

The House is a System:

**Building Science: A New Way
of Thinking About Homes**

ACI at the 2006

RESNET Conference

February 27 – March 1

San Antonio, TX.

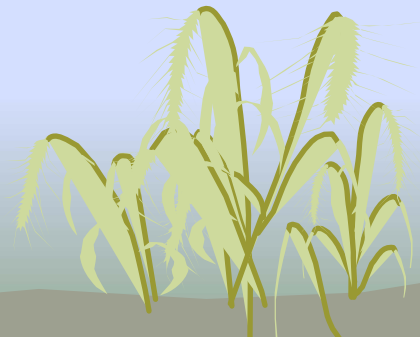


The House Is A System

- **Doug Garrett, CEM**
 - Assoc. of Energy Engineers, Certified Energy Manager
 - ACCA Certif. Instructor, Manuals J, D & S
 - Administered IECC Energy Code for eight years
 - Five Years at the COA Green Building program
 - Several Indoor Air Quality Certifications
 - Former contractor/builder
 - Managed Utility Energy Conservation programs that did 5,000 home and 1,500 commercial audits a year for 12 years.

The House Is A System

- High Performance Homes For The Future!
- “The future ain't what it used to be.”



*In the Beginning, There Was
Darkness,...*

**We foolish mortals thought that
homes were just components
that stood alone and did not
interact**



“I don't want to make the wrong mistake.”



Science Has Come Home! OR...

“The future ain't what it used to be.”

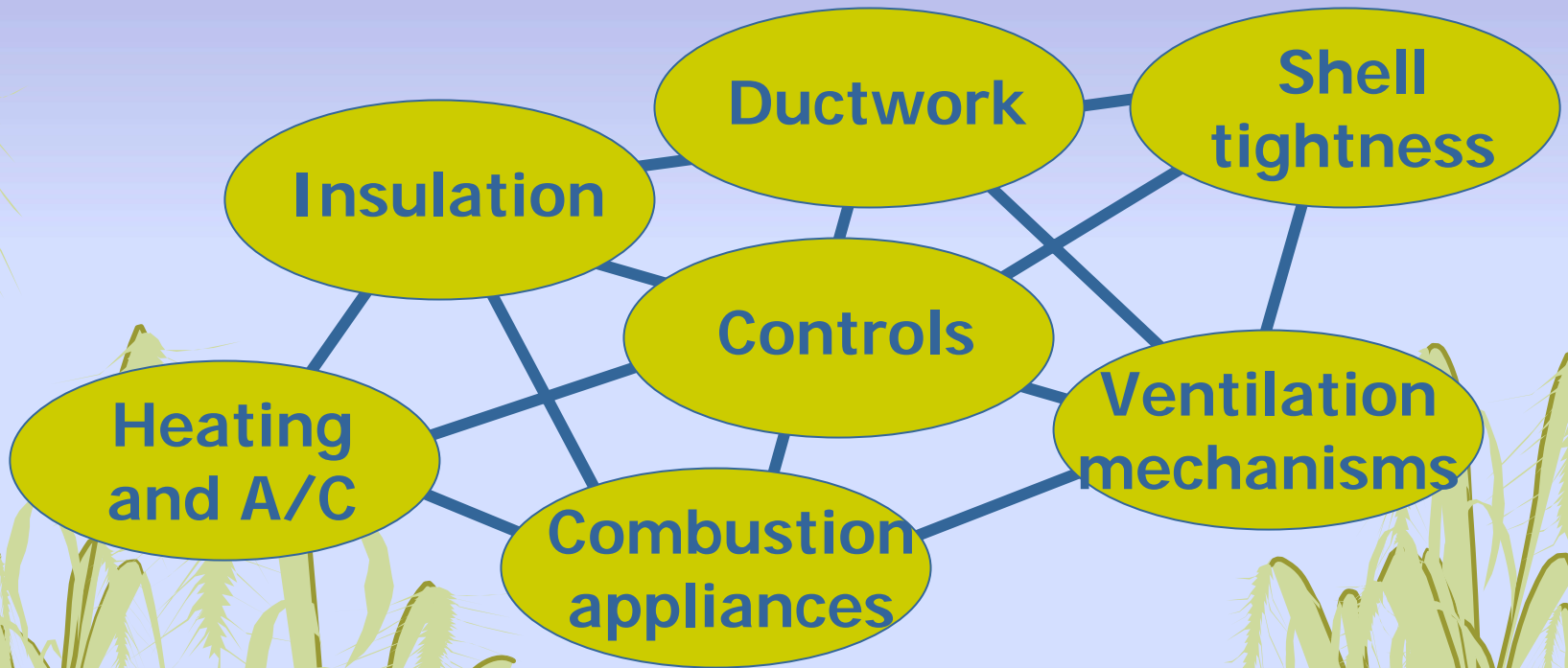
Building researchers have learned a lot about how to make homes *perform* better

*...more comfortable,
healthful, durable, and
cost less to run*



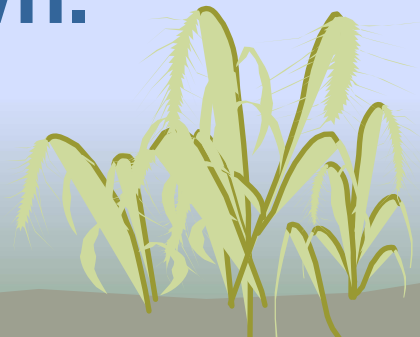
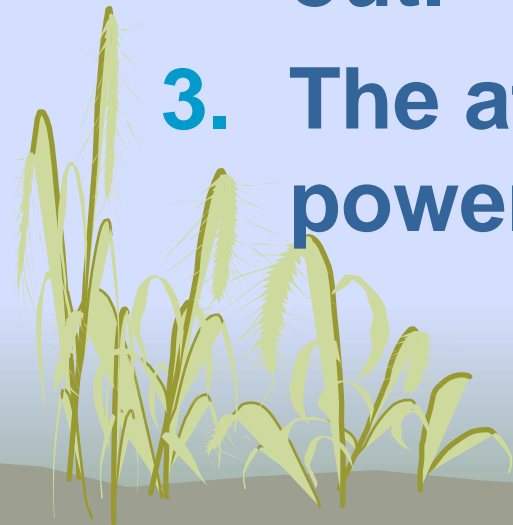
The Whole House Principle:

Everything Interacts!



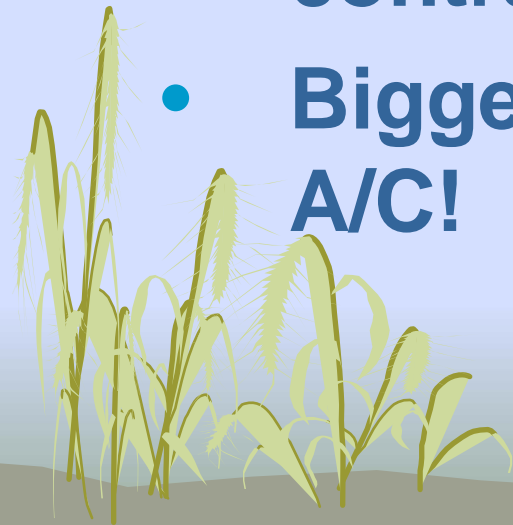
The House Is A System

1. The house isn't cooling well, so we install a bigger A/C.
2. The crawlspace is damp, so we install a fan for ventilation to dry it out.
3. The attic is too hot, so we install a power attic vent to cool it down.



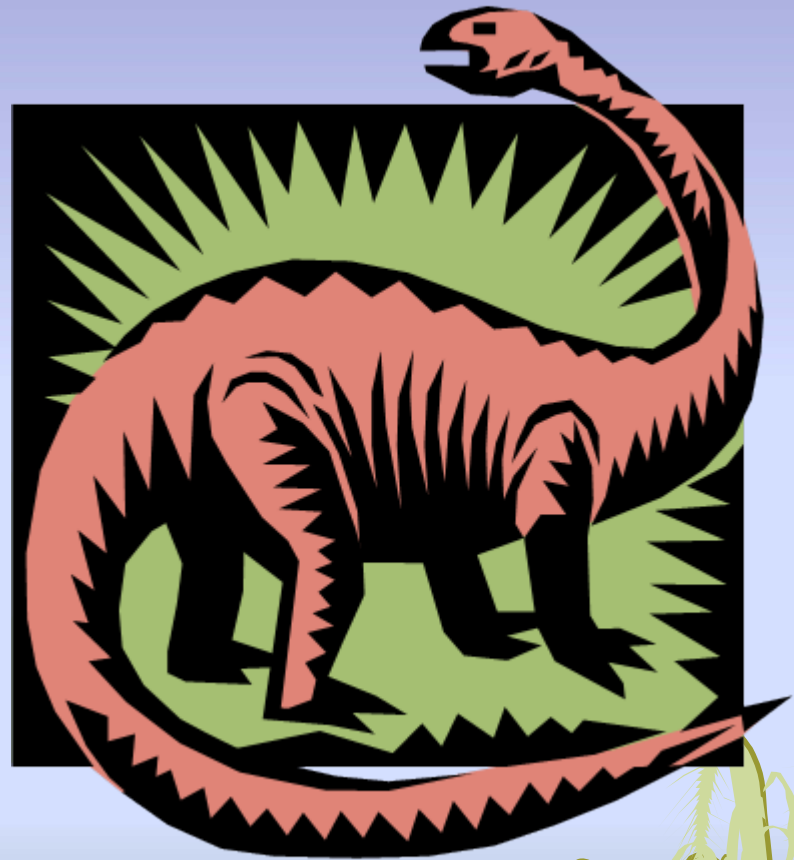
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1. The house isn't cooling well, so we install a bigger A/C.
 - This is a matter of faith for Southern home owners and most contractors.
 - Bigger is Better When it comes to A/C!



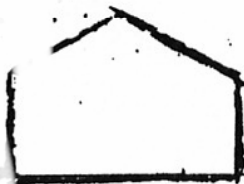
HVAC System:

- Sizing A/C's:
- **Bigger Isn't Better!**
- **ACCA = A/C's
Sized at 1.5 to 2.0
Times What is
Needed**

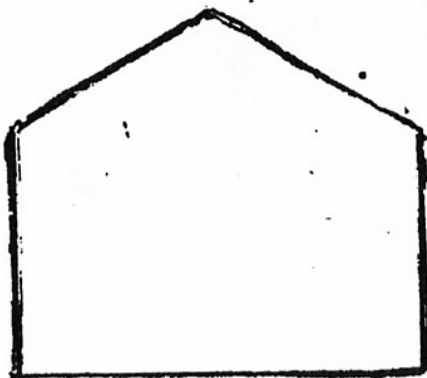


Air Conditioner or Heat Pump SIZING CHART

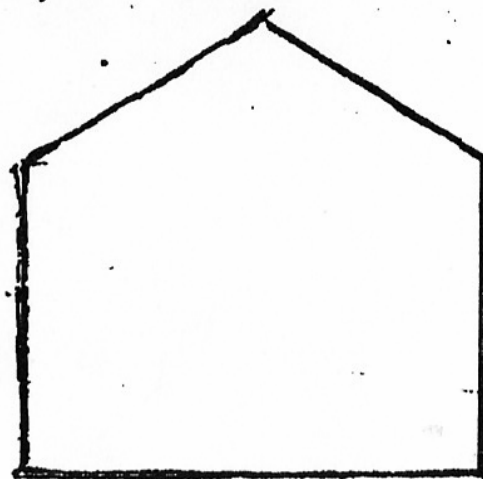
TRIM OUT VERY CAREFULLY ON BLACK LINES, THEN FOLLOW INSTRUCTIONS.



1 1/2 TO 2
TON



2 1/2 TO 3 1/2
TON



4 TO 5
TON

INSTRUCTIONS:
Stand on the curb and look through hole,
if the house fits in a hole thats the size unit to use.

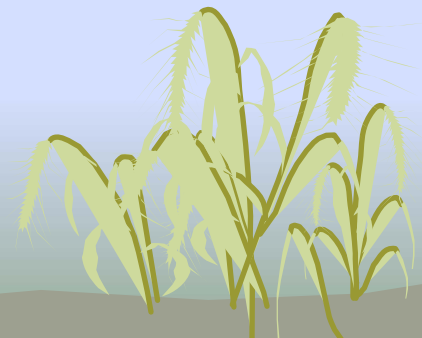
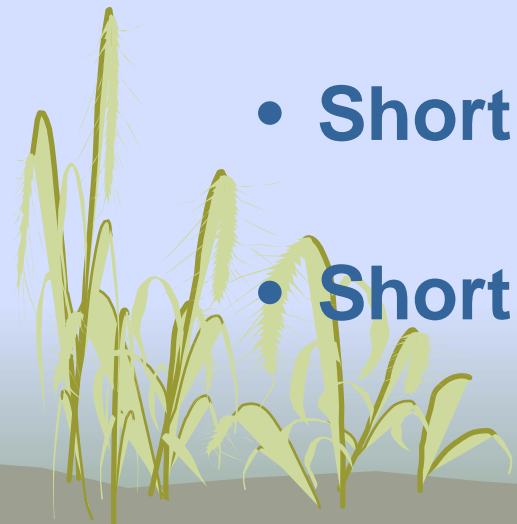
TO

FORM

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HVAC System:

- Most A/C's are oversized for the house - Resulting in Short Cycling
 - Short Cycling – Results in Poor Dehumidification
 - Short Cycling – Reduces Equipment Life
 - Short Cycling – Reduces Efficiency (SEER)
 - Short Cycling – Reduces Filter Effectiveness



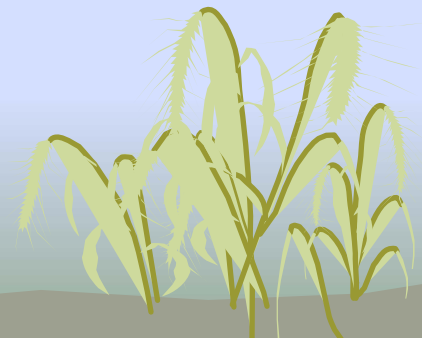
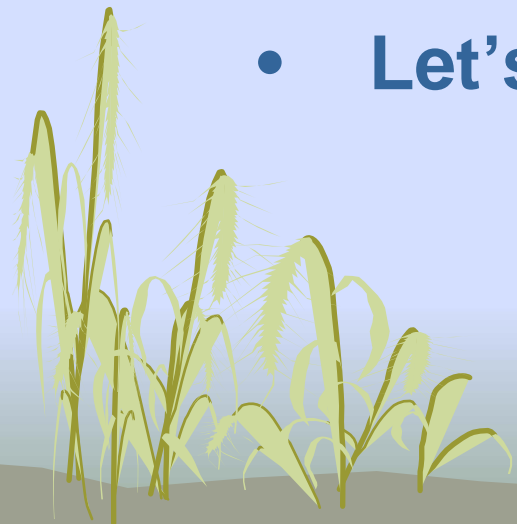
HVAC System:

- A/C Sizing:
- Rules of Thumb – Set in the Late '60's (1Ton/400 to 500 SF)
- Exaggerating design temperatures
- Duct Leakage not accounted for
- Selecting equipment far over calculated load (Load + 15% Maximum)

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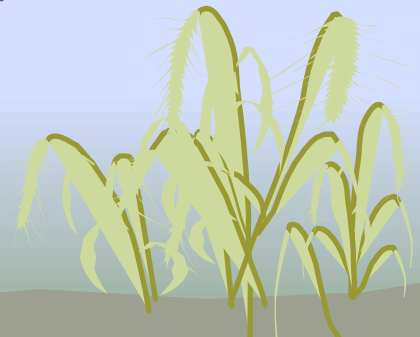
2. The crawlspace is damp, so we install a fan for ventilation to dry it out.

- Many P.E.'s will recommend this solution to this very day!
- Let's talk about moisture sources.



Crawlspaces and Basements

- **Dr. Bill Rose, University of Illinois**
- **Exposed soil is a Major source of Moisture in the home.**
- **100 Lbs. (12.2 gals.) per 1,000 SF of dry exposed soil per day!**
- **Whole Family = 8 gals./day**



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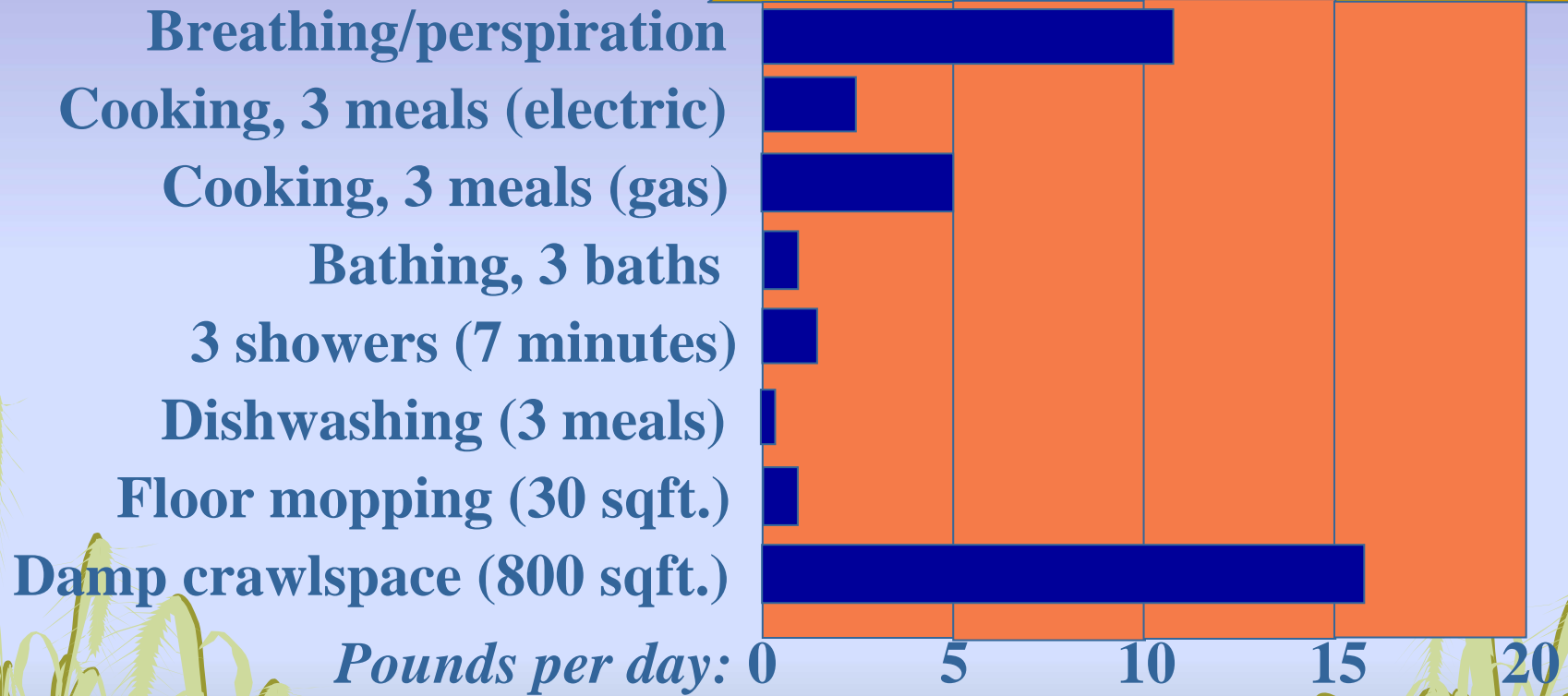
- Crawl Spaces

- Do Not Ventilate Them!!

- Outside Air Is Too Humid to Dry Anything.

- Seal them air tight, use vapor barrier on the floor, insulate the stem wall and pressurize with conditioned air. IRC allows this method of construction.

Moisture Generation





**Healthy, Dry,
No Rot
Crawlspace**

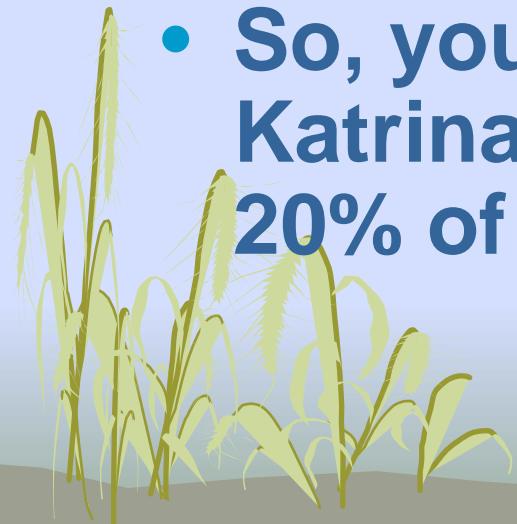
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3. The attic is too hot, so we install a power attic vent to cool it down.

- Even today many engineers still believe that convection loops move the heat from the roof deck down to the attic floor.
- “In theory there is no difference between theory and practice. In practice there is.”
- FSEC research showed that this is not true!

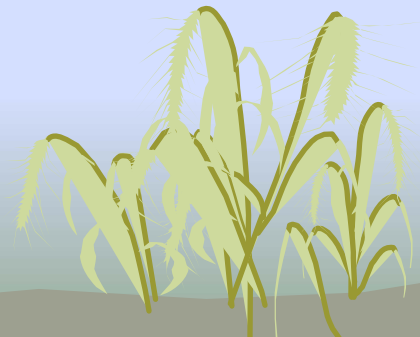
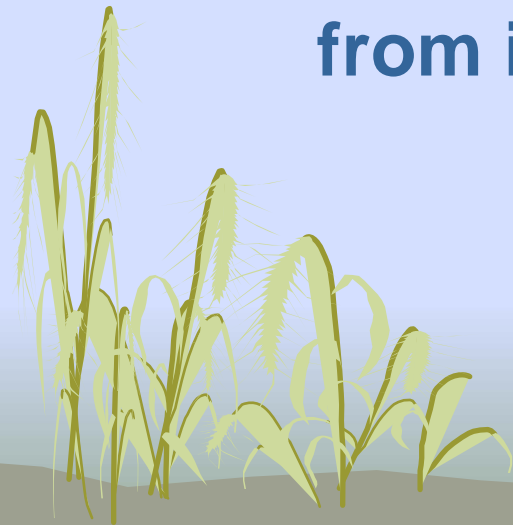
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- Convection loops move only 20% of the heat from the roof deck to the attic floor!
- Radiant heat transfer is responsible for 80%+ of the heat transfer.
- So, you could create Hurricane Katrina in your attic and only affect 20% of the heat transfer.



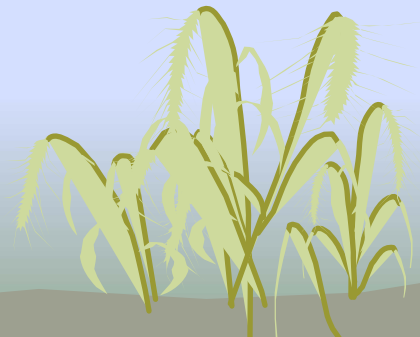
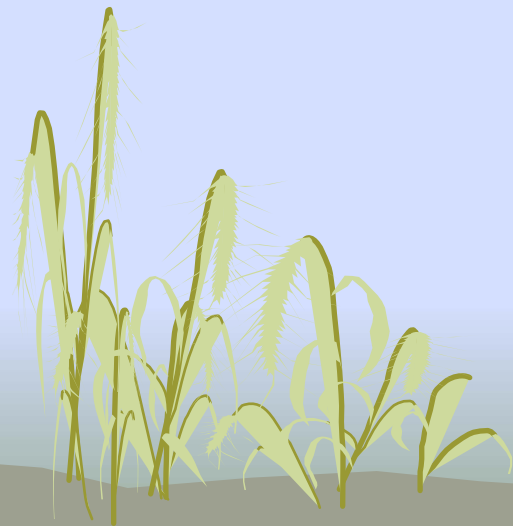
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- What does happen when we power ventilate an attic?
 - The attic becomes a big negative pressure zone – a vacuum cleaner!
 - The air is drawn in from outside and up from inside the house.



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- Research at the Advanced Energy Corporation showed that 40% of the air exhausted by a PAV is conditioned inside air!



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- This leads to back drafting of combustion appliances – CO!
- An equal amount of hot, humid outside air is drawn into the home to replace the exhaust air.
- Indoor humidity rises.
- Comfort goes down, mold grows and wood floors warp, just to name a few side affects.



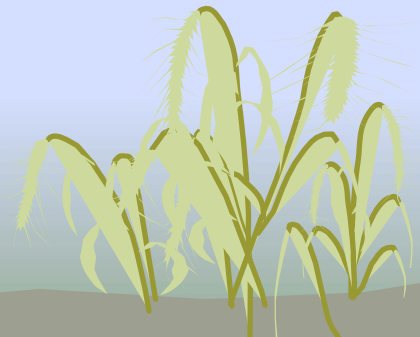
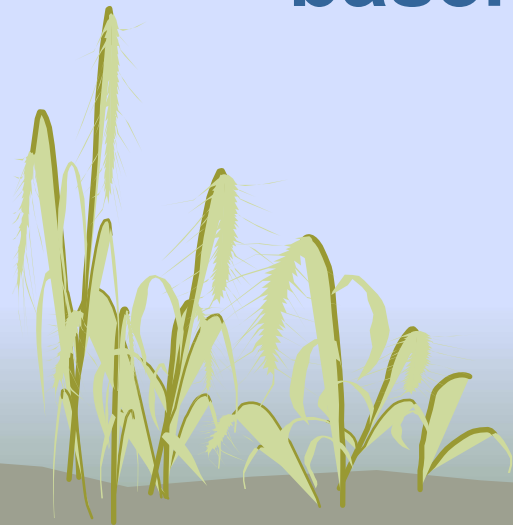
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- Lessons:
 1. Go along with the typical recommendation on fixing an A/C problem and suffer with high bills, poor comfort, high humidity, and grow a bumper crop of mold!



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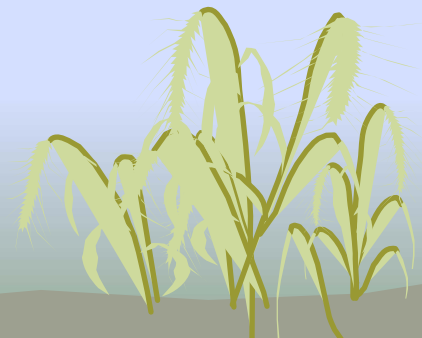
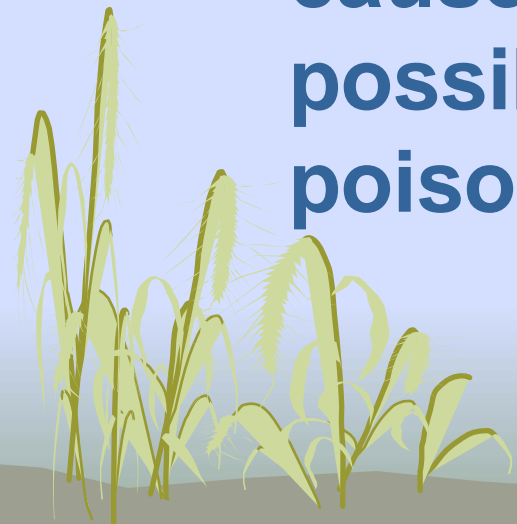
- Lessons:
 2. Follow the crowd to fix a damp crawlspace or basement and make it a truly wet crawlspace or basement!



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- Lessons:

3. “Improve” attic ventilation and run the risk of making the house more humid, more likely to grow mold, cause the electric bills to go up and possibly cause a fire or CO poisoning!



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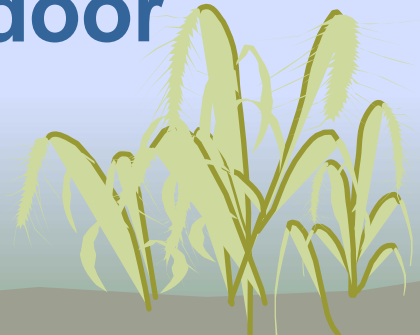
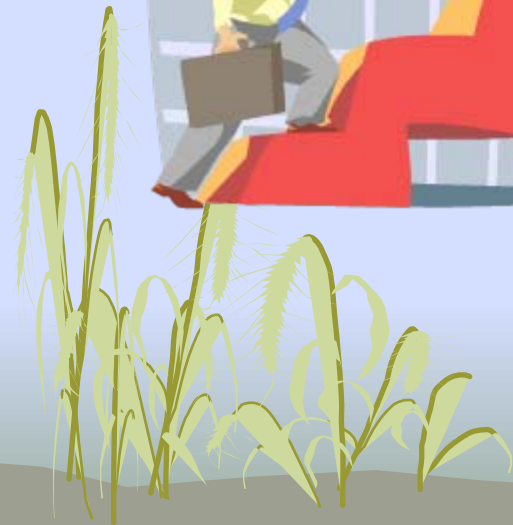
- **Everything Interacts!**
- **See the house as a system!**
- **Understand that changes have multiple side effects in a system.**
- **Don't draw imaginary boundaries between parts of a home or building.**
- **Be curious and don't stop learning!**



The Future's So Bright...

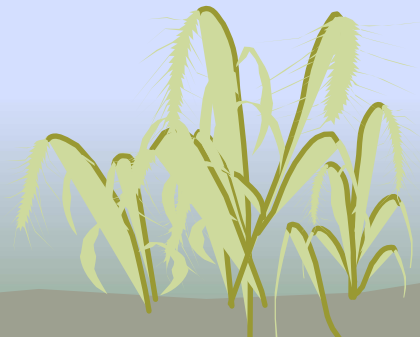
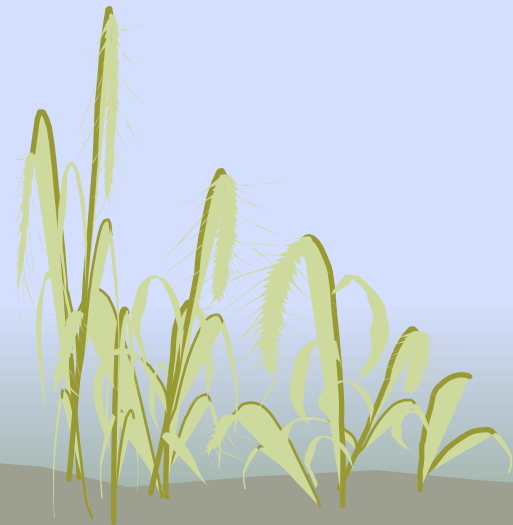


- **Guaranteed Performance**
- **Improved Comfort**
- **Greater Efficiency**
- **Healthy Indoor Air Quality**



The Future's So Bright...

- “You can observe a lot just by watchin’”
- “I never said most of the things I said.”



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