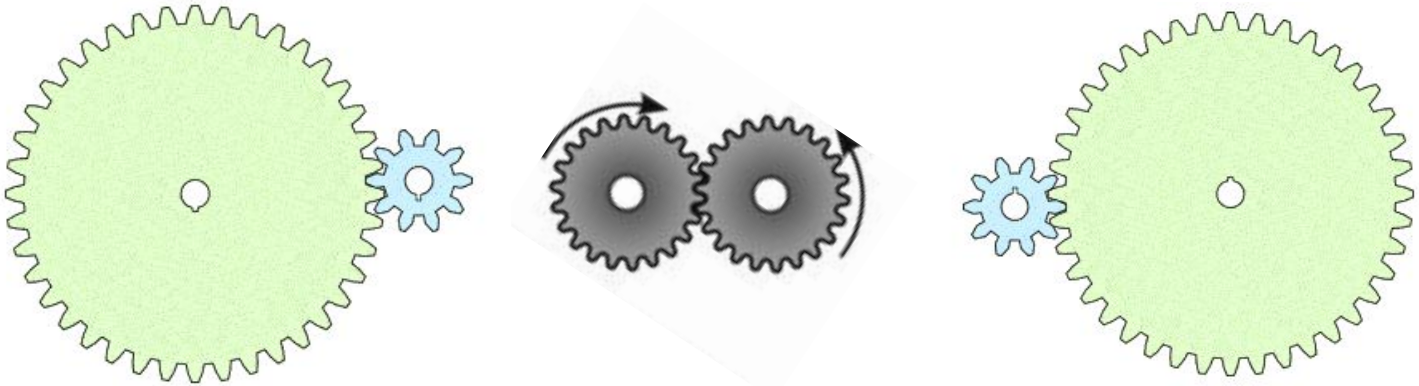
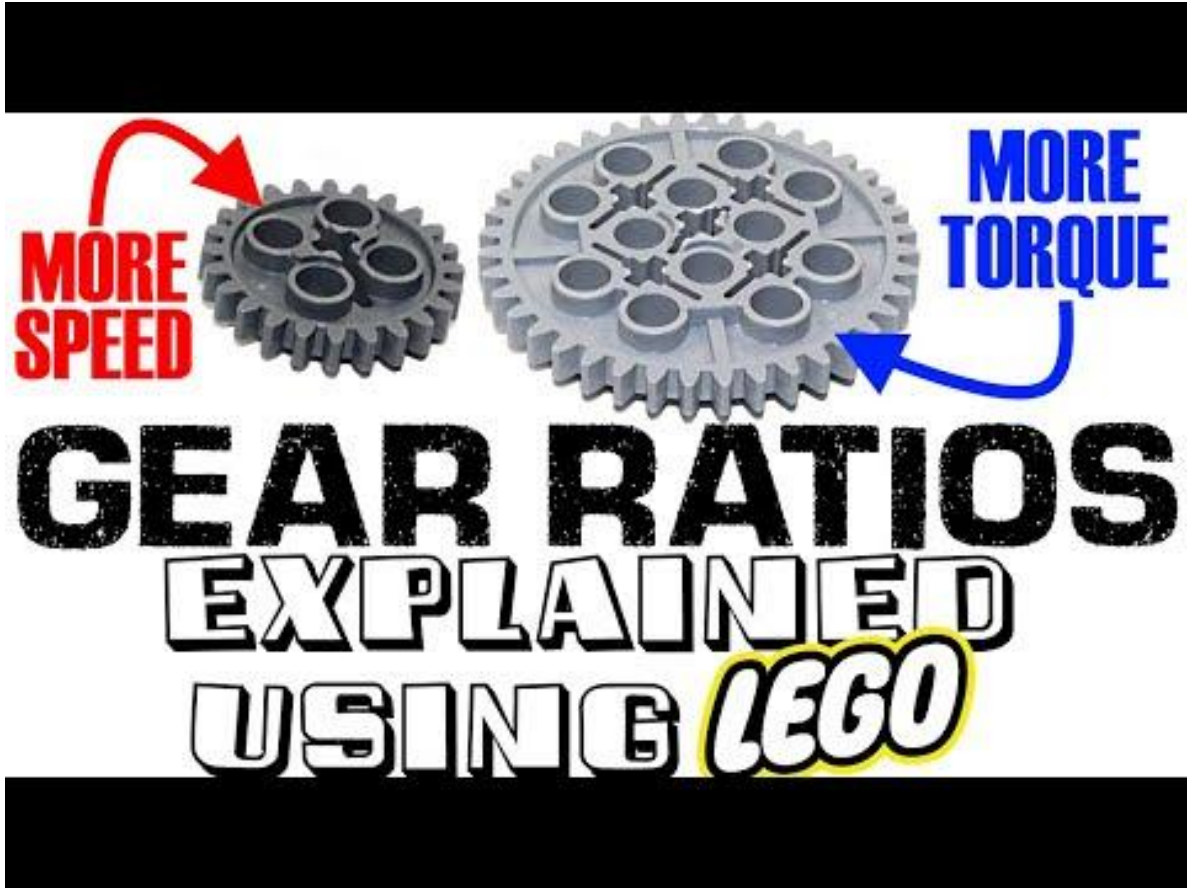
Gears & Gear Ratios

- Gears are used to transfer and transform motion
- Can use different gear size ratios to change the ratio of torque and speed (total power remains the same)
  - Power can be changed by swapping for a different motor

more speed ⟷ **more torque**

(Driving gear on the left)




MORE SPEED
MORE TORQUE
GEAR RATIOS
EXPLAINED
USING LEGO

Video Recap

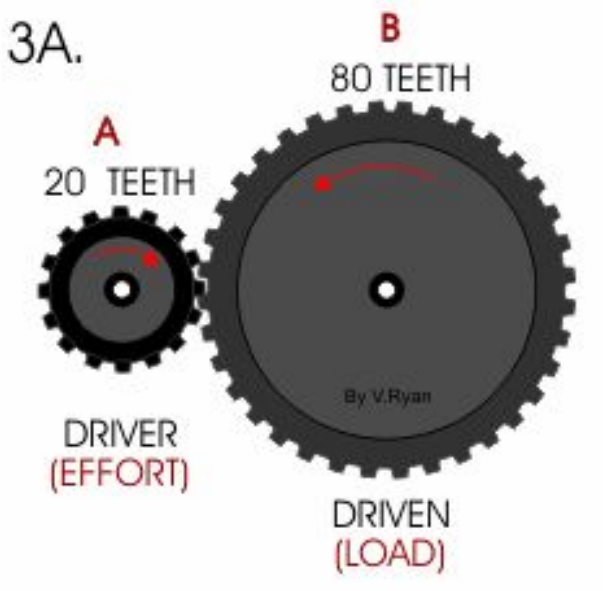
Gear ratio = Driven teeth / driver teeth

Driven torque = Initial torque ✕ gear ratio

Driven rotational speed = Initial velocity / gear ratio

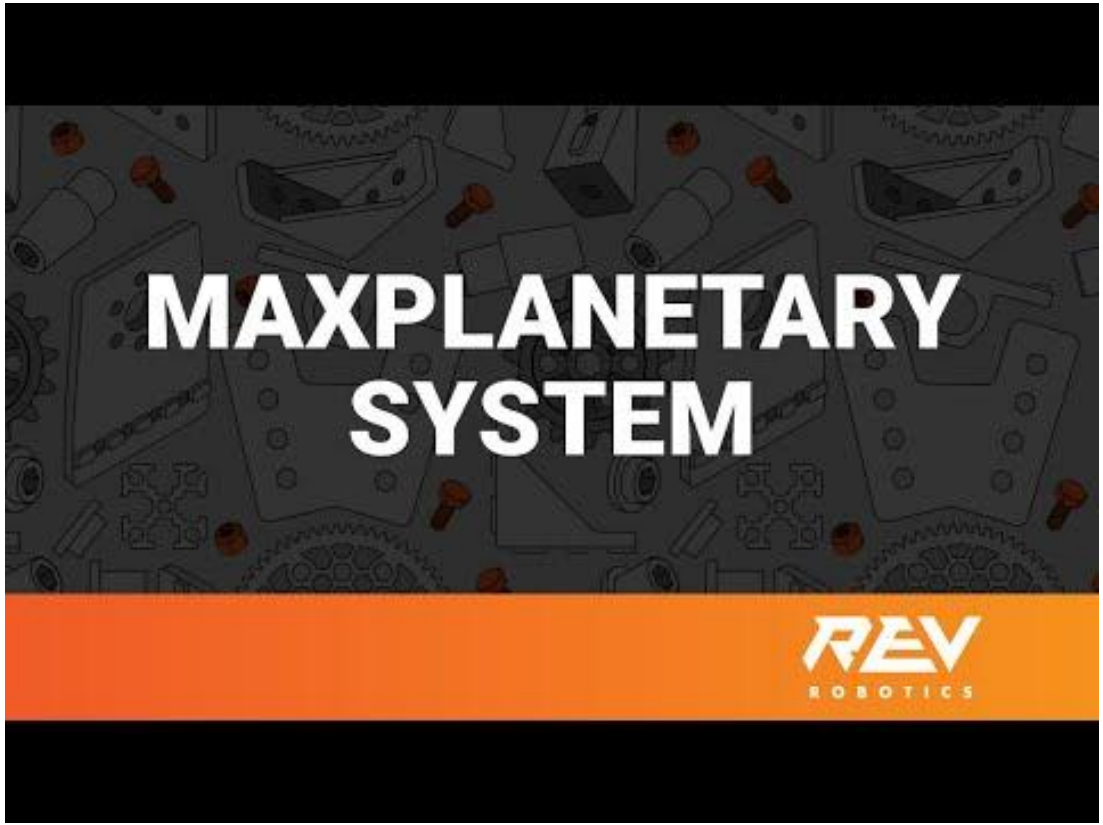
(Notice driven torque and speed are inverses)

Gear Ratio Practice



a) Determine the gear ratio.
b) Suppose gear A rotates at a rate of 200 RPM. What is the rotational speed of gear B?
c) Suppose gear B rotates with a torque of 20 in-lbs. What torque does gear A rotate with?

REV Robotics MAXPlanetary Gearbox System



Power

Proportional to speed $\times$ torque

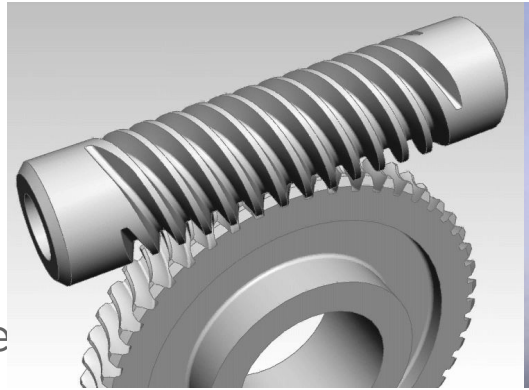
$$\text{Horsepower (HP)} = \frac{\text{Torque (ft-lbs)} \times \text{RPM}}{5252}$$

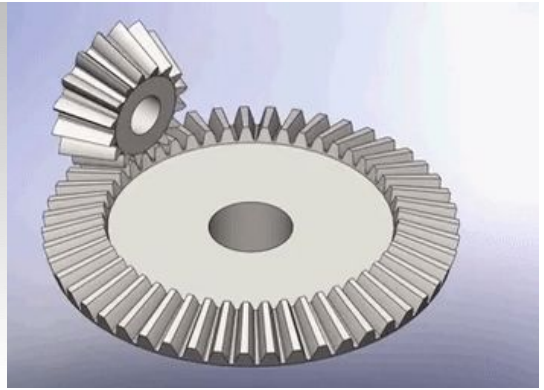
746 Watts (metric) = 1 HP

Power in = power out (ignoring friction)

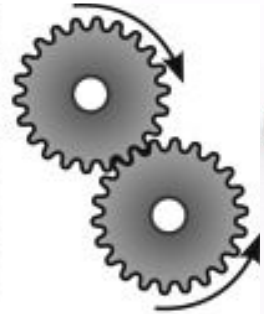
Real mechanical systems have friction: speed is still conserved, but torque out will be less than torque in

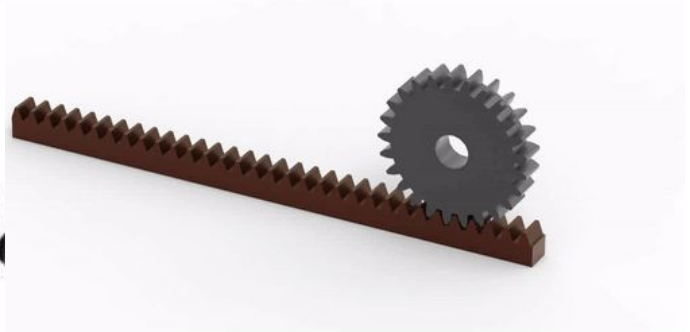
Gear Types





- Spur: “normal” gear
- Bevel: converts motion to a diffe
  angle
- Worm: like bevel, converts direction of motion
  - Cannot be backdriven by mechanical design
- Rack & Pinion: converts between rotational and linear motion
  - Pinion simply refers to a small spur gear





Gear Diagrams & Measurements

Pitch

Pitch Circle

Pitch Diameter

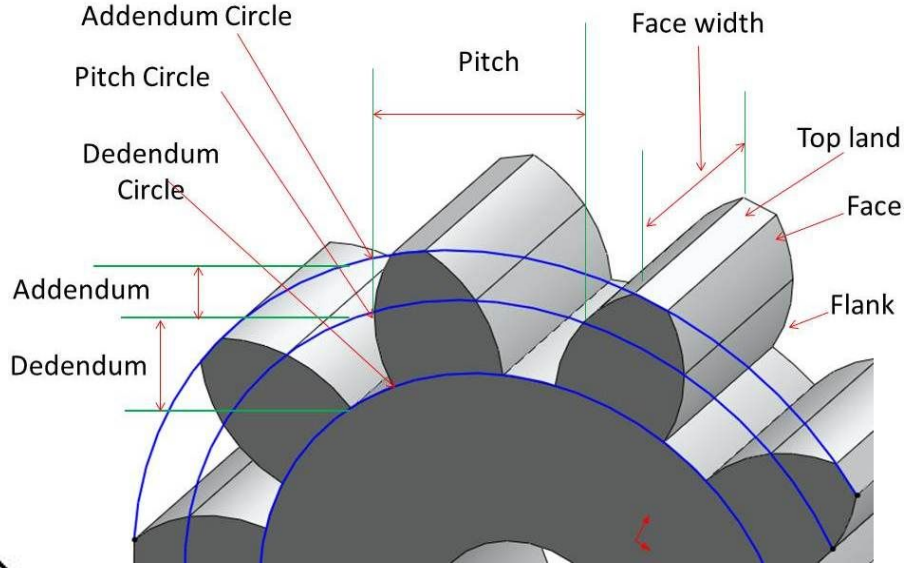
Outside & Inside Diameter

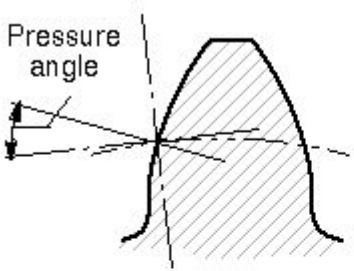
Pressure Angle

Shaft Diameter & Shape

Face Width

Addendum & Dedendum





Sprocket & Chain

- Gears connected across a distance
- Timing belt & pulley are similar but lighter & quieter
- Chain is typically used across larger distances