Heat capacity

Heat is the flow of thermal energy, and the *specific heat capacity* of an object is a measure of the amount of thermal energy that must flow into it to increase its temperature by one degree per unit mass. Heat capacity depends on the material the body is made of, and measuring it can help to identify the material.

Thermal energy naturally flows from hotter to colder bodies, and in general it is not easy to stop the flow of heat. There are several ways in which heat can be transported. One is direct contact of two bodies; the rate of direct heat *conduction* varies a great deal for different materials. Also, the rate of heat flow is roughly proportional to the temperature difference between the two bodies: The greater the difference, the faster the heat flow. For example, in very hot weather, as the temperature difference between a car's radiator and the air flowing past it is decreased, the effectiveness of cooling is diminished.

When one of the bodies is a gas or a liquid that flows away from another body after making thermal contact, heat is said to be transported by *convection*. When the differences in temperature are great, *radiative* heat transfer becomes important; all objects emit thermal radiation, and the amount of this radiated energy grows very rapidly with temperature.

Even if the temperature is constant, heat energy may flow in and out of a system, if an internal rearrangement of atoms is taking place, such as a change of state from liquid to gas (evaporation) or from solid to liquid (melting). This so-called *latent heat* of evaporation or of melting again depends a great deal on the material in question, and can be used to identify the material.

Liquid nitrogen can be used as a handy source of a large temperature difference since the gas becomes liquid at 77 K or $-196°$C, more than 200°C below room temperature. When liquid nitrogen comes into contact with room-temperature objects, a small amount of it evaporates very quickly and forms a thin layer of nitrogen gas. The formation of this gas layer is known as the **Leidenfrost Effect**.

Since heat conduction in a gas is much slower than in a solid or a liquid, this gas acts as a barrier to heat conduction, and it allows the remaining nitrogen to remain in liquid form. One could spill a small amount of liquid nitrogen directly onto skin, and live to tell the tale. But if a drop of liquid nitrogen is trapped in folds of the skin, or if the skin comes into contact with a metal or glass container holding the liquid nitrogen, a serious injury will result.