Indiana Department of Education
Academic Standards Course Framework

Environmental Sustainability

Environmental Sustainability is a specialization course that builds upon prior knowledge learned in previous engineering and science courses. Students investigate and design solutions in response to current challenges such as providing the world with clean and abundant drinking water, an adequate food supply, and renewable energy. Students are introduced to environmental issues and use the engineering design process to design, build, and test potential solutions. This course engages critical thinking and problem-solving skills as students apply and extend their knowledge through designing experiments, managing projects, conducting research, and creating presentations to communicate solutions.

- DOE Code: 4818
- Recommended Grade Level: 11, 12
- Required Prerequisites: Introduction to Engineering Design, Principles of Engineering, and Biology
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
- Counts as a Directed Elective or Elective for all diplomas

Core Standard 1 **Students consider systematic, ethical, and safe solutions to environmental problems.**

- ES-1.1 Apply the steps of the design process to environmental sustainability problems.
- ES-1.2 Apply a professional code of ethics to environmentally sustainable solutions.
- ES-1.3 Apply safety practices when using materials, tools, and equipment.
- ES-1.4 Demonstrate proper use of aseptic techniques and containment measures.
- ES-1.5 Utilize specialized equipment appropriately.

Core Standard 2 **Students will examine how engineering and technology can impact natural and engineered environments.**

- ES-2.1 Investigate principles and practices of sustainability.
- ES-2.2 Analyze local and global impacts of engineered solutions on the environment, society, and the economy.
- ES-2.3 Identify examples of how biogeochemical processes inform and constrain engineered solutions.
- ES-2.4 Discuss examples of interconnectedness and interdependence of social, environmental, and economic systems.
- ES-2.5 Outline strategies that enable the identification and analysis of direct and indirect impacts of an engineered solution.

Core Standard 3 **Students will explore and generate solutions to manage and protect water resources.**

ES-3.1 Evaluate case studies of shortages, contamination, and inadequate distribution of water supplies around the world.

ES-3.2 Analyze direct and indirect use of water in our daily activities to determine the impact of lifestyle and diet on personal water usage.

ES-3.3 Compare and contrast water usage from a personal and global perspective.

ES-3.4 Evaluate water quality using biological and chemical methods to test for the presence of contaminants.

ES-3.5 Design and construct a water purification device to remediate contaminated water.

ES-3.6 Measure how effectively a water purification device removes contaminants.

ES-3.7 Investigate how biological organisms can be used to accelerate water remediation.

ES-3.8 Examine the effects of human activity on local and global water supplies.

ES-3.9 Evaluate methods of remediation, purification, and treatment of water sources and wastewater.

ES-3.10 Design and evaluate a system to remediate a local water supply after becoming polluted or contaminated.

Core Standard 4 **Students will use biotechnology to investigate and propose solutions for world food security.**

ES-4.1 Examine threats to world food security.

ES-4.2 Compare and contrast biotechnological and social solutions to world food security.

ES-4.3 Analyze social, economic, and biological constraints and benefits to utilizing genetically modified organisms.

ES-4.4 Extract and modify DNA from living cells to demonstrate application of the molecular biology principles required to perform this function.

ES-4.5 Apply genetic engineering processes to modify an organism to solve a world food security problem.

ES-4.6 Design a bio-engineered solution to a food security problem.

Core Standard 5 **Students will explore, evaluate, and propose solutions to global energy demands using renewable energy sources.**

- ES-5.1 Compare and contrast energy use from a personal and global perspective.
- ES-5.2 Analyze the types of energy systems used around the world.
- ES-5.3 Predict future energy needs in Indiana, the United States, and the world, based on current and historical data.
- ES-5.4 Use instrumentation to measure and quantify biological processes that generate biofuels.
- ES-5.5 Evaluate the role of renewable energy in a sustainable energy mix.
- ES-5.6 Describe processes used in industry to create biofuels.
- ES-5.7 Create a plan for an industrial scale application of a biofuel production process.
- ES-5.8 Produce precursors or biofuel products using living organisms such as algae and yeast.

Core Standard 6 **Students will explore environmental science, engineering, and biotechnology related careers.**

- ES-6.1 Investigate careers relating to environmental science, engineering, and biotechnology.
- ES-6.2 Analyze education and skill requirements for environmental science, engineering, and biotechnology professions.
- ES-6.3 Explore the outlook, demand, and projected wages for environmental science, engineering, and biotechnology careers.

Career and Technical Student Organizations

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as the **Technology Student Association (TSA).**