

# Mechanical Advantage and Strengthening Structures

Name: \_\_\_\_\_

## Mechanical Advantage

Mechanical advantage is the ability of tools or systems to make it easier to do work. It is a measure of how many times a system multiplies the effort you apply. For example, if the  $MA = 2$ , then the effort you apply to move the load, is doubled by the system. This means you only have to actually put in half of the effort to do the same amount of work.

The greater the mechanical advantage in a particular system, the less effort is needed to perform the task.

Mechanical advantage has two effects: It can multiply input forces and it can multiply input distances.

### Multiplying input forces

This means that the system is able to double or triple the input force (what you apply to lift a load) so that the output force is much bigger.

This is what allows us to lift a very heavy load with very little effort, for example, a compound pulley system.

### Multiplying input distances

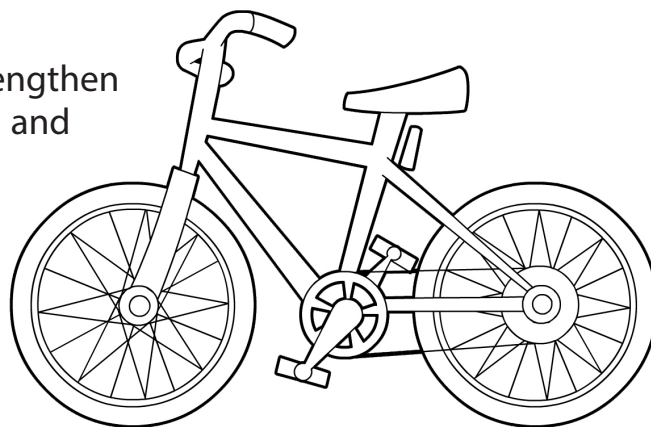
This means that the system is able to double or triple the input distance (the distance you apply to lift the load) so that the output distance is greater.

This allows us to move something a small distance, but the system will move it a greater distance, for example, a fishing reel and rod. The fisherman will wind the reel a small distance, but it will pull the line in from a long distance.

## Strengthening Structures

There are three main methods used to strengthen or stiffen frame structures: Tubing, Folding and Triangulation.

Consider a bicycle. It is a frame structure that incorporates two of the three methods, namely, tubing and triangulation.



Consider the structure of the wheels. The spokes and the wheel rim are attached in such a way that they form triangles. This provides a lot of strength as the wheel carries the bulk of the load. Consider also how the frame of the bike forms triangles.

Consider the structure of the actual frame of the bicycle. It is made of tubes of steel or aluminium that have been connected. The spokes are also cylindrical, or tube-like in shape. These two methods of strengthening provide the structure and stability to make it possible for the bike to perform its task.

Consider a tin can. It is a shell structure that has been strengthened by folding. The folds in a can are called corrugations. The corrugations make the structure more rigid, meaning the structure can stand against a greater force than if it was not corrugated.

