For example, in winter, energy is transferred as heat from a car's surface at 30°C to a cold raindrop at 5°C. In the summer, energy is transferred as heat from a car's surface at 45°C to a warm raindrop at 20°C. In each case, the amount of energy transferred each second is the same, because the substances and the temperature difference (25°C) are the same. See **Figure 10.**

The concepts of heat and temperature help to explain why hands held in separate bowls containing hot and cold water subsequently sense the temperature of lukewarm water differently. The nerves in the outer skin of your hand detect energy passing through the skin from objects with temperatures different from your body temperature. If one hand is at thermal equilibrium with cold water, more energy is transferred from the outer layers of your hand than can be replaced by the blood, which has a temperature of about 37.0°C (98.6°F). When the hand is immediately placed in water that is at a higher temperature, energy is transferred from the water to the cooler hand. The energy transferred into the skin causes the water to feel warm. Likewise, the hand that has been in hot water temporarily gains energy from the water. The loss of this energy to the lukewarm water makes that water feel cool.

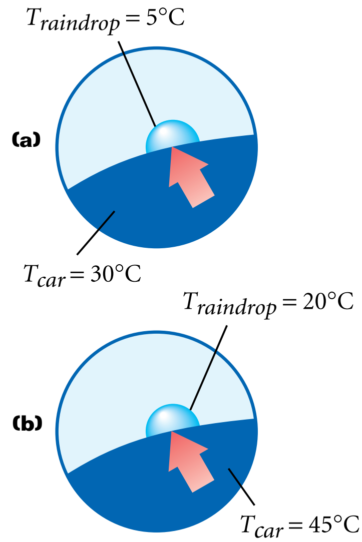

Figure 10
The energy transferred each second as heat from the car's surface to the raindrop is the same for low temperatures **(a)** as for high temperatures **(b),** provided the temperature differences are the same.

Heat has the units of energy

Before scientists arrived at the modern model for heat, several different units for measuring heat had already been developed. These units are still widely used in many applications and therefore are listed in **Table 3.** Because heat, like work, is energy in transit, all heat units can be converted to joules, the SI unit for energy.

Just as other forms of energy have a symbol that identifies them (*PE* for potential energy, *KE* for kinetic energy, *U* for internal energy, *W* for work), heat is indicated by the symbol *Q*.

Table 3 Thermal Units and Their Values in Joules

Heat unit	Equivalent value	Uses
joule (J)	equal to 1 kg • $\left(\frac{m^2}{s^2}\right)$	SI unit of energy
calorie (cal)	4.186 J	non-SI unit of heat; found especially in older works of physics and chemistry
kilocalorie (kcal)	4.186×10^3 J	non-SI unit of heat
Calorie, or dietary Calorie	4.186×10^3 J = 1 kcal	food and nutritional science
British thermal unit (Btu)	1.055×10^3 J	English unit of heat; used in engineering, air-conditioning, and refrigeration
therm	1.055×10^8 J	equal to 100 000 Btu; used to measure natural-gas usage