Mechanical Advantage
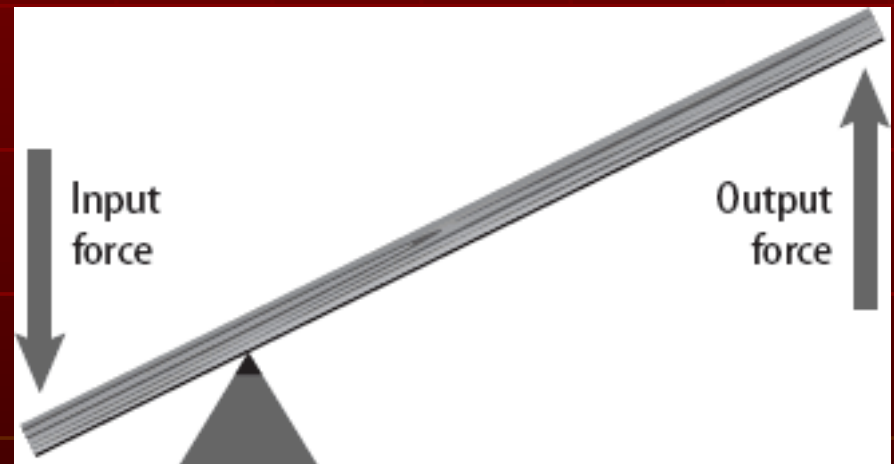
Mechanical advantage (MA) measures the ratio of how much the machine changes the force.

Input force – the applied force
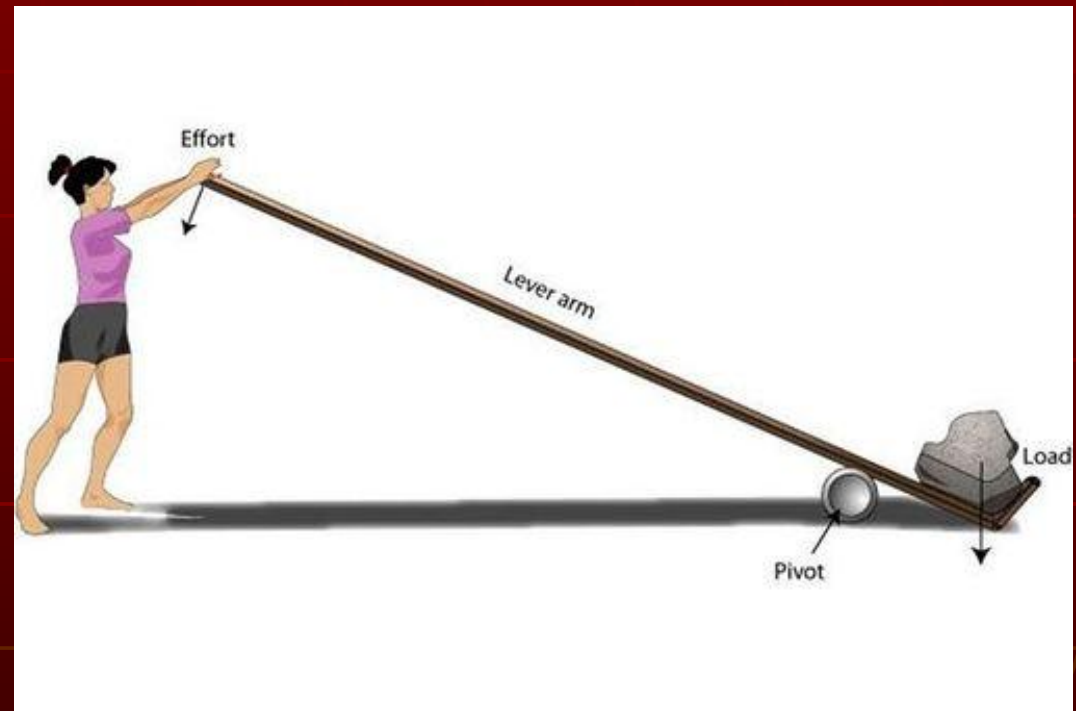
Output force – the resulting force

MA=Output force/Input force

Work Input and Output

- When work is done energy is transferred
  - A machine increases the potential or kinetic energy of an object by doing work on it.

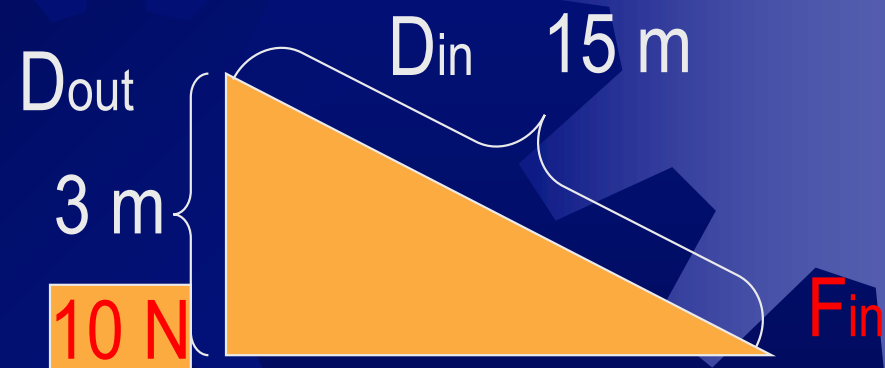- If distance increases the force decreases.   W=Fd

Work input and output

- **Work input is the amount of work done <u>on</u> a machine.**
  - **Input force x input distance**

- **Work output is the amount of work done <u>by</u> a machine.**
  - **Output force x output distance**

$W_{out} = W_{in}$

$F_{out} \times D_{out} = F_{in} \times D_{in}$

$10N \times 3m = 2N \times 15m$

D_{out} D_{in} 15 m

3 m

10 N

F_{in}

Efficiency

- Work input is the amount of work done <u>on</u> a machine.
  - Input force x Input distance

- Work output is the amount of work done <u>by</u> a machine.
  - Output force x Output distance

- Output work is always less than input work.
  - Friction

- Efficiency is the ratio of a machine's output work to the input work.

- Efficiency (%) = Output work/Input work x 100

- No real machine is 100% efficient because machines lose energy to friction, which is why we lubricate moving parts and used streamlined designs.

Compound Machines

- A machine that is made of two or more simple machines is called a <u>compound machine</u>.

- Gears are an example of a compound machine (2 wheel & axles).

- The mechanical advantage of a compound machine is the product of their mechanical advantages.

- Example: the mechanical advantage of a pair of scissors is the product of its 2 levers and 2 wedges.

GEARS-Wheel and Axel

- Each gear in a series reverses the direction of rotation of the previous gear. The smaller gear will always turn faster than the larger gear.
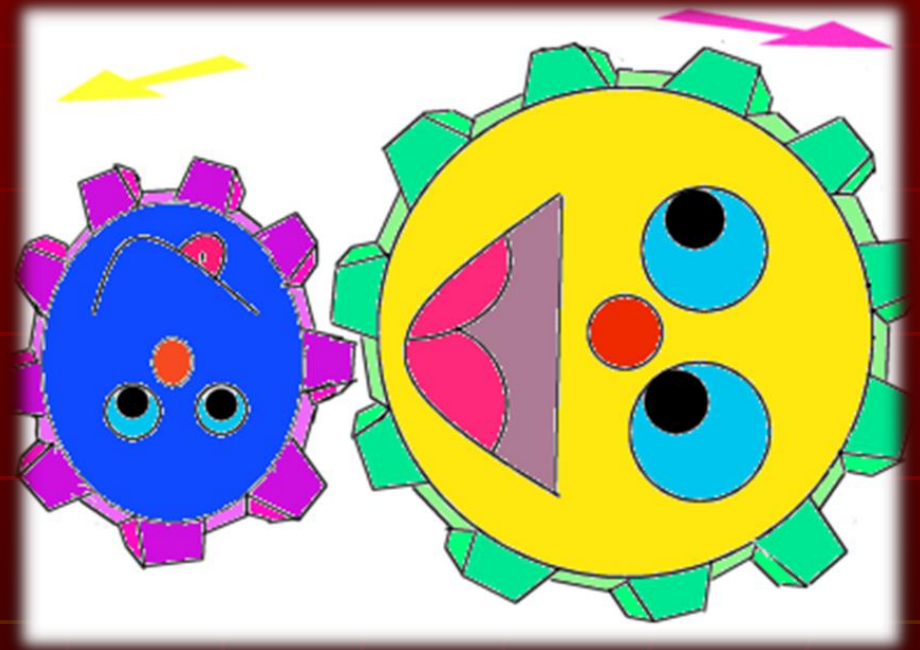
Combined Pulley

- A multiple pulley system makes work easier by changing the distance over which work is done and therefore decreases the force required.

- The main disadvantage is it travels a very long distance.