

Reentering a Flooded Home and Mold Mitigation

Joseph Laquatra
Cornell University



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When to pump the basement?



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Wild animals in house

- Animals get displaced during floods
 - May enter homes



- If there is standing water in the home:
 - Turn off power from a dry location if possible
- Don't turn power off or use electric tool
 - while standing in water



- Have an electrician check the electrical system before turning power back on
 - Some components may have to be replaced
 - Mud-filled receptacles, *e.g.*



Mold

- Fungal colonies that produce woolly or fuzzy growth on paper, hard surfaces, and spoiled foods



Mildew

- Fungal growth on fabric



Mold – always negative?

- Most news stories → negative aspects of mold
 - Mold can prematurely rot wooden structures
 - Exposure to high levels of any type of mold can make people sick



Mold – always negative?

- Mold does provide many benefits for humans



Fungi

- Widespread in the environment
- Comprise 25% of Earth's biomass
- One of the few organisms that can break down wood and wood-based materials into simple digestible compounds.



Houses → Plenty of food for mold

- Most houses are made of wood
- Full of wood-based furniture and cabinets
- Books, paper-based products

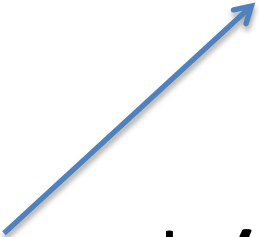


Factors necessary for mold growth

- Besides food, temperatures between 40°F – 100°F
- Significant source of moisture
- Food materials: 70 – 80% saturated



By-products

- From breaking down food sources into useable nutrients
 - Carbon Dioxide (CO_2)
 - Water
 - Volatile Organic Compounds₁ (**mVOCs**)
- Responsible for musty smell
- 



Mycotoxins

- Some fungal species also produce secondary materials: mycotoxins
 - Protects food source from bacteria and competing fungi
 - Penicillin – released by some species of the *Penicillium* genus
 - Very toxic to bacteria



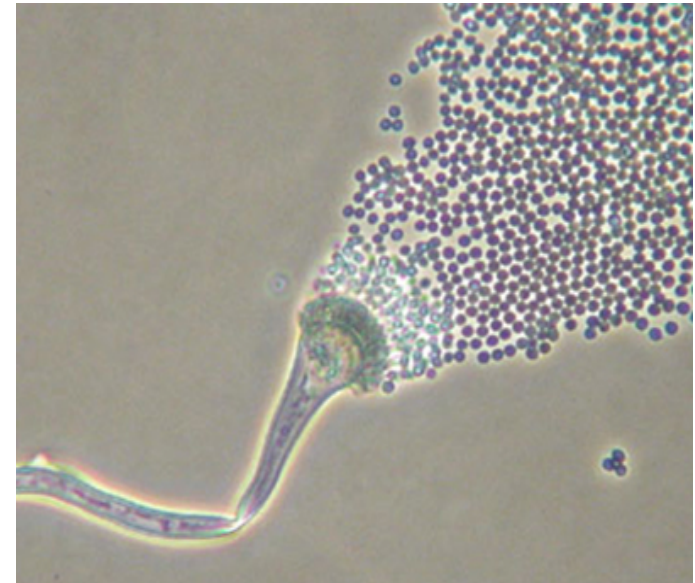
Mycotoxins

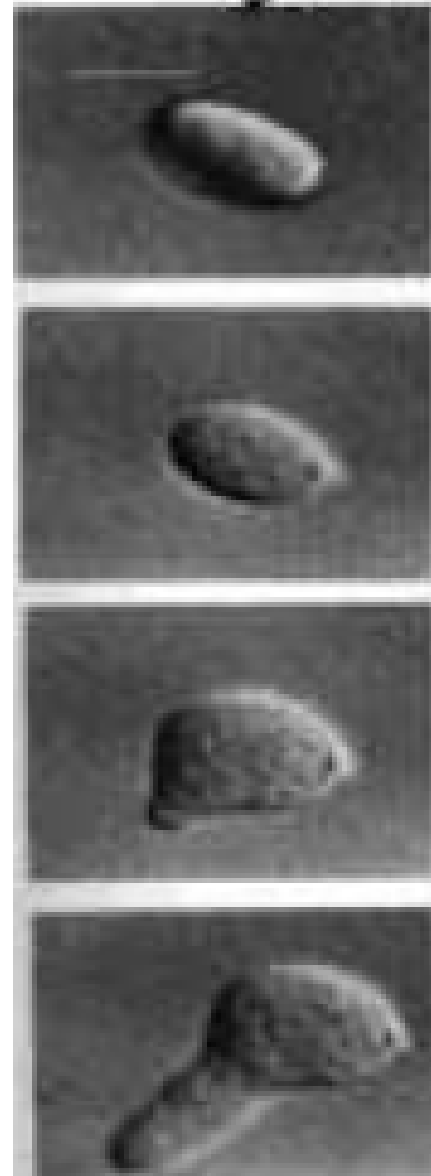
- Some fungal mycotoxins are also toxic to mammals
 - Aflatoxin is produced by molds that grow on spoiled foods, esp. feed grain and peanuts
 - Much more potent than some industrial chemical compounds
- Tricothecene
 - Toxic to humans



Spores

- Fungi also produce massive amounts of spores
 - Fungi → spores
 - Plants → seeds
- Released from fungus and drift in the air
- Rest in a place with favorable environmental conditions





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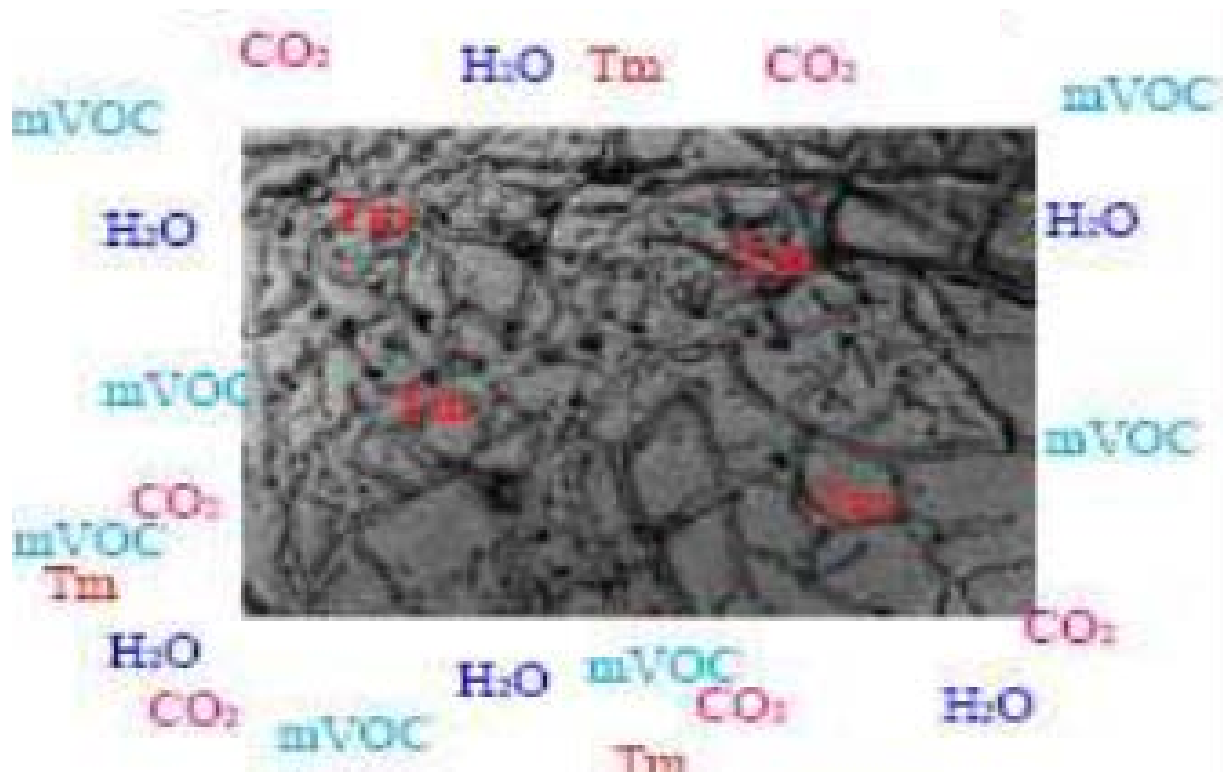


Hyphae



Mycellium





Fungi and Health Problems

- Allergic reactions
- Fungal infections
- Mycotoxicosis



Mitigation DIY?

- ≤ 10 sq. ft. – yes, if not allergic or asthmatic
- ≤ 100 sq. ft. – trained building managers
- > 100 sq. ft. – professional mold remediation contractor
 - License now required in New York State



Environmental Sampling

- Not usually necessary
- Thorough visual inspection generally appropriate for decisions about remediation
- Currently no standards or widely accepted guidelines to compare results



Remediating Mold Caused by Clean Water

- N-95 respirator
- Gloves
- Goggles



Remediating Mold Caused by Clean Water

Books and Papers	HEPA vacuum after drying
Carpet and Backing	Wet vacuum or steam clean HEPA vacuum after drying
Concrete or cinder block	Wet vacuum or steam clean HEPA vacuum after drying
Hard surface, porous flooring	Damp wipe surfaces w/detergent Wet vacuum or steam clean HEPA vacuum after drying



Non-porous hard surfaces (plastics, metals)	Damp wipe surfaces w/detergent Wet vacuum or steam clean HEPA vacuum after drying
Upholstered furniture and Drapes	Wet vacuum or steam clean HEPA vacuum after drying
Wallboard	HEPA vacuum after drying
Wood Surfaces	Damp wipe surfaces w/detergent Wet vacuum or steam clean HEPA vacuum after drying



Mold

Hiring a Mold Remediation Contractor

Joseph Laquatra, Hazel E. Reed Human
Ecology Extension Professor in Family
Policy, Cornell University

Claudette Reichel, Professor,
Louisiana State University AgCenter

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his parents, Ben and Jo.*



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The Contract

- Diagram or survey that details square feet, rooms, or sections of the area in which remediation will be done.
- Specific amount of time it will take to complete the remediation work.
- Itemized list of materials (e.g., lumber, wallboard, carpet and padding, paint) required to complete the remediation.



The Contract

- Who (homeowner or contractor) will provide the renovation materials.
- How the contaminated materials will be handled and whether the homeowner or contractor will remove debris from the site.



The Contract

- Detailed warranties of work and guarantees on remediation.
- Cleanup procedures and products to be used as well as a cost breakdown and total price cap.

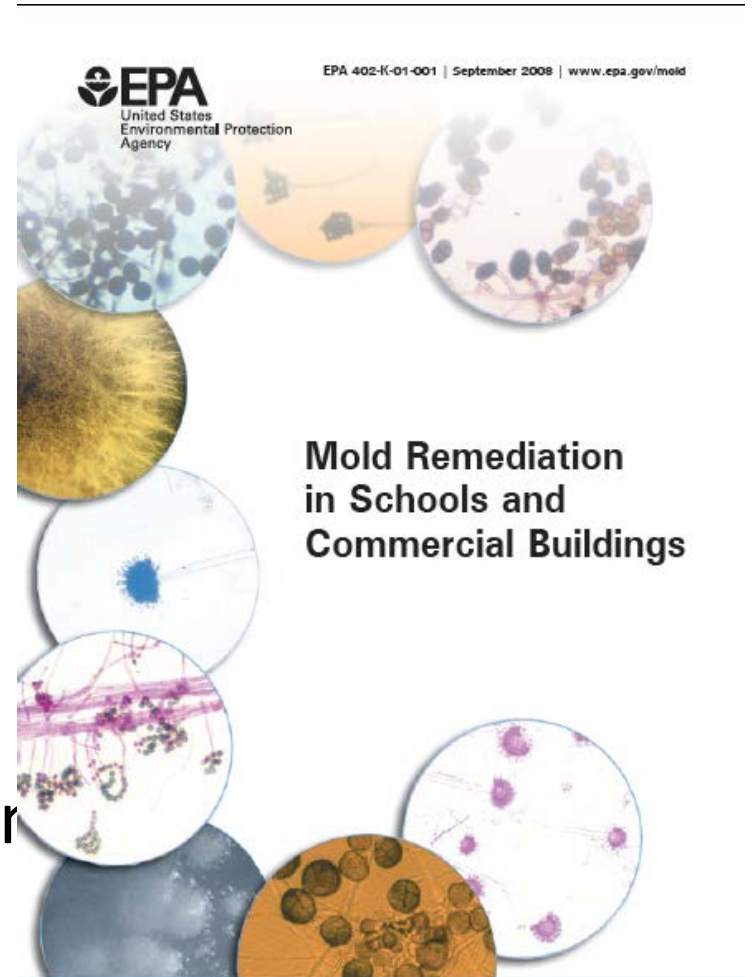


- At least 3 estimates
- Ask for proof of education or training sessions on mold remediation and license
- References from clients



Removing mold

- Variety of methods are used
- Good resource:
- <http://www.epa.gov/mold/remediation.html>




Response to Mold Problems

- **IDENTIFY**
 - extent of moisture damage and contamination
 - dynamics of moisture sources
 - appropriate containment and worker protection
- **DRY** the wet areas in the short term
- **DESIGN**
 - long term intervention in the moisture dynamics
 - fungal clean-up procedures and clearance criteria
- **DISCARD - DECONTAMINATE** contaminated material
- **IMPLEMENT** repairs and program changes to prevent future problems
- See EPA Guidance





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Cleaned
with HEPA
vacuum



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- 
- ✓ Cleaning Solution
 - Detergent and hot water
 - ✓ Assorted brushes, rags, mist spray bottles
 - ✓ Do not use high pressure sprayers



For Bigger Jobs

MUST HAVES:

- Respirator
 - N-95 respirator
- Eye protection
- Rubber gloves
- Coveralls
 - remove/bag them before you leave the work area





Containment may be needed for bigger jobs. See EPA Guidance.



Code Requirements Related to Moisture

- **302.2 Grading and drainage.** All premises shall be graded and maintained to prevent the erosion of soil and to prevent the accumulation of stagnant water thereon, or within any structure located thereon.
- **304.7 Roofs and drainage.**
 - The roof and flashing shall be sound, tight and not have defects that admit rain.
 - Roof drainage shall be adequate to prevent dampness or deterioration in the walls or interior portion of the structure.
 - Roof drains, gutters and downspouts shall be maintained in good repair and free from obstructions.
 - Roofwater shall not be discharged in a manner that creates a public nuisance.



IPMC Requirements Related to Moisture

- **304.6 Exterior walls.** All exterior walls shall be free from holes, breaks, and loose or rotting materials; and maintained weatherproof and properly surface coated where required to prevent deterioration.
- **304.2 Protective treatment.**
 - All exterior surfaces, including but not limited to, doors, door and window frames, cornices, porches, trim, balconies, decks and fences shall be maintained in good condition.
 - Exterior wood surfaces, other than decay-resistant woods, shall be protected from the elements and decay by painting or other protective covering or treatment. . . .
 - All siding and masonry joints as well as those between the building envelope and the perimeter of windows, doors, and skylights shall be maintained weather resistant and water tight.

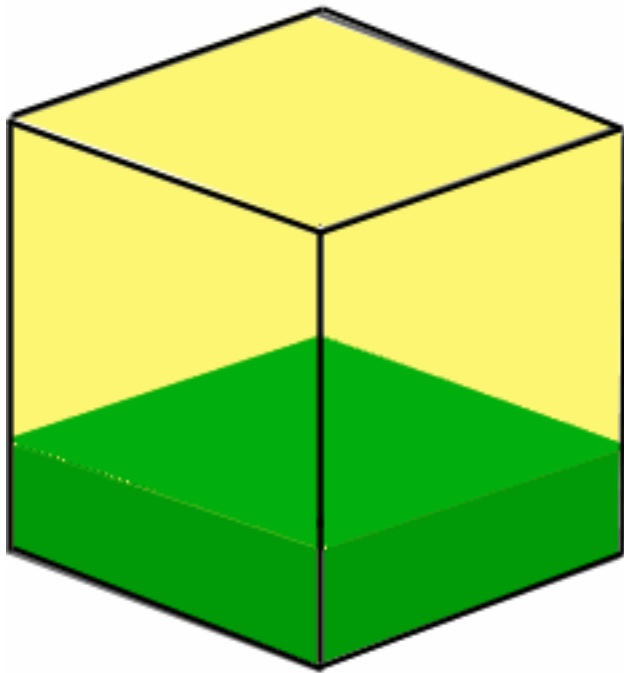


Educate Consumers

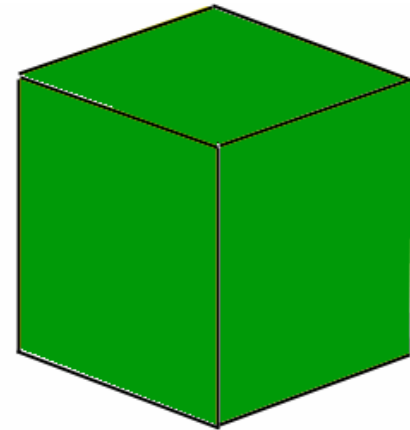
- Many misconceptions about moisture in homes



WARM AIR HOLDS MORE WATER VAPOR THAN COLD AIR



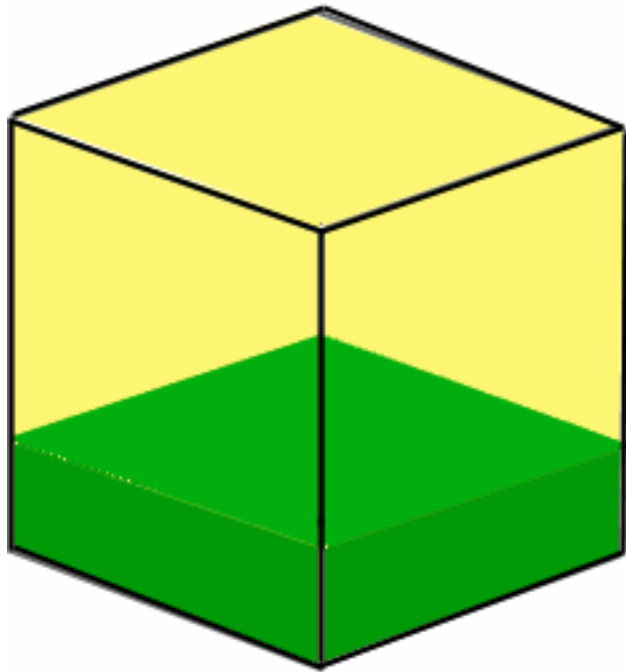
75° F - 30% Relative Humidity



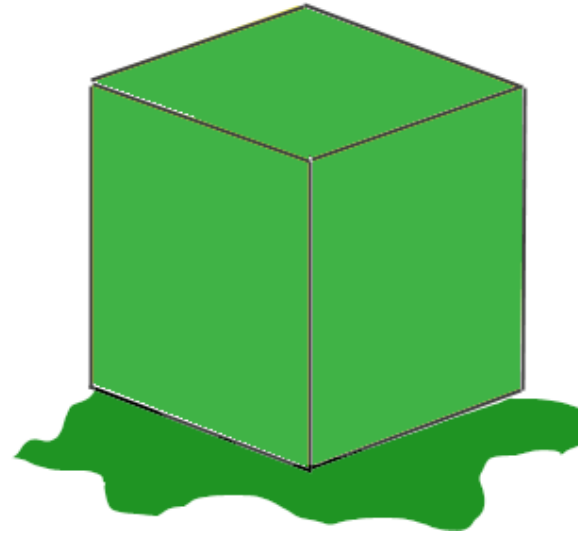
40° F - 100% Relative Humidity



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75° F



40° F

MOISTURE CONDENSES AT 100% RELATIVE HUMIDITY OR SATURATION

THIS IS THE DEW POINT TEMPERATURE



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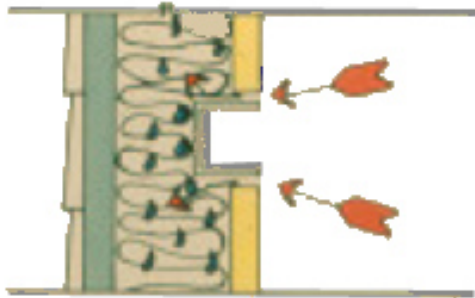
Condensation

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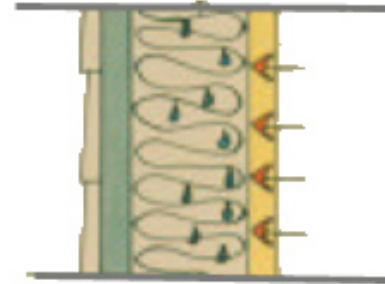
Warm moist air can cause
Condensation on cold windows



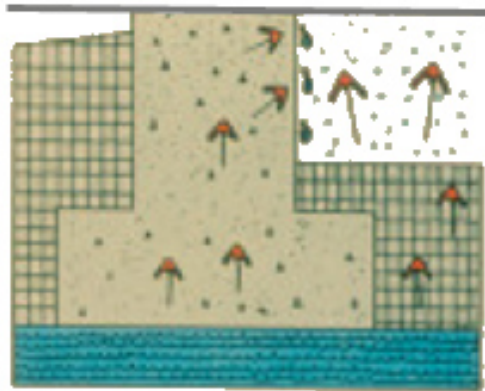
MOISTURE TRANSFER METHODS



Air Movement around Receptacles

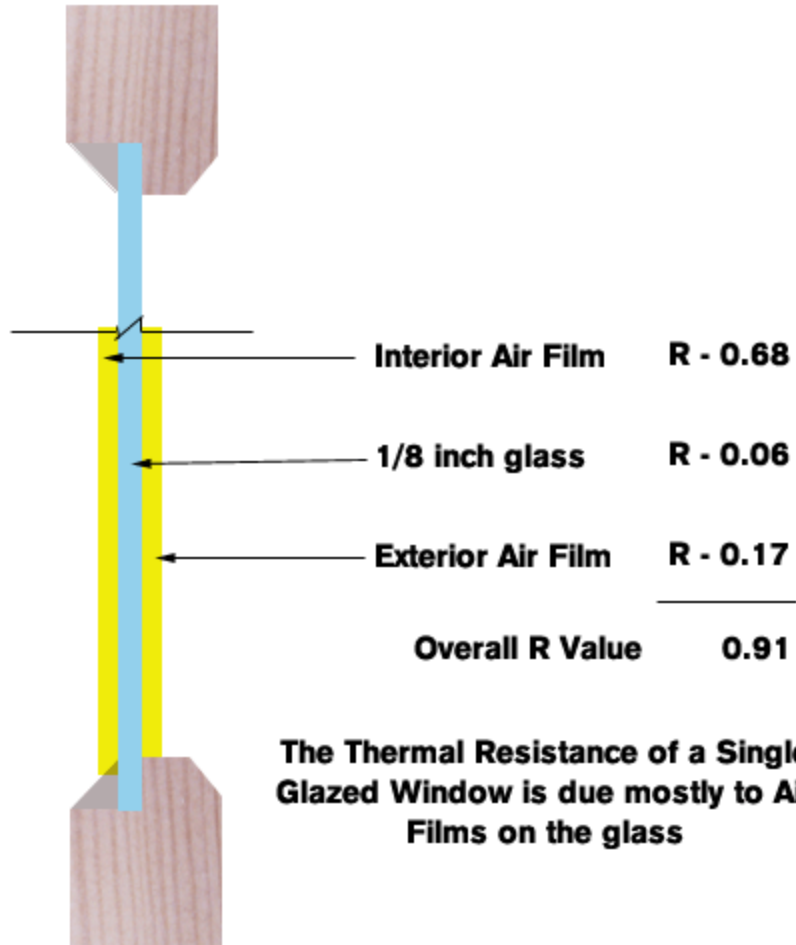


Diffusion through Gypsum Board



**Capillary Action through
a Concrete Foundation**





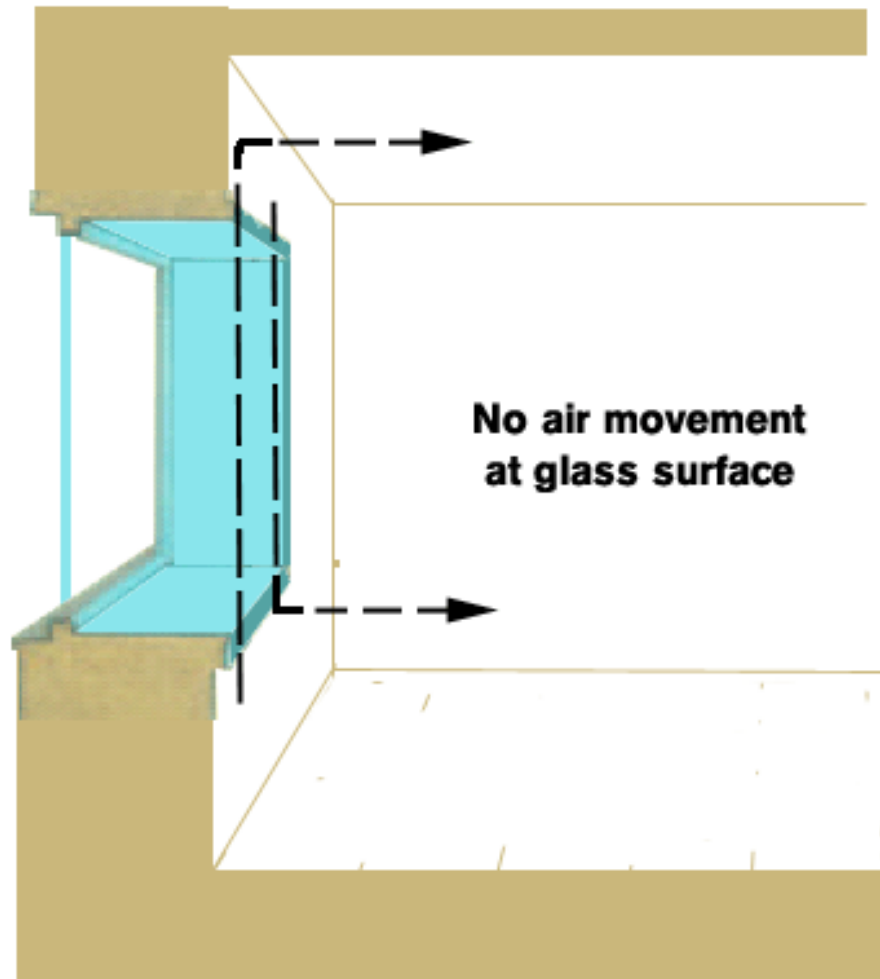
The Thermal Resistance of a Single Glazed Window is due mostly to Air Films on the glass

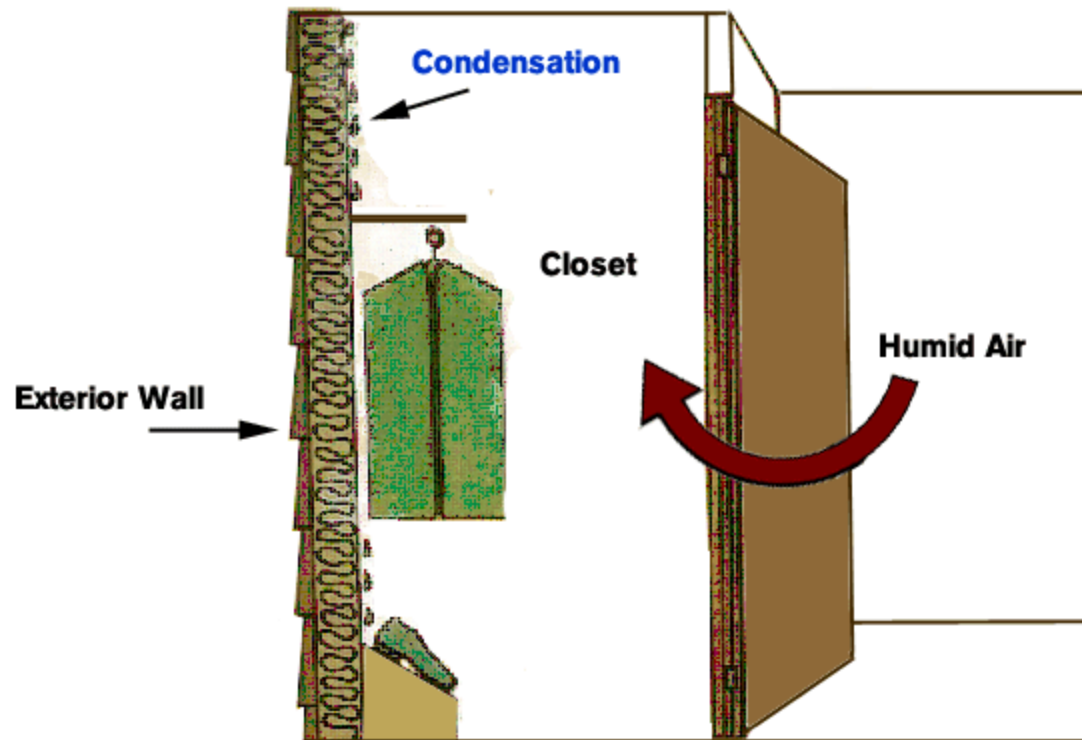




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Condensation at Recessed Windows

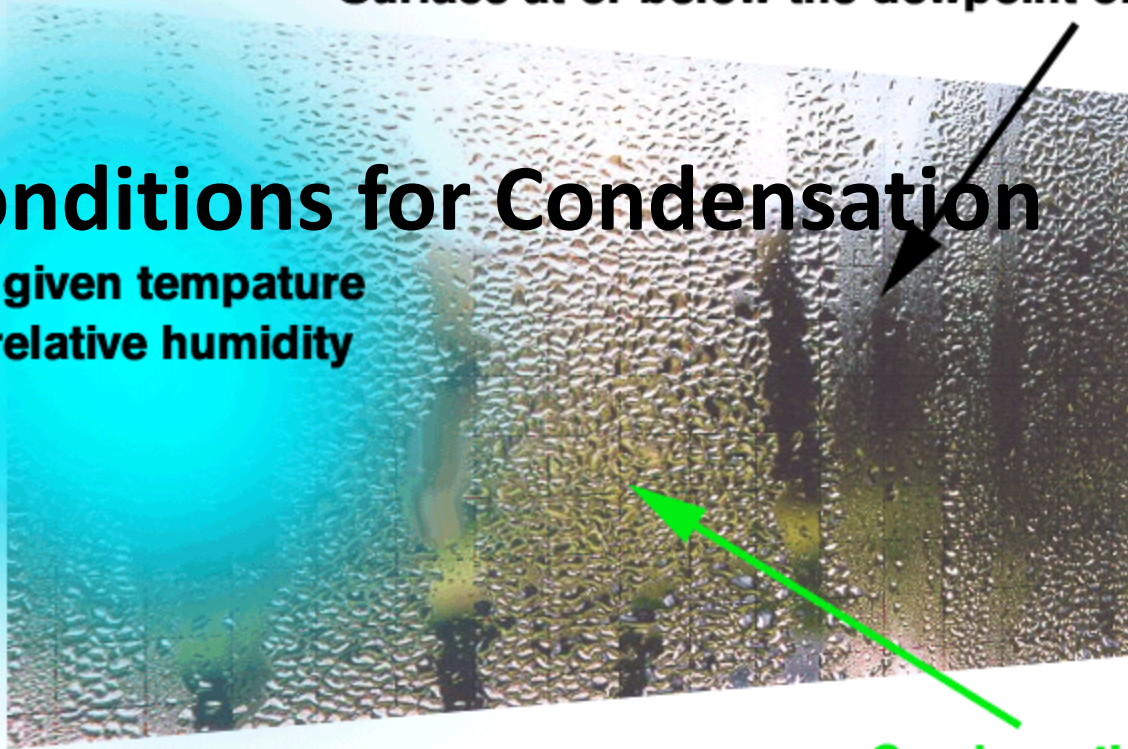




Surface at or below the dewpoint of the air

Conditions for Condensation

**air at given temperature
and relative humidity**

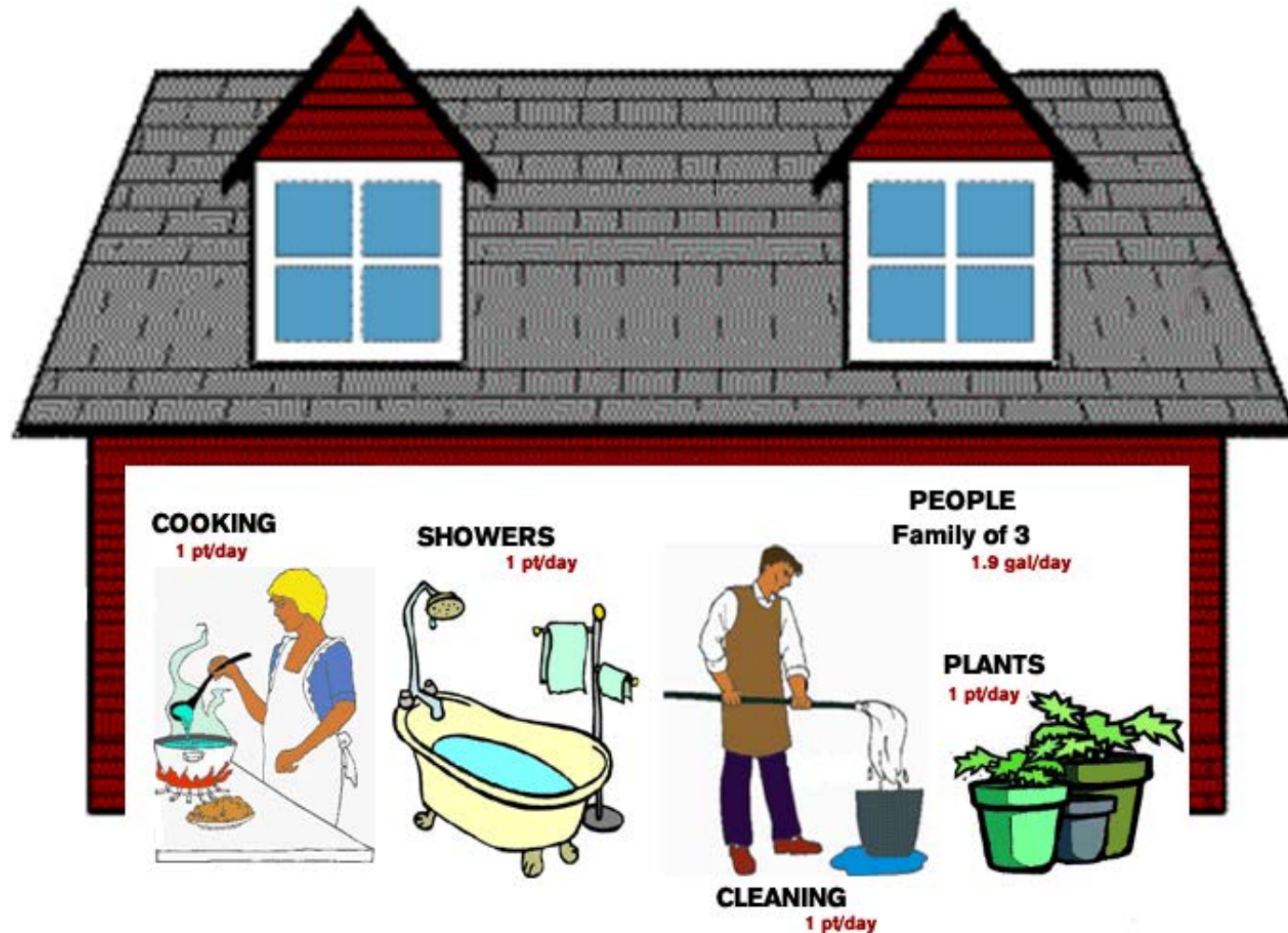


Condensation



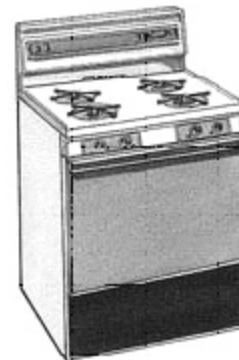
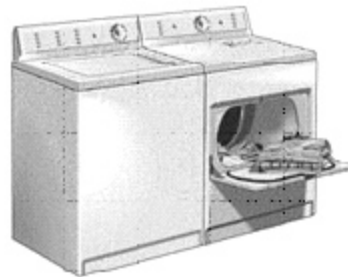
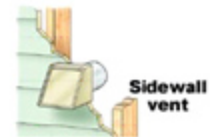
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MOISTURE BALANCE





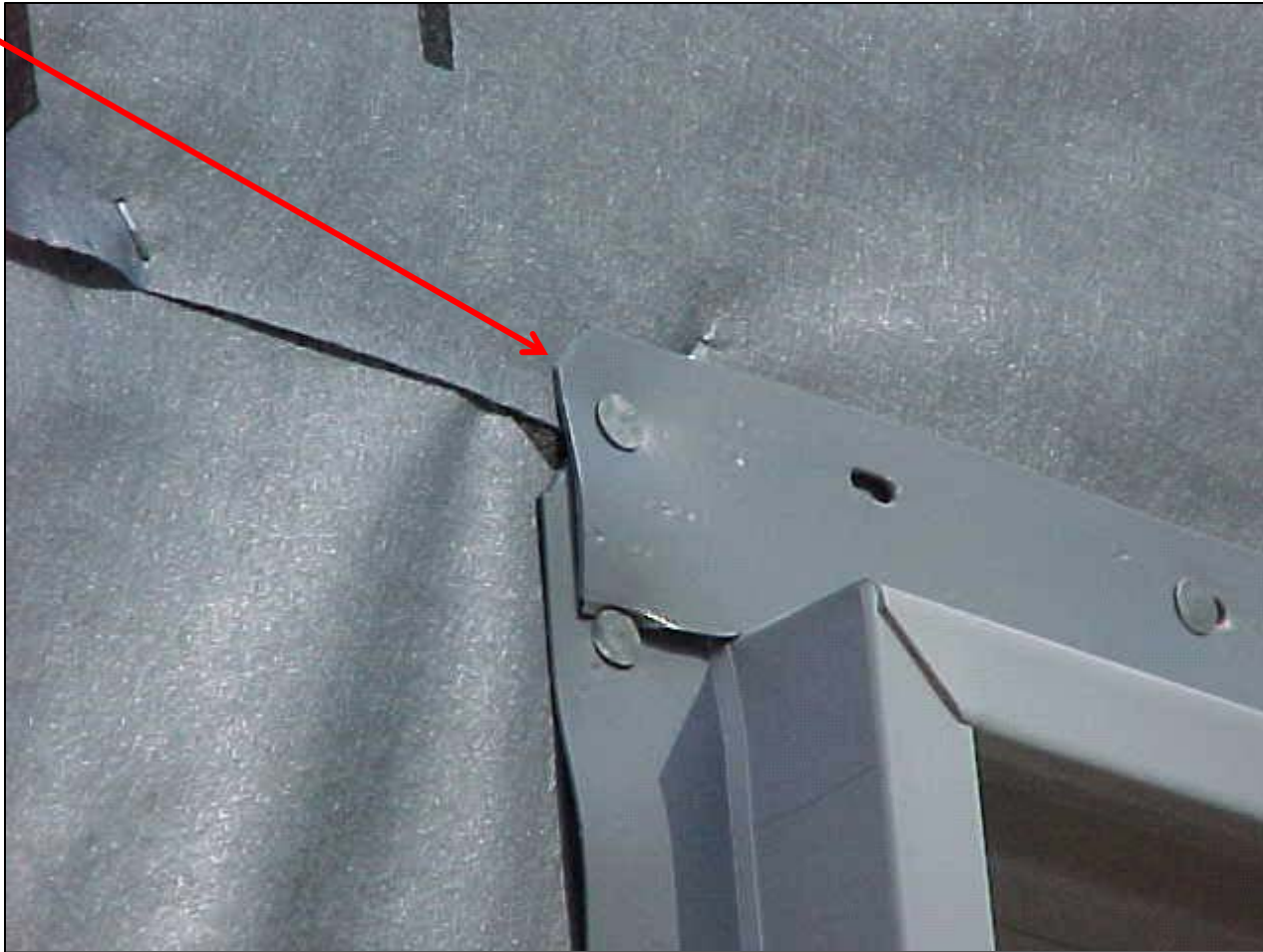
or



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THINGS That Work
An EEBA Educational Series



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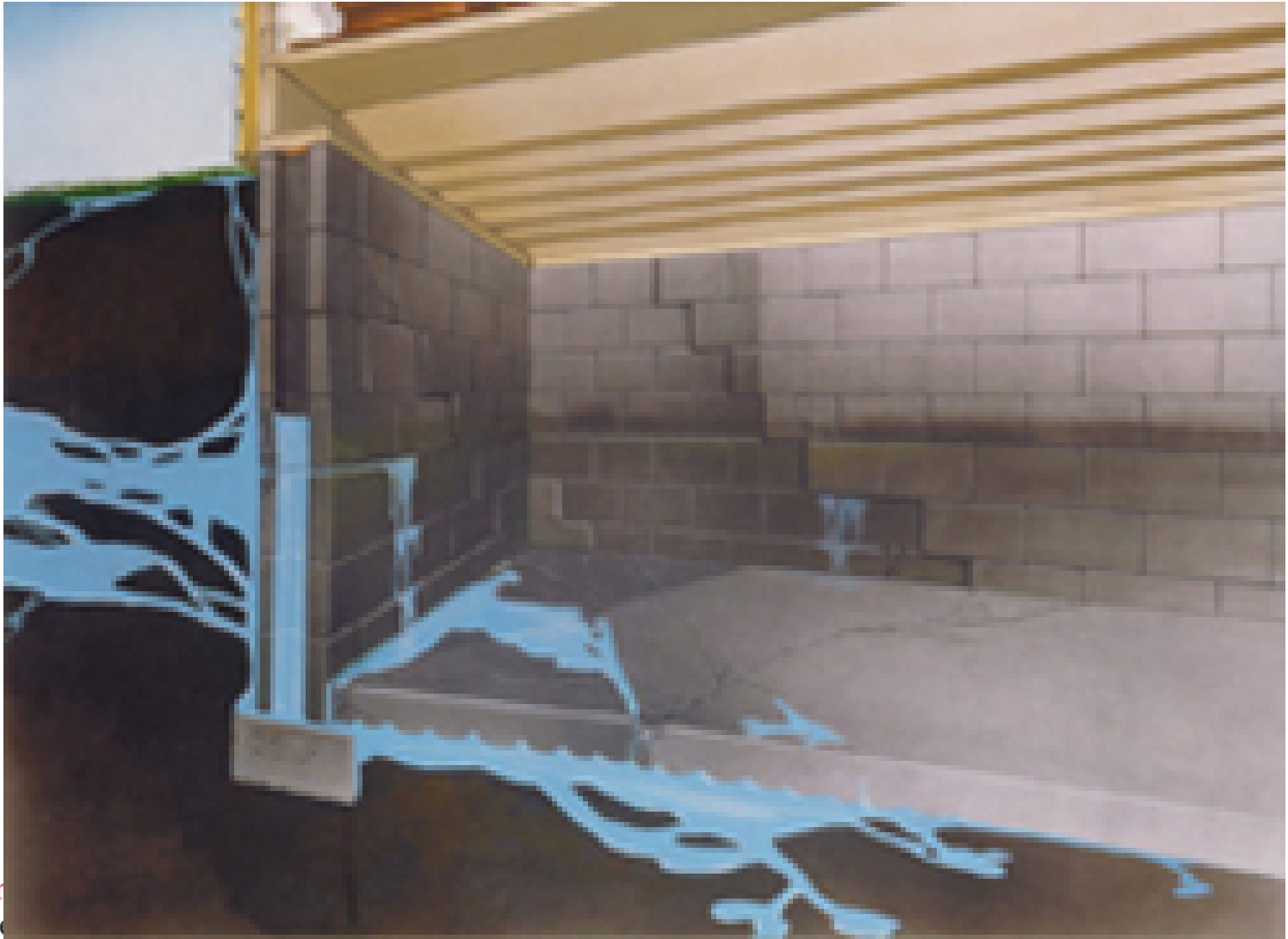
Specifications



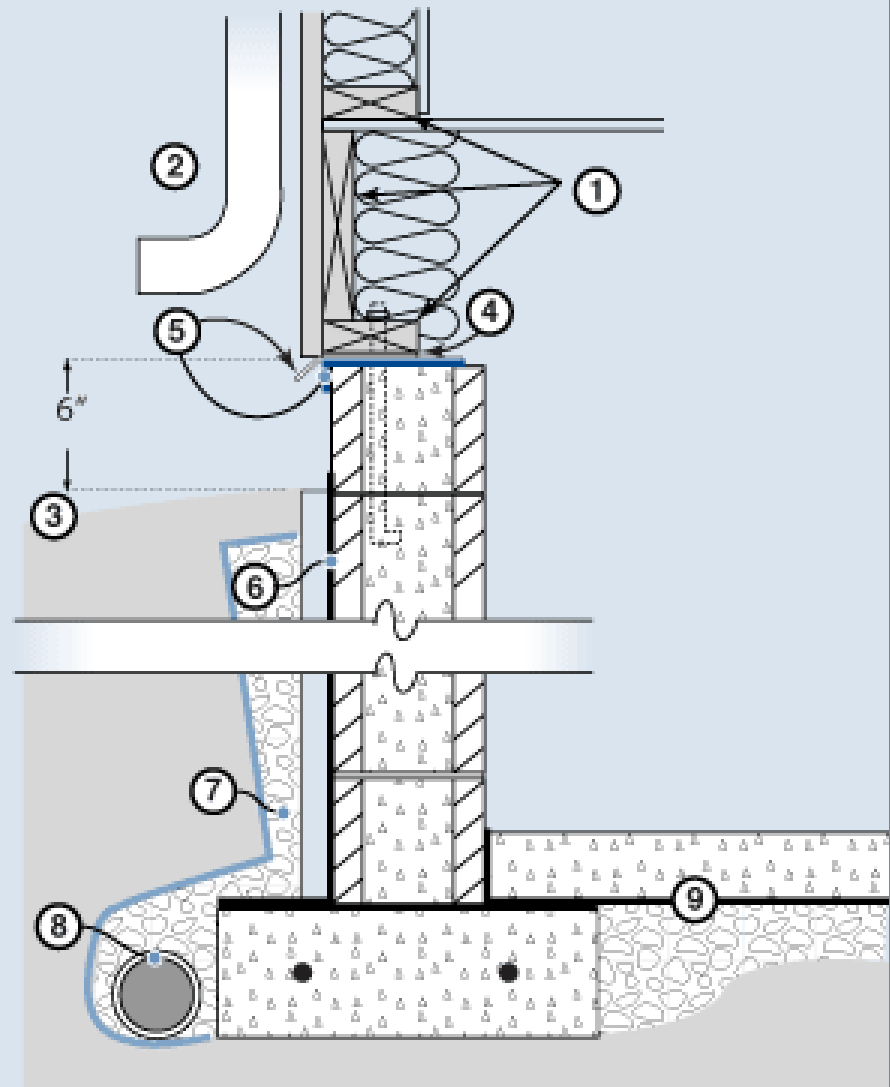
No drainage plane



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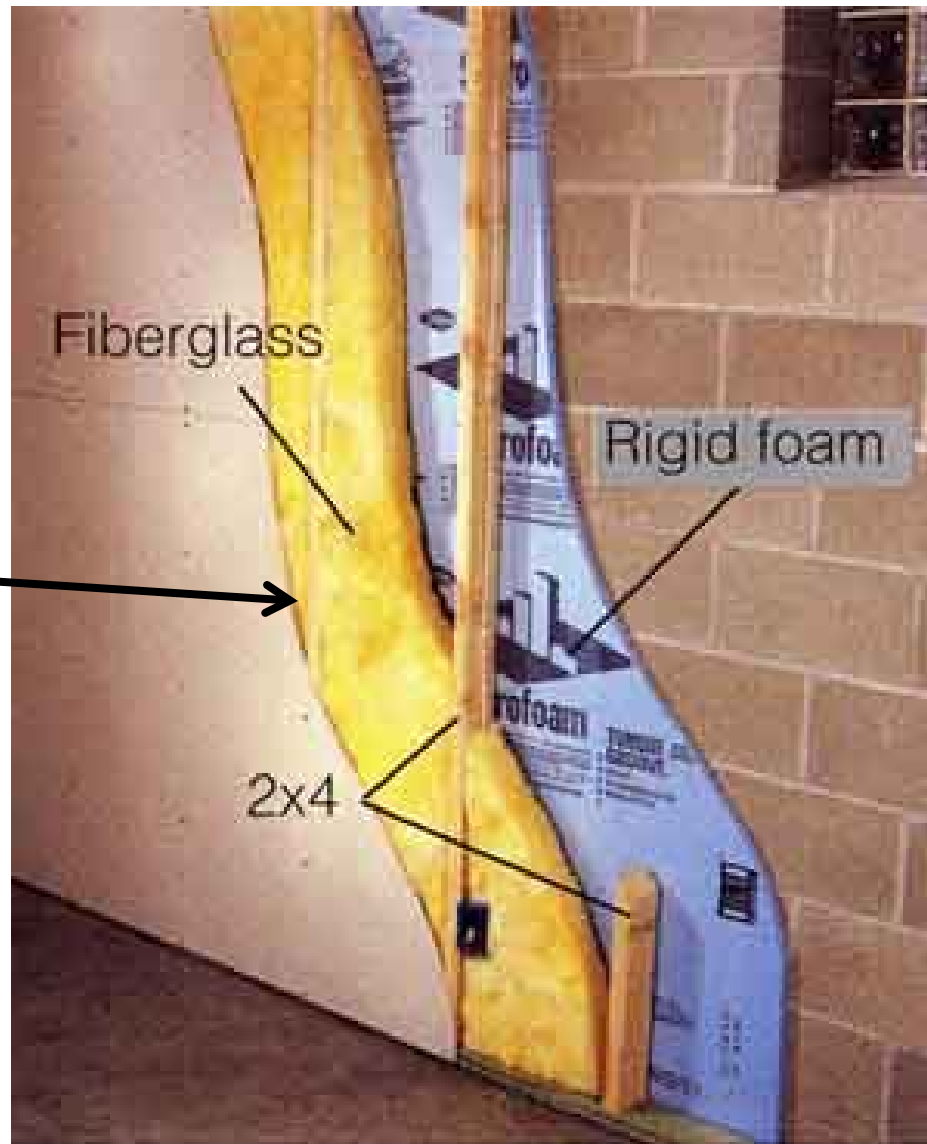
Water-managed Basement Wall and Foundation





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No vapor retarder
below grade





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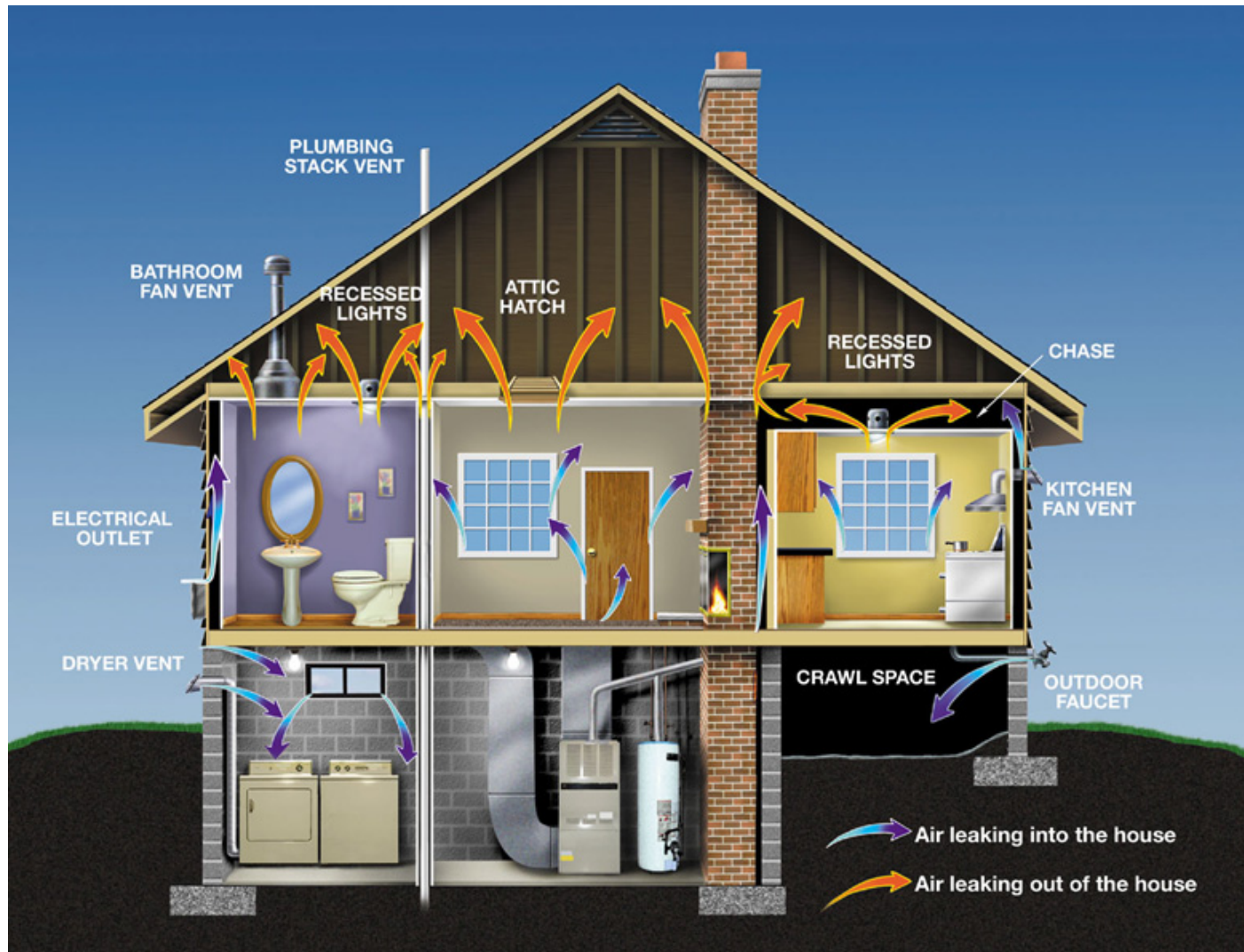
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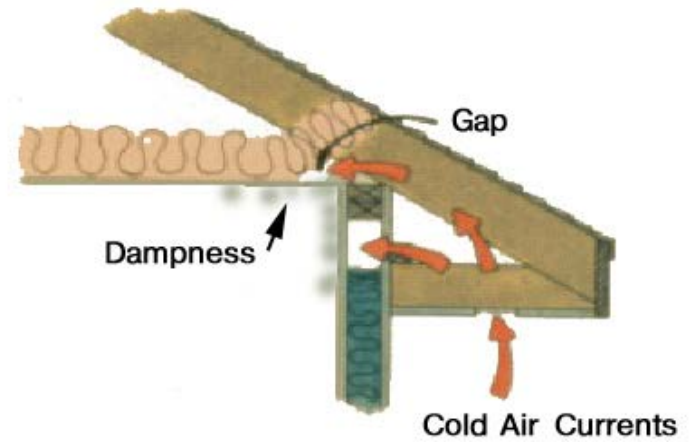
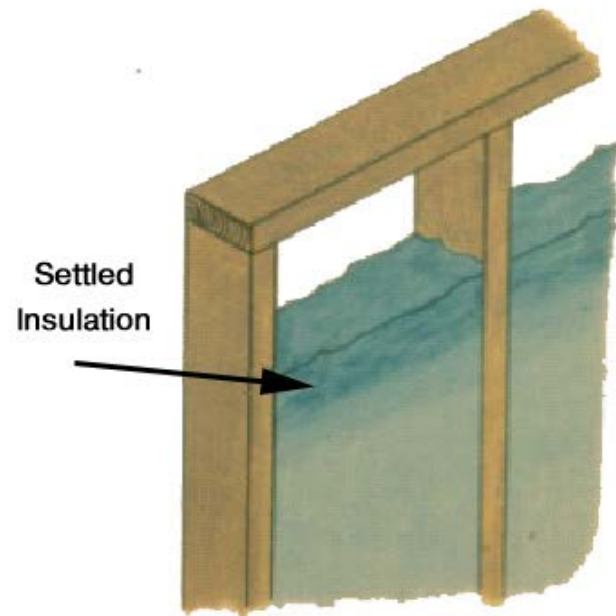
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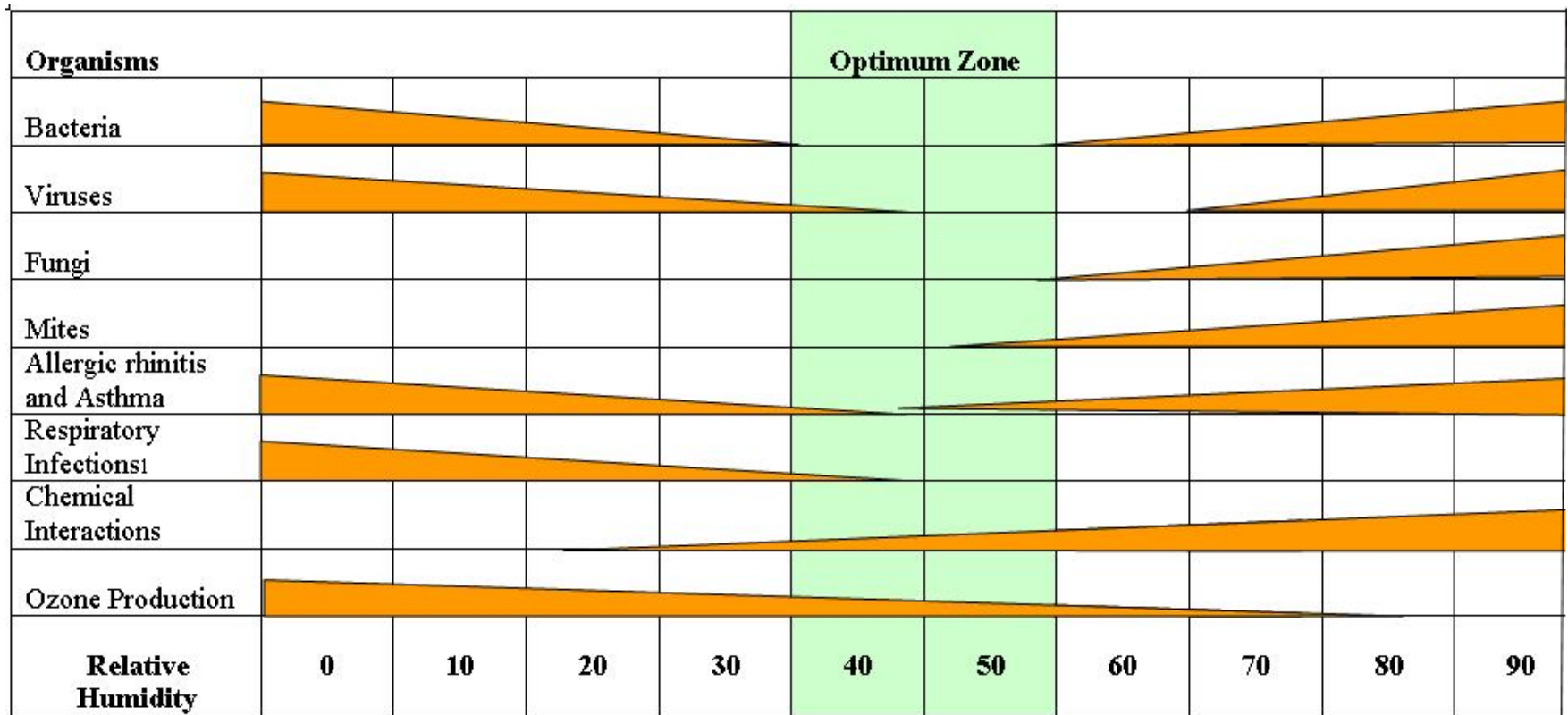


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1. Insufficient data above 50% RH

From "Criteria for Human Exposure to Humidity in Occupied Buildings"
Dr. Elia Sterling, 1984



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Accidental Ventilation



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Spot Ventilation



Makeup Air Inlets



Air-to-Air-Heat Exchanger

