

7. Concepts Relating to Heat

I. Basic concepts

Prepared for EGY 105

Energy in our World

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Temperature and heat

- ▶ Property of all systems
- ▶ Based on kinetic energy of molecules
 - Heat is TOTAL energy of all molecules in a system
 - Typically measured in Calories or BTUs
 - Temperature is AVERAGE energy of all molecules in a system
 - Typically measured in degrees

	Fahrenheit	Celsius	Kelvin
Water freezes	32	0	273
Water boils	212	100	373
Human body	98.6	37	310

Temperature vs heat within and between systems

- ▶ Within a system
 - Increase in heat causes increase in temperature
 - Governed by equation

$$Q = mc(\Delta T)$$

Where:

Q – heat (cal., BTU)

M – mass

C – specific heat

ΔT – change in temp.



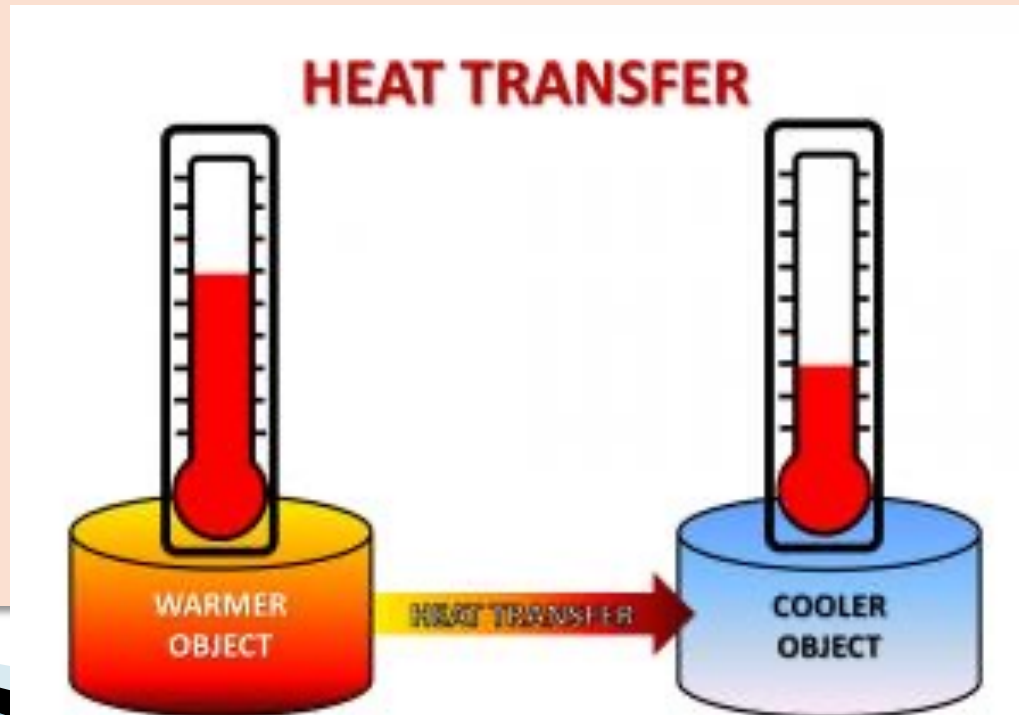
Temperature vs heat within and between systems

- ▶ Between systems
 - Not related
 - One system can have higher heat yet lower temperature



Temperature vs heat within and between systems

- ▶ Heat can move from one system to another
 - Only when there is a temperature difference
 - Move from higher temperature to lower temperature object.

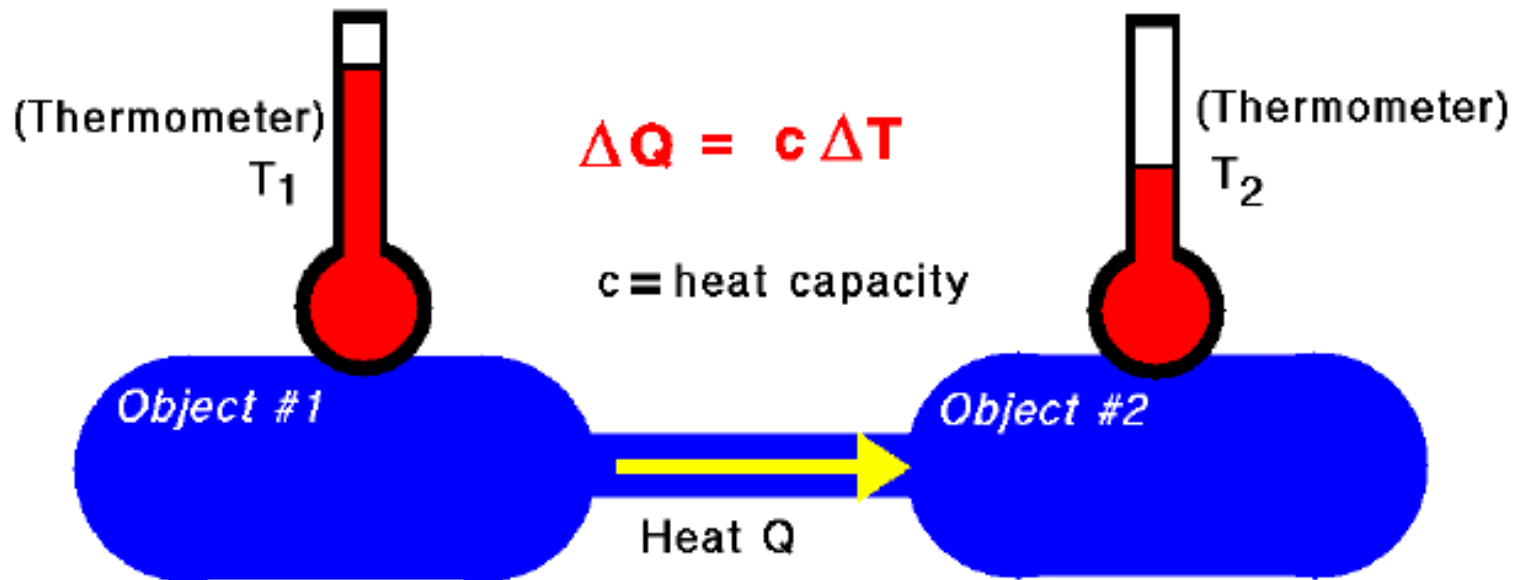


Another way to look at heat transfer



Heat Transfer

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In the process of reaching thermodynamic equilibrium, heat is transferred from the warmer object to the cooler object. At thermodynamic equilibrium heat transfer is zero.

Specific heat (c)

- ▶ Measure of change in temperature as a result of heat absorbed.
 - Metric system: # joules needed to raise 1 kg of material by 1 °C.
 - English system: # BTUs needed to raise 1 lb of material by 1°F.



Examples of specific heats of different substances

Table 4.2 SPECIFIC HEATS OF COMMON SUBSTANCES

Material	Specific Heat (J/kg/°C)	Specific Heat (Btu/lb/°F)
Water	4186	1.00
White pine	2800	0.67
Ice	2090	0.50
Air	1004	0.24
Concrete	960	0.23
Aluminum	900	0.22
Glass	840	0.20
Rock	840	0.20
Iron	448	0.12
Copper	387	0.093

See Table 5.2 on p. 98 of your text

Heat of vaporization and heat of fusion

Involves phase changes

Fusion

solid $\leftrightarrow$ liquid

For water: 80 kcal / kg



Vaporization

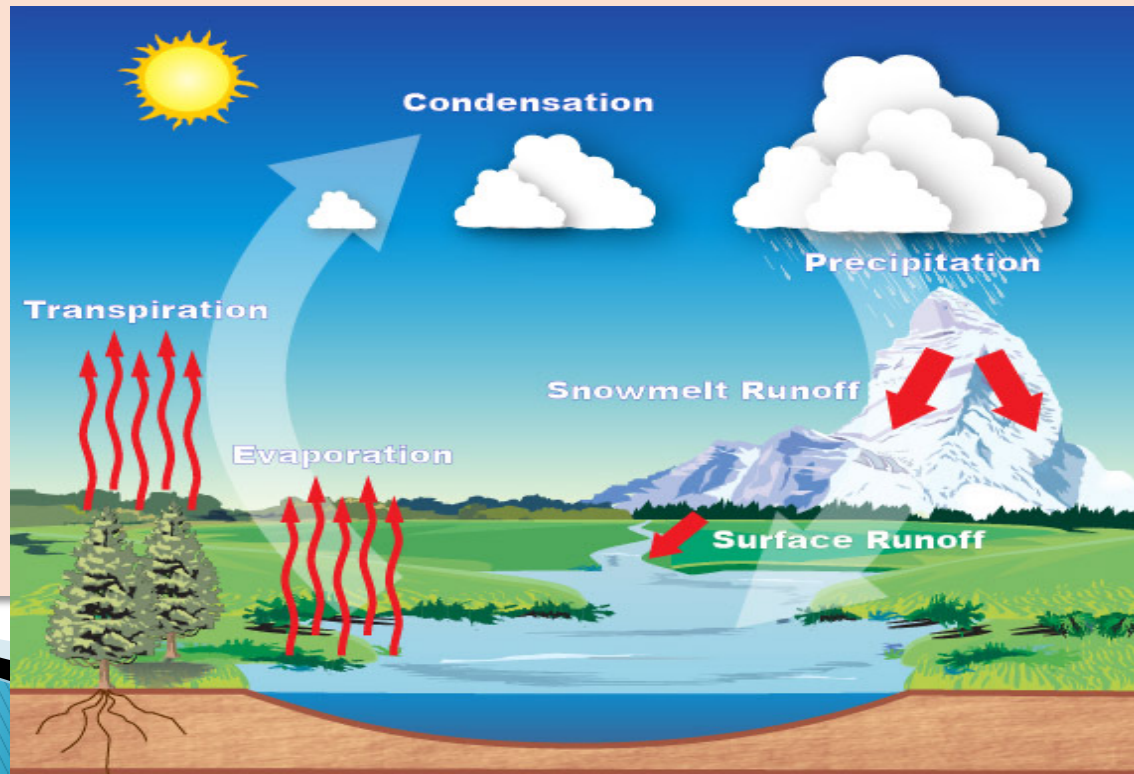
liquid $\leftrightarrow$ gas

For water: 540 kcal / kg

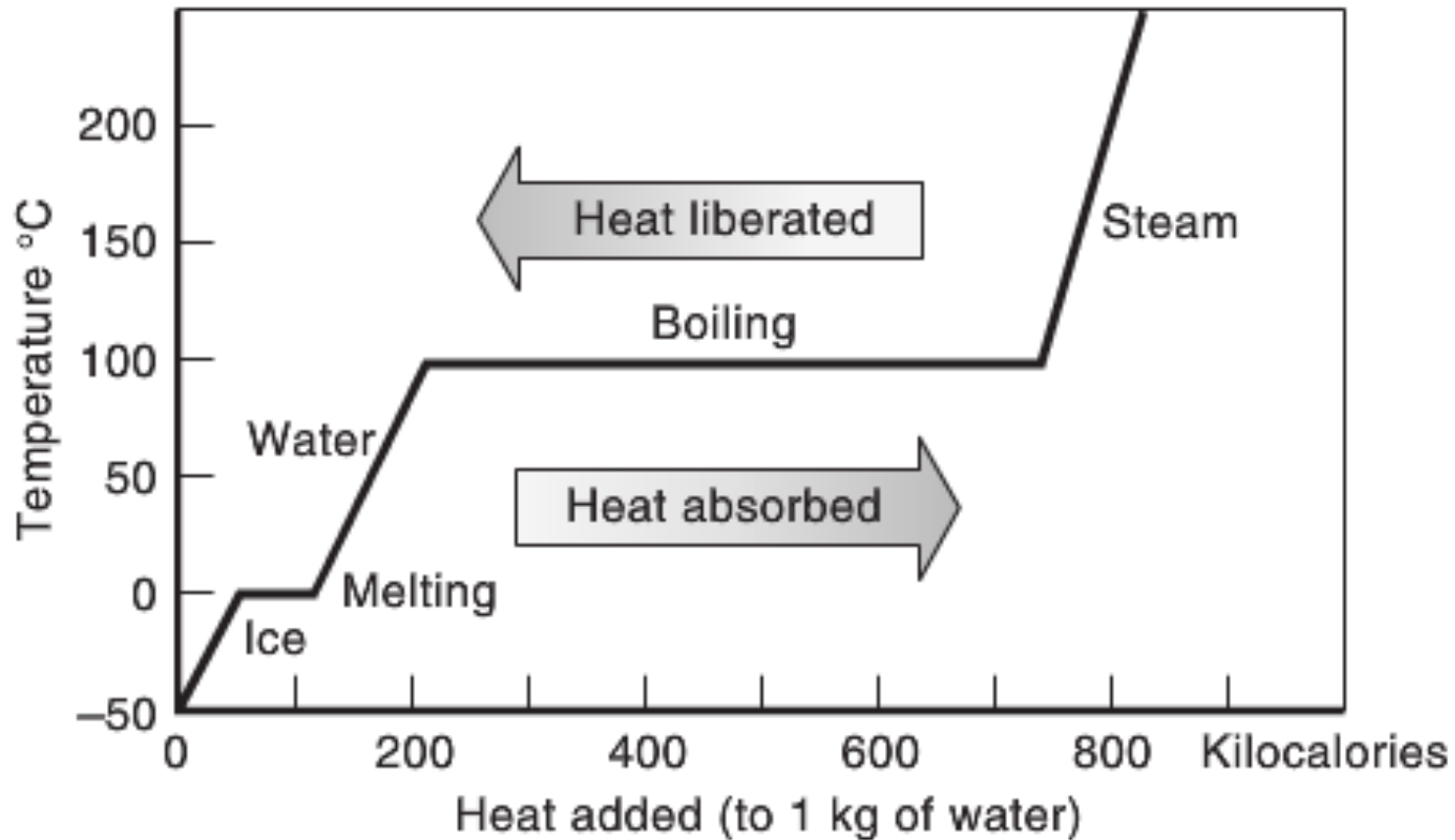


Heat of vaporization and heat of fusion

- ▶ Heat absorbed or released depending on direction
- ▶ Important in heat balance at earth's surface, regulating temperatures of organisms



Temperature as a function of heat in water



See pp. 100-101 of text for more discussion.