

The Six Simple Machines

Inclined Plane



Screw



Wedge



Pulley



Wheel and Axle



Lever



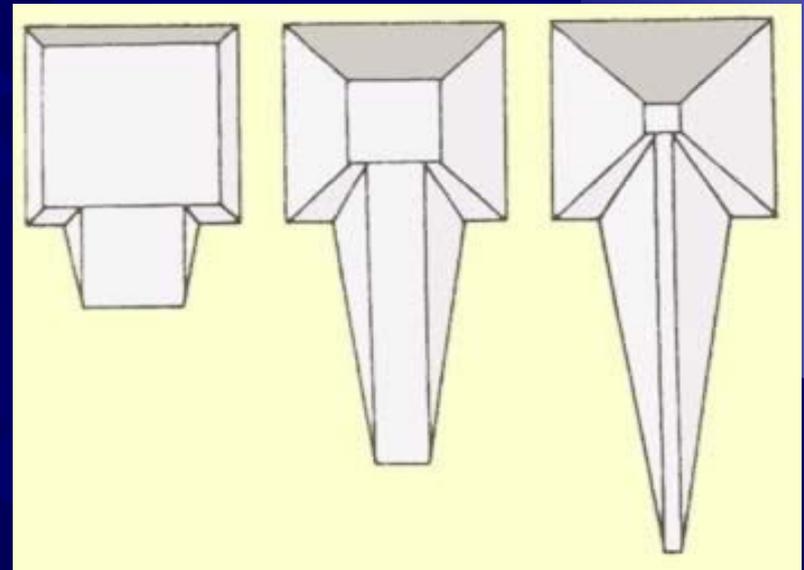
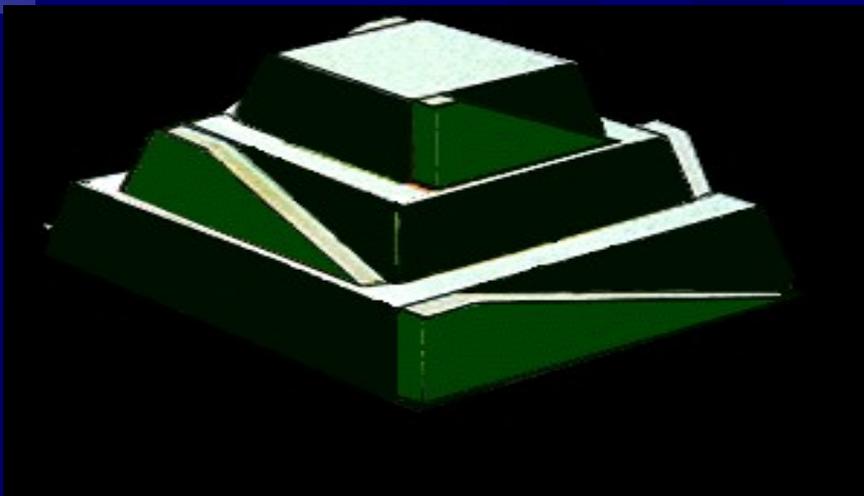
Inclined Plane

- ★ An inclined plane is a flat surface that is higher on one end
- ★ Inclined planes make the work of moving things easier



Inclined Plane

- ★ The Egyptians used inclined planes to build the pyramids.
- ★ One method was to build a very long inclined plane that rose upward to the top of the pyramid very gently.
- ★ The blocks of stone were placed on large logs (another type of simple machine - the wheel and axle) and pushed slowly up the long inclined plane to the top of the pyramid.

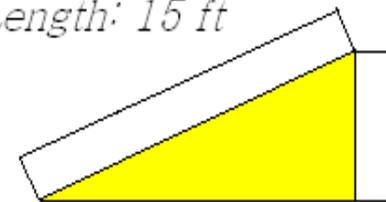


Inclined Plane - Mechanical Advantage

- ★ The mechanical advantage of an inclined plane is equal to the length of the slope divided by the height of the inclined plane.
- ★ While the inclined plane produces a mechanical advantage, it does so by increasing the distance through which the force must move.

THE INCLINED PLANE

Length: 15 ft



height: 3 ft.

$$MA = \text{length} \div \text{height}$$

$$MA = 15/3$$

$$MA = 5$$

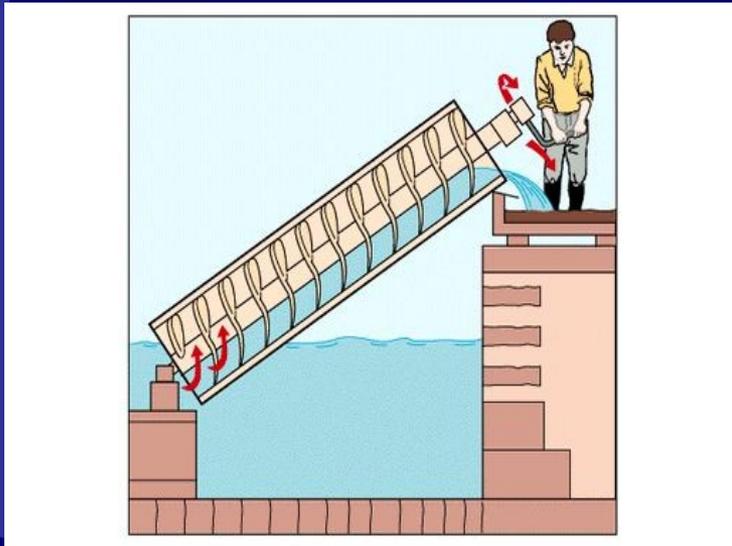
Screw

The screw is an inclined plane wound around a central cylinder.



The mechanical advantage of a screw can be very high because of the huge length of the corresponding inclined plane.

Archimedes' Screw



This machine was first designed by Archimedes in the 3rd century BC. It's used as a water pump.

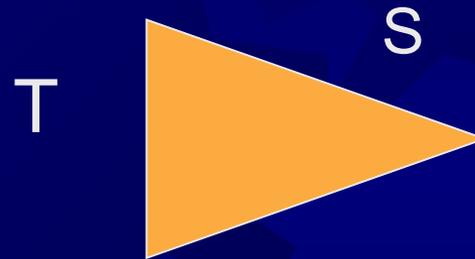
Wedges

- ★ Two inclined planes joined back to back.
- ★ Wedges are used to split things.



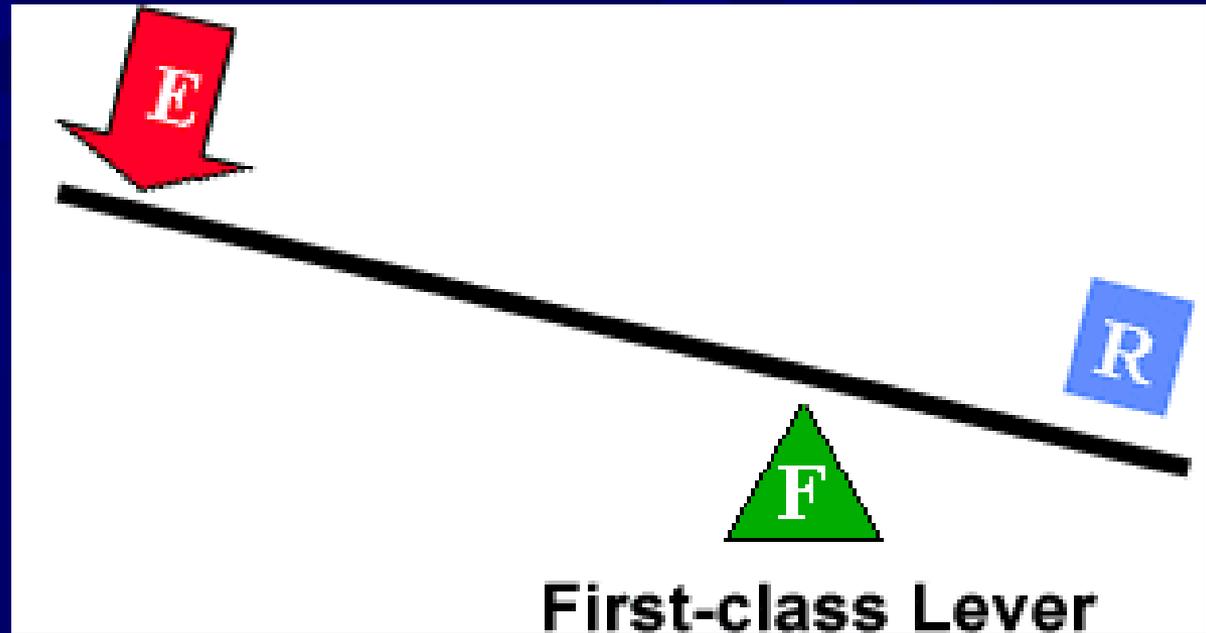
Wedge – Mechanical Advantage

- ★ The mechanical advantage of a wedge can be found by dividing the length of either slope (S) by the thickness (T) of the big end.



- ★ As an example, let's assume that the length of the slope is 10 millimeters and the thickness is 4 millimeters. The mechanical advantage is then equal to $10/4$ or 2.5.
- ★ As with the inclined plane, the mechanical advantage gained by using a wedge requires a corresponding increase in distance.

First Class Lever



Fulcrum is between the effort (E) and the load (R)

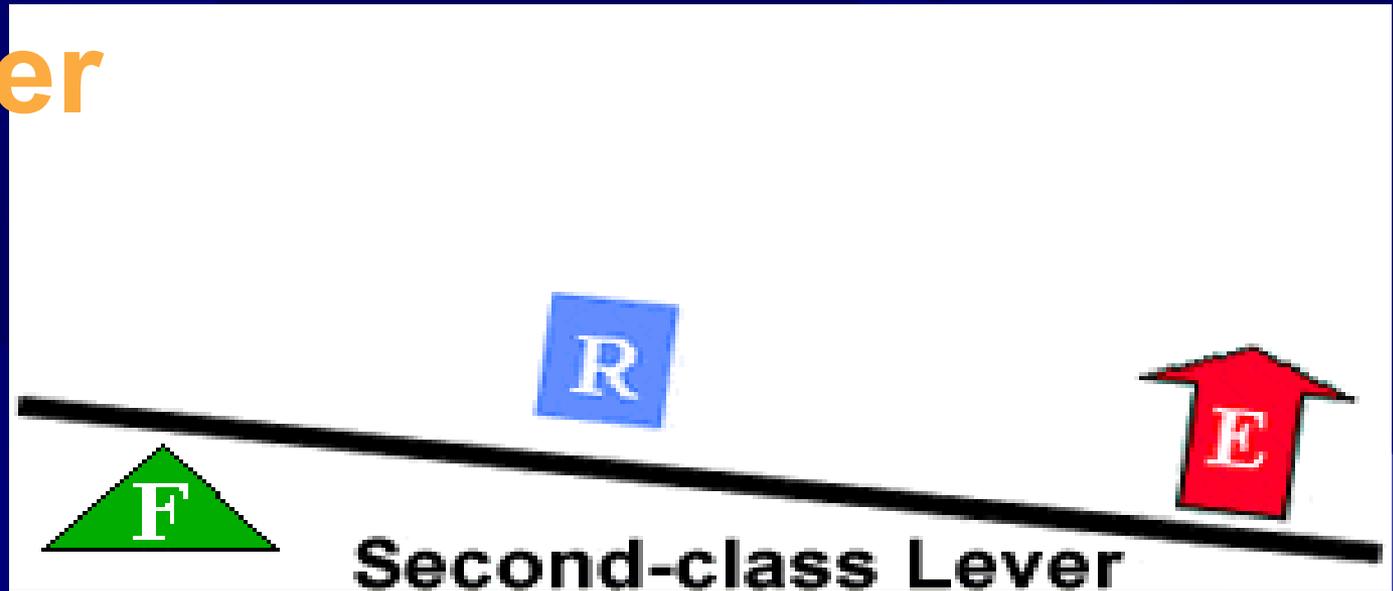
Effort moves further than Resistance.

The mechanical advantage of a lever is the ratio of the length EF to the length RF.

First Class Lever



Second Class Lever



Load (R) is between the fulcrum (F) and the effort (E)
Effort moves further than Resistance.

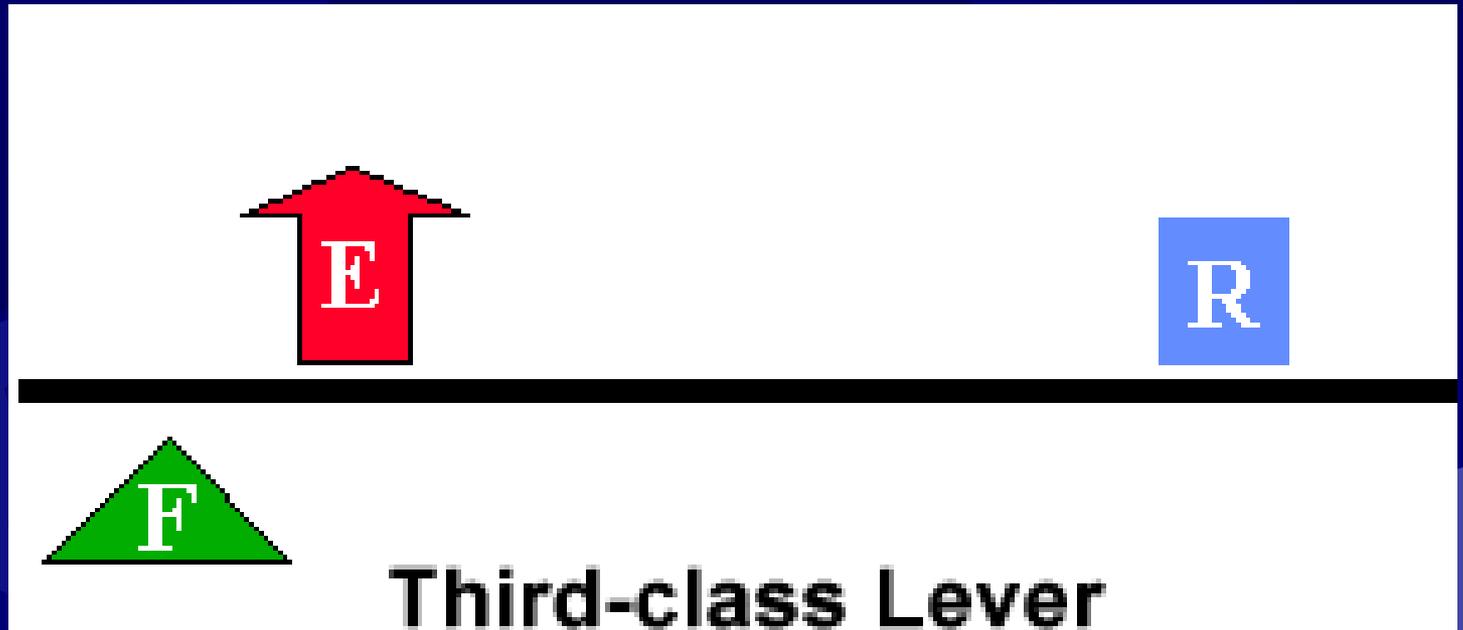
The mechanical advantage of a lever is the ratio of the distance EF to the distance FR.

Second Class Lever

- ★ Examples of second-class levers include nut crackers, wheel barrows, doors, and bottle openers.



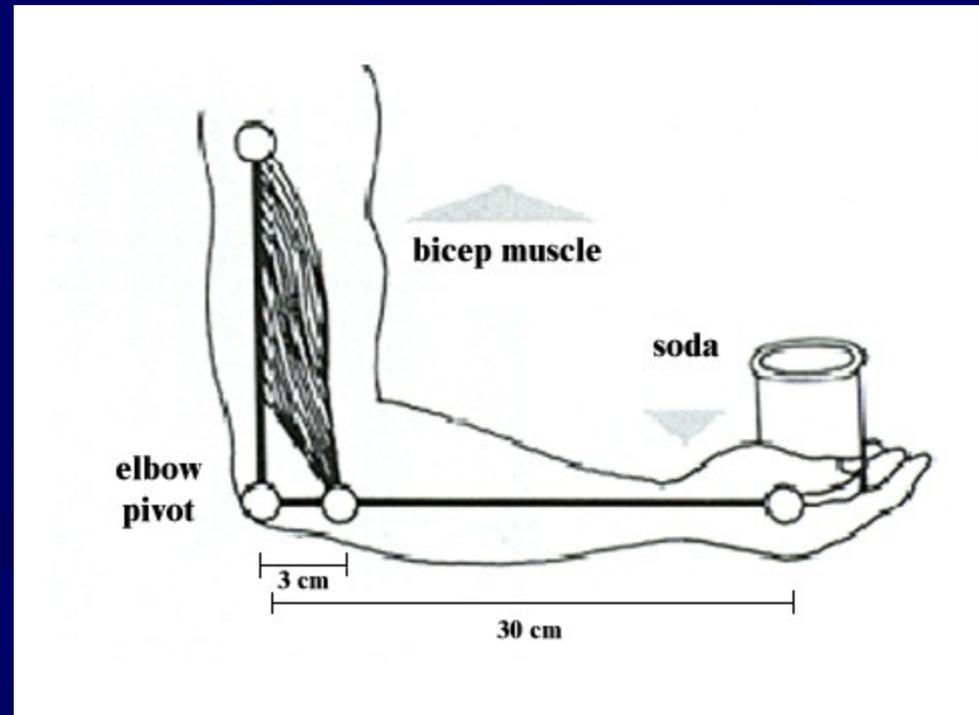
Third Class Lever



The effort E is between fulcrum and the load.
This lever does not multiply the force.

Third Class Lever

- ★ Examples of third-class levers include tweezers, arm hammers, and shovels.



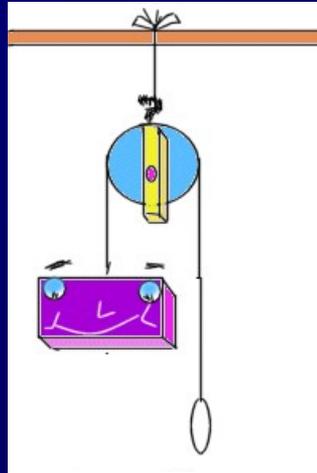
Pulleys

- ★ Pulley are wheels and axles with a groove around the outside
- ★ A pulley needs a rope, chain or belt around the groove to make it do work



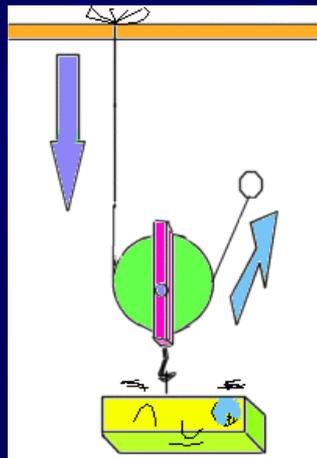
Diagrams of Pulleys

Fixed pulley:



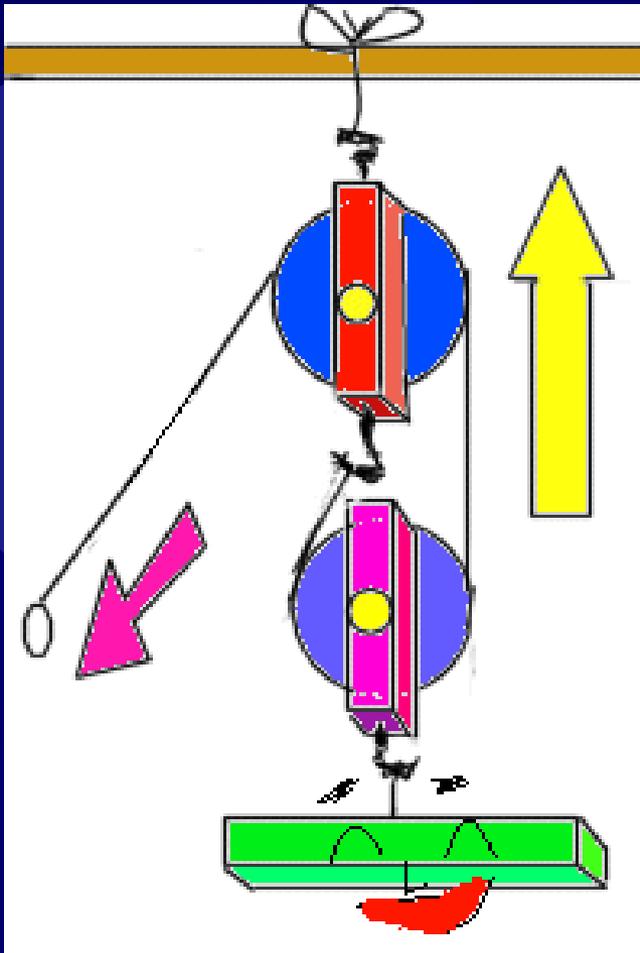
A fixed pulley changes the direction of a force; however, it does not create a mechanical advantage.

Movable Pulley:



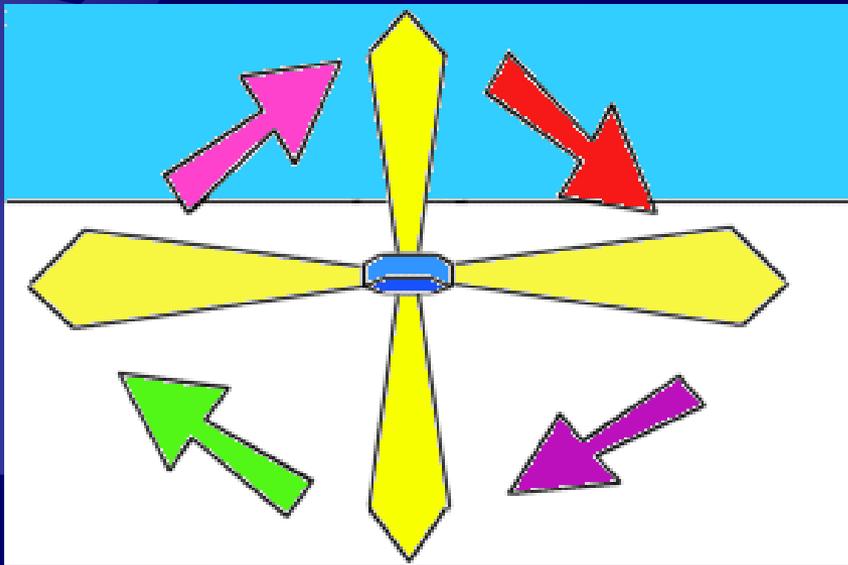
The mechanical advantage of a moveable pulley is equal to the number of ropes that support the moveable pulley.

COMBINED PULLEY



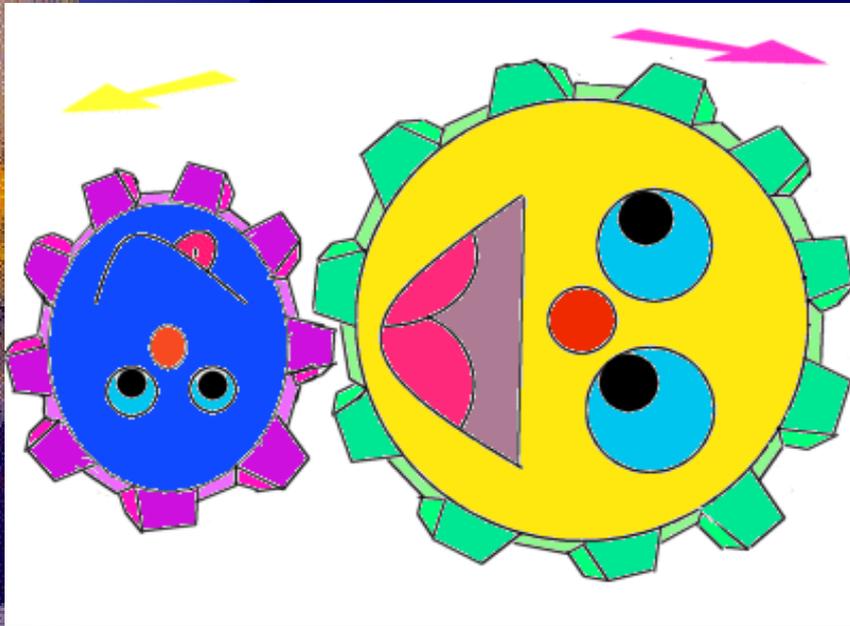
- ★ The effort needed to lift the load is less than half the weight of the load.
- ★ The main disadvantage is it travels a very short distance.

WHEEL AND AXEL



- ★ The axle is stuck rigidly to a large wheel. Fan blades are attached to the wheel. When the axle turns, the fan blades spin.

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.

Questions

- ★ What did the Egyptians use the inclined plane for?
- ★ What is Archimedes' screw used for?
- ★ What are wedges used for?
- ★ Put an example of a first class lever.
- ★ Put an example of a second class lever.
- ★ Put an example of a third class lever.
- ★ Which type of pulley has more mechanical advantage: the simple fixed pulley or the combined pulley?
- ★ Write down an example of a machine that includes wheels and axles.