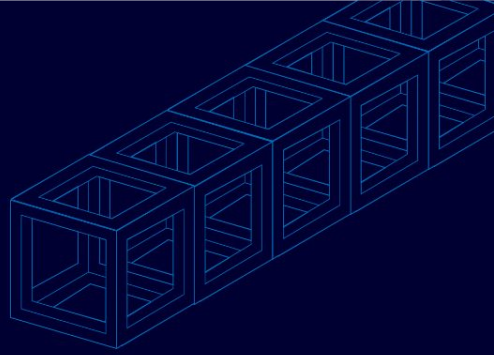
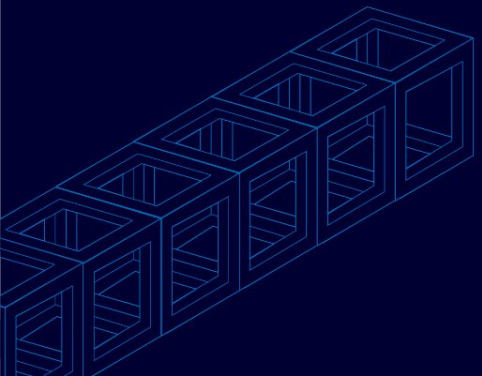
sphero blueprint



Introducing the Pulley

Level 1

Lesson Slides



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What do you see?

- What simple machines do you see at work?
- How do they work?

#1

#2

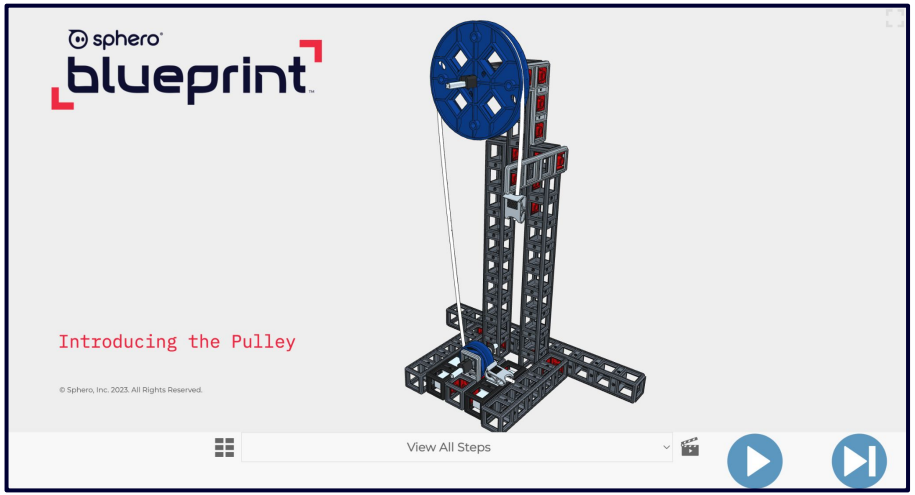
An ***pulley*** is a simple machine that uses a wheel with a grooved rim and rope to lift and move objects. Using multiple pulleys can create mechanical advantage (MA)

Learning objectives

By the end of the lesson, you will be able to:

- describe two purposes of pulleys
- calculate the Ideal Mechanical Advantage (IMA) of different pulley systems
- modify your models to make it as easy as possible to lift heavy objects

Pulley Build Instructions



Stop once you've completed the first pulley system.

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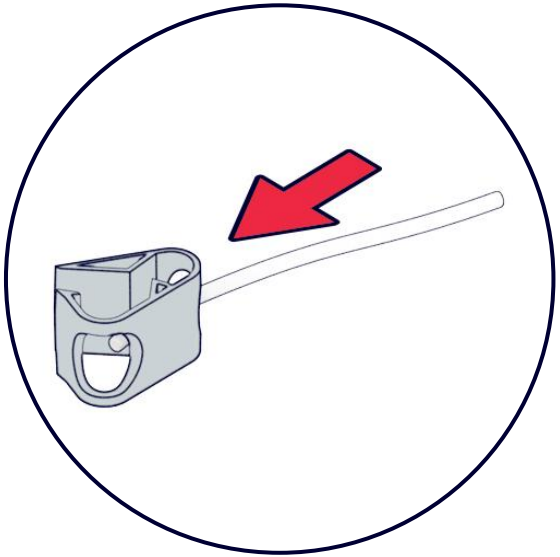
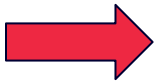
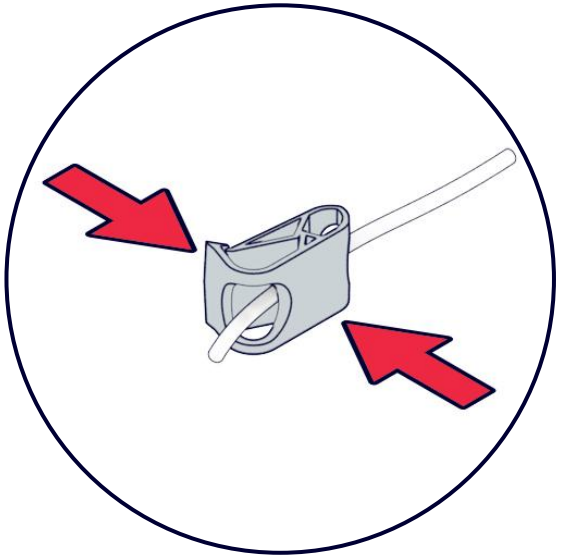
Threading and Attaching Ropes







Thread the rope under the pulley and then pass through a Rope Clamp.

Snap the Rope Clamp to secure the rope.

Note: The Rope Clamp will bump into the pulley and stop the rope from passing through.

Mechanical Advantage in Pulleys [Handout]

sphero blueprint

Name: _____

Date: _____

Mechanical Advantage in Pulleys - Student Handout

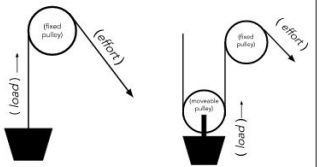
Engineering Background:

pulley: A pulley is a simple machine that uses a wheel with a grooved rim and rope to lift and move objects

mechanical advantage (MA) of a pulley: is the ratio of the distance of the applied effort to the distance the load travels.

$$MA_{pulley} = \frac{d_{effort}}{d_{load}}$$

The MA of a pulley can also be calculated by counting the number of ropes attached to the movable load.

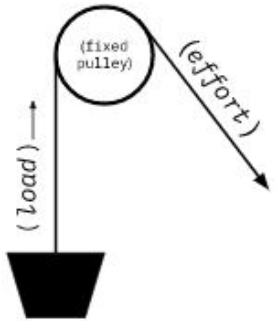


1. Follow the Build Instructions to make the model of a well with one pulley. Sketch your model and label the direction of effort and load.
    - Calculate the MA by pulling the rope a defined distance like 125 mm (a 5x truss). This is the distance of applied effort.
    - Then measure the distance that the load is lifted.

Mechanical advantage (MA) is a change in the magnitude of force required to do work. Simple machines use MA to help minimize the force needed to complete movement.

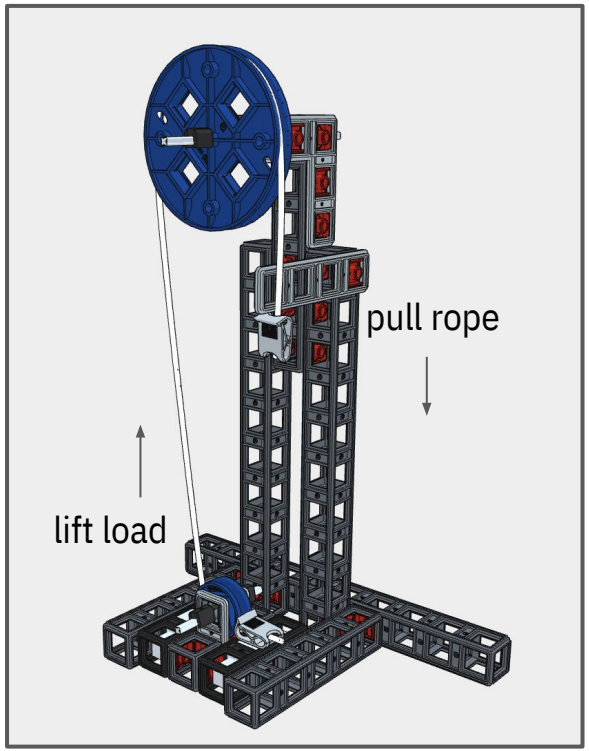
The ideal mechanical advantage (IMA) of a pulley is the ratio of the distance of the applied effort to the distance the load travels.

$$IMA_{pulley} = \frac{d_{effort}}{d_{load}}$$

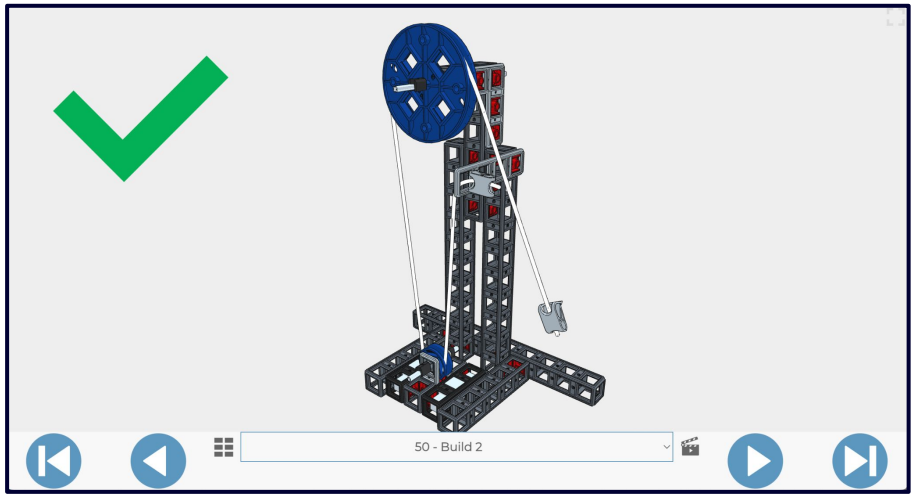


Calculate the MA of the Pulley 1

1. Pull the rope 125mm (a 5x Pitch Truss).
2. Measure how far the load travels.
3. Use the formula for the IMA of a pulley.



Build Pulley 2



Complete the second pulley system.

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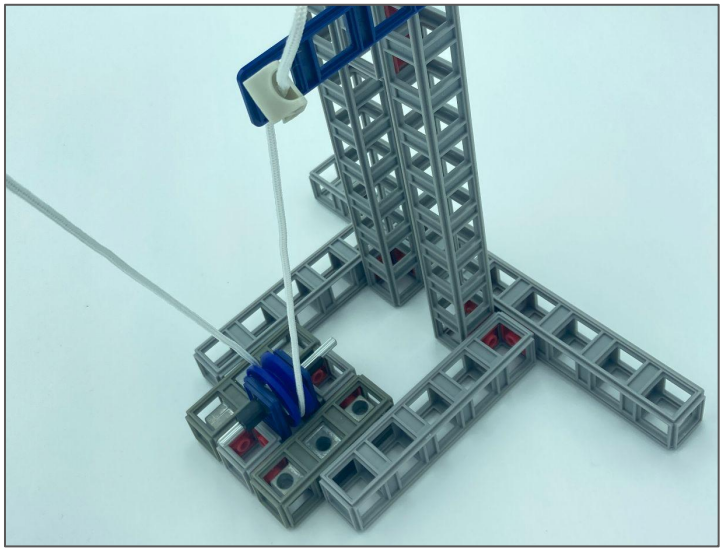
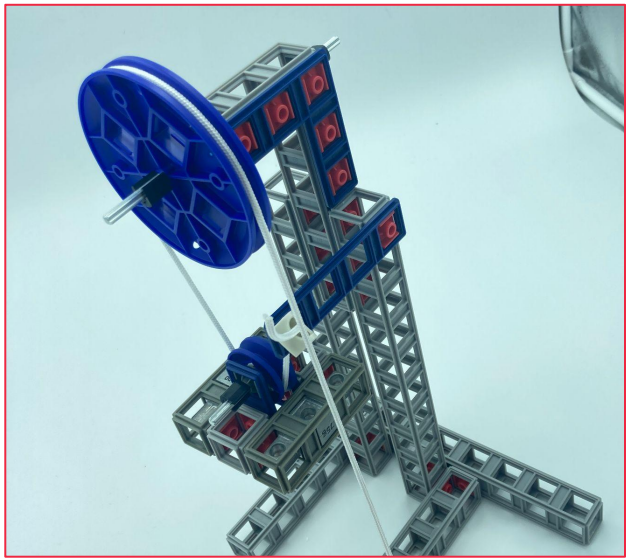
Threading and Attaching Ropes - Pulley 2



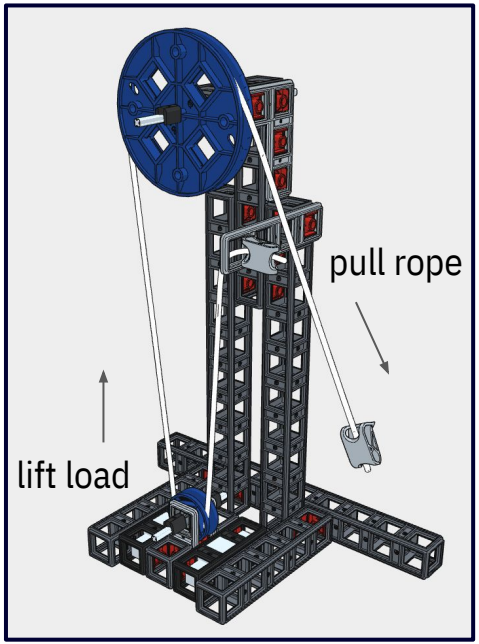
Attach the rope to the plate with the Rope Clamp.



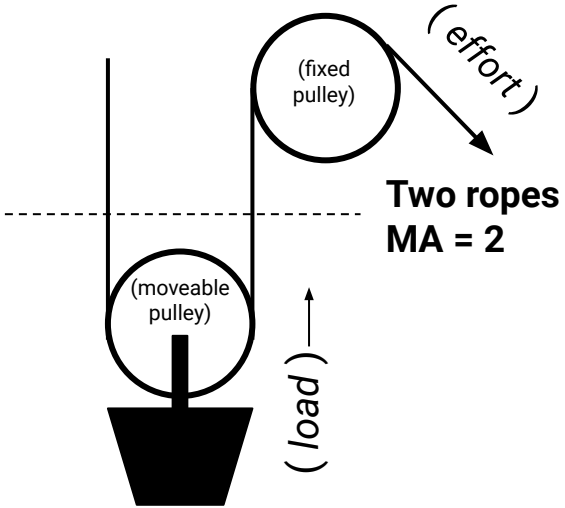
Thread the rope over the top pulley.

Calculate the IMA of the Pulley 2

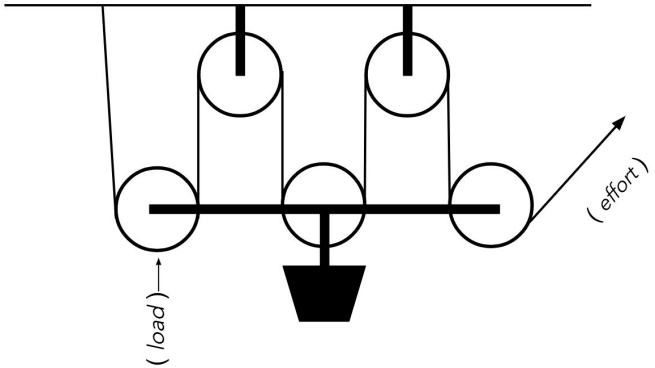
1. Pull the rope 125mm (a 5x Pitch Truss).
2. Measure how far the load travels.
3. Use the formula for the IMA of a pulley.

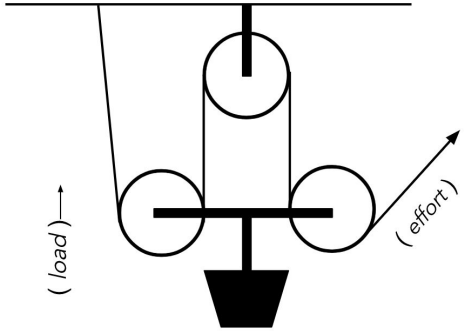


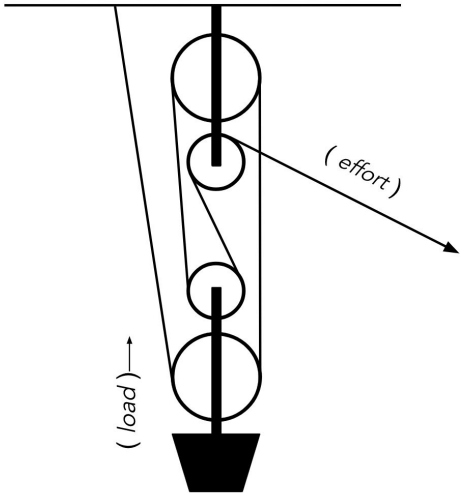
Calculate the IMA using the number of strings



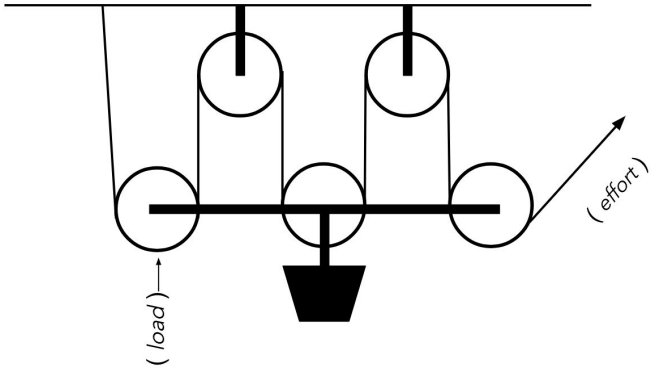
What is the IMA of each pulley system?



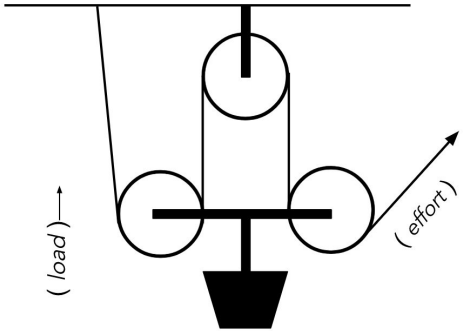




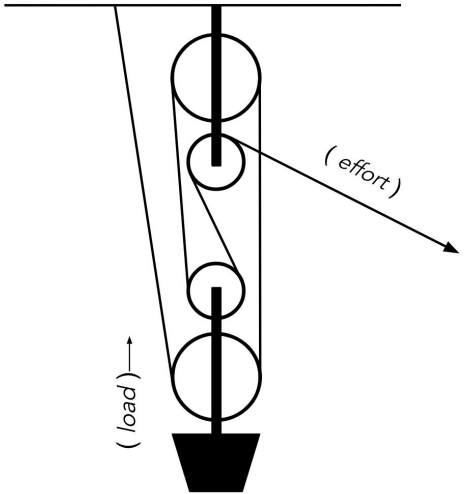
What is the IMA of each pulley system?



IMA = 5



IMA = 3



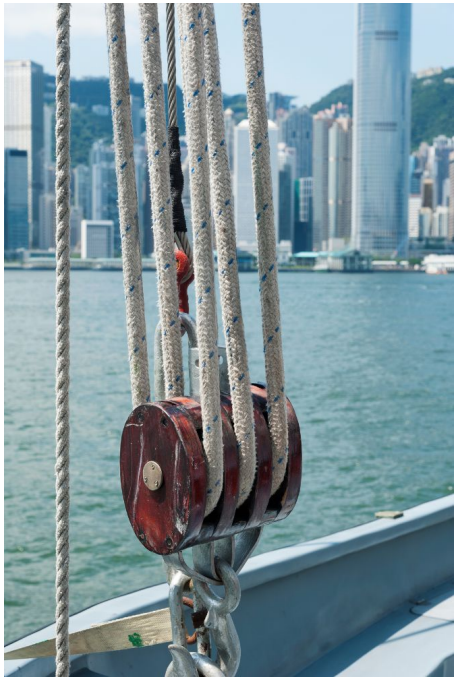
IMA = 4

Primary Purpose of Pulleys

- Pulleys can change the direction of force. Pull the rope down, and the load goes up.
- Pulleys, through MA, can reduce the effort needed to do work.

Discuss:

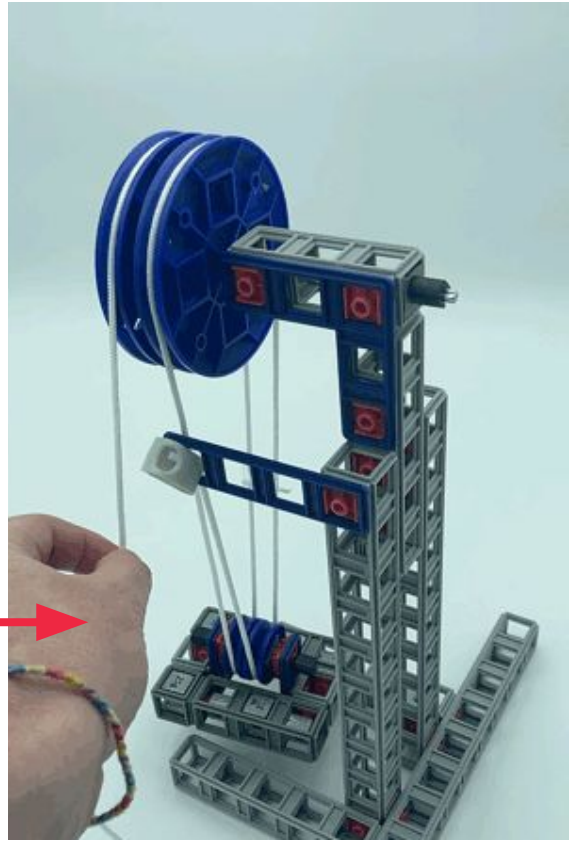
- When is a pulley system with a high MA helpful?
- How can you use multiple pulleys to make hauling the load up the well model as easy as possible?

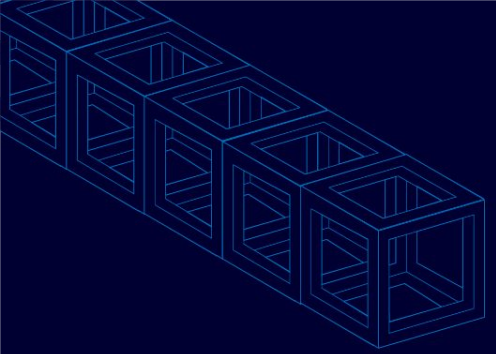


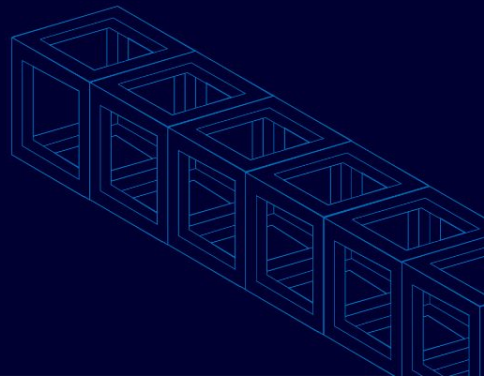
An ***block and tackle*** is is a rope threaded through a sequence of pulleys used to lift heavy objects.

A Blueprint Block and Tackle

Make sure to use Bearing Plates on shaft so pulleys can rotate independently of each other.







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