**Basic Principles of Heat Transfer**

Between 30% and 60% of the total energy used in American households is used to condition or maintain temperature within buildings. This underscores the need to improve the energy efficiency of buildings.

**Essential Concepts**

Regardless of the climate or the building, heat always behaves in predictable ways, and these are useful for understanding how heat moves through structures. As you begin to evaluate the energy efficiency of any structure, always keep these essential concepts in mind:

* Heat always moves from warmer areas to colder areas. An easy way to remember this is that the sun always heats the earth; the earth does not cool the sun.
* The greater the temperature difference (sometimes referred to as a temperature gradient), the faster heat flows. So, for example, when you go outside on a day when it’s 69°F outside, you don't experience much discomfort because there’s not much heat transfer. If it’s 70°F inside and 70°F outside, is there any heat transfer? No. But, if it’s 70°F inside and 0°F outside, there is a lot of heat flow, which is immediately noticeable. Heat flow also has a big impact on comfort, as we will explore further in Lesson 8.
* In a building, greater heat flow through the enclosure means greater energy cost.
* Air contains moisture, so when air moves from warmer to colder along a temperature gradient, it carries moisture. This can have an impact on building durability if the air cools sufficiently to cause the moisture to condense on a surface. (The mechanics of this moisture impact will be discussed in detail in Lesson 7 and covered in detail in Course 2, "Moisture Management").

**Heat vs. Temperature**

Heat is not the same as temperature. Heat is kinetic energy, whereas temperature is a measurement of how intense that kinetic energy is. To illustrate this, take two containers of water — one containing 10 gallons and one containing 1 gallon. The water in both containers is 50°F. Although they are the same temperature, the larger container holds 10 times more heat than the smaller one. The larger container has more thermal mass, so it has more heat capacity. This concept of thermal mass plays a big role in some buildings where thermal mass is typically included in the design to store heat and help regulate indoor air temperatures. For example, a concrete slab covered with tile provides a good heat sink. As the energy from the sun comes through the glass, it heats up the slab and creates a thermal mass, which then re-radiates throughout the building long after the sun has set.