Building Science Education Learning Objectives for the Zero Energy Design Designation (ZEDD)

Objectives are based on the Building Science Education Series by the U.S. Department of Energy Solar Decathlon.

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Required:

Module 1: Buildings and Energy

- Discover how buildings account for 40% of total energy use in the United States and where this energy comes from.
- Gain insight on how electricity is delivered to buildings and how to read an electricity bill.
- Define the three main components of the power grid and how they work together to deliver electricity to buildings and other end users.
- Understand the role of building energy codes, standards, and voluntary programs in driving building efficiency.

Module 2: Zero Energy Buildings

- Understand the critical balance between energy generation and consumption in a zero energy building.
- Distinguish between source energy and site energy, and understand the calculations for each.
- Discuss the relationship between energy efficiency and cost in zero energy building design.
- Identify various passive design elements and understand how they can be implemented to reduce building loads.

Module 3: Building Envelopes

- Explain how heat travels from higher temperatures to lower temperatures using Fourier's Law.
- Understand and describe the methods of heat transfer (conduction, convection, and radiation), and how a well-designed building envelope optimizes each of these to create a comfortable indoor environment.
- Discuss the different types of insulation, windows, and wall

construction materials and their impacts on the final R-value of a wall.
- Define infiltration and exfiltration and discuss commissioning procedures used to pinpoint areas of air leakage in a building.

Module 4: Heating, Ventilation, and Air Conditioning Systems

- Define the various efficiency metrics for heating, ventilating, and air conditioning (HVAC) systems.
- Interpret the science behind heating sources used in buildings and how heat is distributed.
- Discern the differences between types of hot water heating systems and explain why their design matters.
- Discuss the basics of building automation systems and the role they play in making buildings smarter and more efficient.

Module 5: Lighting

- Discuss the differences between incandescent, fluorescent, and LED (light-emitting diode) lighting technologies.
- Understand basic lighting principles such as efficacy, lighting power density, illuminance, and correlated color temperature.
- Considering how lighting affects building occupants by taking a human-centric approach to lighting design.
- Read a Lighting Facts Label and use knowledge of the lighting concepts above to select appropriate lamps and fixtures for a space.

Module 6: Plug and Process Loads

- Understand plug and process loads why they play an increasing large role in building energy consumption.
- Name and discuss various strategies for reducing plug loads in computers, electronics, appliances, and other plug load sub-end uses.
- Discuss some standards and programs that exist to reduce plug and process load consumption.
- Analyze a case study of plug and process load reduction in a commercial office building.

Module 7: Embodied Environmental Impact

- Learn what embodied emissions are and why they are playing an increasingly important role in building design and construction.
- Examine a building's life cycle and the processes and emissions associated with each step.
- Define many important terms including circular economy, cradle-to-grave, scope 1/2/3 emissions, and more.
- Discuss the purpose of life cycle assessments and the software tools that exist to complete them.

Module 8: Renewable Energy and Zero Energy Buildings

- Understand the basics of photovoltaics (PV) and leverage tools to estimate PV sizing and generation for a specific building and location.
- Explain the basics of other renewable energy sources such as wind, geothermal, hydropower, and biomass.
- Learn the importance of aligning building loads with renewable energy profiles and identify strategies to accomplish this.
- Discuss the ways in which buildings can shift, reduce, or store energy to enable a more stable and sustainable future electric grid.

Optional:

Module 9: Building Energy Retrofits

- Understand the industry definition, importance, relevance, and complications of building energy retrofits.
- Learn the principles that add value to a building assessment which must precede the development of a comprehensive retrofit plan.
- Recognize existing deficiencies, fresh air, moisture protection, and thermal resilience as the primary relevant factors that influence a successful retrofit project plan.
- Explain the relevance of material choices for building performance in the context of operational energy and net carbon benefit.
- Perceive what is involved to assess the net benefit of a building retrofit project in comparison to new construction.