

8.5 Lesson 3 Gearing

Q. Why do cars, bikes, clocks and winches have gears?

Note: refer to your lesson on purpose of machines

So gears are needed to deliver the same rotational energy from one place to another but make it go faster or with more force.

Gears generally are used for one of 4 things:

1. Increase speed (or Gearing up)
2. Decrease speed but increase torque (or Gearing down)
3. Change direction (clockwise to anticlockwise or vice versa)
4. Transfer the motion from one place to another (Gear trains)

1. **Gearing Up** means the energy is transferred quickly. The smaller wheel gear turns faster than the big drive (motor) gear.

The size of the wheel speed depends on the gear ratio:

$$= \frac{\text{No. of teeth of drive gear}}{\text{No. of teeth of wheel gear}} \times \text{motor speed.}$$

e.g In diagram Gear ratio = 40/24

$$\text{Wheel speed} = 1.67 \times \text{motor speed.}$$

We often talk about rpm or revs per minute for motor speed.

If the motor turned at 1000 rpm then the gearing above would turn the wheel at 1670 rpm.

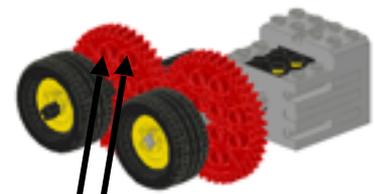
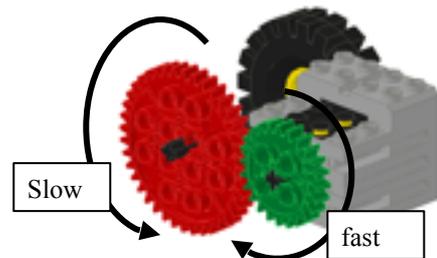
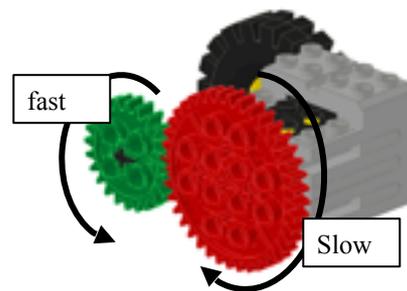
2. **Gearing Down** means slower but stronger.

This gives it more force for pushing objects uphill or carrying heavy weights.

It is correctly called **Torque** which is a combination of Force and radial distance or size of the wheel.

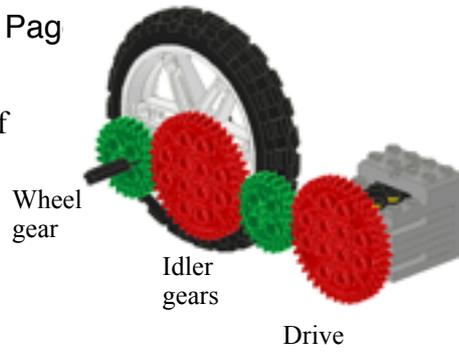
Using low gears in a car increase torque and allow better acceleration as the tyres push off the ground. As you increase speed you change to higher gears with a higher gear ratio.

3. **Changing Direction** is useful for opposing movements such as paper feeders, cranes etc.



Movement of paper

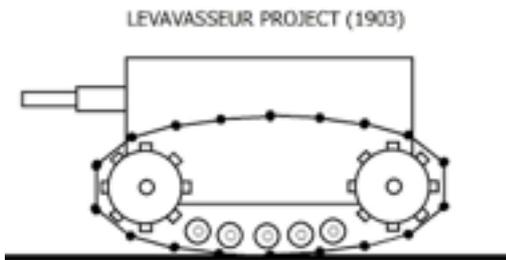
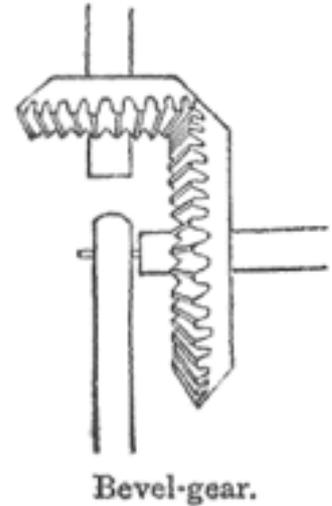
4. Using **Gear trains** which is a combination of gears to transfer the motion further away.



Gears have teeth or cogs which enable intermeshing between wheels.

There are different types of gears for meshing and power:

- Bevelled gears allow motion to be transferred at 90°.
- Worm gears have a spiral thread along a cylinder, acting as a single tooth making it very strong but slow.
- Caterpillar tracks which use gears to link and move a flexible track like a conveyor belt.



Caterpillar Tracks



worm gear

Do Investigations:

8.6 Investigating Gear Ratios

8.7 Investigating Speed and Strength of battery powered cars