

# Green Building Infusion Unit

**GBIU 36 weeks**

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- *Proposed Green/Sustainability Knowledge and Skill Statements*. National Career Technical Education Foundation. 2012.

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## Introduction

The Green Building Infusion Unit was designed for use by teachers to help students achieve specific, validated tasks/competencies within additional Architecture and Construction courses. The instructional framework consists of each task/competency accompanied by a definition.

- Cluster, pathway, and occupation information, as updated in the APG and CPG, will appear here.

**Template material omitted:** A general description of the elements of a course framework and links to generally applicable Web resources appear here.

## Course Description

**Suggested Grade Level:** 9 or 10 or 11 or 12

This document was developed to encourage teachers to infuse instructional units on green building knowledge and skills into existing courses, where appropriate. This is not a stand-alone course, and, therefore, bears no official course code.

## Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted

- Tasks marked with an asterisk (\*) are sensitive.

Task Number	GBIU	Tasks/Competencies
Introducing Sustainability		
001	<input type="radio"/>	Describe the scientific research regarding climate change.
002	<input type="radio"/>	Explore the human impact on the environment.
003	<input type="radio"/>	Define key terms related to sustainability.
004	<input type="radio"/>	Explain the relationship among green, green jobs, sustainability, and sustainable development.
005	<input type="radio"/>	Explain the core concepts of sustainability and green efforts/initiatives.
006	<input type="radio"/>	Define <i>precautionary principle</i> .
007	<input type="radio"/>	Define <i>ecosystem services</i> .
008	<input type="radio"/>	Define <i>ecological footprint</i> .
009	<input type="radio"/>	Define <i>tragedy of the commons</i> .
010	<input type="radio"/>	Define <i>systems thinking</i> .
011	<input type="radio"/>	Define <i>unintended consequences</i> .
012	<input type="radio"/>	Define <i>quality-of-life indicators</i> .
013	<input type="radio"/>	Evaluate an industry practice using the three principles of sustainability (i.e., triple bottom line).
Examining Green Building in Architecture and Construction		
014	<input type="radio"/>	Describe the overarching significance of the building industry in humankind's global "footprint."
015	<input type="radio"/>	Describe the integrated design process (cradle-to-cradle) to accomplish green and sustainable outcomes.
016	<input type="radio"/>	Explain the "cradle-to-cradle" approach in comparison to "cradle-to-grave" life cycles of common household products.

017	<input type="radio"/>	Design a new product from existing products using the cradle-to-cradle approach.
018	<input type="radio"/>	Examine the effects on environmental and societal conditions throughout the life cycle of a building.
019	<input type="radio"/>	Evaluate the benefits and costs of a green and sustainable application in design, construction, and maintenance of the built environment.
020	<input type="radio"/>	Identify methods, materials, and techniques that are consistent with green building and sustainable design.
021	<input type="radio"/>	Describe an energy audit for a facility.
022	<input type="radio"/>	Evaluate options to reduce energy consumption.
023	<input type="radio"/>	Evaluate the regional and global effects of green and sustainable building design and construction.
024	<input type="radio"/>	Communicate the value of green and sustainable practices in a presentation.
025	<input type="radio"/>	Identify the standards, regulations, and codes intended to create a more green and sustainable built environment.
Exploring Design/Pre-Construction Principles		
026	<input type="radio"/>	Identify appropriate members of an integrated design team, based on a given project.
027	<input type="radio"/>	Consult expert sources in the design of green and sustainable building.
028	<input type="radio"/>	Use patterns, systems, and flows of land, materials, energy, and natural resources in the design of green, sustainable building projects.
029	<input type="radio"/>	Describe the growing significance of “embodied” energy (and water) in the total environmental impact of the building industry.
030	<input type="radio"/>	Explain how site selection and design for the facility site and landscape can improve the impact of the built environment on the green environment.
031	<input type="radio"/>	Describe how a site’s selection can mitigate greenhouse gas emissions by governing necessary travel to and from the facility.
032	<input type="radio"/>	Explain how redeveloping a brownfield site can represent a positive step for the community.

033	<input type="radio"/>	Explain how choosing sites in already developed areas can save time and money and reduce negative impacts on the site.
034	<input type="radio"/>	Assess the importance of not building on sites in areas with potential problems.
035	<input type="radio"/>	Describe how a building's relationship to the sun affects energy use.
036	<input type="radio"/>	Use sustainable design principles in landscaping the built environment.
037	<input type="radio"/>	Analyze the impact of material and energy sourcing in design of green and sustainable buildings.
038	<input type="radio"/>	Analyze the impact of design decisions for lighting, heating, and cooling on the sustainability of buildings.
039	<input type="radio"/>	Use energy modeling to determine the effect of design decisions and to differentiate among design alternatives.
040	<input type="radio"/>	Explain how computer applications can be used to improve green and sustainable design decisions for a building.
041	<input type="radio"/>	Calculate heating and cooling thermal loads for a building.
042	<input type="radio"/>	Describe how appropriate landscaping can save energy and reduce pollution.
043	<input type="radio"/>	Redesign an existing building to optimize its performance.
044	<input type="radio"/>	Produce a cost-benefit analysis of employing green and sustainable practices in the operations and maintenance of building systems.
Applying Green Building Requirements to Construction		
045	<input type="radio"/>	Identify how various trades can affect each other's work and can contribute to the greening of a building's construction.
046	<input type="radio"/>	Identify best practices unique to green building projects.
047	<input type="radio"/>	Communicate the importance of a green design plan to subcontractors when pursuing third-party certification.
048	<input type="radio"/>	Explain how properly constructed high-performance building envelopes can eliminate unnecessary uses of energy for heating and cooling.

049	<input type="radio"/>	Describe how site management can mitigate and minimize the negative environmental effects of construction projects.
050	<input type="radio"/>	Explain how indoor air quality considerations can mitigate and minimize the negative environmental and human effects of construction projects.
051	<input type="radio"/>	Explain how the selection of tools and techniques can contribute to green construction of a building.
052	<input type="radio"/>	Explain how the selection of materials and assemblies can contribute to green construction of a building.
Conducting Whole-Building Blower Door Tests		
053	<input type="radio"/>	Prepare the building for testing.
054	<input type="radio"/>	Install the blower door frame in a door jamb.
055	<input type="radio"/>	Install fan in the depressurization direction (fan blowing out).
056	<input type="radio"/>	Install gauges on the door jamb.
057	<input type="radio"/>	Install pressure hoses to gauges.
058	<input type="radio"/>	Install the power supply for the blower door assembly.
059	<input type="radio"/>	Zero the pressure gauges.
060	<input type="radio"/>	Compile data on temperature (interior/exterior) and wind.
061	<input type="radio"/>	Measure air flow and pressure.
062	<input type="radio"/>	Analyze test data.
063	<input type="radio"/>	Determine whether there are any leaks in the home.
064	<input type="radio"/>	Remove the blower door.
Reducing Energy Use through Weatherization		
065	<input type="radio"/>	Explain the purpose, benefits, and origin of the weatherization program.
066	<input type="radio"/>	Describe the methods and materials that could be used to reduce heating and cooling losses as well as air leakage.

067	<input type="radio"/>	Describe how the components that make up a building shell can affect a home's energy usage.
Implementing Green Maintenance Operations		
068	<input type="radio"/>	Describe how preventive maintenance can increase energy efficiency and reduce pollution from a building and its site.
069	<input type="radio"/>	Describe how continuous commissioning (regular maintenance plan) can improve energy efficiency with existing equipment.
070	<input type="radio"/>	Identify ways in which a lighting retrofit could reduce energy pollution and waste.
071	<input type="radio"/>	Identify how water conservation choices in equipment and settings can save energy and reduce pollution.
072	<input type="radio"/>	Determine how green cleaning products can reduce pollution in a building and throughout the product supply chain.
073	<input type="radio"/>	Provide an example of how improving the performance and sustainability of one component in a building system can improve the performance and sustainability of related components.
074	<input type="radio"/>	Analyze the replacement of fossil fuel-based equipment with renewable energies-based equipment when planning building updates.
075	<input type="radio"/>	Conduct an energy audit.
076	<input type="radio"/>	Demonstrate the economic benefits of employing green and sustainable practices in the operations and maintenance of building systems.
077	<input type="radio"/>	Produce a water conservation audit for a local organization.
078	<input type="radio"/>	Create a maintenance and replacement schedule for a given building product based on a life-cycle analysis.
079	<input type="radio"/>	Describe how a previously developed site can be restored to serve as habitat for native species, improve ecosystem services, and reduce irrigation and pest management needs.

Legend:  Essential  Non-essential  Omitted

## Curriculum Framework

# Introducing Sustainability

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## Task Number 001

**Describe the scientific research regarding climate change.**

### Definition

Description should include

- possible causes and potential impacts of climate change
  - charts, graphs, and data showing human impact on the climate change.
- 

## Task Number 002

**Explore the human impact on the environment.**

### Definition

Exploration should include

- the negative and positive effects
  - ways to mitigate the negative effects on energy and material.
- 

## Task Number 003

**Define key terms related to sustainability.**

### Definition

Definitions should be given for the following terms:

- *Green*: The term has been loosely applied to any effort, product, or initiative that proposes to benefit the environment. The term is not scientific, and there is little consensus about which activities can qualify as green and which cannot.

- *Green jobs*: Jobs that help to protect ecosystems and biodiversity; reduce energy, materials, carbon, and water consumption through high-efficiency strategies; and minimize or altogether avoid generation of all forms of waste and pollution.
  - *Sustainability*: The long-term, responsible management of environmental, societal, and business resource use.
  - *Sustainable development*: An approach to development that meets the needs of the present in such a way that future generations can also meet their needs.
- 

## Task Number 004

### Explain the relationship among green, green jobs, sustainability, and sustainable development.

#### Definition

Explanation should include key elements of the relationships among green, green jobs, sustainability, and sustainable development:

- **Green** activities typically, but not always, employ the use of sustainability, sustainable development, or both. Green typically refers to impact on the environment, while sustainability refers to impact on the environment, people, and the economy. Occasionally, activities labeled as green may benefit one aspect of the environment while being a detriment to another (e.g., reduced impact on the environment may mean higher up-front construction costs, sealing air leaks may make a building more susceptible to reduced indoor air quality).
  - **Sustainability** is perceived as a more comprehensive, systematic, and scientific approach.
  - **Green jobs** may include occupations that directly benefit the environment, but they may also refer to occupations grounded in sustainability thinking and practice.
  - **Sustainable development** includes the understanding that economic activities continue and evolve to meet the needs of individuals and communities within the limits of natural resources and ecosystems.
- 

## Task Number 005

### Explain the core concepts of sustainability and green efforts/initiatives.

#### Definition

Explanation should include

- triple bottom line for business
- cradle-to-cradle resource use
- materials life-cycle analysis
- ways these concepts can help solve societal, environmental, and business problems while creating a more sustainable future.

**Triple bottom line for business:** An approach that considers three primary outcomes:

1. higher quality of life for humans (people);
2. healthier ecosystems (planet); and
3. robust and equitable economies (prosperity).

**Cradle-to-cradle resource use:** An approach to the design of systems and materials that strives for resource use that is not just efficient but waste-free and not only mitigates harm to people and the environment but enriches and improves quality of life and ecosystem health.

**Life-cycle analysis:** An inventory or assessment of the effects of relevant energy and material inputs and environmental outputs at all stages of a product's life cycle. A life-cycle analysis is used to make more informed decisions about design, consumption, reuse, recycling, and disposal of product materials to promote the triple bottom line.

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## Task Number 006

**Define *precautionary principle*.**

### Definition

Definition should state the following:

*Precautionary principle:* If an action has a suspected risk of causing harm to people or to the environment, the burden of proof that it is not harmful falls on those taking the action, and the action is not taken until it is shown to be safe.

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## Task Number 007

**Define *ecosystem services*.**

### Definition

Definition should state the following:

*Ecosystem services*: Benefits to humankind from the collective resources and processes of ecosystems (e.g., products such as clean drinking water and air, and processes such as decomposition of wastes).

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## **Task Number 008**

**Define *ecological footprint*.**

### **Definition**

Definition should state the following:

*Ecological footprint*: A standardized measure of human demand on Earth's ecosystems.

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## **Task Number 009**

**Define *tragedy of the commons*.**

### **Definition**

Definition should state the following:

*Tragedy of the commons*: A dilemma arising from the situation in which multiple individuals, acting independently and rationally in their own self-interest, will ultimately deplete or destroy a shared limited resource, even when it is clear that it is not in the group's interest for this to happen.

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## **Task Number 010**

**Define *systems thinking*.**

### **Definition**

Definition should state the following:

*Systems thinking*: The process of understanding relationships, interconnections, and interdependencies within a whole, and applying that understanding.

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## **Task Number 011**

## **Define *unintended consequences*.**

### **Definition**

Definition should state the following:

*Unintended consequences*: Outcomes that are not the ones intended by a purposeful action.

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## **Task Number 012**

### **Define *quality-of-life indicators*.**

#### **Definition**

Definition should state the following:

*Quality-of-life indicators*: Standard indicators of the quality of life include not only wealth and employment but also the built environment; physical and mental health; education; recreation and leisure time; and social belonging.

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## **Task Number 013**

### **Evaluate an industry practice using the three principles of sustainability (i.e., triple bottom line).**

#### **Definition**

Evaluation should include a challenge or opportunity faced by a business or nonprofit organization to improve sustainability efforts while maintaining or increasing profits or organizational health.

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## **Examining Green Building in Architecture and Construction**

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## **Task Number 014**

## **Describe the overarching significance of the building industry in humankind’s global “footprint.”**

### **Definition**

Description should include the building industry’s areas of design, construction, and operation maintenance and its effects on air, food, water, biodiversity, medicine, energy, and other ecosystems.

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## **Task Number 015**

### **Describe the integrated design process (cradle-to-cradle) to accomplish green and sustainable outcomes.**

#### **Definition**

Description should include

- roles of teams involved in the design process and where they are integrated, from start to finish in the building process
  - explanation of full life-cycle costing, including the accounting for social and environmental effects.
- 

## **Task Number 016**

### **Explain the “cradle-to-cradle” approach in comparison to “cradle-to-grave” life cycles of common household products.**

#### **Definition**

Explanation should include the criteria for what makes a product green/sustainable and examples of each type of product.

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## **Task Number 017**

## **Design a new product from existing products using the cradle-to-cradle approach.**

### **Definition**

Design should identify the materials and components that would be used, how they would be used, and how the components would make the built environment more sustainable.

---

## **Task Number 018**

### **Examine the effects on environmental and societal conditions throughout the life cycle of a building.**

#### **Definition**

Examination should include frequently overlooked externalities, such as

- pollution
  - health effects on humans involved in material procurement
  - humans using the building
  - environmental degradation.
- 

## **Task Number 019**

### **Evaluate the benefits and costs of a green and sustainable application in design, construction, and maintenance of the built environment.**

#### **Definition**

Evaluation should include

- selection of a system (e.g., roofing, ventilation, construction materials) within a building
  - upfront monetary cost
  - “true cost.”
-

## **Task Number 020**

**Identify methods, materials, and techniques that are consistent with green building and sustainable design.**

### **Definition**

Identification should include

- recognizing what makes a material or product green/sustainable
  - gauging the range of effects on the environment to determine which green products and processes to use.
- 

## **Task Number 021**

**Describe an energy audit for a facility.**

### **Definition**

Description should include

- defining the audit
  - conducting a survey of energy flow and use
  - compiling data (e.g., energy bills) for a 12-month period
  - performing a visual inspection
  - interviewing maintenance staff.
- 

## **Task Number 022**

**Evaluate options to reduce energy consumption.**

### **Definition**

Evaluation should include

- the design of energy loads and material resource loads of a building
- a comparative analysis with alternative, more sustainable solutions

- incentive programs to enhance the attractiveness of sustainable design, construction, and operation/maintenance for the building owner
  - link between water use and energy use
  - methods to prevent water damage and mold problems
  - methods to optimize energy performance and healthy indoor air quality.
- 

## **Task Number 023**

### **Evaluate the regional and global effects of green and sustainable building design and construction.**

#### **Definition**

Evaluation should include

- consideration of how regional and global climate and resource availability influence strategies of sustainable design and construction
  - regional and global natural/renewable resource availability
  - the full cost of harvesting the resources (e.g., sunlight, water, wind, wood, and/or biofuels)
  - a comparison of the full cost-benefit features with other nonrenewable sources
  - the relationship between affordable green housing and community economic health.
- 

## **Task Number 024**

### **Communicate the value of green and sustainable practices in a presentation.**

#### **Definition**

Communication should include

- using green terms
- explaining sustainability practices used for operating and maintaining green-built structures
- defining *greenwashing* (marketing use to promote an organization's products as environmentally friendly when, in fact, they are not)
- providing balanced and informative green options/choices.

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## **Task Number 025**

**Identify the standards, regulations, and codes intended to create a more green and sustainable built environment.**

### **Definition**

Identification should include

- regulations and standards specific to green building (e.g., National Association of Home Builders [NAHB] Green Standard, Leadership in Energy and Environmental Design [LEED], Living Building, Passive House Institute US [PHIUS], Collaborative for High Performance Schools [CHPS], and international and regional construction codes)
  - green/sustainable standards and principles that go beyond the norm to maintain healthier buildings, ecosystems, and communities.
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## **Exploring Design/Pre-Construction Principles**

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## **Task Number 026**

**Identify appropriate members of an integrated design team, based on a given project.**

### **Definition**

Identification should include the following for a residential, commercial, or renovation project:

- designer(s)
- engineer(s)
- consultant(s)
- stakeholder(s)
- client

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## **Task Number 027**

### **Consult expert sources in the design of green and sustainable building.**

#### **Definition**

Consultation should result in meeting the following green and sustainable goals:

- equity and profitability
- limited environmental impact
- health, wellness, and quality of life of workers and building users

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## **Task Number 028**

### **Use patterns, systems, and flows of land, materials, energy, and natural resources in the design of green, sustainable building projects.**

#### **Definition**

Use should include consideration of

- land-use patterns—urban, suburban, and rural—on the sustainability or unsustainability of the built environment
- the importance of ecosystem services (e.g., cleaning the water) in an undeveloped site and the requirement to maintain or enhance those services
- evaluation of site conditions and natural flows (e.g., sun paths, water flows, nutrient flows, wind patterns).

---

## **Task Number 029**

### **Describe the growing significance of “embodied” energy (and water) in the total environmental impact of the building industry.**

## **Definition**

Description should incorporate the understanding that embodied energy is the amount of energy required to extract, process, manufacture, transport, and erect the materials of a building. It also takes into account the pollution generated by that energy use.

---

## **Task Number 030**

**Explain how site selection and design for the facility site and landscape can improve the impact of the built environment on the green environment.**

### **Definition**

Explanation should include

- the location and orientation of the building on the site
  - energy consumption
  - landscaping and its effect on local ecosystems and habitats (include hardscapes and softscapes)
  - transportation issues and solutions (e.g., methods used to get to and from the site, parking, security, lighting, vehicle barriers)
  - the physical size of the built environment (e.g., campus, multistory building, military complex).
- 

## **Task Number 031**

**Describe how a site's selection can mitigate greenhouse gas emissions by governing necessary travel to and from the facility.**

### **Definition**

Description should include transportation solutions that recognize the need for

- a site's proximity to mass transit
- parking for cars and bicycles
- a dropoff/pickup point for carpools.

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## **Task Number 032**

**Explain how redeveloping a brownfield site can represent a positive step for the community.**

### **Definition**

Explanation should include

- a definition of the term *brownfield* (a property whose redevelopment or reuse may be complicated by contamination, seen or unseen)
- the effect of cleanup and restoration on the environment
- the preservation of green space
- the reinvigoration of local economies and communities.

---

## **Task Number 033**

**Explain how choosing sites in already developed areas can save time and money and reduce negative impacts on the site.**

### **Definition**

Explanation should include

- the effect of commute times on workers
- the cost savings of reusing existing infrastructure (e.g., water and sewer service, electrical service)
- reduced habitat disturbance.

---

## **Task Number 034**

**Assess the importance of not building on sites in areas with potential problems.**

## **Definition**

Assessment should include effects on the quality of life and the cost to the community/taxpayers when buildings are erected on sites that risk potential damage from predictable extreme weather events (e.g., steep slopes, high water tables).

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## **Task Number 035**

### **Describe how a building's relationship to the sun affects energy use.**

#### **Definition**

Description should include how the following can dramatically reduce the need for heating and cooling a building:

- window placement
  - appropriate use of mass storage
  - superinsulation
  - building orientation
  - landscaping.
- 

## **Task Number 036**

### **Use sustainable design principles in landscaping the built environment.**

#### **Definition**

Use of principles should include

- why it is best to select native plants for low-impact landscaping
  - why it is best to select plants with similar needs
  - how xeriscaping can reduce irrigation needs and oil-based pesticide use
  - how designing bioswales and rain gardens can absorb and treat stormwater runoff
  - why it is advantageous to install permeable pavement, particularly in driveways or parking lots.
-

## **Task Number 037**

### **Analyze the impact of material and energy sourcing in design of green and sustainable buildings.**

#### **Definition**

Analysis should include

- options for on-site electrical and thermal energy production
  - ways the choice of construction materials can affect the quality of the indoor environment.
- 

## **Task Number 038**

### **Analyze the impact of design decisions for lighting, heating, and cooling on the sustainability of buildings.**

#### **Definition**

Analysis should include

- an understanding of the application and design options, analysis, and implementation of lighting
  - the effects of glass and glazing systems on the transmission of light, and the selection, performance, and installation of windows
  - distinguishing between green and basic HVAC systems (residential and commercial) for integrated design and systems coordination
  - reasons for choices about
    - air infiltration reduction;
    - superinsulation;
    - moisture control;
    - energy recovery ventilation systems; and
    - other design choices that can reduce or eliminate the need for nonrenewable energy systems.
- 

## **Task Number 039**

## **Use energy modeling to determine the effect of design decisions and to differentiate among design alternatives.**

### **Definition**

Use of energy modeling should include

- identification of typical inputs and outputs
  - software or an application to determine energy consumption of a proposed design
  - development of design alternatives that minimize energy use while meeting client needs
  - the concept of sensitivity analysis.
- 

## **Task Number 040**

### **Explain how computer applications can be used to improve green and sustainable design decisions for a building.**

#### **Definition**

Explanation should include

- ways that building modeling, analysis, and simulation software can be used to produce greener design and construction documents
  - the use of Building Information Modeling (BIM) search engine software for building product specifications based on environmental performance criteria.
- 

## **Task Number 041**

### **Calculate heating and cooling thermal loads for a building.**

#### **Definition**

Calculation should be made at both seasonal and design conditions (minimum/maximum temperatures) to minimize pollution from the building's operation.

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## **Task Number 042**

## **Describe how appropriate landscaping can save energy and reduce pollution.**

### **Definition**

Description should include

- alteration of the climate around a site can reduce energy demand
  - that plantings can improve water quality and reduce the effects of runoff and erosion
  - the outcome of reduced costs in operations and maintenance.
- 

## **Task Number 043**

### **Redesign an existing building to optimize its performance.**

#### **Definition**

Redesign should include

- conducting an energy audit to optimize energy performance
  - changing the operations and maintenance of the building.
- 

## **Task Number 044**

### **Produce a cost-benefit analysis of employing green and sustainable practices in the operations and maintenance of building systems.**

#### **Definition**

Production should cite the benefits to the preservation of ecosystem health and include the following

- monetary
  - environmental
  - social.
-

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# Applying Green Building Requirements to Construction

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## Task Number 045

**Identify how various trades can affect each other's work and can contribute to the greening of a building's construction.**

### Definition

Identification should include the understanding that each trade must be open to innovations in green construction and materials and in ensuring that onsite processes are environmentally friendly.

---

## Task Number 046

**Identify best practices unique to green building projects.**

### Definition

Identification should include, but not be limited to

- adherence to LEED standards
  - use of salvaged or recycled materials
  - efficient use of plumbing systems and conservation of water
  - efficient use of energy
  - indoor environmental quality (e.g., natural lighting and ventilation, emission-free paints, efficient heating and cooling systems)
  - use of sustainable or brownfield sites
  - promotion of public transit, carpooling, or bicycling to the work site.
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## Task Number 047

## **Communicate the importance of a green design plan to subcontractors when pursuing third-party certification.**

### **Definition**

Communication should include reinforcing all green-building requirements during meetings with subcontractors.

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## **Task Number 048**

### **Explain how properly constructed high-performance building envelopes can eliminate unnecessary uses of energy for heating and cooling.**

#### **Definition**

Explanation should include

- defining the *building envelope* (the components of a structure that separate the exterior environment from the interior environment [e.g., walls, foundation, floor systems, roof])
  - the importance of insulation installation in wall performance
  - best practices for reduced air infiltration
  - the basics of building science details that have climate-specific design responses.
- 

## **Task Number 049**

### **Describe how site management can mitigate and minimize the negative environmental effects of construction projects.**

#### **Definition**

Description should include

- the conditions that cause demolition and construction industries to be the single largest contributor to the solid waste stream
  - ways to reduce environmental damage to a project site.
-

## **Task Number 050**

**Explain how indoor air quality considerations can mitigate and minimize the negative environmental and human effects of construction projects.**

### **Definition**

Explanation should include

- ways to recognize signs of and apply techniques for mold prevention
  - conditions needed to improve air quality
  - negative effects of volatile organic compounds (VOC) and exposure to other potentially harmful constructional materials, and how to reduce workers' exposure to such materials.
- 

## **Task Number 051**

**Explain how the selection of tools and techniques can contribute to green construction of a building.**

### **Definition**

Explanation should include

- the understanding that embodied energy is the amount of energy required to bring a product to the consumer
  - an understanding of framing and structural materials, including autoclaved aerated concrete (AAC), structural insulated panels (SIPs), straw bale, adobe, and smart framing.
- 

## **Task Number 052**

**Explain how the selection of materials and assemblies can contribute to green construction of a building.**

### **Definition**

Explanation should cover the following areas:

- Insulation types (e.g., spray foam, recycled, batting, loose fill)
  - Sustainably Forested Initiative
  - Windows (types and location)
  - Landscape management materials (hardscapes and softscapes)
  - Flooring (sustainably grown or eco-engineered)
  - Paints, sealants, and adhesives (VOCs and off-gassing)
  - Lighting (passive solar, light shelves, solar tubes)
  - Furniture and cleaning products (effects on indoor air quality)
  - Regional and local materials
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## **Conducting Whole-Building Blower Door Tests**

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### **Task Number 053**

#### **Prepare the building for testing.**

##### **Definition**

Preparation should include the following:

- Inspect the home for fireplaces or stoves.
    - Are all fires out in the stoves and fireplaces?
    - Have ashes been removed? (If not, cover with newspapers and weight down)
    - Are dampers closed?
  - Inspect doors and windows to ensure they are closed and latched.
  - Open all interior doors.
  - Determine whether live-in basement areas should be included in the test.
  - Adjust thermostat to keep thermostat off.
  - Interview the homeowner to determine where the worst/uncomfortable leaks are.
- 

### **Task Number 054**

#### **Install the blower door frame in a door jamb.**

## **Definition**

Installation should include the following steps:

- Select a door on the side of the house that is shielded from the wind.
  - Assemble the blower door frame with the cams closed.
  - Expand the door frame to roughly fit the door jamb and tighten the knobs.
  - Remove the door frame and attach the nylon cover.
  - Connect the exterior house pressure hose to the outside of the nylon door panel.
  - Run the exterior house pressure hose away from the fan flow direction.
  - Install the door frame in the door jamb and open the cams to lock it into the jamb.
  - Check for leaks and reinstall if necessary.
- 

## **Task Number 055**

**Install fan in the depressurization direction (fan blowing out).**

### **Definition**

Installation should include the following steps:

- Insert the fan into the elastic seal around the door cover hole.
  - Check for leaks and adjust the fan seal, if necessary.
- 

## **Task Number 056**

**Install gauges on the door jamb.**

### **Definition**

Installation should include

- attaching the gauge clamp to the door jamb at viewing height
  - attaching gauges to the gauge clamp.
- 

## **Task Number 057**

## **Install pressure hoses to gauges.**

### **Definition**

Installation should include

- connecting the fan pressure hose between the fan and gauges
  - connecting the interior house pressure hose between the nylon door panel and the house pressure gauge
  - ensuring that the exterior house pressure hose is not exposed to fan flow.
- 

## **Task Number 058**

### **Install the power supply for the blower door assembly.**

#### **Definition**

Installation should include the following steps:

- Connect the fan speed control cord to the female plug for the fan
  - Turn off the fan speed control switch
  - Connect the male fan plug to an extension cord connected to a wall AC power outlet.
- 

## **Task Number 059**

### **Zero the pressure gauges.**

#### **Definition**

Zeroing the gauges should include the following steps:

- Turn on the fan and raise the power several times so the gauges respond.
  - Adjust the gauges to zero.
  - Gently tap the gauges to make them return to zero.
  - Repeat the last three steps until the gauges consistently register zero.
- 

## **Task Number 060**

## **Compile data on temperature (interior/exterior) and wind.**

### **Definition**

Compilation should include the following:

- Temperature inside the home (within 5 degrees Fahrenheit) for use in air density calculations
  - Temperature outside the home (within 5 degrees Fahrenheit) for use in air density calculations
  - Wind conditions (e.g., calm, gusty, gale) for use in evaluating measurement quality.
- 

## **Task Number 061**

### **Measure air flow and pressure.**

#### **Definition**

Measurement should include the following steps:

- Adjust the fan speed for a house pressure of 50 pascals (Pa [the same as 0.20 inches of water]).
  - If you cannot get up to 50 Pa, use the highest pressure that can be reached.
  - Check for open windows and doors.
  - If the flow gauge reading is too low to read, install the low-flow plate.
  - If using the low-flow plate, move the fan pressure hose to the low-flow plate pressure tap.
  - Record the pressure and flow.
  - When the fan is running slowly, use the low speed switch for more sensitivity and fan cooling.
- 

## **Task Number 062**

### **Analyze test data.**

#### **Definition**

Analysis should include

- calculating the house volume in cubic feet (e.g., 1,500 sq. ft. x 8 ft. = 12,000 cu. ft.) using inside and outside temperature to correct data
  - using 50 Pa pressure and flow data (example: 50 Pa and 2,000 cfm), computing 50 Pa Air Changes/Hour (ACH50) (e.g.,  $ACH50 = 2000 \text{ cfm} * 60 \text{ min/hr} / 12000 \text{ cu ft} = 10 \text{ ACH50}$ )
  - using the “can’t reach” table if the house is too leaky to get to 50 Pa
  - computing the natural infiltration by dividing ACH50 by 20 (approximate) (Example:  $10 \text{ ACH50} / 20 = 0.5 \text{ ACH}$  natural infiltration)
  - understanding the ASHRAE minimum infiltration calculation and when a house should be air-sealed.
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## **Task Number 063**

### **Determine whether there are any leaks in the home.**

#### **Definition**

Determination should include

- checking each room for major leaks by partially closing each interior door and feeling for air flow through the door crack
  - using a hand or a smoke puffer to locate leaks
  - being aware that leaks in the upper part of the home cause the worst heat loss.
- 

## **Task Number 064**

### **Remove the blower door.**

#### **Definition**

Removal should include the following steps:

- Turn off the fan speed control.
- Disconnect the two electrical plugs.
- Disconnect the two pressure hoses.
- Remove the fan from the door.
- Release door frame cams.
- Remove the door frame from the door jamb.
- Disconnect door frame and store in its case.
- Remove the gauges and gauge clamp from the door jamb.

- Turn on thermostat/furnace and warm the house, if necessary.
  - Return all doors and windows to original setting.
  - Remove any covers from fireplace or stove ashes.
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## **Reducing Energy Use through Weatherization**

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### **Task Number 065**

**Explain the purpose, benefits, and origin of the weatherization program.**

#### **Definition**

Explanation should include

- Weatherization Assistance Program
  - American Recovery and Reinvestment Act
  - goals and reasons for weatherization (e.g., cost savings to the homeowner, decreased energy consumption, less carbon emissions).
- 

### **Task Number 066**

**Describe the methods and materials that could be used to reduce heating and cooling losses as well as air leakage.**

#### **Definition**

Description should include

- types of insulation and the cost benefits/savings comparisons over time
- use of landscape design and passive solar heating
- comparisons of window types and glazings using U-values

- light shelves and window covers
  - occupant education and behavior modification.
- 

## **Task Number 067**

**Describe how the components that make up a building shell can affect a home's energy usage.**

### **Definition**

Description should include R-value and air infiltration information for

- structural insulated panels
  - autoclaved aerated concrete
  - standard stick-framed walls and flexible insulation
  - house wraps and air-sealant materials
  - straw bale and rammed-earth structures.
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## **Implementing Green Maintenance Operations**

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### **Task Number 068**

**Describe how preventive maintenance can increase energy efficiency and reduce pollution from a building and its site.**

### **Definition**

Description should include a regular maintenance plan and a plan to reduce energy use and water pollution through high-performing systems and conservation choices.

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### **Task Number 069**

## **Describe how continuous commissioning (regular maintenance plan) can improve energy efficiency with existing equipment.**

### **Definition**

Description should include

- calibration of controls
  - a preventive maintenance plan that optimizes building performance
  - a plan for incorporating innovation in technology/green energy/renewable energy into job descriptions and common practices for the building.
- 

## **Task Number 070**

### **Identify ways in which a lighting retrofit could reduce energy pollution and waste.**

#### **Definition**

Identification should include calculating the savings through

- the use of a light meter to assess locations to turn off or remove lights
  - cleaning reflectors
  - adding lights or more efficient bulbs/tubes
  - occupancy and daylighting sensors
  - increased use of daylighting.
- 

## **Task Number 071**

### **Identify how water conservation choices in equipment and settings can save energy and reduce pollution.**

#### **Definition**

Identification should include selection of low-flow or dual-flow devices and using landscaping techniques, as well as a water conservation operations and management plan for a building.

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## **Task Number 072**

**Determine how green cleaning products can reduce pollution in a building and throughout the product supply chain.**

### **Definition**

Determination should include the production, use, and disposal or recycling of the green cleaners.

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## **Task Number 073**

**Provide an example of how improving the performance and sustainability of one component in a building system can improve the performance and sustainability of related components.**

### **Definition**

Providing an example should include retrofitting lighting systems to be energy efficient and reducing waste heat from the lights, which can lower the demand on an existing HVAC system and lower the size needed for a replacement system.

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## **Task Number 074**

**Analyze the replacement of fossil fuel-based equipment with renewable energies-based equipment when planning building updates.**

### **Definition**

Analysis should include a comparison of systems and a calculation of the cost savings of each system.

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## **Task Number 075**

### **Conduct an energy audit.**

#### **Definition**

Conducting an energy audit should result in a redesign of a given building to optimize energy performance through changes in how the building is used and in operations and maintenance.

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## **Task Number 076**

### **Demonstrate the economic benefits of employing green and sustainable practices in the operations and maintenance of building systems.**

#### **Definition**

Demonstration should include calculating the near-term and long-term cost savings of employing energy efficiency and conservation practices in building systems.

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## **Task Number 077**

### **Produce a water conservation audit for a local organization.**

#### **Definition**

Production should include

- an analysis of current water use
  - design of a water conservation plan that includes water use both inside and outside the building
  - an explanation of the basic math used to calculate potential water savings.
- 

## **Task Number 078**

## **Create a maintenance and replacement schedule for a given building product based on a life-cycle analysis.**

### **Definition**

Creating a maintenance and replacement schedule should include

- research into more durable and sustainable products
  - design that changes over the life cycle to optimize performance and energy efficiency
  - an appropriate replacement and repair cycle
  - a checklist for product fatigue or failure
  - procedures to reduce waste and enhance reuse of materials.
- 

## **Task Number 079**

### **Describe how a previously developed site can be restored to serve as habitat for native species, improve ecosystem services, and reduce irrigation and pest management needs.**

#### **Definition**

Description should include

- a comparison of the operation and maintenance cost as well as the environmental effects of landscaping.
  - determination of when it is or is not a sustainable design for a building
  - installation of vegetated roofs to be included as part of restoring a previously developed site
  - removal of existing paved areas and improved infiltration to help meet this goal
  - replacement or retrofitting of an irrigation system to reduce operation and maintenance costs and negative environmental impacts.
- 

## **SOL Correlation by Task**

001	Describe the scientific research regarding climate change.	
002	Explore the human impact on the environment.	
003	Define key terms related to sustainability.	

004	Explain the relationship among green, green jobs, sustainability, and sustainable development.	
005	Explain the core concepts of sustainability and green efforts/initiatives.	
006	Define <i>precautionary principle</i> .	
007	Define <i>ecosystem services</i> .	
008	Define <i>ecological footprint</i> .	
009	Define <i>tragedy of the commons</i> .	
010	Define <i>systems thinking</i> .	
011	Define <i>unintended consequences</i> .	
012	Define <i>quality-of-life indicators</i> .	
013	Evaluate an industry practice using the three principles of sustainability (i.e., triple bottom line).	
014	Describe the overarching significance of the building industry in humankind’s global “footprint.”	
015	Describe the integrated design process (cradle-to-cradle) to accomplish green and sustainable outcomes.	
016	Explain the “cradle-to-cradle” approach in comparison to “cradle-to-grave” life cycles of common household products.	
017	Design a new product from existing products using the cradle-to-cradle approach.	
018	Examine the effects on environmental and societal conditions throughout the life cycle of a building.	
019	Evaluate the benefits and costs of a green and sustainable application in design, construction, and maintenance of the built environment.	
020	Identify methods, materials, and techniques that are consistent with green building and sustainable design.	
021	Describe an energy audit for a facility.	
022	Evaluate options to reduce energy consumption.	
023	Evaluate the regional and global effects of green and sustainable building design and construction.	
024	Communicate the value of green and sustainable practices in a presentation.	
025	Identify the standards, regulations, and codes intended to create a more green and sustainable built environment.	
026	Identify appropriate members of an integrated design team, based on a given project.	
027	Consult expert sources in the design of green and sustainable building.	
028	Use patterns, systems, and flows of land, materials, energy, and natural resources in the design of green, sustainable building projects.	
029	Describe the growing significance of “embodied” energy (and water) in the total environmental impact of the building industry.	
030	Explain how site selection and design for the facility site and landscape can improve the impact of the built environment on the green environment.	
031	Describe how a site’s selection can mitigate greenhouse gas emissions by governing necessary travel to and from the facility.	
032	Explain how redeveloping a brownfield site can represent a positive step for the community.	

033	Explain how choosing sites in already developed areas can save time and money and reduce negative impacts on the site.	
034	Assess the importance of not building on sites in areas with potential problems.	
035	Describe how a building's relationship to the sun affects energy use.	
036	Use sustainable design principles in landscaping the built environment.	
037	Analyze the impact of material and energy sourcing in design of green and sustainable buildings.	
038	Analyze the impact of design decisions for lighting, heating, and cooling on the sustainability of buildings.	
039	Use energy modeling to determine the effect of design decisions and to differentiate among design alternatives.	
040	Explain how computer applications can be used to improve green and sustainable design decisions for a building.	
041	Calculate heating and cooling thermal loads for a building.	
042	Describe how appropriate landscaping can save energy and reduce pollution.	
043	Redesign an existing building to optimize its performance.	
044	Produce a cost-benefit analysis of employing green and sustainable practices in the operations and maintenance of building systems.	
045	Identify how various trades can affect each other's work and can contribute to the greening of a building's construction.	
046	Identify best practices unique to green building projects.	
047	Communicate the importance of a green design plan to subcontractors when pursuing third-party certification.	
048	Explain how properly constructed high-performance building envelopes can eliminate unnecessary uses of energy for heating and cooling.	
049	Describe how site management can mitigate and minimize the negative environmental effects of construction projects.	
050	Explain how indoor air quality considerations can mitigate and minimize the negative environmental and human effects of construction projects.	
051	Explain how the selection of tools and techniques can contribute to green construction of a building.	
052	Explain how the selection of materials and assemblies can contribute to green construction of a building.	
053	Prepare the building for testing.	
054	Install the blower door frame in a door jamb.	
055	Install fan in the depressurization direction (fan blowing out).	
056	Install gauges on the door jamb.	
057	Install pressure hoses to gauges.	
058	Install the power supply for the blower door assembly.	
059	Zero the pressure gauges.	
060	Compile data on temperature (interior/exterior) and wind.	
061	Measure air flow and pressure.	
062	Analyze test data.	
063	Determine whether there are any leaks in the home.	
064	Remove the blower door.	

065	Explain the purpose, benefits, and origin of the weatherization program.	
066	Describe the methods and materials that could be used to reduce heating and cooling losses as well as air leakage.	
067	Describe how the components that make up a building shell can affect a home's energy usage.	
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073	Provide an example of how improving the performance and sustainability of one component in a building system can improve the performance and sustainability of related components.	
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078	Create a maintenance and replacement schedule for a given building product based on a life-cycle analysis.	
079	Describe how a previously developed site can be restored to serve as habitat for native species, improve ecosystem services, and reduce irrigation and pest management needs.	