



Modes of Heat Transfer Handouts

How Our Homes Use Energy

When looking for ways to save energy in a home, it is important to maintain the health and comfort of the occupants. After all, the primary reason energy is used at home is to provide a comfortable and healthy environment.

We have specific requirements for temperature, relative humidity, and general air quality. We also have requirements for the quality and quantity of lighting. Poor air quality at home can lead to an increase in cold-like symptoms, allergies, headaches, and other symptoms.

Turning off lights and lowering the heat in winter can save energy, but doing so without consideration of the impact on those living there can cause unsafe or unhealthy conditions in the building. When the building is treated as a system, energy is saved while maintaining or improving the indoor environment.

Heat, Air, and Moisture Overview

The three main factors that affect the home's energy use and the comfort and health of the occupants are heat, air, and moisture. These three elements are constantly moving into and out of the home. When designing new homes or improving existing ones, we want to put the homeowner in control of the flow of heat, air, and moisture. Without this control, issues can occur that increase energy use and decrease indoor air quality.

■ Heat Transfer

Thermal energy, or heat, is a form of energy associated with the movement of atoms and molecules in any material. The faster the atoms are moving, the greater the amount of energy, which is measured by the increase of temperature.

As mentioned, thermal energy is always moving into and out of the home. Thermal energy always flows from areas of higher temperature to lower temperature. This heat transfer occurs in three ways: conduction, convection, and radiation. Understanding the differences between these mechanisms is important to limiting heat transfer into and out of a home. If we know which heat transfer mechanism is likely to occur, it enables us to treat the heat loss or gain effectively.

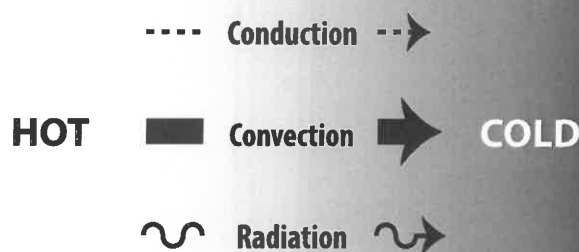
CONDUCTION

This is the transfer of thermal energy between objects that are in contact with each other. The heat transfer occurs through a substance from molecule to molecule by direct contact. The molecules themselves do not necessarily change position, but simply vibrate more or less quickly against each other. When you hold a mug of hot chocolate, you can feel the heat conducting directly from the mug to your hand. In a house, heat is conducted through the walls, floors, ceilings, doors, and windows.

CONVECTION

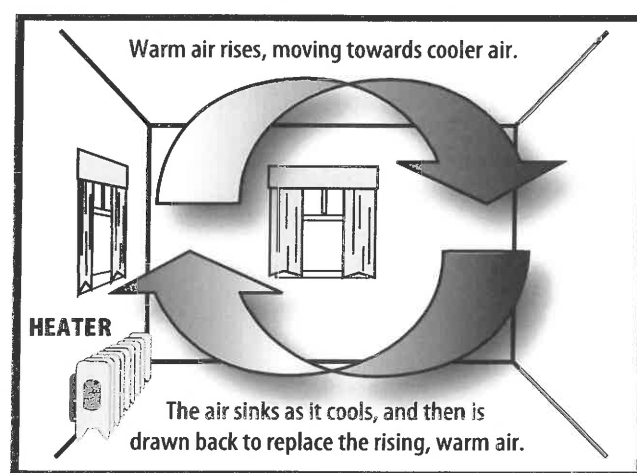
Have you ever watched a lava lamp? If so, you were watching the effects of heat transfer via convection. When a fluid is moving because of uneven heating, convection is occurring. In the lava lamp, the moving fluid is heated by the light bulb at the bottom. The heated fluid becomes less dense than the surrounding fluid, and rises. As it rises, it cools, becoming denser, which causes it to fall back to the bottom.

Thermal Energy Flows



Thermal energy is always moving. It flows from areas of higher temperature to areas of lower temperature. Heat transfer occurs via conduction, convection, and radiation.

Convection in Gases



Though it is harder to see, this same process occurs in air. For example, air on the Earth's surface warmed by intense sunlight, will be heated by contact with the ground, expand, and flow upward, creating a region of low pressure below it. Cooler, surrounding air will then flow in to this low pressure region. The air circulates by convection, creating winds. In winter time in colder climates, warm, heated air in a house rises due to convection, and can pull in cold air through cracks at the bottom of the house. The warm air can escape from the house and into the attic increasing heating costs.

RADIATION

If you have ever been by a campfire, you have noticed that the side of your body facing the fire is much warmer than the side facing away. This is because thermal energy is being released, or emitted, by the fire and then being transmitted to you across the space between. Infrared radiation (sometimes called radiant heat transfer) is the process in which energy is emitted by a warmer body, to another body. Infrared radiation does not require a medium to travel through, but it can occur through air or liquids. Some electric heaters rely on radiant heat transfer. These heaters are not designed to heat the air in the room; rather they transmit their heat directly to people and objects in the room.

Methods of Heat Transfer

Conduction

- The transfer of heat between substances which are in direct contact with each other.

Convection

- The movement of gases and liquids caused by heat transfer.

Radiation

- The transfer of heat by means of electromagnetic waves.

