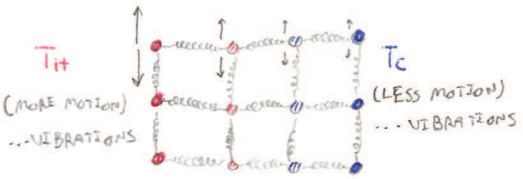
HEAT TRANSFER MECHANISMS

• CONDUCTION

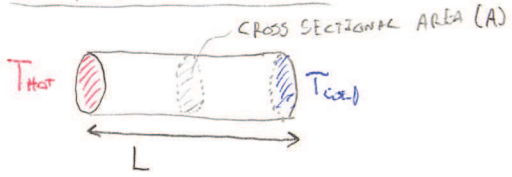
- MICRO MODEL (SOLID)



- DESCRIPTIVE MODEL

- MOLECULES ON THE HOT SIDE ARE MOVING (VIBRATING) MORE THAN ON THE COLD SIDE. THIS MOTIONAL ENERGY PROPAGETS DOWN MATERIAL VIA COLLISIONS WITH ADJACENT MOLECULES.
- ONE VIBRATES THE NEXT, WHICH VIBRATES THE NEXT, AND SO ON.

- PICTORIAL REPRESENTATION



- MATH MODEL

$$\frac{\text{ENERGY}}{\text{TIME}} \quad \frac{Q}{\Delta t} = \left(\frac{kA}{L}\right)\Delta T$$

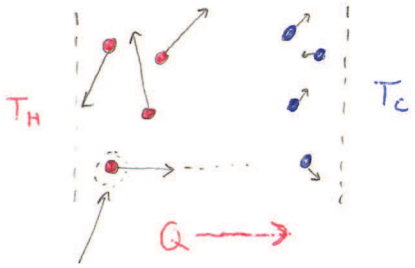
(CHANGE IN TEMP)

THERMAL CONDUCTIVITY $\frac{[M][L]}{[T]^3[K]} \equiv k$

↑ MATERIAL PROPERTY

• CONVECTION

- MICRO MODEL (GAS)

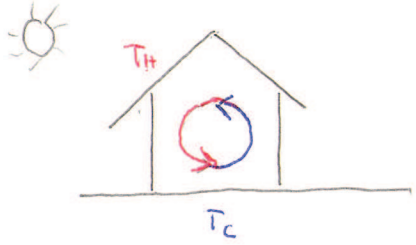


MOVES FROM HOT TO COLD

- DESCRIPTIVE MODEL

- FASTER MOVING HOT MOLECULES MOVE TO THE SLOWER MOVING COLD SIDE, INCREASING AVERAGE KE.
- THIS ACTION MAY CAUSE COLD MOLECULES TO BE PUSHED TO THE HOT SIDE CREATING CONVECTION CURRENTS

- PICTORIAL REPRESENTATION



- MATH MODEL

2 COUPLED PARTIAL DIFFERENTIAL EQUATIONS

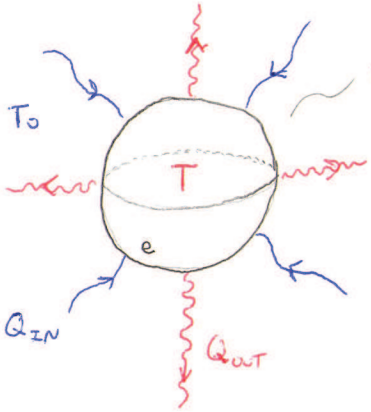
..... COMPLICATED! ....

• RADIATION

- MICRO MODEL / DESCRIPTIVE MODEL

- RADIATION DOES NOT REQUIRE THE PRESENCE OF MATTER TO ACT AS THE MEDIUM TO TRANSFER ENERGY FROM HOTTER LOCATIONS TO COLDER LOCATIONS.
- RADIATION IS ENERGY TRANSFER VIA ELECTROMAGNETIC WAVES.

- PICTORIAL REPRESENTATION



* e - ABILITY OF SURFACE TO RADIATE E+M AS COMPARED TO A "PERFECT" BLACK BODY RADIATOR.
  - BLACK BODY $e=1$
  - OTHER MATERIALS $e<1$

- MATH MODEL

(OBJECT TEMPERATURE)

- RADIATION OUT: $\frac{Q_{out}}{\Delta t} = e\sigma A T^4$

(ENVIRONMENT TEMPERATURE)

- RADIATION IN: $\frac{Q_{IN}}{\Delta t} = e\sigma A T_0^4$

- NET RADIATION: $\frac{\sum Q}{\Delta t} = e\sigma A(T_0^4 - T^4)$

EMISSIVITY [UNITLESS] $\equiv e$

STEFAN-BOLTZMANN CONSTANT $\frac{[M]}{[T]^3[K]^4} \equiv \sigma = 5.67 \times 10^{-8} \frac{W}{m^2 K^4}$