# Energy Movement

# Weatherization Energy Auditor Single Family

Learning Objectives

By attending this session, participants will be able to:

* Discuss the principles of energy and energy movement.
* List the three methods of heat transfer.
* Differentiate between thermal boundaries and air barriers and the proper location of each.
* Describe the forces that cause air leakage.
* Explain the connection between air leakage, energy waste, and moisture problems.
* Explain how air ducts affect pressure balance within the home.

Key Terminology

Air barrier (air boundary)

Backdraft

British thermal unit (BTU)

Carbon monoxide (CO)

Combustion air

Conduction

Convection

Cubic feet per minute (CFM)

Delta T

Direct leakage

Direct-vented appliance

Exfiltration

Heat

Heat recovery ventilation (HRV)

Indirect leakage

Indoor air quality (IAQ)

Infiltration

Kinetic energy

Latent heat

Laws of thermodynamics

Manual J

Phase change

Potential energy

R-value

Radiation

Sensible heat

Temperature

Thermal boundary

Ventilation

Vermiculite

Supplemental Materials

**Handouts and Resources**

Cox, Anthony, and Melissa Byrd. “House of Pressure – A Model of Energy Efficiency.” *Home Energy* Mar./Apr. 2010: 26-28. www.homeenergy.org.

Energy Movement Quiz.

Energy Movement Quiz Answer Key.

**Online Platform Lessons**

Use these online interactive training modules as prerequisites before students attend the course, or as in-class computer lab sessions. Users must first create an account at [www.nterlearning.org](http://www.nterlearning.org) to access the lesson.

i- 3.1 Basics & Modes of Heat Transfer   
<https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 3.3 Driving Forces, Airflow & Stack Effect   
<https://www.nterlearning.org/web/guest/course-details?cid=249>

Classroom Props & Activities

**Potential/Kinetic Energy Demo**: Stretch a rubber band on your fingers. Ask students if the band has potential energy or kinetic energy in this state (potential). Ask which type of energy the rubber band will have when you release it (kinetic). Aim away from faces and let fly.

**House of Pressure**: A house of pressure is a transparent scale model of a house with active mechanical systems that can replicate a number of interactions that may occur between mechanical systems and the building shell in real houses. There are several models on the market. These models have proven themselves as very effective training tools for those who familiarize themselves with their many features. This learning tool can illustrate the interrelationships of home mechanical systems, air-tightness, and connectivity to the basement or garage as they relate to energy efficiency and IAQ issues. Plan intervals where a demonstration can serve to break up the monotony of the lecture and help drive home an important concept. Conduct a few demos such as the effect of a blower door. Use smoke and a manometer to illustrate the effect of unbalanced forced air systems. Think of other scenarios to demonstrate. It’s best if you develop a written script, which contains all of the scenarios you want to demonstrate. A script will instruct the user exactly how to configure the model to produce the same results for each class. Encourage students to gather close to the model rather than watch from a distance.

Class Overview

* Use the presentation to introduce the principles of energy movement and heat transfer.
* List examples of energy: fire, a speeding vehicle, a parked vehicle, stacked firewood, snow on a mountain, etc. Have the class identify each as potential energy or kinetic energy.
* Ask if students have noticed that on still fall nights the temperature frequently “stops” at exactly 32°F for several hours before finally dropping lower. Does anyone know why? (Because of the needed phase change. Water in the environment reaches 32°F, then absorbs the cold until it has changed from water to ice, then the temperature continues to drop.)
* Go over the three energy movement mechanisms: conduction, convection, and radiation. Ask students for examples of each one.
  + Conduction
    - Condensation on nails poking through the roof deck. Warm air condenses on a cold nail since metal is such a good conductor of heat.
    - Cold metal window frames and other “thermal bridges” like framing.
  + Convection
    - Ideally, attic ventilation creates convective heat loss in the attic on a hot summer day as air flows up and out of the attic, taking heat with it.
  + Radiation
    - Sitting in front of the fireplace, people are warmed by radiation even if the net effect is to cool the room due to extra draft sucking warm air out of the house.
    - Halogen (and to a lesser extent, incandescent) light bulbs warm you if you are using them to light a job site.
    - Microwave ovens heat the food and container, while the surrounding air remains at room temperature.