

Review of Simple Machines

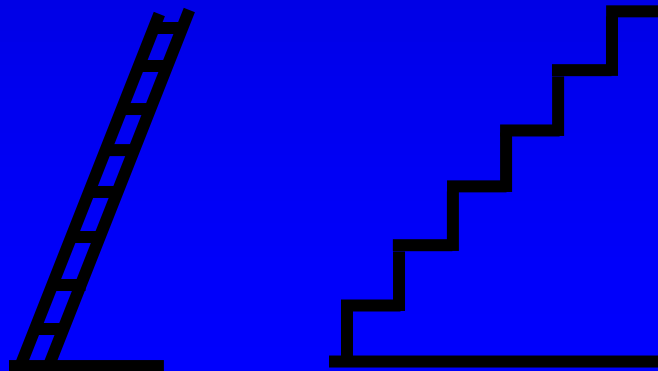
What are they?

Simple machines are machines
with few or no moving parts
that are used to make work easier

Why Simple Machines?

For the **mechanical advantage**...

- Making something easier to do, but it takes a little longer to do it
- For example, going up a longer flight of stairs instead of going straight up a ladder



Types of Simple Machines

Wedge

Wheel and Axle

Lever

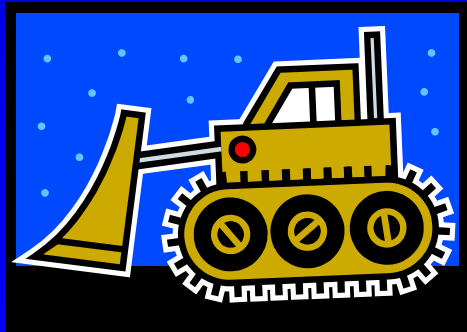
Inclined Plane

Screw

Pulley

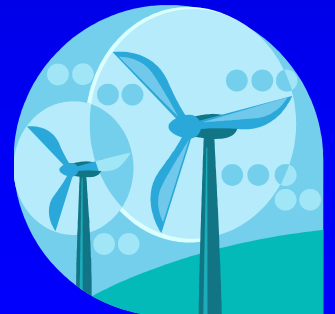
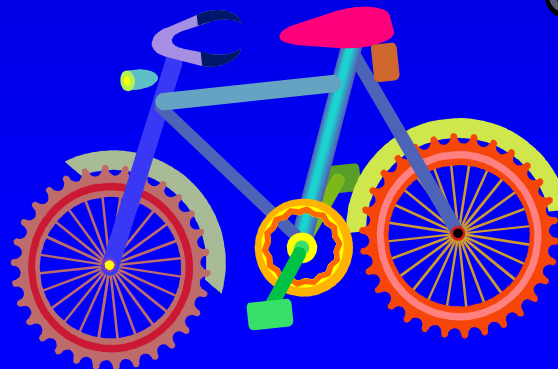
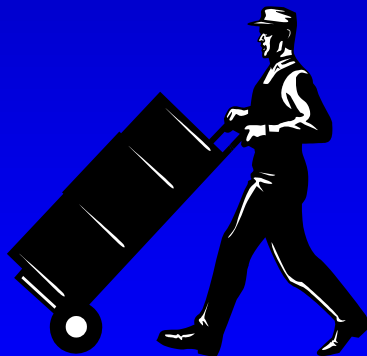
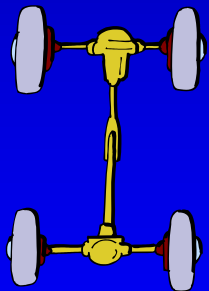
Wedge

- Pushes materials apart, cuts things
- **Examples:** axe, doorstop, chisel, nail, saw, jackhammer, bulldozer, snow plow, horse plow, zipper, scissors, airplane wing, knife, fork, bow of a boat or ship



Wheel and Axle

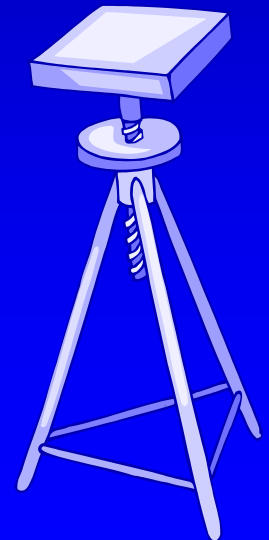
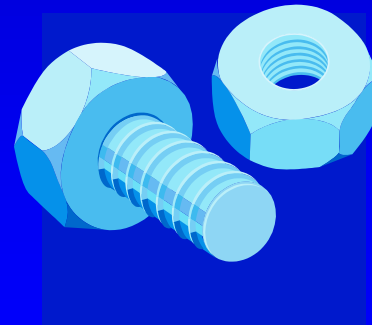
- Makes it easy to move things by rolling them, and reducing friction
- **Examples:** car, bicycle, office chair, wheel barrow, shopping cart, hand truck, roller skates



Screw

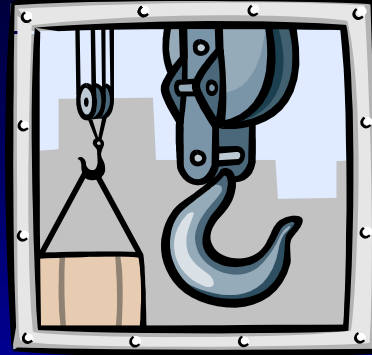


- Turns rotation into lengthwise movement
- Takes many twists to go a short distance
- Holds things together
- **Examples:** screws, bolts, clamps, jar lids, car jack, spinning stools, spiral staircases



Pulley

- Makes lifting things with a rope easier by redirecting force and the addition of additional pulleys
- **Examples:** flag pole, elevator, sails, fishing nets, clothes lines, cranes, window shades and blinds, rock climbing gear



Complex Machines

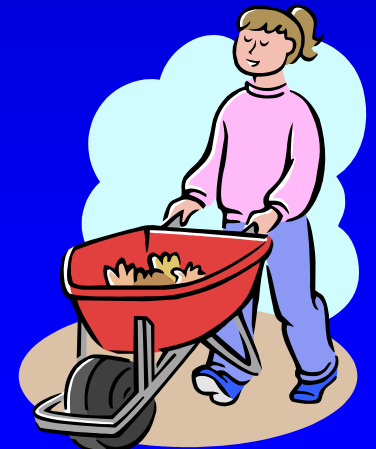


- Combining two or more simple machines to work together

- Examples:



- Car jack **combines** wedge and screw
- Crane or tow truck **combines** lever and pulley
- Wheel barrow **combines** wheel & axle with a lever
- Axe **combines** wedge with a lever



Mechanical Advantages

Wedge

Pushes material apart, cuts

**Wheel
and axle**

**Makes it easy to move objects by
rolling them, and reducing friction**

Lever

**Helps lift heavy weights
using longer distances**

**Inclined
plane**

**Makes it easier to move objects
upward; a longer path but easier
lifting**

Screw

**Turns rotation into lengthwise
movement**

Pulley

**Makes lifting heavy objects easier
by redirecting force**

Mechanical Advantage Formulas

- First Formula to try

$$\text{MA} = \frac{\text{Force out}}{\text{Force in}} \quad \text{MA} = \frac{F_o \text{ (Load force)}}{F_i \text{ (Effort Force)}}$$

A Mechanical advantage greater than 1 means that the machine multiplies the force you put into the machine- gives you a force advantage

A mechanical advantage less than 1 means that the machine does not multiply the force you put in- gives you a speed advantage.

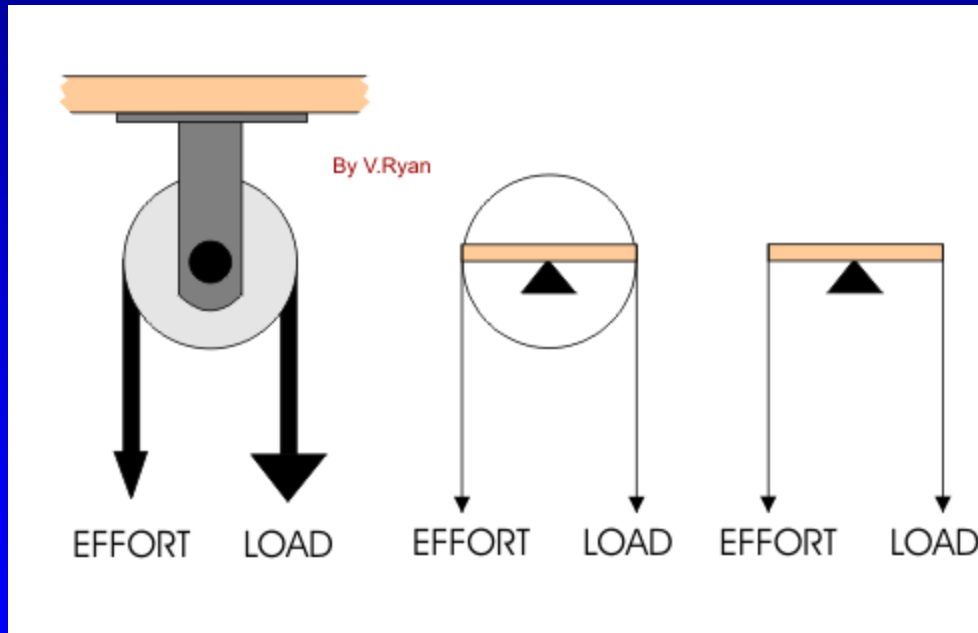
Other formulas

- If you don't have the forces and can't figure them out, here are some other formulas that work.
- Levers - $\frac{\text{Effort Arm}}{\text{Load Arm}}$

Inclined Plane= $\frac{\text{length of incline plane}}{\text{height of incline plane}}$

Other formulas continued

- Pulley- MA is equal to load
effort

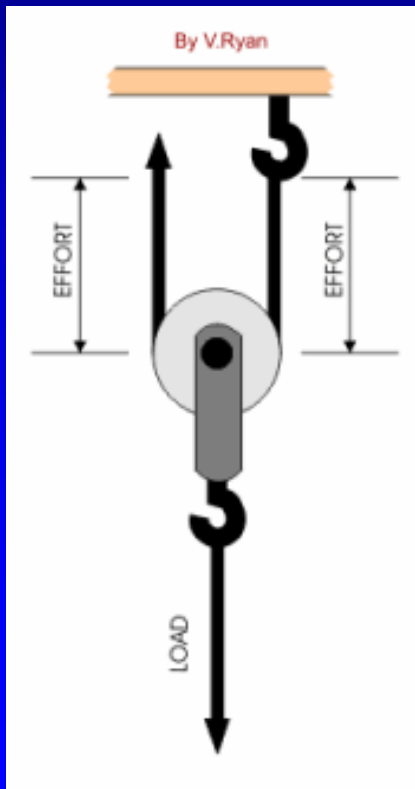


Just
like a
lever

Other formulas

- Moveable Pulleys

MA= number of supporting ropes



The pulley to the left is suspended and because the rope on the left and right of the pulley are both lifting the LOAD, they each lift half its weight. The load is split into 2.

$$MA = \frac{\text{Load}}{\text{Effort}}$$

$$MA = \frac{2}{1} \quad MA = 2$$

NOTE: there are 2 supporting ropes

Work

- Work is done if:
 - A force is exerted on an object
 - The object moves in the direction of the force.
-
- $W = \text{force} \times \text{distance}$
 - The unit for work is
Joule (Newton*meter)

Efficiency

$$\text{Efficiency} = \frac{\text{work done on load}}{\text{work done by effort force}} \times 100\%$$

No machine is 100% efficient due to friction
You can boost efficiency by adding oil or grease on surfaces of machines that rub together.
Some friction is needed- e.g. Car tires on road, chalk on hands when mountain climbing.

References

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