

# Energy

Chapter 15 – Prentice Hall  
*Physical Science*

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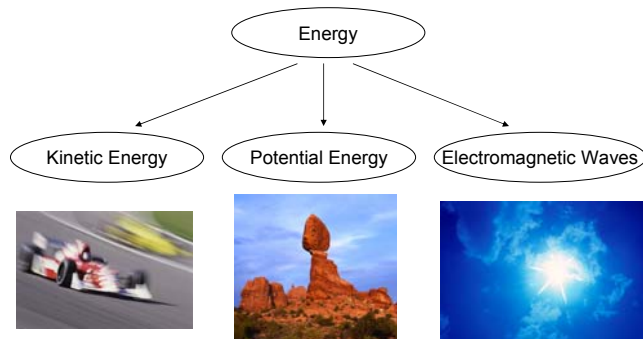
## Energy and Work



- **Energy:** the ability to do work
- **Work:** a force moving an object through a distance
  - Work is a TRANSFER of energy
- SI Unit of Energy and Work: **Joule**
  - A joule is the amount of work done when an object is moved 1 meter by a 1-newton force
  - **1 Joule = 1 Newton x 1 Meter**
- Two general forms of energy: KINETIC and POTENTIAL
  - Many more specific forms of energy can be classified as one of these two.

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## Energy



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## Kinetic Energy

- **Kinetic Energy:** the energy of motion
- Recall that an object in motion has a speed and direction associated with it.
- Kinetic energy of an object depends on its **mass** and its **speed**:

$$KE = \frac{1}{2}mv^2$$

$$\text{Kinetic Energy} = \frac{1}{2} \times \text{mass} \times (\text{velocity})^2$$

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## Calculating Kinetic Energy

- What happens to an object's KE if its mass doubles?
  - KE doubles
- What happens to an object's KE if its speed doubles?
  - KE quadruples
- *Sample problem:* A 680-kg car has a kinetic energy of 76,500 J. How fast is the car moving?

- (Write the solution from class in your notes or the space above. See Math Skills example on p. 448)

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## Potential Energy

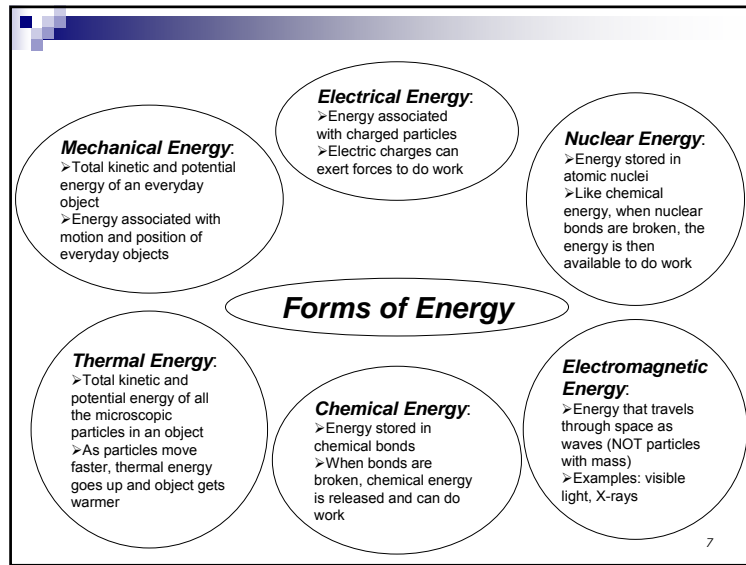
- **Potential Energy:** energy stored as a result of position or shape
- **Gravitational potential energy:** potential energy that depends on an object's position in a gravitational field (i.e. height above Earth's surface)

$$PE_g = mgh$$

Gravitational Potential Energy = mass × acceleration due to gravity × height

- **Elastic potential energy:** potential energy of an object that is stretched or compressed (examples: springs, rubber band, basketball)

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## Energy Conversion



- **Energy Conversion:** process of transforming energy from one form to another
- Energy transformations can occur in many steps
- Example: lighting a match
  - Chemical energy in food → Mechanical energy of hand moving the match across the box
  - Mechanical energy → Thermal energy (via friction forces)
  - Thermal energy + Chemical energy in match chemicals → thermal and electromagnetic energy in flame

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## Law of Conservation of Energy and Mass

- ***In a closed system, mass and energy can be converted from one form to another, but the total amount can never be destroyed.***
- Closed system: one in which nothing can enter or leave
- Example: A bicyclist stops pedaling and has kinetic energy. Where does it go?
  - Friction with the road and air – conversion to thermal energy
  - In this case, the “system” is the bicyclist, bike, surrounding air and the road. If you think of the bicyclist alone, it does look like energy was “lost.”
- Friction causes efficiency of many machines to be less than ideal.

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## Energy and Mass

- Recall that energy and mass can be converted into each other, and the amount of energy held in a given mass can be calculated from Einstein’s equation:

$$E = mc^2$$

- Small amounts of mass can produce LARGE amounts of energy.
- (See notes on nuclear chemistry – chapter 10.)

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## Nonrenewable Energy Resources

- Can only be replaced by processes that take millions of years
- Examples:
  - Oil
  - Natural gas
  - Coal } **FOSSIL FUELS**
  - Uranium (and other **NUCLEAR FISSION** sources)

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## Renewable Energy Resources

- Can be replaced in a relatively short period of time
- Examples:
  - *Hydroelectric* – Water flows downhill and turns turbines attached to generators to convert kinetic to electric energy
  - *Solar* – Sunlight (electromagnetic energy) converted to usable energy (heat and/or electricity)
    - Passive systems: use sunlight to heat a building without machinery or electronics
    - Active systems: uses machinery/electronics to capture sunlight energy (such as flat water collection plates and pumps, or photovoltaic cells)

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## Renewable Energy Resources

- More renewable energy sources:
  - *Geothermal* – Heat stored underground is converted to electric energy
  - *Wind* – Wind turns turbines (similar to hydroelectric)
  - *Biomass* – Using energy stored in living things (burning wood, extracting alcohol from corn crops, etc...)
  - (Possible in future: Nuclear fusion)

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## Conserving Energy Resources

- Energy Conservation: finding ways to reduce consumption of energy resources
- Two ways to conserve:
  - Use less energy
  - Use energy more efficiently
- (See green energy careers assignment)

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