# 11. Work and Energy

- **Condition for scientifically work to be done**

  1. **There must be a displacement**
  2. Displacement must be along the direction of applied force

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    - **When is no work done?**

1. **No displacement [No work is done in circular path]**
2. Displacement occurs perpendicularly to the applied force

Work = Force × Displacement [along force direction]

$W = F \times s$ [Unit – Joule, 1 J = 1 N × 1 m]

- Work-Energy Relationship:
  - The ability to do work is called energy.
  - Energy of the body is equal to the amount of work it can do when its energy is released.
  - A Body possessing energy is only capable of doing work.

**Energy: Unit – Joule**

- **Kinetic energy** (because of motion): It depends on the mass and the speed of the body. Kinetic energy = $\frac{1}{2}mv^2$
- **Potential energy** (Because of position and shape of the body). Potential energy = $mgh$ [gravitational potential energy; $h$ = height, $g$ = acceleration due to gravity]
- **Mechanical energy**: A body is said to have mechanical energy if it possesses either kinetic energy or potential energy or both.
- **Various forms of energy are** Chemical energy, Sound energy, Light energy, heat energy, magnetic energy, and muscular energy.
- Grease and other lubricating substances are used to minimize the energy loss due to the friction.
- **Energy Chain:** The sun's energy reaches us through a series of conversions which is called energy chain i.e the interconversion of energy from one form to various other forms.
- **Conservation of energy:** It states that energy cannot be created or destroyed. It can only be transformed from one form to another.

**Sources of energy:**

- **Bio-mass – Charcoal, cow-dung, vegetable waste, sewage**
- **Wind energy** – Environment friendly, renewable
- **Solar energy** – Solar cooker, solar water heater (very efficient for small scale electricity production)
- **Geothermal energy** – Heat energy inside the earth
- **Nuclear energy** – Not dependent on solar energy, never-ending source, very efficient source, more environment friendly
- **Tidal energy, wave energy, ocean thermal energy**