Figure 11
After this burner has been turned on, the skillet's handle heats up because of conduction. An oven mitt must be used to remove the skillet safely.

THERMAL CONDUCTION

When you first place an iron skillet on a stove, the metal handle feels comfortable to the touch. After a few minutes, the handle becomes too hot to touch without a cooking mitt, as shown in **Figure 11.** The handle is hot because energy was transferred from the high-temperature burner to the skillet. The added energy increased the temperature of the skillet and its contents. This type of energy transfer is called *thermal conduction.*

The rate of thermal conduction depends on the substance

Thermal conduction can be understood by the behavior of atoms in a metal. As the skillet is heated, the atoms nearest to the burner vibrate with greater energy. These vibrating atoms jostle their less energetic neighbors and transfer some of their energy in the process. Gradually, iron atoms farther away from the element gain more energy.

The rate of thermal conduction depends on the properties of the substance being heated. A metal ice tray and a cardboard package of frozen food removed from the freezer are at the same temperature. However, the metal tray feels colder than the package because metal conducts energy more easily and more rapidly than cardboard does. Substances that rapidly transfer energy as heat are called *thermal conductors.* Substances that slowly transfer energy as heat are called *thermal insulators.* In general, metals are good thermal conductors. Materials such as asbestos, cork, ceramic, cardboard, and fiberglass are poor thermal conductors (and therefore good thermal insulators).

Did you know?

Although cooking oil is no better a thermal conductor than most nonmetals are, it is useful for transferring energy uniformly around the surface of the food being cooked. When popping popcorn, for instance, coating the kernels with oil improves the energy transfer to each kernel, so a higher percentage of them pop.

Convection and radiation also transfer energy

There are two other mechanisms for transferring energy between places or objects at different temperatures. *Convection* involves the movement of cold and hot matter, such as hot air rising upward over a flame. This mechanism does not involve heat alone. Instead, it uses the combined effects of pressure differences, conduction, and buoyancy. In the case of air over a flame, the air is heated through particle collisions (conduction), causing it to expand and its density to decrease. The warm air is then displaced by denser, colder air. Thus, the flame heats the air faster than by conduction alone.

The other principal energy transfer mechanism is *electromagnetic radiation.* Unlike convection, energy in this form does not involve the transfer of matter. Instead, objects reduce their internal energy by giving off electromagnetic radiation of particular wavelengths or are heated by electromagnetic radiation like a car is heated by the absorption of sunlight.

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