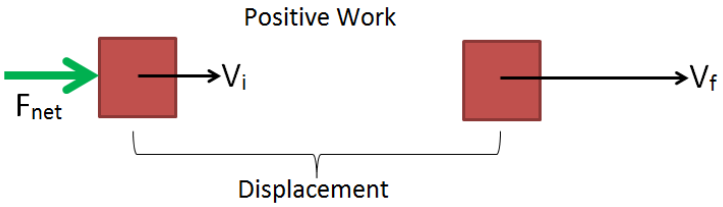
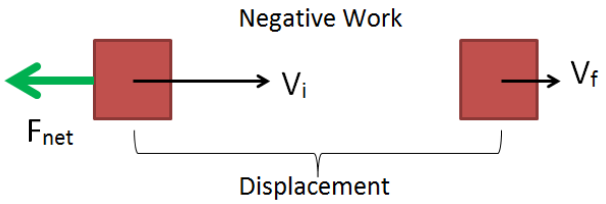
Chapter Ten: Energy, Work, and Simple Machines
Section 1: Energy and Work

Work: (symbol W)

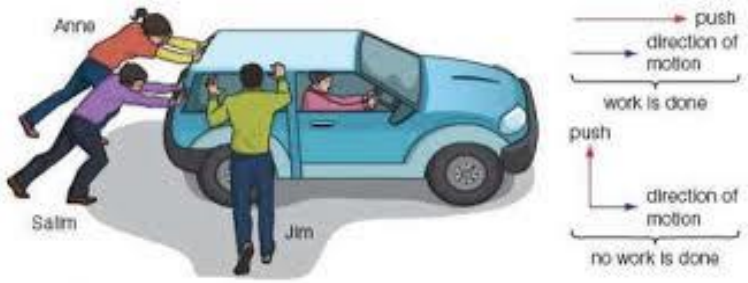
- Means to do something that takes physical or mental effort
- According to physics, work is done when a force is applied through a displacement
- W = F*d
  - Force is constant
  - Label for work is N*m = Joule
    - SI unit for work
    - Named after the physicist James Prescott Joule
- The application of a force alone does not constitute work
  - Force and displacement need to be in the same direction (+work) or in opposite directions (-work)



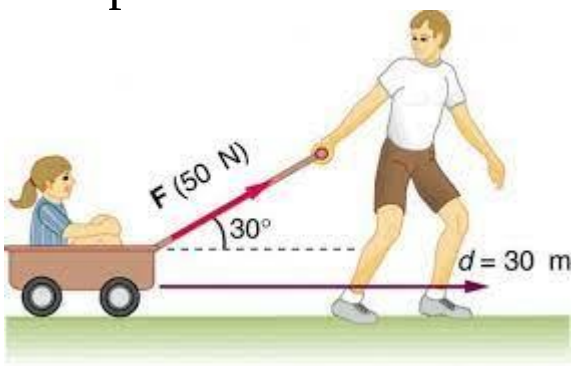


  - A force applied perpendicular to the direction of motion does not constitute work being done to the system
    - Ex. You are in an airplane flying west. You push down on your seat. You are not doing work on

the airplane (system). You are doing work on yourself.



- Any force applied at an angle needs to be broken down into its x- and y-components.



  - Work (angle between force and displacement):
    - W = F*d*cos θ
      - F_{pull} = 50 N
        - F_{xpull} = cos(30º) * 50 N = 43.3 N
        - F_{ypull} = sin(30º) * 50 N = 25N
      - W = F_{xpull} * d = 1299 J
    - Equal to the component of the force in the direction of the displacement, multiplied by the distance moved
- When several forces are exerted on a system, calculate the work done by each force and add the results.

Energy (symbol E): the ability of an object to produce a change in itself or the world around it

- Ability to do work.
  - Transferred from one form to another doing work in the process
- Label for energy is the Joule (J)
- Work-energy Theorem
  - When work is done on a system, the result is a change in the system's energy
  - $W = \Delta E = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$
    - If the external world does work on a system, then work is positive and the energy of the system increases.
    - If a system does work on the external world, then work is negative and the energy of the system decreases.

Kinetic Energy: (symbol KE)

- The energy of an object that is due to the object's motion
- Equal to half the mass of the object times its velocity squared
- translational kinetic energy – energy due to changing position
- $KE = \frac{1}{2} mv^2$
- SI unit of energy is the Joule
  - $1\ J = 1\ N*m = 1\ kg*m^2/s^2$

Power (symbol P):

- The rate at which work is done or energy is transformed
- P = ΔEnergy/time = ΔE/t
- Measured in **watts**
  - 1 W = 1J/s
  - Often measured in kW (1000 W = 1 kW)
- Another way to calculate power
  - P = Force x velocity = F*v
  - P = voltage x current = V*I (from Adv. Science)

Work (W)	N*m = J
Energy (E)	$kg*m^2/s^2$ = J
Power (P)	J/s = Watt (W)

Roughrider electric (for example) uses kilowatt*hours to determine your energy consumption.

- kWh = measures how much energy you use
- Amount of energy you use by keeping a 1000 W appliance running for 1 hour.
- Average household uses 867 kWh per month.
- Watt is measured per unit of time so you need to multiply by time to find energy.