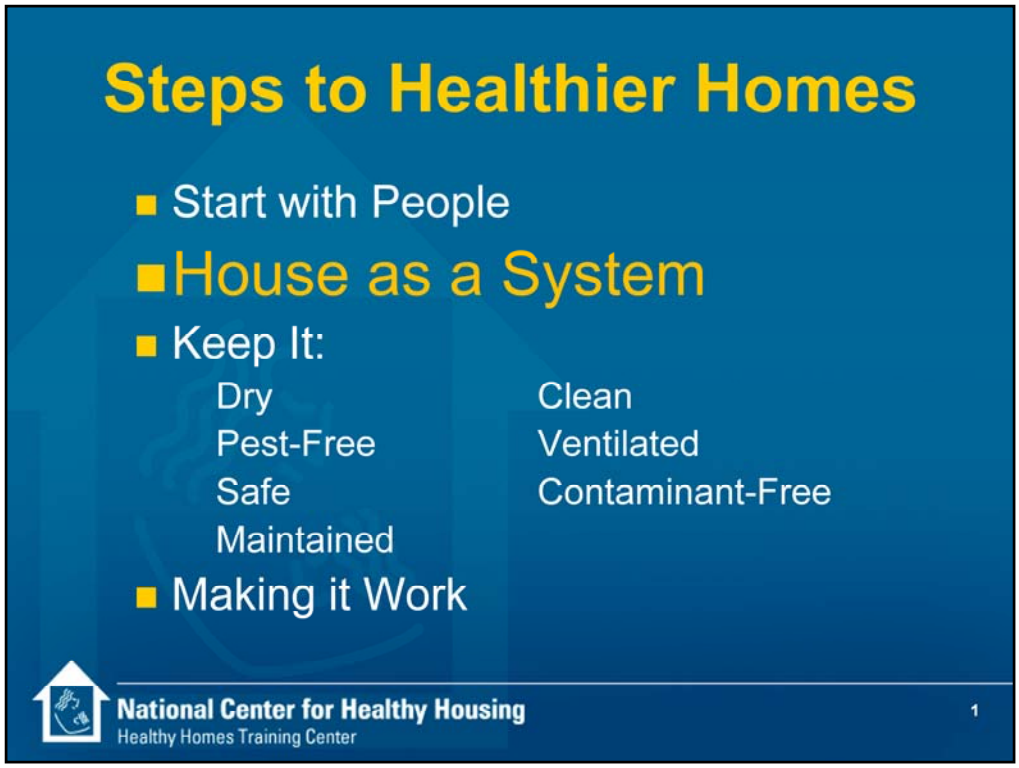


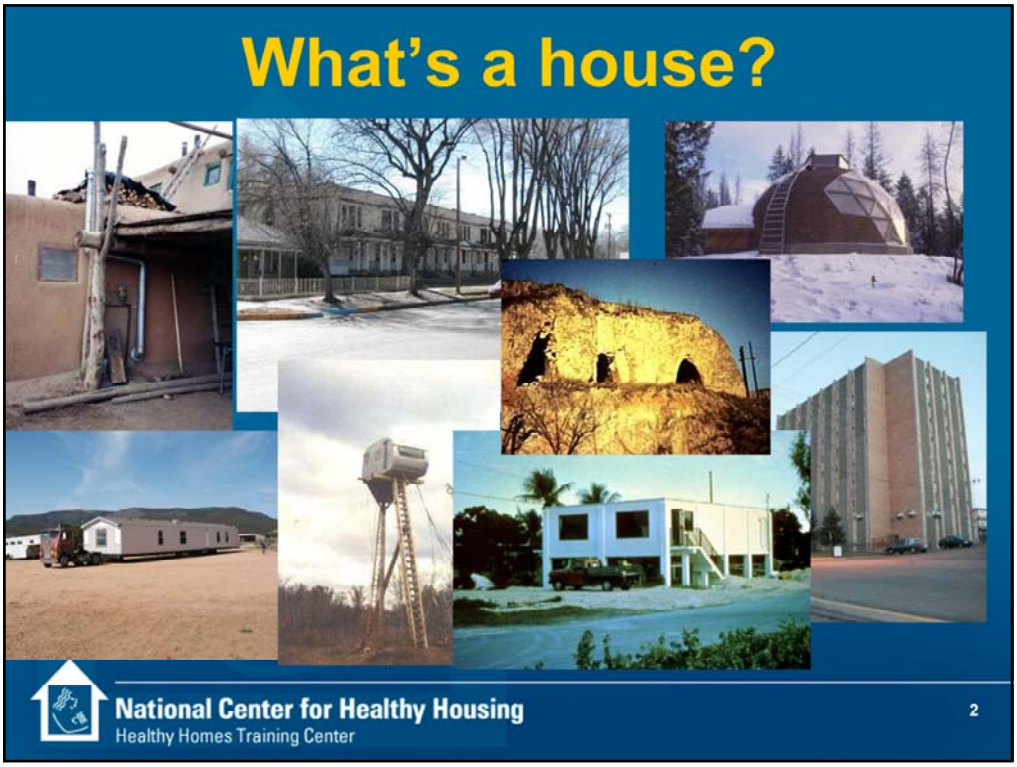
Version 2.2

Version 3/12/09

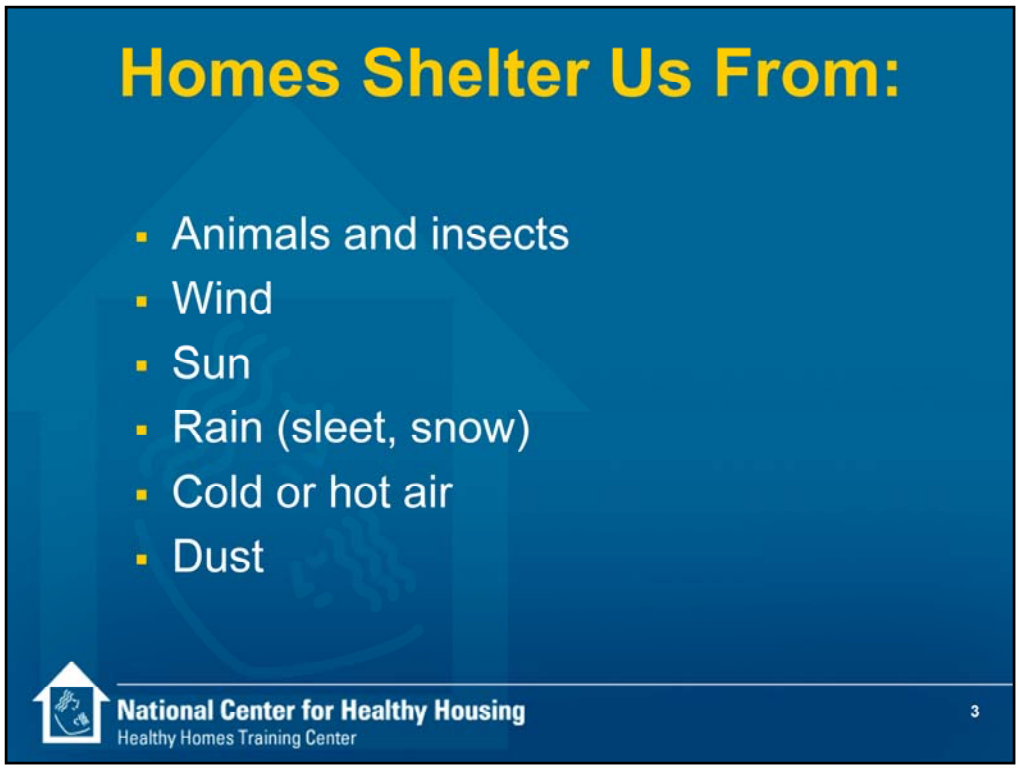
This module has two purposes: help the students see how the house functions as a system and to introduce them to the critical role of air movement in a home. If they do not get these points, they will not understand as well the later materials. Think of this module as introducing them to the Keep It Ventilated module. Since that is covered on Day 2, they need the basics on Day 1.

The focus on the training is a discussion of a typical home. We currently have three types of homes: Two-story home with a furnace and water heater in the basement and a crawlspace; a two-story row house; and a two-story homes with an open crawlspace and air handler in the attic. You can download images of each type at www.healthyhomestraining.org/Practitioner/Materials.htm#References. Use the version without problems.

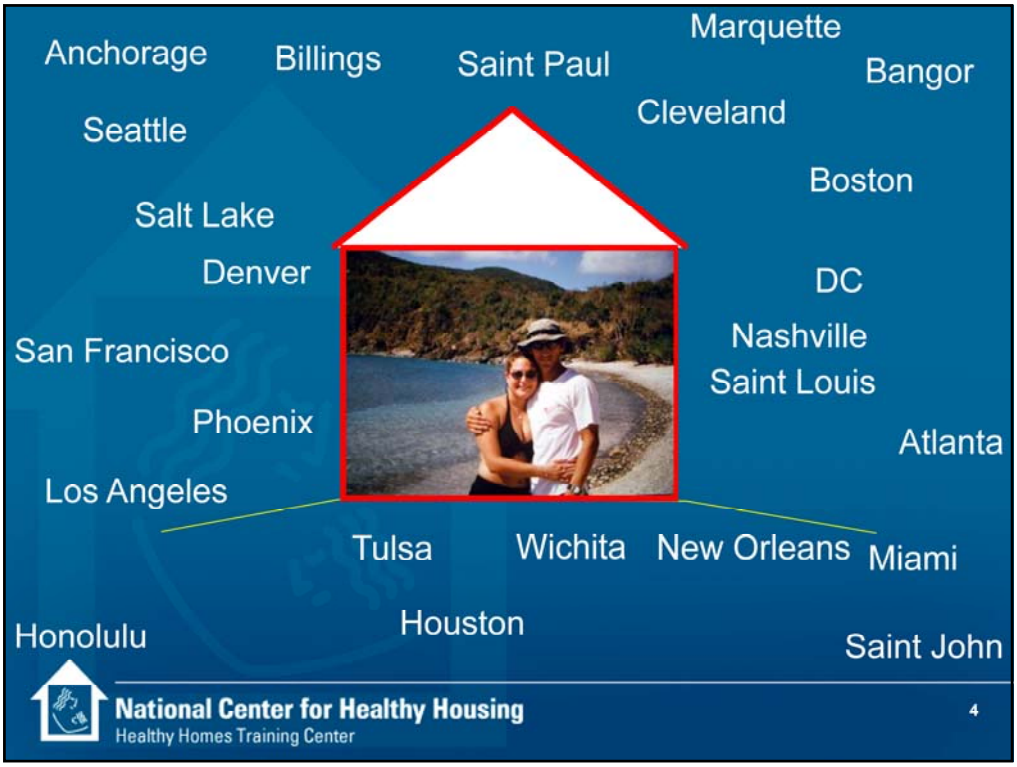
You should view the on-line video of Dennis Livingston covering the House as a System from the perspective of fire, air, water, earth. Go to www.healthyhomestraining.org/On-Line/.



Houses can look drastically different, but they all share a common purpose. Have the students discuss the differences and the types of housing in their community.



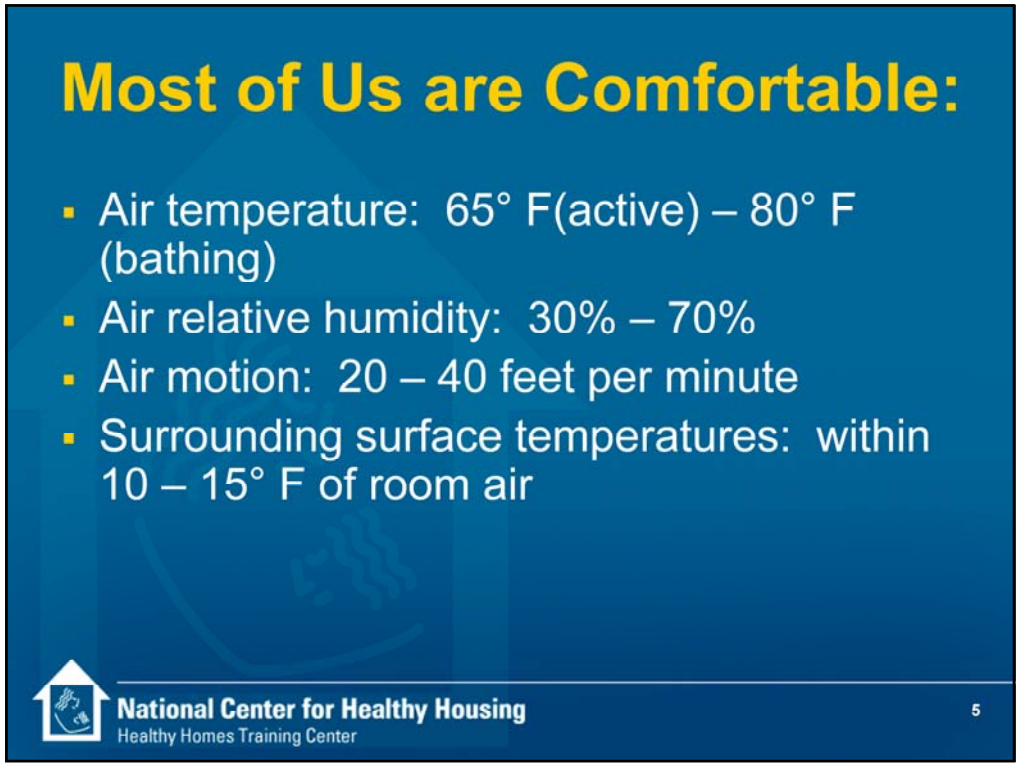
Houses are shelters that protect us from animals, wind, sun, rain, cold, heat, and dust. This slide is straightforward. Use it to remind them of the purpose of a home but move quickly to the next slide.



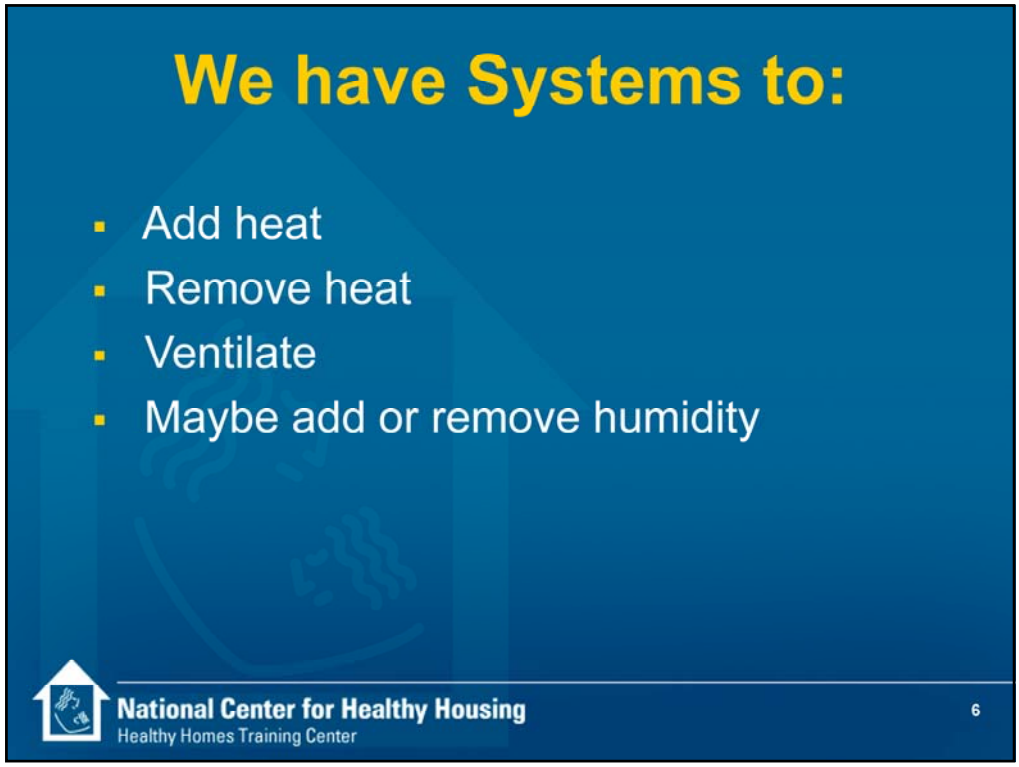
Houses are a way of transporting dry Mediterranean climate to every place on the Earth. Residences may look very different but they must all do the same thing – create a comfortable inside space regardless of what's happening outdoors.

We enclose space with walls, windows, roofs, ceilings, floors and foundations that provide us with shelter from sun, wind and rain and make it possible to heat the space when it is cold out and cool the space when it is hot out. The enclosure is a climatic transition zone whenever outdoor conditions are different than indoor conditions.

Discuss the climate in the community where you are teaching the course and discuss how it may impact a home.

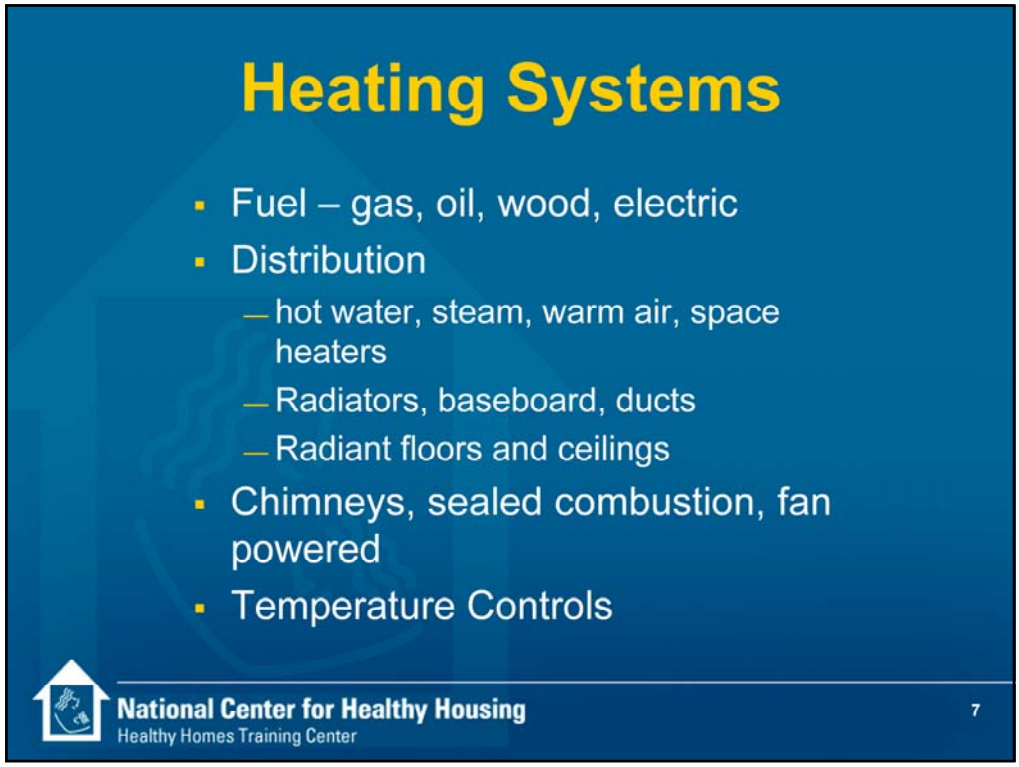


Most people are comfortable in the ranges of temperature, humidity, air speed and surface temperatures shown in this slide. There are of course times when we are not. We are overdressed or underdressed; we are doing heavy work and generating two or three times more heat than when we are sitting; we have just come in from a cold or hot outdoors and have not acclimated to the new conditions; we are simply bored with paradise conditions (hence steam rooms, saunas, cold dips).



The enclosure of a building provides shelter. The mechanical systems do these things to make it more like a Mediterranean climate. They add or remove heat to balance heat loss or gain from outdoors (sometimes humidity loss or gain as well). Things we do in houses generate heat and water vapor – e.g. a person at rest releases around 240 btu of heat and 0.1 pounds water vapor per hour. At higher activity levels this increases. For moderate activity it is more like 800 btu and 0.2 pounds of water vapor are released per hour. During heavy work these rates may double or triple.

In addition to people any piece of operating equipment releases heat – lights, refrigerators, freezers, motors, televisions, and computers.

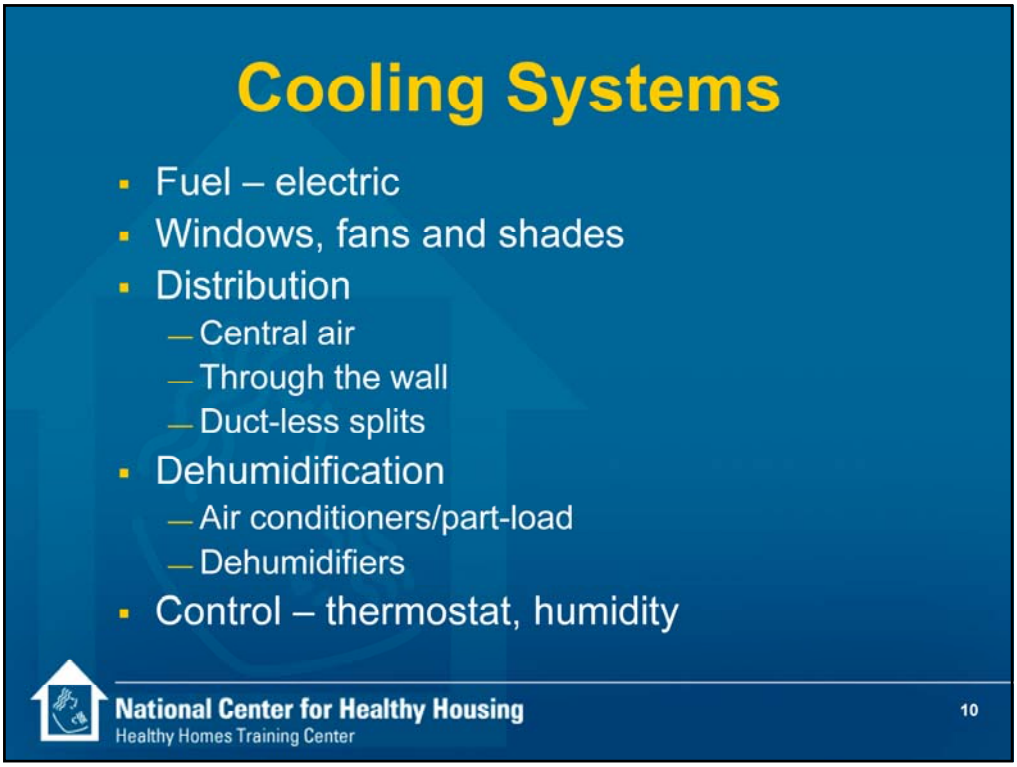


Heating systems can be divided by their fuel source, how they distribute heat to the building, how they vent the combustion by-products and how they are controlled. Heat must be added to a building when the outdoor air cools down and the wind blows. How much heat must be added depends on how well the building has been insulated and air-sealed. The heat released by activities in the building helps to heat it when it gets cold out. An ordinary building has to begin adding heat when the outdoor temperature drops to five degrees below the thermostat setpoint. The heating system in a well-insulated and sealed building may not turn on until the outdoor temperature drops by ten or fifteen degrees.

Left picture: A photo of a gas fired sealed combustion warm air furnace and a power vented hot water heater. A DX cooling coil has been installed in the supply side of the air handler so this is a heating and cooling system. There is no way of inspecting and cleaning this otherwise well designed system. Notice the heat recovery ventilator in the background behind the cylindrical water heater.

Right picture: An oil-fired boiler provides hot water to baseboard radiators. This boiler has a dedicated outdoor air supply ducted directly to the burner air intake.

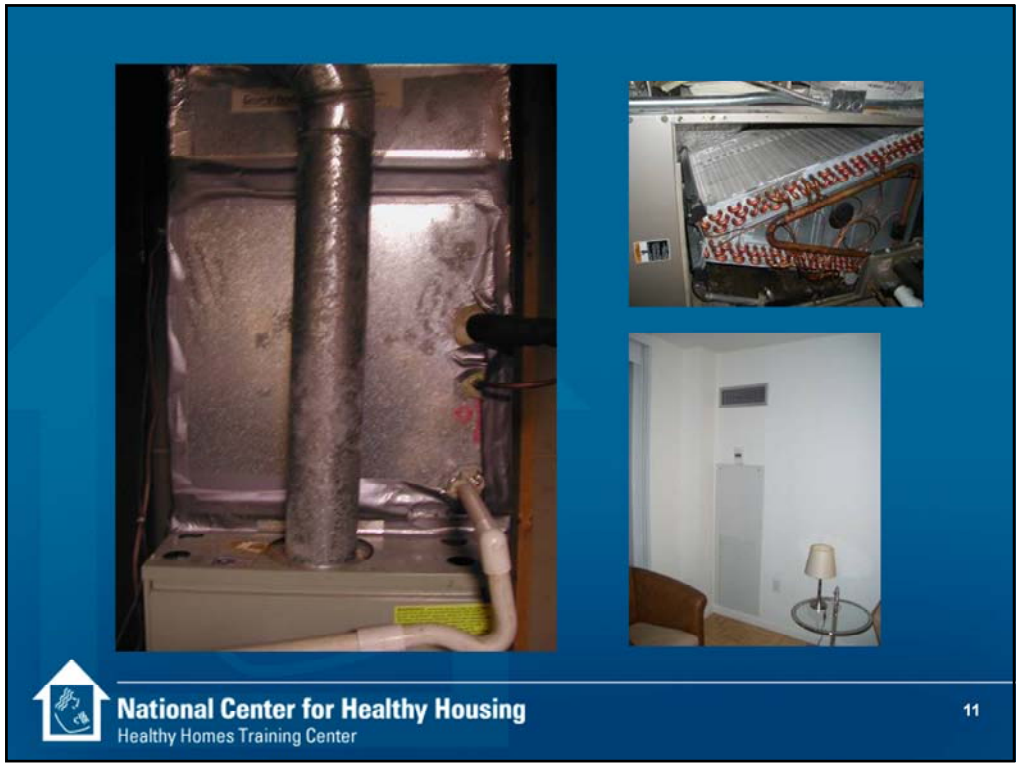
This is a photo of heat exchanger inside a furnace. We are looking at the side where inside air moved. Inside the metal tube is the flame. Two slides forward is a heat exchanger for an air conditioner.



Residential cooling systems are nearly all powered by electricity. There may be one or multiple cooling units. The cool air may be distributed using ductwork or cool air may be blown from the unit directly into the room (window air conditioners and ductless split air conditioners).

Although properly sized air conditioners can dehumidify they are not efficient at it until they run around 20 minutes in each hour. The more oversized an air conditioner is the less it will dehumidify. When this happens people feel cold and clammy – the air cooled to the setpoint but it is humid. The first step is to size the unit correctly. Many ductless split systems have electric resistance reheat in them to improve humidity control and in fact can often be controlled by a humidistat as well as thermostat.

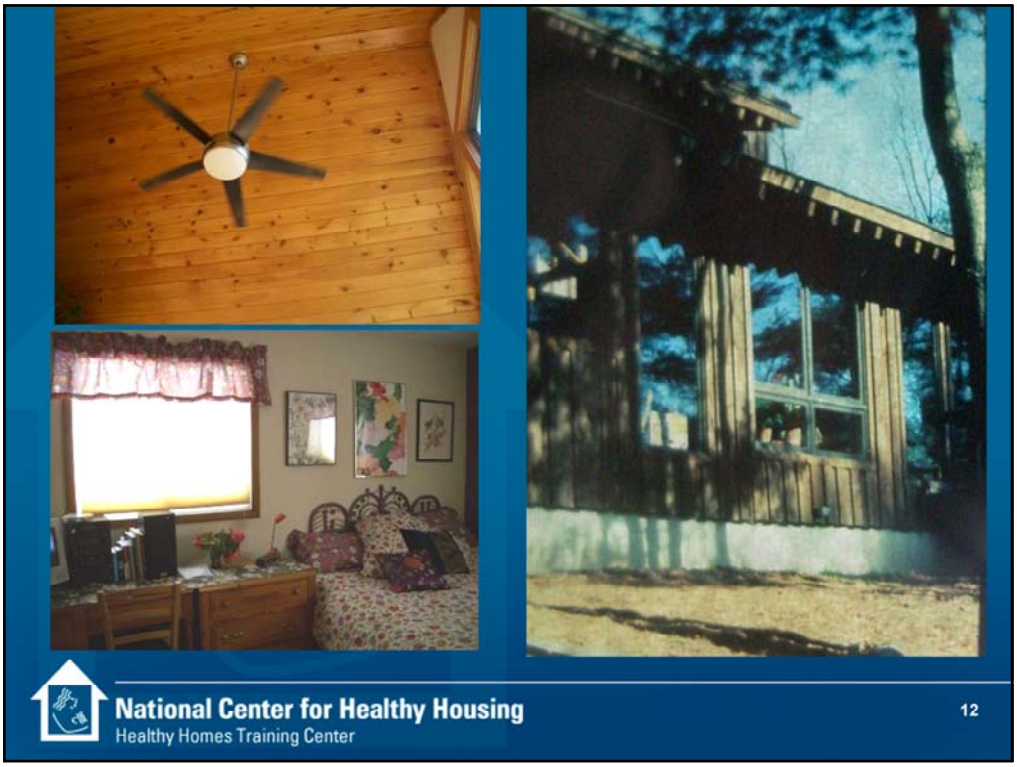
A dehumidifier is an air conditioner that uses the heat it removes from the air to reheat the cold air rather than dumping the heat to the outdoors. A small dehumidifier can be used in combination with an air conditioner to provide both temperature and humidity control.



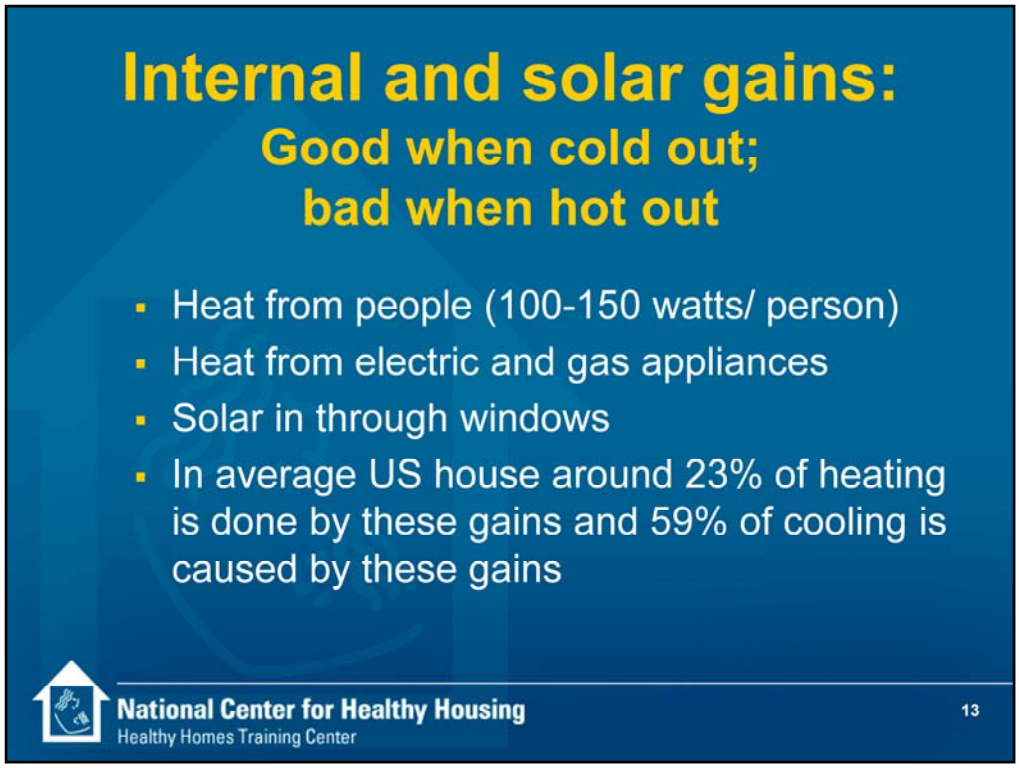
Left: a picture of a warm air furnace with central air conditioning. There is no way to inspect or clean the coil without opening up the ductwork.

Bottom right: a electric heat pump in a multi-family building.

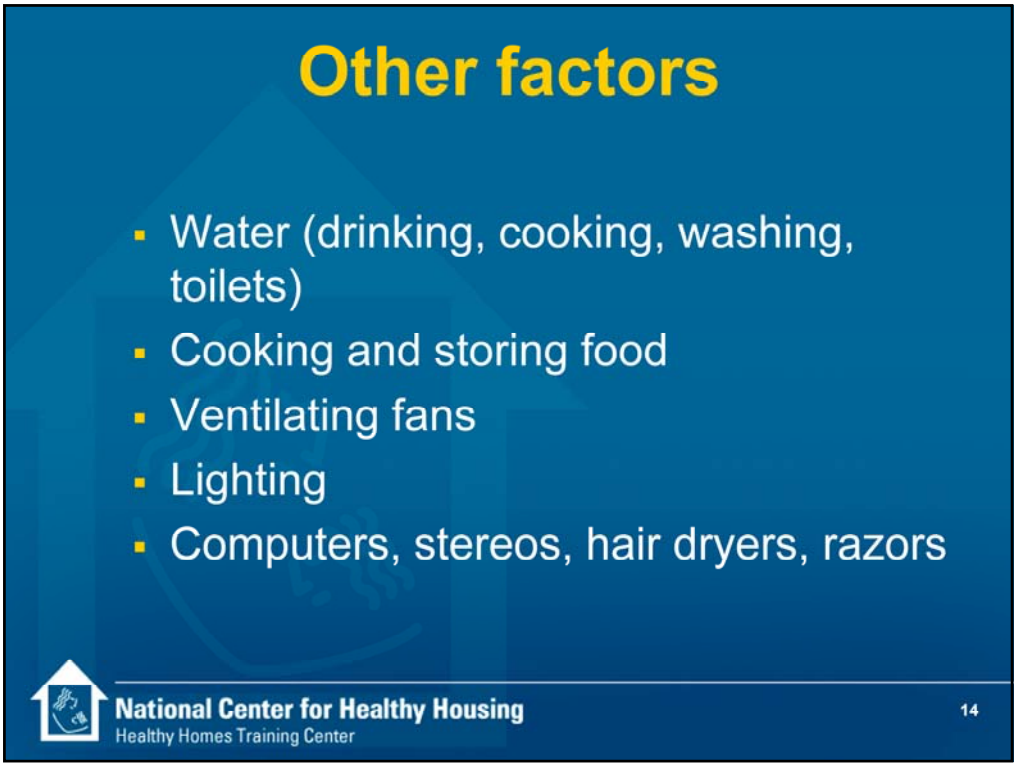
Upper right: an A-coil in a horizontal DX air conditioner.



A significant amount of cooling can be done by blocking the sun (trees, high performance windows, shades) and providing recirculating fans and venting equipment that produces heat (ranges).



Heat from occupants and activities and sunlight shining through the windows can help heat the house when it is cold out, but add to the cooling load when it is hot out.



Again the home and the real world is complex. There are other things that are going on in the house that affect temperature and moisture.

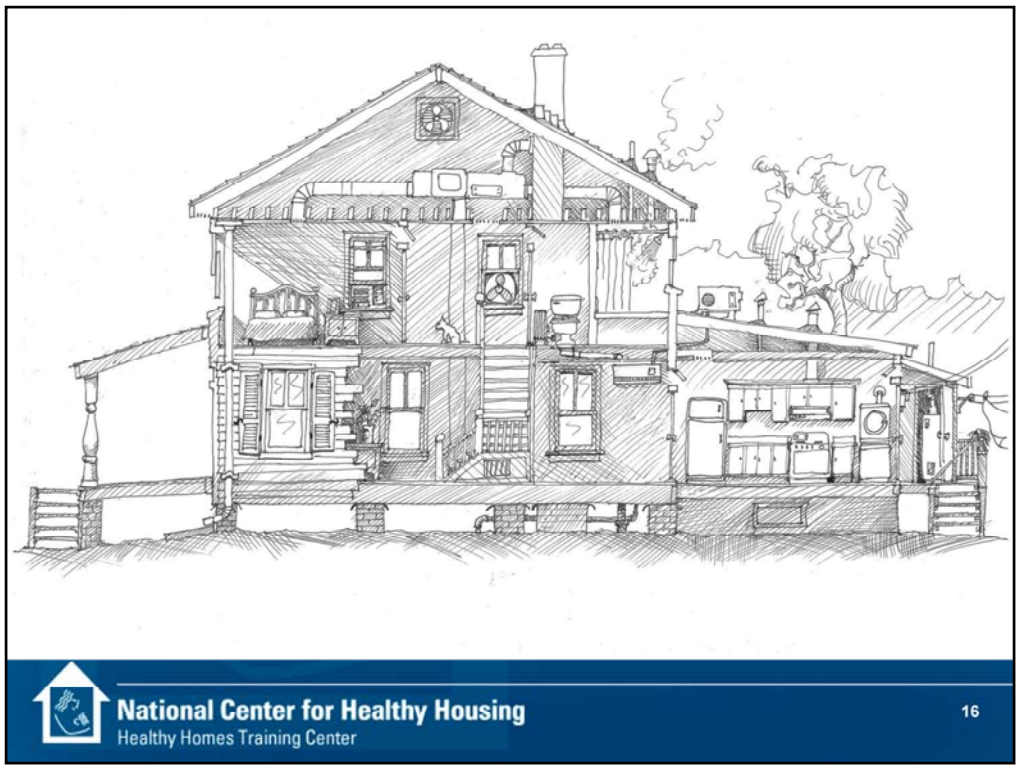
Once people are in the building they need to cook, wash, groom, work, entertain and use the bathroom. Somewhere water comes into the building, does a number of jobs and leaves through a sewage pipe. How does that happen? Where does it happen?

The same is true for electricity and air. Ventilation fans are found in bathrooms and kitchens.

In your trainers packet, you should have larger drawings of different homes: two story with basement, two-story without basement, and a row house. Pick which type you want to use for your interactive discussion of the house using the one that is most relevant to where you are training. You could show the others to highlight the differences.

You need to treat this as an interactive exercise with the students. Start by identifying the sources of fire. Explain where the air comes for the fire and where the burned air goes. Then move to sources of heat that may not involve fire such as rotting garbage, people or pets, and the sun. Don't forget the sun. Highlight places that might have exhaust fans. The key point to make is that we are moving air out of the house. Therefore, air will come in to make up for the lost air. Explore where the air comes from. Without a controlled source of fresh air, it will come from through the foundation or the crawlspace (carrying moisture and radon with it) or through the walls. This is not we want people to breathe. Drive the point home by explaining that houses "suck." You will get a chuckle with this word but they will remember it. You need to build on this theme throughout the course.

If the home has a furnace in the attic, emphasize the impact of air loses into the attic from the air handler. These losses air condition the attic wasting energy. They also act like a big exhaust fan causing the home to suck. How much air is lost depends on how well installed the ductwork is. A duct blaster is a piece of equipment to test the duct for leakage. There have been studies that have found that half the air is lost in the attic.



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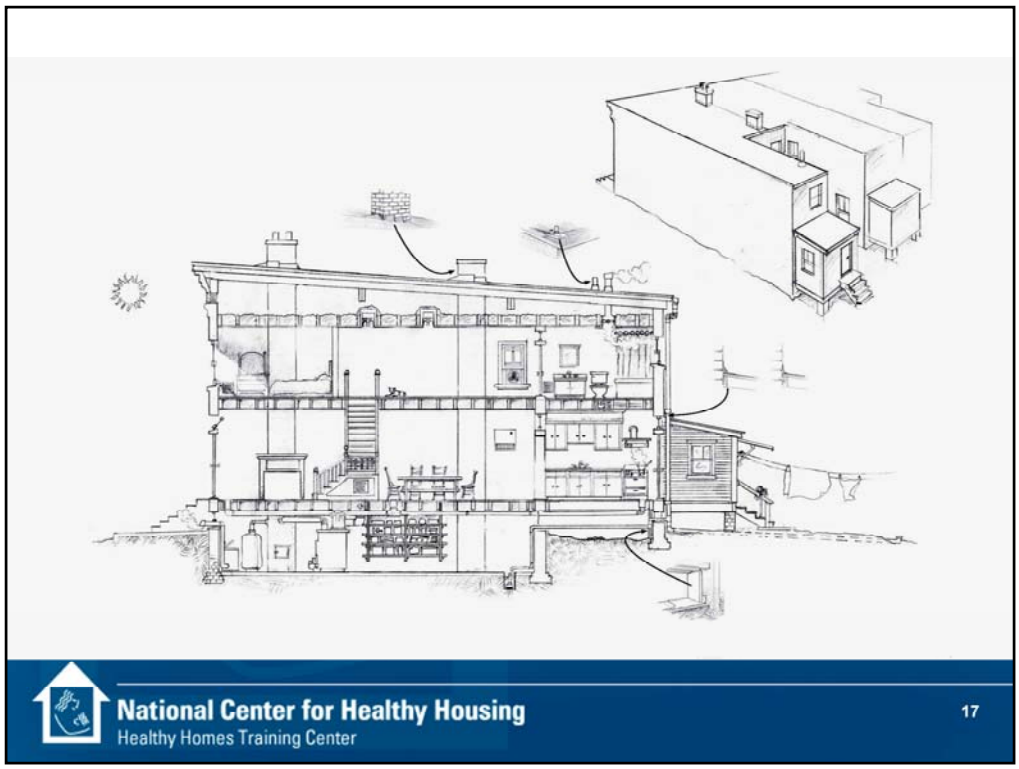

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