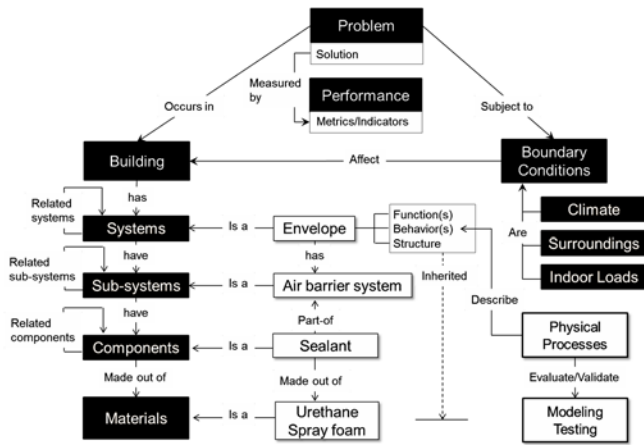


Residential Ventilation and Indoor Air Quality: Study a House as a System of Systems (A Preliminary Study)

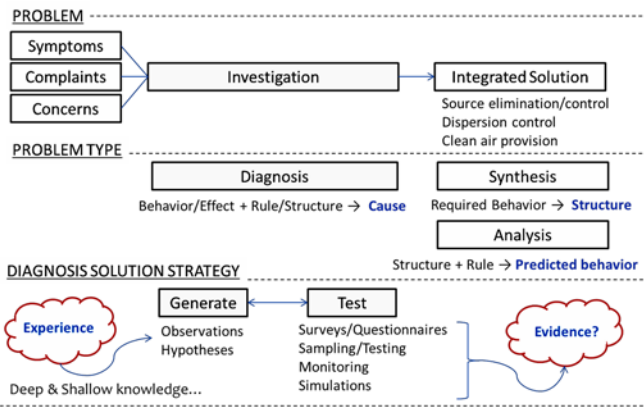
Building Science Graduate Program, Indoor Air Conference 2014

Building Science Integrated Systems:

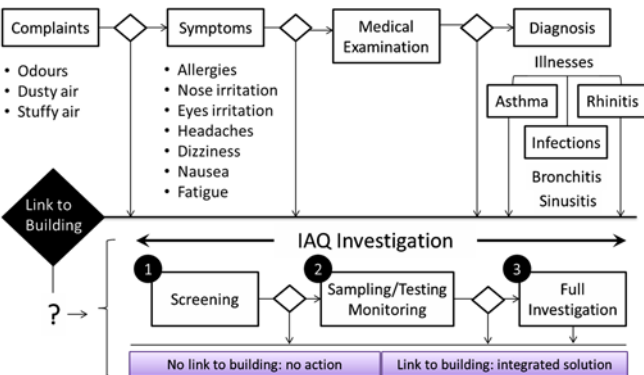
- The need for an integrated systems-based approach to address building science investigations in buildings
- Based on an understanding & application of fundamental principles of building science



The Nature of IAQ Investigation Problems:



Methodology for IAQ Investigations:



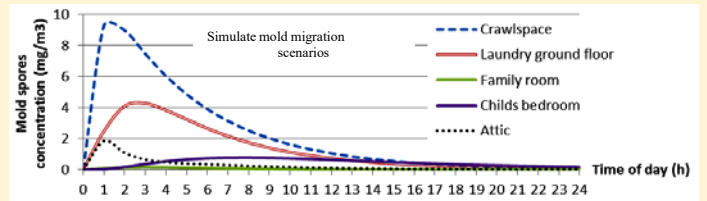
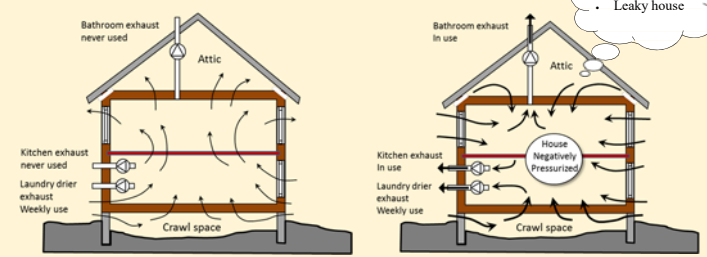
Further Work: How to formalize & support the whole process?

Case Study

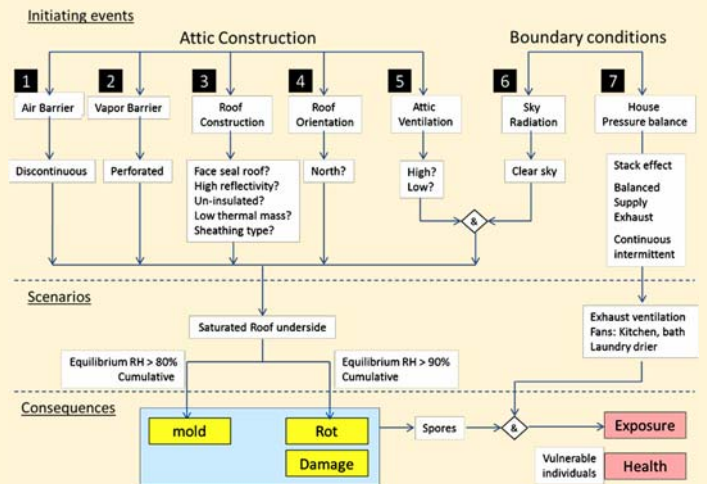
- Child with asthma like symptoms
- Physician: symptoms may be related to living organisms at home
- Marine climate: temperature rain forest, one of earth's most biologically productive ecosystems
- Houses: wood-frame construction, typically moldy attics, crawl spaces, and often enclosure walls
- IAQ investigation: stages 1: screening, and 2) Sampling/Testing Monitoring

Fungal spores identified	Indoors	Crawlspace	Attic	Outdoors
<i>Aspergillus/Penicillium</i>	5,471	11,888	52,603	2,578
<i>Cladosporium</i>	1,841	15,833	12,519	1,631
Total Spores/M³	9,679	30,615	67,174	6,786

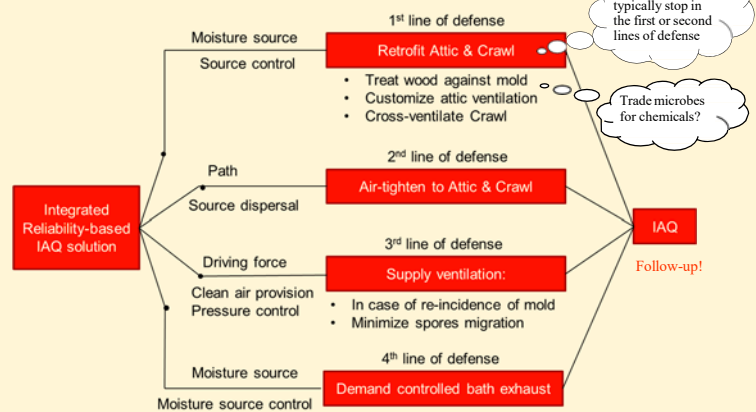
No signs of mold inside the house
Hypothesis: mold spores migrate from the envelope into the house



Attic Source — Fault Model



Integrated Reliability-Based Solution for IAQ



Clean Air Provision

Alternative ventilation systems	Description	House Pressure
A1 – Balanced ventilation	Heat Recovery Ventilator (HRV)	Balanced
A2 – Supply ventilation	Filter & possibly preheat supply air	Positive
A3 – Exhaust ventilation	Continuous or intermittent bathroom fan operation coupled with passive spot vents for makeup air	Negative
A4 – Exhaust ventilation	Continuous or intermittent bathroom fan operation with makeup air through random envelope cracks	Negative

Conclusion: Case study demonstrates that it is important to see the forest... And the trees...