Gearing & Gear Ratios

Why are multiple gears necessary?

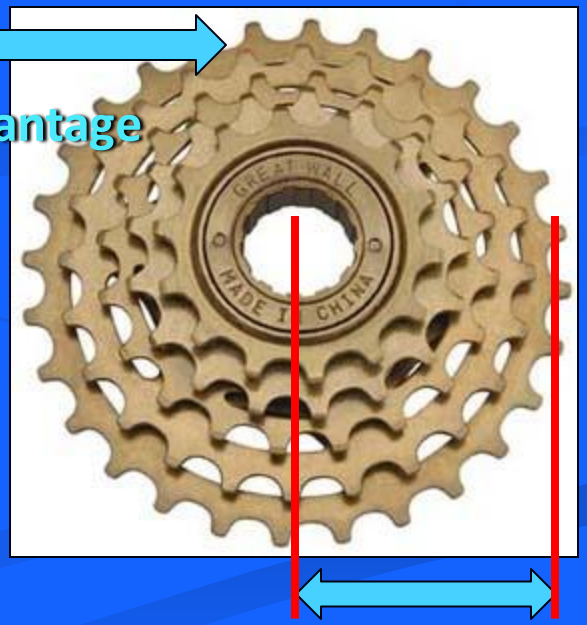
- a single speed bicycle is a compromise…

- having multiple gears allows the rider to…
  - climb steep hills
  - get heavy loads moving (such as cargo on the bike)
  - achieve higher road speeds

How is torque increased?

- climbing hills & moving heavy loads requires more torque
- increasing torque is achieved by selecting gears which are longer lever arms
  - think about it, which gives you greater leverage…

- gears can be used to increase torque
  - first gear (low gear)
  - larger driven gears offer greater mechanical advantage



Torque is great, but my speed is pathetic…

- **long lever arm = higher torque but lower speed**

- ❖ <u>1 revolution of the pedals</u> turns the rear sprocket 1.8 times (50÷28)
- ❖ the circumference of a 26” wheel is 82” (c = π X diameter)
- ❖ 1.8 revolutions of rear wheel = 82 X 1.8 = 148” travelled (≈12’)

How is Speed Increased?

- when higher speeds are needed, *smaller diameter driven gears* are used

- 1 revolution of the pedals turns the rear sprocket 3.6 times
- the circumference of a 26” wheel is 82”
- 3.6 revolutions of rear wheel = 295” travelled (≈24.6’)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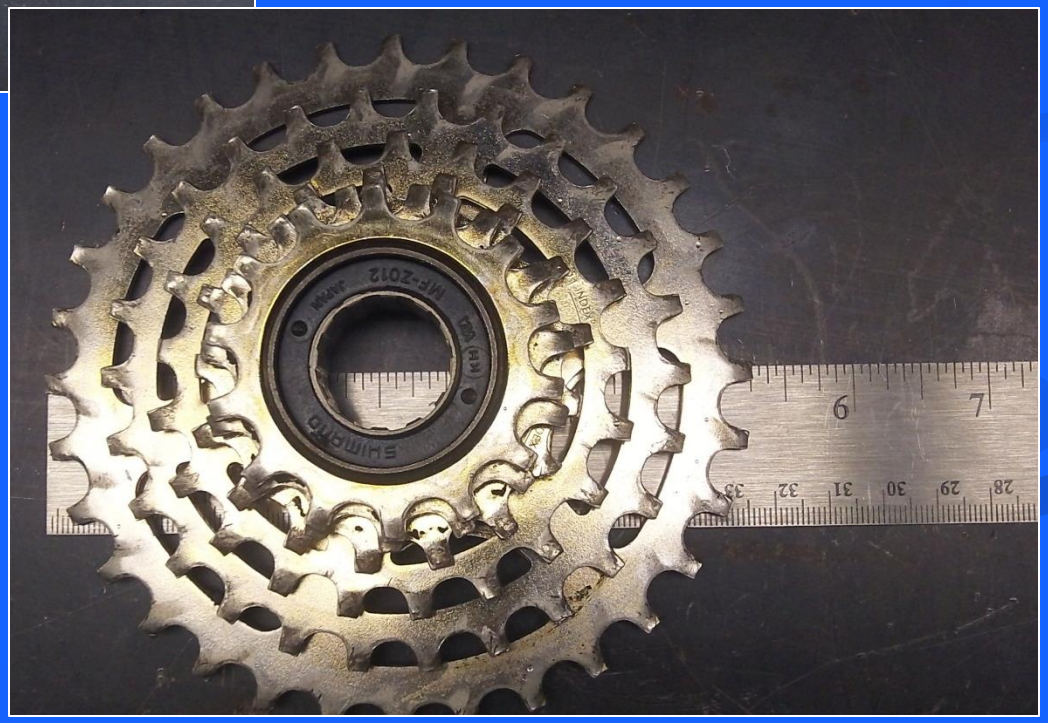
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Need more options?

- **Adding more chain rings increases the number of gear combinations**

- **which chain ring is used for greater torque?**
- **which chain ring is used for higher speeds?**

Calculating Gear Ratios

- calculating gear ratios is helpful when you are replacing rear sprockets, chain rings, wheel sizes or when contemplating an increase in the number of gears

- there are 4 methods to calculate bicycle gear ratios

- the *gain ratio* method takes into account not only sprocket and chain ring size, but also wheel diameter and crank arm length

Calculating Gear Ratios – gain ratio method

- *Gain ratio* can be calculated using this formula…

(wheel radius ÷ crank arm length) × (# of teeth in front chainring ÷ # of teeth in rear sprocket)

- all units must be the same (all mm, cm, inches, etc.)

Gain Ratio Calculator

More is better, right?

Gear chart using Gain Ratios

For 700 X 32 / 32-622 tire with 175 mm cranks

With 9-speed as 11-13-15-17-20-23-26-30-34 Cassette

	48	36	26
11	8.5	6.4	4.6
13	7.2	5.4	3.9
15	6.3	4.7	3.4
17	5.5	4.1	3.0
20	4.7	3.5	2.5
23	4.1	3.1	2.2
26	3.6	2.7	2.0
30	3.1	2.4	1.7
34	2.8	2.1	1.5

What was the design reasoning behind the Penny Farthing?

Built for speed or climbing hills?