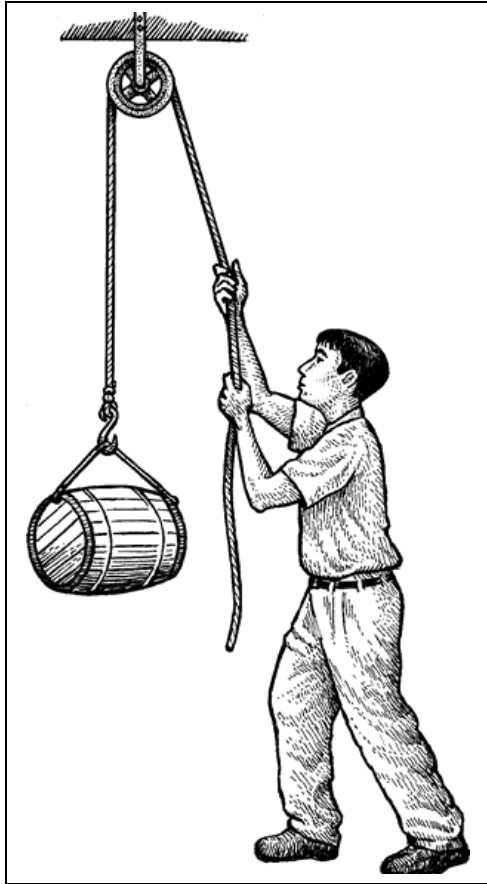


Pulleys



What is a pulley?

The Pulley is a simple machine that consists of a wheel with a groove and a rope. The rope is looped through the groove in the wheel.

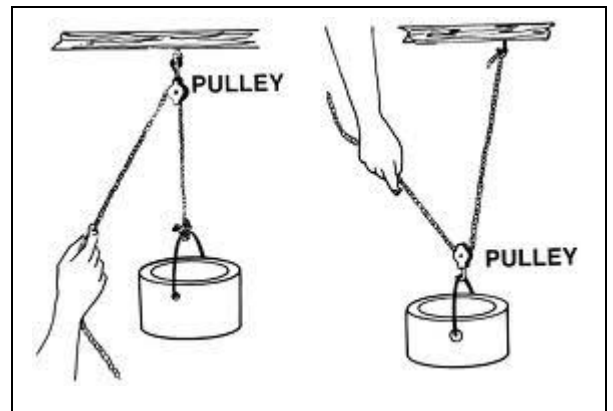
What is a pulley used for?

A pulley is used to lift objects that people could not normally lift on their own. The object you are lifting is called the **load**. You will pull on the rope which will lift the object up. The number of pulleys you use affect how much you have to pull.

There are two types of pulleys:

**Fixed Pulley:** This pulley is attached to a non-moving object. It is usually fixed to the ceiling or high areas.

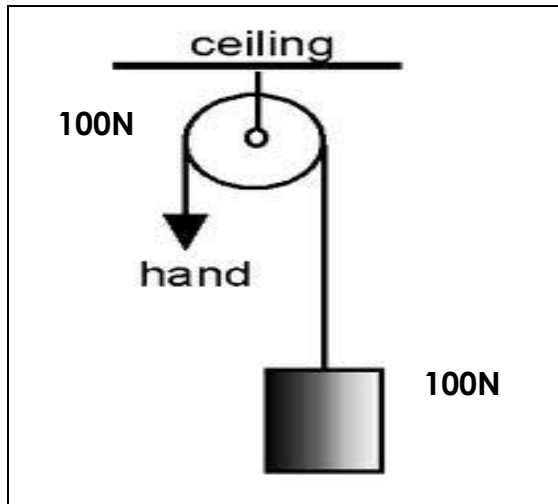
**Movable Pulley:** This pulley is attached to the object you are trying to move. When the object moves, the pulley moves with it.



## Pulleys and Gears Review Package

How do pulleys save us work?

Pulleys help you move heavy things that you could not move on your own. The amount of effort you need to put into lifting the object depends on the weight of the object and pulleys you use.



What happens when I use a Fixed Pulley?

A Fixed pulley will change the direction you pull, but not the effort you put in.

Instead of lifting the object up, with a fixed pulley, you pull down on a rope.

Since only one rope is holding up the object, you still need to pull with a force equal to how much the object weighs.

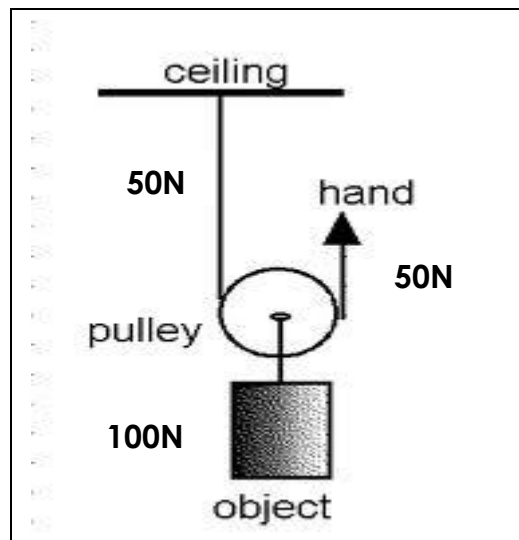
How is a movable pulley different from a fixed pulley?

A movable pulley is attached to the load. You have to pull up now, just like you would if you lifted the object with no pulleys. So direction does not change.

Since the movable pulley moves with the load, one rope is tied to an object and the other is the one you pull. There are now two ropes holding up the object. The one rope takes on half the weight. The effort you have to put in is cut in half.

**If an object weighs 100N, you have to pull with a force of 50N.**

**If the load weighs 100N, they you have to pull with a force of 100N**



This is called having a **mechanical advantage**.

# Pulleys and Gears Review Package

What happens when I use both kinds of pulleys?

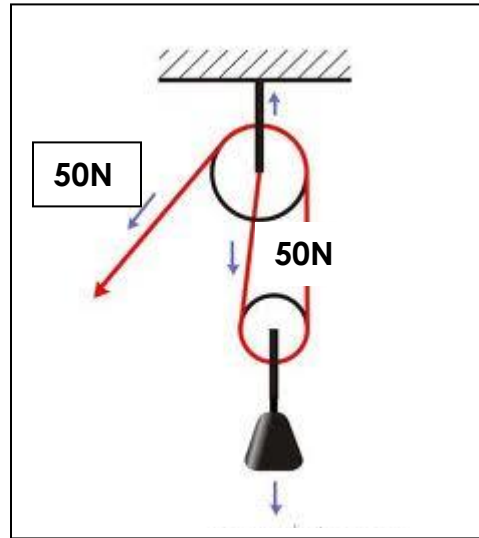
If you have both a movable and fixed pulley, it is called a **block and tackle**. With this, you have to cut the amount of effort you need in half because of the movable pulley.

What if I have more than one of each pulley?

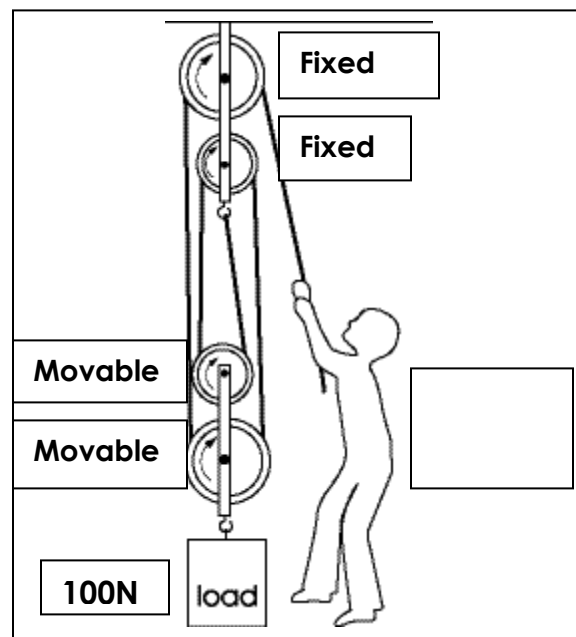
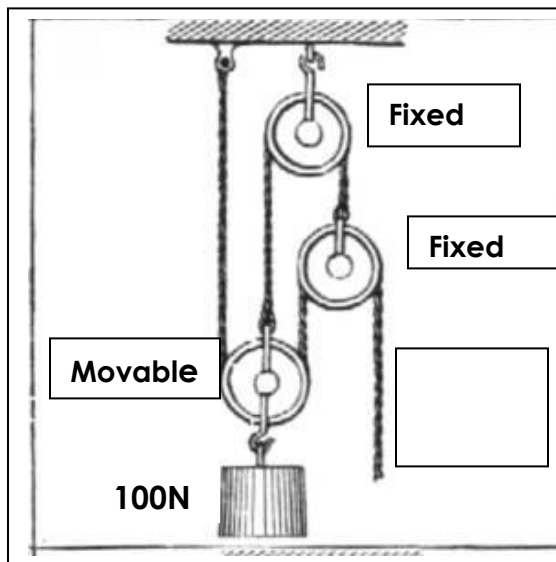
With every movable pulley you include, the effort you have to use is cut in half. The first will cut the original in half, and others after it will cut that number in half.

With two movable pulleys, you will only have to pull with a quarter of the weight of the object.

**If the object is 100N, you would need to pull with 25N.**



Find out how much effort you need to put in to these pulley set-ups.



# Pulleys and Gears Review Package

## What are gears?

Gears are wheels with teeth on their outside edge. They spin around in a circular motion.

## Do gears work alone?

Gears rarely work alone. They usually are found in a **gear train**. A gear train is a set of gears which work together to pass speed or motion from one gear to another.

## How do gears work?

Gears are made to **mesh**, or connect with, the teeth of other gears. When the teeth of one gear meshes with another, the teeth force the second gear to spin.

## What kind of gears are there?

**Spur:** A wheel with teeth on the outside. The most common gear. It can work with other gears.

**Bevel:** Gears that have teeth on an angle. The two gears meet at an angle, changing the direction of the spinning motion.

**Rack and Pinion:** A spur gear that rolls along a flat rack with teeth. This causes motion to change from linear to circular, or circular to linear.

**Worm:** A long cylinder gear connected to a spur gear. The worm gear is used for slow movement. The spur gear can't turn the worm gear.



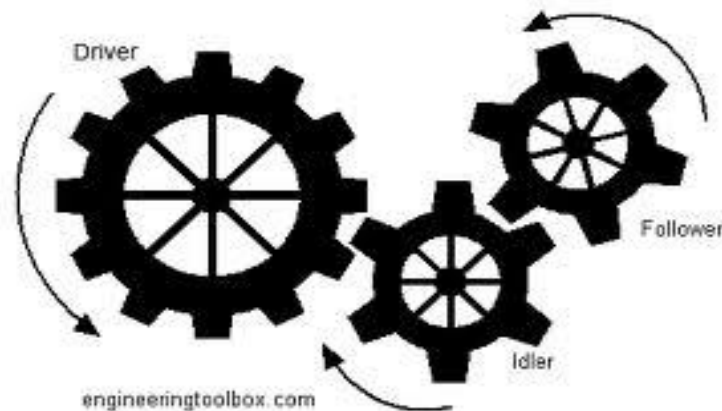
## Pulleys and Gears Review Package

How is movement passed through a gear train?

The first gear is called the **driver gear**. Like the engine of a train, it controls the movement of all other gears that follow it. The driver will determine speed and spin for all the other gears. The gears that come after the driver are called **follower gears**. Like the cars on a train, they have no choice as to how they move. It depends on the gears in front. The last gear in a train is the **driven gear**. It is controlled by all other gears before it, and is the one that give the movement and speed to the device.

What ways do gears spin?

Gears will always spin in the opposite direction of the gear in front of them. The teeth that mesh together will fall in the same direction, causing gears to spin opposite to one another. If the first gear spins clockwise, the next one will spin counter-clockwise.



Can I change the direction of the gear train?

Yes. If you place an **idler gear** in the train, you can choose which way future gears will spin. Idler gears just pass motion to another gear.

How is speed determined in a gear train?

Speed depends on the number of teeth on a gear. Same size gears will spin at the same speed. But different size gears will turn at different speeds. Changing gear sizes will let you change the speed of the turning.

**Large gears have more teeth, so they take longer to spin.**  
**Small gears have fewer teeth, so they can go around more quickly.**

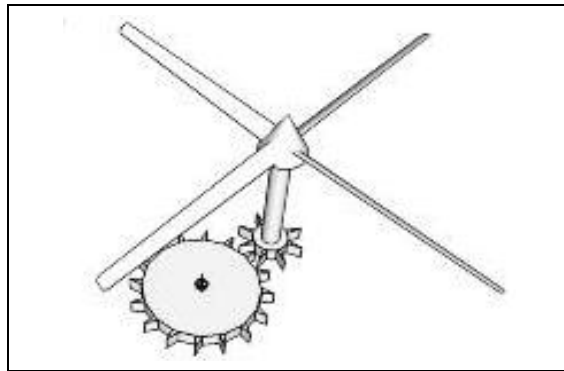
## Pulleys and Gears Review Package

Does the size of the gear really matter?

Yes, the size of the gear will determine what you are going to get.

If you connect a big gear (driver) to a small gear (driven), you will get more speed.

The smaller gear will turn more times, causing the object connected to it to move faster. Think of an egg beater or a power drill. They move fast because of the small gears.



If you connect a small gear (driver) to a big gear (driven), the speed will slow down. But you will get more power out of it. The big gear will take longer to go around, but you will have more force come out of it so you do less work. Think of a chunk key to tighten a drill.



Small gears give me more speed.

Big gears give me more power.

Different jobs=different gear trains

## Pulleys and Gears Review Package

How about the gears on a bike? How do they work?

Gears on a bike work the same as other gears when they spin. But instead of being connected to each other, the gears are connected by a chain. This makes the bike a mix of both pulleys and gears. When you peddle the bike, you set the driver gear in motion. The chain helps to pass the motion from the gears attached to the peddles to the driven gear at the back wheel.

Which gear is good for speed?

The highest gear is made for speed. This means that you have the big gear connected to the peddles and the small gear turning the wheel. The small gear turns the back wheel more often, so you peddle less and move faster.

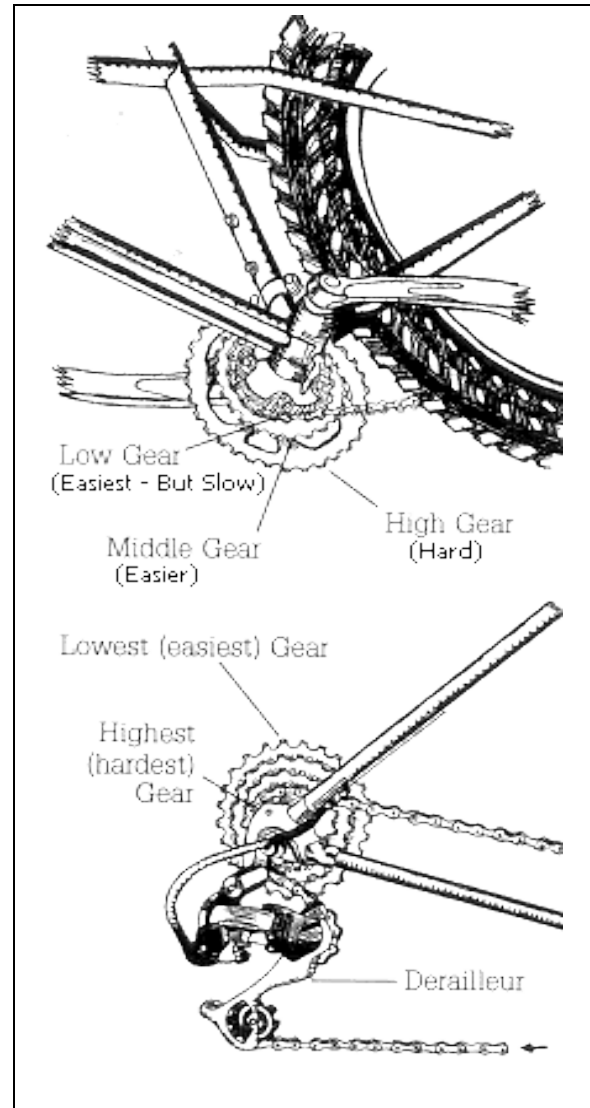
Which gear is good for power?

The lowest gear is for power. This means that you have the small gear connected to the peddles and the big gear turning the wheel. The big gear turns the wheel less because it has more teeth to go around. You have to peddle more, but the back gear shares the work with you. As a result, you don't push down as hard on the peddles.

Which gear is better for me when I'm riding?

The high gear is good for riding on flat open areas. You don't peddle as much and the wheel turns faster, giving you speed.

The low gear is good for going up hills. The back wheel turns less, but gives you help by sharing some of the force. You peddle more because of the small gear, but it's easier to turn the peddles round.



Do I have those gears only at those times?

No. The good thing about bike gears is that you can choose what you like best.