Beyond Diagnostic Testing: An Interpretation of Home Performance

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Tessa Murry
B.S. Residential Building Science
BPI Building Analyst Certified

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Who determines if a home has a performance problem?

Who's qualified to diagnose these problems?

Who's qualified to fix them?


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INDEX

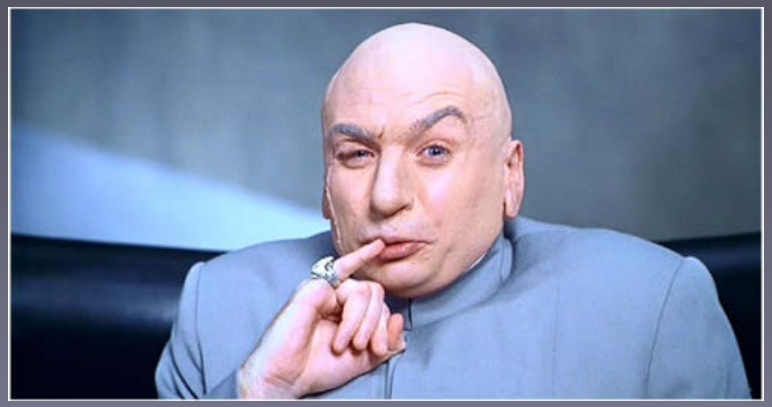
KEY POINTS

1. Understand the basics of building science
2. Diagnostic testing strategies for existing homes
3. Creating sound resolutions
4. Case studies: Interpreting diagnostic testing data

Goal

- Use building science to effectively diagnose and resolve home performance issues

How complicated can it be?



BIG PICTURE

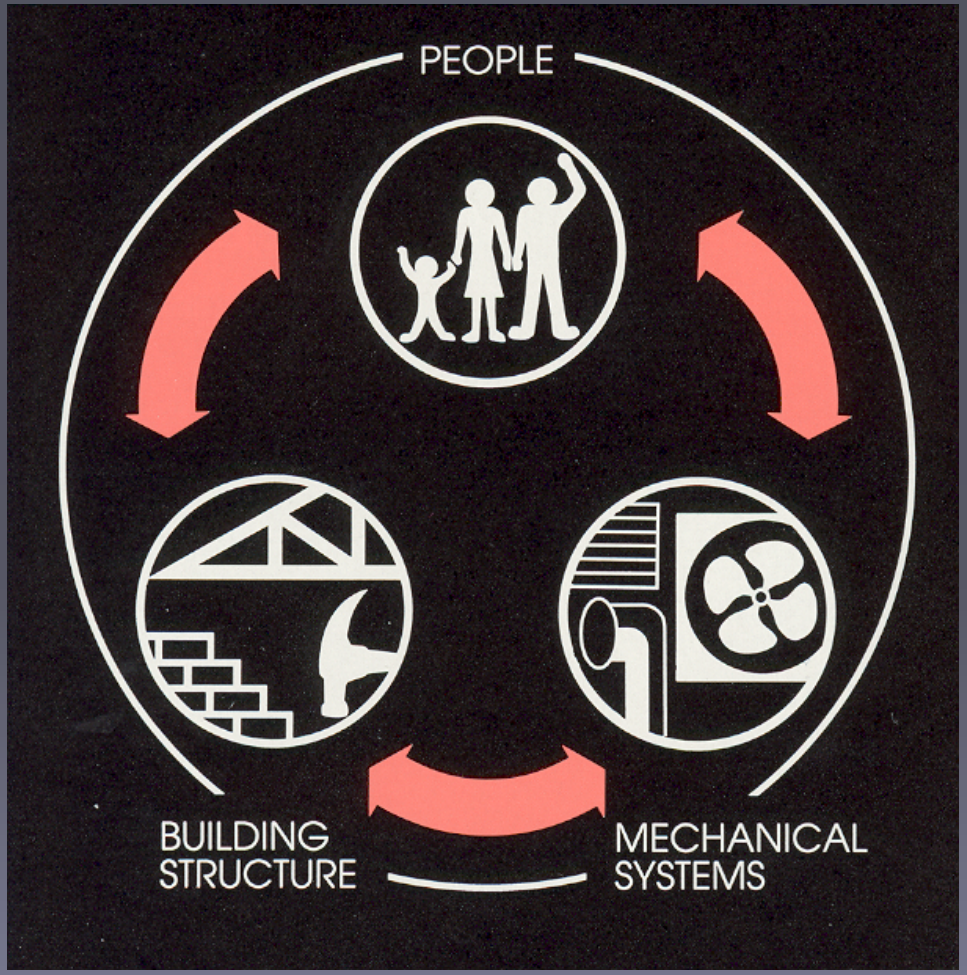
Why Is Building Science Important?

- Provide houses that are:
  - Comfortable
  - Durable
  - Energy Efficient
  - Healthy for Occupants
  - Better for Environment

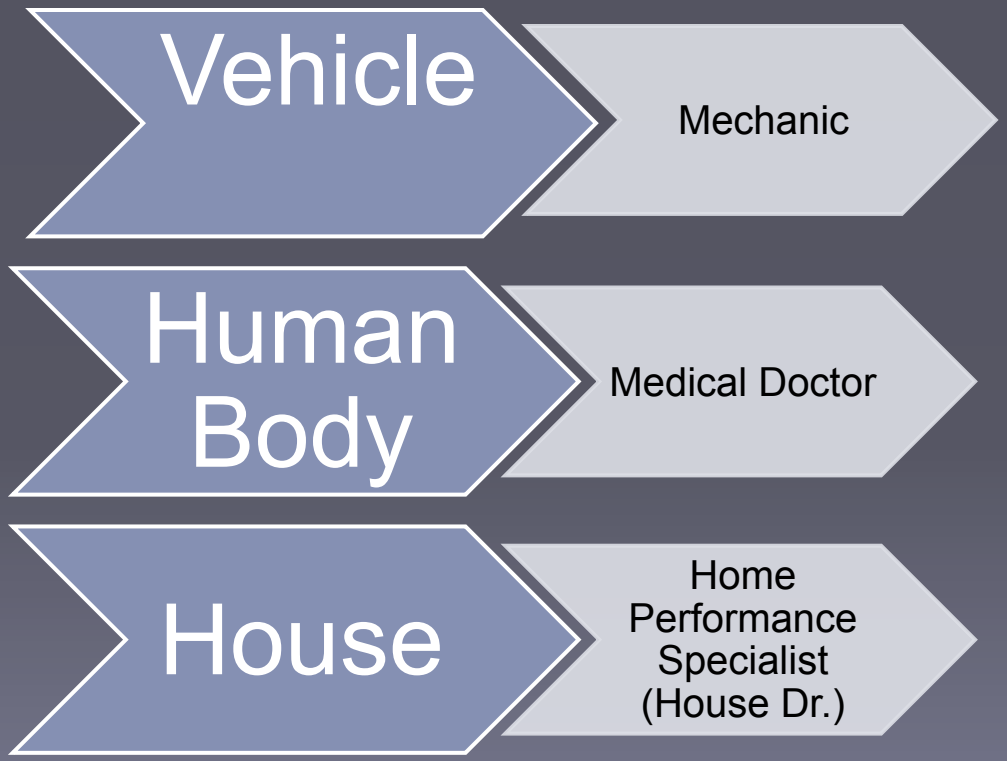
KEY POINTS

1. Understand building science

If you haven't heard…
The house is a SYSTEM



Houses are Becoming More and More Complex



Understanding the Basics:

BUILDING SCIENCE REVIEW

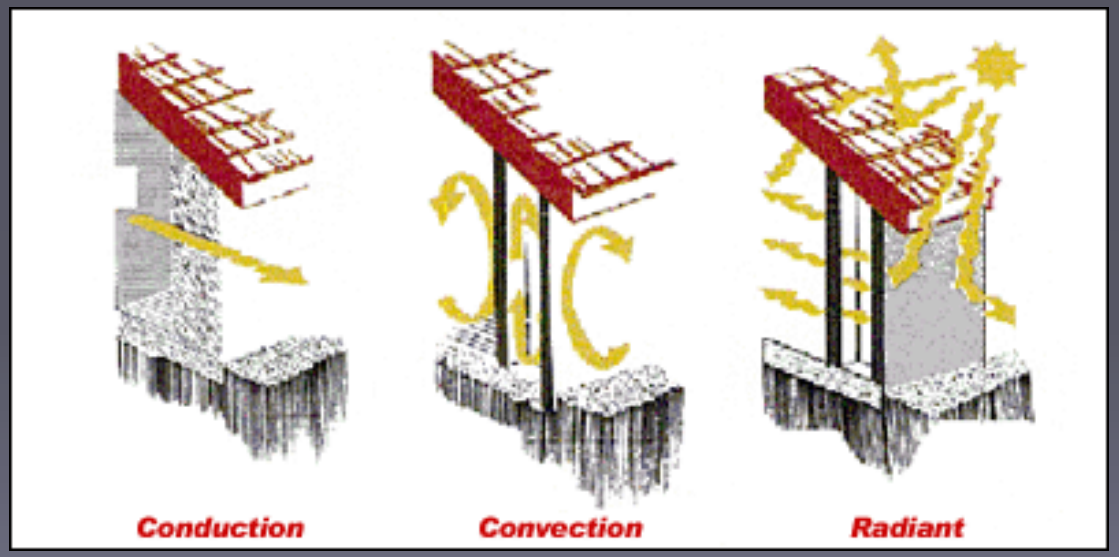
- HAM
  - Heat
  - Air
  - Moisture

Nerd Alert!

1. Heat Transfer

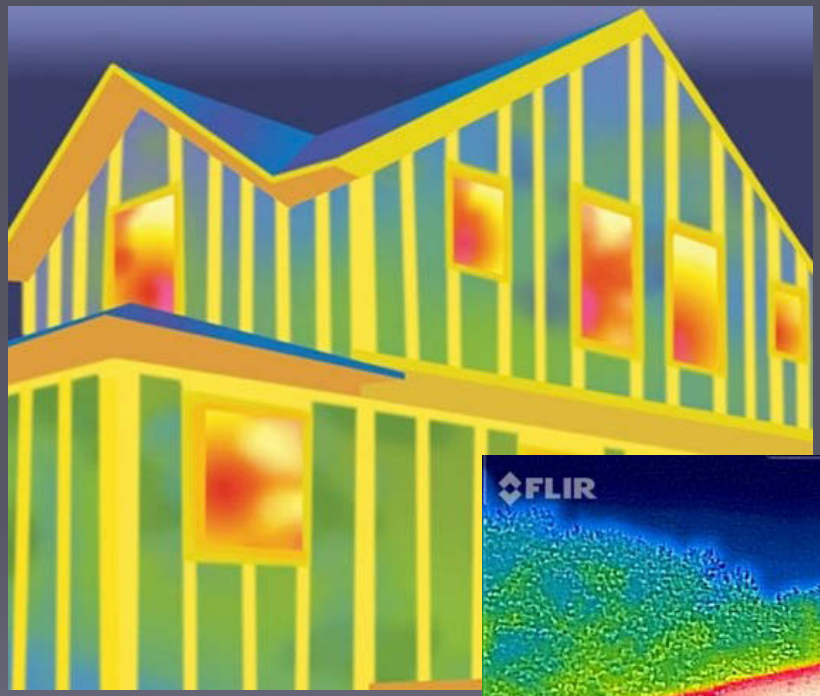
Heat moves from HOT to COLD
(more energy to less energy)

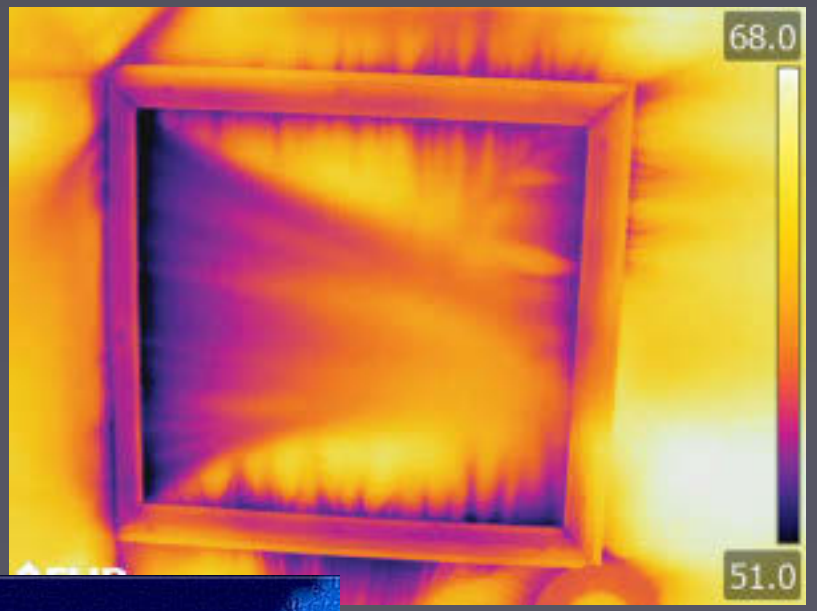
- Conduction
- Convection
- Radiation



http://blocktheheat.com/Assets/Foil%20Pics/typesofheat.gif

Heat Loss / Gain

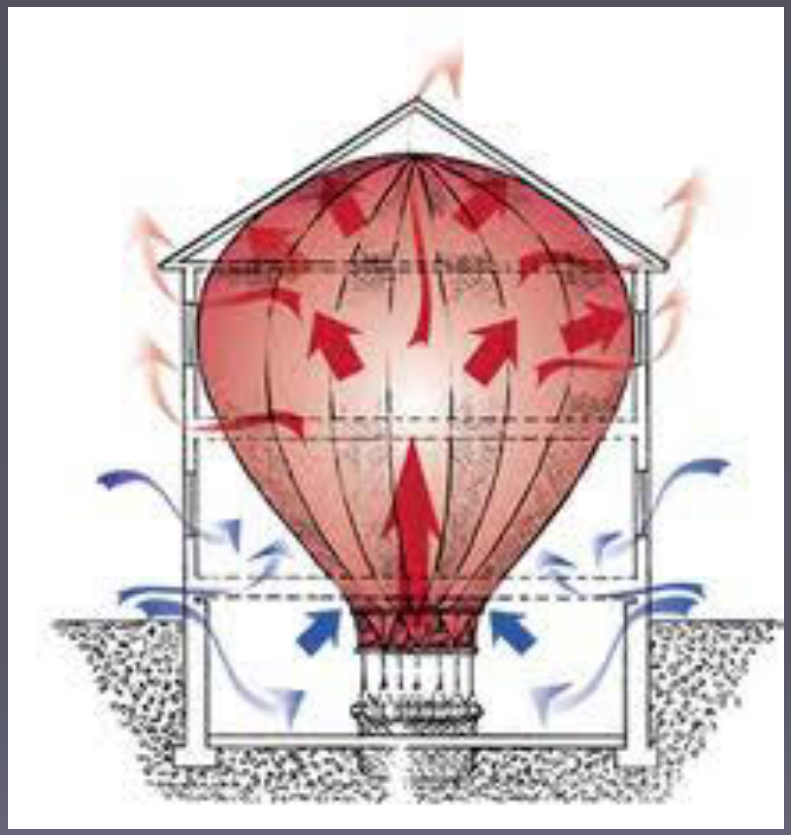




2. Airflow

- Rate of airflow is a function of hole size and pressure difference
- Air flows from areas of high to low pressure

Stack Effect



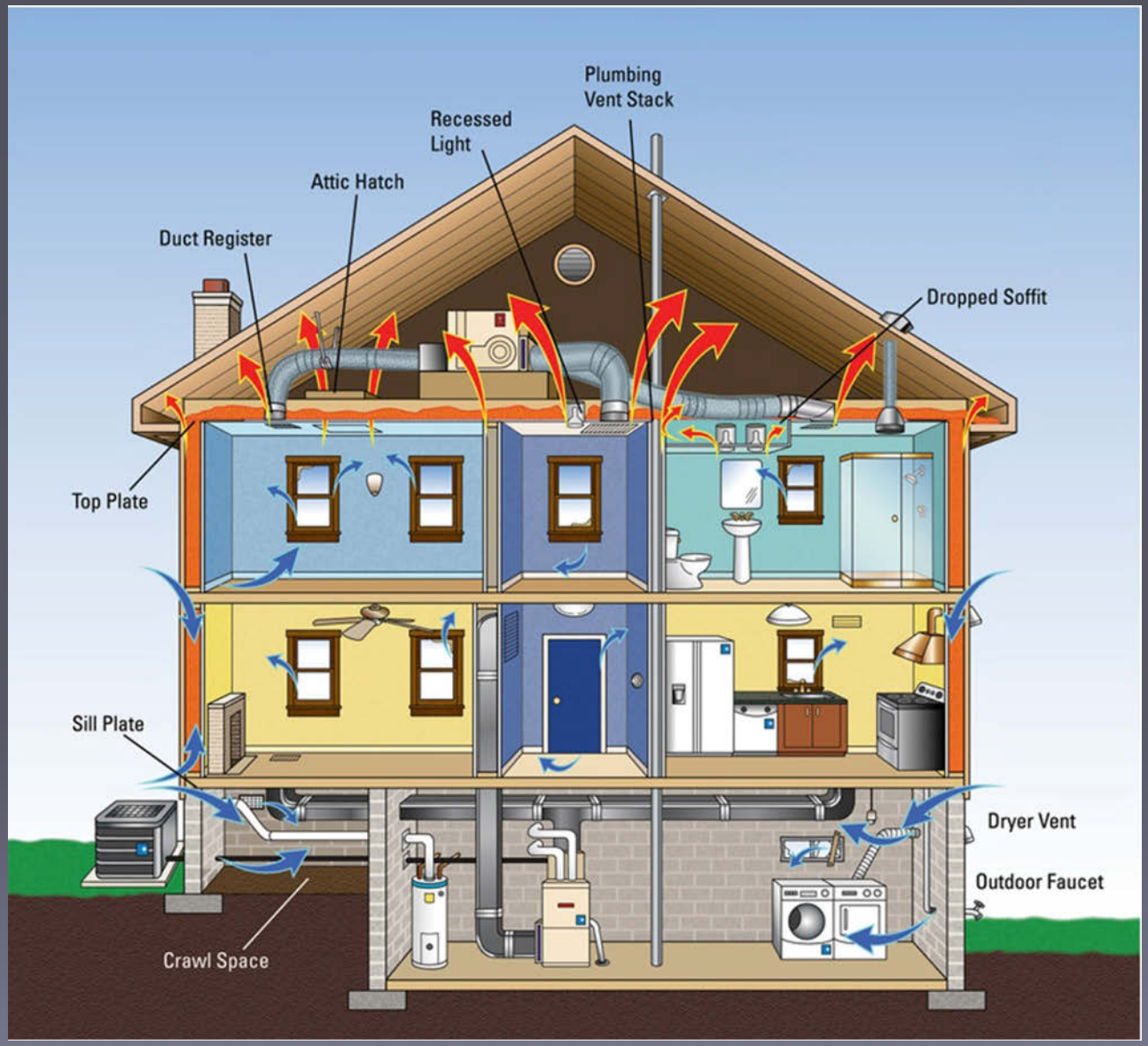


Image courtesy of Energy Star

3. Moisture (Always the Enemy)

3 Phases (Forms)

- Solid - ice
- Liquid - rain
- Gas / vapor - humidity

Moisture Continued

- Moisture Transfer – moves from wet to dry & high to low pressure
  - Liquid – bulk water & capillary action
  - Vapor – air flow & diffusion

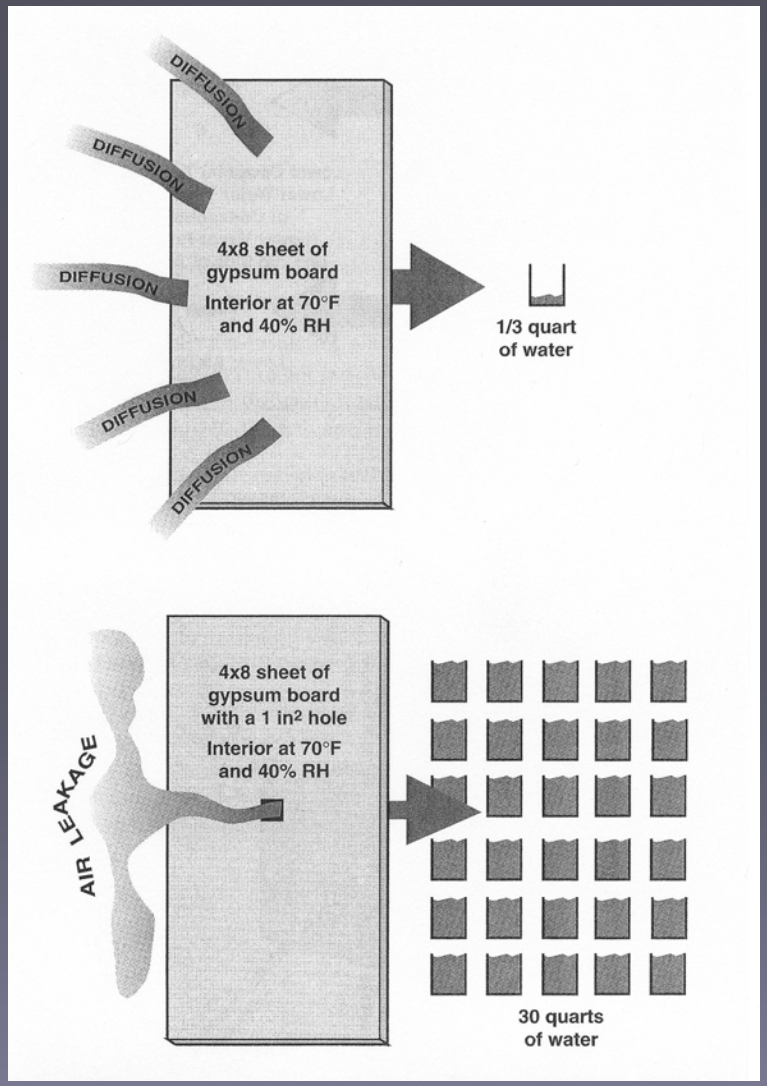
Moisture Transfer: Liquid

Bulk Water

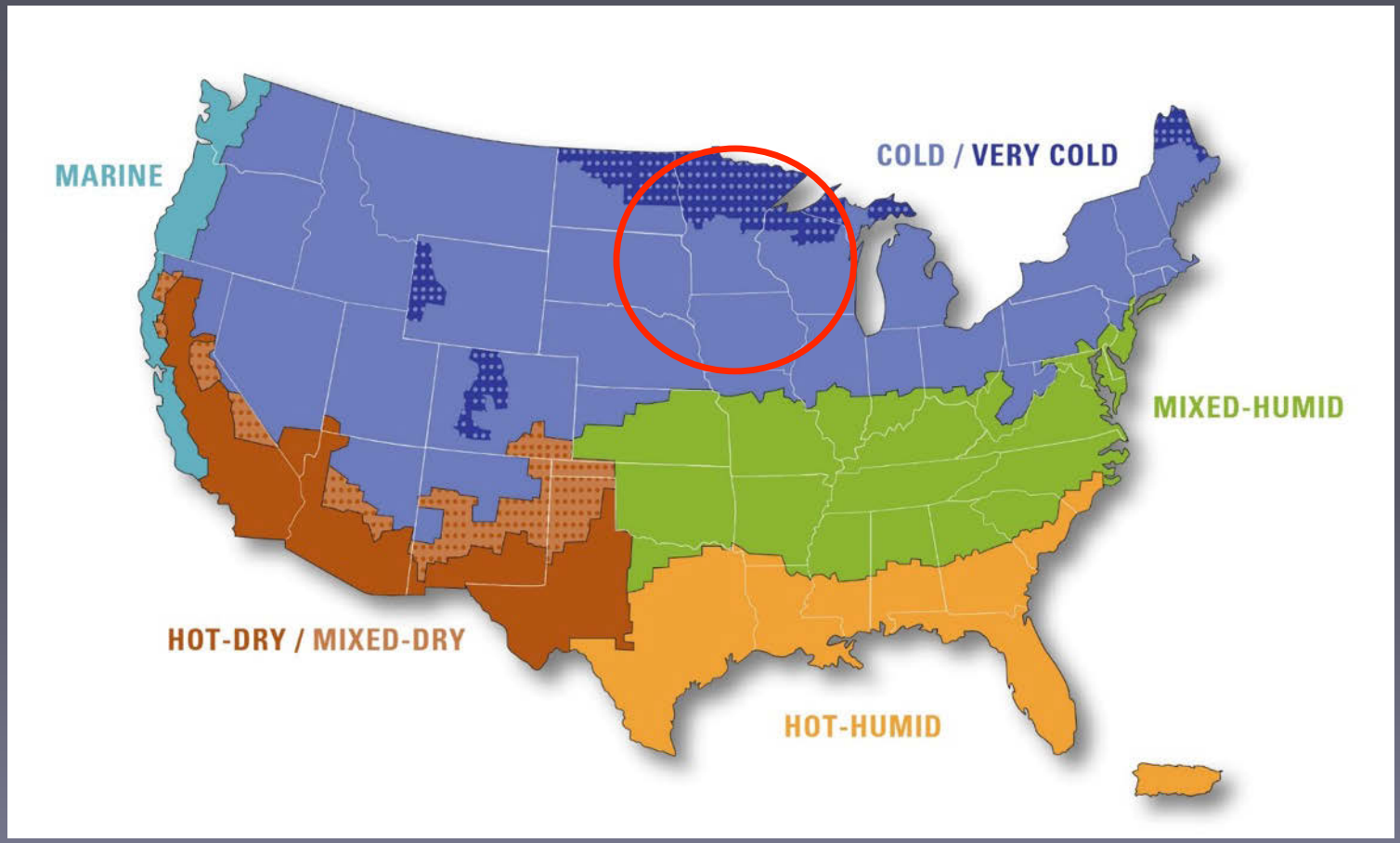
Capillary Action

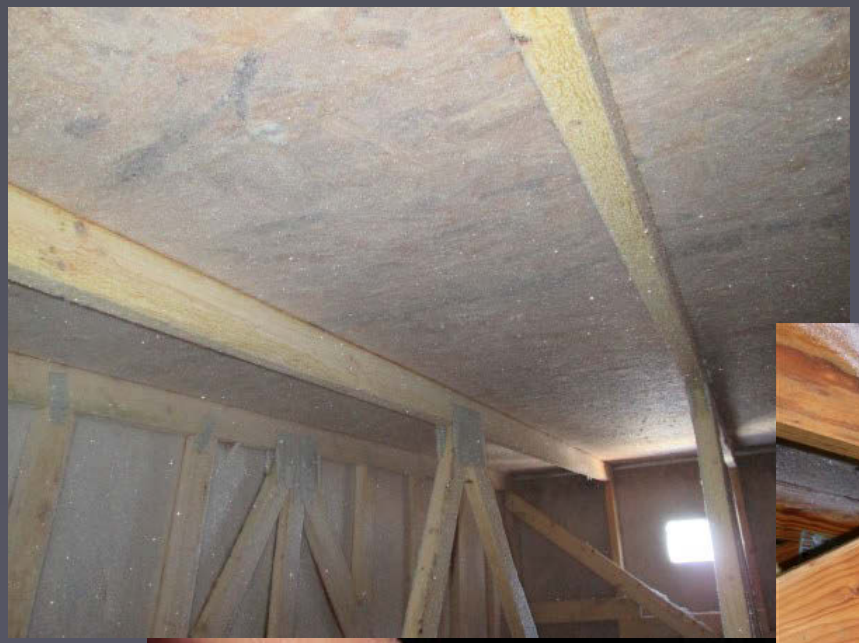
Moisture Transfer: Vapor Drive

Airflow vs. Diffusion



What can vapor drive via airflow look like in a “cold / very cold” climate?





Now apply those concepts to understand…

Cause and effect of:

- Heat transfer
- Moisture transport
- Controlled and uncontrolled airflow
- Building durability
- IAQ

Big Picture

1. Understand the basic physics behind performance issues in a house

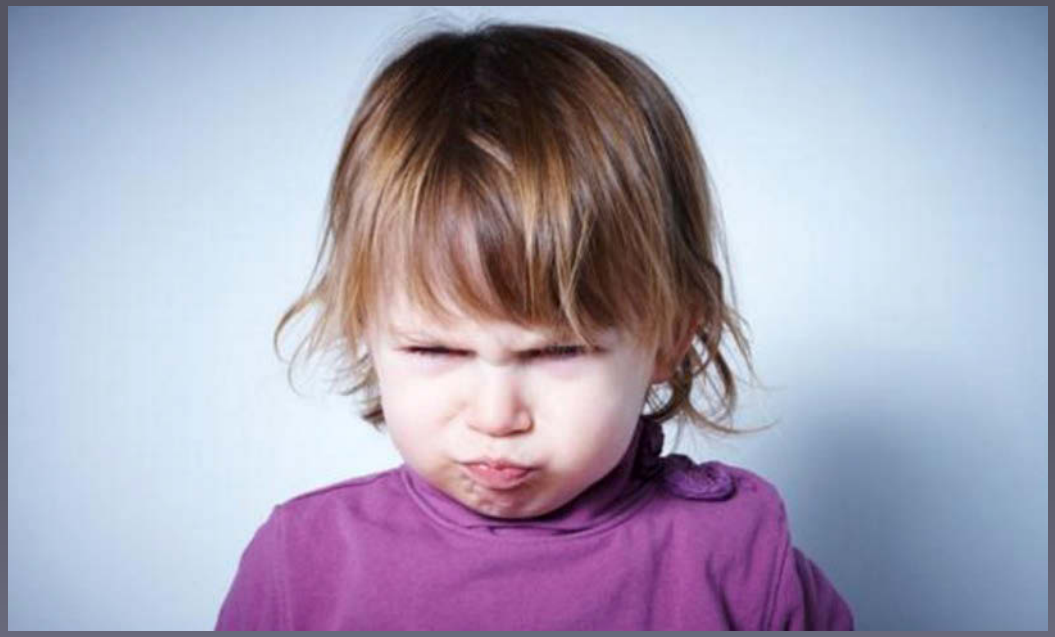
2. Use those concepts to properly diagnose, resolve and prevent performance issues from reoccurring

Importance of Testing

- Goal: Determine the root cause(s) of the “pain” and assess the fragility of the house as a system before any work is done to limit liability and risk (building durability and occupant health and safety) and create measurable results.

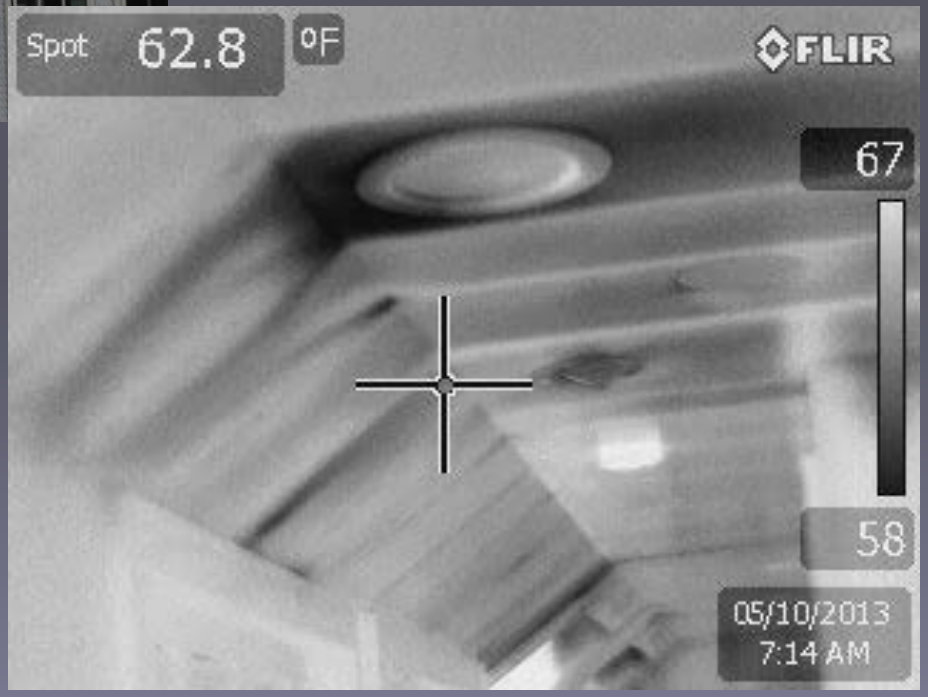
In other words: fix the real problem without making anything else worse!

Building science can be frustrating for those that tend to think in black or white because it tends to be all shades of gray…



Gray Area

Examples of a “sick” home…


Spot 62.8 °F
FLIR
67
58
05/10/2013
7:14 AM

Recipe for a High Performance House

- Control Layers
  - Water
  - Vapor
  - Air
  - Thermal
- Equipment / Mechanicals
  - Safe
  - Effective
  - Efficient

Factors Influencing Performance

- Design
- Construction
- Materials
- Climate
- Location / Site
- Occupant Behavior
- Physics

ALIGNED THERMAL BOUNDARIES AND AIR BARRIERS

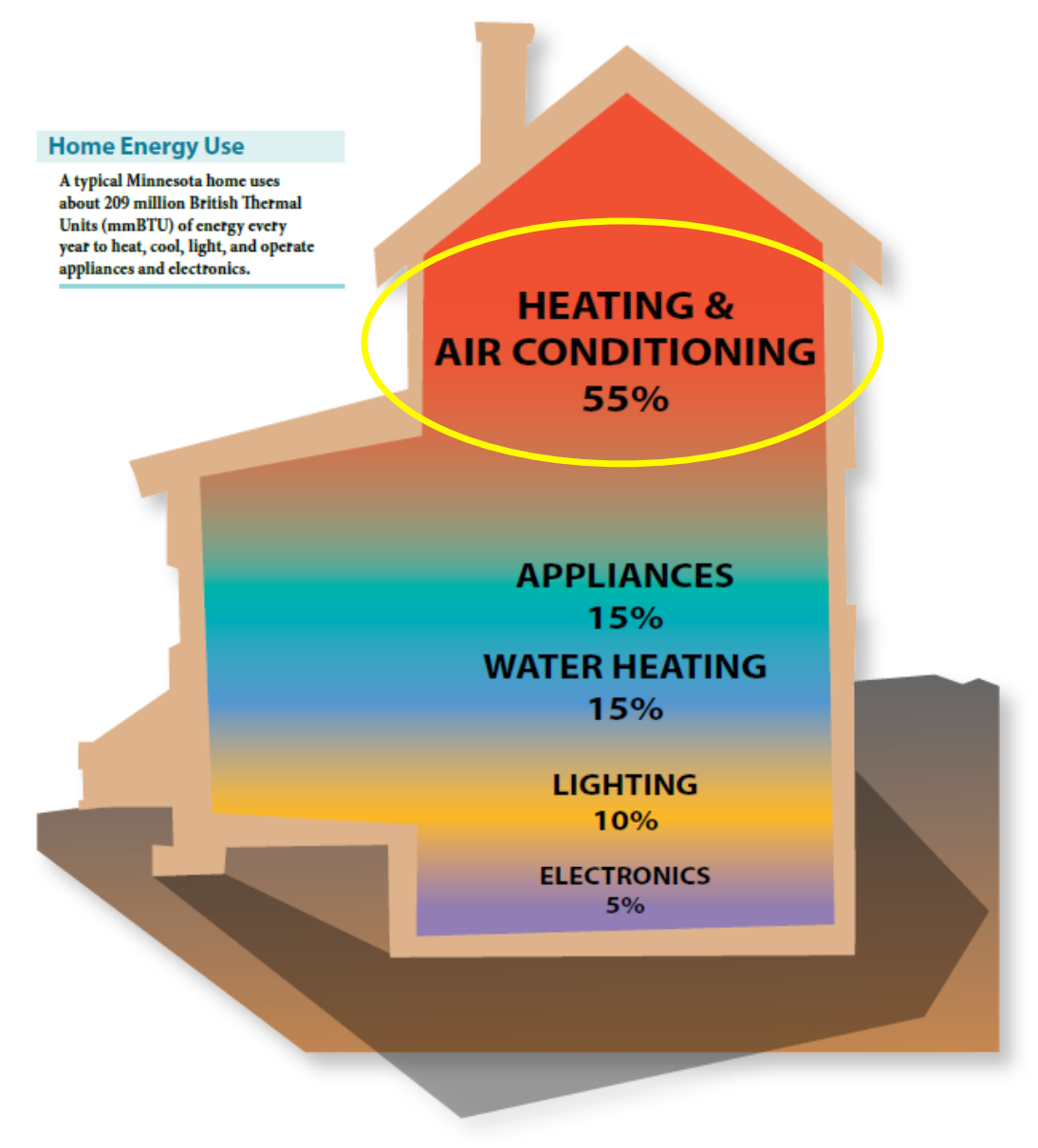


Photo courtesy of Minnesota Department of Commerce Home Envelope Energy Guide

KEY POINTS

2. Diagnostic testing strategies for existing homes

Diagnostic Testing

Step 1: Building Envelope Assessment
Step 2: Equipment Assessment

Diagnostic Testing
Step 1: Building Envelope Assessment

- Site Survey & Visual Inspections – Exterior, Interior, Attics, Crawlspaces
- Blower Door
- Infrared Camera
- Zonal Pressure Diagnostics
- Moisture Testing

Site Survey & Visual Inspection

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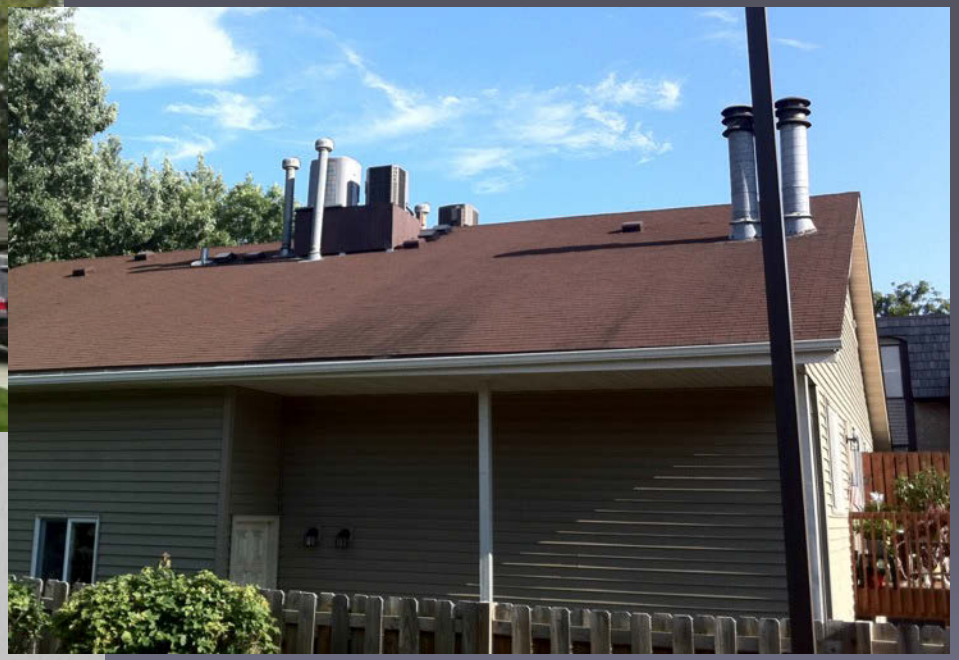

Blower Door and Infrared

Remember This?

- Airflow occurs when there is a pressure difference and a hole