FIRST LEGO LEAGUE - Ontario

Activity Sheet	
Gr 8 - Lesson #3	Move Object – Lifting with MA
Date:	Name(s):

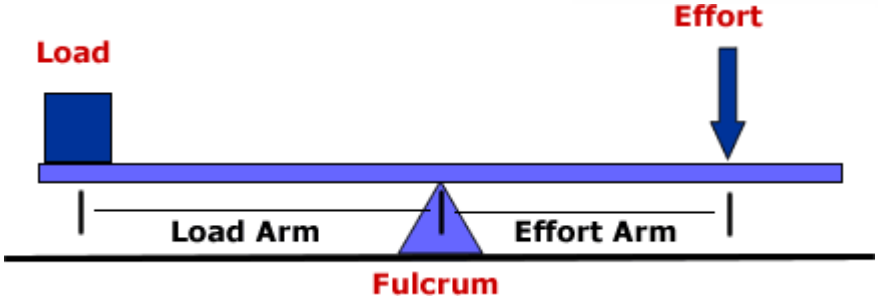
Check That I'm Done ☑		
☐ Commented on my code	☐ Modify it task	☐ Coding Challenge

Learn

Mechanical advantage (MA) happens when a machine allows you to trade force for distance. Two mechanisms that do this well are pulleys and levers. When doing this trade, it is always an equal trade. For example if a lever, such as a crow bar, makes you move 10cm to pry something 1cm, it has also made you precisely 10 times stronger (as well as making you move 10x as far). This does not account, however, for things such as bending and friction. Some levers actually make your weaker, but allow you to reach farther than you could before (like a fishing rod).

MA can be represented by a single number. This number tells you how many more times stronger the machine is making you. For example an MA of 3.5, means the machine is making your 3.5 times stronger. Since the trade for force and distance is always equal, you can predict the ideal MA of a lever, just by measuring it.

$$\text{Mechanical Advantage} = \frac{\text{Input Distance}}{\text{Output Distance}} = \frac{\text{Effort Arm}}{\text{Load Arm}}$$



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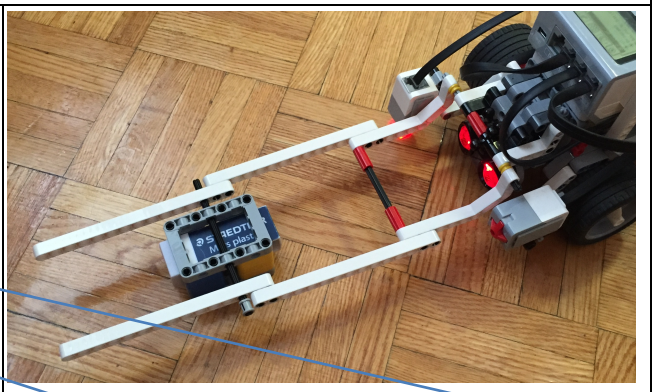
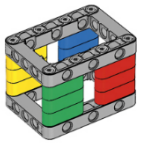
Predict and Plan

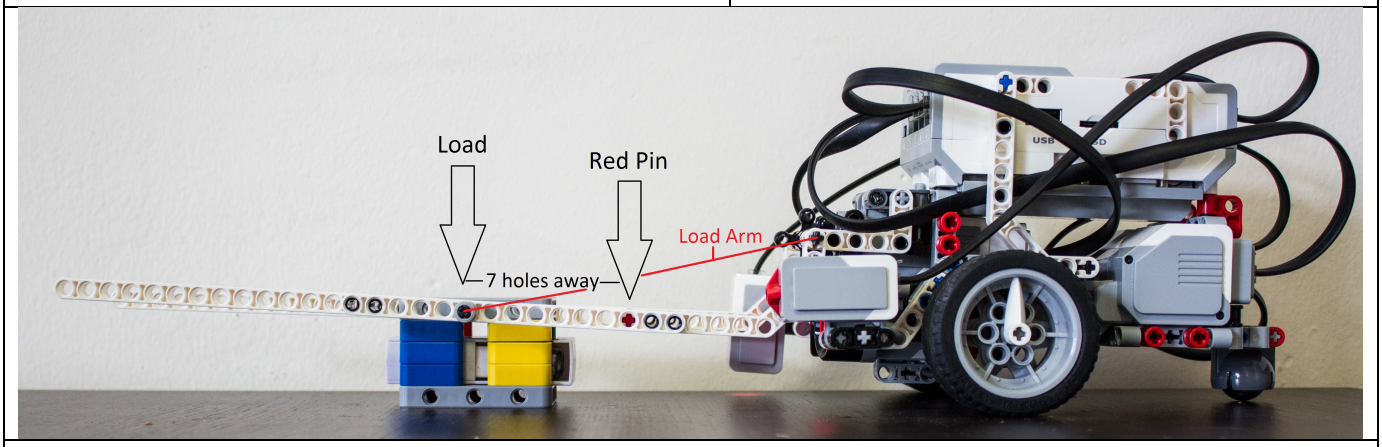
Add Lego beams to your robot so that the length of the arm on the medium motor module is increased to about 25 holes longer than it was before. You will also need a long axel and a bushing to attach your cuboid to the arm.



Also place an eraser, or similar object inside your cuboid to give it some more weight for our experiment.



On the figure below, identify the exact location of the fulcrum.



What effect do you think lengthening the arm will have on its strength and distance capabilities?

_____

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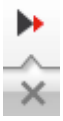
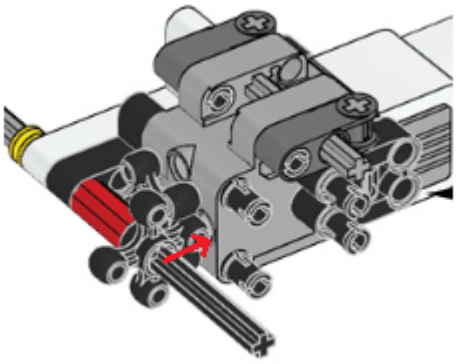
Demonstrate/Design/Discover

- ✓ Create a useful and efficient testing program that tries to lift the arm up for 3 seconds (<u>not rotations</u>), and then pauses for 3 seconds
- ✓ Start with 100% power, and allow your motor to 'coast' afterwards,  so the motor can relax.
- ✓ In the 'Record' section below, find out the exact minimum amount of power you must use to completely lift the cuboid off of the ground (so it's not touching). Fill it out completely.

Tips: Leave your robots USB cable plugged in if possible. You may wish to use sound blocks to tell you where you are in the code, a useful tip. Also, using a loop can make your testing go faster. Try it out!

Special Note



Effort arm = 1.0 cm

The effort arm for this lever is very small. Since the motor is turning a gear, it is the radius of the gear we need to measure. It happens to be exactly 1.0 cm.

This means the lever is set up to lift things farther, but becomes much weaker than the effort going in. The MA then will be much less than 1.

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Record				
Holes Away from Red Pin	**Effort Arm Length (cm)**	**Length of Load Arm (cm)**	**Mechanical Advntage (Ideal)**	**Min. Power Needed to Lift Cuboid (%)**
4	1.0			
8	1.0			
9	1.0			
10	1.0			

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