The 6 Simple Machines

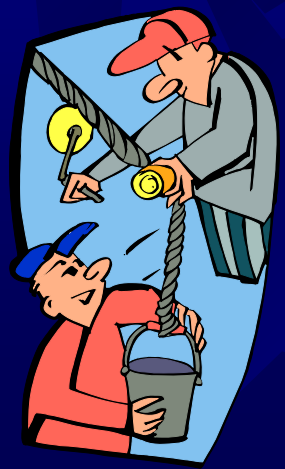
Inclined Plane

Screw

Wedge

Lever

Pulley



Wheel and Axle

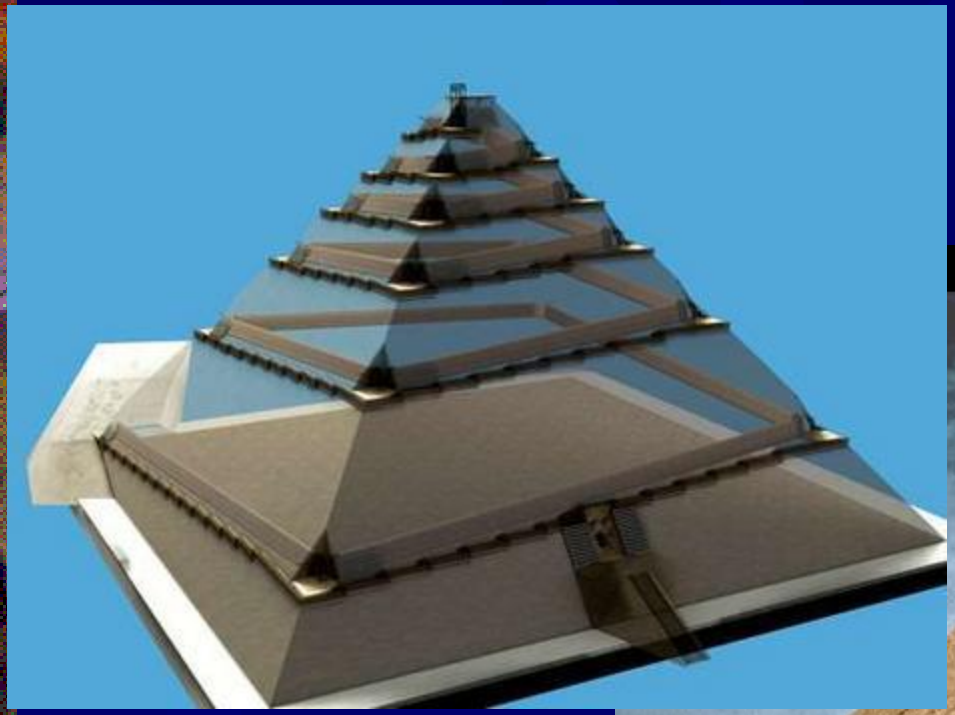
Definitions:

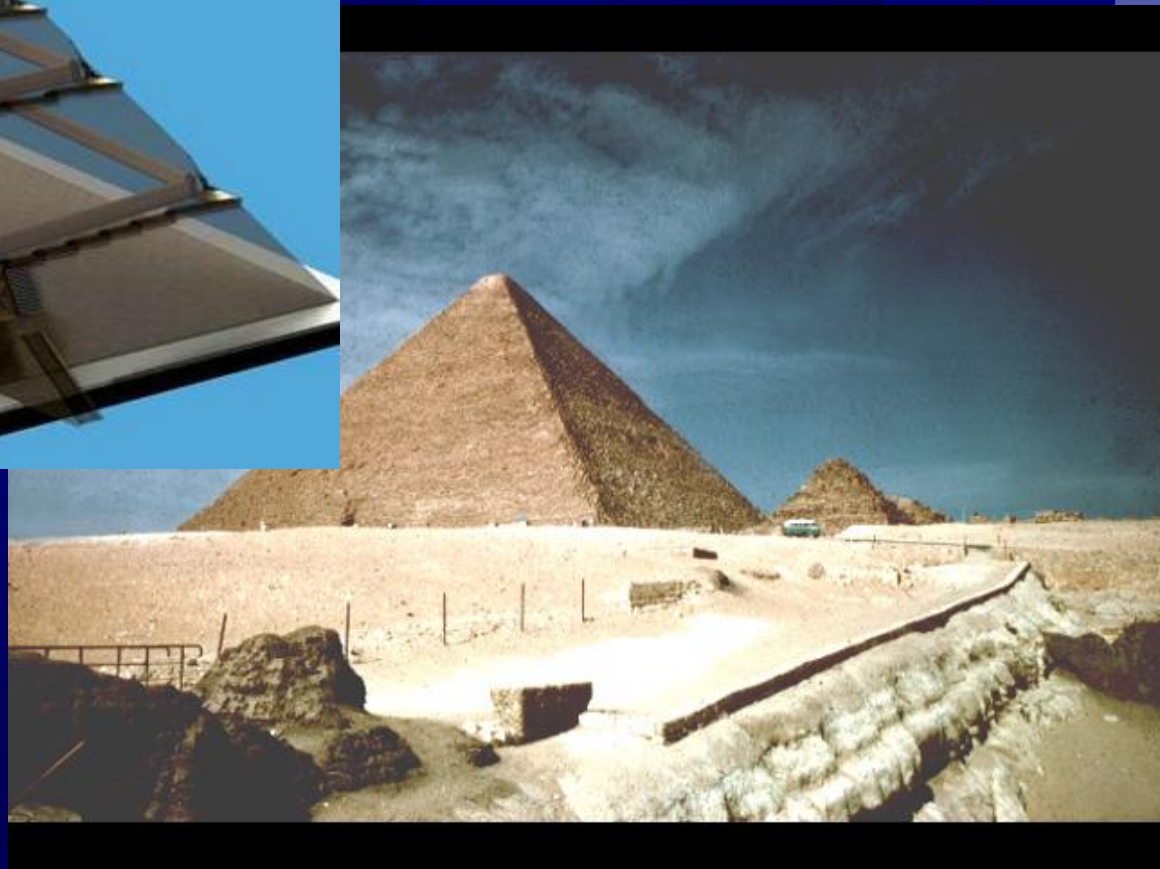
Energy: Ability to do work

Work= Force x Distance

Force: A Push or a Pull

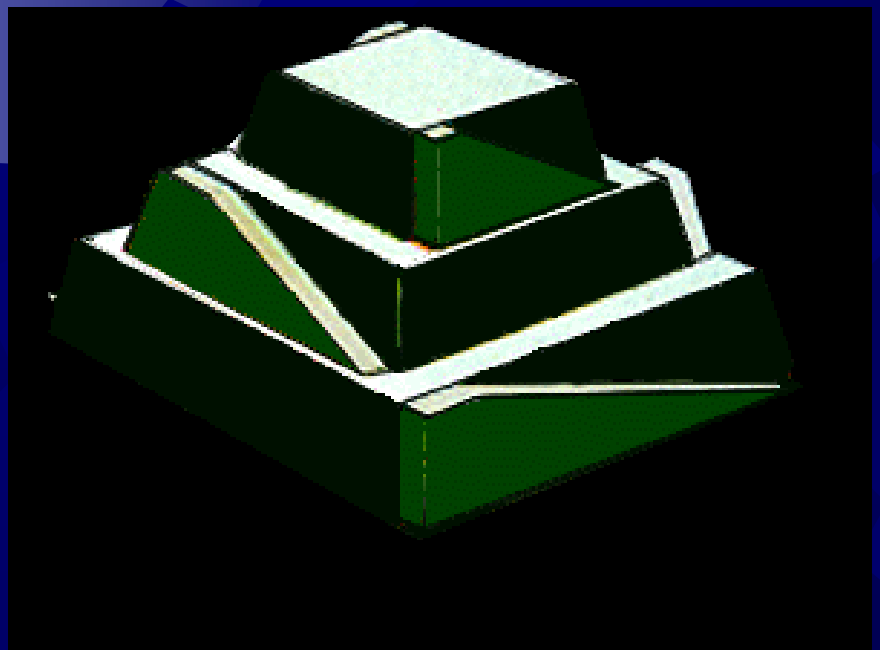
Inclined Plane

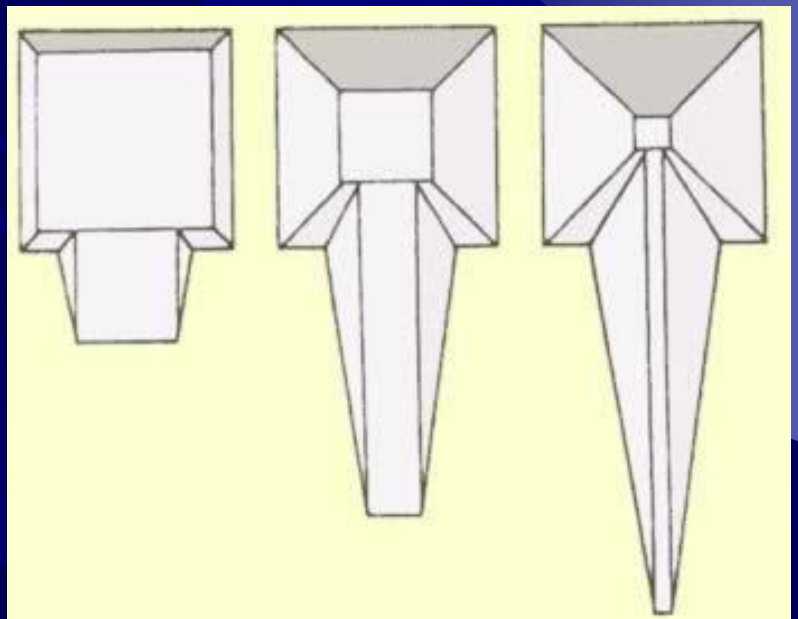




Inclined Plane

- The Egyptians used simple machines to build the pyramids. One method was to build a very long incline out of dirt 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, gentle inclined plane to the top of the pyramid.





Inclined Planes

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

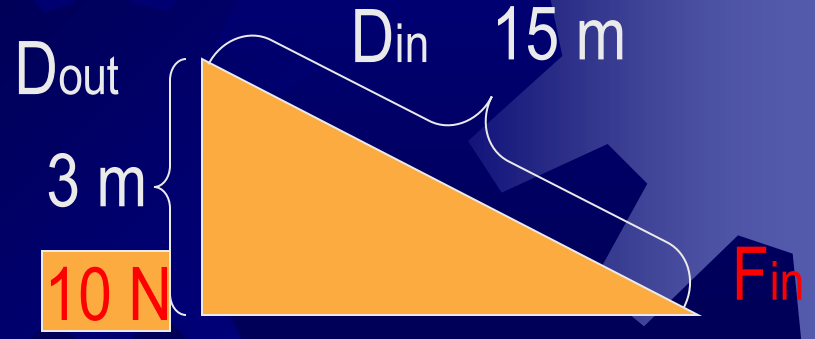
Work input and output

- **Work input is the amount of work done on a machine.**
  - **Input force x input distance**
- **Work output is the amount of work done by a machine.**
  - **Output force x output distance**

$W_{out} = W_{in}$

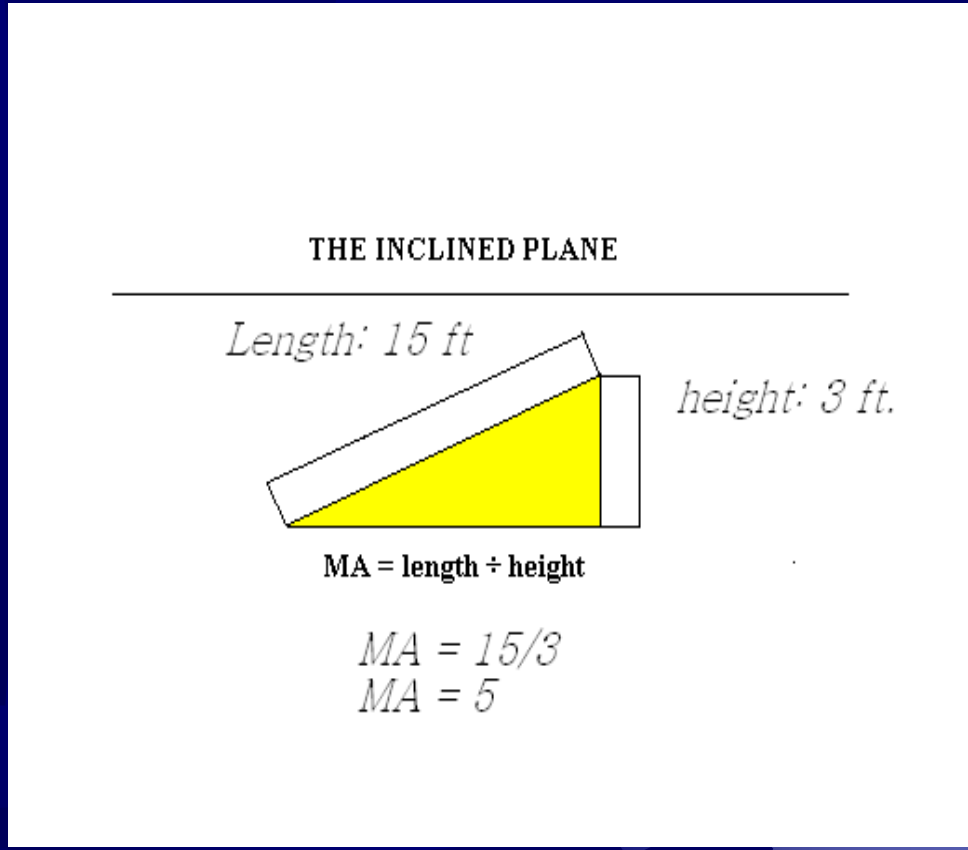
$F_{out} \times D_{out} = F_{in} \times D_{in}$

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

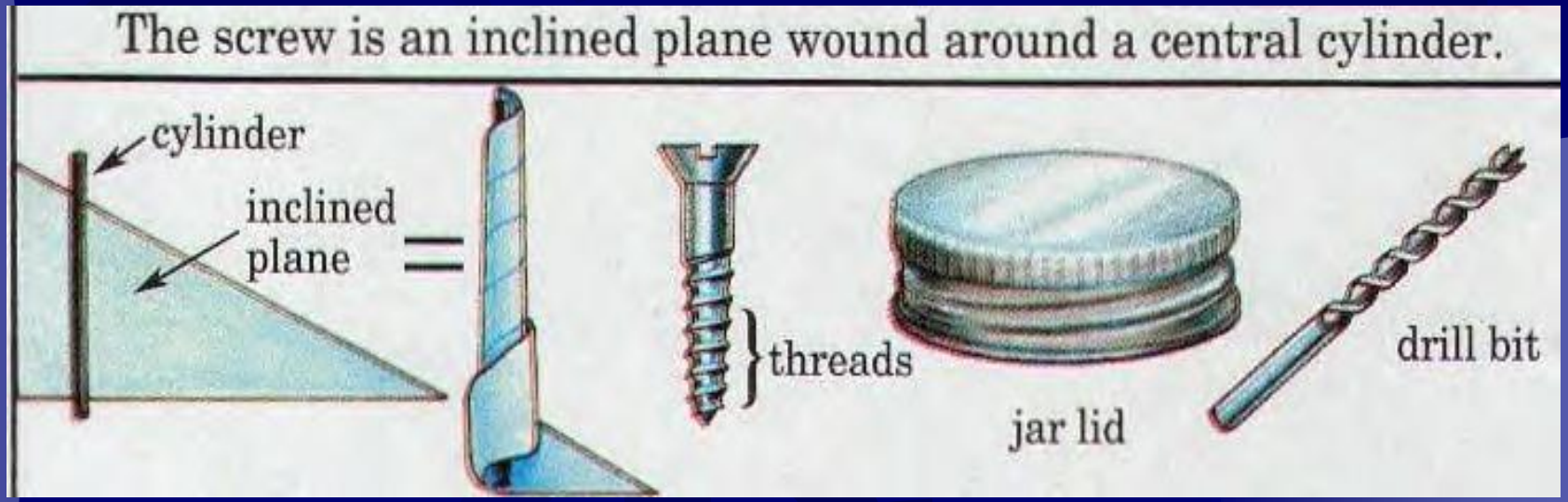


Inclined Plane - Mechanical Advantage

- 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.



Screw



The mechanical advantage of an screw can be calculated by dividing the circumference by the pitch of the screw.

Pitch equals 1/ number of turns per inch.

Wedges

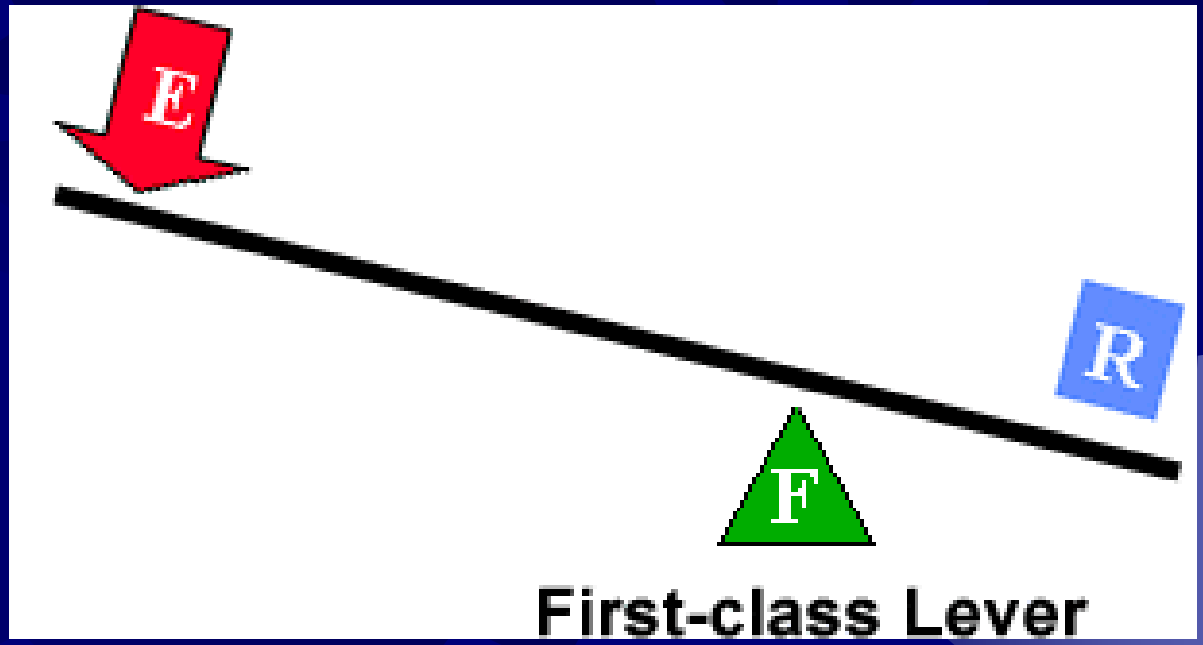
- Two inclined planes joined back to back.
- Wedges are used to split things.

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, assume that the length of the slope is 10 inches and the thickness is 4 inches. The mechanical advantage is equal to 10/4 or 2 1/2. As with the inclined plane, the mechanical advantage gained by using a wedge requires a corresponding increase in distance.

First Class Lever



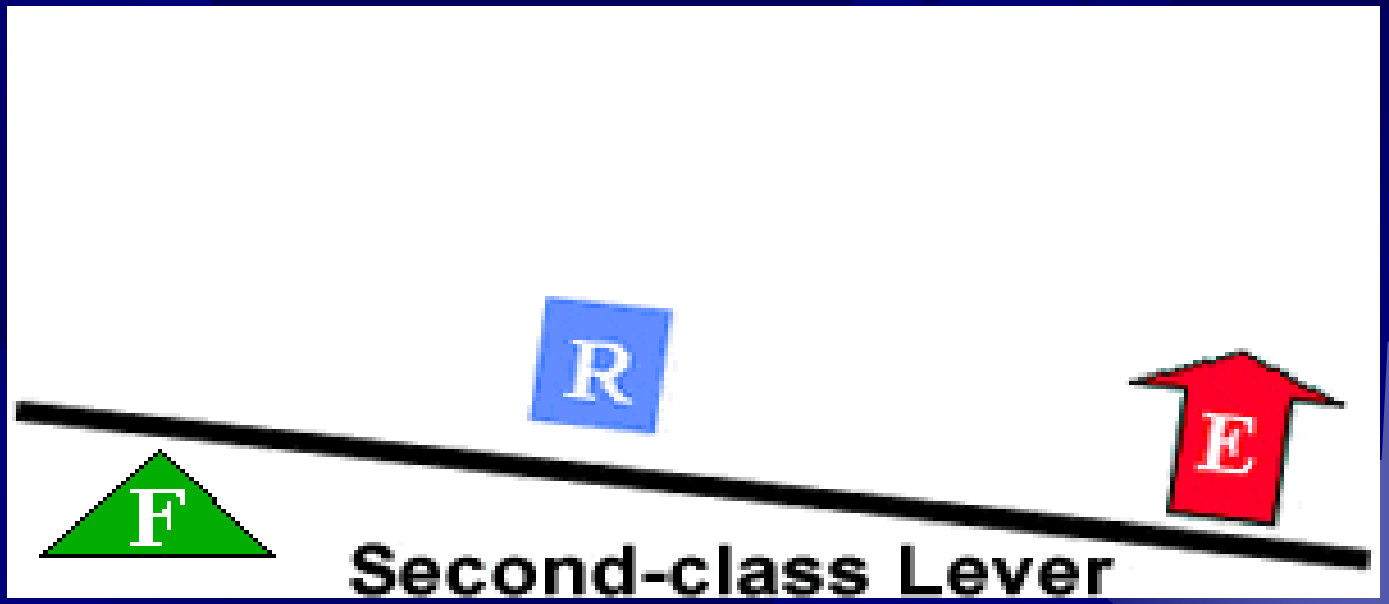
Fulcrum is between EF (effort) and RF (load)
Effort moves farther than Resistance.
Multiplies EF and changes its direction

The mechanical advantage of a lever is the ratio of the length of the lever on the applied force side of the fulcrum to the length of the lever on the resistance force side of the fulcrum.

First Class Lever

- Common examples of first-class levers include crowbars, scissors, pliers, tin snips and seesaws.

Second Class Lever



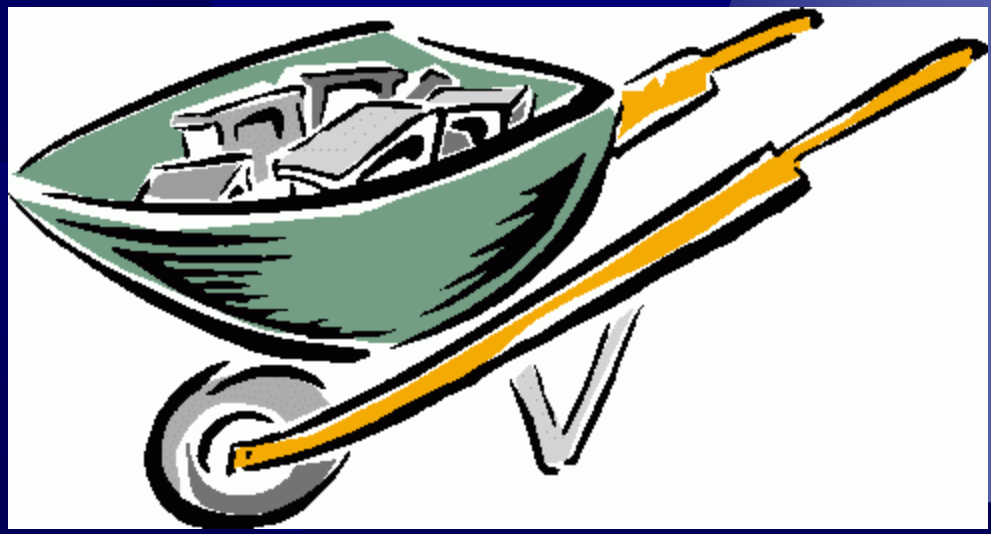
RF (load) is between fulcrum and EF
Effort moves farther than Resistance.

Multiplies EF, but does not change its direction

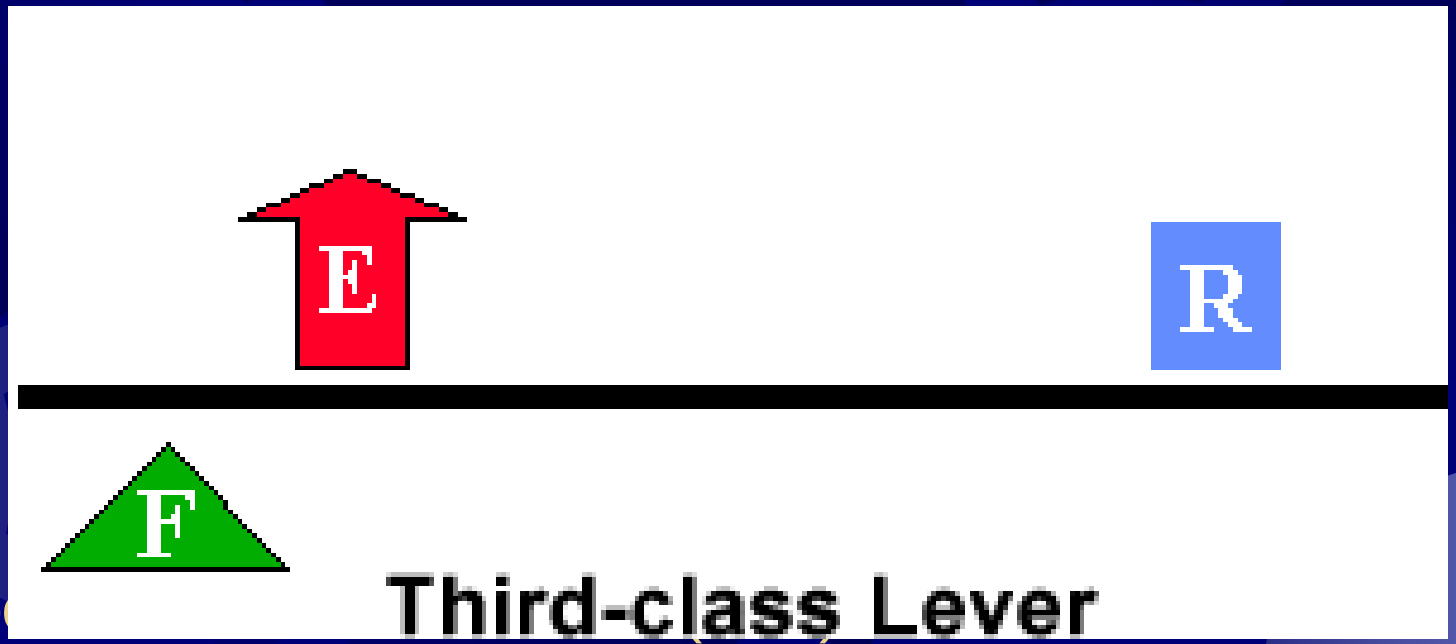
The mechanical advantage of a lever is the ratio of the distance from the applied force to the fulcrum to the distance from the resistance force to the fulcrum.

Second Class Lever

- Examples of second-class levers include nutcrackers, wheelbarrows, doors, and bottle openers.



Third Class Lever



EF is b

Does not multiply force

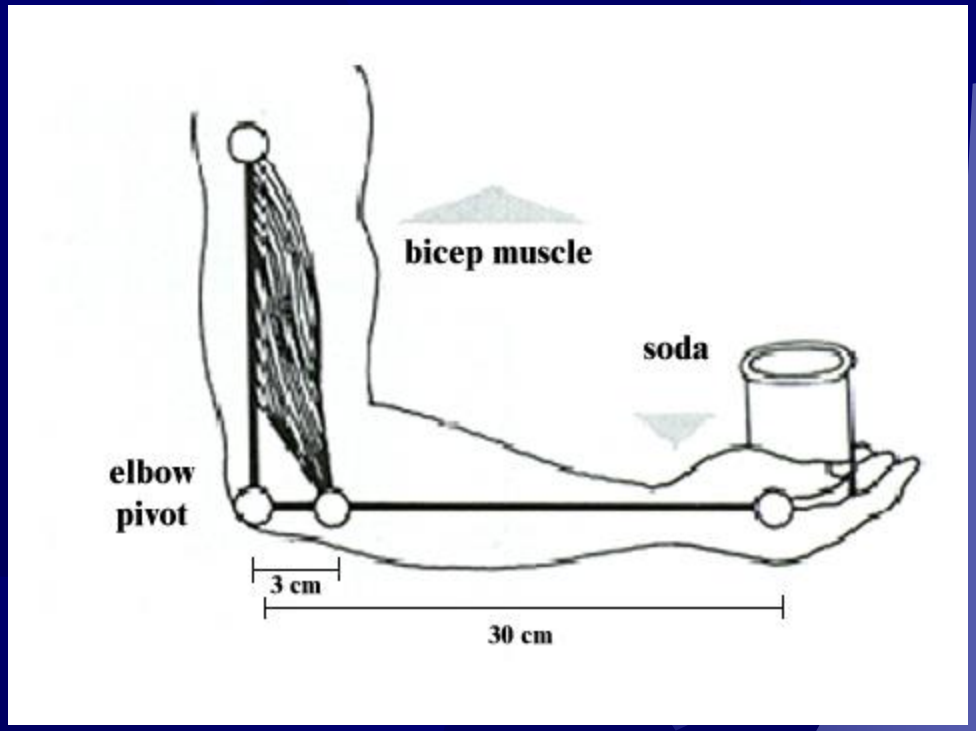
Resistance moves farther than Effort.

Multiplies the distance the effort force travels

The mechanical advantage of a lever is the ratio of the distance from the applied force to the fulcrum to the distance of the resistance force to the fulcrum

Third class lever

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

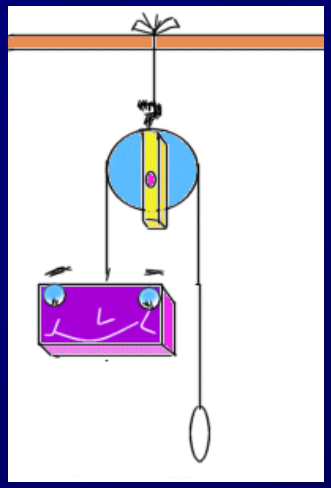


Pulleys

- 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

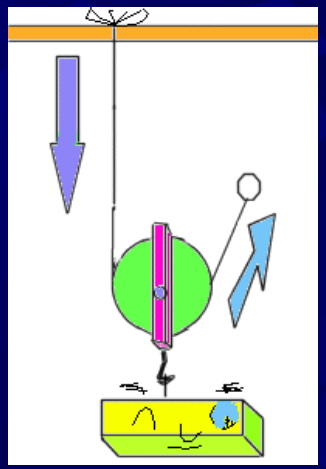
Diagrams of Pulleys

Fixed pulley:



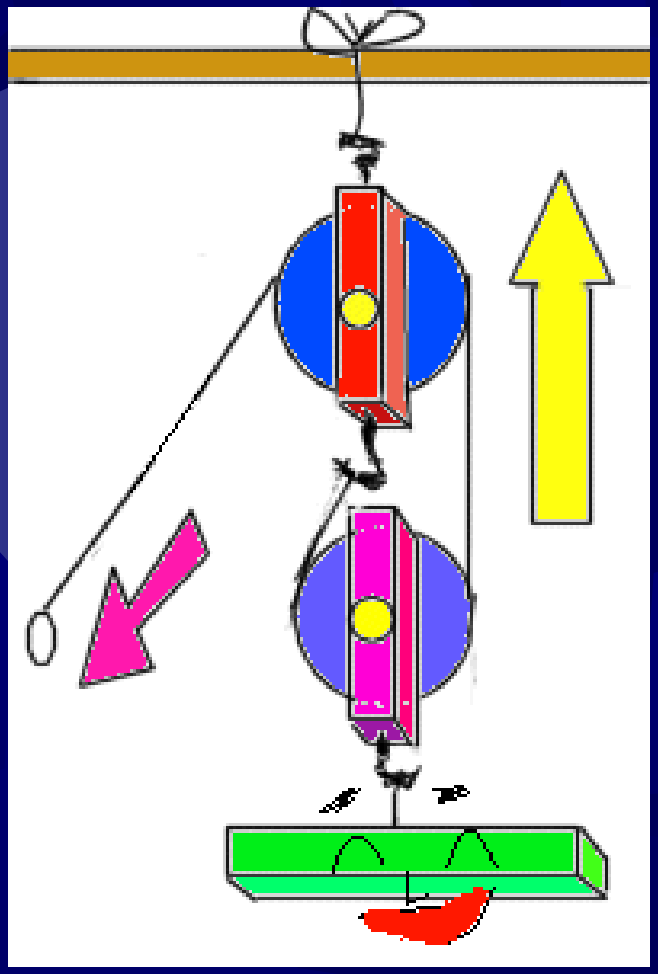
A fixed pulley changes the direction of a force; however, it does not create a mechanical advantage.

Movable Pulley:



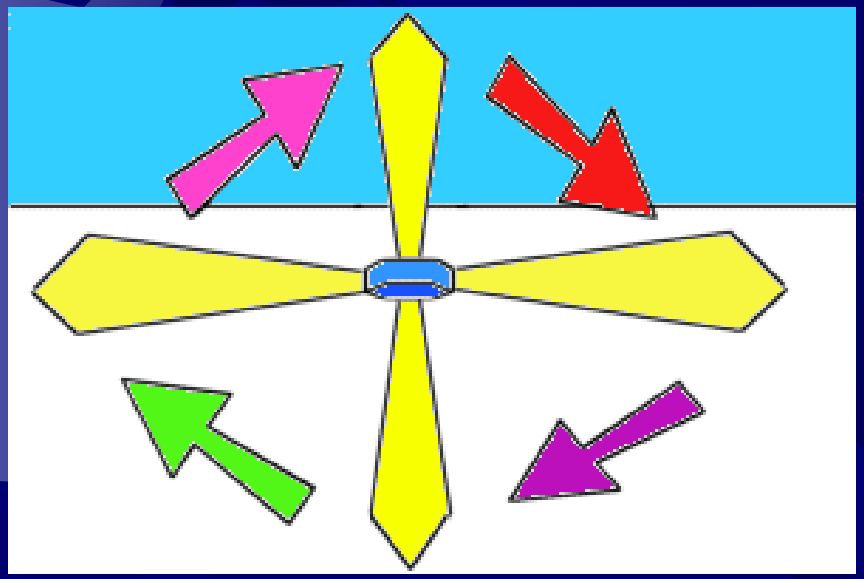
The mechanical advantage of a moveable pulley is equal to the number of ropes that support the moveable pulley.

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 long distance.**

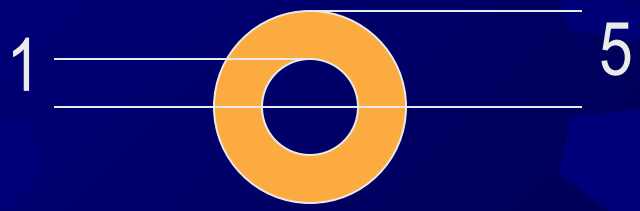
WHEEL AND AXEL



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

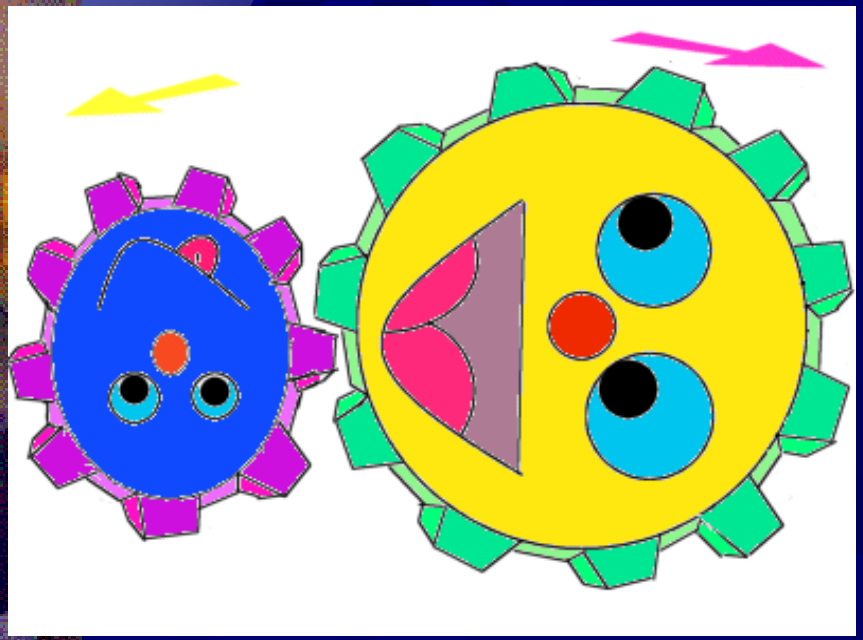
Wheel and Axel

- The mechanical advantage of a wheel and axle is the ratio of the radius of the wheel to the radius of the axle.



- In the wheel and axle illustrated above, the radius of the wheel is five times larger than the radius of the axle. Therefore, the mechanical advantage is 5:1 or 5.
- The wheel and axle can also increase speed by applying the input force to the axle rather than a wheel. This increase is computed like mechanical advantage. This combination would increase the speed 5 times.

GEARS-Wheel and Axel

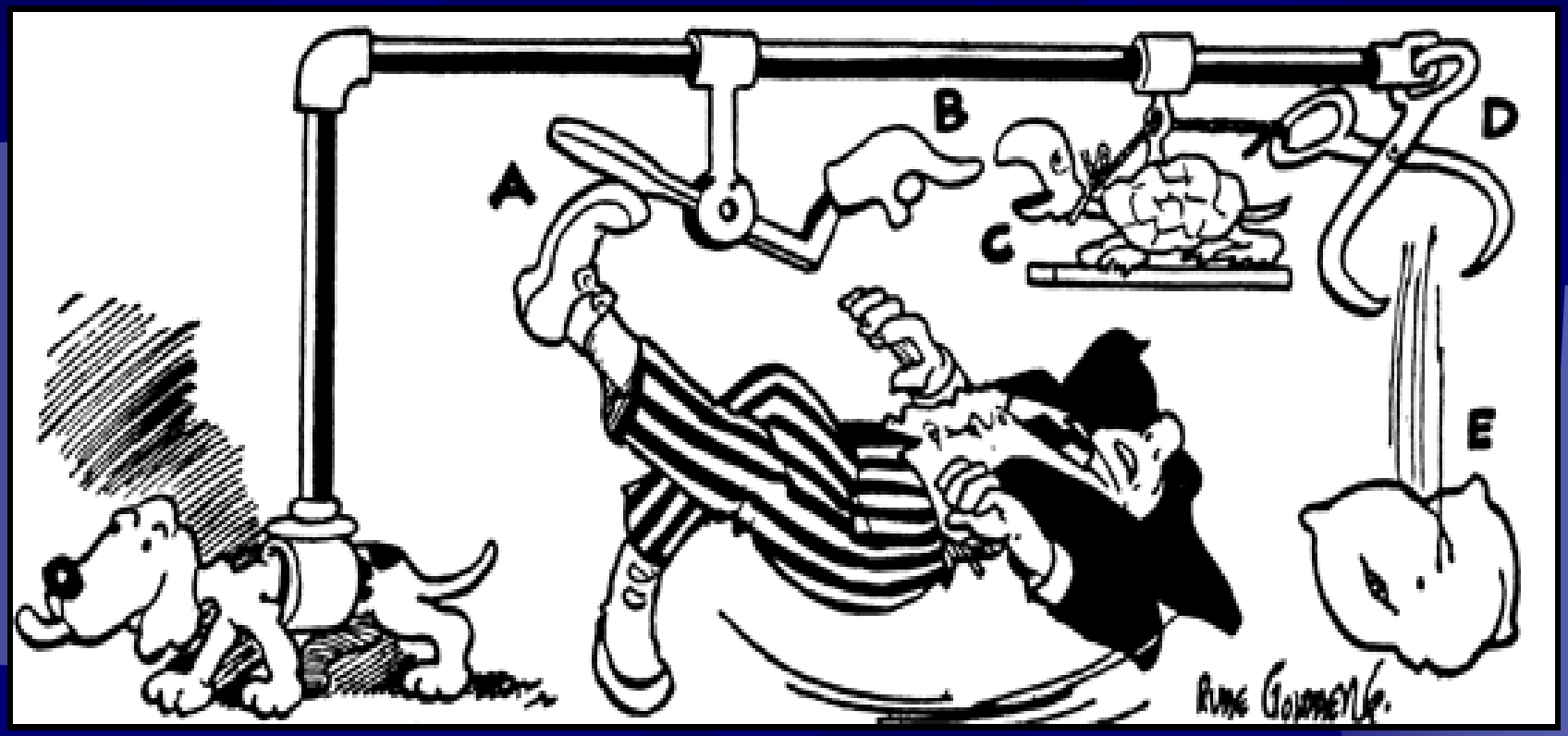


- **Each gear in a series reverses the direction of rotation of the previous gear. The smaller gear will always turn faster than the larger gear.**

Rube Goldberg Machines

- Rube Goldberg machines are examples of *complex machines*.
- All complex machines are made up of combinations of *simple machines*.
- Rube Goldberg machines are usually a complicated combination of simple machines.
- By studying the components of Rube Goldberg machines, we learn more about simple machines

Safety Device for Walking on Icy Pavements



When you slip on ice, your foot kicks paddle (A), lowering finger (B), snapping turtle (C) extends neck to bite finger, opening ice tongs (D) and dropping pillow (E), thus allowing you to fall on something soft.

Squeeze Orange Juice Rube Goldberg Machine