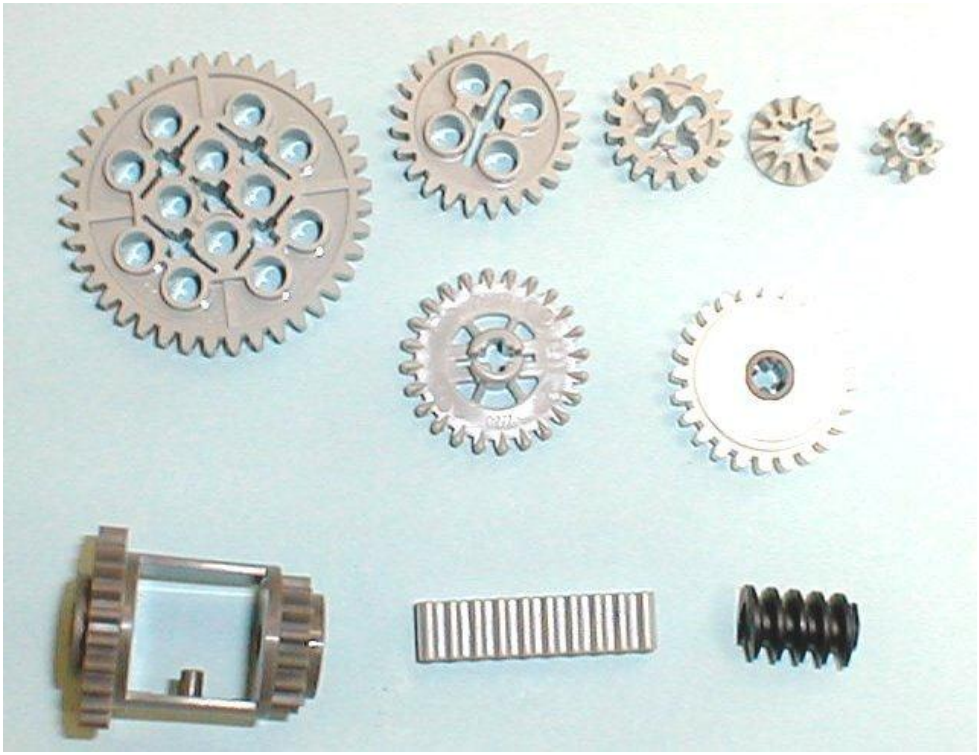
Gears, Gears and More Gears

Teacher Professional Development
Spring, 2002

What is a gear?



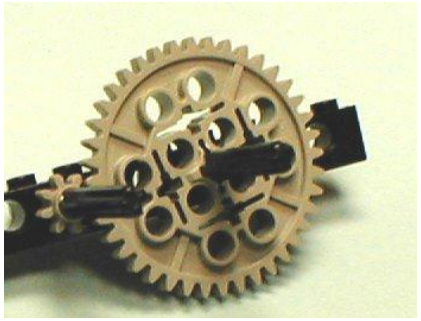
A gear is a wheel with teeth that mesh together with other gears.

Gears change the
- speed
- torque (rot. force)
- direction

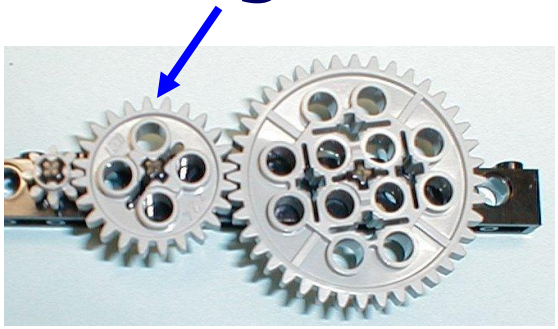
of rotating axles.

Different types of gears

Spur gears



Idler gears



Worm gears

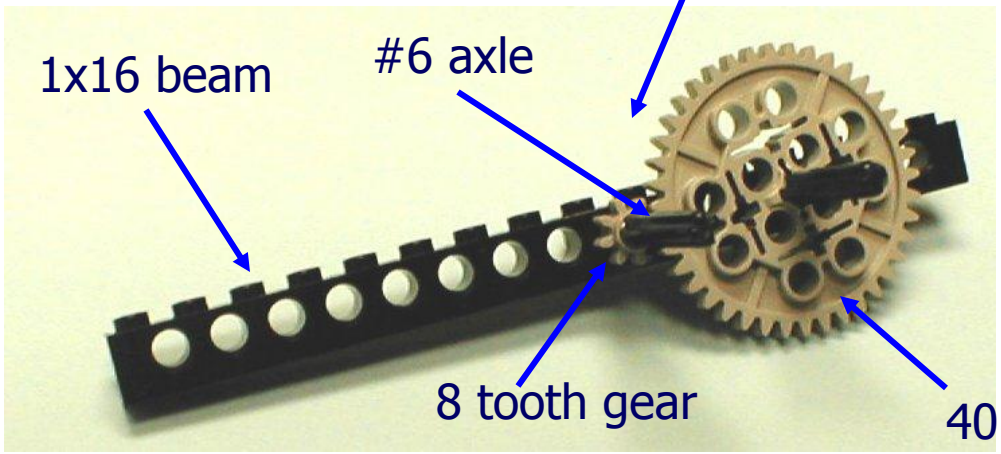
Bevel gears

Belts & Pulleys

Spur Gears

Most "common" type of gear, a wheel with teeth.

Build the following...



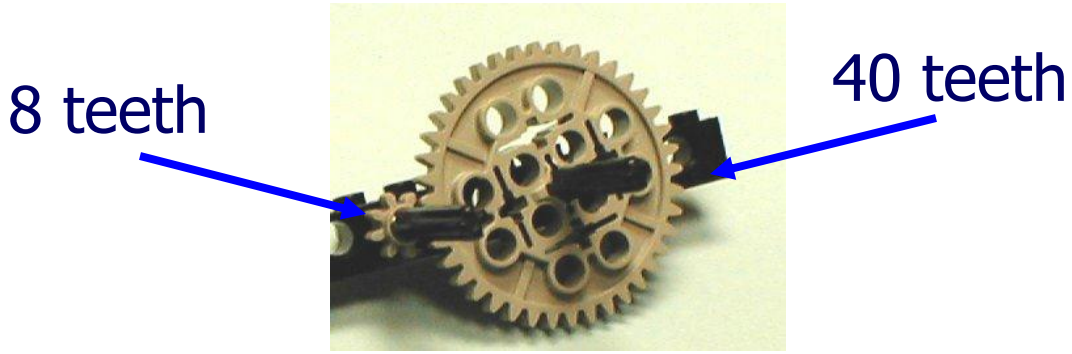
Spur gears do three things.

1. Change rot. speed
2. Change torque
3. Change direction

Make sure there isn't too much friction between the gears and the beam. The gears should spin easily.

Gear Ratios

The **gear ratio** is the ratio of the number of teeth on one gear to the number of teeth on the other gear.



Gear ratio = 40 to 8 or, simplifying, 5 to 1.

That means it takes 5 revolutions of the smaller gear to get 1 revolution of the larger gear. Try it!

Gear Ratios

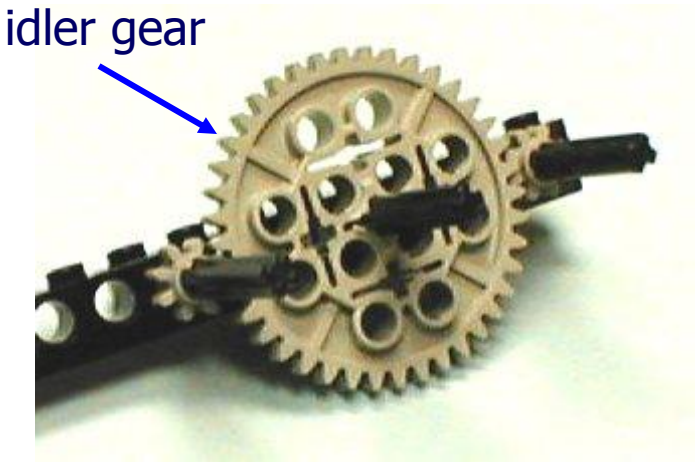
The gear ratio tells you the change in speed and torque of the rotating axles.

If it takes 5 turns of the 8 tooth gear for every 1 turn of the 40 tooth gear, that means the 40 tooth gear will rotate 5 times slower than the 8 tooth gear.

BUT, it also means the 40 tooth gear's axle has 5 times the **torque** (rotational force) as the 8 tooth gear's axle.

Idler Gears

An **idler gear** is a gear that is inserted between 2 other gears.



Build the following. Add another 8 tooth gear to the right of the 40 tooth gear.

How many turns of the 8 tooth gear on the left does it take to make 1 turn of the new 8 tooth gear on the right?

Idler Gears

Answer: 1! It's as if the 8 tooth gears are meshed together.

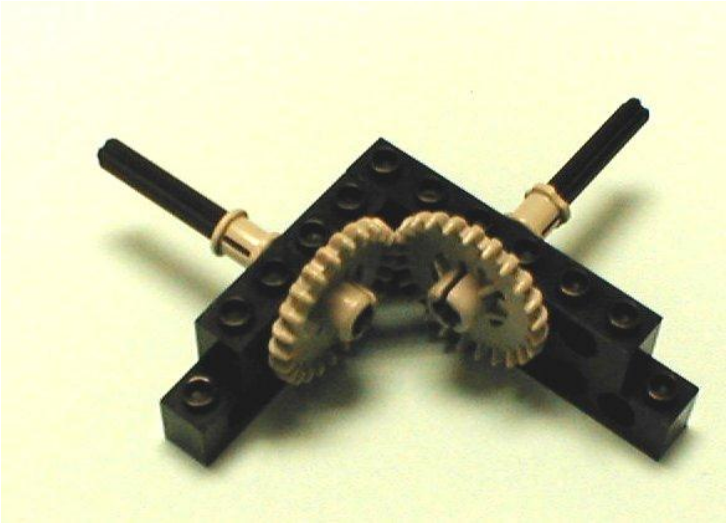
Idler gears DO NOT change the gear ratio.

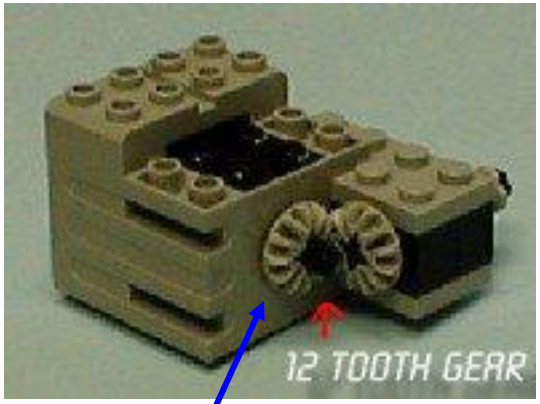
Idler gears DO…

- make both 8 tooth gears rotate in the same direction,
- add spacing between gears.

Bevel Gears

Bevel gears are spur gears that mesh at a 90 degree angle. The gear ratio rules remain the same, but the axles are perpendicular to one another.



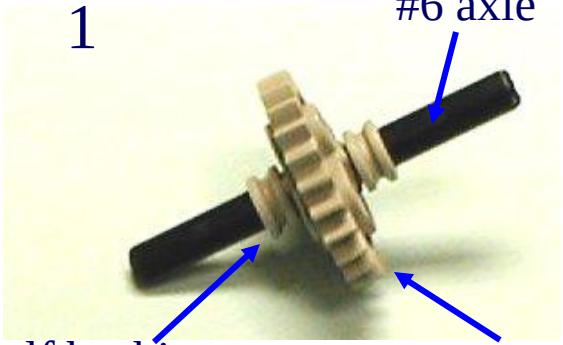


These 12 tooth bevel gears can only mesh with them-selves.

Worm Gears

Build the following….

1



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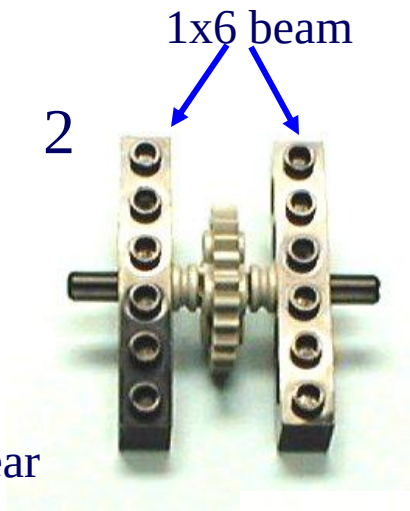

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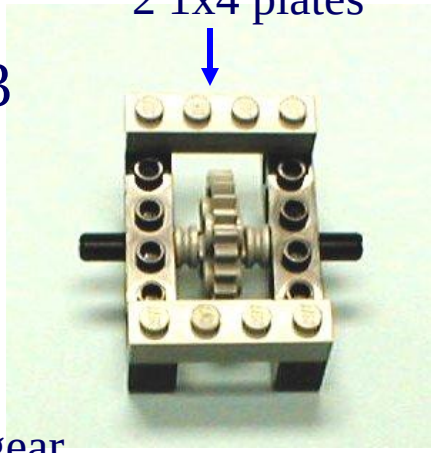

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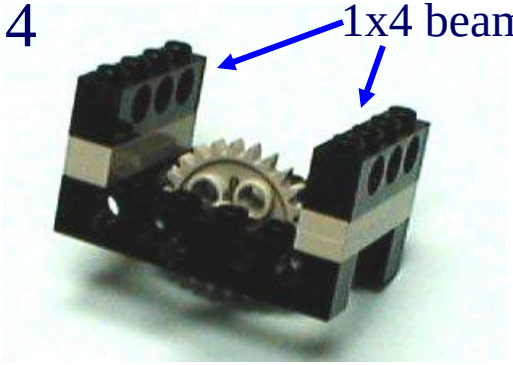

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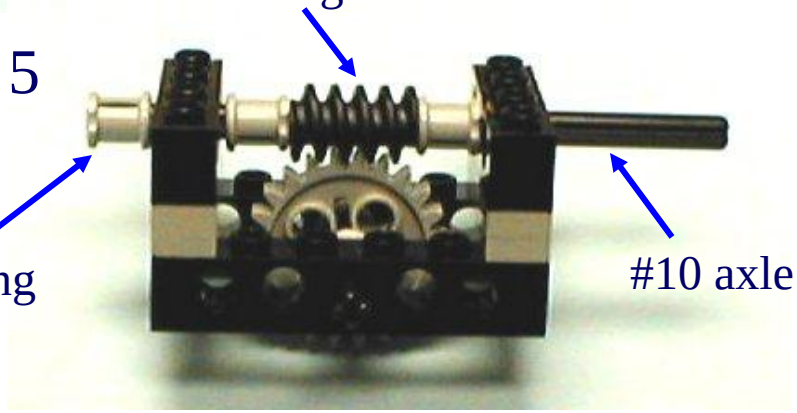
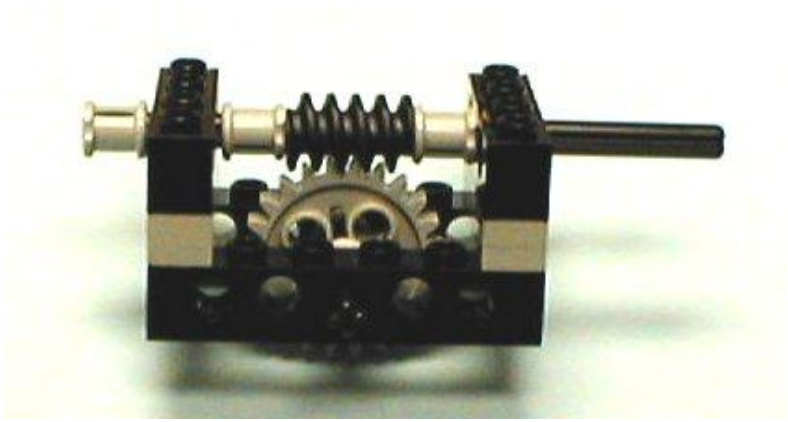


Worm Gears

Worm gears have some special properties.



1: The axles are perpendicular, like bevel gears.

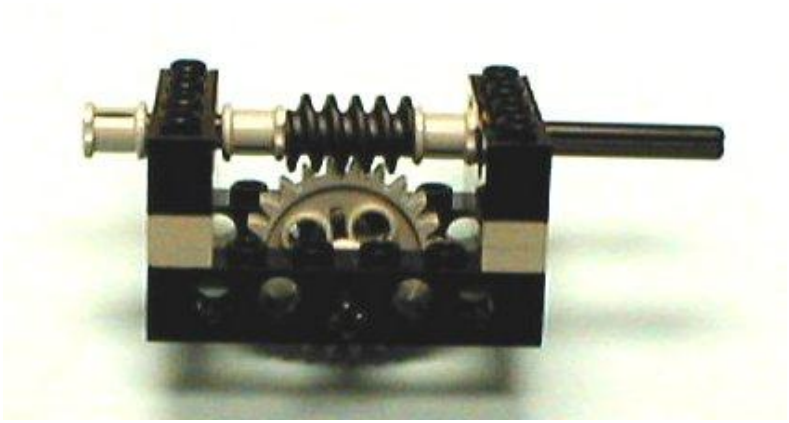
2: How many rotations of the worm gear does it take for 1 rotation of the spur gear?

ANSWER: 24!

The worm gear acts like a gear with 1 tooth! This gives very large gear ratios.

Worm Gears

Worm gears are not back-driveable.



You can turn the worm gear's axle, but you can't turn the spur gear's axle.

This property is used as a locking mechanism.

Belts & Pulleys

Belts & pulleys are related to gears. They change speed and torque, but with a few differences...

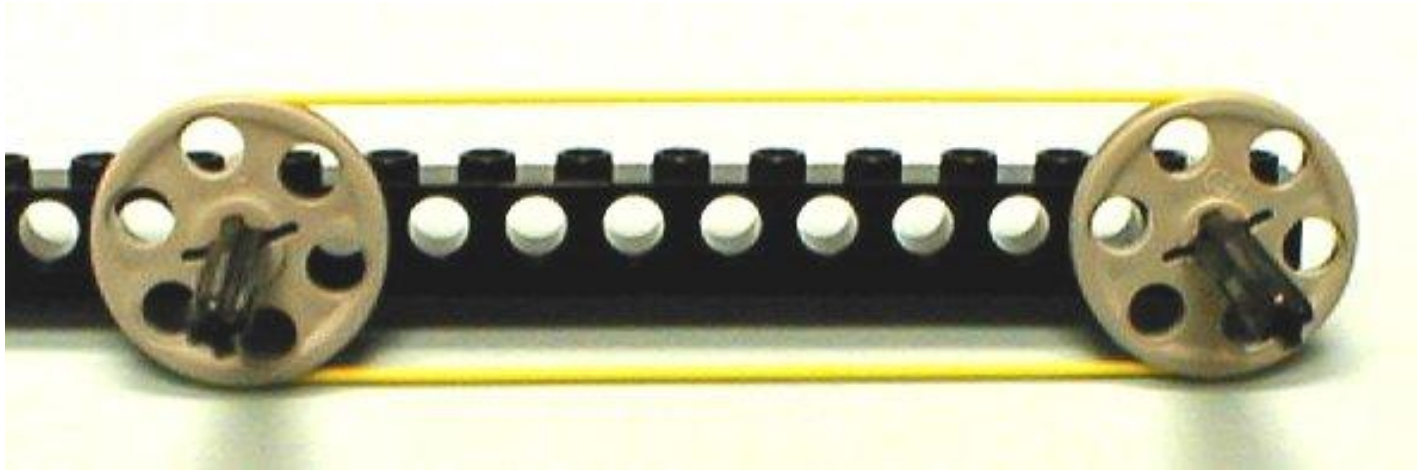
Pulleys transfer their force by the friction of the belts, rather than direct contact with the teeth of gears.

This can cause the belts to slip.

Unlike gears, the pulleys rotate in the **same** direction.

Belts & Pulleys

Belts can transfer force across long distances.



Like gears, however, belts and pulleys do have a "gear ratio." It is the ratio of the diameters of the pulleys.