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# Moisture Effects in Homes with Vented (Airflow) or Unvented (No Airflow) Attics

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About your instructor:  
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- LSBHI Approved Continuing Education Provider
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# EARTH

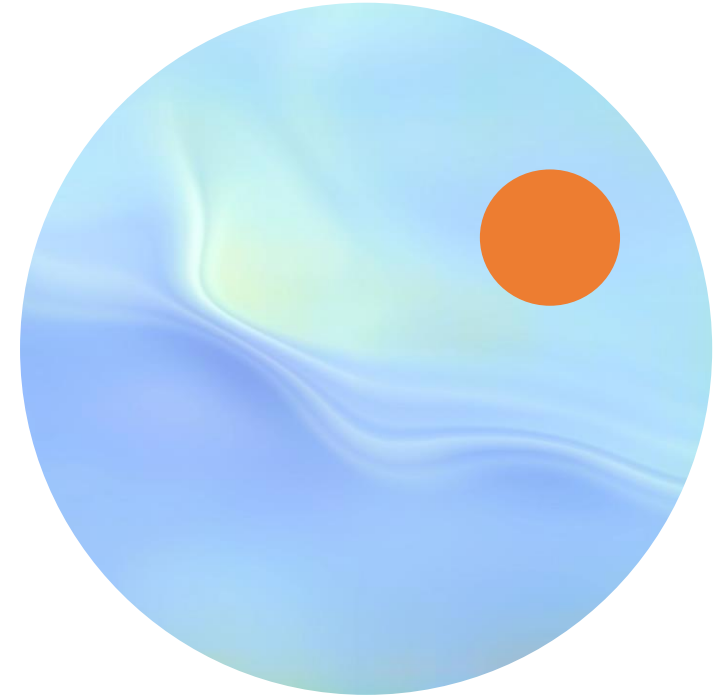
According to <http://www.merriam-webster.com/dictionary/>

- Atmospheric Pressure
  - the pressure exerted in every direction at any given point by the weight of the atmosphere

# When was the first house constructed on earth?



According to: <https://www.artnews.com/art-news/news/wonderwerk-cave-archaeology-earliest-dwelling-1234590843/>



Archaeologists have found evidence that may identify the oldest home in human history. According to a **report** by the Israeli newspaper *Haaretz*, researchers have learned that humans lived in the ancient **Wonderwerk Cave** in South Africa as early as two million years ago.



Oldest  
Known  
Timber /  
Wood Frame  
House in  
North  
America

- The Fairbanks House in Dedham, MA; Circa 1637





# A house and a cave seasonally and dynamically changes naturally





Let's build a  
house  
in New Orleans  
in 2023



# Where are we in the world?

- We are located in a hot humid climate that experiences significant rainfall.
- Sometimes it rains, its cold, its hot, its humid and dry all in the same 24 hours.





- The inside of a house in New Orleans in July will usually be hot and humid
- The inside of a house in New Orleans in January will usually be cold and dry.
  - Sometimes hot and humid

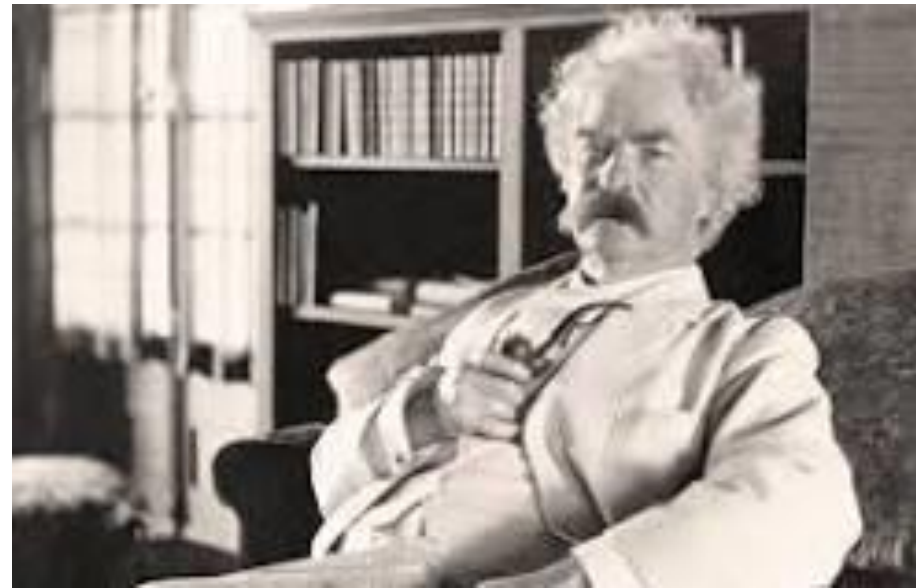


Just like in a cave or the first timber house a house will mimic its atmosphere

“If you do not like the weather in New Orleans just wait a few minutes.”

Accepted New Orleans lingo

Is an adaptation of a quote that “was said or written by Samuel Clemens, a.k.a. Mark Twain.” However, he originally used New England instead of New Orleans.



# Do you choose:

- Vented Attic? Not Energy Efficient
- Unvented Attic? - Extremely Energy Efficient
  - Write down or remember your selection and let's see if you change your mind.



# Choose: Write down your answers for later.

- Slab or Raised Foundation?
- Wood Framed Roof. Wood Framed or Masonry Walls?
  - Roofing Material – Seal tab? Slate? Terra Cotta Tile?
- Exterior Cladding – Brick Veneer, Stucco, Vinyl Siding or Cement Board?
- Attic Insulation if you chose vented attic – Fiberglass Batt, Loose Cellulose or Fiberglass
- Attic Insulation if you chose unvented attic – Open or Closed Cell Spray Foam
- Floor Insulation, if picked raised – Open or Closed Cell Spray Foam, Fiberglass Batt or Rigid Insulation Board

- The house will be:
  - Supported by a continuous footing with a concrete block pier and chain wall foundation.
  - Wood framed raised house covered with a gable seal tab roof with brick veneer exterior cladding.
  - The attic is insulated with 16 inches of loose cellulose.
  - The floors will be insulation with closed cell foam.

- What building materials should we use inside?

- Plaster or Sheetrock?
- Insulated walls or not?

- Write down your choice for later



# Plaster

- According to: <http://en.wikipedia.org/wiki/Plasterwork>
  - The earliest plasters known to us were lime-based. Around 7500 BC, the people of 'Ain Ghazal in Jordan used lime mixed with unheated crushed limestone to make plaster which was used on a large scale for covering walls, floors, and hearths in their houses.
  - Plaster was widely used for centuries throughout the world.

## Pro's and Con's

# Sheetrock

- According to: <http://en.wikipedia.org/wiki/Drywall>
  - The first plasterboard was invented in 1894 by [Augustine Sackett](#) and [Fred Kane](#) called Sacket Board.
    - It utilized wood felt paper with untapped edges.
  - **Gypsum Board** evolved between 1910 and 1930 eliminating the felt paper in favor of paper coverings and taped edges.
    - In 1910 [United States Gypsum Corporation](#) bought Sackett Plaster Board Company and by 1917 came out with a product they called *Sheetrock*.

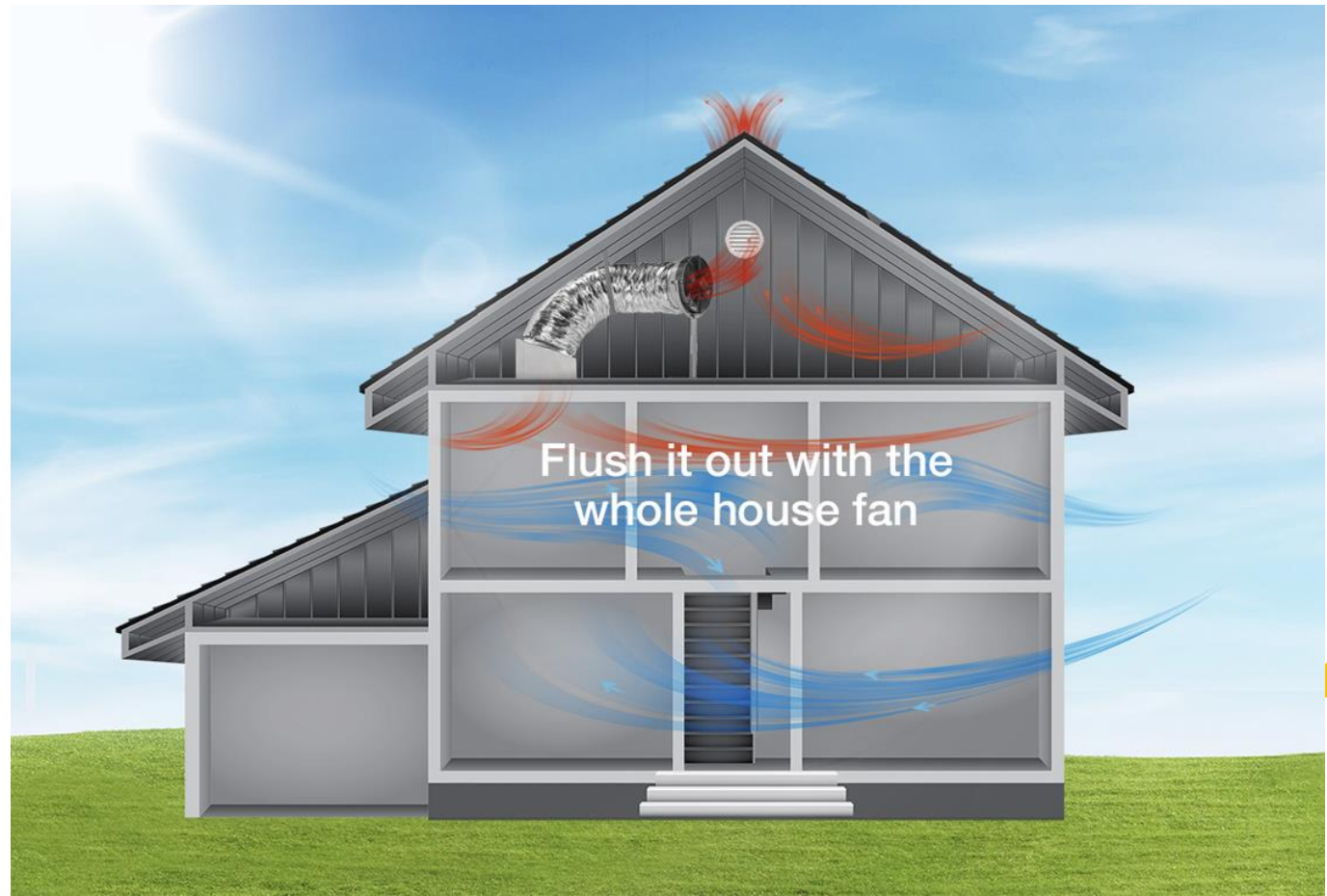
## Pro's and Con's

We choose sheetrock.



Do you want  
to install a  
whole house  
fan?

- Evaporative Cooling is nice.
- A fan would be nice in a cave
- Interior and Exterior Temperatures are the same



# Do we want the inside to feel like outside?

## Interior Comfort

- In the summer, we want it cool and dry inside.
- In the winter, we want it warm and cozy inside.



# Air-conditioning

## Gas or Electric Heat?

According to

<http://www.merriam-webster.com/dictionary/>

- to equip (as a building) with an apparatus for washing air and controlling its humidity and temperature





# Modern Electrical Air-Conditioning

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- According to: [http://en.wikipedia.org/wiki/Air\\_conditioning](http://en.wikipedia.org/wiki/Air_conditioning)
  - In 1902, the first modern electrical air conditioning unit was [invented](#) by [Willis Carrier](#) in [Buffalo, New York](#).
  - The first air conditioner, designed and built in Buffalo by Carrier, began working on 17 July 1902.

Do you want to set  
the temperature?

We want to control  
the temperature  
inside using  
thermostatic control.



# Year Round Temperature Control

- According to: <http://www.greatachievements.org/?id=3854>
  - In 1931, Frigidaire markets the “Hot-Kold” year-round central air-conditioning system for homes.

# This is complicated!





# A modern house is a system of systems



Structural

- Plumbing



Roof

- Electrical



Exterior

- Heating and Air-conditioning



Interior

# Now a house seasonally and dynamically changes mechanically and naturally



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While planning our modern house, we heard that the Joneses had

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# Mold

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after they built their \$400,000 central air-conditioned house using sheetrock and hired a mold remediator.

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It costs them \$200,000 to remediate their new house for mold.

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# Mold: A Modern Concern

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- According to: <http://www.epa.gov/mold/moldguide.html#Why>
  - Molds are part of the natural environment.
  - Mold may begin growing indoors when mold spores land on surfaces that are wet.
  - There are many types of mold, and none of them will grow without water or moisture.



# The Joneses house shortly after construction

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- What's wrong with the picture?????





# One Time Moisture Event vs. Relative Humidity

According to: <http://www.epa.gov/mold/preventionandcontrol.html>

## One Time Event

When water leaks or spills occur indoors - **ACT QUICKLY**. If wet or damp materials or areas are dried 24-48 hours after a leak or spill happens, in most cases mold will not grow.

## Relative Humidity

Keep indoor humidity low. If possible, keep indoor humidity below 60 percent (ideally between 30 and 50 percent) relative humidity.



# The Joneses

Did the Joneses more likely have a humidity or one time leak problem?

# Attorneys: A Modern Concern

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- Search “Mold Lawyer”

# Moisture Control

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- According to:

<http://www.epa.gov/mold/moldguide.html#Why>

- If you clean up the mold, but don't fix the water problem, then, most likely, the mold problem will come back.



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We do not want mold or an attorney in our new house. We better learn how to control moisture in our modern home in New Orleans.

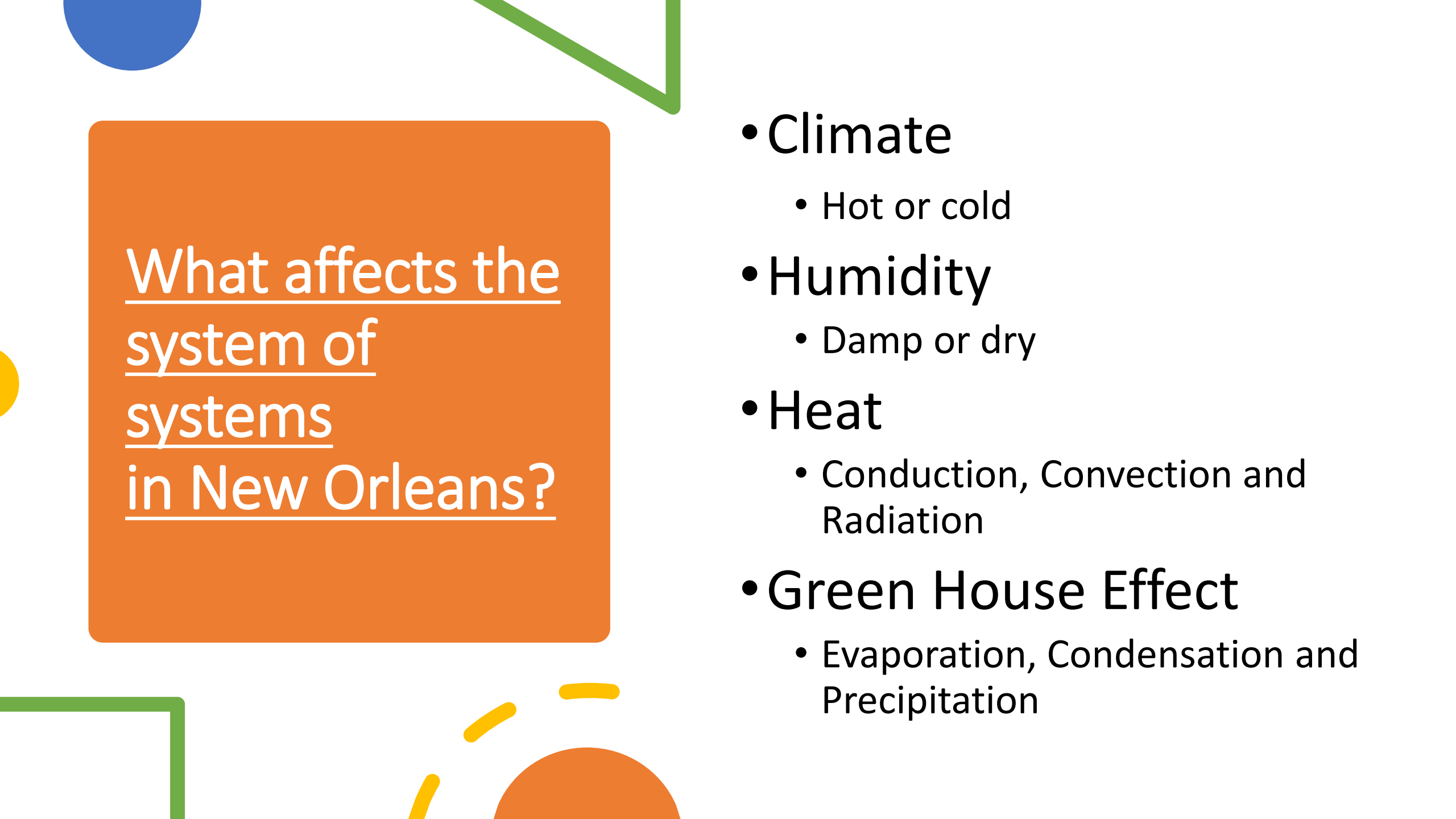


# Moisture Control?

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- According to:  
<http://energy.gov/energysaver/articles/moisture-control>
- Properly controlling moisture in your home will improve the effectiveness of your [air sealing](#) and [insulation](#) efforts, and these efforts in turn will help control moisture.
- The best strategies for controlling moisture in your home depend on your climate and how your home is constructed. Proper [ventilation](#) should also be part of a moisture control strategy.

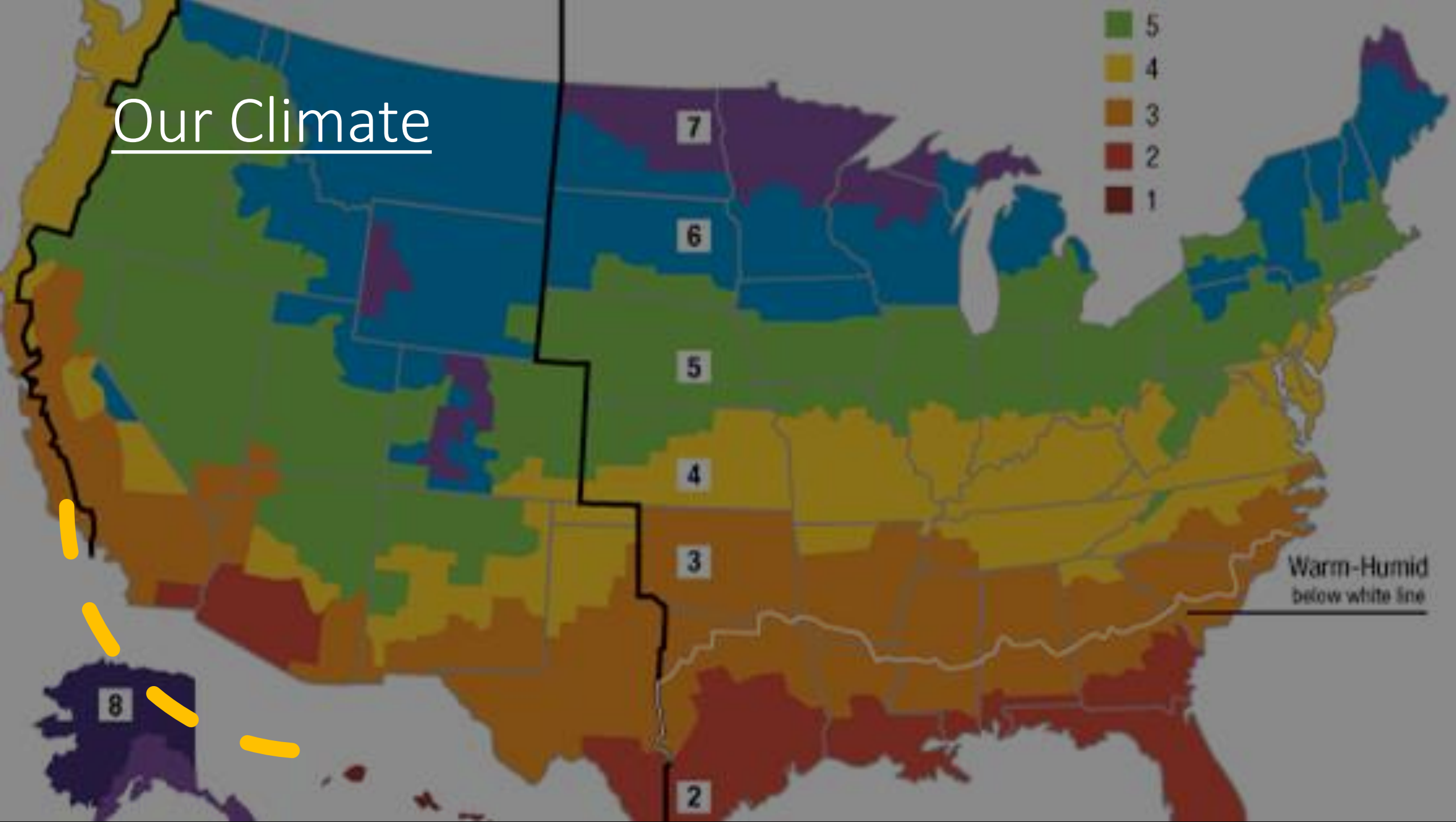




What affects the  
system of  
systems  
in New Orleans?

- **Climate**
  - Hot or cold
- **Humidity**
  - Damp or dry
- **Heat**
  - Conduction, Convection and Radiation
- **Green House Effect**
  - Evaporation, Condensation and Precipitation

# Our Climate

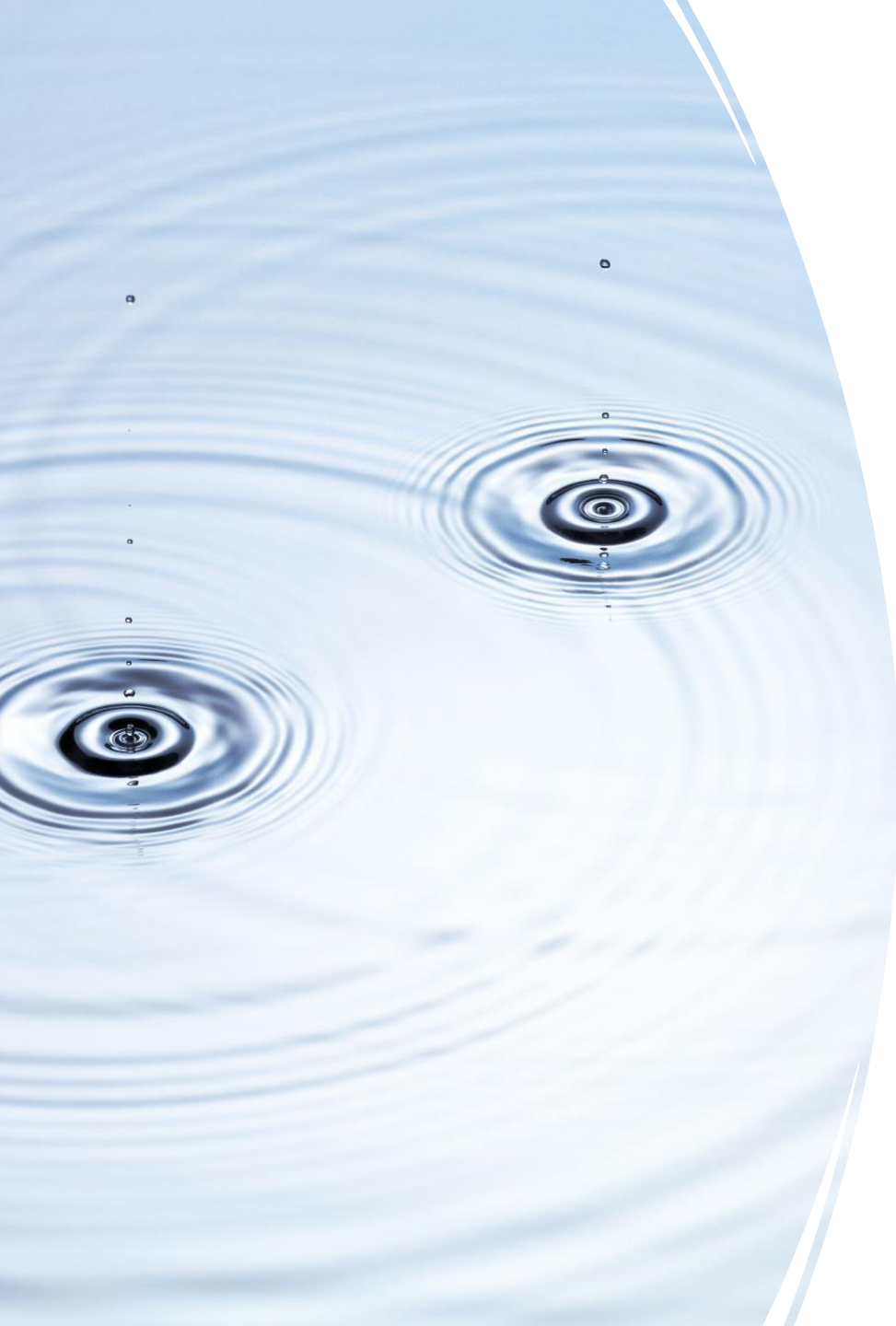


# Climate Zone

## 2

- According to ClimateZone.com
  - New Orleans
    - average precipitation per year is over 50 inches
    - average relative humidity per year is 77%
    - June, July and August average 19 or more days where the temperature is over 90°F





# If not rain, what is moisture?

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According to <http://www.merriam-webster.com/dictionary/>

- Humidity
  - a moderate degree of wetness especially of the atmosphere
- Relative Humidity
  - the ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature

# What is heat?

According to <http://www.merriam-webster.com/dictionary/>

- Heat
  - energy that causes things to become warmer

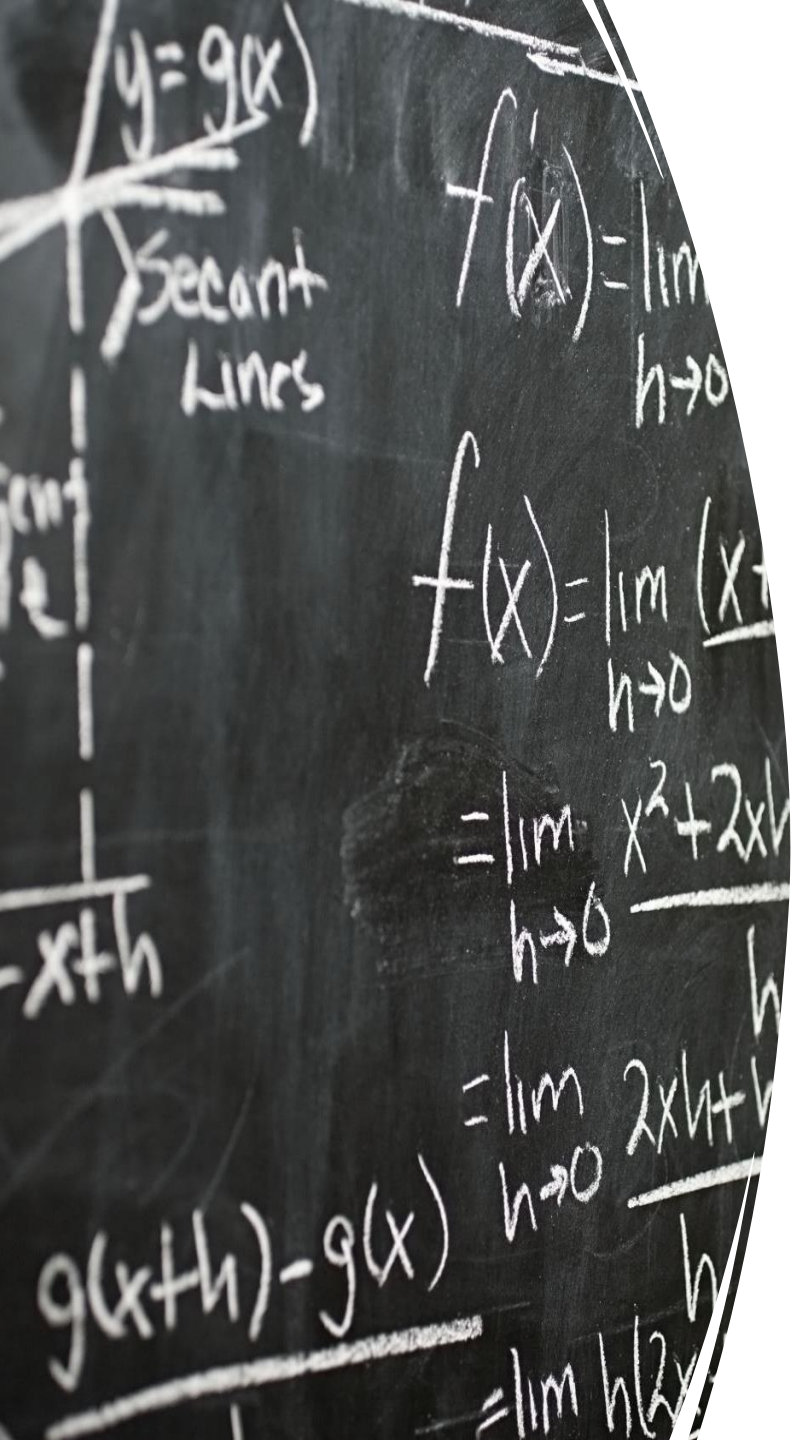


# Law of Conservation of Energy

called also *first law of thermodynamics*

According to <http://www.merriam-webster.com/dictionary/>

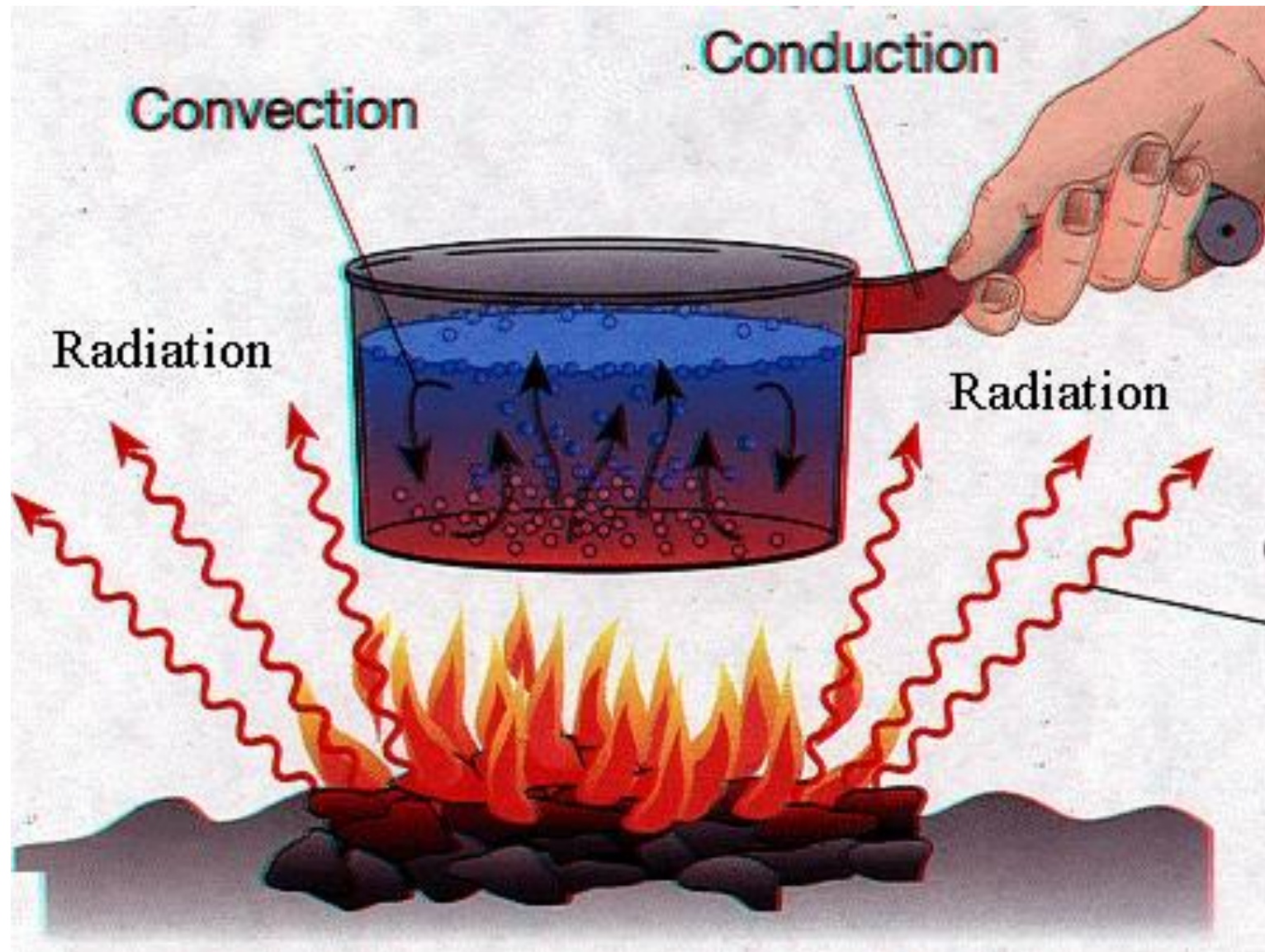
- a principle in physics: the total energy of an isolated system remains constant irrespective of whatever internal changes may take place with energy disappearing in one form reappearing in another.



# How does heat energy flow?

- Conduction
  - transmission through or by means of a conductor
- Convection
  - movement in a gas or liquid in which the warmer parts move up and the colder parts move down; *also* : the transfer of heat by this movement
- Radiation
  - the process of emitting radiant energy in the form of waves or particles



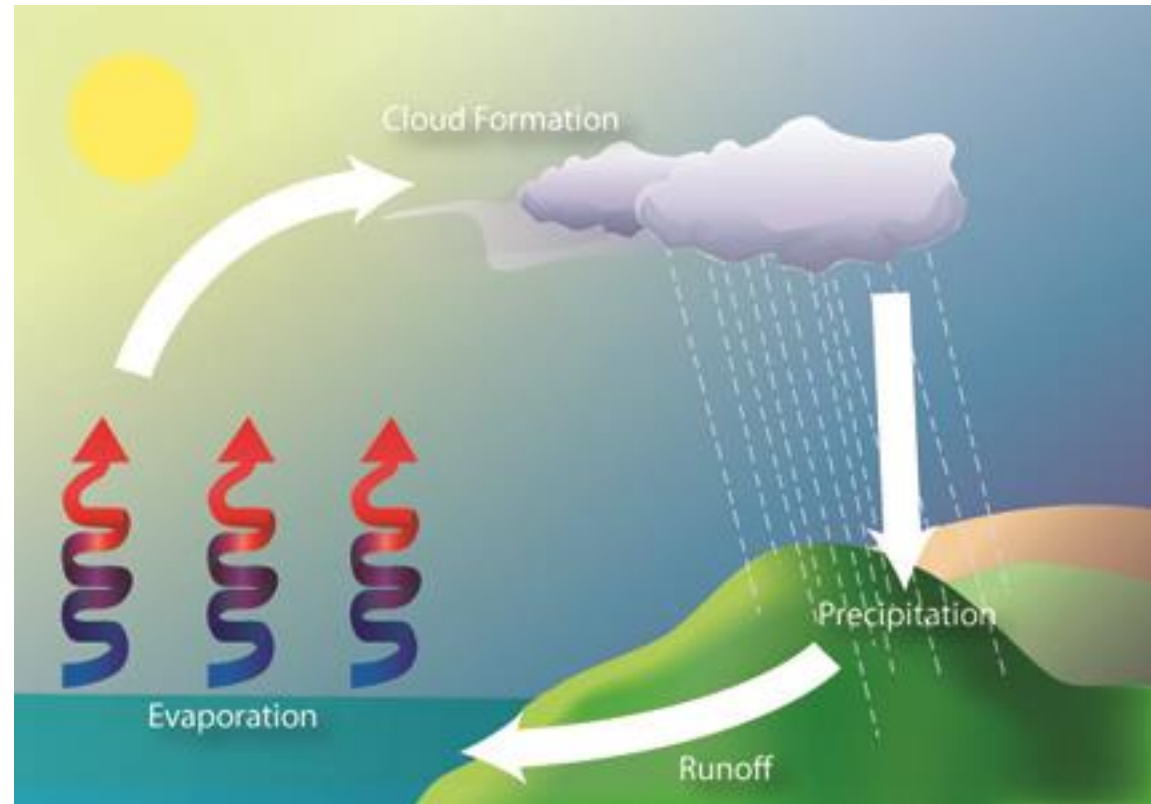


# How does moisture flow?

- According to <http://www.merriam-webster.com/dictionary/>
- Evaporation
  - the change by which any substance is converted from a liquid state into and carried off in vapor
- Condensation
  - the conversion of a substance (as water) from the vapor state to a denser liquid or solid state usually initiated by a reduction in temperature of the vapor
- Precipitation
  - the process of forming a precipitate from a solution

# Atmosphere Green House Effect

Evaporation, Condensation and Precipitation



# How does moisture flow in a house?

- According to:  
<http://energy.gov/energysaver/articles/moisture-control>
- ...moisture or water vapor moves in and out of a home in three ways:
  - With air currents.
  - By diffusion through materials.
  - By heat transfer.



# How does hot humid air move through a house?

According to:

<http://scienceforkids.kidipede.com/physics/weather/hotairrises.htm>

- **1- Hot air rises as vapor**

When air is hotter its molecules are larger and the molecules take up less space than the surrounding cooler air.





Moisture moves from:

**WARM** to **COLD**.

# How does hot humid air move through a house?

- 2 – It condenses  
on cooler surfaces

As hot humid air rises and  
contacts cooler surfaces  
condensation can form and drip  
back down as moisture droplets





# What is Dew Point?

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- According to:  
<http://energy.gov/energysaver/articles/moisture-control>
- The temperature and moisture concentration at which water vapor begins to condense is called the "dew point."

Moisture moves from:

MORE to less.

# Seasonal Moisture Flow in New Orleans

**Summer** (Hot and Humid)

All of the outside heat and humidity is trying to get into the house

**Winter** (Cold and Dry)

All of the inside heat and humidity is trying to get out of the house

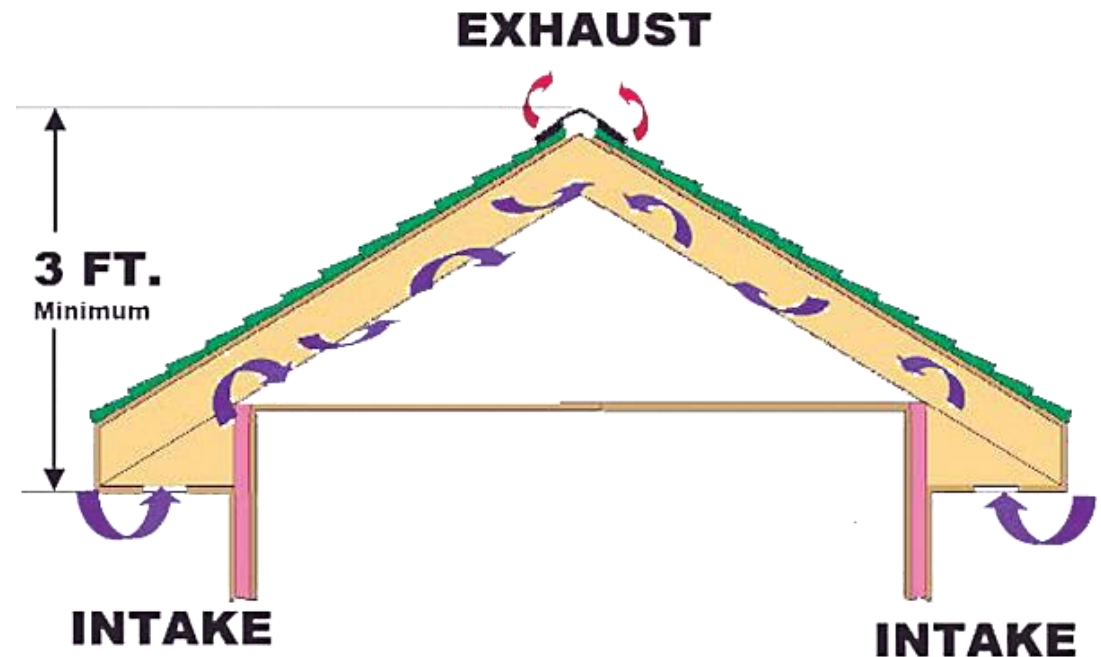


# How does hot humid air move through a vented house?

- 3 – sufficiently ventilate it

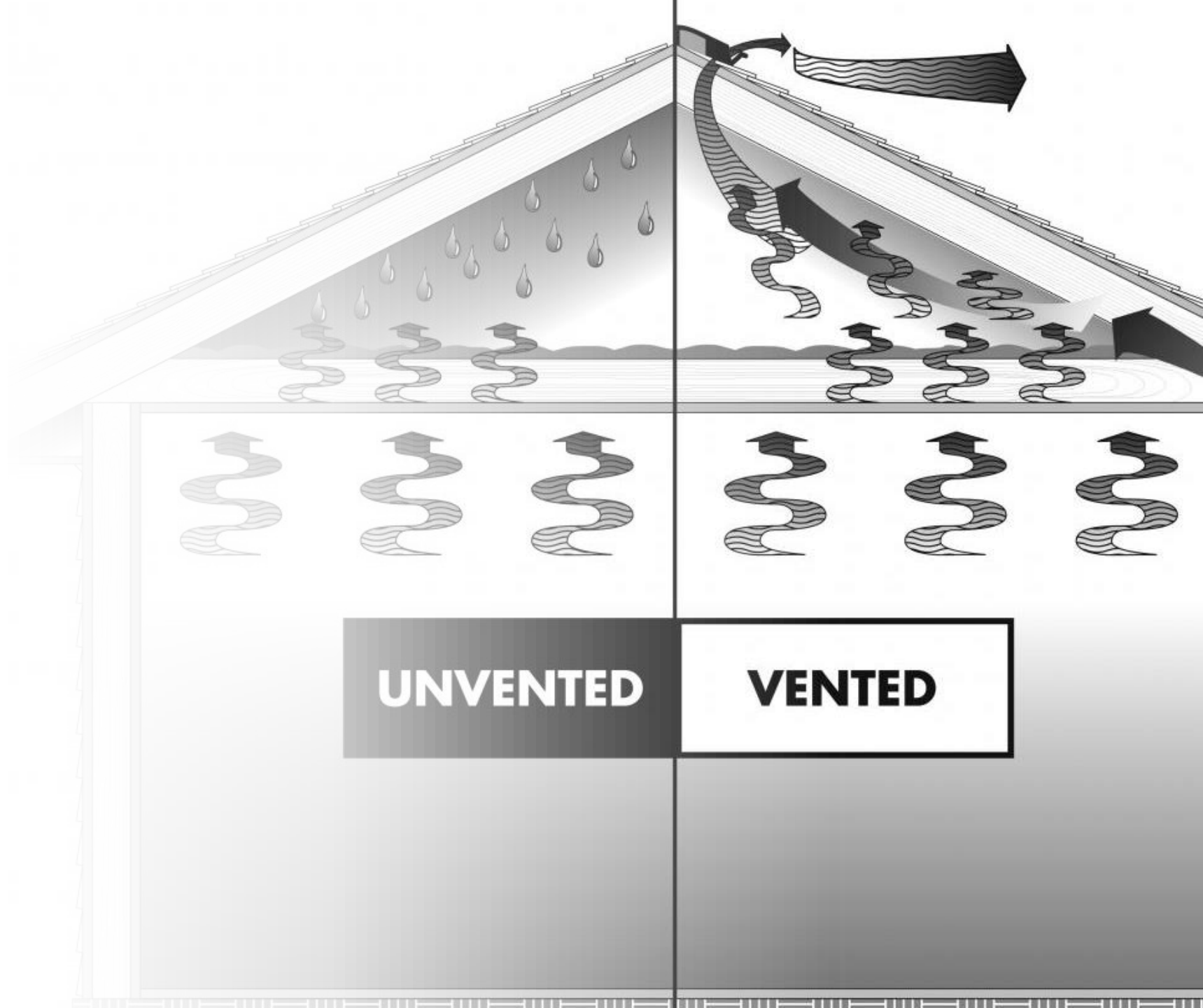
- The hot humid air is allowed to escape back into atmosphere

## What Is Ventilation?



# What is a vented attic?

- A vented attic is an attic that allows air flow in through an entry point and air flow out through an exit point.



# Non-mechanical and mechanical attic ventilation types

## Non-Mechanical

- Soffit and gable vent
- Soffit and continuous ridge vent
- Gable and continuous ridge vent



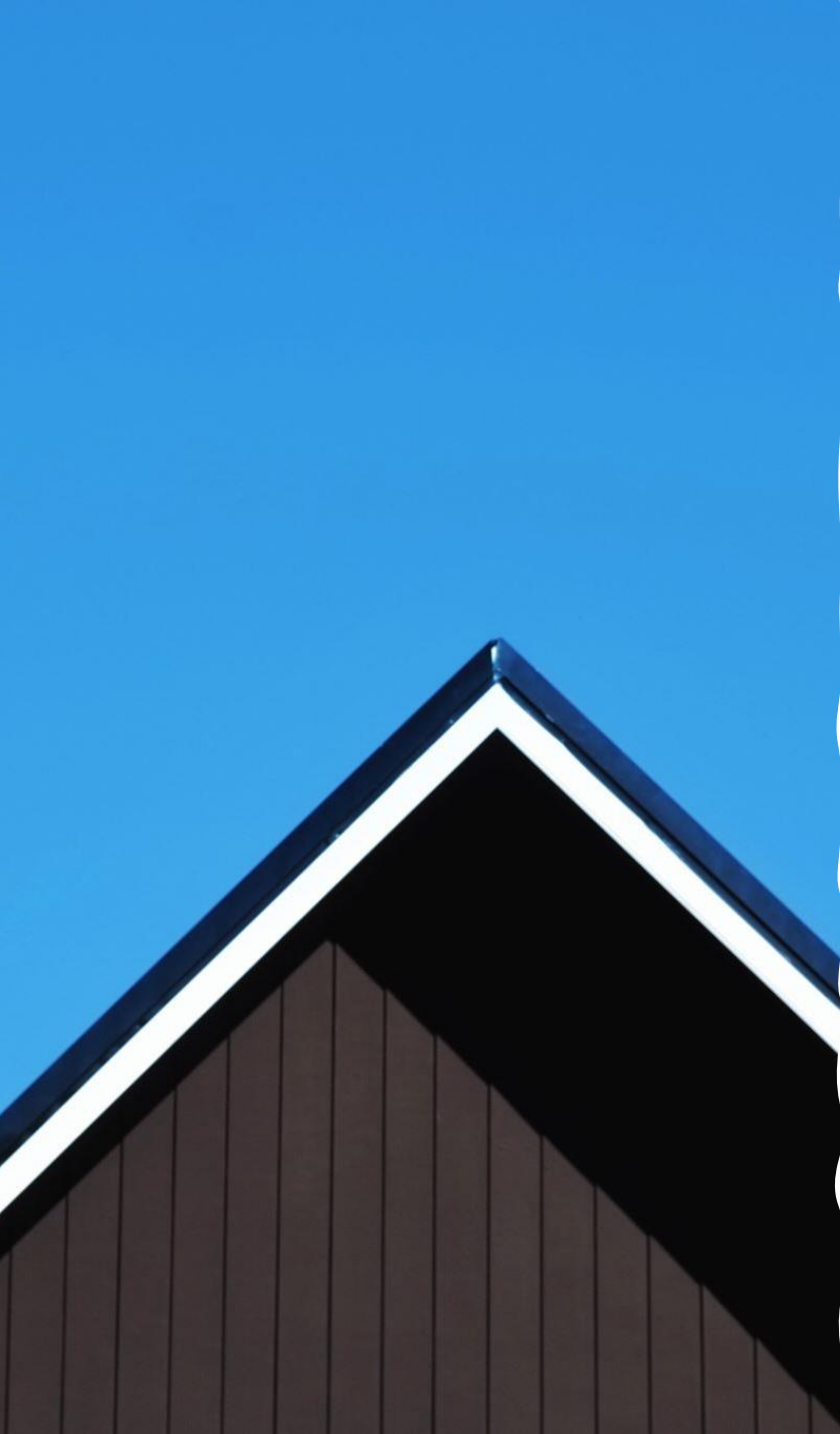
## Mechanical

- Soffit and wind turbine
- Soffit and electrical-powered thermostatically controlled fan
- Soffit and solar-powered fan



# How does moisture flow in a vented attic?

- According to: <http://energy.gov/energysaver/articles/moisture-control>
- ...moisture or water vapor moves in and out of a home in three ways:
  - With air currents. Primary
  - By diffusion through materials. Contributory
  - By heat transfer. Contributory



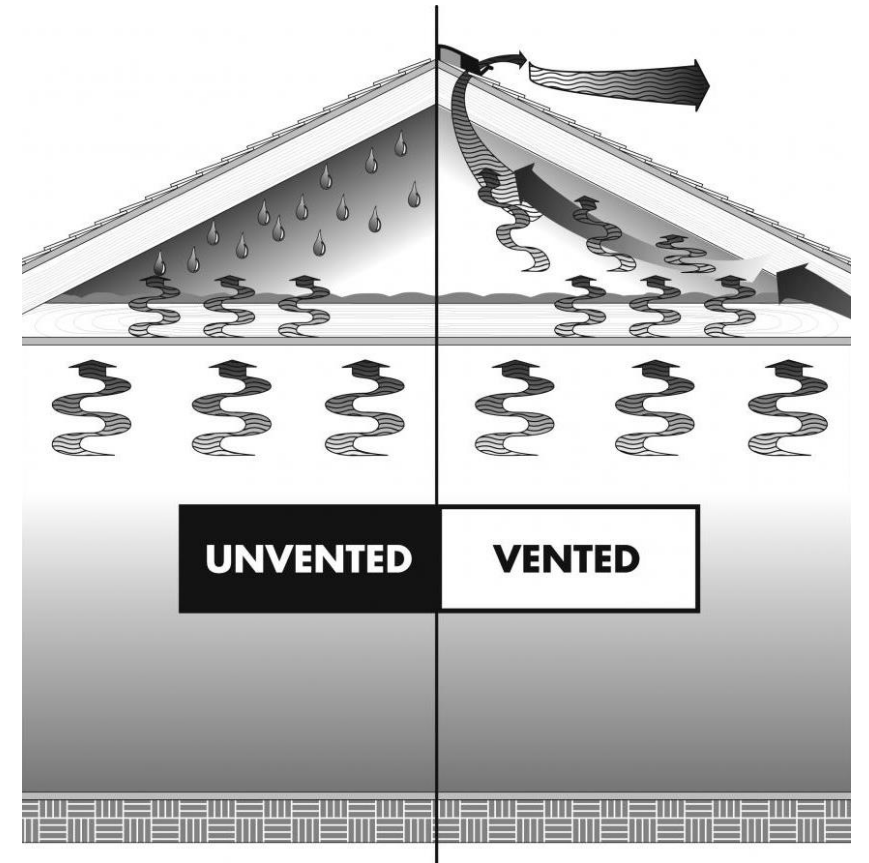
# Concerns with a Vented Attic?

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# What is an unvented attic?

- An unvented attic is the opposite of a vented attic
- Or one that does not allow airflow through an entry and an exit point.
- It could also be no attic space



# Vaulted Ceilings can have unvented attics Why no moisture?




Flat roofs  
typically have  
unvented attics





## Equalized Atmospheric Pressure

- Why do we see apparent surface molds in exterior closets?
    - Because the materials reach their dew point and the outside molds stick to the wet surfaces.
    - Add air-condition and this will go away. Air conditioning dries the air, if allowed to cycle long enough.
- 

# How does moisture flow in an unvented attic?

- According to: <http://energy.gov/energysaver/articles/moisture-control>
- ...moisture or water vapor moves in and out of a home in three ways:

So...in unvented attics?

- ~~With air currents.~~ No air space limits this one
- By diffusion through materials.
- ~~By heat transfer.~~ Contributory but insulation limits this one

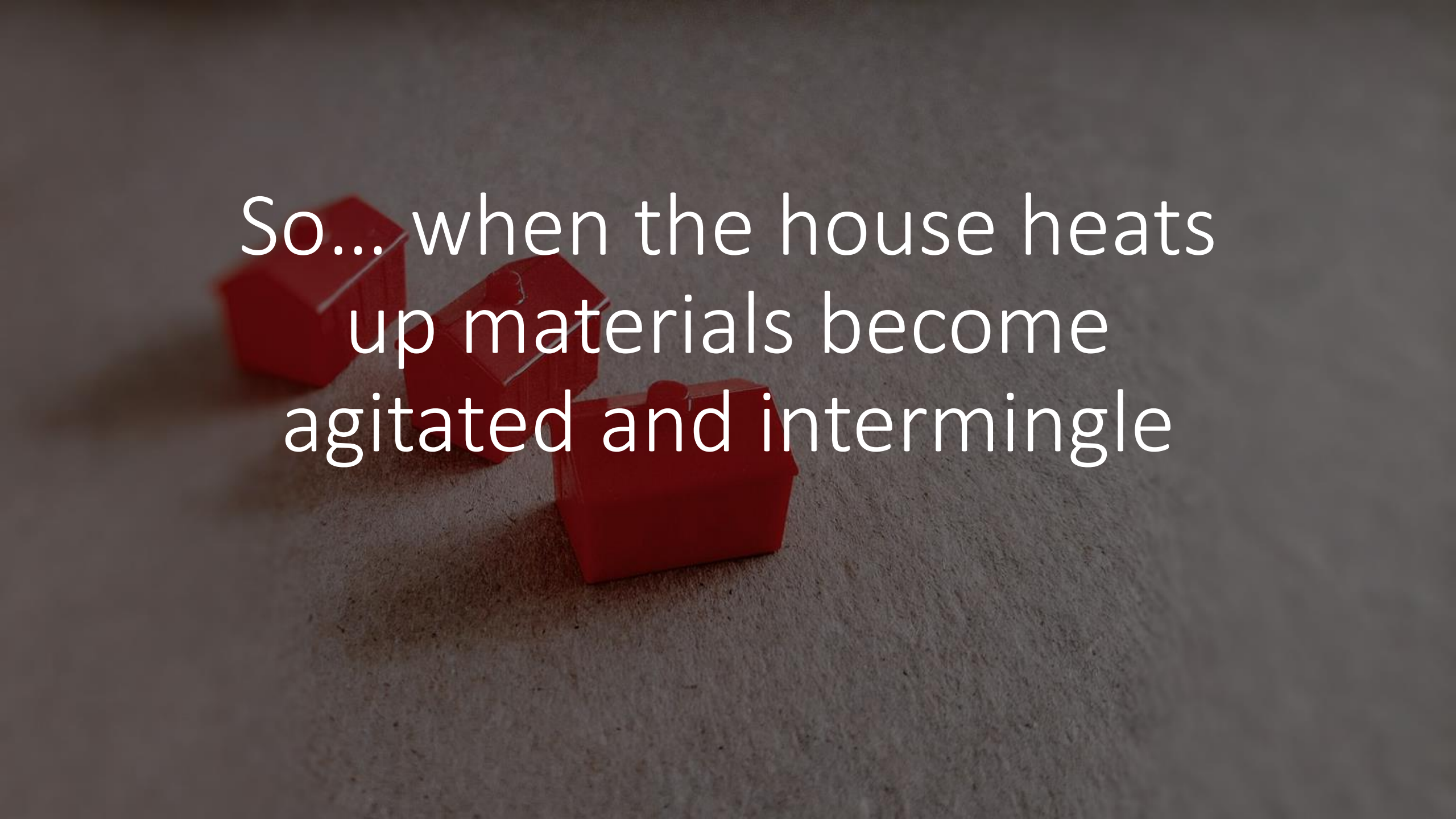


Concerns with an  
Unvented Attic?



# Thermal Agitation and Diffusion

- According to: <http://www.merriam-webster.com/dictionary/diffusion>
  - Thermal
    - : of, relating to, or caused by heat <tactile and *thermal* senses>
  - Agitate
    - : to disturb, excite, or anger (someone)
  - Diffusion
    - :the process whereby particles of liquids, gases, or solids intermingle as the result of their spontaneous movement caused by thermal agitation

The image features three red LEGO bricks on a grey, textured surface. The bricks are arranged in a diagonal line from the top-left towards the bottom-right. The text 'So... when the house heats up materials become agitated and intermingle' is overlaid in white, sans-serif font across the center of the image, partially obscuring the bricks.

So... when the house heats  
up materials become  
agitated and intermingle

# Do materials intermingle continuously?

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- No – Heat is the requirement.
  - So in the winter the heat is inside and you want to hold it in while minimizing condensation effects from the exterior.
  - So in the summer we want to keep the heat out while minimizing condensation on the interior.
  - When is it hottest in New Orleans?
  - How do you slow the intermingling and reduce condensation?

How do you slow things down?

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- **INSULATION**



# Types of commonly used insulation in New Orleans

Fiberglass  
batts

Loose  
Fiberglass

Cellulose

Spray foam

We are going  
to focus on  
spray foam

# Spray Foam Insulation

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- According to: [http://en.wikipedia.org/wiki/Spray\\_foams\\_\(insulation\)](http://en.wikipedia.org/wiki/Spray_foams_(insulation))
  - **Spray foam insulation** is an alternative to traditional building insulation such as [fiberglass](#).

# Basic Types of Spray Foam

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- According to: <http://sprayfoamlouisiana.com/closed-vs-open-cell.html>
- Open Cell Foam
  - where the tiny cells of the foam are not completely closed. They are broken and air fills all of the “open” space inside the material. This makes the foam weaker or softer feeling than closed-cell foam.
- Closed Cell Foam
  - differs in that all of its tiny foam cells are closed and packed together. They are filled with a gas that helps the foam rise and expand and become a greater insulator.

# Biggest Differences - Open vs. Closed Cell

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- According to: <http://www.advancedinsulationla.com/open-vs-closed-cell-foam.html>
- The main differences between open and closed cell foam are moisture permeability, R-Value, and flexibility.
  - Closed cell foam is a moisture vapor barrier.
  - Closed cell has a higher R-value than open cell.
  - Closed cell foam is more rigid.

# Spray Foam Insulation Installation

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- According to: <http://sprayfoamlouisiana.com/attic-insulation.html>
- Traditional
  - In a traditional vented attic, insulation is used on the attic floor to insulate the ceiling from the seasonal heat and/or cold. Spray foam is used where traditional fiberglass batts, or cellulose is used; between the floor joists.
- New Technology
  - In this application, considered the most effective, by most of the SPF industry, the foam is sprayed directly to the underside of the roof between the joists, down around the rim and into the soffit areas, on the gable wall ends, and effectively sealing off and insulating the entire attic space from any air infiltration.





# New Technology

effectively sealing off and insulating the entire attic space from any air infiltration. It just about stops atmospheric pressure.

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If air can't  
get in; can it  
get out?







Open Cell Foam Sealed Attic's are Unvented That  
Require Semi-Conditioned Interior Spaces

# How does moisture flow in an unvented attic?

- According to:  
<http://energy.gov/energysaver/articles/moisture-control>

- ...moisture or water vapor moves in and out of a home

in three ways:

So...in foam sealed attics?

- ~~With air currents.~~ No air flow prevents this one
- By diffusion through materials.
- ~~By heat transfer.~~ Contributory but insulation greatly limits

# Opportunities with sealing off attics in New Orleans?

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“Vent less attics are a high performance insulation technique. *If all of the implications of this type of system are not considered when a home is retrofitted they can significantly affect other aspects of the interior of the house relating to safety, comfort, indoor air quality and mechanical systems.*”

*Compass Inspection Services, LLC*



# Opportunities with sealing off attics in New Orleans?

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Insulation on the floor of the sealed attic?

Air has to communicate between the living space and the sealed attic; creating a semi-conditioned interior space

# Opportunities with sealing off attics in New Orleans?

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What if the foam attic is not sealed or adequately ventilated?

Do you need insulation on the ceiling?

Does it have to be adequately ventilated?

# Opportunities with sealing off attics in New Orleans?



What if that foam sealed attic has a gas furnace or water heater inside?



IRC 2009 states in G2407.6 that outdoor combustion air shall be provided through openings to the outdoors in accordance with a one or two method permanent opening.

## Opportunities with sealing off attics in New Orleans?

What if the gas appliance has  
a leak in a foam sealed attic?

## Opportunities with sealing off attics in New Orleans?

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What happens to the sealed attic when you add combustion air?

It is not sealed. A mechanical damper that opens when the furnace is on seems to be accepted.

# Other Heating Options

## Furnaces

- Electric
- Heat Pump
- Closed combustion

## Water Heaters

- Electric
- Move outside

## Others?



# Opportunities with sealing off attics in New Orleans?

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What if bathroom fans  
are terminated in the  
attic and not to the  
exterior?

They will add humidity  
to the attic.

Good or Bad

## Improperly Sized Air-Conditioning

What happens when the A/C short cycles?

Humidity builds up in the house then mold has a place to grow inside.

# Manual J Calculations

These calculations take into account the many systems of the house and offer proven calculations to properly size the A/C and Heating systems.

They are paramount to minimize concerns to the indoor air quality of the house.



# General Accepted Rules of Thumb

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- Older drafty construction:
  - 1-ton of every A/C for every 500 sq. ft.
- Newer tighter construction:
  - 1-ton of every A/C for every 800 sq. ft.
- Spray foam sealed attic
  - It's Complicated!!

# Opportunities with sealing off attics in New Orleans?

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What if the house has sealed walls, floors and a sealed attic?

Ice-chest house

How are we going to breath?

Fresh air

How much?

Fresh  
Air

Will the air in the house become stagnant or release toxins?





# Sick Building Syndrome

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- According to: [http://en.wikipedia.org/wiki/Sick\\_building\\_syndrome](http://en.wikipedia.org/wiki/Sick_building_syndrome)
  - Sick Building Syndrome could be caused by:
    - inadequate ventilation
    - chemical contaminants from indoor or outdoor sources
    - and/or biological contaminants.
  - Many volatile organic compounds, which are considered chemical contaminants, can cause acute effects on the occupants of a building.
  - "Bacteria, molds, pollen, and viruses are types of biological contaminants" and can all cause SBS.

We better add fresh air!



# ASHRAE

## 62.1

According to:

[http://en.wikipedia.org/wiki/Sick\\_building\\_syndrome](http://en.wikipedia.org/wiki/Sick_building_syndrome)

- The [American Society of Heating, Refrigerating and Air-Conditioning Engineers](#) (ASHRAE)
  - ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality (Tables 6.2.2.2.1)
    - reduces minimum of 15 [cfm](#) of outdoor air per person (20 cfm/person in office spaces)
      - to 10 CFM per classroom person and 5 CFM per office occupant.

# ASHRAE


## 62.2 History

- 62-1973 – 20 CFM per person
- 62-1981 – 5 CFM per person
- 62-1989 – 15 CFM per person or .035, whatever greater
- 62.1 – 1997 – separated all buildings from low-rise residential
- 62.2 – 1999 – First published for low-rise residential
  - 7.5 CFM per person; assuming two people; plus 0.01 cfm per sq. ft. of occupiable area
- 62.2 – 2013 – 7.5 CFM per person; assuming two people; plus 0.03 per sq. ft. of occupiable area

# ASHRAE 62.2

- ASHRAE Standard 62.2 is the ventilation standard that applies to low-rise residential buildings of three stories or less in the U.S. ASHRAE Standard 62.1 applies to all other buildings.
- 62-1973 – 20 CFM per person
- 62-1981 – 5 CFM per person
- 62-1989 – 15 CFM per person

# Ventilation Tool

 **ASHRAE 62.2-2013 Ventilation** Reset Print ?

New or existing construction Existing ▼  
Use infiltration credit Yes ▼

Closest weather station United States ▼  
-- Select a State/Territory -- ▼

Weather and shielding factor [1/hr] =

Floor area [ft2 ▼]   
Number of occupants ▼  
Building height [ft ▼]   
Measured leakage @ 50Pa [CFM ▼]

Use Advanced Blower Door Inputs

Use Local Ventilation Alternative Compliance

**Whole-Bldg Ventilation Results**  
Effective annual avg infiltration rate [CFM ▼] =  
Total required ventilation rate [CFM ▼] =  
Infiltration credit [CFM ▼] =  
Required mechanical ventilation rate [CFM ▼] =

**Whole-Bldg Ventilation Run-Time Solver**  
Fan capacity [CFM ▼]   
Fan run-time per hour [min ▼] =

**Whole-Bldg Leakage Rate Solver**  
Target mechanical ventilation rate [CFM ▼]   
Corresponding building leakage @ 50Pa [CFM ▼] =

Version 2016-07-06\_01:30 © 2016 Residential Energy Dynamics, LLC

[Watch ASHRAE 62.2-2013 video tutorials](#)



OPEN or  
CLOSED CELL  
AIR TRANSFER

- **CLOSED CELL**

AIR and VAPOR BARRIER  
– No air transfer

- **OPEN CELL**

PERMEABLE  
– Limited air transfer

# What About Between Seasons?

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- How do you control humidity in the house when the air is not running?
- A dehumidifier would control humidity within the house year round.
  - It is recommended but not required at this point

# Other concerns with spray foam attics

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What if the roof leaks?

What dries the framing after a leak in a vented attic?

With no air flow in a foam attic will it take longer to dry?

Will that promote rot and termites?

The wood framing not visible.

- Hidden termite damage
- Hidden moisture and rot damage

These next pictures of an  
original 50 year old house with  
a 3 year old addition

# Open Cell, No Insulation and Fresh Air

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# Electric Furnace and Bathroom to the exterior

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# WRONG!

**Closed cell foam**



**Window not sealed**



# Wrong! — What happens when we shower?

**Insulation remaining on floor**



**Bathroom vent to attic**





# Wrong!

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**Gas furnace in utility room opens up to sealed attic**

What would you choose?

Vented  
attic

Unvented  
attic

# The Point

- Ventilated attics in houses have been time tested for hundreds of years. However, they are not as energy efficient as unvented attics.
- Unvented attics are newer and not time tested. Codes do not fully address this material yet However, they are energy efficient.

**Stay Tuned!**



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