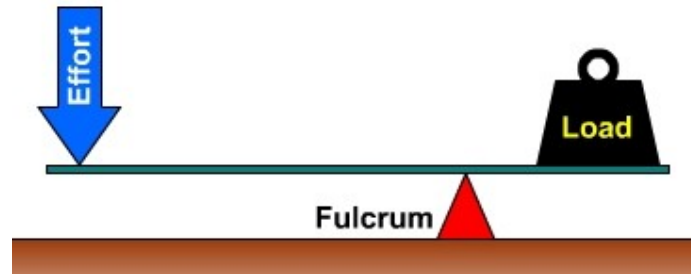


Levers

What is a lever?

A lever is a rigid bar that pivots about a fulcrum. It transmits an input motion and force, (the effort) through the lever pivoting on a fulcrum to a resistance force called a load.



Load

The load is anything that is being moved by a lever.

Effort force

The effort force is the energy applied to a lever to move a load.

Fulcrum

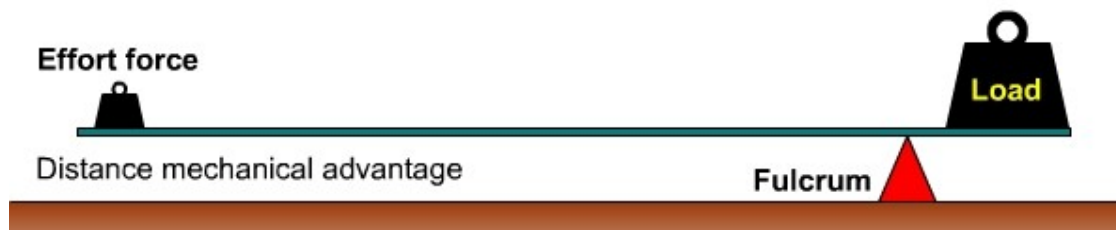
The fulcrum is the point at which the lever pivots. A lever may rest on a fulcrum or it may swivel on an axle, e.g. a see-saw (class 1 lever) and a wheel barrow (class 2 lever).

Mechanical advantage (MA)

Machines and mechanical devices are used to create a mechanical advantage. Mechanical advantage helps us do work such as move heavy loads for a relatively small amount of effort. Mechanical advantage can be worked out by dividing the load force by the effort force,

$$\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$$

Levers create a mechanical advantage. The long lever pivoted near one end enables a small effort force to lift a heavy load.



This type of mechanical advantage is called **distance mechanical advantage**.

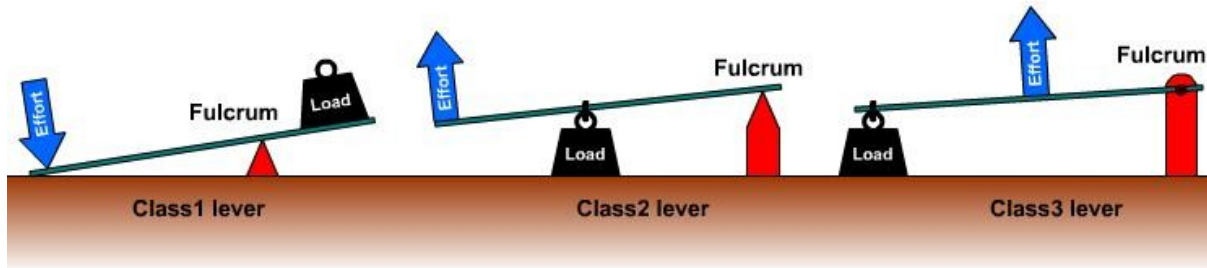
Creating a mechanical advantage using a lever

The mechanical advantage of a lever is worked out by dividing the distance of the effort force to the fulcrum by the distance of the load force to the fulcrum.

$$\text{MA} = \frac{\text{Distance of effort force to fulcrum}}{\text{Distance of load force to fulcrum}}$$

Classes of levers

There are three classes of levers. Each class of lever has the load and effort force in specific positions relative to the fulcrum.



Class 1 lever

A Class 1 lever has the fulcrum between the load and the effort force.

Class 2 lever

A Class 2 lever has the load between the fulcrum and the effort force.

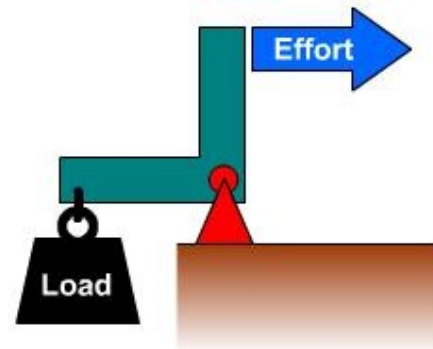
Class 3 lever

A Class 3 has the effort force between the load and the fulcrum.

Bell Crank Lever

A bell crank lever is an angled Class 1 lever. It is a Class 1 lever because the fulcrum is between the load and the effort force.

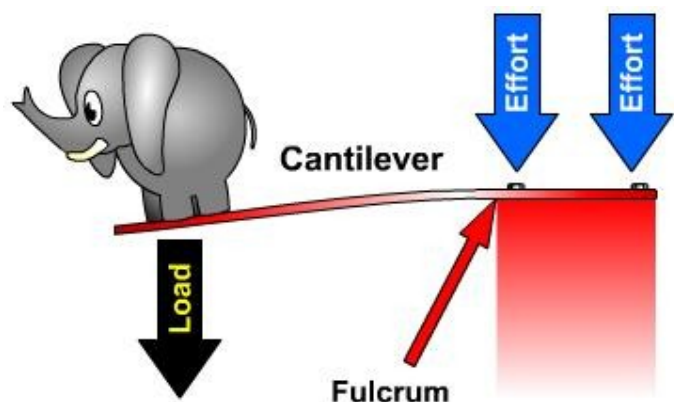
The bell crank lever is used when the effort force must be at an angle, usually a right angle, to the load.



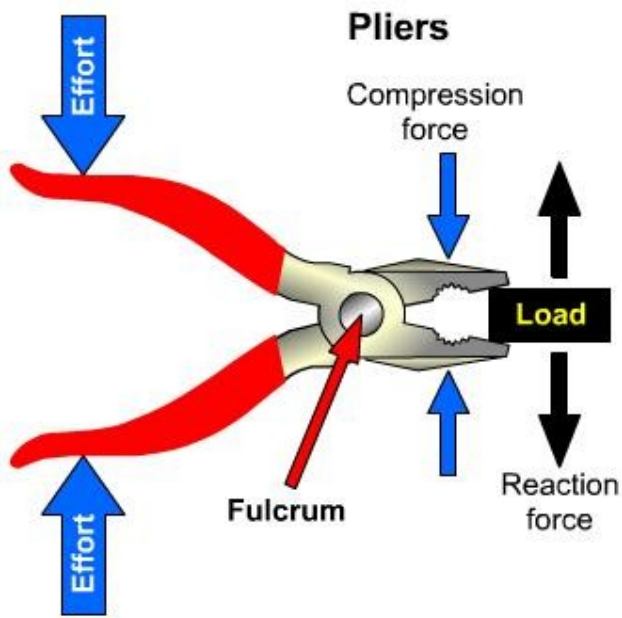
Cantilever

A cantilever is a beam that is fixed at one end only. Load is applied to the unsupported end.

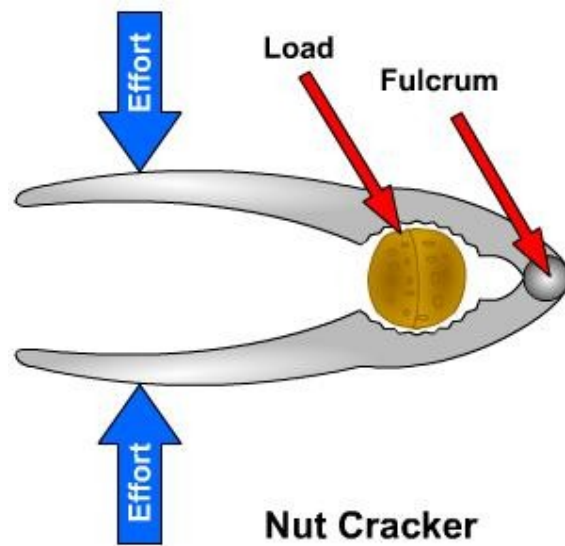
A cantilever may be classified as a type of Class 1 lever as fulcrum is between the effort force and the load.



Examples of the use of levers



Class 1 lever: a pair of pliers



Class 2 lever: a nut cracker



Class 3 lever: the lower digger arm

Three examples of tools that utilise levers are shown.

The pair of pliers has its fulcrum between the effort force and the load, so it is a Class 1 lever.

The nut cracker has the load between the effort force and the fulcrum, so it is a Class 2 lever.

The lower arm of the digger has its effort force between the fulcrum and the load, so it is an example of a Class 3 lever.