BUILDING SCIENCE PRIMER

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Overview

- What is Building Science?
- Why is water vapor important?
- How does moisture affect building performance?
- How do we deal with water vapor?

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Building Science

- Study of heat, air, and moisture flows across the building enclosure
- Building enclosure – separation between exterior environment and interior conditioned space

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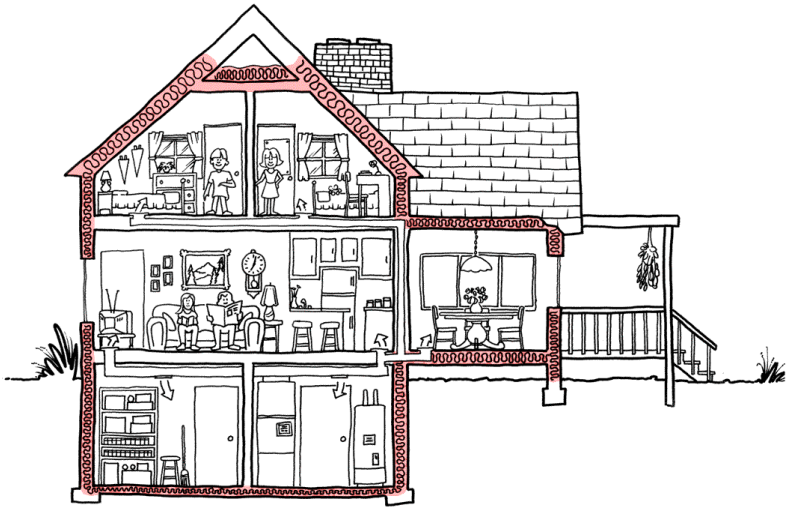
THE BUILDING ENCLOSURE



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FUNCTIONS OF BLDG ENVELOPE

- Support (structural)
- Control (heat, air, moisture, smoke, odor, sound, fire, insects, etc.)
- Aesthetics (exterior and interior finishes)
- Distribution of Services (MEP)

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History

- Historically, housing's primary purpose was shelter from rain, wind, sun
- Gradually developed with materials and skills
- Industrial revolution brought mass production of building materials
- Oil crisis – more of an emphasis on energy

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MOISTURE

- More specifically, moisture present in interior (conditioned) space
- Water Vapor

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FUNDAMENTALS

- Vapor pressures
- Vapor pressure → Temperature
- Relative humidity
- Dew point
- Psychometric chart
- Condensation

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Vapor Pressure

- Saturation Vapor Pressure:

$$P_{sat} = 1000 \times e^{(52.58 - \frac{6790.5}{T} - 5.028 \ln(T))}$$

- Partial Vapor Pressure
  - Measured value representing amount of moisture present

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Relative Humidity

- RH = Partial Pressure / Saturation Pressure

29° Low

Snow Shower

Chance of Snow:	40%
Wind:	W at 11 mph
Humidity:	76%
UV Index:	0 - Low
Snowfall:	0 in
Sunset:	4:59 pm
Moonrise:	2:56 am
Moonphase:	Waning Crescent
Past 24-hr Precip:	0 in
Past 24-hr Snow:	0 in

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Dew Point

- Temperature at which Partial Vapor Pressure = Saturation Vapor Pressure
- Partial VP cannot exceed Saturation VP
- Result = Condensation

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Psychrometric Chart

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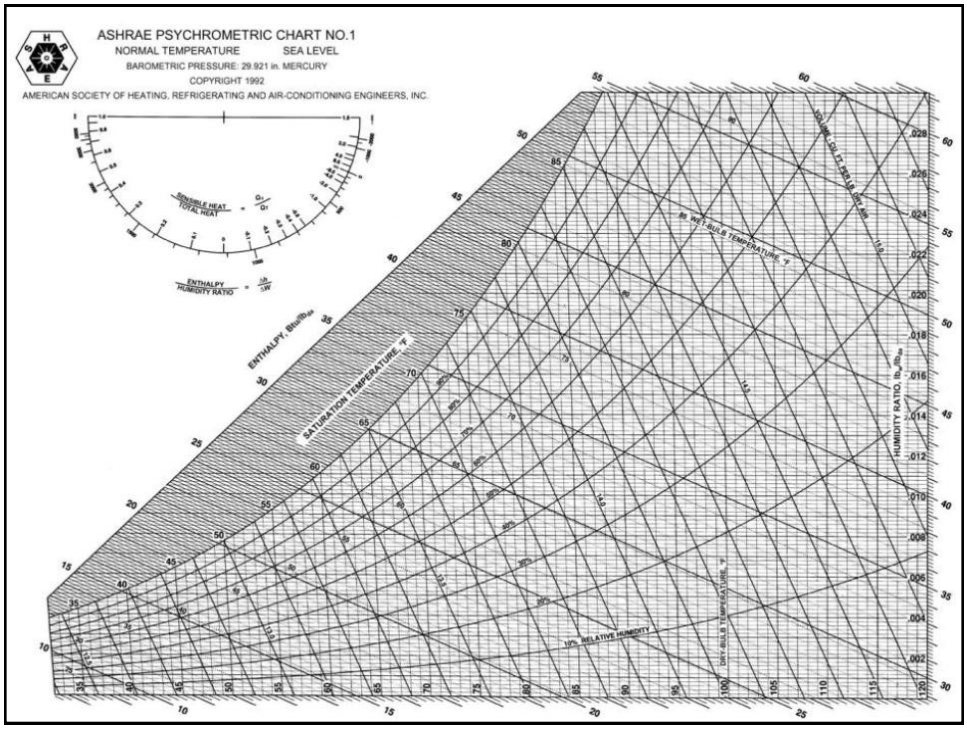

Summer Picnic Example

- Assumptions:
  - July
  - PM
  - Temperature = 85°
  - Relative Humidity = 50%
- At what temperature will your beverage "sweat"?

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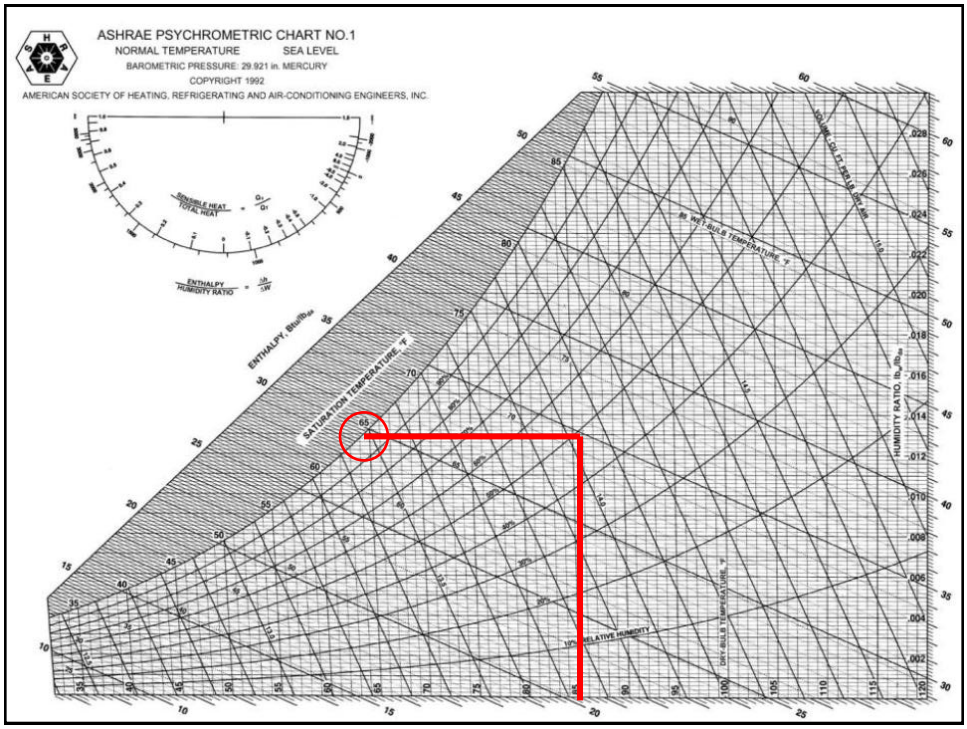

CONDENSATION

- When humid air (high RH) comes in contact with a cool surface, condensation can occur
- Where might this happen?

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BUILDING PERFORMANCE

- What are some characteristics that determine how well a building "performs"?

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"Occupant Comfort"

- According to ASHRAE:
  - Conditions acceptable to 80% or more of occupants

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Ideal Relative Humidity

- What are the factors at play?
  - Occupant comfort
  - Building performance
  - Occupant health
- ASHRAE Standards

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Low Relative Humidity

- RH < 25%
  - Occupant health issues (dry nose, throat, eyes, and skin)
  - Static shock
  - Shrinkage of wood floors, furniture
  - Low risk of mold growth
    - Dew point temperature (70° indoor air) = 32°

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High Relative Humidity

- RH > 60%
  - Reduced durability of building systems
  - Mold – health issues
  - Condensation

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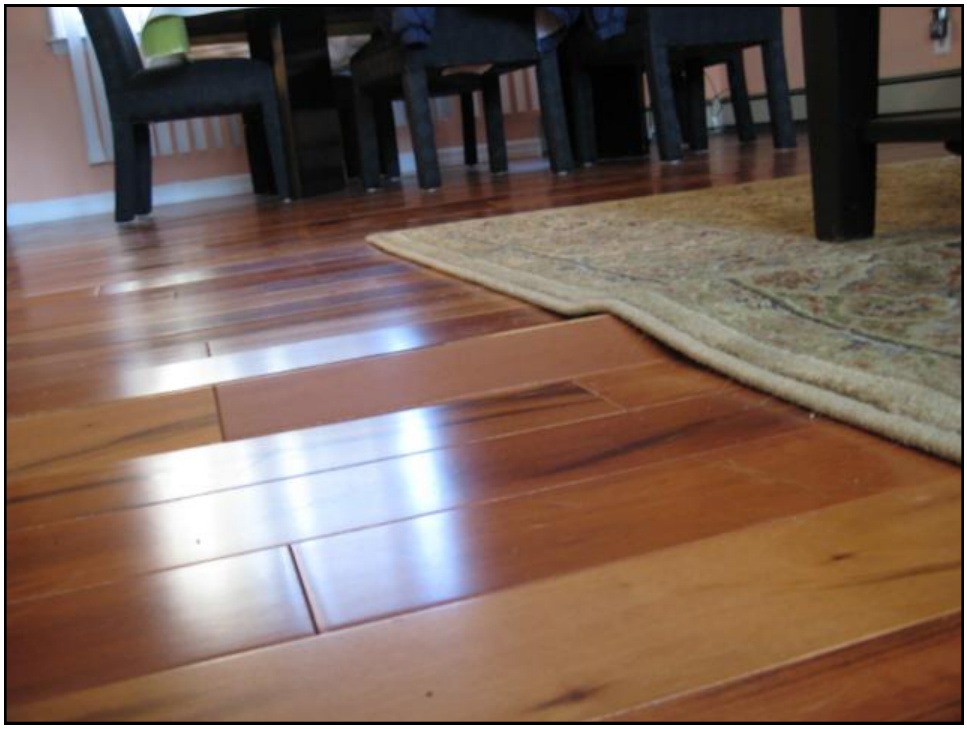

MOLD

- RH greater than 70% can lead to mold, dust mites, decay, corrosion, etc.
- Heating climates:
  - Interior surfaces of exterior walls cool from heat loss
  - Moisture levels within space too high
  - RH rises as temperature drops

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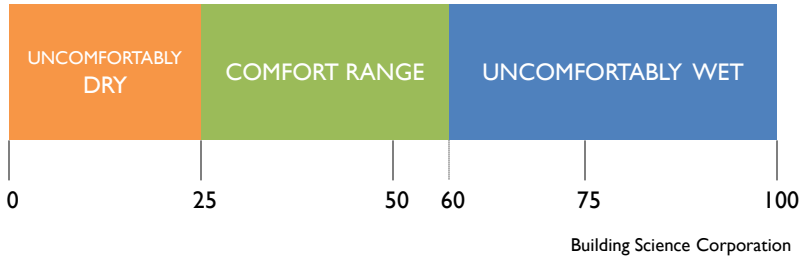
IDEAL RELATIVE HUMIDITY



- Most people are not capable of sensing RH fluctuations between 25-60%

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Moisture Strategies

- Humidification / dehumidification
  - Keep RH as low as possible in winter months
  - Portable units vs. whole house systems
- Spot ventilation
  - Bathrooms
  - Kitchen

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Other Design Considerations

- Overall building envelope design
  - Heat
  - Air
  - Moisture
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QUESTIONS?