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# Macro-Scale Energy

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# The Basics

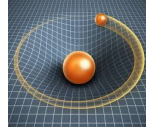
- Energy: the capacity to do work
- Energy cannot be created or destroyed (conserved)
- It's a scalar
- Measured in joules (j)
- Use energy to analyze motion



# Forms of Macro-Scale Energy

- Kinetic or mechanical

- Gravitational



- Elastic

- Heat



- Chemical



- Electrical

- Nuclear



- Mass

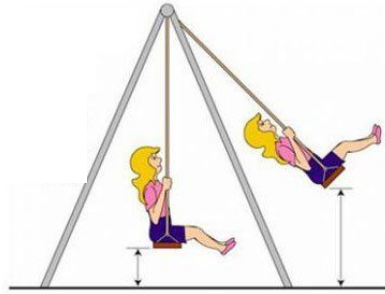
# Work

- The measure of the energy needed to cause a force to move through displacement.
- $W = \int \mathbf{F} \cdot d\mathbf{r}$ 
  - **Work** equals **force** integrated over **distance**
- Net work: work done by all forces in a system
- $W_{\text{net}} = \Delta KE$ 
  - **Net work** done on an object equals the change in its **kinetic energy**

# Work (Continued)

- A force can also be exerted on an object but still enact no work
  - Only does work if it causes movement/motion
- Negative work: Forces done against motion
  - Energy put into the system = positive
  - Energy taken out = negative

# Kinetic Energy



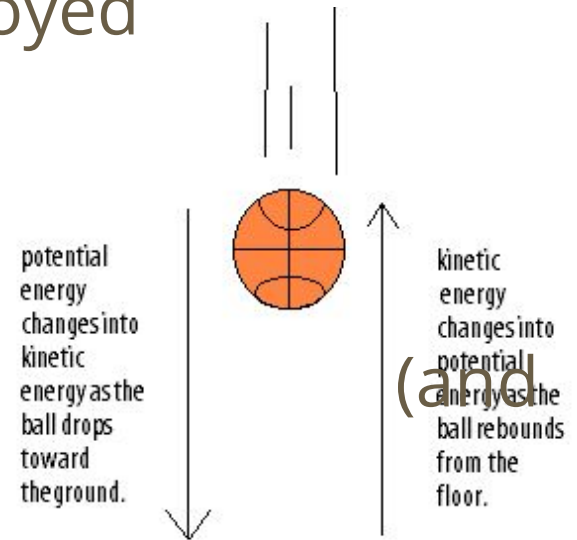
- Energy of motion
- $KE = \frac{1}{2}mv^2$ 
  - The **kinetic energy** of an object equals half of the object's **mass** multiplied by the square of its **speed**
- Net force x distance = kinetic energy
  - $Fd = \frac{1}{2}mv^2$

# Potential Energy

- Stored energy; energy of position or configuration
  - Doesn't matter how something got to that position | independent of path taken
- $PE_g = mgh$ 
  - The **gravitational potential energy** of an object is equal to the product of the object's **weight** and its **height**

# Law of Conservation of Energy

- Total energy in isolated system=constant
- Energy cannot be created or destroyed (only transferred)
  - $PE_1 + KE_1 = PE_2 + KE_2$
- Ex: as KE increases, PE decreases (and vice versa)





# Power

- Power: rate at which work is done or energy is transformed
- Measured in watts (W)
  - 1 watt= 1 joule/second
- $P = dW/dt$ 
  - **Power** equals the rate at which **work** is done over **time**



**Thank You!**