the right of 1 space (.4 in) you get a rise of 4 spaces (1.6 in).



Span /**span**/noun

the full extent of something from end to end: the amount of space that something covers

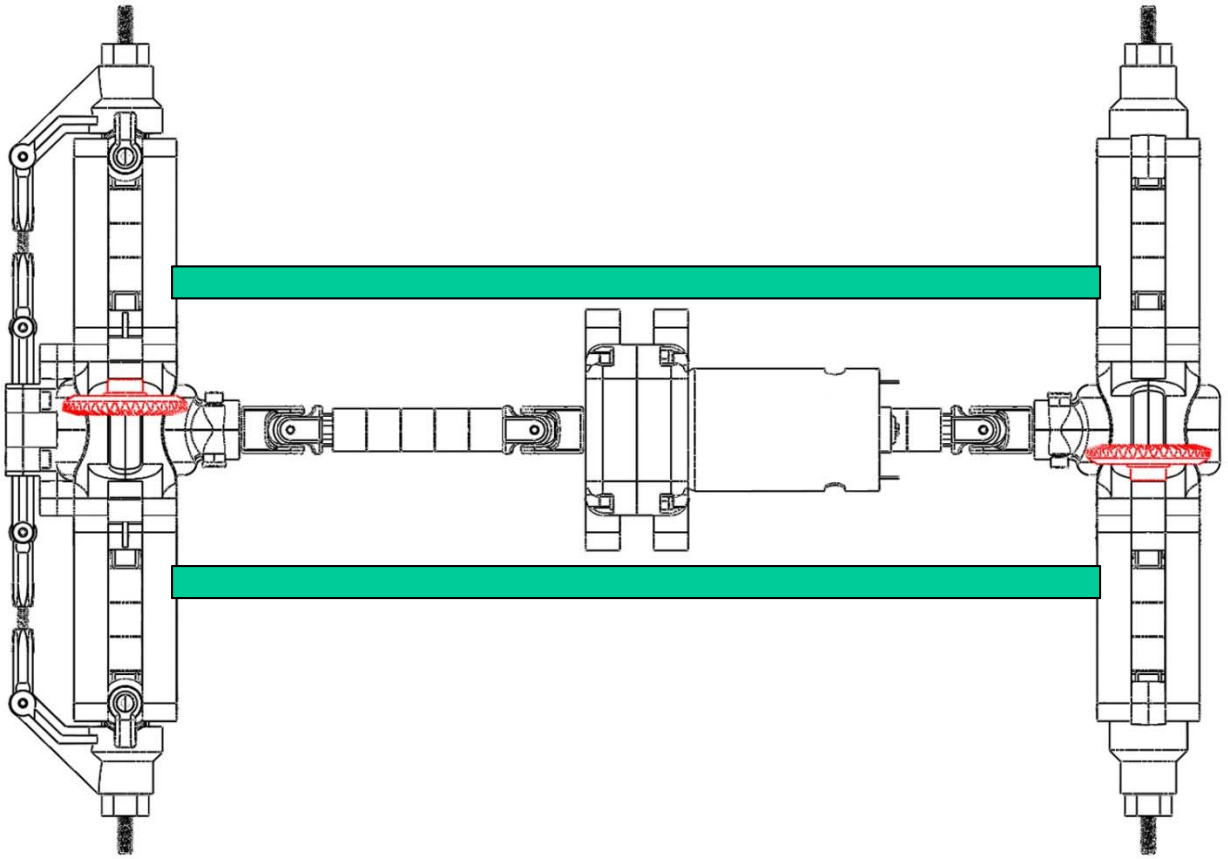
Span

Any object with a length, width or height has span.

The bridge above is a good example of an object covering a span.

MINDS-i and Span

With the MINDS-i system we use our beams to span the distances between our drivetrain components.



Real World

- Work within your teams to identify examples of levers, cams and span around you or in your daily life.