• Simple Machines

Bicycle Gears

The first bicycles did not have multiple gears for ease of riding. Cyclists worked hard to cover ground. They sat over the front wheel because the pedals were attached directly to the wheel's axle. Rotating the pedals once around moved the front wheel only one complete revolution. The invention of the chain drive allowed the rider to sit in a safer, more balanced position between the front and back wheels.

Chain drives transfer the power from the rider's legs, which push down on the pedals attached to levers (the cranks), which turn the axle of the toothed wheel (front sprocket, or chain ring). The chain is a continuous loop attached to the chain ring and a rear sprocket. As the chain ring rotates, it moves the chain, which moves the rear sprocket, which turns the rear wheel's axle. Thus, the invention of the chain drive meant that a rider propelled the bike forward by moving the rear wheel, not the front one. If you think chain drives resemble pulley systems, you're right!

Later, the addition of gears with varying ratios made it easier to ride up steep inclines and pedal more efficiently. Gear ratios are figured by dividing the number of teeth in the front sprocket by the number of teeth in the rear sprocket. If there are 54 teeth in front and 27 in back, the ratio is 2 to 1 because $54 \div 27 = 2$. This means that the rear sprocket goes around twice each time the rider moves the chain ring one complete revolution. If the rear sprocket has 13 teeth, the ratio is about 4 to 1. One turn of the pedals will rotate the back sprocket four times. On downhills or level ground, a rider doesn't have to work as hard to move the bicycle in the "fourth" gear as in the "second."

On the other hand, the steeper the incline, the more difficult it is to ride a bike in a high gear (think of lifting a heavy object straight up instead of pushing it along a ramp). In this case the rider's goal is to easily turn the pedals several times before the rear sprocket completes a revolution. The rider needs to shift into a lower gear.

1. Complete the table below by computing the gear ratios (round to the nearest whole number).

2. Which gear would be best for riding up a steep hill?

_____

_____

Gear	Number of teeth in rear sprocket	Number of teeth in front sprocket	Gear ratio
a	11	60	
b	22	54	
c	41	84	
d	60	54	