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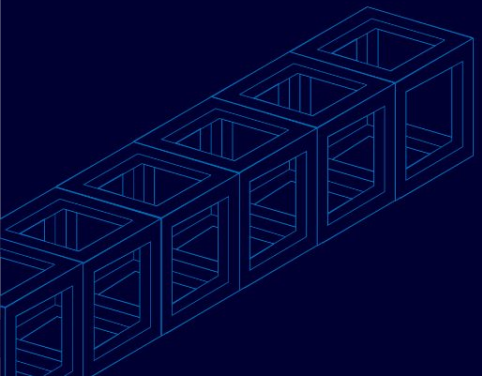
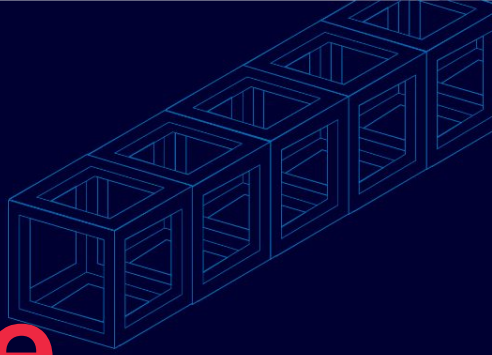
Introducing the Wheel and Axle

Level 1

Lesson Slides





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Transportation

What are some ways that we get from one place to another?

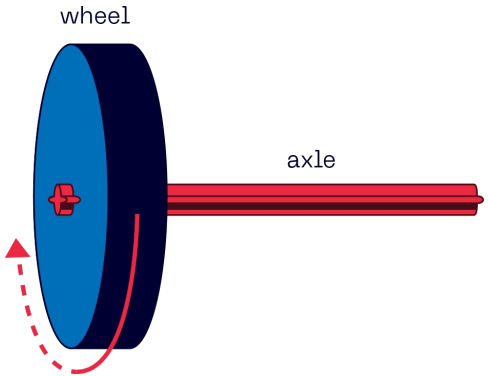
Transportation

Which transportation methods involve wheels?

A ***wheel*** is a a circular object that revolves on an axle.

An ***axle*** is a rod or spindle (either fixed or rotating) passing through the center of a wheel

A ***wheel and axle*** is a simple machine that is created when a wheel is attached to a smaller axle so that they can rotate together, and transfer force between each other

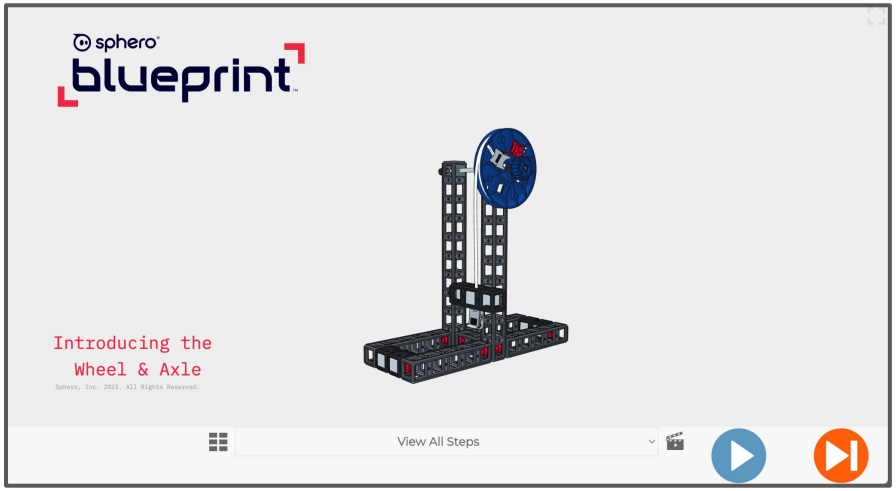


Learning objectives

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

- identify and build a wheel and axle system
- measure the ideal mechanical advantage (IMA) of the system
- understand the factors that can change the mechanical advantage (MA) of a wheel and axle

Wheel and Axle Build Instructions



Stop once you've completed the first wheel and axle.

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Mechanical Advantage in Wheels and Axles [Handout]

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Name: _____

Date: _____

Mechanical Advantage in the Wheel and Axle - Student Handout

Engineering Background:

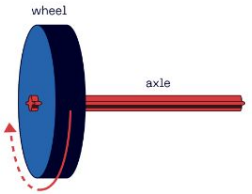
wheel: a circular object that revolves on an axle

axle: a rod or spindle (either fixed or rotating) passing through the center of a wheel

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

Ideal mechanical advantage (IMA) is the theoretical mechanical advantage based on the assumption that no energy is lost to friction, wear, or other resistance.

The IMA of a wheel and axle is the ratio of the diameter of the input (D_{input}) to the diameter of the output (D_{output}).



$$IMA_{wheel\ \&\ axle} = \frac{D_{input}}{D_{output}}$$

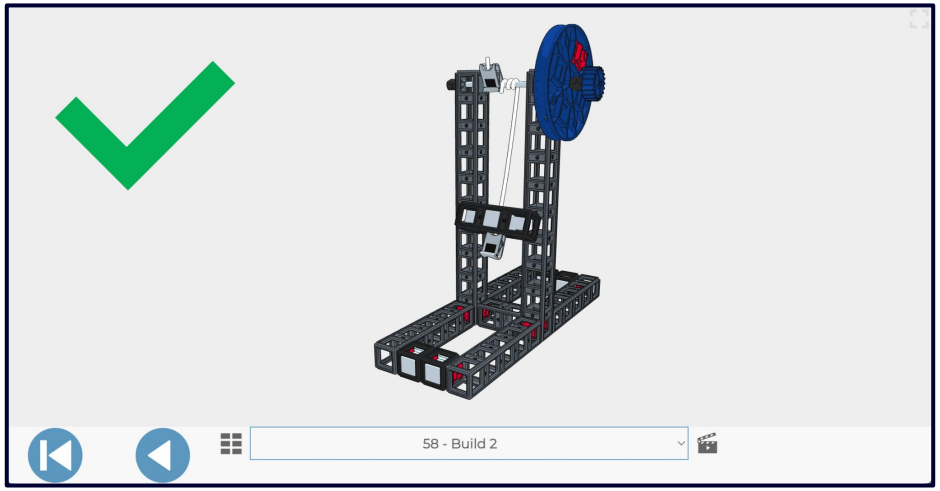
Note: The direction the wheel is spinning in the above diagram doesn't really matter, what is important is where the force is being applied: the axle or the wheel.

Introducing the Wheel and Axle

Ideal mechanical advantage (IMA) is the theoretical mechanical advantage based on the assumption that no energy is lost to friction, wear, or other resistance.

The IMA of a **wheel and axle** can be calculated by dividing the diameter of the input wheel or axle by the diameter of the output wheel or axle.

Wheel and Axle Build Instructions



Complete the second wheel and axle.

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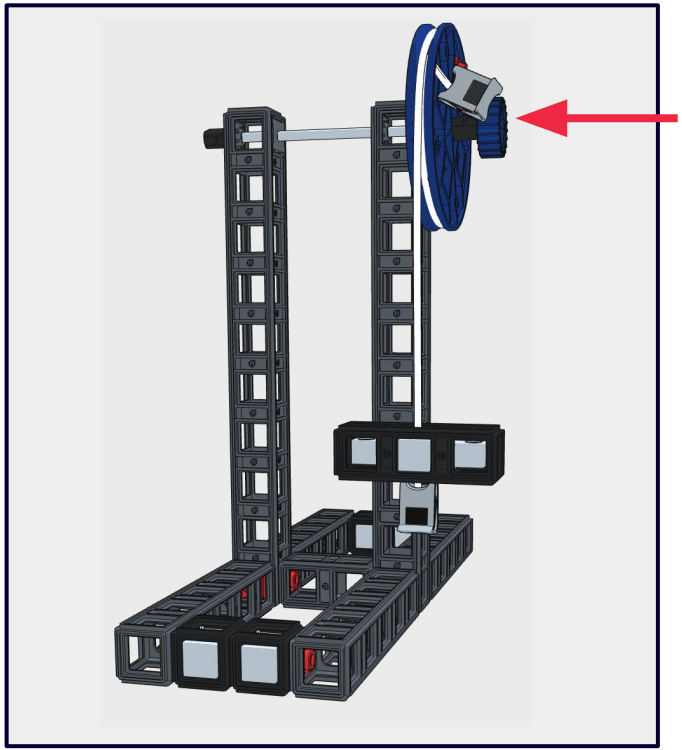
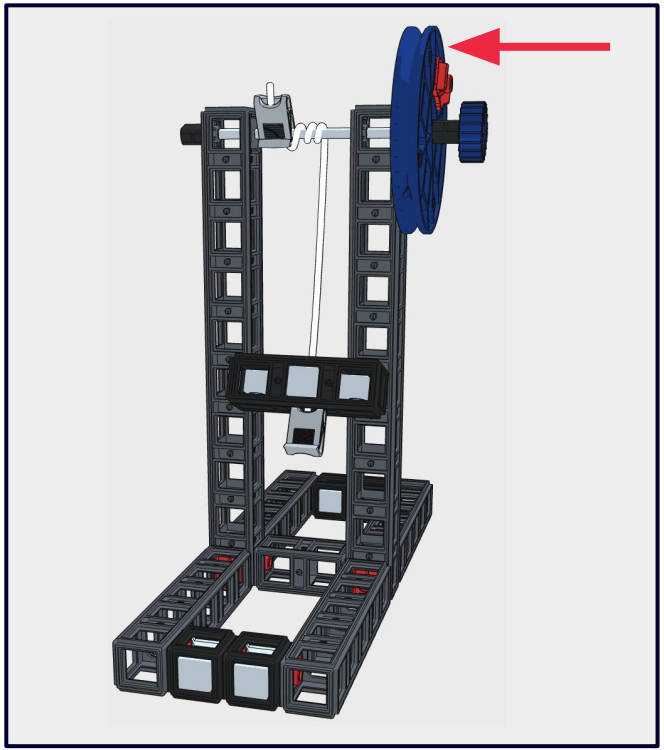
Input force applied to axle



Input force applied to wheel



- Where is the force being applied?
- Which object do you think has greater IMA?
- Calculate the IMA using the information on your handout.

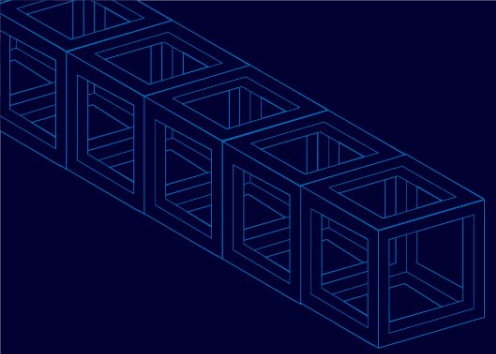
Calculate the Actual Mechanical Advantage

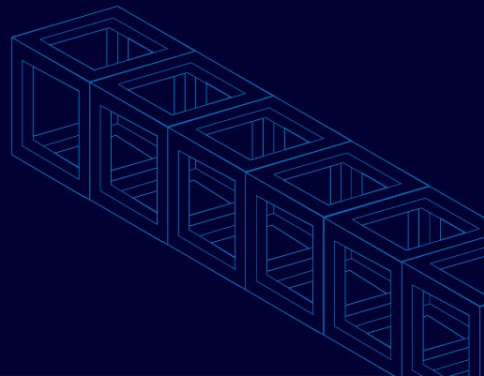
Optional - Force meters required

Based on the discussion earlier do you expect AMA to be higher or lower than the IMA you measured?

Check your assumptions by using a force meter to measure the AMA of the two types of wheel and axle from this lesson.

$$AMA_{wheel\ \&\ axle} = \frac{F_{output}}{F_{input}}$$





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