PNNL-24143, Rev 2

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Guidelines for Building Science Education

August 2017

CE Metzger
P Huelman
S Rashkin
A Wagner

U.S. DEPARTMENT OF
ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <http://www.ntis.gov/about/form.aspx>
Online ordering: http://www.ntis.gov

This document was printed on recycled paper.
(8/2010)

PNNL-24143, Rev 2

Guidelines for Building Science Education

CE Metzger
P Huelman
S Rashkin
A Wagner

August 2017

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The U.S. Department of Energy's (DOE's) residential research and demonstration program—Building America—has triumphed through 20 years of innovation. Partnering with researchers, builders, remodelers, and manufacturers to develop innovative processes like advanced framing and ventilation standards, Building America has proven an energy efficient design can be more cost-effective, healthy, and durable than the design of a standard house. As building technologies become more advanced the need for highly skilled and qualified workers has increased. Both residential and commercial building industries struggle to capture the full benefit of these technologies because of the limited building science knowledge base of the professionals designing, building, and selling these structures.

To help address this need, the DOE's residential building integration program initiated the Guidelines for Building Science Education (GBSEs), which are described in this report. This guideline effort has focused on the fundamental building science knowledge base for a wide range of building industry jobs. DOE's commercial building integration program hosts a full suite of impactful initiatives including the Better Buildings Workforce Guidelines (BBWGs), which provide voluntary national guidelines from which stakeholders can develop high-quality and nationally recognized training and certification programs. The BBWG framework helps to improve quality and scalability issues for five energy efficiency related jobs: Building Energy Auditor, Building Commissioning Professional, Building Operations Professional, Building Operations Journey-worker and Energy Manager.

The residential and commercial building programs are both interested in helping to create better buildings through an improved workforce. These program initiatives complement each other in many ways. The GBSEs pave the way for more specialized training and education offered by industry and academia, which lead to credentials that signify competency. The BBWGs cover credentialing for energy efficiency jobs—a critical area that DOE felt could benefit from incentives for credentialing bodies and building operators that would improve the energy efficiency of commercial buildings. This report summarizes the steps DOE programs have taken to develop guidance for building science education and outlines a path forward toward creating real change for our building industry.

Acknowledgments

Pacific Northwest National Laboratory (PNNL) prepared this report for the U.S. Department of Energy (DOE) Residential Buildings Integration Program and the Commercial Buildings Integration Program. The authors thank David Lee, Eric Werling, Samuel Rashkin, Jason Hartke, and Priya Swamy at DOE for providing support and oversight. The authors also recognize the exceptional effort of Roger Grant at the National Institute of Building Sciences, who was very involved in the coordination with the Better Building Workforce Guidelines. The authors thank Michael Baechler, Manager of the Building America program at PNNL for providing oversight. This work would not be possible without the inspiring dedication of time and effort from Samuel Taylor and the members of the Joint Committee on Building Science Education. The authors also express their deep appreciation to the many participants not mentioned by name who helped with the development of the Guidelines for Building Science Education.

Cheryn Metzger, PE PMP LEED AP
Pacific Northwest National Laboratory

Acronyms and Abbreviations

ABET	Accreditation Board for Engineering and Technology
ACI	Affordable Comfort Incorporated
ACS	American Chemical Society
AIA	American Institute of Architects
ASHRAE	American Society of Heating Refrigeration and Air-Conditioning Engineers
BASC	Building America Solution Center
BASF	Badische Anilin- und Soda-Fabrik
BBWGs	Better Buildings Workforce Guidelines
BETEC	Building Enclosure Technology and Environment Council
BMI	Building Media Incorporated
BPI	Building Performance Institute
BSE	Building Science Education
CARE	Center for Advancement of Roof Excellence
CBI	Commercial Building Integration
CEA	Certified Energy Auditor
CWCC	Commercial Workforce Credentialing Council
DOE	U.S. Department of Energy
DOW	DOW Chemical Company
EEBA	Energy & Environmental Building Alliance
EPA	U.S. Environmental Protection Agency
FSEC	Florida Solar Energy Center
GBSEs	Guidelines for Building Science Education
HUD	U.S. Department of Housing and Urban Development
HVAC	heating, ventilation and air-conditioning
IAPMO	International Association of Plumbing and Mechanical Officials
IAQ	indoor air quality
IBS	International Builders Show
ICC	International Code Council
InterNACHI	International Association of Certified Home Inspectors
IREC	International Renewable Energy Council
JC	Joint Committee on Building Science Education
JTA	Job Task Analyses
LEED	Leadership in Energy and Environmental Design
NAHB	National Association of Home Builders
NAR	National Association of Realtors
NATE	North America Technician Excellence

NCEES	National Council of Examiners for Engineering and Surveying
NFRC	National Fenestration Rating Council
NIBS	National Institute of Building Sciences
NREL	National Renewable Energy Laboratory
PNNL	Pacific Northwest National Laboratory
RBI	Residential Building Integration
REEO	Regional Energy Efficiency Offices

Contents

Figures

Tables

1.0 Introduction

The U.S. Department of Energy's (DOE's) residential research and demonstration program—Building America—has triumphed through 20 years of innovation. Partnering with researchers, builders, remodelers, and manufacturers to develop innovative processes like advanced framing and ventilation standards, Building America has proven an energy efficient design can be more cost-effective, healthy, and durable than the design of a standard house.

As Building America partners continue to achieve their stretch goals, they have found that a primary barrier to true market transformation for high-performance homes is the limited knowledge base of the professionals working in the building industry. With dozens of professionals taking part in the design and execution of building and selling homes, each person *should* have basic building science knowledge relevant to his/her role, and an understanding of how various home components interface with each other. Instead, our building industry typically takes a fragmented approach to home building and design.

Hence, building science education became a focus for DOE's residential and commercial building programs to enhance the knowledge base of the professionals working in the building industry and create better buildings through an improved workforce.

The Pacific Northwest National Laboratory (PNNL) has been helping to manage the many moving parts associated with this project since 2015.

1.1 Building Science Education Kick-Off Meeting

On November 7, 2012, DOE hosted a summit to discuss how to overcome these education barriers and create a roadmap for building science education efforts going forward. More than 30 participants (see Appendix A for a detailed list of participants) represented public and private industry stakeholders, including building science educators, building science researchers, manufacturers, consultants, production builders, training organizations, and other government programs.

In addition to helping create the overall strategy for DOE's efforts in building science education, the summit was a first step in engaging a diverse set of players in working together more effectively as a group rather than solely as individuals. This ***"****Collective Impact****"*** concept is the subject of a research paper by John Kania and Mark Kramer that was published in the winter 2011 edition of the *Stanford Social Innovation Review*. The authors' research revealed examples of "remarkable exception" for implementing large-scale social change and a common basis for their success. The Building America Building Science Education Roadmap outlines the structure of the summit and documents the collective input the industry needs to make a difference with future generations of professionals working in the building industry.

Although each stakeholder group at the summit fully supported DOE's efforts, it became clear that none of the individual stakeholders were positioned to lead the overarching initiative. With manufacturers, certifications organizations, and training organizations focusing on one set of stakeholders, no group but DOE was able to maintain a cross-cutting perspective on the efforts for building science education.

1.2 Overall Building Science Education Strategy at DOE

After obtaining important input from stakeholders at the kick-off meeting, DOE created a building science education strategy addressing education issues that were preventing the widespread adoption of high-performance homes. This strategy targets the next generation workforce and provides valuable guidance for the current workforce. Strategic initiatives and their purposes include the following:

- **Race to Zero Student Design Competition**. Engage universities and provide students who will be the next generation of architects, engineers, construction managers, and entrepreneurs with the necessary skills and experience to begin careers in clean energy and generate creative solutions to real-world problems.
- **Building Science to Sales Translator**. Simplify building science into compelling sales language and tools to sell high-performance homes to customers.
- **Building Science Education Guidance**. Bring together industry and academia to solve problems related to building science education.

The DOE's Race to Zero Student Design Competition (Race to Zero) inspires collegiate students to become the next generation of building science professionals through a design challenge for zero-energy ready homes. Students become part of a new leadership movement to achieve truly sustainable homes. 2017 will mark the fourth annual Race to Zero competition hosted by DOE at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. The Building Science to Sales Translator has been undergoing collaborative development since early 2013. Interested stakeholders have supported DOE in this mission by helping brainstorm, critique, and finalize sales terms that adequately represent the benefits of each building science principle in the Building America Solution Center (BASC), which provides access to expert information about hundreds of high-performance construction topics. The Building Science to Sales Tool, which debuted as part of the BASC in 2015, provides a glossary of terms that can be used across the industry to consistently reinforce the value of high-performance homes.

1.3 Report Content and Organization

This report summarizes the steps DOE has taken to develop workforce guidance for building science education fundamentals, and it outlines a path forward toward creating real change for the building industry. It describes the development of Building Science Education Guidelines, the deeper collaborative role assumed by the Commercial Buildings Integration Program, the Building Science Education Matrix, the Building Science Education Guidelines developed for external stakeholders to use to self-certify their programs, the Building Science Education Solution Center, and the Collective Impact Campaign for the Guidelines for Building Science Education. Appendices contain more detailed Guidelines for Building Science Education relevant to particular job classifications, a Building Science Education Matrix, and lists of summit and meeting participants.

2.0 Development of Building Science Education Guidelines

In addition to the broad strategy that surfaced during the kick-off meeting, specific near-term (before 2018) goals were established for building science education guidance. These goals may be seen as outcomes of the roadmap linked to in the previous chapter and are paraphrased as follows:

- Identify a set of proficiency/skill levels across all stakeholder groups who build, buy, or sell residential buildings.
- Establish core competency topics related to building science education.
- Map proficiency levels to core competency topics for key construction trades, university/college programs, and transaction process officials.

2.1 Overall Strategy for Development of Building Science Education Guidelines

Based on the goals paraphrased above, the following two complementary tactics were used to develop Building Science Education Guidelines:

1. Host stakeholder review meetings at relevant building science events to gain valuable input and feedback on the development process and content.
2. Enlist Pat Huelman (Winner of the Excellence in Building Science Education Award in 2013) and the NorthernSTAR Building America team to lead the development of a matrix that cross-ranks job classifications and core competency levels with proficiency guidelines.

The tag-team approach to these two tactics is shown in the timeline below (Figure 2.1) as a reference for the rest of this chapter of the report.

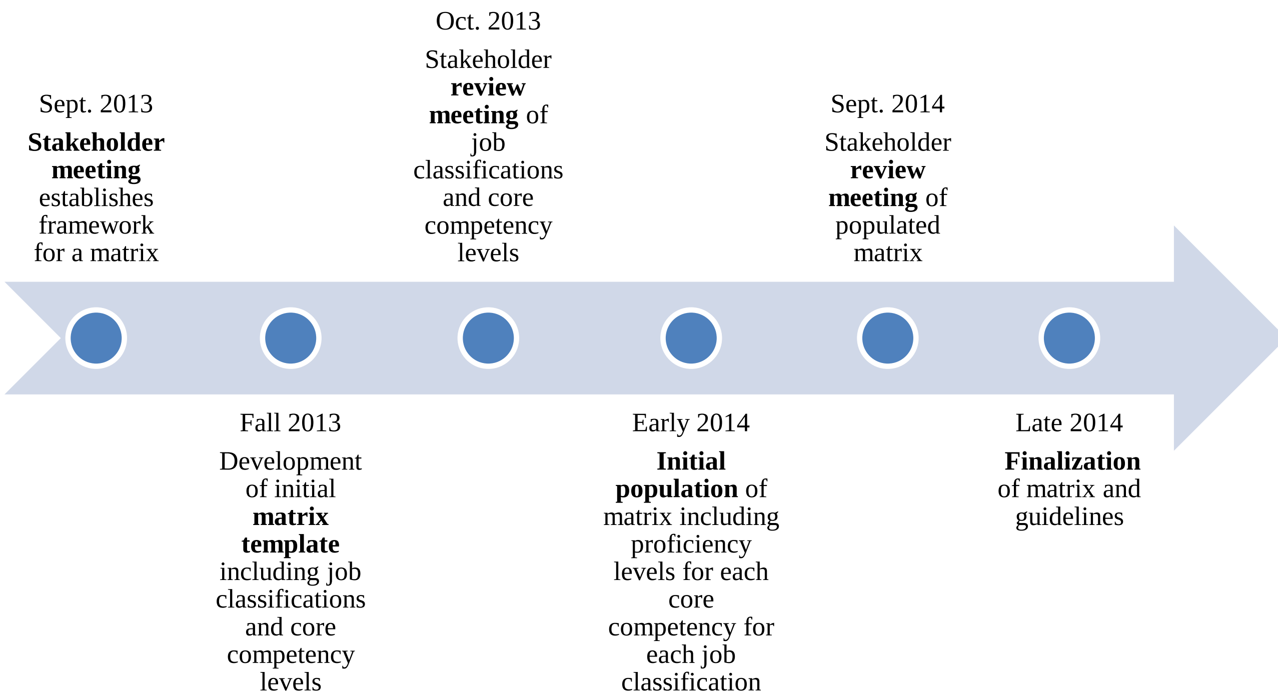


Figure 2.1. Matrix Development Timeline

2.2 Initial Stakeholder Meeting

A meeting was held in conjunction with the 2013 Energy & Environmental Building Alliance (EEBA) conference to review the building science roadmap and to brainstorm the appropriate next steps for developing the guidelines. At the meeting, more than 20 participants (see Appendix B for attendee list) helped DOE develop the framework for the Building Science Education Matrix.

2.3 Development of a Matrix Template

To achieve the goals stated at the kick-off meeting, the NorthernSTAR team was challenged to find a means of simultaneously presenting cross-categorized information about job classifications, core competencies, and proficiency levels. Ultimately, a decision was made to use a two-dimensional matrix (or table) template, as outlined in Table 2.1 below.

Table 2.1. Matrix Template for the Guidelines for Building Science Education

	Job Classification #1	Job Classification #2	Job Classification…
Core Competency #1			
Core Competency #2			
Core Competency…			

It was decided that in each cross-categorized cell, a proficiency level would denote the recommended *level* of knowledge, skill, or ability that job classification should maintain.

The first step in filling out the matrix was to determine the important job classifications and core competencies that exist throughout the entire residential buildings industry. After making some progress in this area, it became evident that inclusion of the commercial building jobs and competencies would provide a more complete reference without adding much work to the process.

2.4 Meeting to Review Job Classifications and Core Competency Levels

After the initial list of job classifications and core competencies was established, a review meeting was held in conjunction with the Building America Planning Meeting on October 30, 2013. Some minor edits were made, but the overall approach and categories were agreed upon by the various stakeholders.

2.5 Initial Population of the Matrix

The NorthernSTAR team, along with the Joint Committee on Building Science Education (http://buildingscienceeducation.net/), established proficiency levels that quantify relationships between various job classifications and competencies. The scale was one through six, with six being the ability to design a unique system. Some basic rules-of-thumb were implemented as well. For example, the person authorizing the work should have no less than one proficiency level below the person conducting the work.

2.6 Meeting to Review the Populated Matrix

In September 2014, another meeting was held in conjunction with the EEBA conference in St. Louis, Missouri. The purpose of the meeting was to review the populated matrix with industry stakeholders. The outcome of the meeting was a fully edited matrix. (The attendee list for the meeting is in Appendix E.)

2.7 Fine-tuning the Matrix

In late 2014, input from the NorthernSTAR team was combined with the granular input from the review meeting. Where possible, the matrix was also slightly condensed to provide a clearer picture to stakeholders who may not have been involved throughout the development process.

2.8 Other Stakeholder Engagement

In addition to the DOE-hosted meetings, other entities hosted meetings at which DOE representatives presented information about the matrix development and other related topics. Lively discussions were encouraged at these meetings to gain even more stakeholder input to factor into the guidelines. Table 2.2 lists the date, title, and location of meetings at which parts of the DOE strategy were presented. The DOE-hosted meetings are italicized for reference.

Table 2.2. Building Science Education Meetings with DOE Representation

Date	Meeting	Location
7/30/12	Planning Meeting	Westford, MA
11/7-8/12	*DOE-Hosted Kick-Off Meeting*	*NAHBRC Campus - Upper Marlboro, MD*
1/21/13	National Consortium of Housing Research Centers	NAHB – IBS, Las Vegas, NV
3/21/13	Joint Committee on Building Science Education Meeting	Minneapolis, MN
5/2/13	ACI/EEBA/DOE meeting	Denver, CO
8/2/13	Westford Symposium on Building Science	Westford, MA
9/23/13	*DOE-Hosted Stakeholder Meeting*	*EEBA – Phoenix, AZ*
10/28/13	*DOE-Hosted Review Meeting*	*Washington, DC*
12/2/13	BUILDINGS XII	Clearwater, FL
1/6/14	National Institute of Building Sciences Credentialing Council	Washington, DC
1/17-20/14	ASHRAE	New York, NY
2/2014	National Consortium of Housing Research Centers	Las Vegas, NV
3/24-26/14	ACS	Wash., DC
4/6/14	ASTM/NIBS/JC Workshop	Toronto, ON
4/2014	DOE Building Technologies Office Peer Review Meeting	Alexandria, VA
4/26-28/14	Race to Zero Competition	Golden, CO
6/18-19/14	Penn State Meeting	State College, PA
6/27-7/14	ASHRAE	Seattle, WA
7/9/14	National Consortium of Housing Research Centers Executive Committee Meeting	Alexandria, VA
8/3/14	Westford Symposium on Building Science	Westford, MA
9/22/14	*DOE-Hosted Review Meeting*	*EEBA – St. Louis, MO*

3.0 Commercial Buildings Integration

In October 2016, the Commercial Buildings Integration (CBI) Program took on a deeper collaboration role for this effort. The ongoing collaboration effort has the following three main goals:

1. Ensure that the Guidelines for Building Science Education and the Better Buildings Workforce Guidelines are consistent where appropriate.
2. Ensure that the commercial buildings industry is equally well represented in the matrix.
3. Provide a clear path for users/stakeholders of the Guidelines for Building Science Education and Better Buildings Workforce Guidelines programs to use to select and implement the programs to improve the energy efficiency of buildings.

The first step in helping to meet these goals was for the program managers and implementers from both programs to compare and contrast their programs, and then understand how the programs could complement each other. Once a path forward was established, PNNL did a full industry sweep to determine whether any commercial buildings job classifications or competency topics were missing from the original matrix. These missing job classifications and competency recommendations were vetted by the management team (including the National Institute of Building Sciences [NIBS]) and presented to the Commercial Workforce Credentialing Council (CWCC) for review, comment, and approval. All of the changes made to the guidelines herein, reflect this process and provide further detail regarding the results.

3.1 Better Buildings Workforce Guidelines

The Better Buildings Workforce Guidelines (BBWGs) are voluntary national guidelines for improving the quality and consistency of commercial building workforce credentials for five key energy efficiency jobs: Building Energy Auditor, Building Commissioning Professional, Building Operations Professional, Building Operations Journey-worker and Energy Manager.

The BBWGs align all elements of the Better Buildings Workforce Framework with the goal of supporting high-quality industry and government-recognized credentials for the five key commercial energy efficiency job titles. Industry subject matter experts reviewed job descriptions and associated skills and knowledge to develop Job Task Analyses (JTAs) for the five energy efficiency jobs. Together, the JTA documents and the certification schemes compose the basis of the voluntary, industry-developed, and industry- and government-recognized BBWGs.

3.2 Similarities and Differences Between the Original Residential and Commercial Efforts

The two original workforce guideline programs from Residential Building Integration (RBI) and CBI have many similarities. Both of them were focused on improving building performance through a critical mass of an improved workforce. They both used industry involvement and input to develop guidelines for specific job classifications. Both programs have used those guidelines to work with outside training and credentialing (in the case of BBWG) programs and try to help define consistency in the job classifications that have been outlined.

The differences between these programs are three-fold, as shown in Figure 3.1. BBWG focuses on four specific job classifications, while the Guidelines for Building Science Education (GBSEs) effort focuses on a much broader range of job classifications (see Section 4.1). The goal of the BBWG program is to provide a framework for knowledge, skills, and abilities that support specific tasks identified by the BBWGs, whereas the goal of GBSE program is to provide general building science knowledge that can be applied to any task. Lastly, the partnering strategy (described in more detail in Section 7.1) is more exclusive for the BBWG program, requiring a rigorous accreditation process to achieve DOE recognition, while the GBSE program aims to involve as many organizations in the movement as possible.

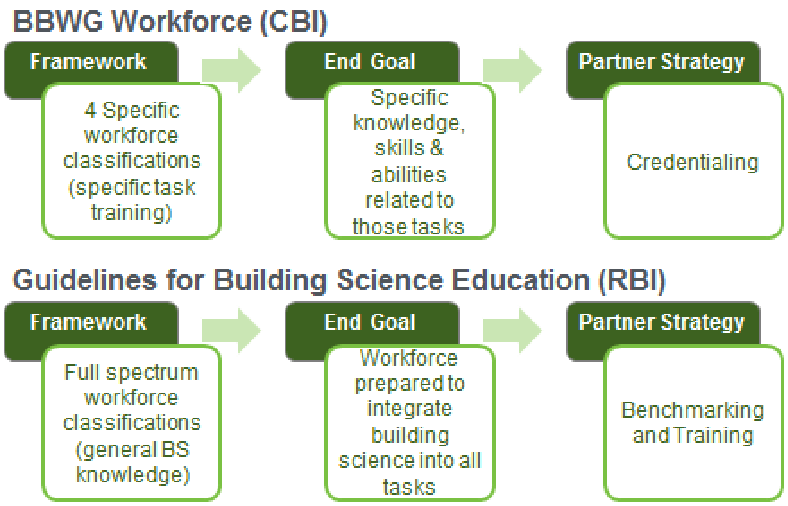


Figure 3.1. Comparison of Residential and Commercial Guideline Program Elements

3.3 Integration of the Better Buildings Workforce Guidelines

Through stakeholder coordination and strategic management, the BBWGs and GBSEs are complementary and integral to each other. To provide useful resources to all relevant workforce classifications, the GBSE program benchmarks proficiency levels relevant to building science education applicable to a wide range of building industry jobs. The BBWGs builds on the GBSEs and provides accreditation for programs that meet or exceed the BBWGs in the focused area of commercial building energy efficiency. At this time, the BBWG program focuses on accreditation for five job classifications: Building Operations Professional, Building Operations Journey-worker, Building Commissioning Professional, Commercial Buildings Energy Auditor, and Energy Manager, and its goal is to achieve more accredited options in the future as needs arise.

The BBWG jobs generally represent requirements for master level professionals recognized through the certifications of individuals. To complement these high-level certifications, the BBWG and GBSE programs are also working together to develop less rigorous options for recognizing certificate-awarding education programs where appropriate. The goal is to provide a broader range of recognized job classifications and levels to help expand the pool of qualified workers to affect energy use in buildings.

4.0 Building Science Education Matrix

The final Building Science Education Matrix can be viewed in Appendix B of this report. This chapter defines the final job classifications, core competencies, and proficiency levels that appear in the full matrix. While updating this report to include commercial buildings content, the categories in this section were also updated and clarified based on the stakeholder conversations to date.

4.1 Job Classifications

It is important for the job classifications in the matrix to adequately represent the full design, installation, and value chain associated with buildings. The 37 job classifications below represent the final recommendations.

1. General Public
   a. *Owner* – People with building science knowledge obtained through high school education.
2. Builders/Remodelers
   a. *Builder/General Contractor (Owner)* – Owner of a building construction company who primarily manages the business.
   b. *Builder/General Contractor (Foreman)* – Builder who works in the field as a general contractor or foreman.
   c. *Remodeler (Owner)* – Owner of a building remodeling company or contracting business who primarily manages the business.
   d. *Remodeler (Foreman)* – Remodeler who works primarily in the field.
   e. *Insulation Contractor* – Foreman of an insulation crew that potentially performs air sealing as well as insulating.
   f. *HVAC/Mechanical Contractor* – Foreman of a heating, ventilation, and air-conditioning (HVAC) crew, responsible for installation and repair of HVAC equipment. For residential construction, also responsible for sizing calculations and specifying equipment.
   g. *Enclosure Service Contractor* – Foreman of a framing, siding, roofing, concrete, or window installation crew.
   h. *Plumber* – Foreman of a plumbing crew responsible for installation and repair of plumbing systems. For residential construction, also responsible for system layout, equipment sizing and specification.
   i. *Home Performance Contractor* – Foreman of a crew that performs residential performance testing such as thermal imaging and blower door testing, while also installing insulation and air sealing.
3. Program and Project Managers
   a. *Utility Program Manager* – Manager of an electric or natural gas utility-based program that supports energy audit programs or product efficiency rebates.
   b. *Green Building Certification Professional* – Manages the certification of buildings under green building or energy efficiency programs such as ENERGY STAR, Leadership in Energy and Environmental Design (LEED), Passive House, Green Globes, Living Building Challenge, Nearly zero-energy buildings (NZEBs), and WELL Building Standard.

c. *Building Operations Professional*[1] – Manages the maintenance and operation of building systems and installed equipment, and performs general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity, and safety of the building occupants.

d. *Building Operations Journey-worker*[2] – Maintains and operates building systems and installed equipment, and performs general maintenance to maintain the building's operability, optimize building performance, and ensure the comfort, productivity, and safety of the building occupants. The Building Operations Journey-worker may provide leadership and training to less senior personnel.

e. *Facility/Asset Manager* – Manager or owner who is responsible for investment and upgrade decisions.

4. Transaction Process

   a. *Real Estate Agent* – Licensed to produce contracts to buy and sell real estate.

   b. *Appraiser* – Licensed to value property for real estate transactions.

   c. *Building Inspector* – Certified or licensed to inspect and evaluate the physical condition of buildings.

   d. *Insurer* – Licensed to evaluate the risk of a natural or man-made disaster.

   e. *Underwriter* – Licensed to evaluate the risk of a building owner defaulting on a loan.

5. Design and Construction Professionals

   a. *Architectural Engineer* – Licensed architectural engineer responsible for integrating structural, mechanical, electrical, plumbing, HVAC, and/or fire protection engineering with building design.

   b. *Licensed Architect* – Licensed architect responsible for a building's design, including incorporating the specification of envelope, structural, mechanical, and electrical systems.

   c. *Mechanical Engineer* – Licensed to design and specify mechanical systems including HVAC for buildings.

   d. *Electrical Engineer* – Licensed to design and specify electrical systems for buildings.

   e. *Lighting Designer* – Designer who designs and plans lighting systems and corresponding electrical systems.

   f. *Civil/Structural Engineer* – Licensed for various aspects of building design including structural and site development

   g. *Material Science Engineer* – Licensed to design materials and construction products for use in buildings.

   h. *Interior Designer* – Educated in design and specification of interiors.

   i. *Landscape Architect* – Licensed landscape architect or unlicensed site planner/designer experienced with landscape design including grading and site drainage, shading, irrigation systems, and plant specifications.

   j. *Construction Manager* – Working onsite to supervise, schedule, and coordinate construction activities among various trades, develop installation sequences, and select and purchase appropriate construction materials.

---

[1] This is the job description provided at https://www.nibs.org/?page=cwcc_resources

[2] This is the job description provided at https://www.nibs.org/?page=cwcc_resources

6. Building Science Professionals

   a. *Building Forensic Professional* – Engineer, architect, or other individual who performs onsite investigations to help determine the causes of failure or damage to various components of a building, but is primarily focused on the envelope and structure.

   b. *Building Commissioning Professional*[3] – An individual who leads, plans, coordinates and manages a commissioning team to implement commissioning processes in new and existing buildings.

7. Energy Professionals

   a. *Commercial Building Energy Auditor*[4] – An energy solutions professional who assesses building systems and site conditions, analyzes and evaluates equipment and energy usage, and recommends strategies for optimizing building resource utilization.

   b. *Residential Energy Auditor* – A certified (Building Performance Institute [BPI], Certified Energy Auditor [CEA], etc.) professional who measures the energy performance of a home. This can include tasks such as checking the energy use of major appliances, inspecting insulation levels, measuring air leakage, using infrared thermography to find thermal bridges and air leaks, and checking the performance and safety of ventilation and mechanical equipment.

   c. *Residential Performance Assessor* – A certified (BPI, CEA, etc.) professional who has more energy assessment experience than the field technician or energy auditor. Additional responsibilities may include management, writing energy assessment and recommendation reports, and conducting energy modeling to provide energy ratings and quantify energy savings from recommended improvements.

   d. *Commercial Building Energy Manager*[5] – An individual who is responsible for managing and continually improving energy performance in commercial buildings by establishing and maintaining an energy program management system that supports the mission and goals of the organization.

8. Building/Energy Code Officials

   a. *Code Official* – Experienced local or state officials responsible for ensuring buildings are built to meet minimum code requirements in their jurisdiction (e.g., building, energy, plumbing, electrical, mechanical, and fire codes).

4.2 Core Competency Definitions

Key elements of the four core competencies listed by number below are highlighted in italics in the subordinate details that define the terms.

1. Integration of the Whole-Building System

   a. The *simultaneous consideration* of the impacts design decisions have on energy use, assembly durability, human comfort, indoor air quality, safety, security, cost, aesthetics, and building resilience.

   b. The concept of life-cycle cost analysis as it relates to payback, net-present value calculation, and *annualized cash flow*.

---

[3] This is the job description provided at https://www.nibs.org/?page=cwcc_resources
[4] This is the job description provided at https://www.nibs.org/?page=cwcc_resources
[5] This is the job description provided at https://www.nibs.org/?page=cwcc_resources

c. Understanding the techniques used to minimize disruption to buildings and infrastructure systems due to *natural or man-made disasters*.

d. *Integrated design and construction* of the building as shown through coordinated trades and disciplines including:

- the integration of building science into all construction documentation and specifications (Lukachko et al., 2011) and
- the integration of building science into onsite energy generation considerations (example: roof that can withstand the weight of solar panels).

e. *Quality management* as it relates to designing, specifying, and verifying the performance of a building.

f. *Energy modeling* topics including iterative modeling to optimize loads early in the design process, as well as more detailed modeling used to refine variables like glazing specifications, insulation values, and HVAC design.

g. Whole-building *cost trade-off analysis (optimized first costs)* to optimize the first cost of a building against future costs associated with items such as energy use and maintenance or replacement.

2. Building Science Principles Related to the Enclosure

a. *Heat transfer* and the movement of heat by convection, conduction, and radiation.

b. *Moisture transport* (liquid, vapor) and the movement of water. This topic also includes psychometric and phase change effects.

c. *Convective air transport* including the movement of air across building enclosures as a consequence of pressure differences.

d. *Material selection* related to indoor air quality effects of off-gassing, comfort effects related to thermal mass storage, and the vulnerability of materials to damage due to moisture accumulation.

e. *Control layers* and the flow of heat, vapor, water, air, and solar gain through building components.

f. *Hygrothermal analysis* and the ability to predict the flow of heat and moisture across enclosure assemblies using computer software.

g. *HVAC* systems including heating, ventilation, and air-conditioning systems.

h. *Interactions between HVAC systems and the enclosure.*

i. *Fenestration considerations* including National Fenestration Rating Council (NFRC) labels, solar orientation, sun angles, shading, daylighting, and distribution factors such as window to wall area.

j. *Plumbing systems – domestic hot water* topics including water heater options, distribution systems, and conservation strategies.

k. *Electrical systems* within the building, interfaces with utility infrastructure, and integration of renewable electric production.

l. *Lighting, appliances, and miscellaneous electric loads.*

m. *Control/Automation systems* (manual or automated) to control energy-consuming devices such as HVAC systems and lights.

n. *Indoor environmental quality* including thermal comfort, air movement, moisture content, indoor pollutants, and extraction.

3. Operations and Maintenance

    a. *User controls* including all equipment used by building occupants or building operators to control energy-consuming devices and systems (ex: thermostat).

    b. *Preventative maintenance* including actions taken to prevent premature failure of building systems such as HVAC equipment and enclosure systems (ex: cleaning air filters).

    c. Determination of *appropriate replacement choices* upon material or equipment failure.

4. Building Testing and Certification

    a. *Commissioning* important building systems after their installation to ensure they perform as expected. This includes continuous commissioning where performance of key systems is periodically verified.

    b. *Diagnostic strategies* used to discover the underlying causes of building system failures and implementing solutions to prevent future failures.

    c. *Monitoring* the performance of a building and assessing the cause and effect of certain building behaviors.

    d. Consideration of *national codes and standard* requirements as they relate to building science principles.

    e. *Certification programs* including the U.S. Environmental Protection Agency's (EPA) ENERGY STAR Certified New Homes program, the DOE's Zero Energy Ready Home program, LEED, Passive House, Green Globes, Living Building Challenge, NZEB, WELL Building Standard.

4.3 Proficiency Levels

To obtain the appropriate degree of competency across all job classification groupings, a set of defined proficiency levels was derived from Bloom's Taxonomy (Bloom 1956). These definitions were used to compare the job expectations of one occupation to another. The six levels defined below range from simple recognition of terms to complex mechanical design.

1. **Remember**: Remember facts, terms, and basic concepts.
2. **Understand**: Demonstrate understanding by describing, defining, and interpreting concepts.
3. **Apply**: Apply knowledge in familiar situations to solve problems.
4. **Analyze**: Identify causes of unique problems and use past evidence to support actions.
5. **Evaluate**: Identify solutions to unique problems using past evidence to support actions.
6. **Create**: Use fundamental knowledge to create unique plans, patterns, and alternatives.

Figure 4.1 shows the relative rigor of each proficiency level. It shows that the difference between level one and two is much smaller than the difference between level two and three.

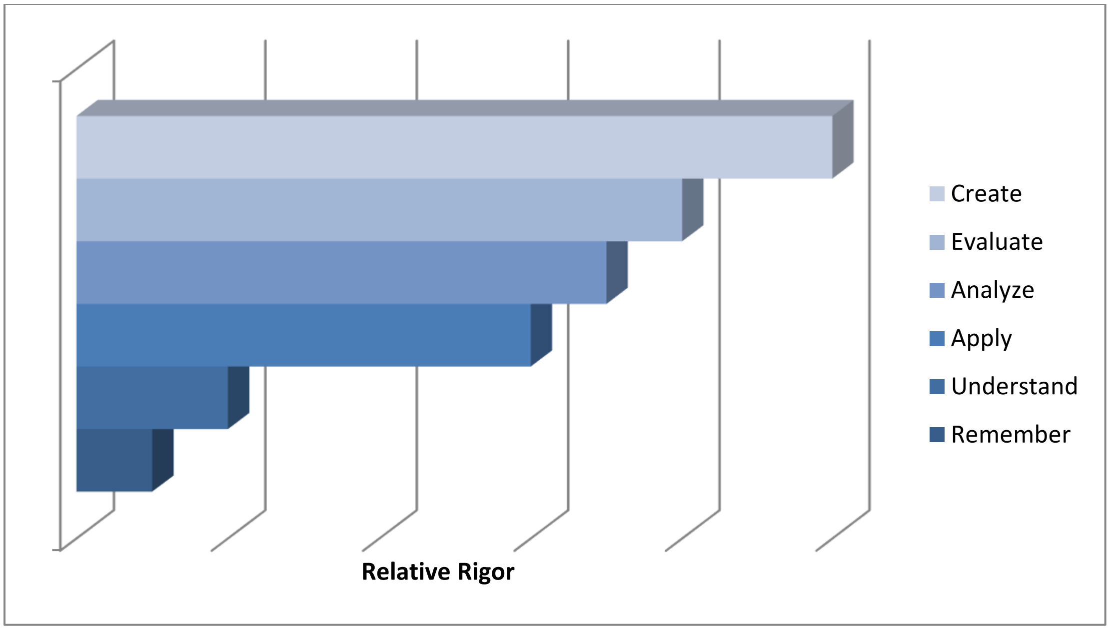


Figure 4.1. Relative Rigor of Proficiency Levels Used in the Matrix

4.4 Completed Matrix

The following goals, originally drafted at the 2012 Building Science Education Summit, were achieved through many hours of collaboration across the buildings industry:

- Identify a set of proficiency/skill levels across all stakeholder groups who build, buy, or sell residential buildings.
- Establish core competency topics related to building science education.
- Map proficiency levels to core competency topics for key construction trades, university/college programs, and transaction process officials.

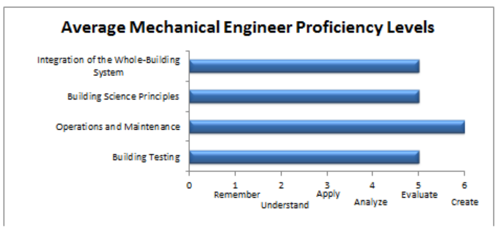
A copy of the full matrix can be seen in Appendix B of this document.

5.0 Building Science Education Guidelines

The following building science education guidelines have been developed for external stakeholders to use to self-certify their programs. The guidelines are intended to be used primarily by training organizations, universities, and certification bodies that would like to include aspects of building science in their curricula. Each guideline in Appendix A can be printed or saved as a stand-alone document for ease of use by the respective stakeholder group. A sample of a guideline for Mechanical Engineers is shown in Figure 5.1.

Building Science Education Guidelines for Mechanical Engineers

A summary of the proficiency levels[1] for the core competencies are displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing home energy certifiers, a mechanical engineer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	4	☐
Quality management	5	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	6	☐
Moisture transport of liquid	5	☐
Convective air transport due to pressure differences	6	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	6	☐
HVAC interactions with the enclosure	6	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	5	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	6	☐
Control/automation systems	5	☐
Operations and maintenance	Average = 6	
User controls (ex: thermostat)	6	☐
Preventative maintenance (ex: cleaning air filters)	5	☐
Determination of appropriate replacement choices	6	☐
Building testing and certification	Average = 5	
Commissioning	6	☐
Diagnostics and forensics	5	☐
Monitoring	6	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________ mechanical engineer certification body has incorporated all of the relevant information in the above checklist into their training materials.

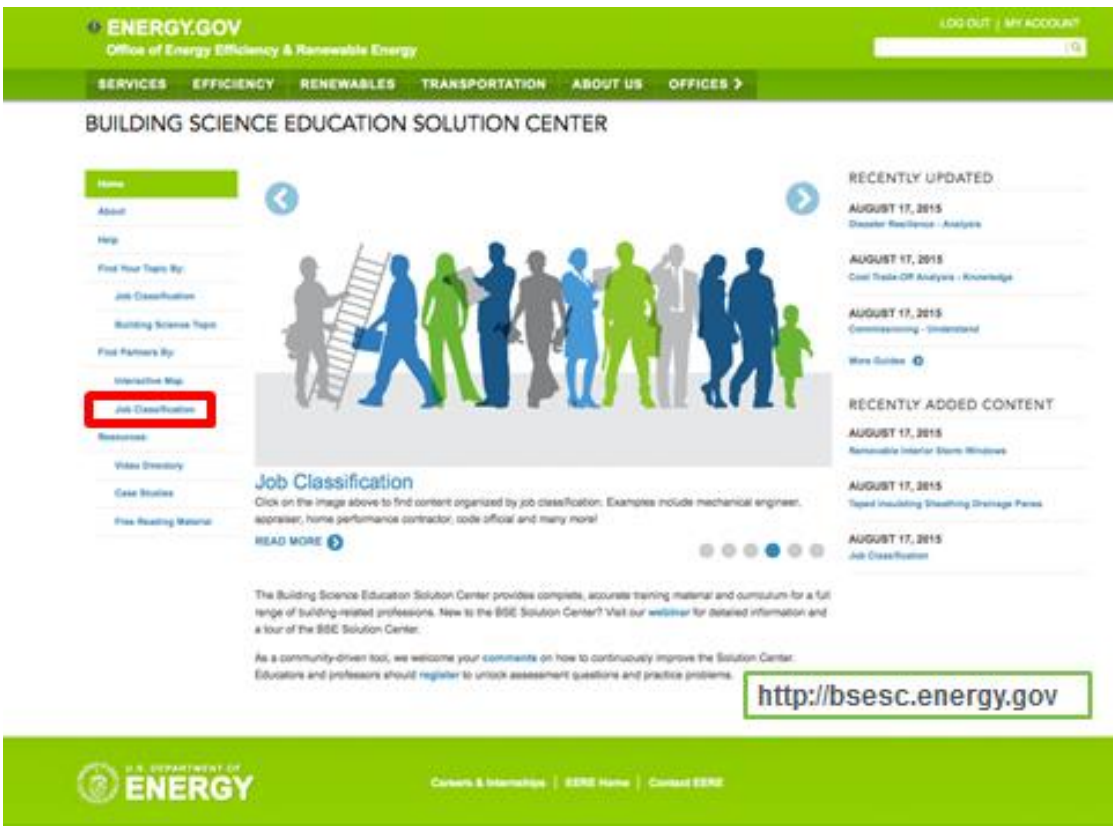
Signature ____

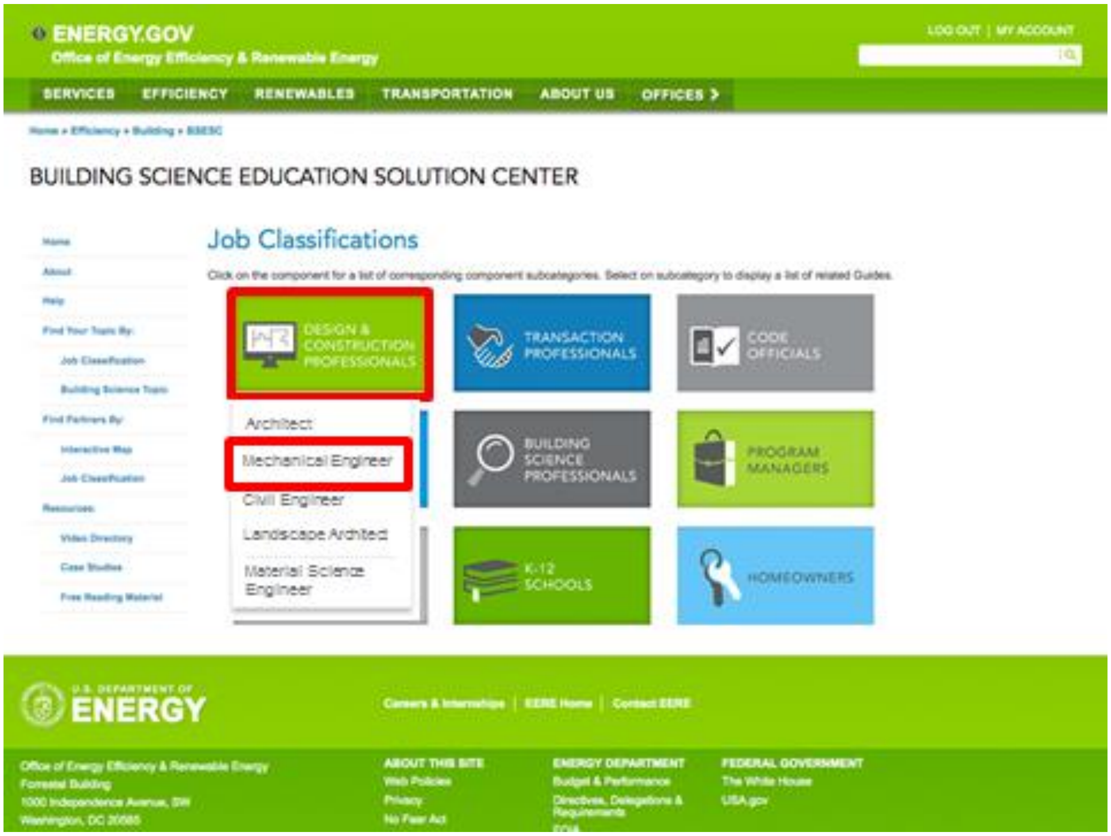
Figure 5.1. Sample of a Building Science Education Guideline

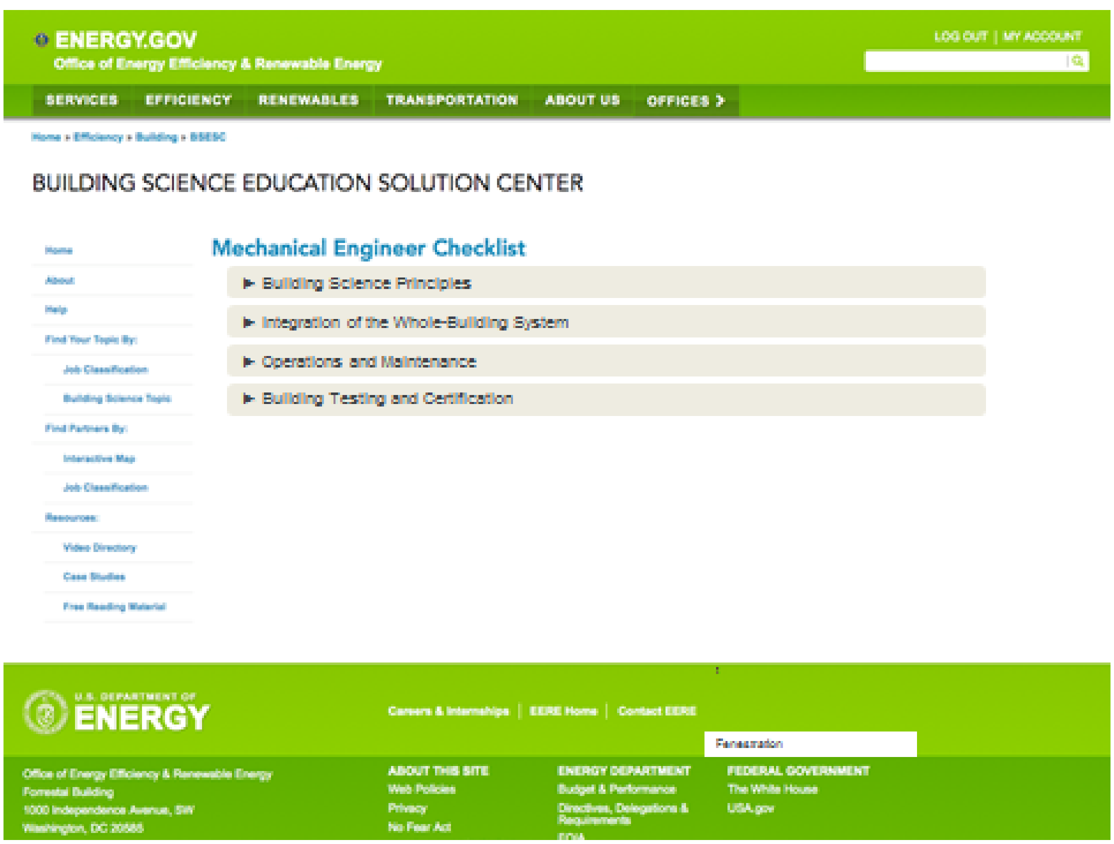
6.0 Building Science Education Solution Center

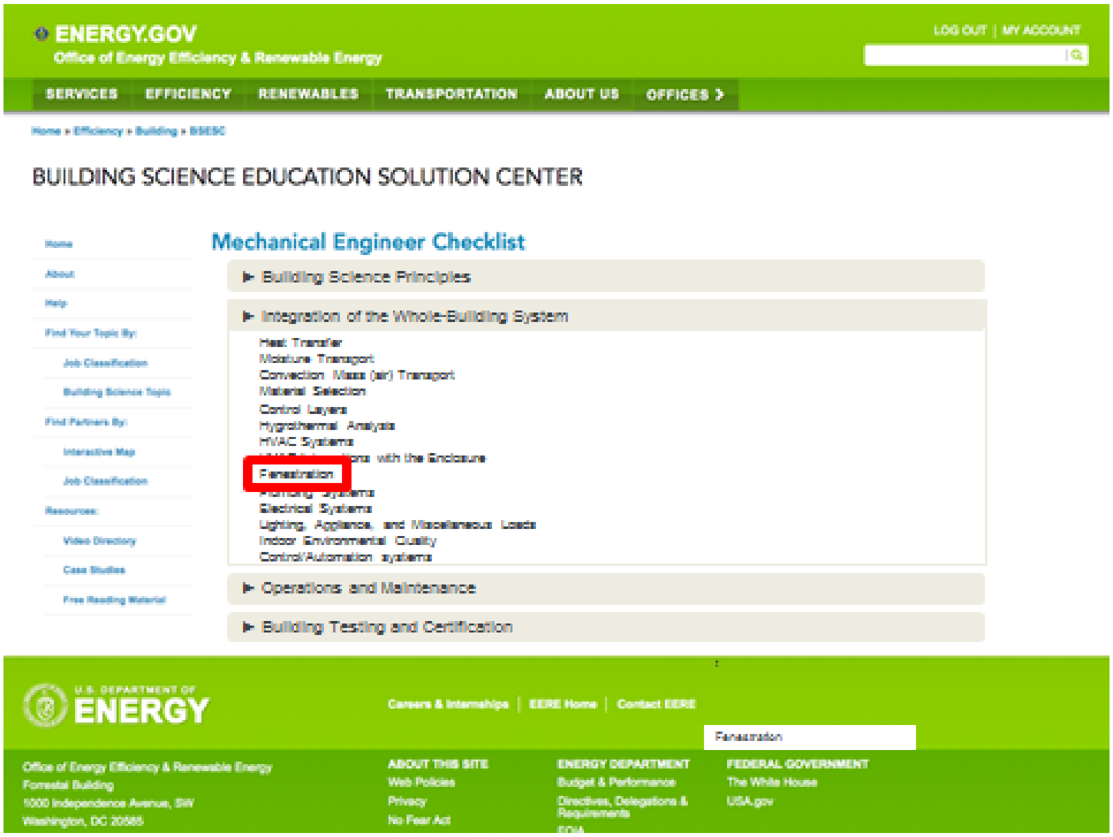
As stakeholders were consulted about this effort, it became evident that a roadblock for infusing building science education curriculum into programs was simply the lack of time to develop content for their classes. This seemed like another obstacle that DOE could help solve, using many of the resources that it had already developed by other programs. DOE also has many connections with other public and private programs that would be willing to share their resources with others. So, the Building Science Education Solution Center website now provides professors, trainers, and students with training materials for a full range of building-related professions. The mockup of the Building Science Education Solution Center website presented in Figure 6.1 outlines the pages that allow users to easily share, access, and use building science education content.

As discussed with stakeholders from both programs, the BBWG job classifications will be added to the website portfolio and BBWG partners will be added to the stakeholder map and list feature. BBWG partners will be recognized for their efforts leading up to and maintaining accreditation.

a. 

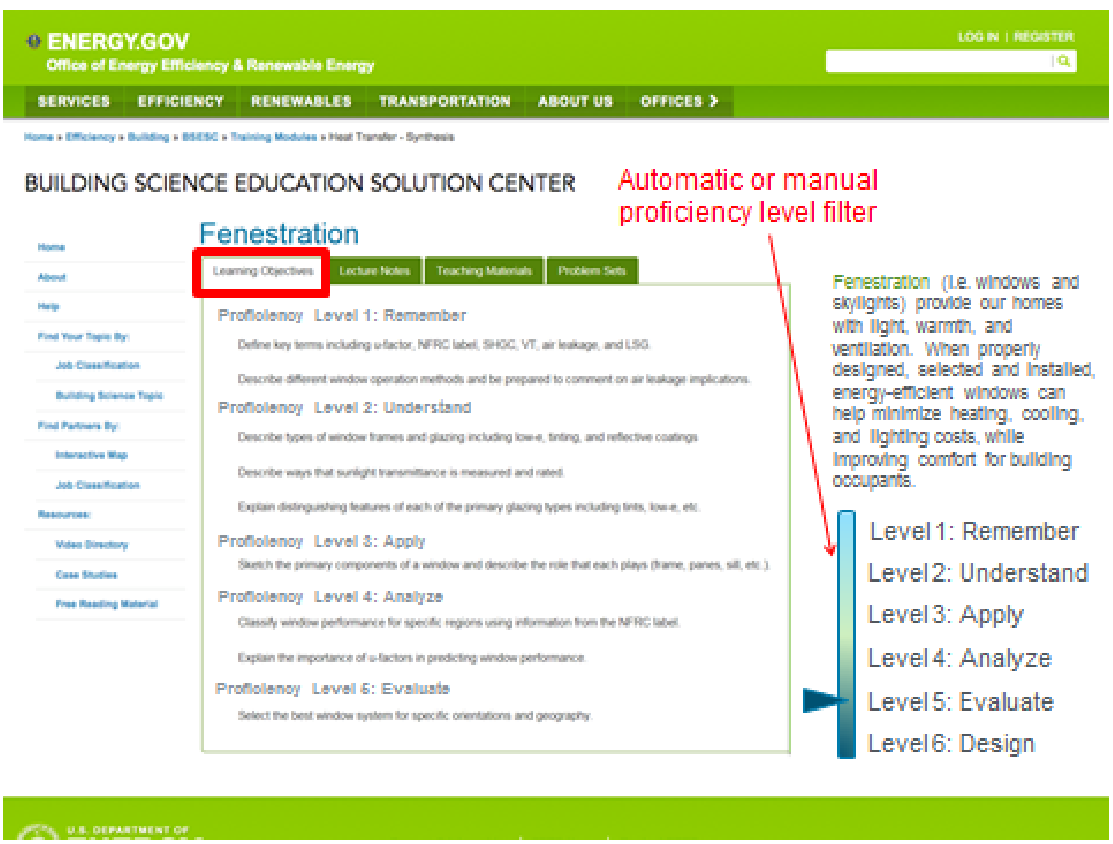
b. 
ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG OUT | MY ACCOUNT
SERVICES
EFFICIENCY
RENEWABLES
TRANSPORTATION
ABOUT US
OFFICES
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Job Classifications
DESIGN & CONSTRUCTION PROFESSIONALS
TRANSACTION PROFESSIONALS
CODE OFFICIALS
Architect
Mechanical Engineer
Civil Engineer
Landscape Architect
Material Science Engineer
BUILDING SCIENCE PROFESSIONALS
PROGRAM MANAGERS
K-12 SCHOOLS
HOMEOWNERS
ENERGY

c. 
ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG OUT | MY ACCOUNT
SERVICES
EFFICIENCY
RENEWABLES
TRANSPORTATION
ABOUT US
OFFICES
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Mechanical Engineer Checklist
Building Science Principles
Integration of the Whole-Building System
Operations and Maintenance
Building Testing and Certification
ENERGY



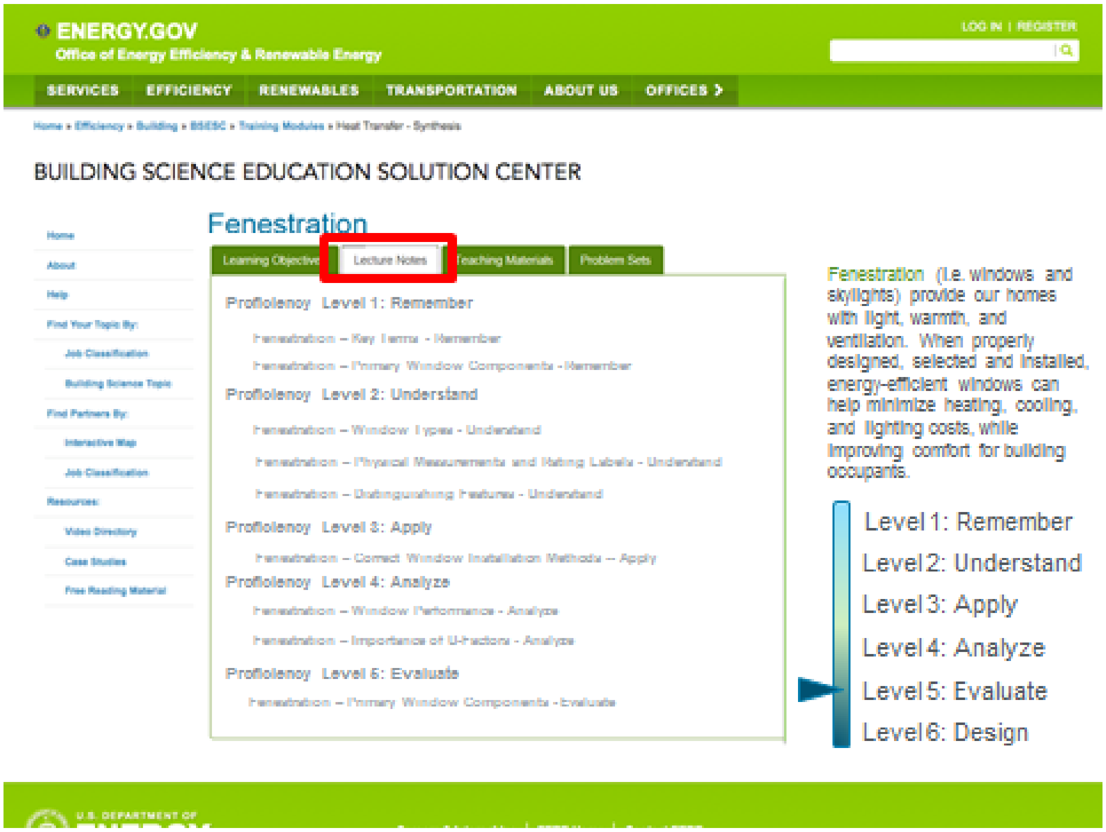
ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG OUT | MY ACCOUNT
SERVICES
EFFICIENCY
RENEWABLES
TRANSPORTATION
ABOUT US
OFFICES
Home » Efficiency » Building » BSESC
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Home
About
Help
Find Your Topic By:
Job Classification
Building Science Topic
Find Partners By:
Interactive Map
Job Classification
Resources:
Video Directory
Case Studies
Free Reading Material
Mechanical Engineer Checklist
Building Science Principles
Integration of the Whole-Building System
Heat Transfer
Moisture Transport
Convection Mass (air) Transport
Material Selection
Control Layers
Hygrothermal Analysis
HVAC Systems
Fenestration
Electrical Systems
Lighting, Appliance, and Miscellaneous Loads
Indoor Environmental Quality
Control/Automation systems
Operations and Maintenance
Building Testing and Certification
U.S. DEPARTMENT OF
ENERGY
Careers & Internships | EERE Home | Contact EERE
Fenestration
Office of Energy Efficiency & Renewable Energy
Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585
ABOUT THIS SITE
Web Policies
Privacy
No Fear Act
ENERGY DEPARTMENT
Budget & Performance
Directives, Delegations & Requirements
FOIA
FEDERAL GOVERNMENT
The White House
USA.gov

d.

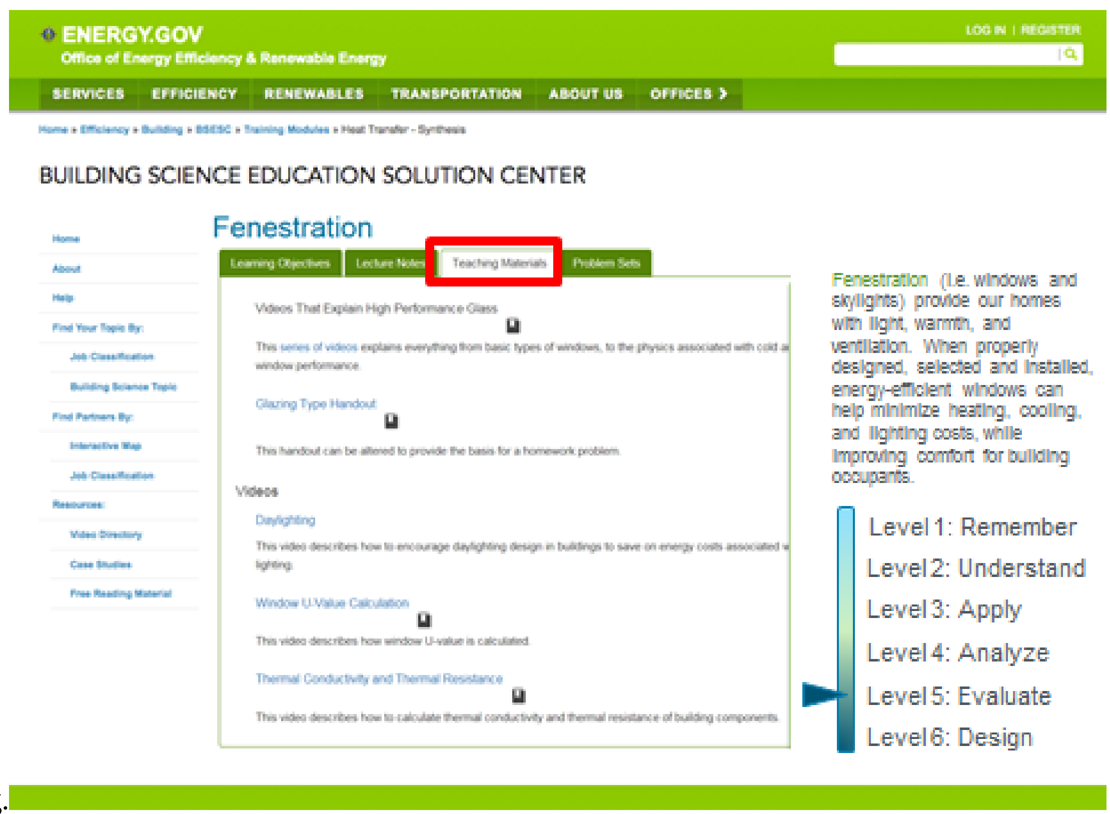


ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG IN | REGISTER
SERVICES
EFFICIENCY
RENEWABLES
TRANSPORTATION
ABOUT US
OFFICES
Home » Efficiency » Building » BSESC » Training Modules » Heat Transfer - Synthesis
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Automatic or manual proficiency level filter
Fenestration
Home
About
Help
Find Your Topic By:
Job Classification
Building Science Topic
Find Partners By:
Interactive Map
Job Classification
Resources:
Video Directory
Case Studies
Free Reading Material
Learning Objectives
Lecture Notes
Teaching Materials
Problem Sets
Proficiency Level 1: Remember
Define key terms including u-factor, NFRC label, SHGC, VT, air leakage, and LSG.
Describe different window operation methods and be prepared to comment on air leakage implications.
Proficiency Level 2: Understand
Describe types of window frames and glazing including low-e, tinting, and reflective coatings.
Describe ways that sunlight transmittance is measured and rated.
Explain distinguishing features of each of the primary glazing types including tints, low-e, etc.
Proficiency Level 3: Apply
Sketch the primary components of a window and describe the role that each plays (frame, panes, sill, etc.).
Proficiency Level 4: Analyze
Classify window performance for specific regions using information from the NFRC label.
Explain the importance of u-factors in predicting window performance.
Proficiency Level 5: Evaluate
Select the best window system for specific orientations and geography.
Fenestration (i.e. windows and skylights) provide our homes with light, warmth, and ventilation. When properly designed, selected and installed, energy-efficient windows can help minimize heating, cooling, and lighting costs, while improving comfort for building occupants.
Level 1: Remember
Level 2: Understand
Level 3: Apply
Level 4: Analyze
Level 5: Evaluate
Level 6: Design
U.S. DEPARTMENT OF

e.


ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG IN | REGISTER
SERVICES EFFICIENCY RENEWABLES TRANSPORTATION ABOUT US OFFICES
Home » Efficiency » Building » BSESC » Training Modules » Heat Transfer - Synthesis
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Home
About
Help
Find Your Topic By:
Job Classification
Building Science Topic
Find Partners By:
Interactive Map
Job Classification
Resources:
Video Directory
Case Studies
Free Reading Material
Fenestration
Learning Objectives
Lecture Notes
Teaching Materials
Problem Sets
Proficiency Level 1: Remember
Fenestration – Key Terms - Remember
Fenestration – Primary Window Components - Remember
Proficiency Level 2: Understand
Fenestration – Window Types - Understand
Fenestration – Physical Measurements and Rating Labels - Understand
Fenestration – Distinguishing Features - Understand
Proficiency Level 3: Apply
Fenestration – Correct Window Installation Methods – Apply
Proficiency Level 4: Analyze
Fenestration – Window Performance - Analyze
Fenestration – Importance of U-Factors - Analyze
Proficiency Level 5: Evaluate
Fenestration – Primary Window Components - Evaluate
Fenestration (i.e. windows and skylights) provide our homes with light, warmth, and ventilation. When properly designed, selected and installed, energy-efficient windows can help minimize heating, cooling, and lighting costs, while improving comfort for building occupants.
Level 1: Remember
Level 2: Understand
Level 3: Apply
Level 4: Analyze
Level 5: Evaluate
Level 6: Design
U.S. DEPARTMENT OF

f.


ENERGY.GOV
Office of Energy Efficiency & Renewable Energy
LOG IN | REGISTER
SERVICES EFFICIENCY RENEWABLES TRANSPORTATION ABOUT US OFFICES
Home » Efficiency » Building » BSESC » Training Modules » Heat Transfer - Synthesis
BUILDING SCIENCE EDUCATION SOLUTION CENTER
Home
About
Help
Find Your Topic By:
Job Classification
Building Science Topic
Find Partners By:
Interactive Map
Job Classification
Resources:
Video Directory
Case Studies
Free Reading Material
Fenestration
Learning Objectives
Lecture Notes
Teaching Materials
Problem Sets
Videos That Explain High Performance Glass
This series of videos explains everything from basic types of windows, to the physics associated with cold a
window performance.
Glazing Type Handout
This handout can be altered to provide the basis for a homework problem.
Videos
Daylighting
This video describes how to encourage daylighting design in buildings to save on energy costs associated w
lighting.
Window U-Value Calculation
This video describes how window U-value is calculated.
Thermal Conductivity and Thermal Resistance
This video describes how to calculate thermal conductivity and thermal resistance of building components.
Fenestration (i.e. windows and skylights) provide our homes with light, warmth, and ventilation. When properly designed, selected and installed, energy-efficient windows can help minimize heating, cooling, and lighting costs, while improving comfort for building occupants.
Level 1: Remember
Level 2: Understand
Level 3: Apply
Level 4: Analyze
Level 5: Evaluate
Level 6: Design

g.

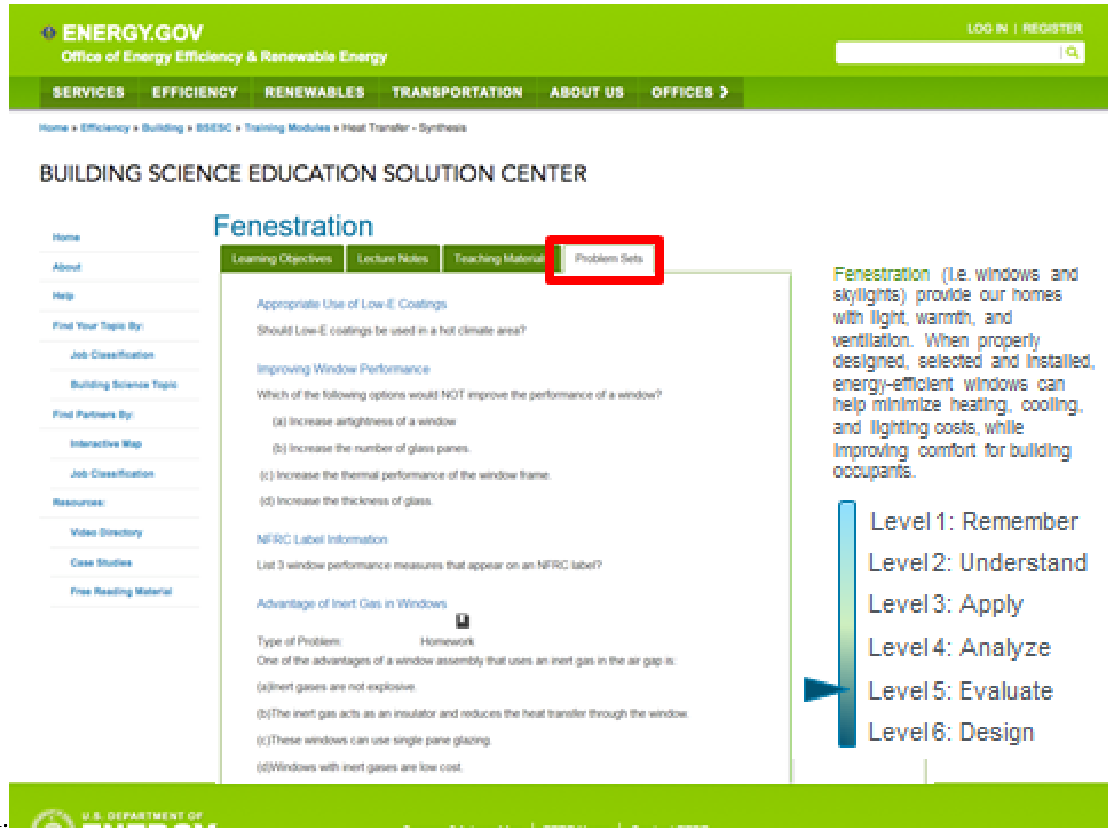
h. 

Figure 6.1. Mockup of the Building Science Education Solution Center Website. a. Homepage; b. Job Classifications landing page; c. example checklist; d. example dropdown with core competencies; e. example Fenestration module – learning objectives tab; f. example lecture notes tab; g. example training materials tab; and h. example problem sets tab.

7.0 Collective Impact Campaign for the Guidelines for Building Science Education

By engaging a diverse set of educators in working toward a common goal, the collective influence on the market can be exponentially more impactful than the incremental influence of individual organizations. This concept is demonstrated by John Kania and Mark Kramer (Kania and Kramer, 2011) and repeated in the Building Science Education Campaign.

In 2015, DOE launched a multi-year campaign to promote the adoption of the GBSEs in a variety of training settings. The goals of the campaign include the following:

- Encourage the whole-building industry to work toward safe, healthy, and durable high-performance homes.
- Provide a mechanism for recognizing excellence in the building training and education industry.
- Work with partners to improve the GBSEs to be representative of the knowledge, skills, and abilities appropriate for their workforces.

As found during the initial kick-off meeting in 2012, DOE is in a unique position to lead the campaign and help the industry grow as one unit toward a common goal. With leadership from PNNL, DOE will arrange one-on-one meetings to develop collaborations for the campaign. DOE looks forward to facilitating this process, but the important social change goal can only be achieved with broad commitment to actively participate in the process.

7.1 Collaboration Opportunities with DOE

DOE offers three types of collaboration opportunities in building science education/workforce development. The first two types are related to the collective impact campaign. The third type is only available through the BBWG process.

- *Collaborator* – Individual or organization that provides (or peer reviews) content that is used on the Building Science Education Solution Center website.
- *Stakeholder* – Organization that helps to develop or implements a guideline for a relevant job classification.
- *Recognized by the BBWG* – A certification program that is aligned with the BBWG program and has received qualified accreditation by the American National Standards Institute, International Accreditation Service, or other bodies that can accredit to ISO/IEC 17024:2012. A certification program that is aligned with the BBWG program and has received qualified accreditation by the American National Standards Institute, International Accreditation Service, for ANSI/ASTM 2659-15 or by the International Renewable Energy Council (IREC) for ANSI/IREC 14732-14.

To start the process of becoming a collaborator or stakeholder, please contact Cheryn Metzger at Cheryn.metzger@pnnl.gov.

For more information about the BBWG program and receiving recognition from it, visit the Better Buildings website at https://betterbuildingssolutioncenter.energy.gov/workforce/better-buildings-workforce-guidelines.

8.0 References

American National Standards Institute. 2015. ANSI/ASTM 2659-15.

American National Standards Institute. 2014. ANSI/IREC 14732-14.

Bloom, B. S. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co Inc.

International Organization for Standardization. 2012. ISO/IEC 17024:2012.

Kania J and M Kramer. 2011. Collective Impact. *Stanford Social Innovation Review*, Winter 2011, 9(1).

Lukachko, A., C. Gates, and J. Straube. 2011. The Strategy Guideline: Advanced Construction https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/strat_guide_constr_doc.pdf

Appendix A

Guidelines for Building Science Education

Appendix A

Guidelines for Building Science Education

The Guidelines for Building Science Education are expanded upon in this appendix. Stakeholders who work with the job classifications listed below can work with DOE and PNNL to self-certify their programs to comply with these guidelines.

Guidelines for Owner

Guidelines for Builder/Genral Contractor (Owner)

Guidelines for Builder/General Contractor (Foreman)

Guidelines for Remodeler (Owner)

Guidelines for Remodeler (Foreman)

Guidelines for Insulation Contractor

Guidelines for HVAC/Mechanical Contractor

Guidelines for Enclosure Service Contractor

Guidelines for Plumber

Guidelines for Home Performance Contractor

Guidelines for Utility Program Manager

Guidelines for "Green" Building Certification Professional

Guidelines for Building Operations Professional (see BBWG)

Guidelines for Building Operations Journey-worker (see BBWG)

Guidelines for Facility/Asset Manager

Guidelines for Real Estate Agent

Guidelines for Appraiser

Guidelines for Building Inspector

Guidelines for Insurer

Guidelines for Underwriter

Guidelines for Architectural Engineer

Guidelines for Architect

Guidelines for Mechanical Engineer

Guidelines for Electrical Engineer

Guidelines for Lighting Designer

Guidelines for Civil/Structural Engineer

Guidelines for Material Science Engineer

Guidelines for Interior Designer

Guidelines for Building Landscape Architect

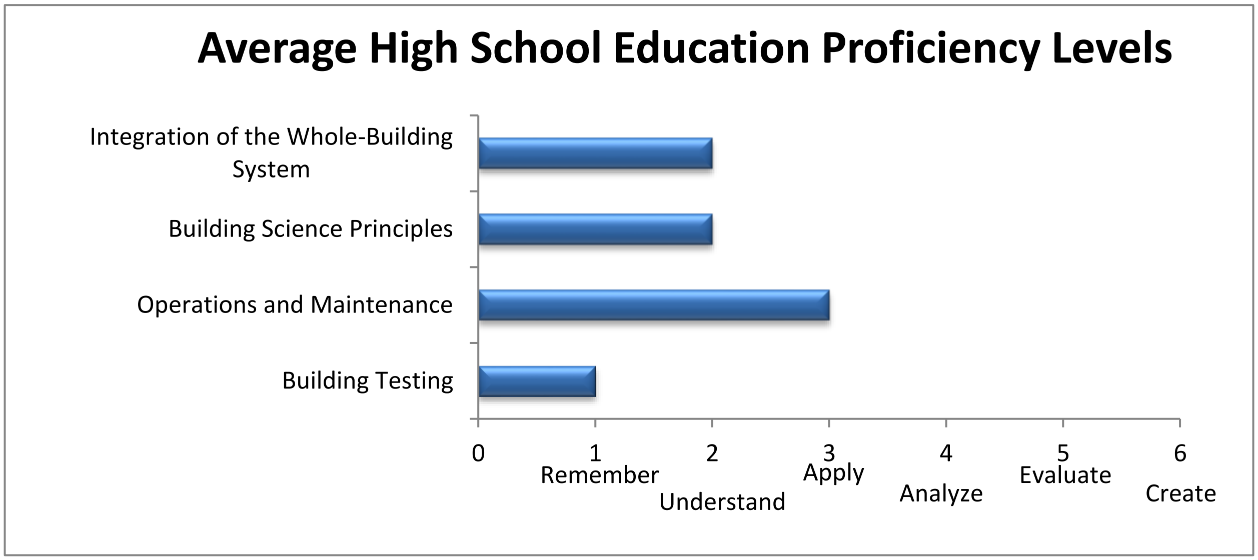
Guidelines for Construction Manager

Guidelines for Building Forensic Professional

Guidelines for Commissioning Professional (see BBWG)
Guidelines for Commercial Building Energy Auditor (see BBWG)
Guidelines for Residential Energy Auditor
Guidelines for Residential Performance Assessor
Guidelines for Commercial Building Energy Manager (see BBWG)
Guidelines for Building Code Official

Building Science Education Guidelines for Owner

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below.
For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for making decisions related to a house, a home owner/high school graduate should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 2	
Simultaneous consideration of energy, durability, comfort and IAQ	1	☐
Annualized cash flow	2	☐
Building techniques related to natural and man-made disasters	2	☐
Integrated design and construction	2	☐
Quality management	2	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	2	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

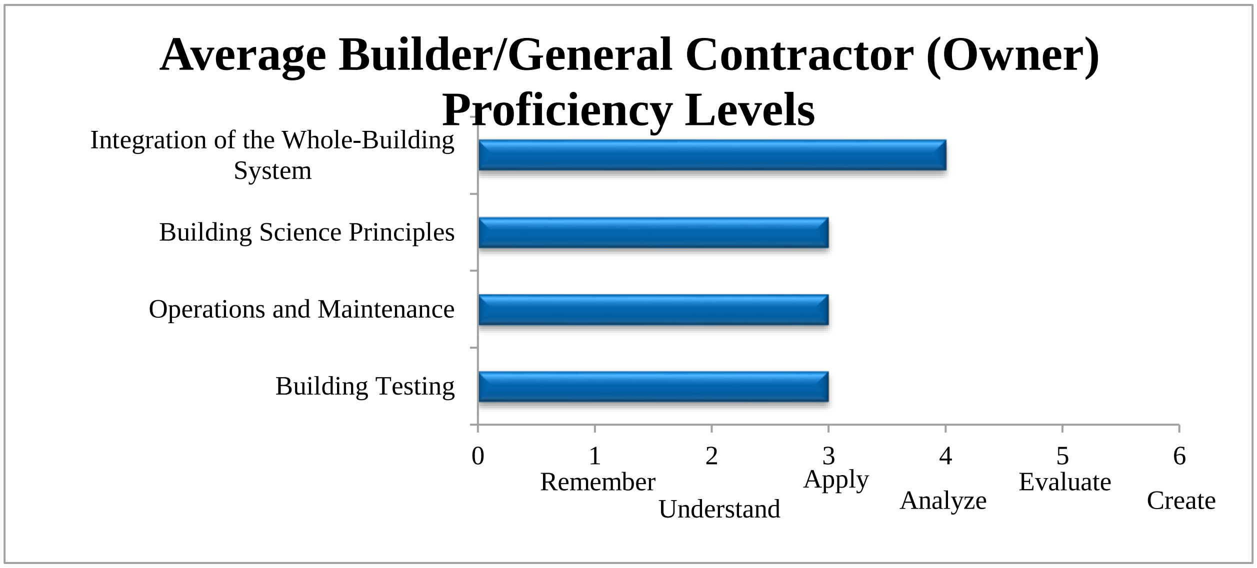
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	1	☐
Moisture transport of liquid	1	☐
Convective air transport due to pressure differences	1	☐
Material selection (IAQ, thermal mass, moisture)	1	☐
Controls layers (heat, vapor, water, air and solar gain)	1	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	2	☐
HVAC interactions with the enclosure	2	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	2	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	2	☐
Building testing and certification	Average = 1	
Commissioning	1	☐
Diagnostics and forensics	1	☐
Monitoring	2	☐
National codes and standards	1	☐
Certification programs	1	☐

The ______________________________ high school education certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Builder/General Contractor (Owner)

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for making decisions related to building, a builder/general contractor (owner) should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	4	☐
Quality management	5	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

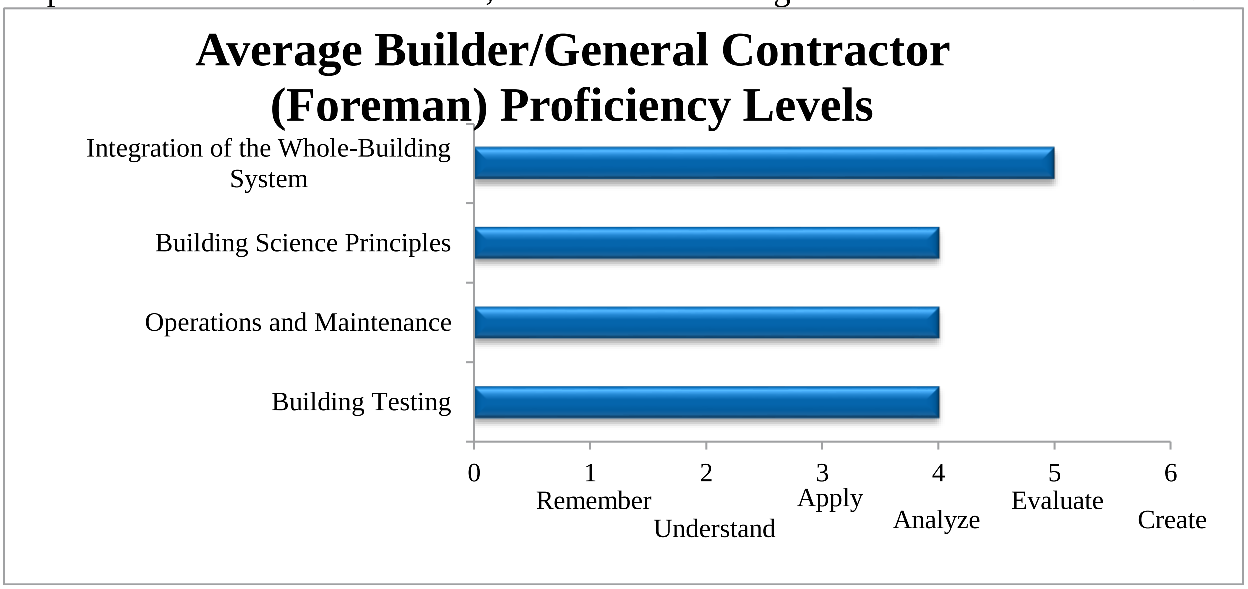
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	2	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	3	☐
Monitoring	3	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ builder/general contractor (owner) certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Builder/General Contractor (Foreman)

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing a construction crew, a builder/general contractor (foreman) should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	5	☐
Quality management	6	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

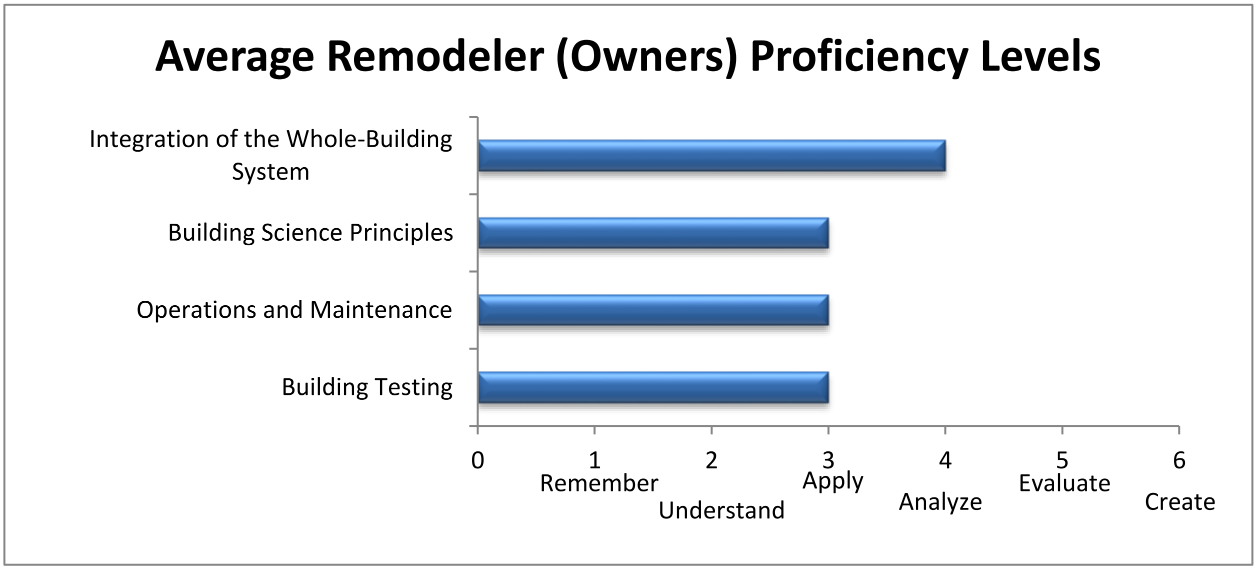
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 4	
Commissioning	4	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ builder/general contractor (foreman) certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Remodeler (Owners)

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing remodeling contractors, a remodeler (owner) should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	4	☐
Quality management	5	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

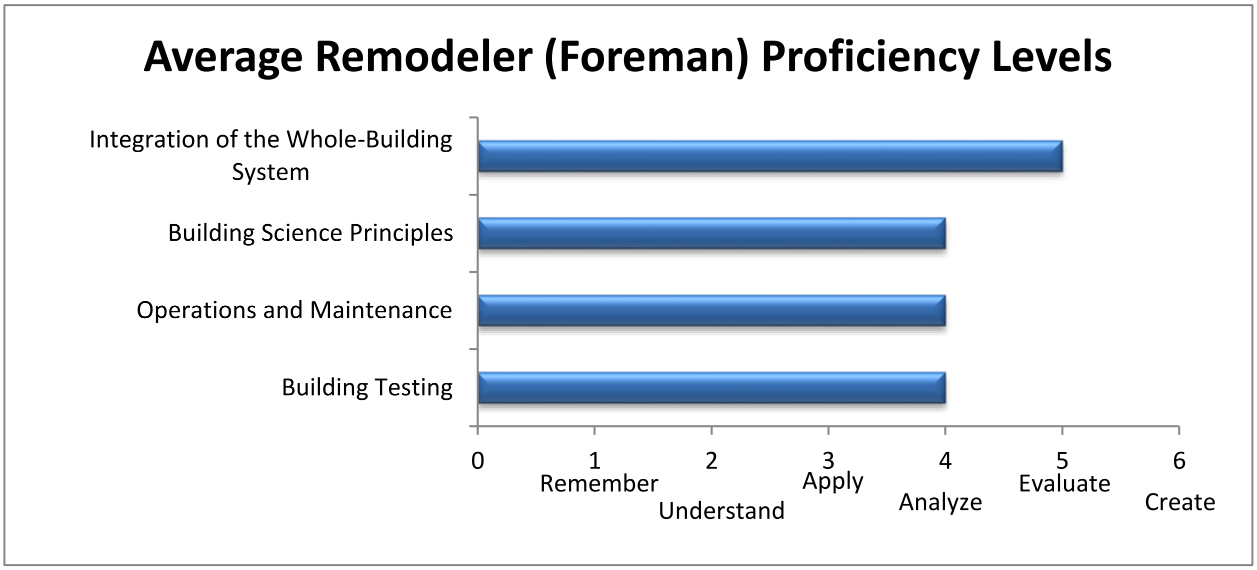
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	2	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	3	☐
Monitoring	3	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ remodeler (owner) certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Remodeler (Foreman)

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for remodeling many aspects of a building, a remodeler (foreman) should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	4	☐
Quality management	6	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

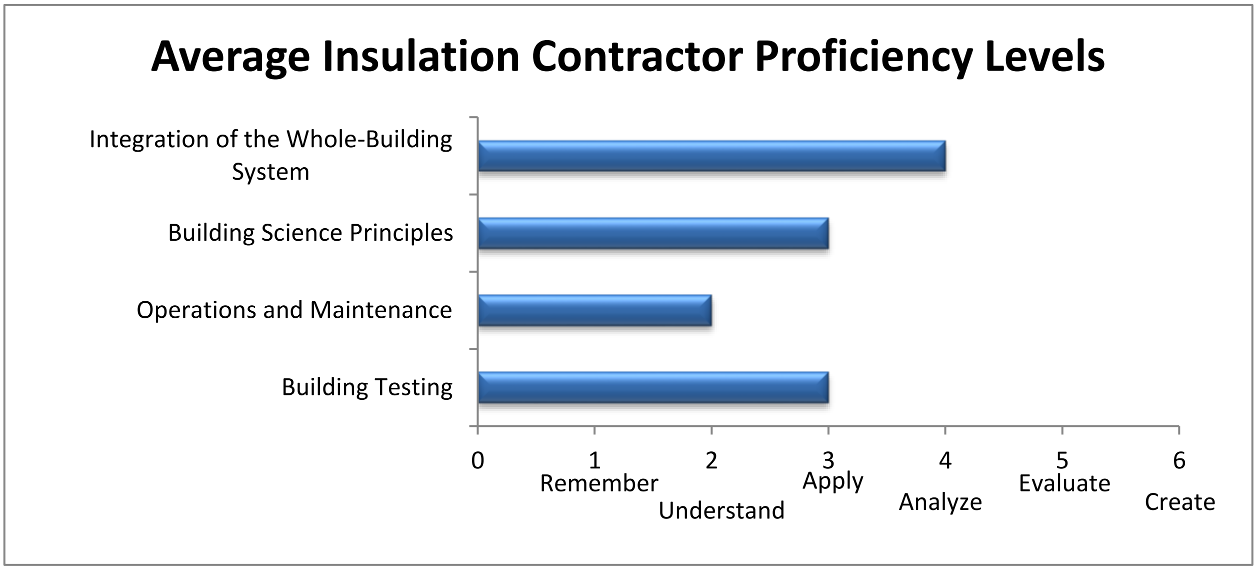
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 4	
Commissioning	4	☐
Diagnostics and forensics	4	☐
Monitoring	3	☐
National codes and standards	4	☐
Certification programs	3	☐

The ______________________________ remodeler (foreman) certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Insulation Contractors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for installing insulation, an insulation contractor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	3	☐
Quality management	6	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

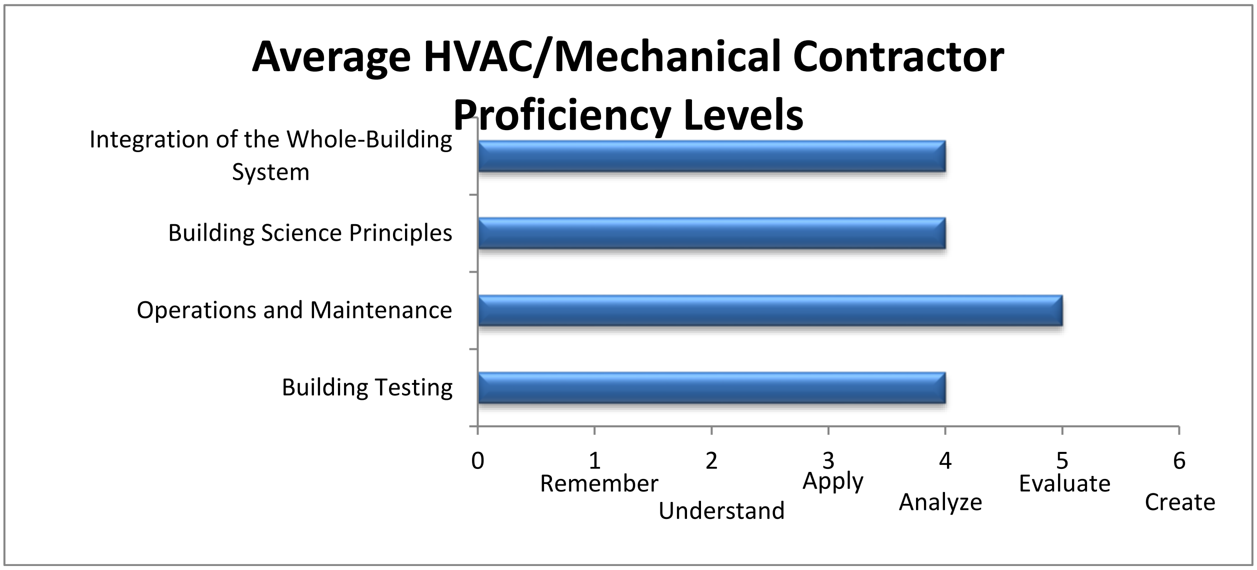
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	5	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	4	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 3	
Commissioning	4	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ insulation contractor certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for HVAC/Mechanical Contractors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for installing the HVAC system, a HVAC/Mechanical contractor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	2	☐
Integrated design and construction	4	☐
Quality management	6	☐
Building energy modeling	4	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

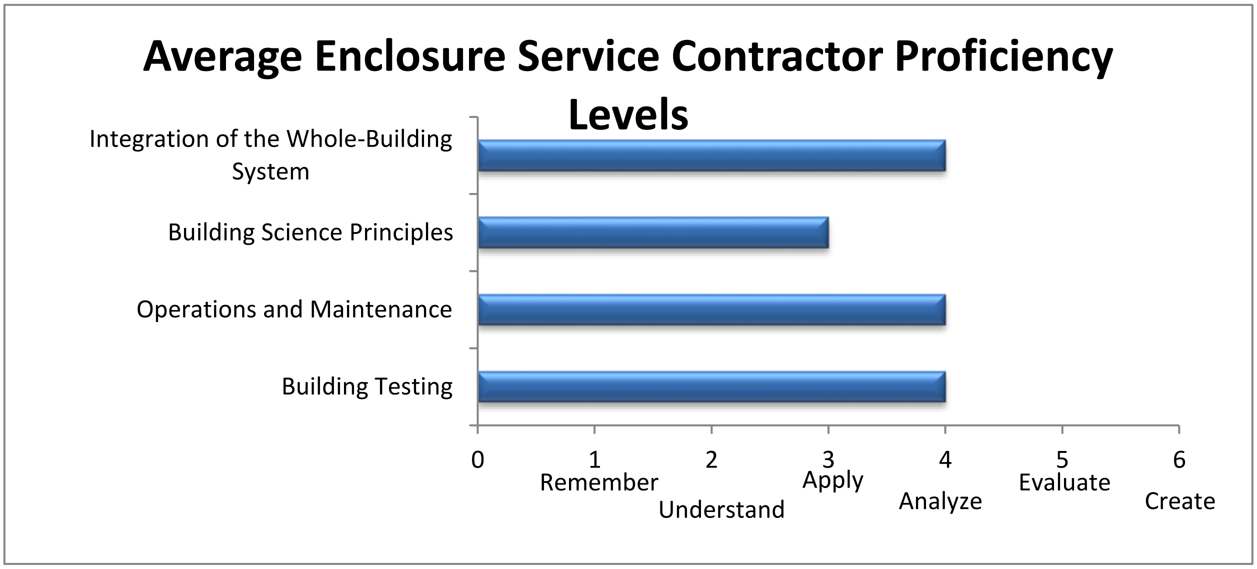
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	2	☐
HVAC interactions with the enclosure	5	☐
HVAC systems (heating, cooling and ventilation)	5	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	5	☐
Control/automation systems	5	☐
Operations and maintenance	Average = 5	
User controls (ex: thermostat)	5	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	5	☐
Monitoring	5	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ HVAC/mechanical contractor certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Enclosure Service Contractors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for repairing the enclosure, an enclosure service contractor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	4	☐
Quality management	6	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

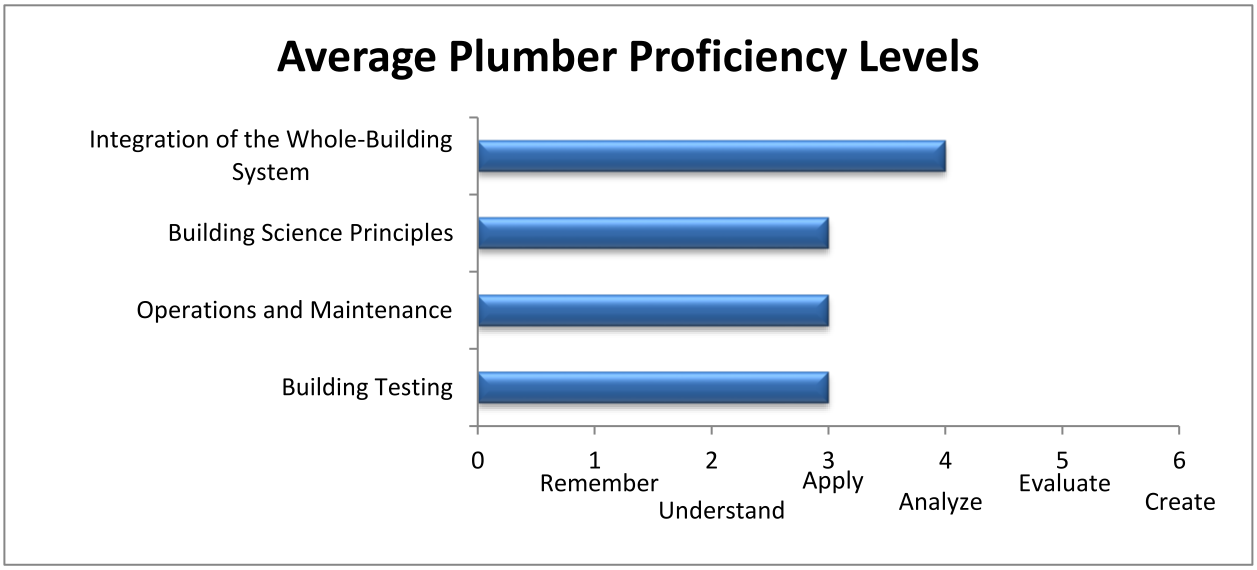
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ enclosure service contractor certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Plumbers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for installing plumbing systems, a plumber should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	3	☐
Quality management	6	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category.

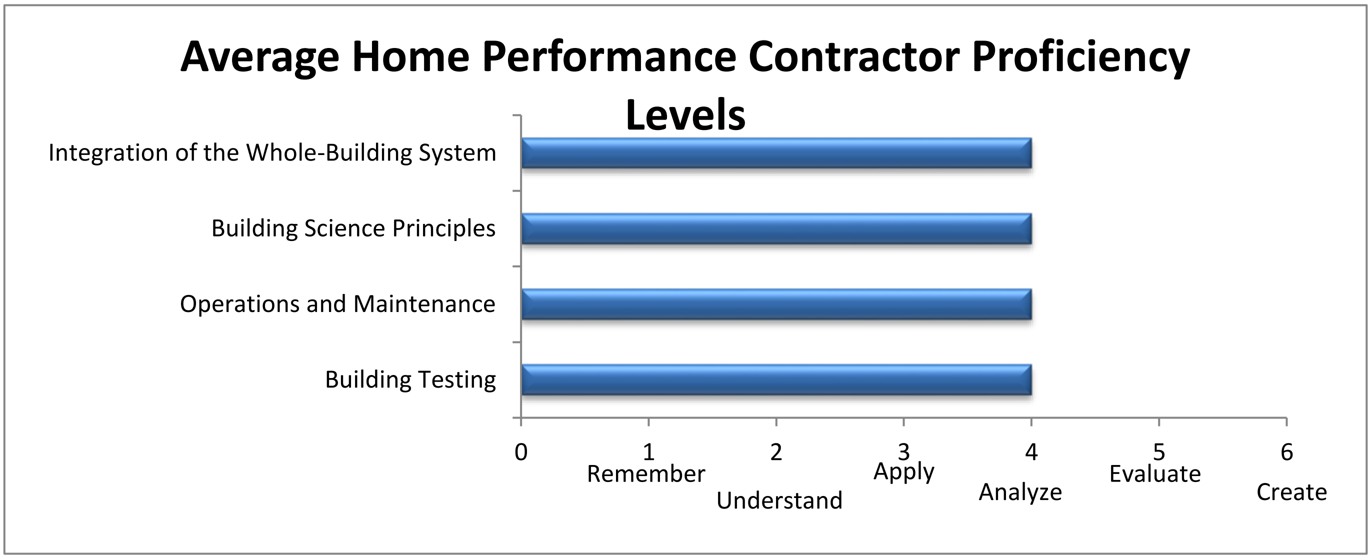
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	2	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	2	☐
Hygrothermal analysis	2	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	5	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	4	☐
Monitoring	2	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ plumber certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Home Performance Contractors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing home energy certifiers, a home performance contractor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	4	☐
Quality management	5	☐
Building energy modeling	4	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

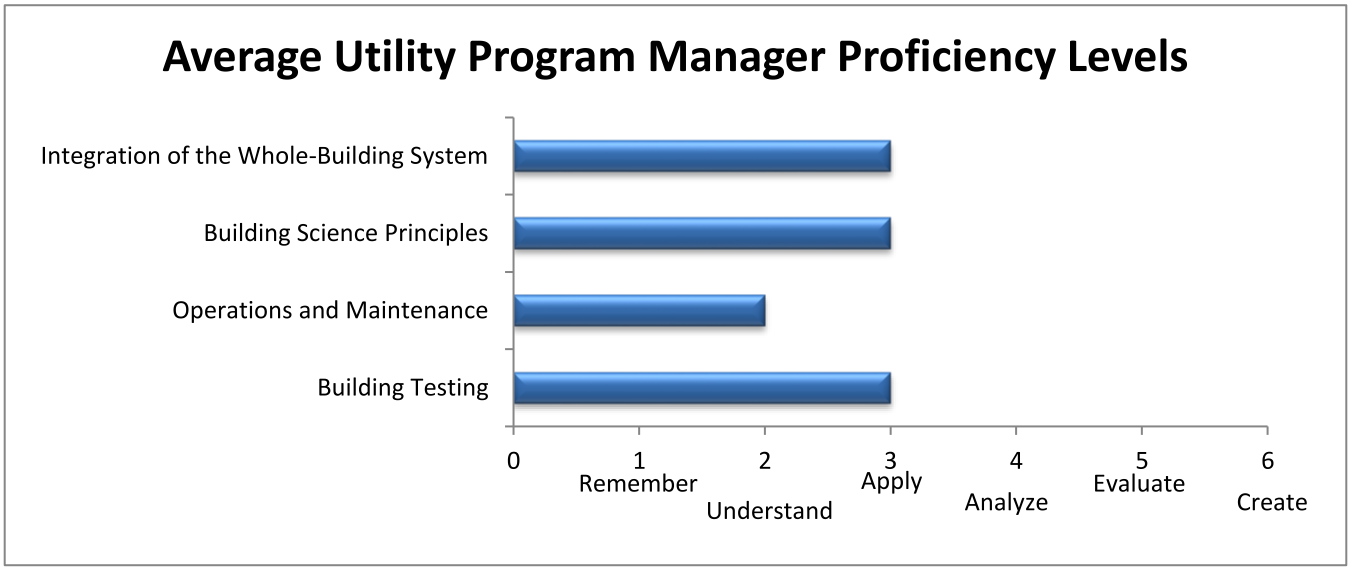
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	4	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	5	☐
Monitoring	5	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ home performance contractor certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Utility Program Managers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for determining incentive programs, a utility program manager should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 3	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	2	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	2	☐
Quality management	4	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	3	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

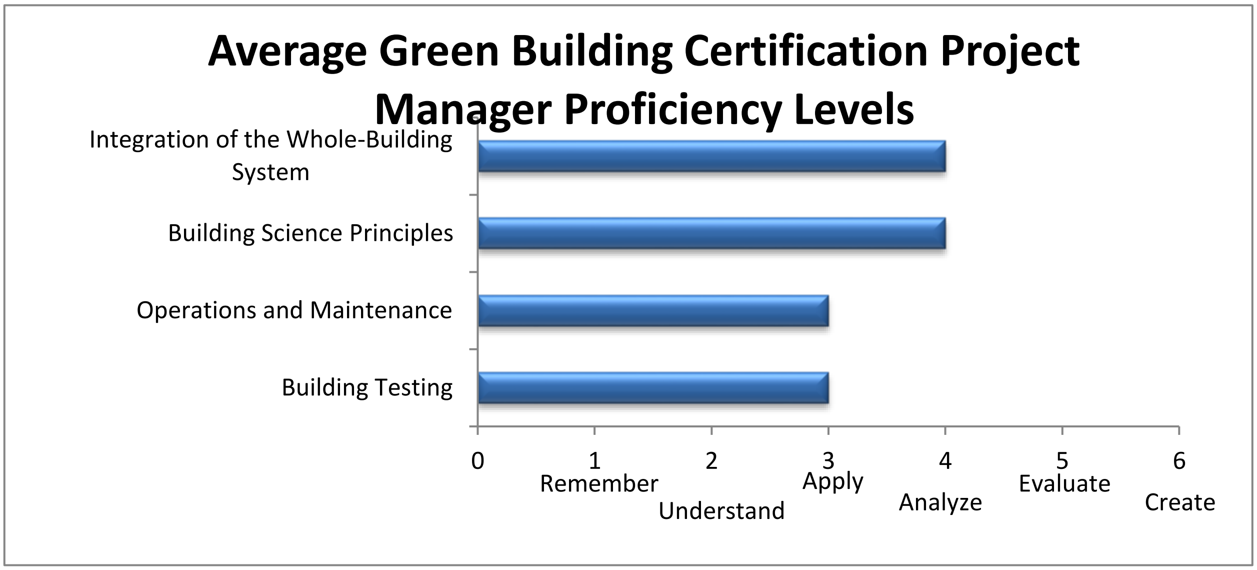
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	3	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	3	☐
Monitoring	3	☐
National codes and standards	1	☐
Certification programs	3	☐

The ______________________________ utility program manager certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Green Building Certification Professionals

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for certifying sustainable buildings, a green building certification professional should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	4	☐
Quality management	3	☐
Building energy modeling	6	☐
Cost trade-off analysis (optimized first costs)	3	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

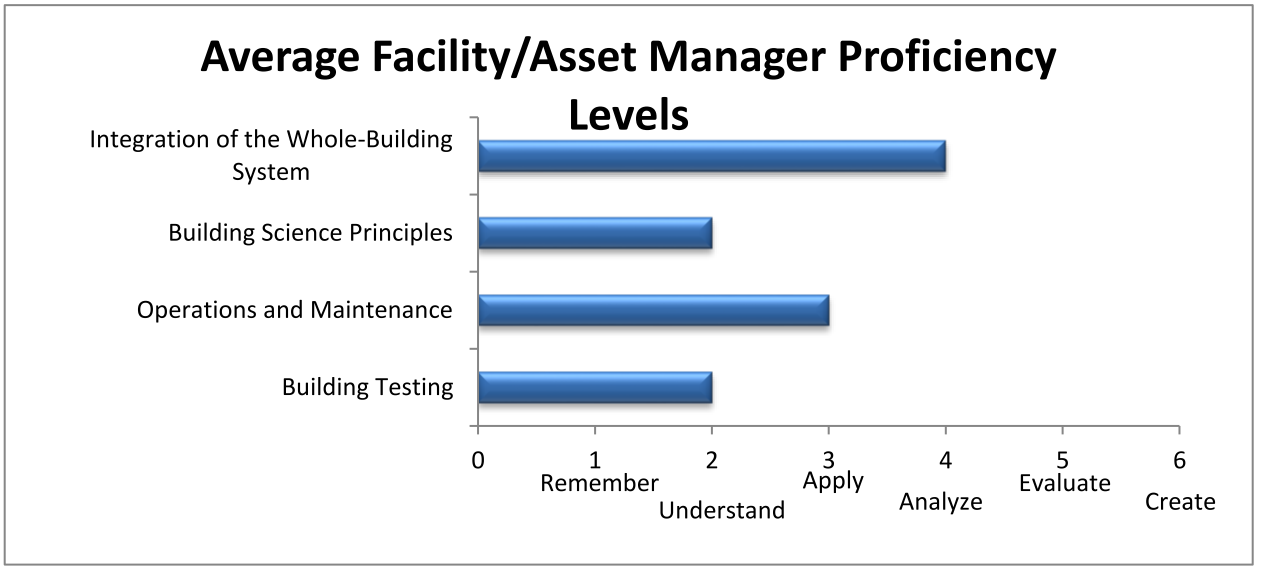
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	5	☐
Material selection (IAQ, thermal mass, moisture)	5	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	4	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	5	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 3	
Commissioning	4	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	2	☐
Certification programs	3	☐

The ______________________________ green building certification professional certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Facility/Asset Managers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing facilities, a facility/asset manager should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	3	☐
Quality management	4	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

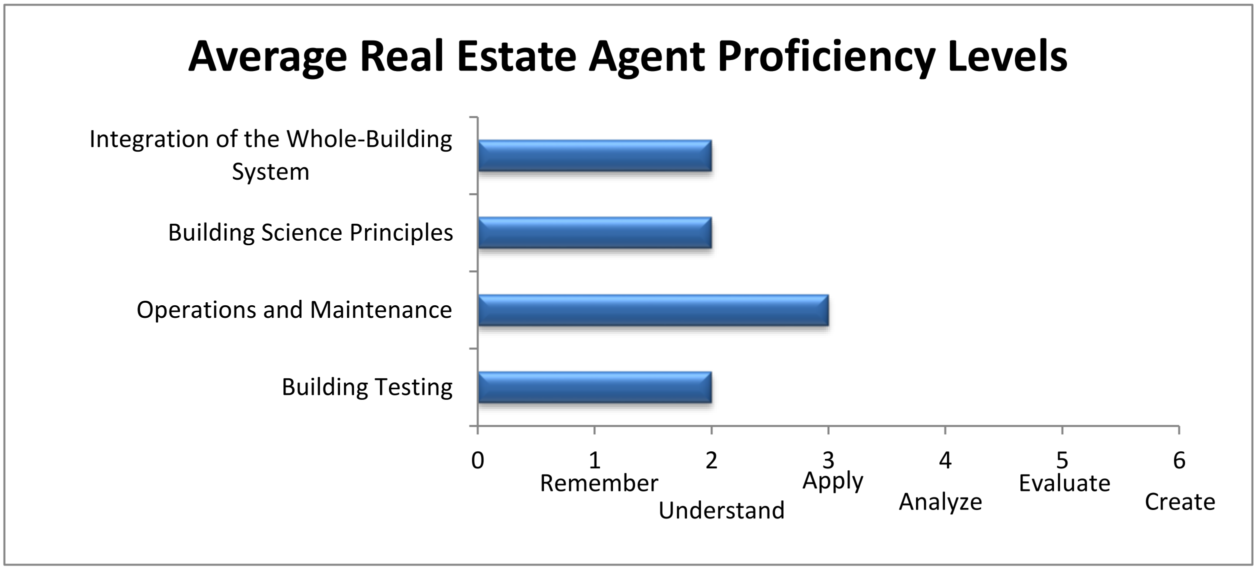
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	2	☐
Convective air transport due to pressure differences	2	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	2	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	2	☐
HVAC interactions with the enclosure	2	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	2	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 2	
Commissioning	2	☐
Diagnostics and forensics	2	☐
Monitoring	3	☐
National codes and standards	1	☐
Certification programs	2	☐

The ______________________________ facility/asset manager certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Real Estate Agents

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing the real estate transaction, a real estate agent should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 2	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	2	☐
Building techniques related to natural and man-made disasters	2	☐
Integrated design and construction	2	☐
Quality management	2	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	3	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

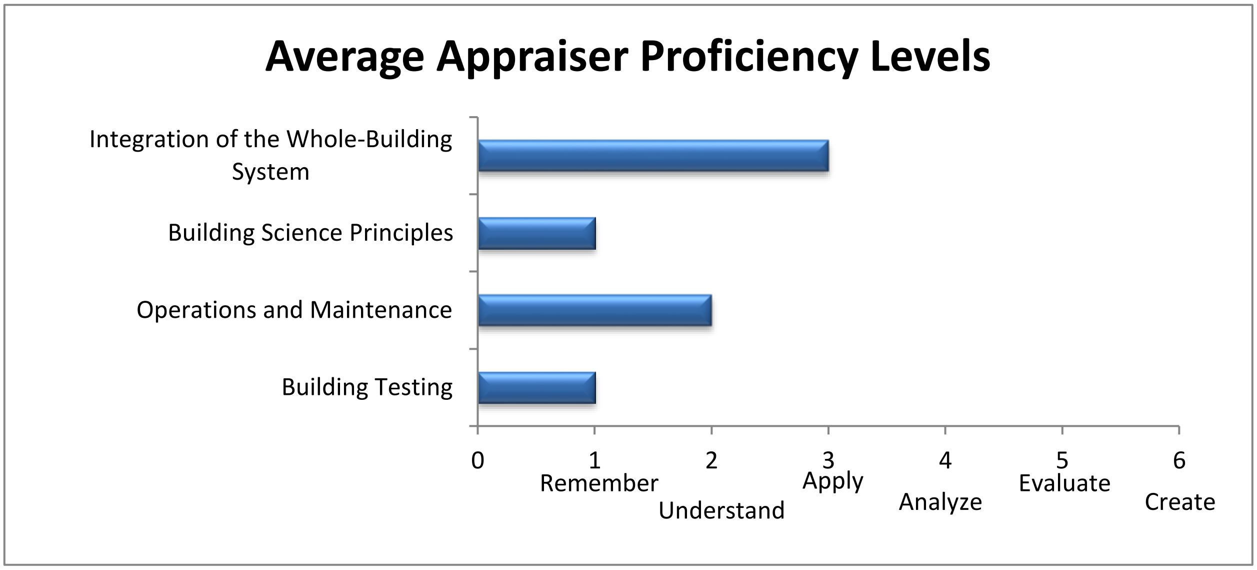
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	2	☐
Convective air transport due to pressure differences	2	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	2	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	2	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 2	
Commissioning	2	☐
Diagnostics and forensics	2	☐
Monitoring	2	☐
National codes and standards	1	☐
Certification programs	3	☐

The ______________________________ real estate agent certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Appraisers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for determining the value of a building, an appraiser should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 3	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	2	☐
Quality management	0	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

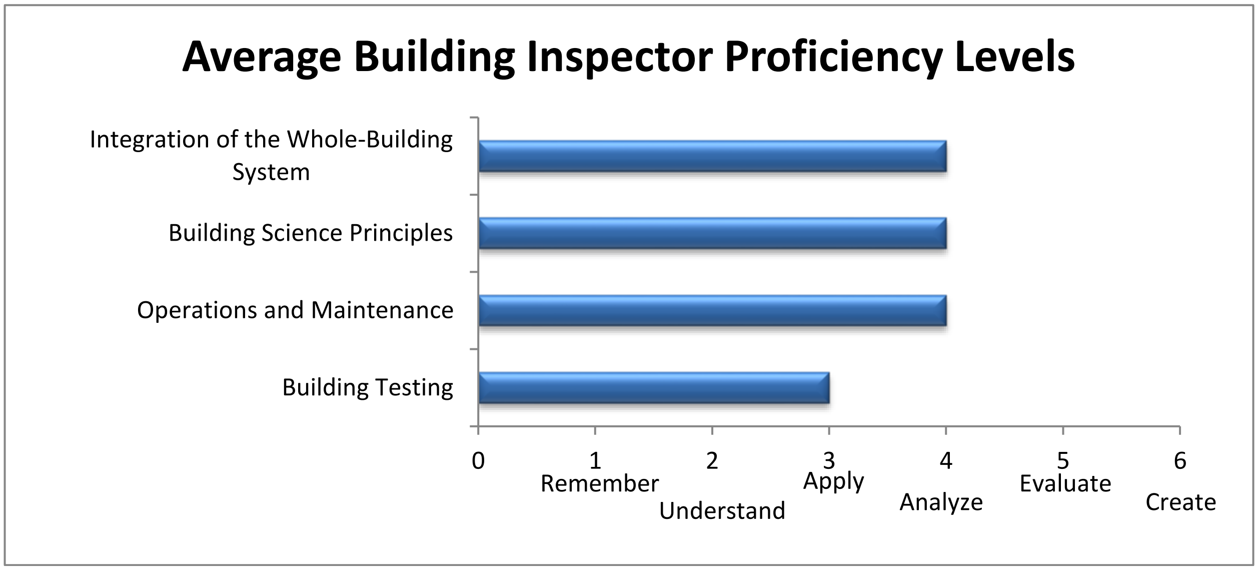
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 1	
Heat transfer (convection, conduction and radiation)	0	☐
Moisture transport of liquid	0	☐
Convective air transport due to pressure differences	0	☐
Material selection (IAQ, thermal mass, moisture)	0	☐
Controls layers (heat, vapor, water, air and solar gain)	2	☐
Hygrothermal analysis	0	☐
HVAC systems (heating, cooling and ventilation)	2	☐
HVAC interactions with the enclosure	2	☐
Fenestration considerations	0	☐
Plumbing systems (heating, distribution, conservation)	0	☐
Electrical systems	0	☐
Lighting/appliances and miscellaneous loads	1	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	2	☐
Control/automation systems	1	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	0	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 1	
Commissioning	2	☐
Diagnostics and forensics	0	☐
Monitoring	0	☐
National codes and standards	1	☐
Certification programs	2	☐

The ______________________________ appraiser certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Building Inspectors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for inspecting buildings prior to sale, a building inspector should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	3	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	3	☐
Quality management	4	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	3	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

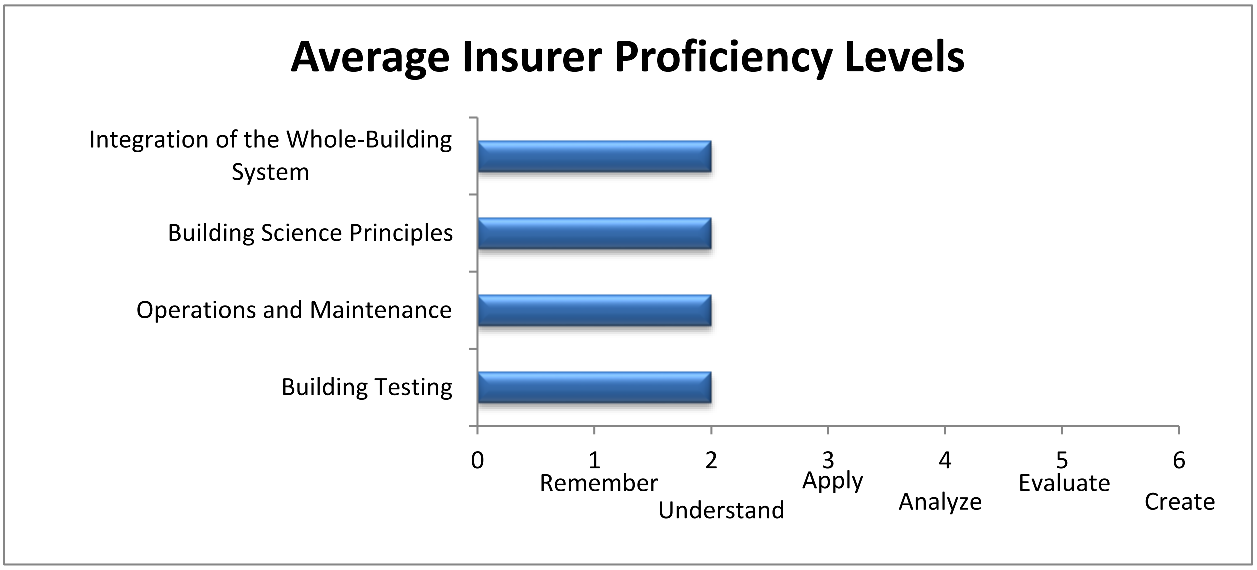
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	2	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	4	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ building inspector certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Insurers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for understanding the risk associated with a building, an insurer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 2	
Simultaneous consideration of energy, durability, comfort and IAQ	2	☐
Annualized cash flow	3	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	2	☐
Quality management	2	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	2	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

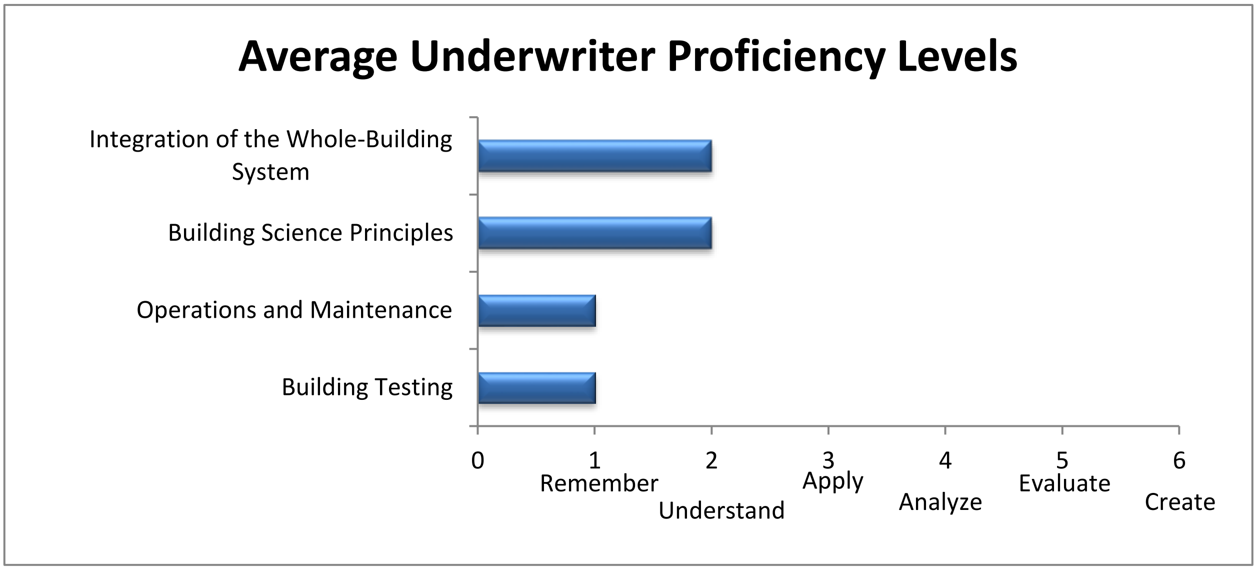
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	2	☐
Convective air transport due to pressure differences	2	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	2	☐
Hygrothermal analysis	2	☐
HVAC systems (heating, cooling and ventilation)	2	☐
HVAC interactions with the enclosure	1	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	1	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	1	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	2	☐
Building testing and certification	Average = 2	
Commissioning	2	☐
Diagnostics and forensics	3	☐
Monitoring	2	☐
National codes and standards	2	☐
Certification programs	3	☐

The ______________________________ insurer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Underwriters

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for approving loans for buildings, an underwriter should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 2	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	1	☐
Quality management	2	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	2	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

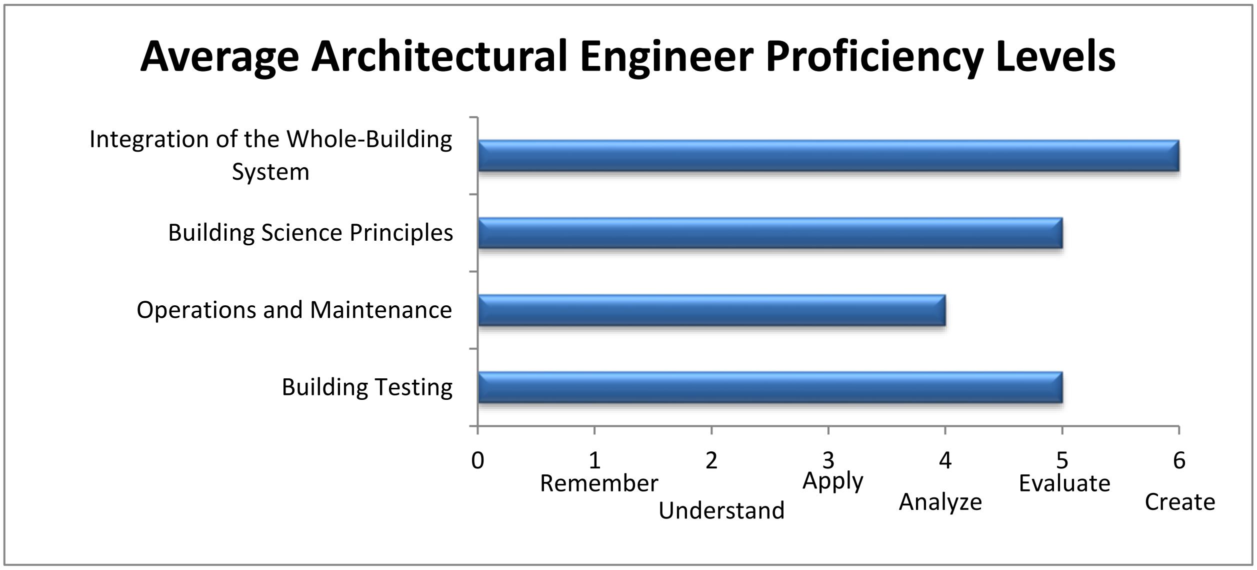
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	1	☐
Moisture transport of liquid	1	☐
Convective air transport due to pressure differences	1	☐
Material selection (IAQ, thermal mass, moisture)	2	☐
Controls layers (heat, vapor, water, air and solar gain)	1	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	2	☐
HVAC interactions with the enclosure	1	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	2	☐
Control/automation systems	2	☐
Operations and maintenance	Average = 1	
User controls (ex: thermostat)	1	☐
Preventative maintenance (ex: cleaning air filters)	1	☐
Determination of appropriate replacement choices	2	☐
Building testing and certification	Average = 1	
Commissioning	2	☐
Diagnostics and forensics	1	☐
Monitoring	1	☐
National codes and standards	1	☐
Certification programs	2	☐

The _____________________________ underwriter certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Architectural Engineers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing buildings, an architectural engineer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 6	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	6	☐
Integrated design and construction	5	☐
Quality management	5	☐
Building energy modeling	6	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

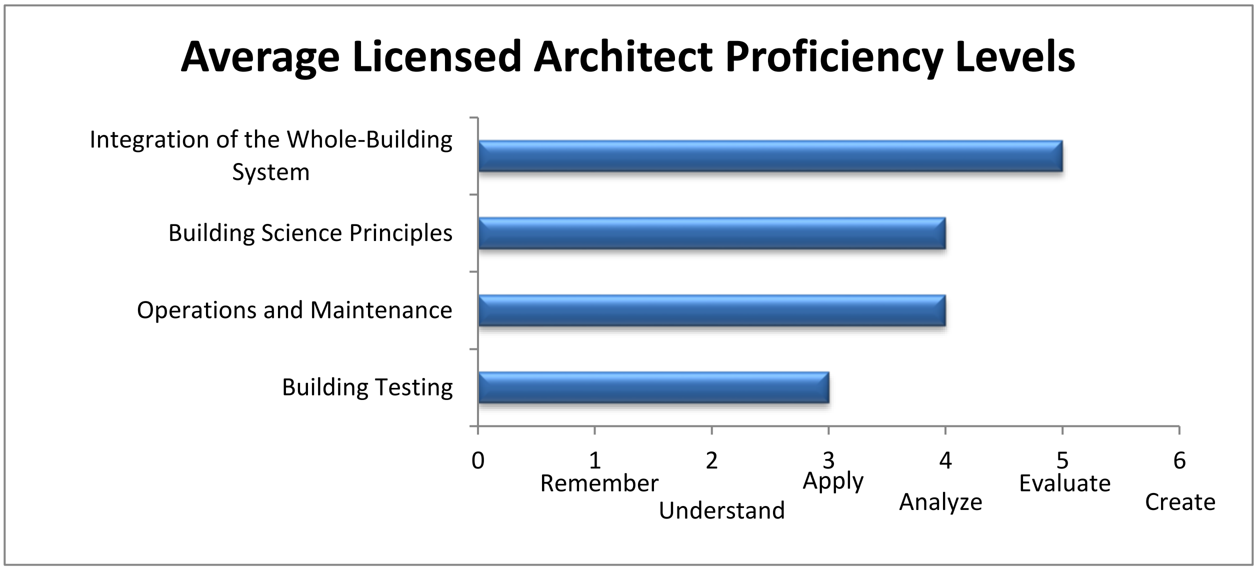
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	5	☐
Moisture transport of liquid	5	☐
Convective air transport due to pressure differences	5	☐
Material selection (IAQ, thermal mass, moisture)	5	☐
Controls layers (heat, vapor, water, air and solar gain)	6	☐
Hygrothermal analysis	6	☐
HVAC systems (heating, cooling and ventilation)	6	☐
HVAC interactions with the enclosure	5	☐
Fenestration considerations	6	☐
Plumbing systems (heating, distribution, conservation)	6	☐
Electrical systems	5	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	5	☐
Control/automation systems	5	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 5	
Commissioning	6	☐
Diagnostics and forensics	5	☐
Monitoring	6	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ architectural engineer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Licensed Architects

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing a building, a licensed architect should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	6	☐
Integrated design and construction	5	☐
Quality management	4	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

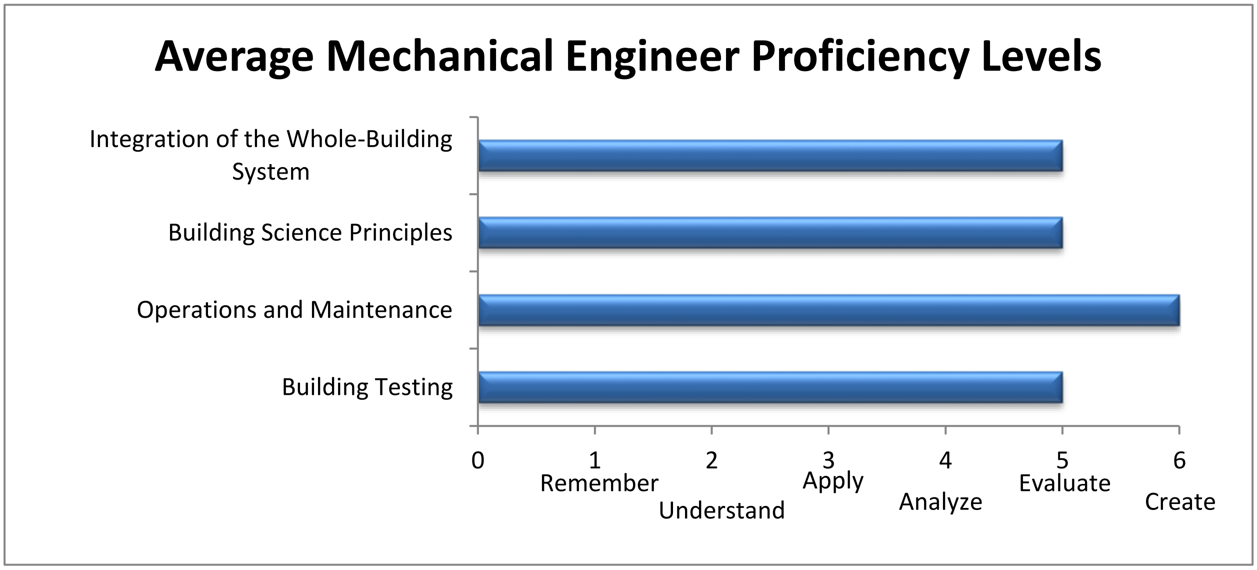
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	5	☐
Convective air transport due to pressure differences	5	☐
Material selection (IAQ, thermal mass, moisture)	5	☐
Controls layers (heat, vapor, water, air and solar gain)	6	☐
Hygrothermal analysis	5	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	5	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 3	
Commissioning	4	☐
Diagnostics and forensics	3	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ licensed architect certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Mechanical Engineers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing HVAC systems, a mechanical engineer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	4	☐
Quality management	5	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

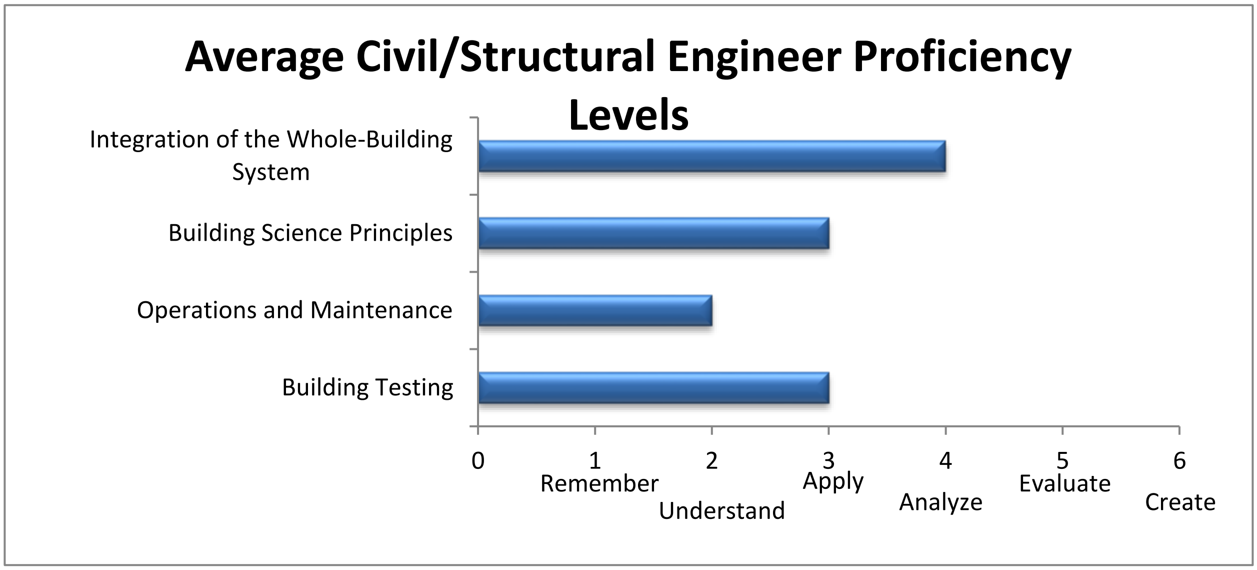
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	6	☐
Moisture transport of liquid	5	☐
Convective air transport due to pressure differences	6	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	4	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	6	☐
HVAC interactions with the enclosure	6	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	5	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	6	☐
Control/automation systems	5	☐
Operations and maintenance	Average = 6	
User controls (ex: thermostat)	6	☐
Preventative maintenance (ex: cleaning air filters)	5	☐
Determination of appropriate replacement choices	6	☐
Building testing and certification	Average = 5	
Commissioning	6	☐
Diagnostics and forensics	5	☐
Monitoring	6	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ mechanical engineer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Civil/Structural Engineers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing the structure of a building, a civil/structural engineer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	3	☐
Quality management	5	☐
Building energy modeling	4	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

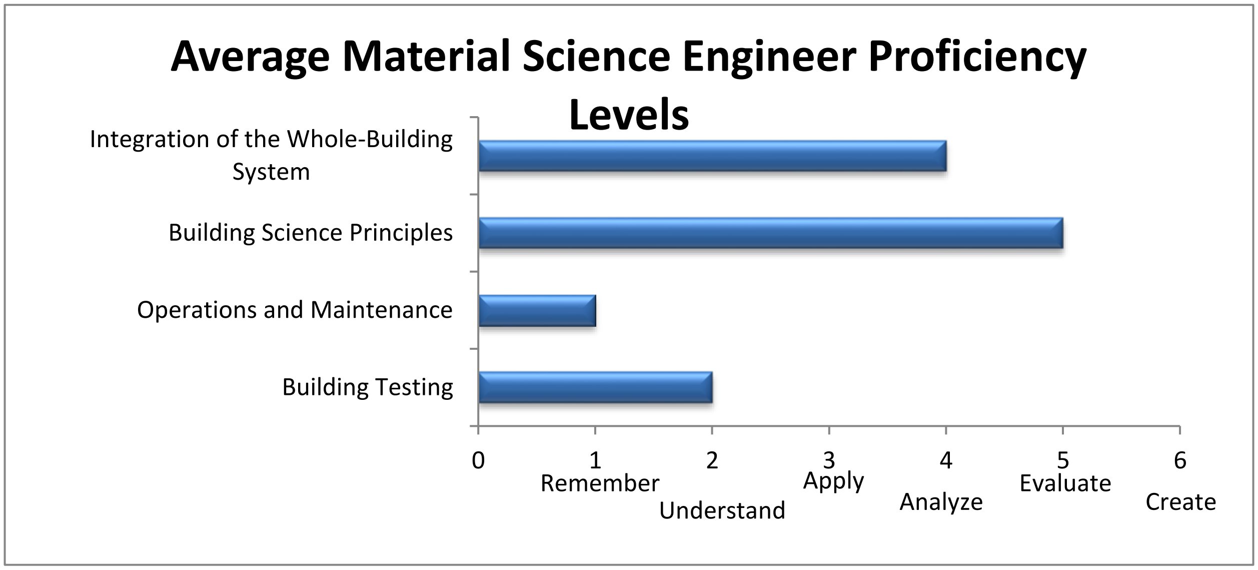
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	3	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	2	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	1	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	2	☐
Control/automation systems	1	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	1	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	3	☐
Monitoring	3	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ civil/structural engineer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Material Science Engineers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing materials that go into buildings, a material science engineer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	6	☐
Integrated design and construction	3	☐
Quality management	3	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	4	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

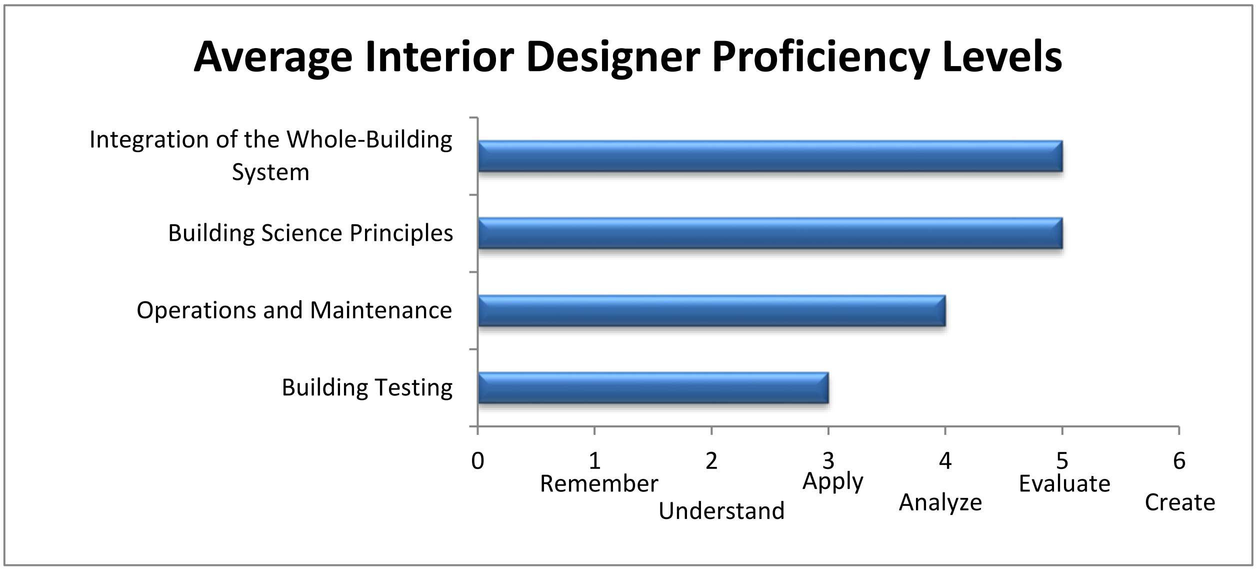
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	6	☐
Moisture transport of liquid	6	☐
Convective air transport due to pressure differences	6	☐
Material selection (IAQ, thermal mass, moisture)	6	☐
Controls layers (heat, vapor, water, air and solar gain)	6	☐
Hygrothermal analysis	6	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	5	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	4	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	1	☐
Operations and maintenance	Average = 1	
User controls (ex: thermostat)	1	☐
Preventative maintenance (ex: cleaning air filters)	1	☐
Determination of appropriate replacement choices	1	☐
Building testing and certification	Average = 2	
Commissioning	1	☐
Diagnostics and forensics	1	☐
Monitoring	1	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ material science engineer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Interior Designers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for moving furniture in a building, an interior designer should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	6	☐
Quality management	5	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

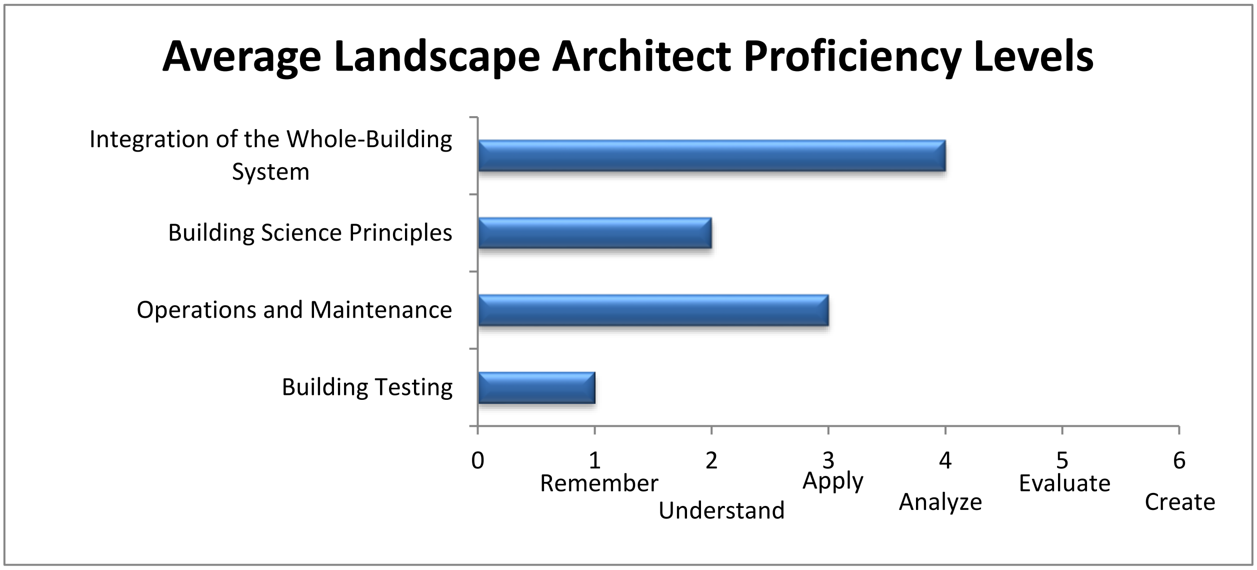
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	4	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	6	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	4	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	4	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	4	☐
Lighting/appliances and miscellaneous loads	5	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	6	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 3	
Commissioning	4	☐
Diagnostics and forensics	3	☐
Monitoring	4	☐
National codes and standards	2	☐
Certification programs	1	☐

The ______________________________ interior designer certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Landscape Architects

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for designing landscapes near buildings, a landscape architect should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 4	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	4	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	3	☐
Quality management	4	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	3	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

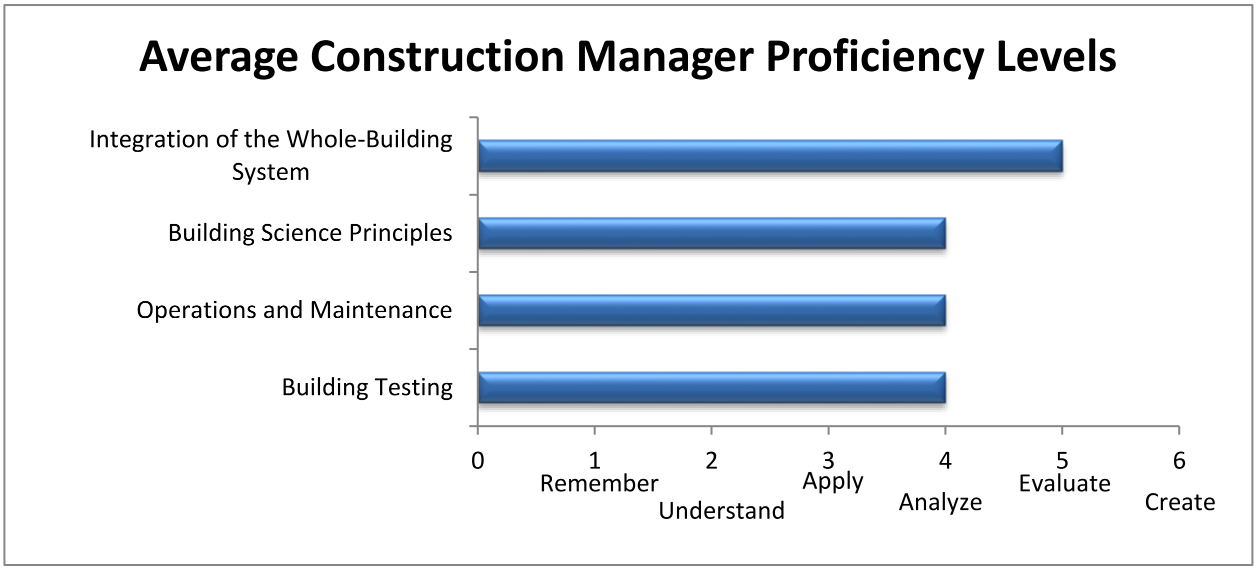
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 2	
Heat transfer (convection, conduction and radiation)	2	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	2	☐
Material selection (IAQ, thermal mass, moisture)	1	☐
Controls layers (heat, vapor, water, air and solar gain)	1	☐
Hygrothermal analysis	1	☐
HVAC systems (heating, cooling and ventilation)	1	☐
HVAC interactions with the enclosure	1	☐
Fenestration considerations	2	☐
Plumbing systems (heating, distribution, conservation)	2	☐
Electrical systems	2	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	1	☐
Control/automation systems	1	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 1	
Commissioning	1	☐
Diagnostics and forensics	2	☐
Monitoring	1	☐
National codes and standards	2	☐
Certification programs	1	☐

The ______________________________ landscape architect certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Construction Managers

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for managing construction sites, a construction manager should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	5	☐
Integrated design and construction	5	☐
Quality management	6	☐
Building energy modeling	4	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

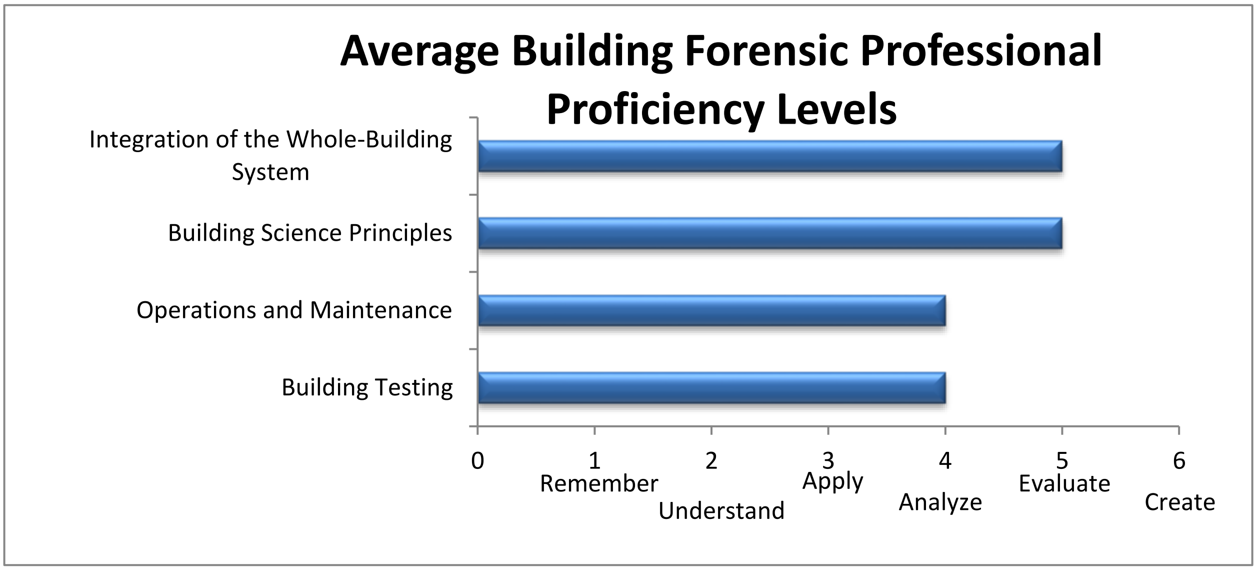
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 4	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	4	☐
Convective air transport due to pressure differences	4	☐
Material selection (IAQ, thermal mass, moisture)	4	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	4	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	2	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	5	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	3	☐

The ______________________________ construction manager certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Building Forensic Professionals

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for determining building faults, a building forensic professional should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	6	☐
Annualized cash flow	6	☐
Building techniques related to natural and man-made disasters	6	☐
Integrated design and construction	5	☐
Quality management	5	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

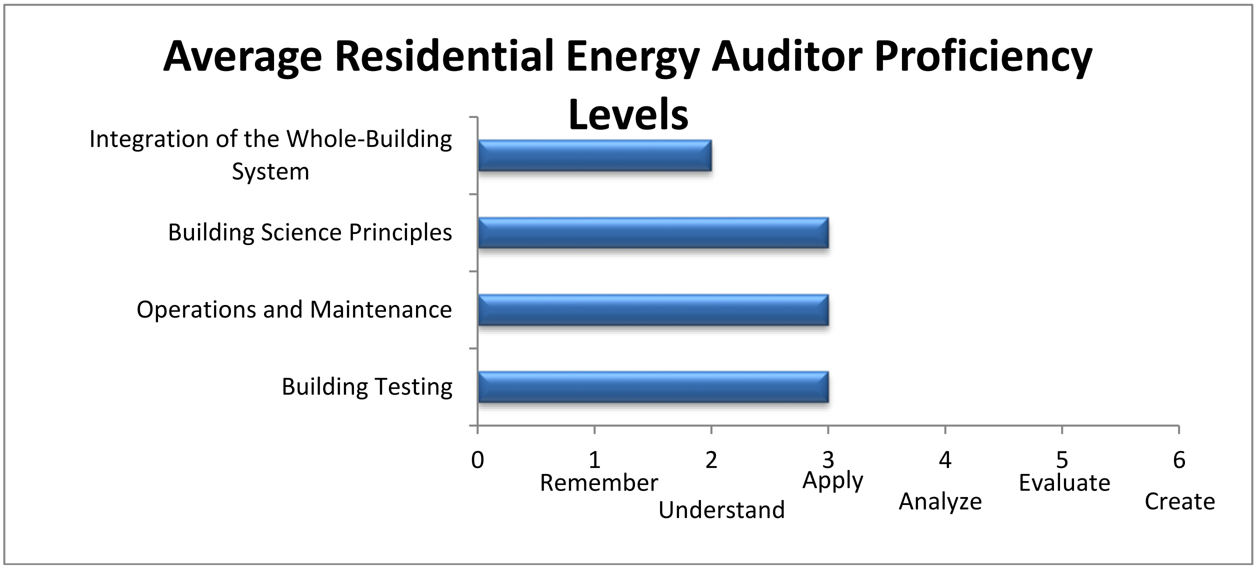
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	6	☐
Moisture transport of liquid	6	☐
Convective air transport due to pressure differences	6	☐
Material selection (IAQ, thermal mass, moisture)	5	☐
Controls layers (heat, vapor, water, air and solar gain)	6	☐
Hygrothermal analysis	6	☐
HVAC systems (heating, cooling and ventilation)	5	☐
HVAC interactions with the enclosure	6	☐
Fenestration considerations	6	☐
Plumbing systems (heating, distribution, conservation)	5	☐
Electrical systems	4	☐
Lighting/appliances and miscellaneous loads	5	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	5	☐
Control/automation systems	5	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	5	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	5	☐
Monitoring	5	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ building forensic professional certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Residential Energy Auditors

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for measuring the energy performance of a home, a residential energy auditor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 2	
Simultaneous consideration of energy, durability, comfort and IAQ	4	☐
Annualized cash flow	1	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	2	☐
Quality management	2	☐
Building energy modeling	3	☐
Cost trade-off analysis (optimized first costs)	2	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

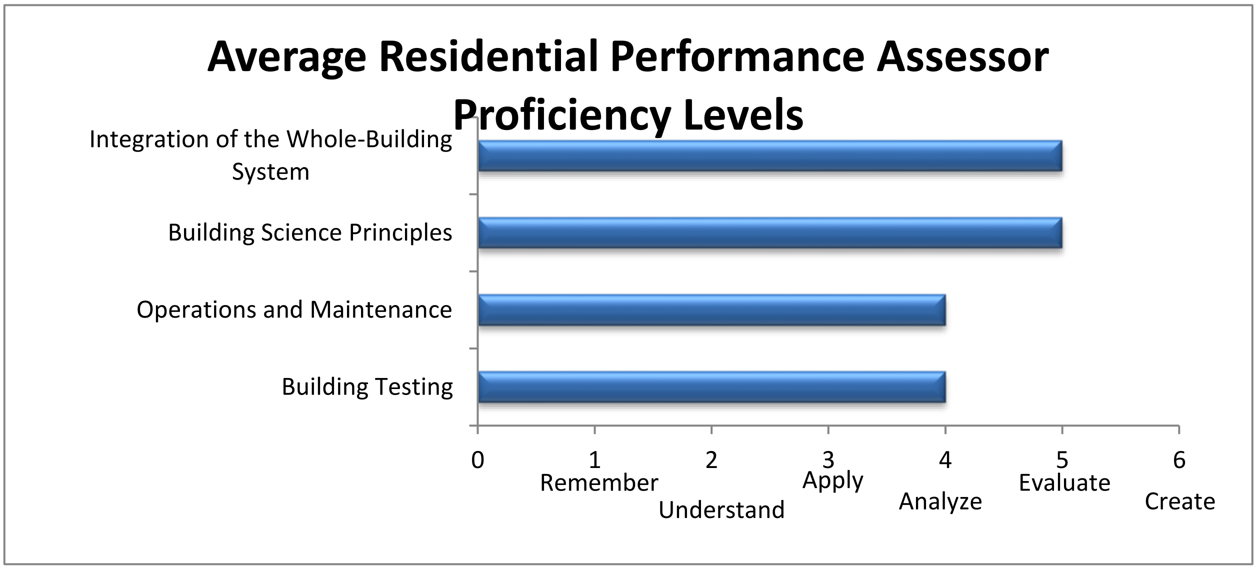
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	3	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 3	
User controls (ex: thermostat)	3	☐
Preventative maintenance (ex: cleaning air filters)	3	☐
Determination of appropriate replacement choices	3	☐
Building testing and certification	Average = 3	
Commissioning	4	☐
Diagnostics and forensics	4	☐
Monitoring	4	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ residential energy auditor certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Residential Performance Assessor

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for determining the performance level of a home, a residential performance assessor should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 5	
Simultaneous consideration of energy, durability, comfort and IAQ	5	☐
Annualized cash flow	5	☐
Building techniques related to natural and man-made disasters	4	☐
Integrated design and construction	5	☐
Quality management	5	☐
Building energy modeling	5	☐
Cost trade-off analysis (optimized first costs)	5	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

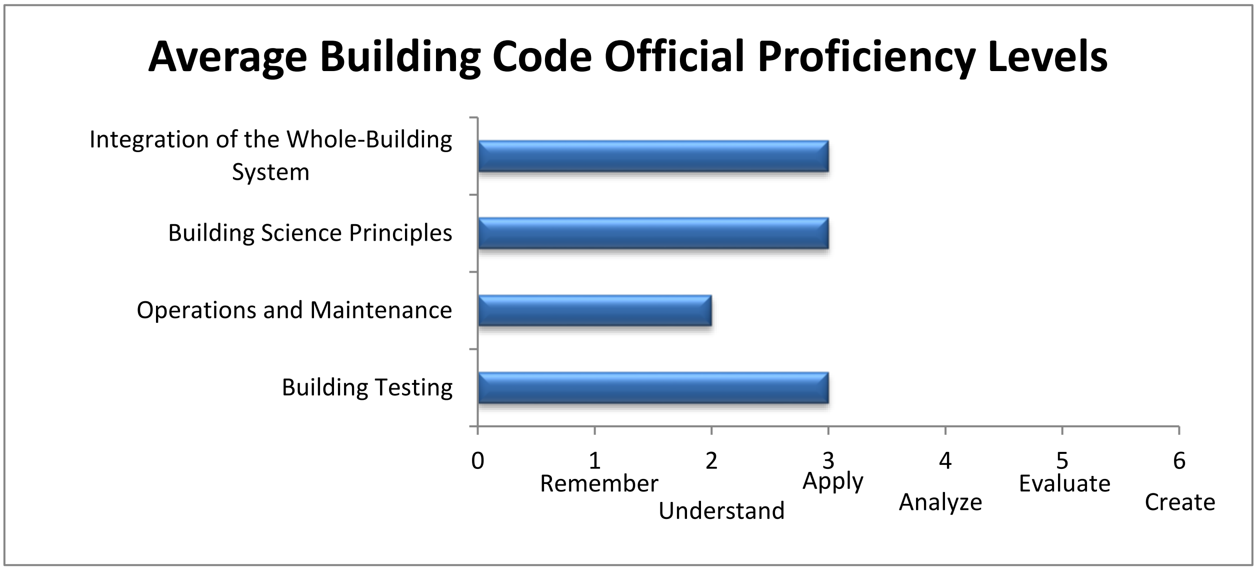
Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 5	
Heat transfer (convection, conduction and radiation)	5	☐
Moisture transport of liquid	5	☐
Convective air transport due to pressure differences	5	☐
Material selection (IAQ, thermal mass, moisture)	5	☐
Controls layers (heat, vapor, water, air and solar gain)	5	☐
Hygrothermal analysis	5	☐
HVAC systems (heating, cooling and ventilation)	4	☐
HVAC interactions with the enclosure	5	☐
Fenestration considerations	5	☐
Plumbing systems (heating, distribution, conservation)	4	☐
Electrical systems	4	☐
Lighting/appliances and miscellaneous loads	4	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	4	☐
Control/automation systems	4	☐
Operations and maintenance	Average = 4	
User controls (ex: thermostat)	4	☐
Preventative maintenance (ex: cleaning air filters)	4	☐
Determination of appropriate replacement choices	4	☐
Building testing and certification	Average = 4	
Commissioning	5	☐
Diagnostics and forensics	5	☐
Monitoring	5	☐
National codes and standards	3	☐
Certification programs	2	☐

The ______________________________ residential performance assessment certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Building Science Education Guidelines for Building Code Officials

A summary of the proficiency levels[1] for the core competencies is displayed in the graphic below. For each core competency level described in this checklist, it is assumed that the organization or student is proficient in the level described, as well as all the cognitive levels below that level.



As the entity responsible for analyzing the code compliance of a building, a building code officials should be proficient in the following categories:

Topic	Proficiency Level	Checkbox
Integration of the whole-building system	Average = 3	
Simultaneous consideration of energy, durability, comfort and IAQ	3	☐
Annualized cash flow	2	☐
Building techniques related to natural and man-made disasters	3	☐
Integrated design and construction	3	☐
Quality management	3	☐
Building energy modeling	2	☐
Cost trade-off analysis (optimized first costs)	2	☐

[1] The average level shown here is the whole number that best represents the combination of individual scores from each sub-category

Topic	Proficiency Level	Checkbox
Building science principles related to the enclosure	Average = 3	
Heat transfer (convection, conduction and radiation)	3	☐
Moisture transport of liquid	3	☐
Convective air transport due to pressure differences	3	☐
Material selection (IAQ, thermal mass, moisture)	3	☐
Controls layers (heat, vapor, water, air and solar gain)	3	☐
Hygrothermal analysis	3	☐
HVAC systems (heating, cooling and ventilation)	3	☐
HVAC interactions with the enclosure	3	☐
Fenestration considerations	3	☐
Plumbing systems (heating, distribution, conservation)	3	☐
Electrical systems	3	☐
Lighting/appliances and miscellaneous loads	3	☐
Indoor environmental quality (temperature uniformity and indoor pollutants)	3	☐
Control/automation systems	3	☐
Operations and maintenance	Average = 2	
User controls (ex: thermostat)	2	☐
Preventative maintenance (ex: cleaning air filters)	2	☐
Determination of appropriate replacement choices	2	☐
Building testing and certification	Average = 3	
Commissioning	3	☐
Diagnostics and forensics	2	☐
Monitoring	2	☐
National codes and standards	4	☐
Certification programs	2	☐

The ______________________________ building code official certification body has incorporated all of the relevant information in the above checklist into their training materials.

Signature ____

Appendix B

Final Building Science Education Matrix

Appendix B

Final Building Science Education Matrix

Building Science Education Matrix v15

JOB CLASSIFICATIONS	Average High School Education Proficiency Levels	Average Owner	Average Builders/Remodelers Proficiency Levels	Average Builder/General Contractor (Owner) Proficiency Levels	Average Builder/General Contractor (Foreman) Proficiency Levels	Average Remodeler (Owner) Proficiency Levels	Average Remodeler (Foreman) Proficiency Levels	Average Insulation Contractor Proficiency Levels	Average HVAC/Mechanical Contractor Proficiency Levels	Average Enclosure Service Contractor Proficiency Levels	Average Plumber Proficiency Levels	Average Home Performance Contractor Proficiency Levels
1. Integration of the Whole-Building System												
a. Simutaneous consideration of energy, durability, comfort, IAQ		1		4	5	4	5	5	5	5	4	4
b. Life cycle cost-effectiveness analysis		2		5	5	5	5	4	4	4	4	4
c. Disaster resistance/resiliency		2		3	4	3	4	4	2	5	3	4
d. Integrated design and construction		2		4	5	4	4	3	4	4	3	4
e. Quality management		2		5	6	5	6	6	6	6	6	5
f. Building and energy modeling		2		2	3	2	3	3	4	3	2	4
g. Cost trade-off analysis		2		4	5	4	5	4	4	4	4	5
2. Building Science Principles												
a. Heat transfer (conduction, radiation, convection)		1		2	3	2	3	5	4	4	2	4
b. Moisture transport (liquid, vapor, psychrometrics)		1		3	4	3	4	4	4	4	2	4
c. Convective mass (air) transport (pressure/flow)		1		3	4	3	4	4	4	3	3	4
d. Material selection (IAQ, thermal mass, moisture)		1		2	3	2	3	4	2	4	2	4
e. Control layers (water, air, vapor, thermal, solar)		1		4	5	4	5	5	4	5	2	4
f. Hygrothermal analysis		1		2	3	2	3	4	2	3	2	4
g. HVAC Systems (heating, cooling, ventilation, dehumidification)		2		3	4	3	4	3	5	3	3	4
h. HVAC interactions with enclosure		2		3	4	3	4	3	5	3	3	4
i. Fenestration		2		2	3	2	3	3	4	4	2	4
j. Plumbing systems (heating, distribution, conservation)		2		3	4	3	4	2	3	3	5	4
k. Electrical systems		2		2	2	2	3	2	3	3	2	3
l. Lighting, appliances & misc. loads		2		2	3	2	3	2	3	2	3	4
m. Control/Automation systems		2		3	4	3	4	2	5	3	2	4
n. Indoor environmental quality (thermal comfort, health, safety)		2		3	4	3	4	4	5	3	3	4
3. Operations and Maintenance												
a. User interface and controls		3		3	4	3	4	2	5	3	2	4
b. Preventative maintenance		3		2	3	2	3	2	4	4	3	4
c. Replacement & renovation		2		3	4	4	5	3	5	5	4	5
4. Building Testing												
a. Commissioning		1		3	4	3	4	4	5	5	3	5
b. Diagnostics & forensics		1		3	4	3	4	4	5	4	4	5
c. Performance monitoring/assessment		2		3	4	3	3	4	5	4	2	5
d. National codes and standards		1		3	3	3	4	3	3	3	3	3
e. Certification programs		1		3	3	3	3	2	2	2	2	2

JOB CLASSIFICATIONS	3. Average Program and Project Manager Proficiency Levels	Average Utility Program Manager Proficiency Levels	Average Green Building Certification Professional Proficiency Levels	Building Operations Professional Proficiency Levels	Building Operations Journey-worker Proficiency Levels	Average Facility/Asset Manager Proficiency Levels	4. Transaction Process	Average Real Estate Agent Proficiency Levels	Average Appraiser Proficiency Levels	Average Building Inspector Proficiency Levels	Average Insurer Proficiency Levels	Average Underwriter Proficiency Levels
1. Integration of the Whole-Building System												
a. Simutaneous consideration of energy, durability, comfort, IAQ		3	5			3		3	3	5	2	3
b. Life cycle cost-effectiveness analysis		2	5			5		2	4	3	3	4
c. Disaster resistance/resiliency		3	4			3		2	3	4	4	3
d. Integrated design and construction		2	4			3		2	2	3	2	1
e. Quality management		4	3			4		2	0	4	2	2
f. Building and energy modeling		3	6			3		2	2	3	2	2
g. Cost trade-off analysis		3	3			5		3	4	3	2	2
2. Building Science Principles												
a. Heat transfer (conduction, radiation, convection)		3	4	Refer to Better Buildings Workforce Guidelines	Refer to Better Buildings Workforce Guidelines	2		2	0	4	2	1
b. Moisture transport (liquid, vapor, psychrometrics)		3	4			2		2	0	4	2	1
c. Convective mass (air) transport (pressure/flow)		3	5			2		2	0	4	2	1
d. Material selection (IAQ, thermal mass, moisture)		3	5			2		3	0	4	2	2
e. Control layers (water, air, vapor, thermal, solar)		3	5			2		2	2	4	2	1
f. Hygrothermal analysis		1	4			1		1	0	2	2	1
g. HVAC Systems (heating, cooling, ventilation, dehumidification)		4	4			2		3	2	4	2	2
h. HVAC interactions with enclosure		3	4			2		2	2	4	1	1
i. Fenestration		3	5			2		2	0	4	3	2
j. Plumbing systems (heating, distribution, conservation)		3	4			2		2	0	4	2	2
k. Electrical systems		3	2			2		2	0	4	2	2
l. Lighting, appliances & misc. loads		4	4			4		3	1	3	2	2
m. Control/Automation systems		3	3			4		2	1	2	2	2
n. Indoor environmental quality (thermal comfort, health, safety)		4	5			2		3	2	4	1	2
3. Operations and Maintenance												
a. User interface and controls		2	3			2		3	2	4	1	1
b. Preventative maintenance		2	3			2		3	0	3	2	1
c. Replacement & renovation		3	3			4		3	3	4	2	2
4. Building Testing												
a. Commissioning		3	4			2		2	2	3	2	2
b. Diagnostics & forensics		3	4			2		2	0	4	3	1
c. Performance monitoring/assessment		3	4			3		2	0	4	2	1
d. National codes and standards		1	2			1		1	1	3	2	1
e. Certification programs		3	3			2		3	2	2	3	2

JOB CLASSIFICATIONS	5. Design and Construction Professionals	Average Architectural Engineer Proficiency Levels	Average Licensed Architect Proficiency Levels	Average Mechanical Engineer Proficiency Levels	Average Electrical Engineer Proficiency Levels	Average Lighting Designer Proficiency Levels	Average Civil/Structural Engineer Proficiency Levels	Average Material Science Engineer Proficiency Levels	Average Interior Designer Proficiency Levels	Average Building Landscape Architect Proficiency Levels	Average Construction Manager Proficiency Levels
1. Integration of the Whole-Building System											
a. Simutaneous consideration of energy, durability, comfort, IAQ		6	6	6	6	6	5	6	6	4	6
b. Life cycle cost-effectiveness analysis		6	6	6	6	5	5	6	5	4	6
c. Disaster resistance/resiliency		6	6	5	5	5	5	6	5	4	5
d. Integrated design and construction		5	5	4	4	4	3	3	6	3	5
e. Quality management		5	4	5	5	5	5	3	5	4	6
f. Building and energy modeling		6	5	5	3	3	4	3	5	3	4
g. Cost trade-off analysis		5	5	4	4	4	4	4	5	3	5
2. Building Science Principles											
a. Heat transfer (conduction, radiation, convection)		5	4	6	3	3	3	6	4	2	3
b. Moisture transport (liquid, vapor, psychrometrics)		5	5	5	2	2	4	6	4	3	4
c. Convective mass (air) transport (pressure/flow)		5	5	6	3	3	3	6	4	2	4
d. Material selection (IAQ, thermal mass, moisture)		5	5	4	3	4	3	6	6	1	4
e. Control layers (water, air, vapor, thermal, solar)		6	6	4	2	3	3	6	5	1	5
f. Hygrothermal analysis		6	5	3	2	2	3	6	4	1	3
g. HVAC Systems (heating, cooling, ventilation, dehumidification)		6	4	6	3	2	3	4	4	1	4
h. HVAC interactions with enclosure		5	4	6	3	2	2	5	4	1	3
i. Fenestration		6	5	5	4	5	4	4	5	2	4
j. Plumbing systems (heating, distribution, conservation)		6	3	5	3	2	3	4	4	2	3
k. Electrical systems		5	3	3	6	5	3	4	4	2	3
l. Lighting, appliances & misc. loads		4	5	4	6	6	1	2	5	3	2
m. Control/Automation systems		5	4	5	5	6	1	1	4	1	3
n. Indoor environmental quality (thermal comfort, health, safety)		5	4	6	3	3	2	4	6	1	4
3. Operations and Maintenance											
a. User interface and controls		3	4	6	6	6	1	1	4	2	5
b. Preventative maintenance		4	4	5	5	3	2	1	4	3	4
c. Replacement & renovation		5	5	6	6	5	4	1	5	3	4
4. Building Testing											
a. Commissioning		6	4	6	5	5	3	1	4	1	5
b. Diagnostics & forensics		5	3	5	5	4	3	1	3	2	4
c. Performance monitoring/assessment		6	4	6	6	4	3	1	4	1	4
d. National codes and standards		3	3	3	3	2	3	3	2	2	3
e. Certification programs		3	3	3	3	3	3	3	1	1	3

JOB CLASSIFICATIONS	6. Building Science Professionals	Average Building Forensic Professional Proficiency Levels	Building Commissioning Professional Proficiency Levels	7. Energy Professionals	Commercial Building Energy Auditor Proficiency	Average Residential Energy Auditor Proficiency Levels	Average Residential Performance Assessor Proficiency Levels	Commercial Building Energy Manager	8. Building Inspectors	Average Building Code Official Proficiency Levels
1. Integration of the Whole-Building System										
a. Simutaneous consideration of energy, durability, comfort, IAQ		6				4	5			3
b. Life cycle cost-effectiveness analysis		6				1	5			2
c. Disaster resistance/resiliency		6				3	4			3
d. Integrated design and construction		5				2	5			3
e. Quality management		5				2	5			3
f. Building and energy modeling		5				3	5			2
g. Cost trade-off analysis		5				2	5			2
2. Building Science Principles										
a. Heat transfer (conduction, radiation, convection)		6	Refer to Better Buildings Workforce Guidelines		Refer to Better Buildings Workforce Guidelines	3	5	Refer to Better Buildings Workforce Guidelines		3
b. Moisture transport (liquid, vapor, psychrometrics)		6				3	5			3
c. Convective mass (air) transport (pressure/flow)		6				3	5			3
d. Material selection (IAQ, thermal mass, moisture)		5				3	5			3
e. Control layers (water, air, vapor, thermal, solar)		6				3	5			3
f. Hygrothermal analysis		6				3	5			3
g. HVAC Systems (heating, cooling, ventilation, dehumidification)		5				3	4			3
h. HVAC interactions with enclosure		6				3	5			3
i. Fenestration		6				3	5			3
j. Plumbing systems (heating, distribution, conservation)		5				3	4			3
k. Electrical systems		4				3	4			3
l. Lighting, appliances & misc. loads		5				3	4			3
m. Control/Automation systems		5				3	4			3
n. Indoor environmental quality (thermal comfort, health, safety)		5				3	4			3
3. Operations and Maintenance										
a. User interface and controls		4				3	4			2
b. Preventative maintenance		4				3	4			2
c. Replacement & renovation		5				3	4			2
4. Building Testing										
a. Commissioning		5				4	5			3
b. Diagnostics & forensics		5				4	5			2
c. Performance monitoring/assessment		5				4	5			2
d. National codes and standards		3				3	3			4
e. Certification programs		2				2	2			2

Appendix C

Attendee List from Building Science Education Summit, November 7, 2012

Appendix C

Attendee List from Building Science Education Summit, November 7, 2012

Host: Sam Rashkin, Chief Architect, DOE
Facilitator: Sarah Mabbitt, Facilitator, Energetics Incorporated

First	Last	Organization
Building Science Educators		
Ben	Bigelow	Texas A&M University
Tony	Grahme	Univ. of Georgia
Patrick	Huelman	Univ. of Minnesota
Joe	Laquatra	Cornell University
Arn	Mcintyre	Ferris State University
Robert	Reed	Univ. of Missouri
Georg	Reichard	Virginia Tech
Bill	Rose	Univ. of Illinois at Urbana-Champaign
Mike	Mazor	Michigan State University
Building Science Researchers		
Michael	Baechler	PNNL
Pam	Cole	PNNL
Tom	Kenney	NAHB Research Center
Janet	McIlvaine	FSEC
Cheryn	Metzger	NREL
Stacy	Rothgeb	NREL
Building Science Organizations/Product Manufacturers		
Keith	Aldridge	Advanced Energy Corp.
James	Brew	Rocky Mountain Institute
Amy	Fazio	ACI
Jessica	Hunter	Rocky Mountain Institute
Alexis	Karolides	Rocky Mountain Institute
Brian	Lieburn	DOW Building Solutions
Chris	Little	BASF
Sydney	Roberts	Southface
Craig	Savage	Building Media, Inc.
Karen	Thull	EEBA
Paul	Totten	NIBS/BETEC/Catholic University of America
Linda	Wigington	ACI
Government Programs Promoting Building Science		
Elizabeth	Cocke	HUD
Eric	Werling	DOE
Housing Industry Leaders		
CR	Herro	Meritage Homes

First	Last	Organization
John	Sader	Sader Power Enterprises
Building Science Advocates		
Rose	Grant	State Farm Insurance
Sam	Taylor	Sam Taylor

Appendix D

Attendee List for Stakeholder Meeting in Conjunction with EEBA, September 24, 2013

Appendix D

Attendee List for Stakeholder Meeting in Conjunction with EEBA, September 24, 2013

Host and Facilitator: Sam Rashkin, U.S. Department of Energy

First	Last	Organization
Sandy	Adomatis	Adomatis Appraisal Services
Lois	Arena	Steven Winter Associates
Michael	Baechler	Pacific Northwest National Laboratories
Aaron	Baugh	Rinnai Corporation
Matt	Belcher	Midwest Energy Efficiency Research Consortium
Loraine	Bittles	LP Building Products
Robert	Broad	Pulte Group
Greg	Cobb	Sonoran
Glenn	Cottrell	IBACOS
Walter	Cuculic	Solar City
Mick	Dalrymple	Arizona State University- Global Institute of Sustainability
Laura	Dwyer	DuPont
Amanda	Evans	Santa Fe Community College, New Mexico Energy$mart Academy Center of Excellence for Green Building and Energy Efficiency
Jeff	Farlow	Pentair
Charlise	Goodbread	BASF
Francois	Gratton	Beazer Homes -Phoenix Division
C.R.	Herro	Meritage Homes
Pat	Huelman	University of Minnesota
Stacy	Hunt	Confluence Communications
Alexis	Karolides	Rocky Mountain Institute
Matt	Keeler	Advanced Energy
Dr. Sanjeev	Khanna	University of Missouri-Midwest Energy Efficiency Center
Brian	Lieburn	DOW
Chris	Little	BASF
Corbett	Lunsford	Green Dream Group
Dave	Mallay	Home Innovation Research Labs
Eric	Martin	FSEC
Carla	Maxwell	Affordable Comfort, Inc.
Cheryn	Metzger	NREL
Martin	Pecholcs	Bayer Material Science
Sam	Rashkin	U.S. Department of Energy
Robert	Reed	Midwest Energy Efficiency Research Consortium (MEERC)

First	Last	Organization
Georg	Richard	Virginia Polytechnic Institute and State University: Myers-Lawson School of Construction
Chad	Riedy	NAHB
Jon	Sader	Sader Power Enterprises
Craig	Savage	BMI
Craig	Schiller	RMI
Brent	Stephens	Illinois Institute of Technology
Sam	Taylor	Energy and Resource Efficiency
Gale	Tedhams	Owens Corning
Melissa	Wahl	Cobblestone Homes
Theresa	Weston	DuPont Building Innovations
Dan	Wildenhaus	Fluid MS

Appendix E

Attendee List for Review Meeting in Conjunction with EEBA, September 22, 2014

Appendix E

Attendee List for Review Meeting in Conjunction with EEBA, September 22, 2014

Host and Facilitator: Sam Rashkin, U.S. Department of Energy

First	Last	Organization
Stacy	Hunt	Confluence Communications
Duncan	Prahl	IBACOS
Eric	Werling	DOE
Ray	Martinez	Appraisal Institute
David	Fransik	Sierra Homes
Mike	Collignan	Green Builder Coalition
Christine	Barbour	Newport Partners, LLC
Pat	Huelman	University of Minnesota
Joe	Nebbia	Newport Partners, LLC
Laureen	Blissard	Green Builder Coalition
Gary	Klein	Gary Klein Associates
Jim	Urtz	LIUNA Training and Education Fund
Janet	McIlvaine	FSEC
Cheryn	Metzger	PNNL
Sharon Patterson	Grant	EcoEdge
Jim	Williamson	Steven Winter Associates

Appendix F

Organizations Working in the Area of Workforce and/or Building Science Education Guidelines

Appendix F

Organizations Working in the Area of Workforce and/or Building Science Education Guidelines

Organization
Joint Committee on Building Science Education
NIBS BETEC Education Committee
Society of Building Science Educators

Pacific Northwest
NATIONAL LABORATORY

U.S. DEPARTMENT OF
ENERGY

Proudly Operated by Battelle *Since 1965*

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
1-888-375-PNNL (7665)

www.pnnl.gov