

7. Concepts Relating to Heat

I. Basic concepts

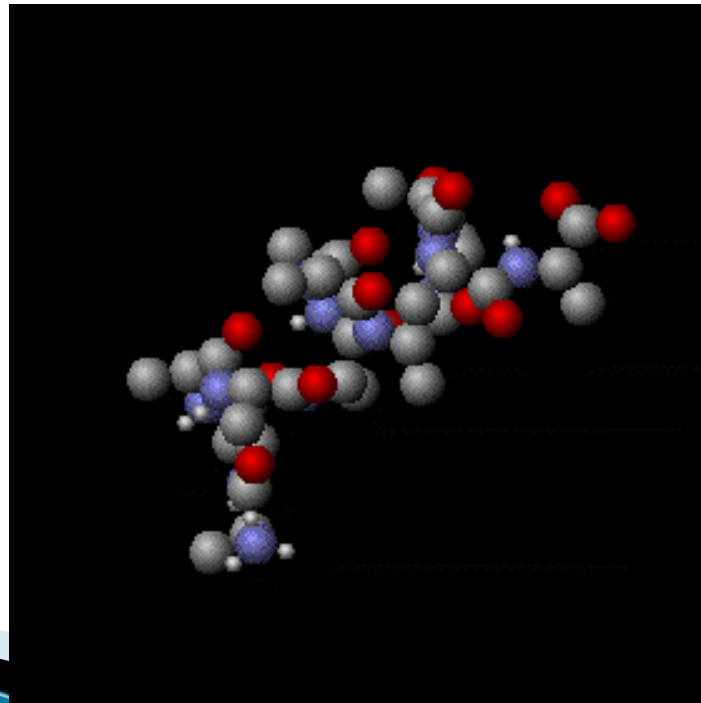
Prepared for EGY 105

Energy in our World

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Introductory concepts

- ▶ All objects are composed of molecules
- ▶ Molecules typically contain kinetic energy and are in motion.



Temperature, thermal energy, and heat

Temperature

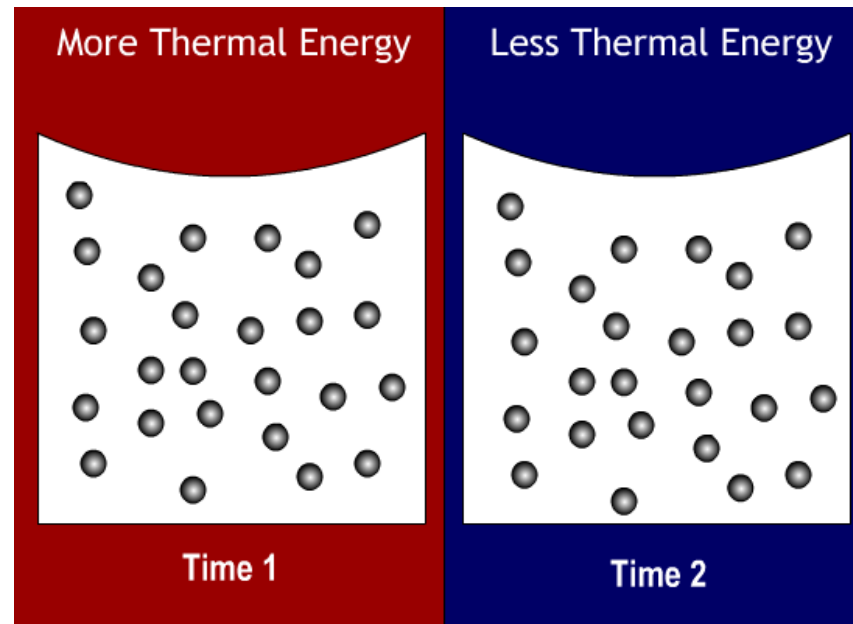
- Temperature is the AVERAGE energy of all molecules in a system
 - Typically measured in degrees

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

Temperature, thermal energy, and heat

Thermal energy

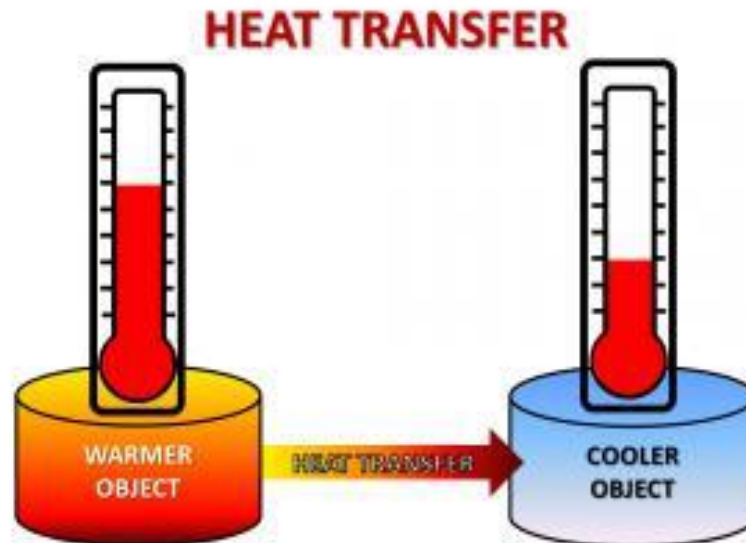
- Thermal energy is the total kinetic energy of all molecules in a system
- Related to temperature



Temperature, thermal energy, and heat

Heat

- The form of energy that is transferred between two objects of different temperatures.
 - From warmer object to colder object.
 - Measured in energy units: calories, joules

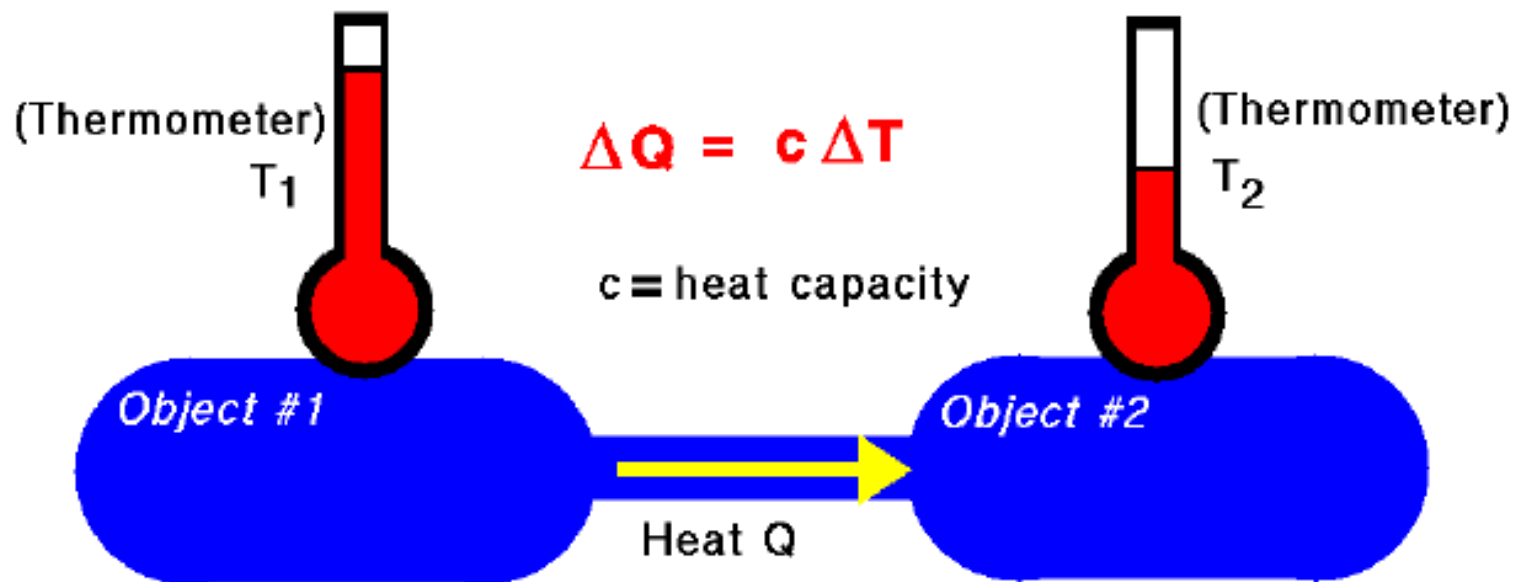


Another way to look at heat transfer



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

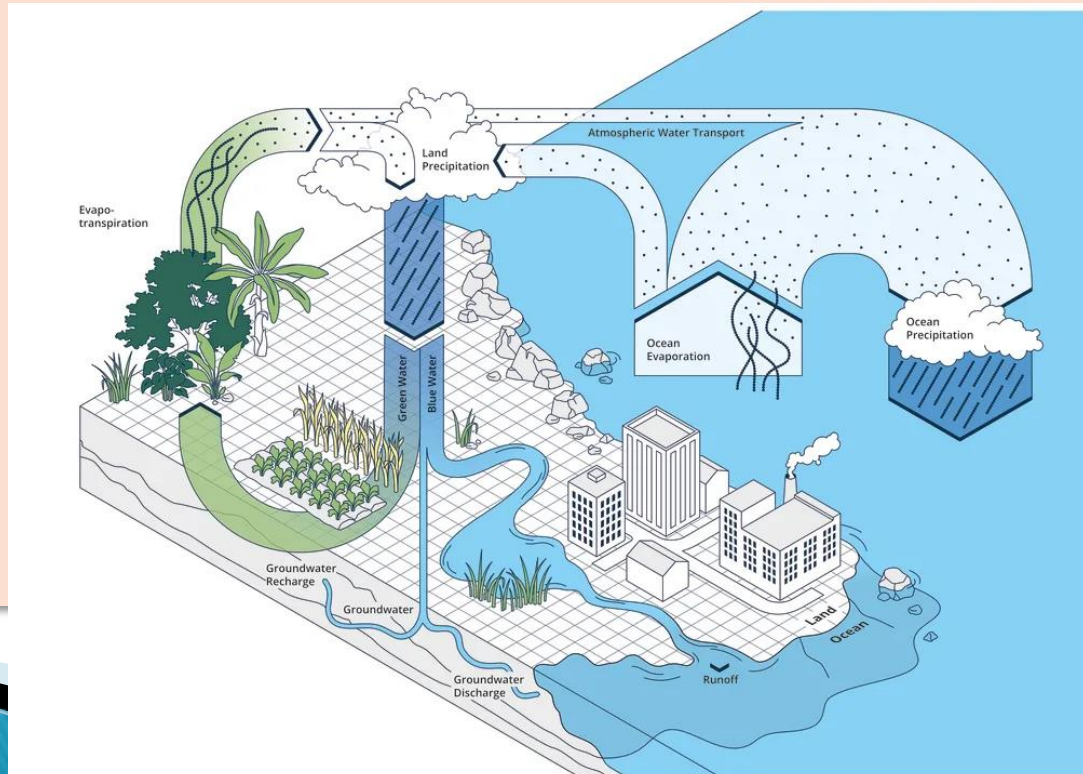
liquid $\leftrightarrow$ gas

For water: 540 kcal / kg

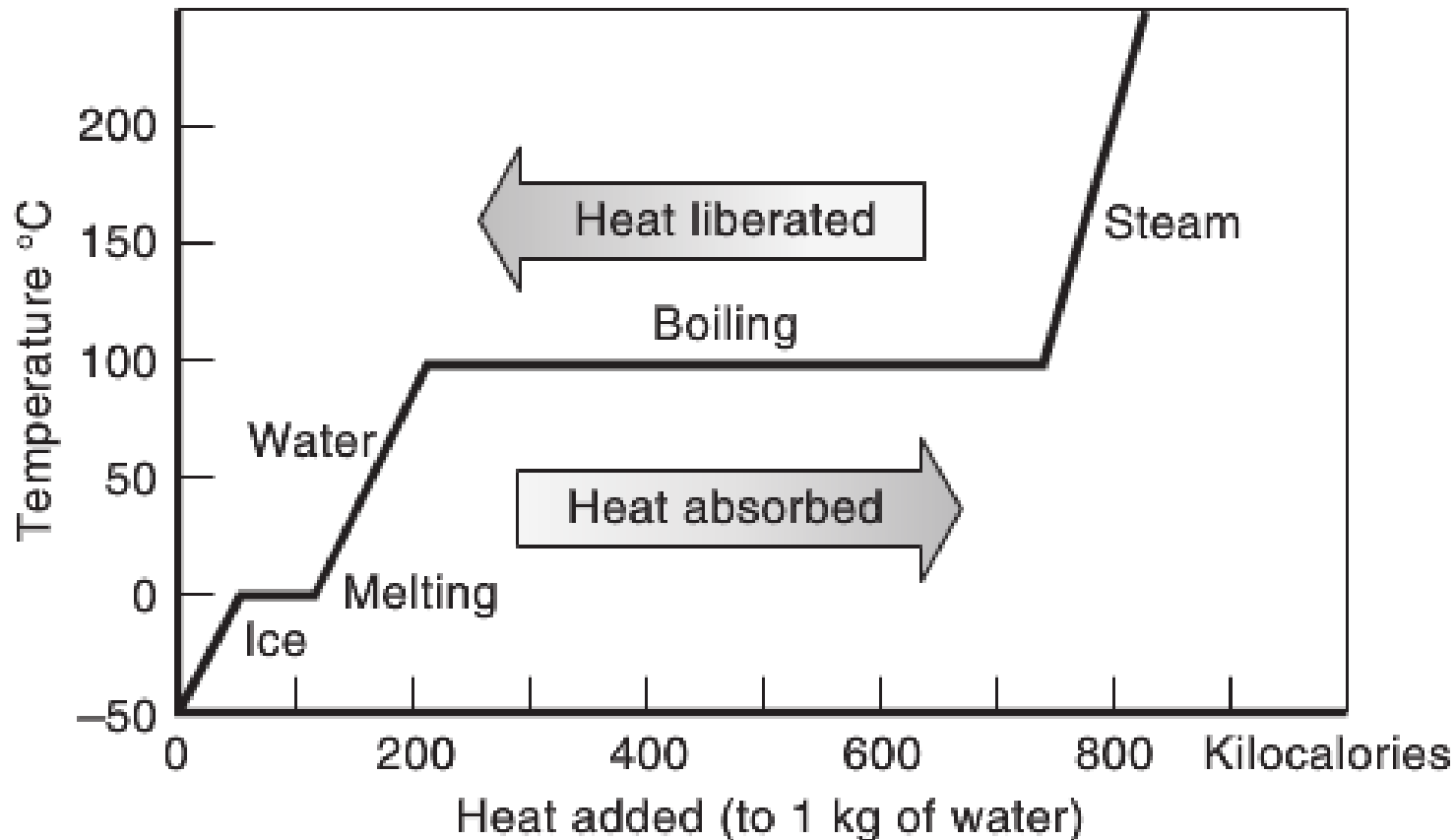


Heat of vaporization and heat of fusion

- ▶ 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.