Building Science Syllabus

Sunday Evening: Introductions
   - Welcome, overview of class,
   - Brief discussion: what do you want to learn? What has been your experience? What are your goals?

Monday AM: Context/BS 101
   - What is Building Science (BS)?
   - Identify major topics of BS: heat, moisture, structure, acoustics, fire, combustion
   - History of BS
   - BS today: practical application, organizations, resources
   - Thermodynamics 101:
     - Three forms of heat transfer (featuring classroom demos)
     - Sensible vs. Latent Heat
     - Examples in the built environment

Monday PM: BS 101
   - Thermodynamics Continued
   - Hygrodynamics 101:
     - Three basic phases of water and its properties
     - How water moves (featuring classroom demos)
     - Hygro properties of building materials
     - Hygrothermal Dynamics: How heat and water work together
       - Moisture transport/drive
       - Drying potential
       - Latent heat of moisture

   - The Physics of Comfort

*Homework: find one example each of hygrothermal dynamics in natural ecosystem, built environment, other industry or context*

Tuesday AM: Applied Science in the Building: The Shell

   - Components of the shell:
     - basements
     - walls
     - roofs
- Material types and their jobs, ratings, and evaluations (i.e. insulation, R-value, ASTM rating, inverse of conductance)
  - Heat:
    - Insulation
    - Mass
    - Windows and Doors
    - Air barriers
  - Moisture:
    - Vapor barriers
    - Weather-resistant barriers
    - Flashing
    - Drainage planes
    - Cladding/roofing

Tuesday PM: Applied Science in the Building: The Shell (cont.)

Envelope Theory and Detailing
  - Thermal Envelopes/Boundaries
    - defining the envelope
    - components: insulation and air barrier
    - requirements:
      - conductive/radiant loss
      - convective loss
      - cooling
      - vapor loading
      - liquid moisture
  - Issues - Heat:
    - Thermal bridging
    - Air bypasses
    - Overheating and cooling
    - Old vs. new construction strategies
  - Moisture and the envelope:
    - Condensation
    - Precipitation
    - Other leaks
    - Old vs. new construction strategies

  - Field trip to building to perform infrared thermography and blower-door test to illustrate functioning of building systems

Homework: Draw one foundation-to-wall or wall-to-roof detail of your choice, identifying thermal and moisture control systems and their connections
**Wednesday AM: The Building as a Whole System**

- Interconnection of envelope, mechanical systems, layout, use patterns
- Renovation: a history of mistakes
- New construction: troubleshooting high-performance building strategies
- Systems of the building:
  - heating

**Wednesday PM: Systems of the Building (cont.)**

- cooling
- ventilation
- DHW
- Electricity
- Other gains - maximizing and minimizing:
  - Solar gain
  - Internal gains: lighting, plug loads
- Tours of system types
  - combustion testing
  - IR scanning of heating systems
  - ventilation system eval/exhaust fan testing

*Homework: Design the mechanical schematics for a model building*

**Thursday AM: Designing with Science**

- Start with the site
  - climate (rainfall, HDD/CDD, insolation)
    - challenge: find all relevant climate data for your location
  - sun
  - wind/exposure
  - regulations and local ordinances
- Invest in the envelope
  - shape
  - orientation
  - profile
  - construction
  - upfront vs long-term costs
- Consider mechanicals
  - appropriate sizing
  - fuel types
  - water systems
  - air and ventilation
  - upfront vs long-term costs
Thursday PM: Predicting and Prescribing Performance

- Modeling for heat loss/energy load
- Determining ventilation requirements
- Specifying DHW loads
- Ecological science and building performance

*Homework: Begin final design project - design a high-performance new building, or performance retrofit of existing project of your choice, including basic shell and mechanical specification in response to specific climatic and site-based circumstances.*

**Friday AM: Studio - Final Project**

**Friday PM: Present Final Project**