



Gears

Rotational Forces and Mechanical Advantage

Keys Terms:

Gears, rack & pinion, lock, paddles

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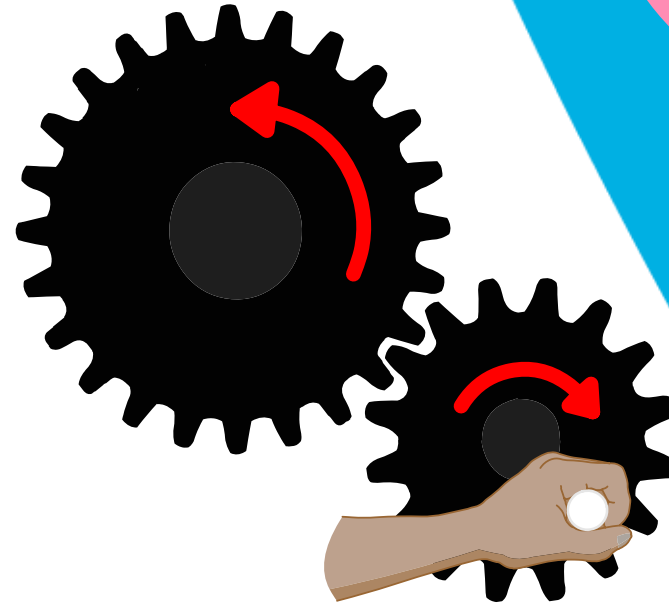
Objectives

- Understand how mechanisms can make work easier.
- See how rotary motion can be converted to linear motion.
- Understand how lock paddle gears work.

What are gears?

- Gears are rotating wheels with teeth that mesh together to transfer energy.
- They can be used increase torque (turning force) as well as to change the speed or direction of a force.

Driven/Output Gear



Driver/Input Gear

Turning a gear makes the adjoining gear move in the **opposite** direction.

Where do we use gears?

Can you identify these objects that all use gears?



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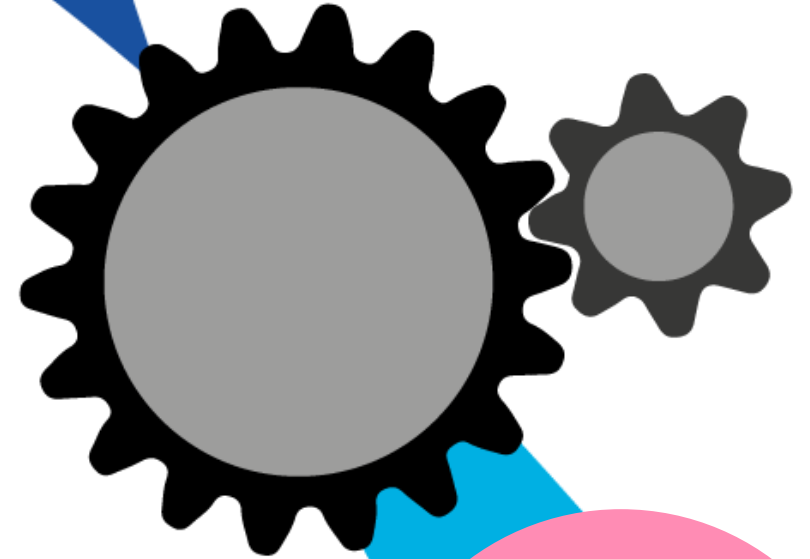


Torque/Turning Force

To increase torque, gear wheels need to be different sizes.

We measure the size of a gear by counting its teeth.

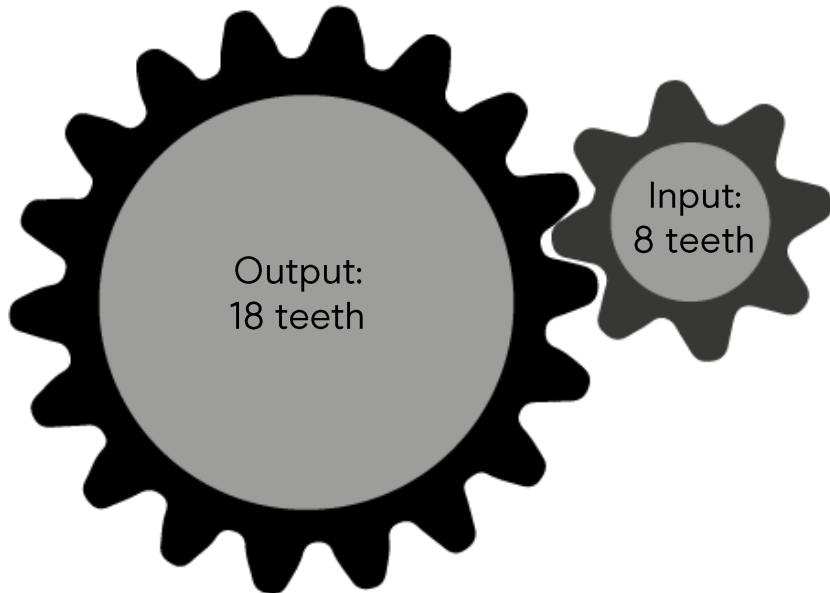
When the driver wheel is smaller than the driven wheel we create a **mechanical advantage**.



Smaller gears spin faster but with less force.

Mechanical Advantage

To find the **MA** we divide the size of the **output** gear by the size of the **input** gear.



What is the MA of this gear train?

$$18 / 8 = ?$$

$$2.25$$

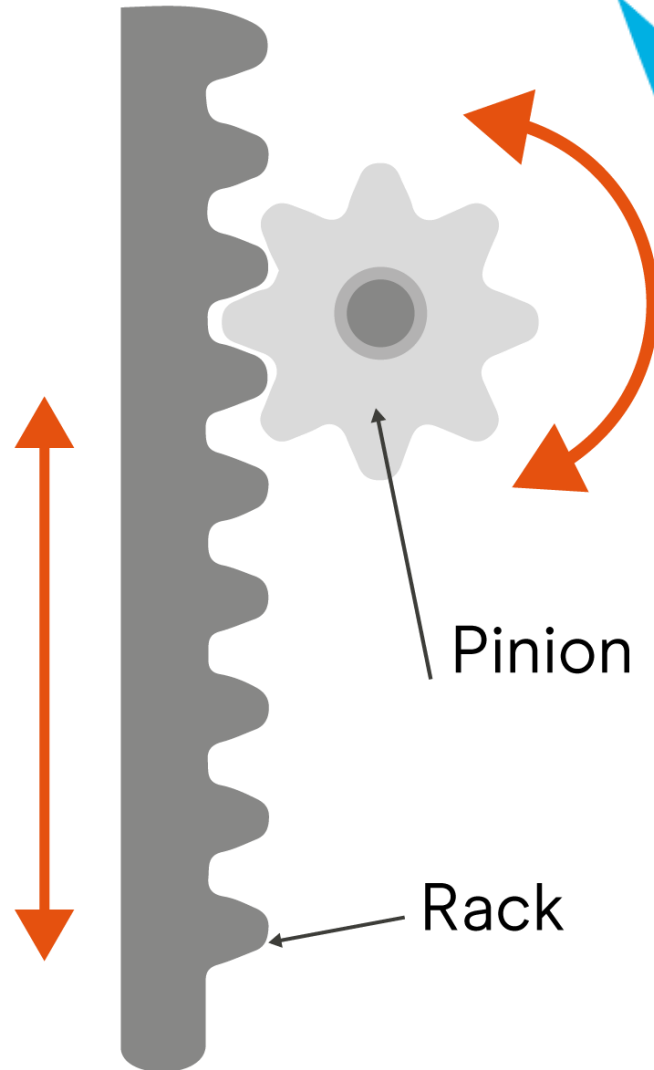
For the large gear to spin around once, the small gear must turn 2.25 times.

Rack and Pinion

This is a different gear mechanism that changes rotary motion into a linear motion.

It's used in places like car steering racks and...

canal locks.

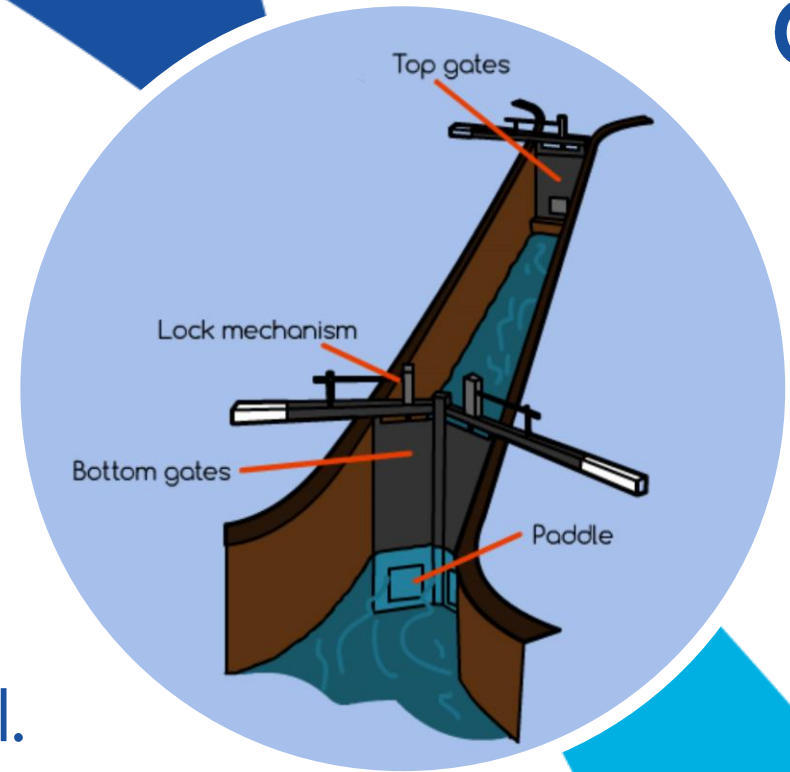


What is a Lock?

Locks have paddles (small sliding doors) that allow water into and out of the lock chamber to raise or lower the water level.

Canal locks use gears systems to open and close the paddles.

Watch the [‘How a Lock Works’](#) video to find out more...



Paddle Gears

This clever system uses mechanical advantage to increase force and then changes rotary motion into a linear motion.

Discuss how you think it works.



Your Task

Your challenge is to create model of the paddle gear.

Making a model is a great way to test ideas.



You can use the fact file printable gear template on our website to help you or make your own design.

Engineers make models (physically and digitally) to test out ideas and designs.