

# Putting Gears to Work

Gears are generally used for one of four different reasons:

1. **To reverse the direction of rotation**
2. **To increase or decrease the speed of rotation**
3. **To move rotational motion to a different axis**
4. **To keep the rotation of two axes synchronized**

Gears work to change the direction of motion. When you turned the big gear one way, the little gear turned the other way! Gears also change speed of motion. When you turn the big gear slowly, the smaller gear turns faster. This helps save energy, because you don't have to work as hard to turn the big one slowly as if you had to turn the small one quickly.

You can also try this project with water bottle caps that have ridges, or with gears from a building set like Lego or K'Nex.

Most [gears](#) that you see in real life have **teeth**. The teeth have three advantages:

- They prevent slippage between the gears. Therefore, axles connected by gears are always synchronized exactly with one another.
- They make it possible to determine exact gear ratios. You just count the number of teeth in the two gears and divide. So if one gear has 60 teeth and another has 20, the gear ratio when these two gears are connected together is 3:1.
- They make it so that slight imperfections in the actual diameter and circumference of two gears don't matter. The gear ratio is controlled by the number of teeth even if the diameters are a bit off.

## Bicycle

Turn a bicycle upside down to observe gears. To count revolutions of large front sprocket, mark a tooth with a piece of masking tape. Turn the pedal. What is the ratio of turns between the front sprocket and the back sprocket? Explain why the front sprocket is larger than the rear sprocket. How does this affect speed?

## Egg Beater

When the handle goes around once, how many times does the operating end rotate?

## Can Opener

Twist the handle and watch the gears. Point out how the gears move in opposite directions on the can opener which causes the can to move around the blades.

## Gears and Torque

Gears are used in tons of mechanical devices. They do several important jobs, but most important, they provide a [gear reduction](#) in motorized equipment. This is key because, often, a small motor spinning very fast can provide enough [power](#) for a device, but not enough [torque](#). For instance, an electric screwdriver has a very large gear reduction because it needs lots of torque to turn screws, but the motor only produces a small amount of torque at a high speed. With a gear reduction, the output speed can be reduced while the torque is increased.