

- What is **heat transfer**?

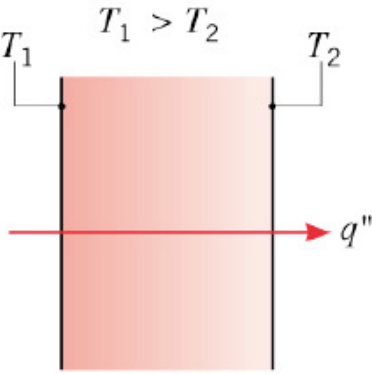
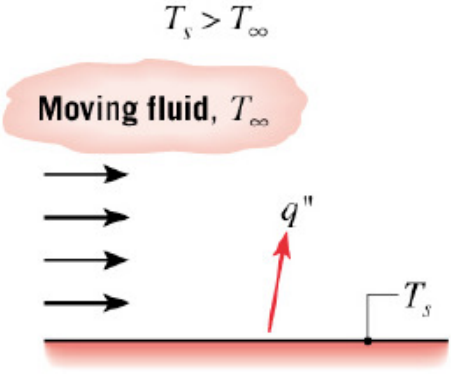
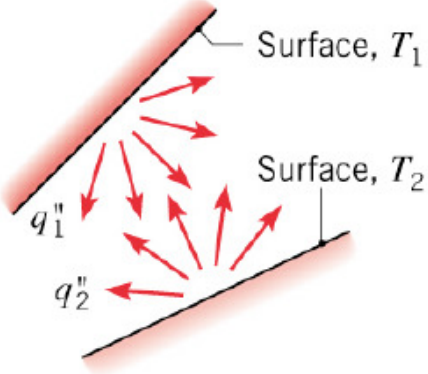
Heat transfer is thermal energy in transit due to a temperature difference.

- What is **thermal energy**?

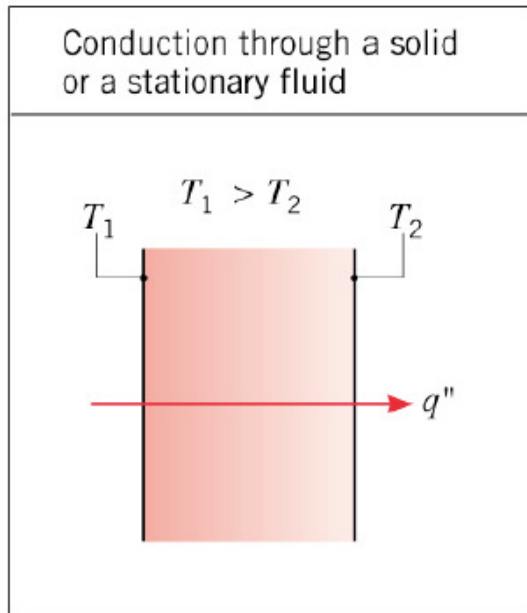
Thermal energy is associated with the translation, rotation, vibration and electronic states of the atoms and molecules that comprise matter. It represents the cumulative effect of microscopic activities and is directly linked to the temperature of matter.

Modes of Heat Transfer

- Conduction
- Convection
- Radiation

Conduction through a solid or a stationary fluid	Convection from a surface to a moving fluid	Net radiation heat exchange between two surfaces
 <p>Diagram illustrating conduction through a solid or stationary fluid. A rectangular block is shown with temperature T_1 on the left face and T_2 on the right face, where $T_1 > T_2$. A red arrow labeled q'' indicates the direction of heat transfer through the block.</p>	 <p>Diagram illustrating convection from a surface to a moving fluid. A horizontal surface is shown at temperature T_s. Above the surface, a moving fluid is shown at temperature T_∞. Black arrows indicate the direction of fluid flow. A red arrow labeled q'' indicates the direction of heat transfer from the surface to the fluid.</p>	 <p>Diagram illustrating net radiation heat exchange between two surfaces. Two surfaces are shown, labeled Surface, T_1 and Surface, T_2. Red arrows represent radiation exchange between the surfaces. q_1'' is the radiation from Surface, T_1 to Surface, T_2, and q_2'' is the radiation from Surface, T_2 to Surface, T_1.</p>

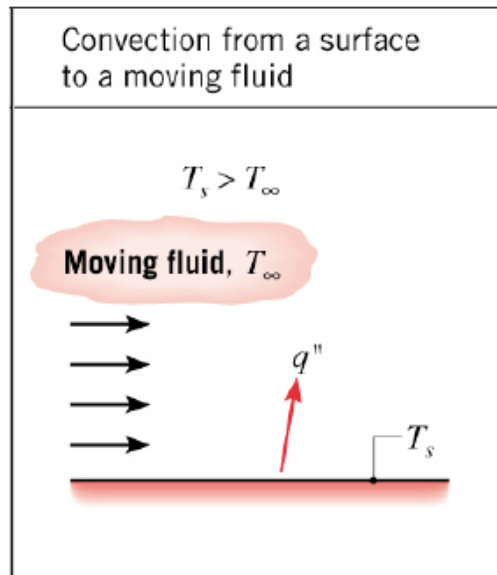
Conduction



- Heat transfer in a solid or a stationary fluid (gas or liquid) due to the **random motion** of its constituent atoms, molecules and /or electrons.
- Requires the presence of temperature variations in the material medium

Transport Law: Fourier's Law

Convection



- Heat transfer due to the combined influence of **bulk and random motion** for fluid flow over a surface.
- Requires the presence of temperature variations in the material medium

Transport Law: Newton's Law of Cooling

Radiation

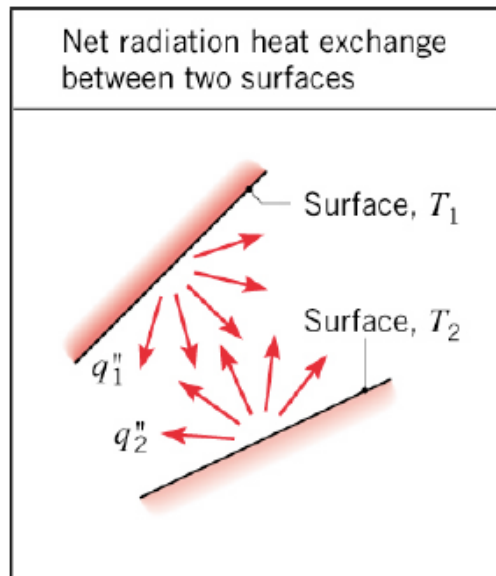
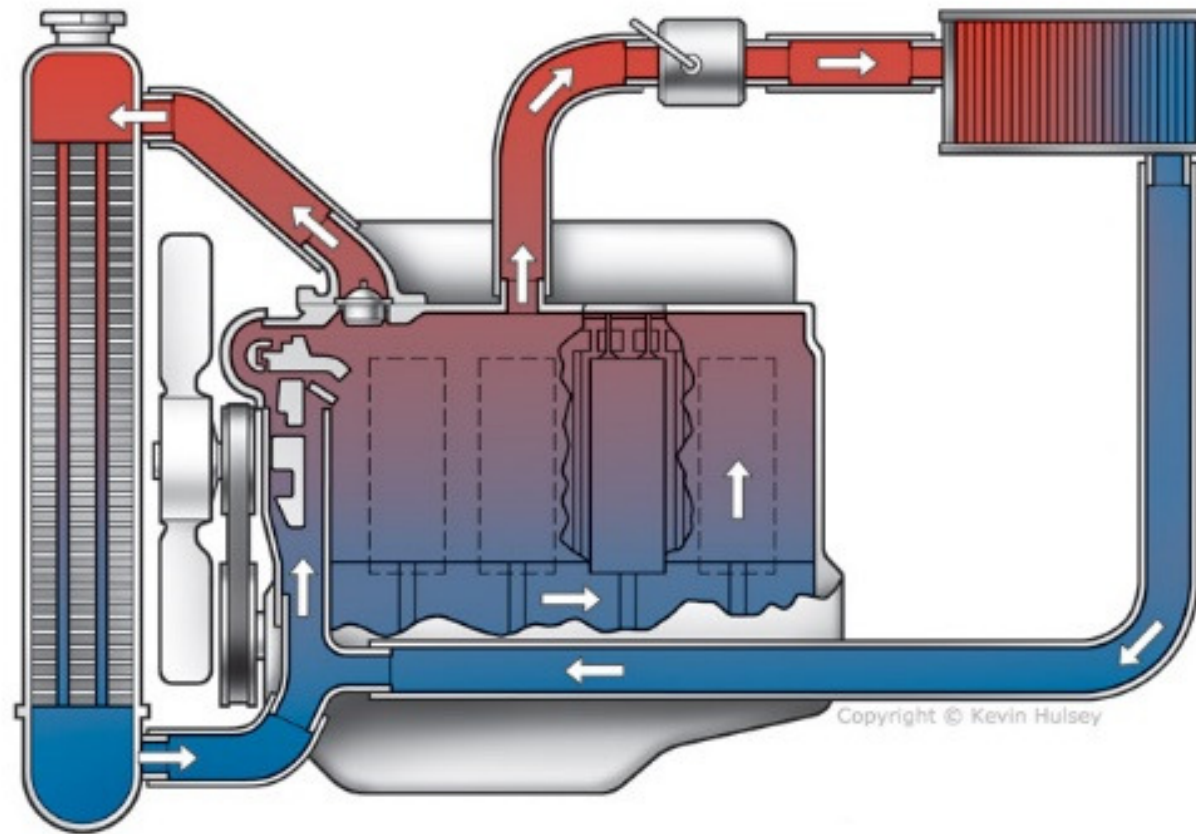


Figure 1.1(c) Radiation

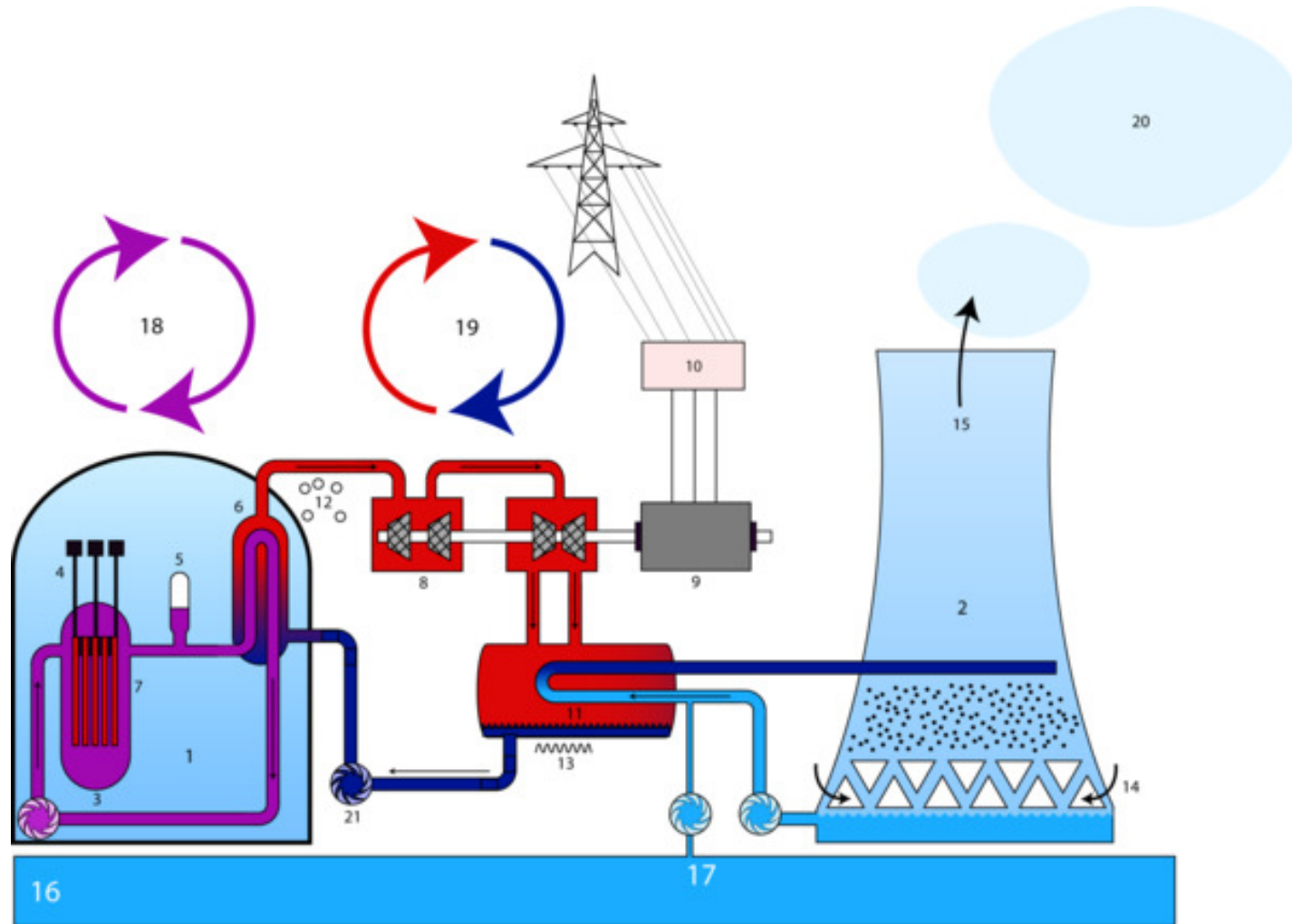
- Energy that is **emitted by matter** due to changes in the electron configurations of its atoms or molecules and is transported as electromagnetic waves (or photons).
- Transport does not require a material medium and occurs most efficiently in a vacuum.

Transport Law: Stefan-Boltzmann's Law

Car engine cooling system



Nuclear reactor power station



Solar furnace



Physiological heat transfer

