

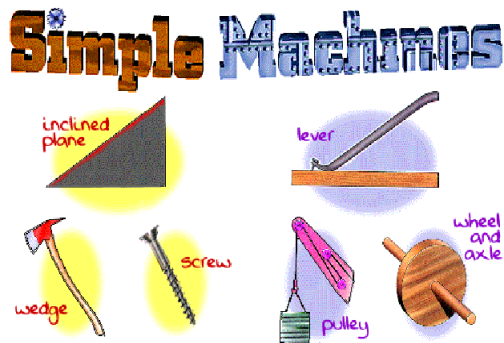
Simple machines

□ Simple Machine

- A device which makes work easier or more effective with motion in one direction

Six Simple Machines

- Pulleys
- wheel and axle
- Wedge
- Inclined Plane
- Levers
- Screws



Simple Machines

- A **machine** is a device that helps make work easier to perform or more efficient by accomplishing one or more of the following functions:
 - transferring a force from one place to another,
 - changing the direction of a force,
 - increasing the magnitude of a force, or
 - increasing the distance or speed of a force

Machines make work easier in 3 ways

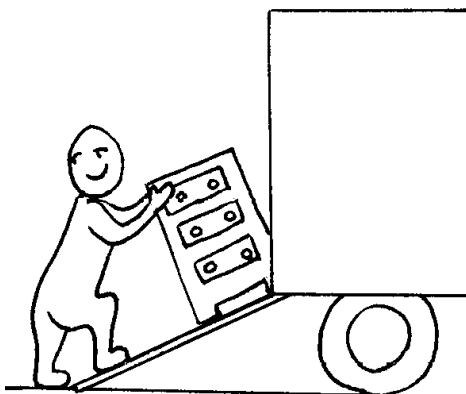
- Multiplying force (makes us stronger)
- Multiplying distance (moves objects a greater distance)
- Changing directions (works with gravity)

No machine can increase **both** the **magnitude** and the **distance** of a force at the same time.

Mechanical Advantage

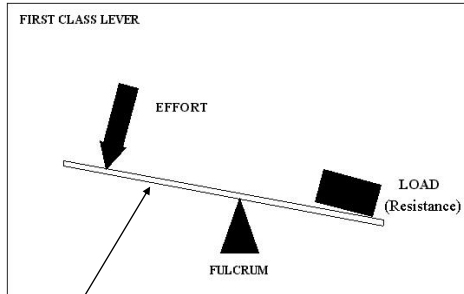
- Think about a machine in terms of the **input force** (the force you apply) and the **output force** (force which is applied to the task).
- **Input force** – the force you exert on the machine (cause)
- **Output force** – the force exerted by the machine (effect)
- When a machine takes a small input force and increases the magnitude of the output force, a **mechanical advantage (MA)** has been produced.
 - **Mechanical Advantage** – The number of times a machine multiplies the input force

Inclined Planes



- A slope or ramp that goes from a lower to higher level
- Makes work easier by taking less force to lift something a certain distance
- Trade off: the distance the load must be moved would be greater than simply lifting it straight up
- <http://www.youtube.com/watch?v=z8ScILNusG4>

Lever

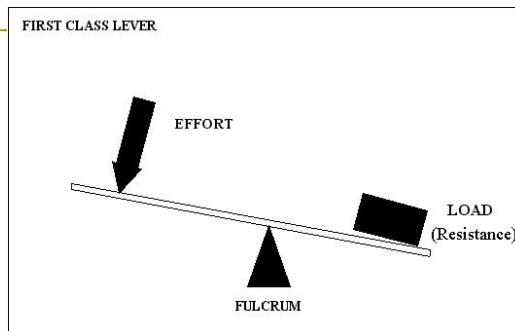


Load Arm

- A rigid board or rod combined with a fulcrum and effort
- By varying position of load and fulcrum, load can be lifted or moved with less force
- Trade off: must move lever large distance to move load small distance
- There are 3 types of levers
- http://www.youtube.com/watch?v=1dJbY72_H9M

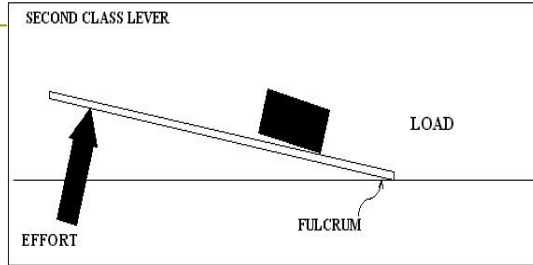
1st Class Lever

- The fulcrum is located between the effort and the load
- Direction of force always changes
- Examples are scissors, pliers, and crowbars



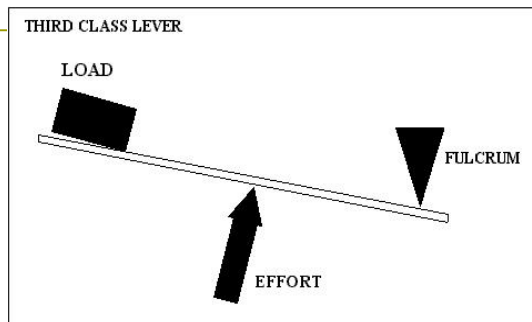
2nd Class Lever

- ❑ The resistance is located between the fulcrum and the effort
- ❑ Direction of force does not change
- ❑ Examples include bottle openers and wheelbarrows



3rd Class Lever

- ❑ The effort is located between the fulcrum and the resistance
- ❑ Direction of force does not change, but a gain in speed always happens
- ❑ Examples include ice tongs, tweezers and shovels

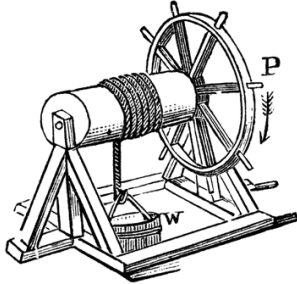


Wheel and Axle



- A larger circular wheel affixed to a smaller rigid rod at its center
 - The object with the larger diameter is the **wheel**
 - The object with the smaller diameter is the **axle**

<http://www.youtube.com/watch?v=hquIP2AI24U>



- Used to translate force across horizontal distances (wheels on a wagon) or to make rotations easier (a doorknob)
- Trade off: the wheel must be rotated through a greater distance than the axle

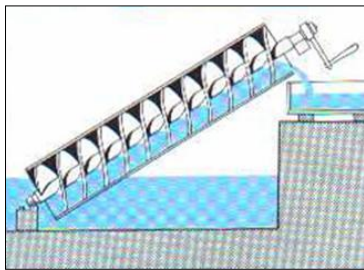
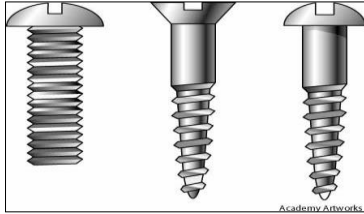
Wedge



- A device that is thick at one end and tapers to a thin edge at the other end
 - An inclined plane on its side
- Used to cut or force material apart
- Often used to split lumber, hold cars in place, or hold materials together (nails)



Screw



- An inclined plane wrapped around a rod or cylinder
- A spiral inclined plane forms the threads on a screw
- The tighter the threads are together on a screw the greater the MA
- Used to lift materials or bind things together
 - Lid on a jar



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
 - Pulleys can provide:
 - Mechanical advantage
 - Directional advantage
- **Three types of pulleys**
 - Fixed pulley
 - Movable pulley
 - Block and tackle – Pulley system
 - A combination of fixed and movable pulleys used to raise an object

Simple machine

