WOW sheet

Screw

A screw is one of the six types of **simple machines**.

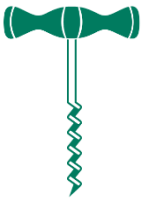
A machine is a device that does a physical task. **Simple machines** are the most basic devices that allow work to be done with less effort. A simple machine can change the direction or the magnitude of a force, or the point where the force is applied.

What is a screw?

A screw is an inclined plane wrapped around a central point or cylinder. It is a simple machine that can reduce the force required to move a vertical distance or change the direction of a force.

Common examples of screws include:

- light bulbs
- screw-top jars
- corkscrews



A screw is actually an **inclined plane** wrapped around a central point. The line that is formed by the inclined plane is called a **thread**. If you could unwrap and straighten out the thread, it would form one inclined plane. The more threads there are on a screw, the longer the inclined plane.

The distance between the threads is called the **pitch** of the screw. The closer together the threads are to each other, the smaller the pitch.

Why use a screw?

All screws are inclined planes that are wrapped around a central point in a twisting manner. That's why they are sometimes called winding inclined planes.

Because screws are a type of inclined plane, they are commonly used to do the same type of work. That is to say, screws can help move a vertical distance with less force.

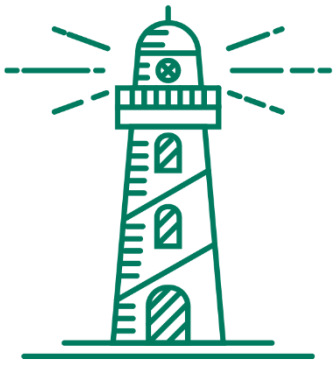
Here's an example

A staircase is a type of inclined plane with steps on it. A staircase makes it easier to travel a vertical distance, such as to an upper floor in a building.

A spiral staircase is an example of screw. It is an inclined plane (staircase) wrapped around a central point.

Just like the regular stairs, a spiral staircase makes it easier to move vertically.

The screw shape allows you to get the benefit of an inclined plane but in a much more compact design. This makes spiral staircases the best option for buildings like lighthouses which are tall but very narrow.

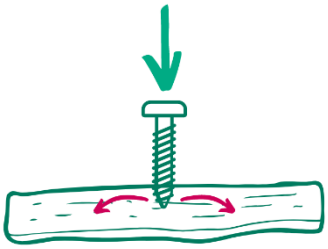


Screws can also be used to change the direction of a force. This includes spreading that force out along the full length of the screw's threads, which can be helpful to hold materials together.

Here's an example

A wood screw is a very common example of a screw. But did you know it is actually a **compound machine**? That's because it is made up of two simple machines which work together to perform one task.

The main body of a wood screw is a screw, but its tip is a **wedge** which helps the screw cut into and split apart wood.



When you press down on the screw using a screwdriver, the wedge tip changes the vertical force into horizontal forces.

As you turn the screw, the circular motion of the screwdriver is changed by the threads of the screw, which is what drives the screw up or down. One complete circle of the screw will move the screw up or down a distance equal to the pitch of the screw.

The threads of the screw then push against the wood, holding it in place.

Mechanical advantage of a screw

Like all simple machines, you can calculate the mechanical advantage of a screw by dividing the force of resistance by the force of effort.

$$Mechanical\ Advange = \frac{Force\ of\ resistance}{Force\ of\ effort}$$

Remember that a screw is actually an inclined plane wrapped around a central point. In an inclined plane, the length of the slope (L) is equal to the force of resistance and the height of the plane (H) is equal to the force of effort. So, the equation is simply the length divided by the height ($\frac{L}{H}$).

The shape of a screw changes how the inclined plane works. When you turn a screw in one complete circle, the screw moves up or down a distance equal to the pitch (that is, the distance between the threads) of the screw.

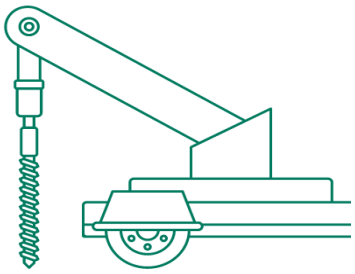
Instead of the length and the height of the screw, the relationship between the pitch and circumference of the screw is what gives the mechanical advantage.

The circumference of the screw shaft is calculated like any other circle, by multiplying the radius (r) by 2π.

The ideal **mechanical advantage** (MA) for a screw is equal to the circumference of the screw (2πr) divided by the pitch of the screw (d).

$$MA = \frac{2\pi r}{d}$$

Here's an example



An auger is a machine that uses a large screw to drill a hole deep into the ground.

Let's say the radius of the screw is 12.5cm (r) and that the pitch is 20cm (d). The equation for the mechanical advantage of a screw is:

$$MA = \frac{2\pi r}{d}$$

Because π (pi) is an irrational number, let's round the answer we get to the tenths place.

That means the mechanical advantage of using the auger's screw is:

$$\frac{2\pi 12.5cm}{20cm} = 3.9$$

What does that '3.9' mean? It means that the screw multiplies the input force by 3.9 times.

You can think of it the opposite way too: however hard the auger works to push down into the ground, it would have to work 3.9 times harder without the screw!