Heat Transfer

- The transmission of energy from one region to another as a result of temperature gradient
- Ex:

Mass Transfer

- The process of transfer of mass as a result of **concentration difference** in a system/mixture.

- Ex: Dissolution of sugar added to cup of coffee

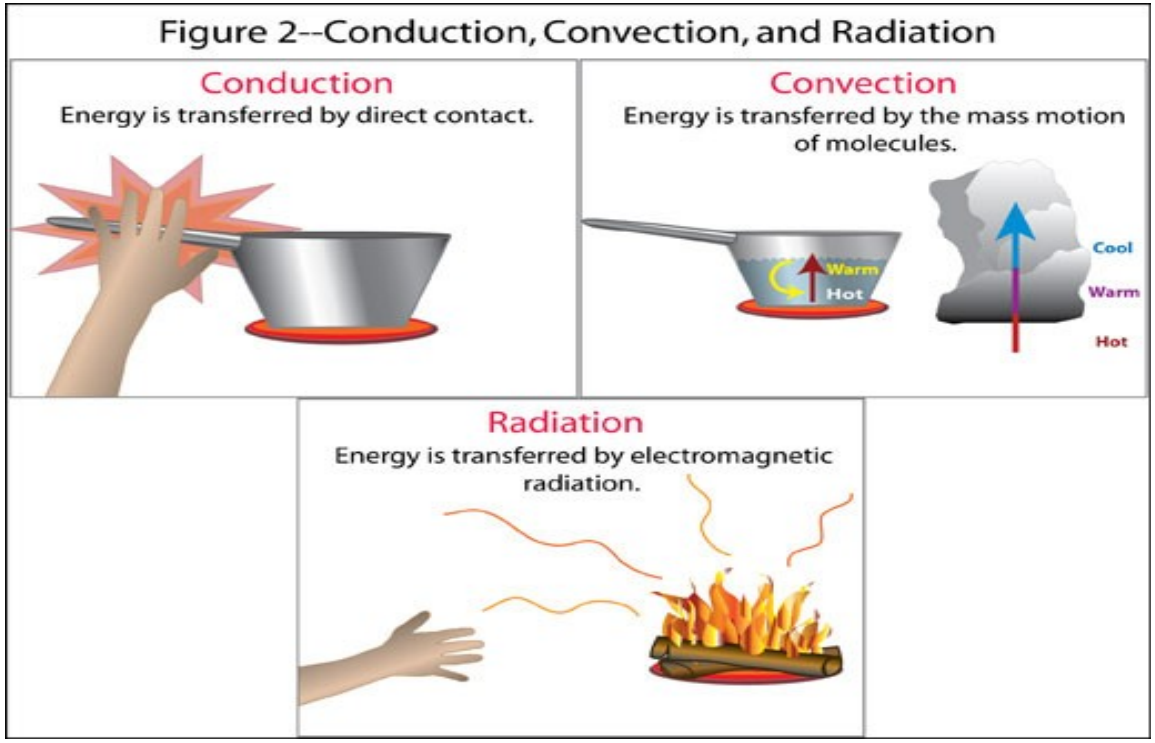
DIFFERENCE BETWEEN THERMODYNAMICS AND HEAT TRANSFER

- Thermodynamics tells us:
  - how much heat is transferred (dQ)
  - how much work is done (dW)
  - final state of the system

- Heat transfer tells us:
  - how (with what modes) dQ is transferred
  - at what rate dQ is transferred
  - temperature distribution inside the body

Modes of Heat Transfer

- Heat transfer takes place by
  - ✓ Conduction
  - ✓ Convection
  - ✓ Radiation



Conduction

- ***Conduction*** is the transfer of thermal energy through the direct contact of particles.

- Touched a metal spoon sitting in a pan of boiling water ?

Conduction In Solids , Liquids & Gases

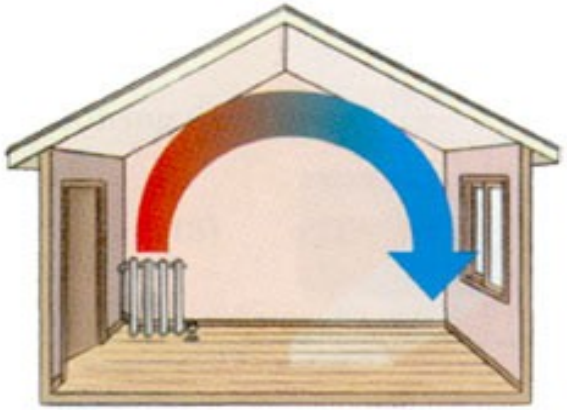
- In Solids
  - By lattice vibrations
  - By transport of free electrons

- In gases and liquids, conduction is due to the collisions and diffusion of molecules during their random motion.

- Solids are better conductors than liquids, and liquids are better conductors than gases

Convection

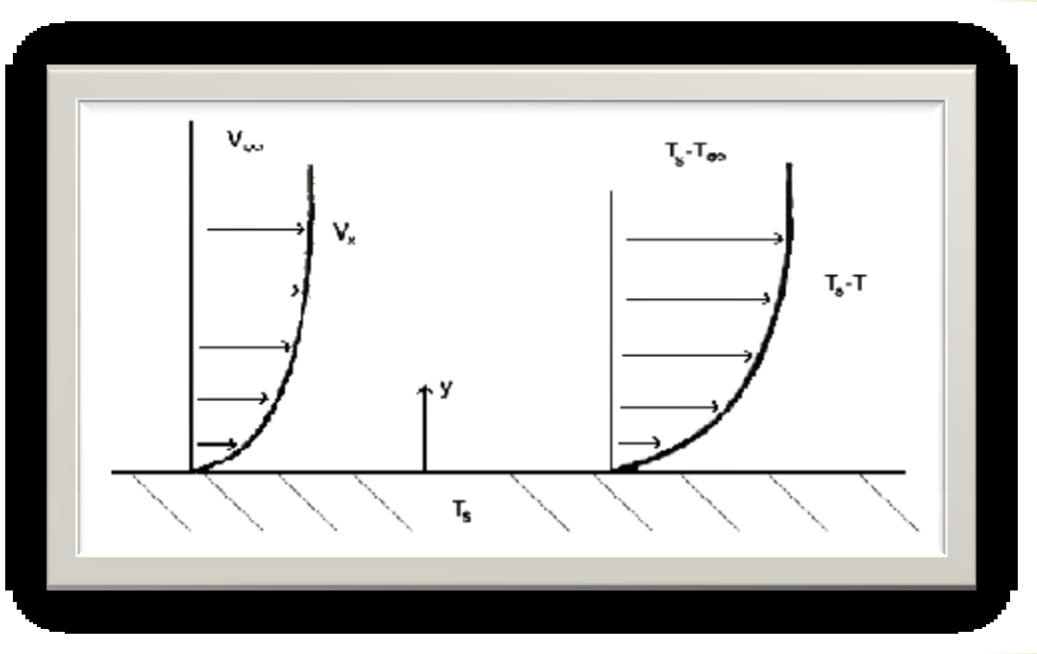
- Convection is the transfer of heat with in a fluid by mixing one portion of the fluid with another.
- Have you ever noticed that the air near the ceiling is warmer than the air near the floor? Or that water in a pool is cooler at the deep end?
- Ex:



Heat Transfer by Convection

- The heat transfer rate between a surface and adjacent fluid is ,

$$Q = h A (T_s - T_\infty)$$



Radiation

- Radiation is the transfer of heat through space or matter by means other than conduction or convection
- Radiation is the transfer of energy by electromagnetic waves
- Ex: Heat Lamps

Sun