G|PRO
Green Professional Building Skills Training

FUNDAMENTALS OF BUILDING GREEN

TEST YOURSELF QUESTIONS: Answer Key

PART A: SUSTAINABILITY

CHAPTER 1: Sustainability

1. **What is the definition of sustainability?**
   Sustainability is the capacity to thrive long-term without using up resources. It means meeting the needs of the present without compromising the ability of future generations to meet their own needs *(see page 5)*.

2. **How do humans rely on the environment?**
   Environmental systems provide the resources for human life. Plants and algae, powered by the sun, create the oxygen we need to breathe and absorb pollutants from the air. Soil purifies our water. Plants and animals provide us with food, and insects pollinate the plants. The sun provides the energy that makes this all happen *(see page 5)*.

3. **How will the transition to sustainability impact the job market and economy?**
   Transitioning to sustainability will involve projects such as improving building envelopes, installing more energy- and water-efficient building systems, and managing our use of energy and materials more effectively, all of which will account for more jobs *(see page 6)*.

CHAPTER 2: Challenges in Our Use of Natural Resources

1. **What are the biggest threats to our sources of drinking water?**
   Increased demand and drought are the two biggest threats to our drinking water sources *(see page 7)*.

2. **What are the three types of air pollutants that are directly harmful to humans?**
   1. Tiny particles like soot and dust
   2. Nitrogen- and sulfur-based acids (NO_x and SO_x)
   3. Harmful gases, such as carbon monoxide (CO), and chemical vapors
      (see page 8)

3. **How does the extraction and production of fossil fuels impact the environment?**
   Extraction and production of fossil fuels harms the environment. Some examples include:
   - Mountaintop removal for coal mining is destroying entire valleys and local ecosystems in the Appalachian Mountains.
   - Extracting oil from tar sands requires strip mining or open pit mining, which can permanently destroy land and pollute surrounding waterways.

- Deep sea offshore drilling can create huge oil spills.
- Hydraulic fracturing, or fracking, for natural gas and oil requires pumping high- pressure chemicals deep into the earth, a process that some people claim has contaminated local drinking water supplies *(see page 9).*

4. **How does the consumption of fossil fuels contribute to air pollution?**
   Coal, oil, and natural gas are burned to make electricity and heat our buildings. Burning fossil fuels releases air pollutants such as particulates, mercury, and oxides of sulfur and nitrogen. These cause asthma, lung cancer, and other health problems. Carbon dioxide, another pollutant released, contributes to climate change *(see page 10)*.

5. **How can we discard less waste?**
   We can discard less waste by reducing the amount of useable materials that are thrown away *(see page 10)*.

6. **How does extracting natural resources damage the environment?**
   Mining raw metals can destroy landscapes, contaminate streams with harmful chemicals, and make people sick *(see page 11).*

7. **Why is maintaining biodiversity important?**
   Greater biodiversity is important for our food sources because with more variation in species, the greater the potential to resist a wider range of diseases and environmental changes. Indirectly, this leads to a higher level of food security and stability of both plant and animal (including fish) products. We use plants and animals not only for food, but also for medicines. Plant-based products may eventually offer cures to diseases such as cancer, Alzheimer's disease, and depression. In fact, 70% of plants that the U.S. National Cancer Institute identifies as useful in the treatment of cancer are found only in rainforests *(see page 12)*.

CHAPTER 3: Environmental Successes

1. **What are the preservation and conservation movements? How are they similar and different?**
   The conservation movement focuses on protecting and managing natural resources for humans to use. The conservation movement brought hundreds of millions of acres under control of the U.S. Forest Service, mandated to manage forests in a sustainable way while using them as a resource for lumber.
   The preservation movement's goal is to protect the environment from human activity. This movement was responsible for the creation of the U.S. National Park System, starting with Yellowstone National Park in 1872. These parks strive to preserve nature in its undeveloped condition *(see page 14).*

2. **What brought about the modern environmental movement?**
   The modern environmental movement was brought about in response to a series of critical environmental issues. In 1962 Rachel Carson's book "Silent Spring" revealed that DDT, a chemical compound used as an agricultural insecticide, was bringing some bird species close to extinction. Later that decade, the Cuyahoga River in Ohio caught fire. It was so polluted from decades of industrial discharges that it had virtually no remaining wildlife and carried flammable liquids on its surface. The image of a burning river captured the attention of the nation. In response to these

events, the first Earth Day was held on April 22, 1970, during President Nixon's administration. It was established as a protest and an estimated 20 million people joined across the country, the largest demonstration in U.S. history *(see page 15).*

3. **What does the Clean Air Act mandate, and why is the Act important?**
   The Clean Air Act set standards for industry and transportation that limit the level of pollutants in the air. Each state must regulate their large polluters to meet these standards. The Clean Air Act is one of the most successful pieces of environmental legislation in our country's history. In its first 20 years, the Clean Air Act prevented 205,000 premature deaths, 843,000 asthma attacks, and 18 million childhood respiratory illnesses *(see page 16).*

4. **What is an example of all nations working together to face a global environmental challenge? How was it handled?**
   Preventing the depletion of the ozone layer is an example of all countries working together to face a global environmental challenge. In 1987, every country in the United Nations agreed to the Montreal Protocol, which phased out the production and use of ozone- depleting chemicals *(see page 17).*

5. **What is the definition of environmental justice?**
   Environmental justice is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." *(see page 17).*

CHAPTER 4: Climate Change

1. **How are weather and climate different?**
   Weather is the current state of the atmosphere: a combination of temperature, rainfall, humidity, clouds, and wind. It is measured over short periods of time, in hours, days, and weeks.
   Climate is the average weather pattern at one place over an extended period of time, 30 years or more. It includes both normal and extreme weather (such as storms or heat waves)
   (see page 19).

2. **What is the greenhouse effect? How does it affect us both positively and negatively?**
   The greenhouse effect is the process of trapping solar radiation in the Earth's atmosphere. Greenhouse gases, such as carbon dioxide and methane, trap heat in the atmosphere. These gases act like the glass windshield of a car, letting in sunlight, which warms the Earth's surface. Like any warm object, the Earth then radiates the heat back into space. The greenhouse gases absorb much of this radiated heat instead of letting it pass through. As a result, some of the energy that came in as sunlight is now trapped at the Earth's surface as heat. The strength of the greenhouse effect and how warm the planet will be depend on the amount of greenhouse gases in the atmosphere.

   The positive role of the greenhouse effect is that it keeps our atmosphere warm enough to support life. The greenhouse effect impacts us negatively when the amount of greenhouse gases in the atmosphere is too high. High amounts of greenhouse gases lead to a dangerous increase in global temperatures *(see page 19)*.

3. **How do we know that global climate change is happening?**
    - Global surface temperatures have increased 0.5°F every 10 years since the 1970s.
    - The planet's 13 hottest recorded years have all occurred since 1998.
    - 2012 was the warmest year on record for the continental U.S. and the ninth warmest year since 1880 globally *(see page 20).*

4. **How does burning fossil fuels impact global warming?**

    Burning fossil fuels releases carbon dioxide (CO_2) into the atmosphere. CO_2 is a greenhouse gas. The high amount of CO_2 in the atmosphere intensifies the Earth's natural greenhouse effect, and causes global warming *(see page 21).*

5. **What are the two possible future scenarios that predict how our behaviors will affect global warming?**

    Worst Case Scenario: We continue taking fossil fuels out of the earth and burning them, with only weak attempts to reduce emissions. This can be called a "business as usual" scenario, since we make no major changes from the ways we use energy now. We would emit a total of about six trillion tons of CO_2 by 2100, and as a result, the concentration in the air would rise to about 940 ppm. Global temperature would increase by 3.6°F by 2050 and 6.7°F by 2090. Sea level would rise one foot by 2050, and two feet by 2090.

    Best Case Scenario: People around the world undertake a wide range of steps to lower emissions. These steps include lowering energy demand and converting to clean energy sources. As a result, we would only emit a total of about one trillion tons of CO_2, and the concentration would rise to about 420 ppm, slightly above where we are now. Global temperature would increase by about 1.8°F by 2050. Sea level would rise 9 to 10 inches by 2050, and 18 inches by 2090.The impact on the climate would be far smaller and less dangerous *(see pages 23-24)*.

6. **What are today's environmental responses to climate change?**

    Mitigation: Climate change mitigation is any action that reduces the risk of climate change, such as constructing energy-efficient buildings. Current policy solutions include:
    - Requirements that utilities generate a larger portion of their electric power from renewable sources.
    - A price on carbon, whether a tax or market-based solution, to make less efficient technologies more expensive.
    - Strengthening and enforcing national building energy codes.
    - Improved mileage standards for cars and trucks.

    Adaptation: Adaptation solutions will make us more resilient to the effects of climate change by allowing buildings to withstand floods, higher temperatures, and stronger storms. Climate adaptation strategies include:
    - Moving critical infrastructure away from flood zones to reduce the impacts of flooding from sea level rise and increasingly intense storms.
    - Restoring wetlands that protect coastal property from storms and planting more green space in cities to filter and control stormwater.
    - Raising smaller buildings and waterproofing larger buildings in low-lying areas to prevent damage from flooding.
    - Strengthening building codes to require buildings that can withstand more extreme temperatures and winds *(see pages 26-27).*

PART B: GREEN BUILDING

CHAPTER 5: The Benefits of Green Building

1. **What are the benefits of green building?**

   The four main benefits of green building are:

   1. Improves the economy.
   2. Creates more jobs for highly skilled workers.
   3. Safeguards the health of workers and occupants.
   4. Protects the environment, fighting climate change and ensuring cleaner air and water *(see page 30)*.

2. **How has green building impacted the economy and job market?**

   The Economy: The U.S. green building market has grown tremendously in the last few years, even during the recession when the overall building market declined. The total value of the green building market in 2011 was $78 billion; seven times the level in 2005. The total value of green construction is projected to reach as much as $248 billion in 2016.

   The Job Market: By stimulating the economy, green building spurs job growth and creates new job opportunities ("green jobs") for incumbent workers. Green buildings require workers with the skills, knowledge, and abilities to implement sustainable strategies *(see pages 31)*.

3. **What does the saying "the greenest building is one that is already built" mean?**

   Renovating and retrofitting existing buildings to current green standards often has a smaller overall environmental impact and can be less expensive than starting from scratch *(see page 32)*.

4. **How can construction materials affect your health?**

   Poor on-site air quality during construction can negatively affect people's health both during construction and after the building is occupied. Poor air quality is mainly caused by dust, volatile organic compounds (VOCs), carbon monoxide (CO), and other chemicals that building products release into the air.

   - **Dust:** Construction workers and building occupants can inhale microscopic bits of particulate matter (soot and other fine particles). Workers are exposed to dust when blasting with abrasive cleaners, handling dry cement, cutting wood, masonry, and drywall, welding, and breathing the exhaust from internal combustion motors.
   - **Volatile Organic Compounds (VOCs):** VOCs are carbon- based materials that evaporate into the air at room temperature. A variety of tasks on the job-site related to painting, gluing, sealing, coating, and cleaning use solvents and adhesives containing VOCs. Formaldehyde is one of hundreds of ingredients in products that when inhaled can cause health problems, including some cancers.
   - **Carbon Monoxide (CO):** CO is a colorless, odorless gas produced by incomplete burning. On the job-site, small engines or fuel-fired, temporary heating systems can release CO. During building operations, CO can come from improperly vented gas-fired air or water heaters, chimneys that are improperly installed or maintained, or any other combustion apparatus that is not functioning correctly. In low doses in the body, CO can cause flu-like symptoms such as nausea and headaches. High doses can cause brain damage and death *(see pages 33-34)*.

CHAPTER 6: Green Building Characteristics

1. **How does a green building save money for an owner?**
   Green buildings have lower operational costs than conventional buildings, due to lower fuel, electricity, and water use over time. This provides significant financial returns to the building owner. In addition to energy and utility savings, green buildings also frequently outperform conventional buildings across a wide variety of measurements, including building value, occupancy rates, and tenant satisfaction (*see page 36*).

2. **What is the whole-building approach?**
   The whole-building approach is a way of thinking about buildings as integrated systems that depend on one another, rather than addressing each system individually *(see page 38)*.

3. **How is an integrated design process different from a typical design process?**
   - **Early and ongoing design charrettes:** Design charrettes are collaborative meetings in which all team members – including architects, engineers, owners, operators, construction teams, and even the future occupants – discuss decisions on all aspects of the design, construction, and operation of the building.
   - **Modeling multiple versions of the building using performance analysis tools:** Building analysis tools provide estimates of energy and water use, and life-cycle costs of materials and buildings. These inform designers of the effect small design changes can have on the whole building system. This can give contractors and subcontractors a clear view of both the design and the project schedule.
   - **Early decision-making:** By engaging the whole team and using modeling tools, it is easier to make important decisions early on. The later it gets in the design process, the more expensive changes become. Although using the integrated design process may increase the duration of the planning process, it reduces the duration of the construction phase and can reduce costs *(see page 39)*.

CHAPTER 7: Measure Building Performance

1. **What are codes and standards? How are they similar and different?**
   Building codes: the basic legal structures establishing minimum levels of construction quality in order to protect occupants' health and safety, and regulate energy use. It is important to understand that codes are the lowest legal level of building safety and performance. It may be difficult to sell a building or get a permit for alterations if the building does not comply with codes *(see page 40)*.
   Standards: voluntary measures that aim to define building quality above and beyond code levels. Buildings that meet these standards show substantial improvements in performance *(see page 41)*.

2. **What are some building adaptation strategies to deal with the effects of climate change?**
   Adaptation strategies include:
   - Tightly seal and insulate buildings to ensure they maintain livable temperatures during power outages.
   - Design buildings to withstand warmer temperatures by minimizing window areas on east and west facades, shading southern windows against summer sun, and increasing wall and roof insulation.

- Prepare for more frequent floods and storms by raising buildings above the flood level, increasing the amount of stormwater that buildings can hold, using materials that are resistant to mold, and designing buildings that will withstand strong winds and hurricanes.
- Make various forms of backup and standby power more available *(see page 45).*

3. **What are the different green building rating systems used in the U.S.?**
    - **Leadership in Energy and Environmental Design (LEED):** Established by the nonprofit U.S. Green Building Council (USGBC) in 1998, LEED is an internationally known certification system that provides third-party review and verification of a variety of sustainability measures.
    - **ENERGY STAR:** ENERGY STAR applies to homes, commercial, and industrial buildings, as well as equipment and products. It provides guidelines, technical information, and performance-measuring tools for energy-efficient solutions and suggests best management practices.
    - **WaterSense:** A U.S. EPA program that certifies new single or multi-family home construction in water efficiency. It examines both the interior systems of the home, as well as the irrigation system and landscape design.
    - **Health House:** Health House provides standards for healthier home indoor air quality. Verified by a third party, "Health House Recognized" homes are durable, high-performing, and create a healthy and comfortable indoor environment.
    - **Enterprise Green Communities:** Enterprise Green Communities is the only standard for green affordable housing. The buildings must follow criteria that cover integrative design, location, site, water, energy, materials, indoor environment, and operations and maintenance.
    - **Green Globes:** Green Globes is used in Canada and the U.S. The Canadian government has adopted the rating system for their entire real estate portfolio. It has a simpler reporting structure and is ideal for use on smaller projects, but is generally regarded as less rigorous than LEED.
    - **Passive House:** Passive House goes far beyond the basic requirements of building codes and even greatly exceeds LEED requirements in energy efficiency. It is considered to be the most rigorous energy standard in wide use today, with a goal of reducing energy consumption in buildings by at least 90%.
    - **Living Building Challenge:** The Living Building Challenge further surpasses the concept of passive design to create “living buildings”. A living building “generates all of its own energy with renewable, nontoxic resources, captures and treats all of its water, and operates efficiently and with maximum beauty” *(see pages 42-43)*.

CHAPTER 8: Create Sustainable Sites

1. **What is the heat island effect?**

    The heat island effect explains why developed areas are warmer than their natural surroundings. This is because asphalt roads, black roofs, and other dark surfaces absorb and store more energy from the sun than light surfaces or planted areas. The stored energy is then released as heat, which warms the city and forms a heat island *(see page 48).*

2. **What are absorbent landscapes, and how do they help reduce stormwater runoff?**

    Absorbent landscapes are natural or manmade materials that allow water to trickle directly into the ground, naturally filtering out contaminants. The tree roots, plants, rocks, and soil naturally filter the water and slow runoff *(see page 50)*.

3. **What are the benefits of green roofs?**
    - Reduce stormwater runoff by 50-90%.
    - Protect roof membranes and increase the life expectancy of the roof.
    - Increase the humidity in dry climates, which helps ease breathing difficulties.
    - Develop a natural habitat for animals and plants.
    - May create recreation areas for occupants.
    - Reduce the heat island effect.
    - Reduce cooling costs in buildings.
    - Increase durability of buildings and improve performance of rooftop mechanical equipment, due to the low temperature of air intakes *(see page 51).*

4. **What are four different types of pollution on construction sites?**
    1. Contaminated soil and runoff leaving the site.
    2. Air pollution from diesel construction vehicles contains over 40 toxic contaminants.
    3. Light pollution disturbs sleep cycles, which can lead to health problems from obesity to depression.
    4. Noise pollution causes similar health problems to light pollution. In addition, it can cause hearing loss for workers, stress-related illnesses, and high blood pressure *(see page 52-53)*.

5. **What is a CAPP Plan?**
    A CAPP Plan is a set of procedures that reduce contamination from work sites, and parts of it, such as an Erosion and Sediment Control Plan, are required by building codes in many regions of the U.S *(see page 52).*

CHAPTER 9: Reduce Water Use

1. **What is the goal of water efficiency in buildings?**
    To reduce the amount of water we waste in our buildings by applying simple water conserving tactics for many of these uses. The goal is to maintain our health and hygiene benefits while using less water *(see page 56).*

2. **What are some examples of water-efficient fixtures?**
    - High-efficiency toilets (HET) using 1.28 gallons (one pint) per flush and high-efficiency urinals (HEU) using 0.125 gallons per flush
    - Flow restrictors built into faucet aerators
    - Fixtures with automatic controls
    - Dry fixtures such as composting toilet systems and waterless urinals *(see page 56)*

3. **What is WaterSense?**
    WaterSense is an EPA program that certifies new single or multi-family home construction in water efficiency. WaterSense examines both the interior systems of the home, including all fixtures and appliances, as well as the irrigation system and landscape design outside. In order to get WaterSense certification, homes must be built by a WaterSense building partner, meet all applicable criteria, and be certified by a licensed third party *(see page 42 & 56)*.

4. **What are three alternative sources of water?**
    1. **Rainwater:** Rainwater can be collected from roofs and reused for non-potable needs. Rainwater harvesting is not legal in some regions because of water-rights issues.
    2. **Greywater:** Greywater is untreated wastewater that has not come into contact with toilet or kitchen waste. Greywater systems reuse water from bathtubs, showers, bathroom sinks, and sometimes washing machines, for use inside and outside buildings.
    3. **Blackwater:** Blackwater is wastewater containing food or human waste from toilets, urinals, kitchen drains, and dishwashers *(see page 57).*

5. **What are some methods to reduce water use on a construction site?**
    - Create paths with crushed stone to prevent dirt from being tracked into newly constructed areas.
    - Have a walk-off mat at the site entrance to allow workers to wipe their feet.
    - Clean tools with buckets of water, instead of running water.
    - Use brooms, vacuums, or dry squeegees to clean first. Then, if water is necessary, use water brooms or trigger guns attached to hoses *(see page 58)*.

CHAPTER 10: MANAGE ENERGY EFFIECIENTLY

1. **What are some building systems that can waste energy?**
    - **Poorly performing building envelopes:** A building's foundation, exterior walls, roof, windows, and doors are called the *building envelope*. If improperly designed, building envelopes can have many holes that let excessive amounts of heat and air pass in and out of the building.
    - **Inefficient lighting:** Lighting accounts for about 25% of electricity used in buildings. Needlessly high-powered overlit areas and older lamps and ballasts can waste substantial energy.
    - **Oversized or undersized HVAC systems:** Oversized boilers or chillers provide too much heating or cooling which can make occupants uncomfortable. Oversized systems also short cycle (turn on only for very short periods), which stresses the systems and can lead to malfunctions and shorter life spans. Undersized units work harder than they were designed to and can burn out quickly.
    - **The building not being operated as designed:** Building operators must be well-trained to handle the equipment in the buildings they operate. For example, if a building is constructed with an automatic daylighting system, but the system is not properly calibrated, the occupants will leave the lights on all the time, losing out on future savings *(see page 60)*.

2. **What are the three methods for improving energy performance in a building?**
    Strategies to improve energy efficiency fall into three categories:
    1. Reduce the end-use demand for energy.
    2. Increase the efficiency of energy systems.
    3. Generate energy from renewable sources (see page 61).

3. **What are the benefits of retrofitting a building?**
    In addition to saving energy, retrofitting creates local jobs, reduce building operating costs, and make the building more comfortable for occupants *(see page 62)*.

4. **What are examples of passive design strategies used to increase efficiency in buildings?**
    - Insulating and air sealing the building to levels well beyond common practice in the U.S. to minimize heat gain in summer and heat loss in winter.

- Using large, south-facing windows that are shaded by carefully calculated overhangs to lower cooling loads in summer and allow heat gain in winter.
- Taking advantage of natural ventilation when possible, and using heat recovery ventilation during the heating and cooling seasons. Heat recovery ventilation systems (HRVs) allow the outgoing warm air to preheat the fresh, cold air being drawn in during winter. In summer, incoming fresh air is precooled by the cooler exhaust air *(see page 63)*.

5. **What is the definition of commissioning? For a LEED building, what systems must be commissioned?**

   Commissioning (Cx or Cx'g) is a process that verifies and documents that a new facility and all of its systems are installed, tested, and operated to meet the design intent specified in the Owner's Project Requirements (OPR). The following items must be commissioned in LEED certified buildings: heating, ventilation, air conditioning, HVAC controls, lighting and controls, domestic hot water, renewable energy (wind, solar, etc.), building envelope, and indoor environmental quality. Additional components and systems that may require commissioning: mechanical insulation, water treatment system, stormwater management system, and IT infrastructure *(see page 65)*.

6. **How are specific trades involved in the commissioning process?**
   1. **Contractors and subcontractors** contribute expertise during the development of the Cx Plan, arrange for installation inspections, and coordinate pre-functional and start-up tests and system troubleshooting.
   2. **Tradespeople** provide access and detailed information to the CxA about the building systems during installation.
   3. **Building operators** learn how systems operate before the building is officially turned over, diagnose potential operational problems before they occur, and maintain these systems to ensure lower energy consumption and maintenance costs over the life of the building. *(see page 66)*

CHAPTER 11: Reuse & Recycle Materials

1. **What are three ways to measure the environmental impact of a building product? Which method is the most comprehensive?**
   1. **Embodied energy** is the total amount of energy required to extract a product's raw materials and produce, transport, distribute, and install the product. Unlike carbon footprint, embodied energy does not include how a product is used; it only measures the energy needed to create it. Embodied energy is expressed in energy per unit of mass.
   2. **Carbon footprint** is the measurement of the total amount of all greenhouse gas emissions released during the production, use, and disposal of any product. It is measured in pounds and is presented in equivalent pounds of CO_2 (carbon dioxide equivalency, written CO_2e).
   3. **Life cycle assessment (LCA)** is a comprehensive analysis that provides a more complete understanding of a product's total impact. LCA includes all the materials, processes, and services that go into making and using a product, and accounts for the balance between different phases of a product's life *(see pages 26 and 68)*.

2. **How do mining, harvesting, and manufacturing practices affect human health and the environment?**

   Extracting raw materials for construction products and building operations contribute to a project's carbon footprint. In addition, many of the mining, harvesting, and manufacturing practices create toxic waste and pollution. For example:

   - **Clear cutting** and other poor forestry practices destroy habitats, erode soil, and kill species.
   - **Polyvinylchloride (PVC)** is a type of plastic that is used almost everywhere, from floor tiles to drain pipes. The manufacturing process uses crude oil and chlorine gas that release hazardous chemical byproducts. The leftover waste can contain lead and other toxic substances, which can cause cancer, brain damage, or problems to your reproductive and immune systems. Toxic gases are produced when PVC is burned, either in an incinerator or accidental fire.
   - **Mining** iron, copper, and gypsum require digging huge pits that destroy ecosystems and produce hazardous waste.
   - **Hazardous Elements** in lighting equipment such as mercury and phosphorus *(see page 69)*.

3. **What are the five ways to use materials sustainably? How do they benefit the environment?**
   1. **Reduce:** The first step in managing waste is reducing the demand for materials. Reducing consumption is the least expensive and most effective strategy to protect the environment.
   2. **Reuse:** The second step is using the same item more than once. This can apply to entire buildings or component parts.
   3. **Recycle:** After reducing demand and reusing materials, the third step for treating waste products is recycling. Waste products can be recycled into materials that can be used to create new products.
   4. **Regional:** Regional materials are extracted and manufactured near your construction site. Using regional materials supports the local economy and stimulates local job growth. It also greatly reduces the amount of energy used to transport products.
   5. **Rapidly Renewable:** Rapidly renewable materials are able to regrow in a short time period – ten years or less. Rapidly renewable materials come from plants (bamboo, corn, cork, cotton, linoleum, natural rubber, and soy) or animals (wool) *(see pages 70-73)*.

4. **What materials can the contractor and tradesperson be responsible for recycling?**

   Contractors can recycle all of the following items: cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet, and insulation materials *(see page 74).*

CHAPTER 12: Build Healthy Indoor Environments

1. **How can poor indoor air quality harm humans?**

   After the building is complete, occupants can be exposed to dangerous substances if the building's ventilation systems are not properly managed. The level of pollutants inside a building can be as high as 200 times the level outdoors. Health impacts are widespread and varied, but include the following:

   - Over 18 million Americans have asthma. Indoor air pollutants worsen asthma symptoms, possibly triggering attacks.
   - Mold in damp environments causes upper-respiratory symptoms such as coughing or wheezing.

- Each year, more than 40,000 people seek medical help after exposure to carbon monoxide. *(see page 76)*

2. **What are some common indoor air contaminants and where do they come from?**
    - **Formaldehyde:** Adhesives in plywood and other pressed wood products, wallpaper, and furnishings release formaldehyde. It causes lung irritation, headaches, and allergic reactions. The International Agency for Research on Cancer classifies formaldehyde as a known human carcinogen (cancer- causing substance).
    - **Organic chemical particulates:** Chemicals from aerosol sprays, solvents, glues, and cleaning products can damage the liver, kidney, and brain, and cause various types of cancer.
    - **Loose asbestos:** Asbestos from damaged insulation, fireproofing, or acoustical materials causes lung cancer, mesothelioma, and other cancers.
    - **Lead:** Lead paint dust can cause nerve and brain damage, kidney damage, and developmental delays, especially in children *(see page 77)*.

3. **What are five products with low-emitting alternatives? How can you tell they are healthier than conventional products?**
    1. Carpets and flooring systems
    2. Composite wood and agrifiber (plant fibers other than wood) materials
    3. Furniture and furnishings
    4. Ceiling and wall systems
    5. Paints, adhesives, coatings, and sealants

    As a construction professional, you may notice that green products such as paints and sealers are water-based, rather than solvent-based, and are easier to clean up. Carpets and carpet adhesives do not have the intense, irritating odors found in conventional materials. Dust from plywoods and other composite woods using low-emitting adhesives is less likely to sting your eyes and nose than those using urea- formaldehyde *(see page 78).*

4. **What are two dangerous substances that must be cleaned up on-site by professionals?**
    1. **Asbestos:** Asbestos is a set of naturally occurring minerals that were once used in building components like acoustic baffles, fireproofing, insulation, and wall siding. When these building materials are disturbed, they can release asbestos fibers into the air. When inhaled, the resulting irritation can cause chronic lung disease, lung cancer, and other harm to the body that often isn't detectable for years. If asbestos is discovered, all work in the area should stop and professionals should be contacted immediately.
    2. **Lead:** In the past, lead was added to paints to make them water-resistant and durable. Lead was discovered to be toxic, especially to children, and was banned in paints and other products in 1978 *(see page 79-80)*.

5. **What measures are included in a CIAQ Plan?**
    - **Ventilation:** Provide fresh air supply for workers.
    - **HVAC System Protection:** Protect HVAC components such as equipment and ductwork from contamination.
    - **Source Control:** Limit sources of pollutants by airing out carpet and woodwork in unoccupied spaces before installation, and using low- or no-VOC adhesives, sealants, paints, and coatings.

- **Pathway Interruption:** Use partitions or plastic sheeting to isolate areas where contaminants are present. Depressurize indoor construction areas so contaminants do not escape into completed or occupied areas.
- **Housekeeping:** Confirm daily sweeping and wet mopping to control dust, immediately clean up spills, and control debris. Protect moisture sensitive materials by covering up equipment and materials, and elevating materials off the ground, especially porous items such as drywall, ceiling tiles, and insulation.
- **Scheduling:** Schedule work so that messy activities such as sawing, sanding, and cutting wood and metals do not occur in completed or occupied spaces. Provide sufficient time for materials to fully off-gas prior to occupancy. Provide time for the designated flush- out procedure *(see page 81)*.