

# make a difference

radiation  
convection  
conduction

## Science of Sustainability



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Be a **heat science detective!**

This **heat loss survey** will help you find the  
ways energy is being lost in your house and  
how to use different simple tools to detect  
those energy losses.

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**Project SOS | the Science of Sustainability** operates through the  
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## Be a **heat science detective!**

Here are ways you can explore your house or other buildings to find out if and how energy is being lost.

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### **Questions to ask yourself?**

Which way does the heat energy flow? Is it through convection, conduction or radiation? Is the air flow into or out of a gap? Is it just circulation within the room and not leaving the house? What detective tools worked best and why?

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### **Find the likely suspects!** Look around your house, inside and outside.

#### ***Outside of your house...***

- All exterior corners
- Outdoor water faucets
- Where siding and chimneys meet
- Areas where the foundation and the bottom of exterior brick or siding meet.

#### ***Inside your house...***

#### ***Inspect for any cracks and gaps that could cause air leaks:***

- Electrical outlets
- Switch plates
- Door and window frames
- Electrical and gas service entrances
- Baseboards
- Weather stripping around doors
- Fireplace dampers
- Attic hatches
- Skylights
- Wall- or window-mounted air conditioners.
- Cable TV and phone lines
- Where dryer vents pass through walls
- Vents and fans
- Basement or crawl space
- Ductwork – any ducts through unheated spaces should be sealed, check for air leaks. Are there dirt streaks near seams? Or spider webs?

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### **In your tool kit:**

- contact thermometer
- puffer to detect convection bottle
- flashlight
- piece of paper to put under a door or window when closed to see if it's easy to pull out
- post-its to mark where trouble spots are
- finsel
- pencil

# This is all about air leaks and air movement

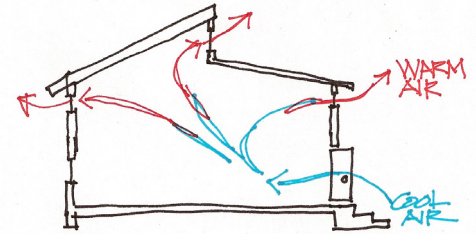
## Convection

(drafts that transport warm air out of living space)

### How does this happen in your home?

**Air leaks:** Heated air will escape from living spaces to the outside or into unheated parts of a house.

If there is an opening low in the house, the loss of hot air is even faster, like cold air drawn into a chimney.



### Find the likely suspects!

Look for **gaps** in doorways, walls and windows where air could get through.

### How do we detect these air leaks through convection?

For air to escape, we need to detect the flow of air taking the heat away.

### Tools:

Squeeze the **puffer bottle** gently when it is on its side, a smooth steady stream of dust will come out that is **very sensitive to drafts**.

A piece of **tinsel** or fine thread on a stick will move like a flag in the wind if there is a draft.

Use the **flashlight** or the **piece of paper** to look for gaps. If you can see through the gaps or shine light through, air will go through it too. If a **piece of paper** can slide between a door and its frame, **air can get past too**.



**What to look for:** Air flow through gaps in walls, windows, doors.

location	tool?	your observation...what do you see...what's happening?	what could you do to reduce the heat energy loss?
window frames:			
living room bedroom			



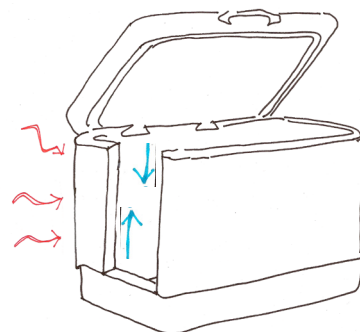
# This is all about how heat transfers through materials

## Conduction

(movement of heat through and between two materials in contact)

### How does this happen in your home?

If a wall, door, or window **conducts (moves) heat well**, on a cold day, energy from inside will **conduct (move) outward** through it. On a hot day, heat energy from outside will easily conduct to the inside of the house. This is why coolers are made of materials that are poor conductors of heat like rigid foam instead of materials made of good conductors of heat like metal.



### Find the likely suspects!

Single-pane windows: windows can have a much higher conductivity than walls if they only have one pane of glass in them.

Building materials that conduct heat well: **metal** frames on windows, **metal** doors and **un-insulated** roofs or ceilings. To compare two materials that are at the same temperature, touch each with your hand. The better conductor will feel colder as heat energy conducts away from your hand more easily.

### How do we detect heat **conduction** (movement)?

Hot or cold spots on the inside surfaces of walls, ceilings, floors, windows, or window frames will indicate places with good conduction - that's where the heat moves more easily.

### Tools:

Put your **hand** on a surface. If the surface material is much colder than your hand (which is about 85 °F) then your hand will feel cold.

A **contact thermometer** is even better than your hand since it can measure smaller differences in temperature.



You can use your **eyes** to spot surfaces that are warmer than others.

When it is cold out and it has snowed, a roof that conducts heat and becomes warmer will melt the snow very easily.

**What to look for:** Using your hand or thermometer, compare the wall with the temperature of objects in a room (coffee table, closet door). Are there outside surfaces of your house that are colder than the objects in a room?

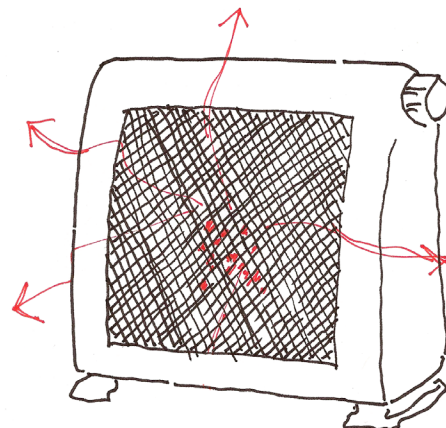
location	tool?	your observation...what do you see...what's happening?	what could you do to reduce the heat energy loss?

# This is all about losing heat energy through invisible light Radiation

(energy loss in the form of invisible infrared light leaving a surface of anything)

## How does this happen in your home?

**Any surface will radiate energy away** from it. A surface that is relatively cold will absorb more radiation than it gives off. By insulating outside walls, heat-energy from the inside cannot get to the outside surface to radiate away. Radiation passing through windows can be minimized if they are coated with the right materials. This can keep heat-energy inside during the winter and keep your house cooler during the summer



## Find the likely suspects!

**Building surfaces:** does the a snow covered roof show melted spots? If so, the roof was warm enough to melt snow and it must be warmer than the surrounding surfaces and radiating energy. **Windows:** single-pane glass allows too much energy to get in (summer) and too much energy to get out (winter).

## How do we detect if radiation is happening?

Measure the temperature of a surface. If a surface is warm, it will be radiating away heat energy. The hotter the surface, the more it is radiating. Measure the increase of the temperature of a surface due to light coming through a window.

## Tools:

Use the **contact thermometer** to measure surface temperatures. Put your **hand** a short distance away from the walls and windows to see if it feels hot or cold. If the temperature is below body temperature, your body is radiating more heat to the surface than the surface is radiating back to you. If the object is warmer than your hand, your hand will feel warmer. Put your hand into a sun-beam passing through a window. Does it feel warmer than when you block the light from the window? If so, then the window is good at letting radiation through.

## What to look for:

Surfaces that are heated that don't need to be heated.  
Windows that transmit radiation easily.

location	tool?	your observation...what do you see...what's happening?	what could you do to reduce the heat energy loss?

Do you have additional observations on **convection**, **conduction** or **radiation**? Note them here.

location	tool?	your observation...what do you see...what's happening?	what could you do to reduce the heat energy loss?

**Check how hot your tap water is** at your house by using the “Hot Water Gauge” card.

Read and follow the directions to find out if you should turn down your water heater thermostat to use less energy, be safer, and save money! *Describe what you discovered and what your family decided to do about your hot water temperature:*

**Create a windy day!** The best time to check doors and windows for places where heat can escape or cooler air can come in, is when it's a windy day. However, you can create conditions like a windy day by closing places where air normally comes in (windows, vents, etc.), turning on any exhaust fans in the house, and using a box fan in one window to blow air out of the building. That will cause outside air to rush in wherever it can and will make it easier to see where there are gaps, etc.  
*Describe what you tried and what you discovered:*