Detailed Course Module Description

Module/Learning Objectives	Level of Detail in Module by Audience		
	Consumers	Gen Ed/ Community College	Trades
1. Energy Issues and Building Solutions Learning Objectives: • Define terms of building science, ecological systems, economics of consumption • Relate building science perspective, ecology, social science • Explain historical energy and environmental issues related to buildings • Compare Site and source energy • Examine the health, safety and comfort issues in buildings • Examine the general context for building solutions (zero energy green home with durability as the goal) • Explain a basic overview of alternative energy (total solar flux) – do we have enough energy • Examine cash flow to homeowners • Demonstrate ability to find, evaluate and synthesize knowledge regarding building performance and sustainability • Define Business case – career opportunities • Explain appropriate technology and systems (and how to research them with every lesson) • Define interconnections / inter-relationships among building systems	High	High	High
2. Introduction to Sustainable Design & Building Performance Learning Objectives: • Describe how a building works as a system • Explain the flow of air, heat, liquid water and water vapor • Describe the importance of climate-specific design details • Relate IEQ issues to health • Relate Building performance to overall sustainability • Describe the characteristics of available fuel choices • Examine the roles and responsibilities of the building team • Explain the need for respect within the building team	High	High	High
3. Flows: Air, Heat, Water, Vapor (Site related) Learning Objectives: • Comprehend specific issues related to pressure- and temperature-induced flows • Grasp the significance of water flows and their roles in building details related to the drainage plane and other building elements • Recognize the need to manage relative humidity (condensation) • Understand the air change rate and its relationship to above concepts • Describe how heat, air, and moisture flows are linked (use hanging mobile) • Show examples of buoyant forces and the tendency for warm air to move in a particular way	Medium	Medium	High

• Water flow
  o Show capillary effect of wood, concrete and glass
  o Discuss moisture storage of building materials as time and temperature specific
  o Design to ensure drying; dry-ability = durability; 4D's – deflection, drainage, drying and durability
• Describe the relationship between relative humidity and health, r.h. and condensation (temperature) and r.h. and durability (again condensation)
• Recognize by source the pressures acting to move air in a building (air leakage forces)
• Quantify amount of heat loss (or gain) (average) attributable to air leakage
• Explain how to control air, heat and moisture flow in buildings
• Recognize psychrometric chart and the cause of condensation
• Define dew point and give an example of its occurrence and result			

4. Building Materials and Their Properties
Learning Objectives:
• Differentiate between different materials based on their porosity and the impact it has on properties, such as wetting and drying, capillarity, etc.
• Define and be able to use:
  o Vapor perm ratings
  o Air perm ratings
  o r-values/u-values – look at all materials, including glazing
• Differentiate between individual material ratings and the performance of installed materials in the context of the completed assembly
  o Thermal by-pass
  o Resistance as r-value
  o radiation
• Practice waste reduction and use regionally appropriate and ecological materials
• Predict effect of mass and phase change on building performance
• Compare life span of materials
• Account for embodied energy
	Medium	Medium	High

5. Climate and Designing with Nature Learning Objectives: • Identify hydro-thermal regions • Apply heating and cooling degree day concept and summer and winter design conditions to construction details • Discuss relationships among temperature, precipitation, and construction techniques • Give examples showing the importance of climate-appropriate design and construction detail • Explain the relationship between solar geometry and building/window orientation • Define daylighting methods and give examples of applications • Describe methods to control solar gain (shading) to occupants benefit • Describe how wind influences design location of intake and exhaust • Describe methods to apply natural ventilation to	High	High	High

occupants' benefit • Identify building details related to seismic conditions, hurricane-resistance, wind, fire, corrosion and other climate-specific factors that affect structural durability			
6. Building Design, Systems Engineering Learning Objectives: • Explain systematic relationships among conditioning source, distribution network, and (location and selection) and terminal units with building envelope. • Identify sources of thermal by-pass (residential air leakage) • Name appropriate control methods for thermal by-pass • Discuss reasons why work and storage spaces should be isolated from living space • Name methods to accomplish isolation • Describe the method for insulating and isolating attics and crawl spaces (maybe move to 8?) • Identify methods used in performance diagnostics	High	High	High
6b. Building Design, Systems Engineering and Commissioning Learning Objectives: • Demonstrate correct use of blower door, duct blaster, and similar diagnostic tools • Define the role of design details, specifications, and trade contractor scopes of work with respect to quality and high performance • Explain the process of building commissioning • Given typical commissioning records, interpret system performance • Explain importance of maintaining commissioning records	Low	Low	High
7. Site: Drainage, Pest Control, Landscaping Learning Objectives: • Relate water run-off to site grading • Explain the practices to manage residual toxins, termites, rodents, and other pests • Discuss proper placement of vegetation, mulch, and other decorative land cover • Relate soil properties to soil conditioning • Describe the effects of irrigation on the durability of the building	High	Medium	High
8. Foundation: Moisture Control and Energy Performance Learning Objectives: • Describe foundation construction techniques essential for the prevention of moisture and management of soil gas entry (radon) • Relate foundation systems to overall building energy performance • Explain climate-specific use of alternative foundation insulation systems	Medium	Medium	High
9. Building Envelope: Moisture Control and Energy Performance Learning Objectives: • Learn roof and wall assembly materials and techniques essential to water management (including flashing) • Learn roof and wall assembly materials and techniques essential to air infiltration • Learn roof and wall assembly materials and	High	High	High

techniques essential for the prevention of vapor intrusion and drying of interstitial spaces • Learn climate- and design-specific use of alternative glazing systems • Become familiar with insulation selection criteria, advantages and disadvantages of various types of insulation • Explain what happens when insulation gets wet • Explain the purpose of a vapor retarder and the reasons for where it is placed • Distinguish between vapor retarder materials and weather barriers and their functions in buildings • Become familiar with appropriate climatic treatments for flashing (waterproofing) window penetrations • Explain the concept of drainage planes, gravity flow, roof penetration flashing, and how to keep the house dry • Describe the effect of voids and imperfections in insulation			
9b. Windows, Doors and Other Penetrations • Describe radiation effect, conduction and convection heat flows through windows and doors • Discuss low E films, gas fills and low conduction spacers • Discuss NFRC labels and explain U/R value, visual transmittance, solar heat gain, coefficient & condensation resistance • Describe the sequence of a gravity-layered flanged window installation • Recall that there are two types of windows: windows that leak now, and windows that will leak • Describe appropriate materials for flashing that are waterproof, durable, compatible, formable and their mechanical properties • Analyze flashing requirements for drainage, continuity, end dams, drip effect and accommodate movement • Describe where to flash; wall assemblies, roof lines, top & bottom of doors and windows, penetrations, balconies, doors and decks • Recognize that some water will get past the cladding, always install a weather barrier that drains • Describe the importance of installing a weather barrier from the bottom of the building to the top, layered, shingle-fashion	High	High	High
10. Mechanicals/Electrical/Plumbing: Systems Engineering, Energy Performance, Occupant Health, Safety, Comfort, and Envelope/Mechanicals Management, Part I Learning Objectives: • Identify equipment and explain duct issues • Relate mechanical system design to architectural design • Explain best practices for selection, installation and maintenance of mechanical equipment • Describe efficiency standards and appliance ratings • Explain the concepts air conditioning • Describe hot water systems • Explain issues related to ducts for air distribution • Explain the use of controls and monitoring and their impact on energy performance	Low	Low	High

• Describe the use of spot ventilation to control moisture at its source • Calculate ventilation rates using ASHRAE 62.2 • Describe the use and application of evaporative cooling			
11. Mechanicals/Electrical/Plumbing: Systems Engineering, Energy Performance, Occupant Health and Safety, Comfort, and Envelope/Mechanicals Management, Part II Learning Objectives: • Explain the purpose function operation and maintenance of ventilation systems • Describe the conditions that cause and effects the result from back draft issues • Describe control and venting of combustion products and symptoms of failure • Recognize a sealed combustion system and discuss IAQ effects • Identify and use appropriate methods to seal penetrations (e.g. wires, pipes, ducts) • Demonstrate ability to seal and test duct work for air leakage • Explain the role of indoor relative humidity in building performance and the conditions-based need for dehumidification/humidification • Describe the operation, control and application of alternative heat pumps • Describe operation control and application of combustion appliances (e.g. wood burners, fireplaces and natural gas inserts) • Walk on water	**High**	**High**	**High**
11b. Electricity Payload Learning Objectives: • Recognize the Energy Star label and interpret its information • Introduce TED and tell us how to know him better and what he can do for us • Explain a “phantom” load and why it affects your utility bill • Define watt, kWh, BTU (British thermal unit) • Explain the three different electrical lighting types (compact fluorescent, incandescent, halogen, and LED) and their advantages and disadvantages • Estimate your own hot water use and describe how renewable energy sources might provide this energy service	**High**	**High**	**High**
11c. On-site Generation Learning Objectives: • Describe the application of PV & wind generated power to the building load • Discuss the use of solar thermal systems for water and space heating • Discuss future technologies such as fuel cells and plug-in hybrid cars	**Medium**	**High**	**High**
12. Field Issues: Construction Management, Codes, and Other Regulatory Matters (0ptional) Learning Objectives: • Relate practical matters that affect implementation of design details, specifications or purchasing	**Low**	**Low**	**High**

requirements, and scopes of work including construction labor issues and homebuyer concerns • Describe code enforcement and zoning ordinance issues that may obstruct the construction of high performance housing and effective counter strategies • Impact of codes/standards on building performance and sustainable design • Discuss local public policy; Impact of policy, regulation and enforcement • Review the process of policy development and change • Relate that high performance construction is a team process, just because a general contractor or buyer wants high performance, it takes subcontractors and employees to understand the details and importance to succeed			
12b. Benchmarking performance: meeting and exceeding the norm Learning Objectives: • Apply building simulation tools and techniques for measurement and prediction o Metrics of performance – how to measure performance and make adjustments o Ability to use tools to analyze buildings and make design decisions (energy, environment, etc.) • Exceeding Code o Compare valuation methodologies for building performance and sustainable design (HERS, LEED for homes, local green building program, etc.)	**Low**	**Low**	**High**
13. Community Scale Learning Objective: • Describe relationship between single building & site land use, infrastructure and ecological impacts • Relate buildings to utility systems (electric, gas, water and sewerage) • Explore impact of peak loads on the utility system • Identify rate structure and potential effects on decision-making • Relate building location and density to community transportation options (cars, public transportation, biking and walking) • Discuss community-scale generation options (district heating and cooling, landfill gas generation, etc.)	**Medium**	**High**	**High**
14. Putting it all Together: Experiential Learning in the Field / Office Learning Objectives: • Integrate class lessons with field demonstrations o Trade only: through a partnership with a high performance builder, shadow a construction manager for an assigned time during a one-week period o Participate in utility or third party audit • Assess best practice via web-based case studies (new construction and retrofit) o Discuss differences and similarities o Discuss what works and what doesn't o Discuss design intent vs. as-built performance • Create new information o Perform evaluation of local buildings and compare	**Medium**	**High**	**High**
15. Homeowner Education (Communicating with the Consumer)	**High**	**High**	**High**

Learning Objectives: • Identify tax incentives • Related building performance to financing and insurance: e.g. energy improvement mortgages • Explain the value of commissioning, punch lists, and home inspection • Develop/apply best practices: O&M manuals • Evaluate occupancy lifestyle impacts: e.g. TED • Selling energy efficiency • Analyze home energy audits • Encourage energy efficiency & technology: behavior via social diffusion • Trades only: promote and apply cleanliness of the job site			
16. Conclusions, Implications, sources of further learning and continuing education Learning Objectives: • Review and Reinforce materials covered and studio and field experiences • Discuss current research topics regarding high performance buildings • Restate the need for life long learning • Reflection • Diagram all of the energy inputs and losses from a building • List all systems involved in air circulation in a building • Identify most important factors affecting building comfort and safety • Identify all sources of energy inputs to the construction of a building • Explain how HPB can effect world energy issues • List ways to make a difference in current world energy imbalances	**High**	**High**	**High**