# Project Lead The Way [PLTW] Environmental Sustainability

PEIMS Code: N1303746

Abbreviation: ENVSUS

Grade Level(s): 9–12

Award of Credit: 1.0

## Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

## Course Description:

In PLTW Environmental Sustainability, students design solutions to solve real-world challenges related to clean drinking water, a stable food supply, and renewable energy. Students are introduced to environmental issues and use the engineering design process to research and design potential solutions. Through both individual and collaborative team activities, projects, and problems, students solve problems as they practice common design and scientific protocols, such as project management, lab techniques, and peer review. Students practice problem-solving with structured activities and progress to open-ended projects and problems that require them to develop planning, documentation, communication, and other professional skills. Building enthusiasm for and a real understanding of the role, impact, and practice of environmental sustainability is a primary goal of the course.

## Essential Knowledge and Skills:

(a) General Requirements. Environmental Sustainability is recommended for students in Grades 9-12. Recommended Prerequisites: At least one credit in a Level 2 or higher course in engineering or renewable energy. Students successfully completing this course shall be awarded one credit.

(b) Introduction.

(1) In Environmental Sustainability (ES), students design solutions to solve real-world challenges related to clean drinking water, a stable food supply, and renewable energy. Students are introduced to environmental issues and use the engineering design process to research and design potential solutions. Environmental issues and solutions are the focus of the activities and projects conducted throughout this course.

(2) Through both individual and collaborative team activities, projects, and problems, students problem-solve as they practice common design and scientific protocols, such as project management, lab techniques, and peer review. Building enthusiasm for and a real

understanding of the role, impact, and practice of environmental sustainability is a primary goal of the course.

(3) PLTW Environmental Sustainability engages students in authentic experiences that translate career awareness and exploration into preparation for careers focused on environmental sustainability, such as careers related to producing renewable fuels, providing food security, and managing our water supply.

(4) Students are encouraged to participate in extended learning experiences, such as career and technical student organizations, leadership or extracurricular organizations, and work-based experiences.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills.

(1) Career Readiness. The student uses the professional skills and knowledge required of engineers to pursue opportunities and create sustainable solutions to improve and enhance the quality of life of individuals and society. The student is expected to:

(A) demonstrate the educational, professional, and technical skills required for professional engineering practice;

(B) describe the educational and professional licensure requirements for engineering practice and engineering professionals;

(C) describe the role of engineers in society;

(D) define engineering as the creation of solutions such as new and improved products, technologies, systems, and processes to meet the needs of people and society;

(E) investigate engineering successes and failures and their impact on individuals and society;

(F) describe and distinguish among the different disciplines of engineering; and

(G) explain why engineering disciplines continue to evolve and emerge as new interdisciplinary fields or sub-disciplines to better meet the needs of society.

(2) Communication. The student communicates effectively with a variety of audiences using multiple modalities. The student is expected to:

(A) communicate effectively with an audience based on audience characteristics;

(B) demonstrate use of established conventions of written, oral, and electronic communications, including grammar, spelling, usage, and mechanics;

(C) demonstrate use of acceptable formats for technical writing and professional presentations;

(D) describe how the size and characteristics of an audience affect communication;

(E) modify the content, format, level of technical detail, and length of communications to meet the needs of the audience;

(F) cite references properly for all communication in an accepted format;

(G) label tables and figures clearly with units and explain the information presented in context;

(H) describe characteristics important to oral delivery of information such as volume, tempo, eye contact, and energy; and

(I) vary communication elements of delivery to convey and emphasize information and engage the audience.

(3) Collaboration. The student demonstrates an ability to function on multidisciplinary teams. The student is expected to:

(A) facilitate an effective team environment to promote successful goal attainment;

(B) describe the various individual roles and interdependence of a collaborative team;

(C) solicit and negotiate diverse views and beliefs to reach workable solutions;

(D) identify, describe, and justify a diverse composition of engineering and other disciplines that might work together to address challenges, including the Grand Challenges of Engineering;

(E) contribute individually to overall collaborative efforts;

(F) describe one's individual role and expectations of performance within the team;

(G) manage project timelines and resources as part of an engineering design process; and

(H) select and use a system of collaborative tools such as cloud-based tools, document sharing, and video and text functions to successfully complete a project.

(4) Ethical Reasoning and Mindset. The student applies ethical consideration to engineering decision making. The student is expected to:

(A) explain how engineers demonstrate the responsibility they have to serve the public interest, his or her clients, and the profession with a high degree of honesty, integrity, and accountability;

(B) assess an engineering ethical dilemma between environmental limitations and the needs and wants of our society;

(C) explain how engineering solutions can have significantly different impacts, including environmental, economic, social, political, health, and welfare, on an individual, society, and the natural world;

(D) identify an ethical dilemma that has positive and negative outcomes resulting from an engineering decision or series of decisions;

(E) create sustainable solutions to meet the needs of society without compromising the ability of future society to meet their needs;

(F) identify principles that help guide development of sustainable solutions with considerations for sustainable development to include people, planet, and profit; and

(G) describe the life cycle of a product or service and identify energy consumption, wastes, and emissions that are produced in the process.

(5) Critical and Creative Problem-Solving. The student explains and justifies an engineering design process. The student is expected to:

(A) describe major steps of a design process and identify typical tasks involved in each step;

(B) explain the importance of carefully and specifically defining a problem or opportunity, design criteria, and constraints to develop successful design solutions;

(C) identify the step in which an engineering task would fit in a design process;

(D) outline how iterative processes inform engineering decisions, improve solutions, and inspire new ideas; and

(E) explain the role of research and the role of stakeholders in the process of design.

(6) Critical and Creative Problem-Solving. The student synthesizes an ill-formed problem into a meaningful, well-defined problem. The student is expected to:

(A) collect, analyze, and interpret information relevant to the problem or opportunity at hand to support engineering decisions;

(B) document a design process according to best practices in an engineering notebook;

(C) identify and define visual, functional, and structural design requirements with realistic constraints against which solution alternatives can be evaluated; and

(D) list potential constraints for a defined problem that may impact the success of a design solution, such as economic, environmental, social, political, ethical, health and safety, manufacturability, technical feasibility, and sustainability.

(7) Critical and Creative Problem-Solving. The student generates multiple potential solution concepts. The student is expected to:

(A) represent concepts using a variety of visual tools such as sketches, graphs, and charts to communicate the details of an idea;

(B) develop models to represent design alternatives and generate data to inform decision making, test alternatives, and demonstrate solutions;

(C) describe the use of a model to accurately represent the key aspects of a physical system, including the identification of constraints such as cost, time, or expertise that may influence the selection of a model;

(D) define various types of models that can be used to represent products, processes, or designs such as physical prototypes, mathematical models, and virtual representations and explain the purpose and appropriate use of each; and

(E) explain why there are often multiple viable solutions and no obvious best solution.

(8) Critical and Creative Problem-Solving. The student selects the best design solution for real-world problems. The student is expected to:

(A) select a solution path from many options to successfully address a problem or opportunity; and

(B) develop and carry out a justifiable scheme to compare and evaluate competing solutions paths using a decision matrix to compare and evaluate competing solutions based on design criteria.

(9) Critical and Creative Problem-Solving. The student makes judgments and decisions based on evidence. The student is expected to:

(A) consider and evaluate constraints and criteria throughout an engineering design process;

(B) plan and execute an investigation to collect valid quantitative data to serve as a basis for evidence and inform decisions;

(C) identify the data needed to answer a research question and the appropriate tools necessary to collect, record, analyze, and evaluate the data;

(D) describe testing considerations, such as cost, risk, time, environmental, social, and personal impacts to ensure a valid, reliable, safe, and ethical investigation; and

(E) evaluate evidence and arguments to identify deficiencies, limitations, and biases for appropriate next steps in the pursuit of a better solution.

(10) Critical and Creative Problem-Solving. The student demonstrates independent thinking and self-direction in pursuit of accomplishing a goal. The student is expected to:

(A) show proficiency in time management skills through the accomplishment of a goal without direct oversight;

(B) explain the limitations of one's knowledge and skills in pursuit of accomplishing a goal;

(C) plan how to gain additional knowledge and understanding to accomplish a goal;

(D) demonstrate and explain the value of flexibility and adaptability to change;

(E) adapt to varied roles, job responsibilities, schedules, and contexts;

(F) describe why persistence is important when identifying a problem and pursuing solutions;

(G) accept failure as part of an evolution of individual growth and necessary to the expansion of the engineering profession by explaining the value and importance of modifications and revisions to solutions that are a critical part of the iterative design process;

(H) reflect critically on past experiences to inform future progress; and

(I) explain why risk is necessary for progress and that engineers must work with an acceptable level of risk.

(11) Engineering Tools and Technology (ETT). The student uses a variety of measuring devices to measure and report quantities accurately and to a precision appropriate for the purpose. The student is expected to:

(A) explain why all measurements approximate the true value of a quantity;

(B) explain and differentiate between the accuracy and precision of measurement;

(C) use dimensional analysis and unit conversions to transform data to units appropriate for a particular purpose or model; and

(D) select and effectively use the appropriate tool for accurately measuring specific volumes; i.e., micropipette, serological pipet, graduated cylinder, and beaker.

(12) Engineering Tools and Technology. The student uses a spreadsheet application to help identify and solve a problem. The student is expected to:

(A) populate a spreadsheet application with data and organize the data to be useful in accomplishing a specific goal;

(B) use the functions and tools within a spreadsheet application to manipulate, analyze, and present data in a useful way, including regression analyses and descriptive statistical analyses; and

(C) use spreadsheet programming features, including macros, to demonstrate the ability to reduce repetitive actions and increase efficiency.

(13) Engineering Tools and Technology. The student constructs physical objects. The student is expected to:

(A) describe a process to build a physical object based on a conceptual communication such as a drawing or description; and

(B) calculates ratios and proportions.

(14) Engineering Tools and Technology. The student applies mathematical models and interprets the output of models to test ideas or make predictions. The student is expected to:

(A) represent data for two quantitative variables on a scatter plot and describe how the variables are related; and

(B) interpret the rate of change (slope) and the intercept (constant term) in the context of the data for linear models.

(15) Engineering Tools and Technology. The student applies system thinking to consider how an engineering problem and its solution fit into broader systems. The student is expected to:

(A) explain why the framing of problems and defining assumptions make problems manageable in the context of larger systems; and

(B) list realistic considerations that constrain solutions within the broader system.

(16) Foundations in Math and Engineering Science. The student analyzes environmental and physical factors related to safe drinking water. The student is expected to:

(A) analyze the relationship between population growth and water resources;

(B) describe how human health is affected by the quality of drinking water sources;

(C) explain the characteristics of clean water;

(D) explain why clean water is necessary for survival;

(E) describe common sources of drinking water contamination;

(F) explain contaminant cycling through an ecosystem;

(G) describe the types of water found on Earth and the relative amounts of each type;

(H) describe the most common sources of drinking water in the United States and compare them to drinking water sources in other parts of the world; and

(I) describe the infrastructure components of private wells and public drinking water systems.

(17) Foundations of Math and Engineering Science. The student uses a variety of chemical and biological assays to detect contaminants in water. The student is expected to:

(A) explain how water quality is quantitatively measured using chemical and biologically based testing processes; and

(B) perform and analyze a culture assay to detect coliform and E. coli in water.

(18) Foundations of Math and Engineering Science. The student identifies appropriate wastewater treatment processes and designs to address common wastewater contaminants. The student is expected to:

(A) outline the stages of treatment that a typical modern sewage treatment plant uses to treat sewage water; and

(B) explain the role of bacteria in water treatment.

(19) Foundations of Math and Engineering Science. The student identifies and applies appropriate water remediation techniques to purify water. The student is expected to:

(A) describe the interacting roles of bacteria, protozoa, and rotifers in a wastewater treatment ecosystem;

(B) describe and provide examples of how physical, chemical and biological processes work in the process of purifying contaminated water;

(C) explain how plants remove nitrates from contaminated water;

(D) use the engineering design process to design, build, and test a water filtration system;

(E) design and perform an experiment to use phytoremediation to remove contaminants from water; and

(F) design and conduct a scientific experiment to test a variable affecting the bacteria's ability to decompose oil.

(20) Foundations of Math and Engineering Science. The student explains the meaning and value of food security and analyzes environmentally and socially sustainable and unsustainable food production methods. The student is expected to:

(A) analyze the advantages and disadvantages of genetically modified crops;

(B) list and explain potential ways that crop plants might be improved through genetic modification;

(C) explain how transgenic plants could lead to positive and negative consequences to the environment and local ecosystem;

(D) describe the economic and socio-political issues associated with genetically modified food crops;

(E) investigate and summarize the ethical ramifications of genetic engineering and recombinant DNA technologies;

(F) analyze socially sustainable and unsustainable food production methods; and

(G) recognize that food security exists when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.

(21) Foundations of Math and Engineering Science. The student understands the structure and function of DNA. The student is expected to:

(A) recognize that genetic information is contained in DNA molecules, which are double-helical structures with nucleotides;

(B) describe the relationship between chromosomes, DNA, genes, and proteins;

(C) illustrate the process of DNA replication;

(D) use the universal genetic code to determine the amino acids coded by a DNA sequence;

(E) illustrate transcription and translation;

(F) recognize that the DNA inserted into a plasmid may provide the code for a new protein; and

(G) analyze resulting DNA fragments on a gel.

(22) Foundations of Math and Engineering Science. The student applies the scientific techniques used in molecular biology. The student is expected to:

(A) ligate DNA from two organisms to create a unique plasmid vector;

(B) isolate plasmid DNA from a bacterial cell and analyze the composition of the plasmid using restriction enzymes and gel electrophoresis;

(C) describe the process of gene cloning;

(D) map a plasmid in terms of the location of its restriction sites, sites that are recognized and cut by specific restriction enzymes;

(E) use proper laboratory techniques and safety protocols to extract and isolate DNA from food items;

(F) recognize that polymerase chain reaction (PCR) is a laboratory procedure that produces multiple copies of a specific DNA sequence;

(G) use proper laboratory techniques and safety protocols to insert a new plasmid into bacterial cells through the process of bacterial transformation;

(H) use proper laboratory techniques and safety protocols to separate DNA fragments using gel electrophoresis;

(I) recognize that plasmids that are cut with restriction enzymes can be joined or ligated to DNA, from any species, that has been cut with the same enzyme; and

(J) recognize that the results of a ligation experiment can be gauged by restriction analysis of an extracted plasmid with subsequent visualization of resultant bands via electrophoresis, demonstrating the number of gene inserts and their orientation.

(23) Foundations of Math and Engineering Science. The student develops and justifies an argument for or against the use of genetic recombination methods in order to improve food security. The student is expected to:

(A) develop logical and factual arguments in support of or against the creation and use of genetically modified organisms;

(B) investigate and summarize the ethical considerations of genetic engineering and recombinant DNA technologies;

(C) identify the ethical concerns with creating and using genetically modified organisms;

(D) recognize that genetically modified plants contain genes that have been physically moved or added to enhance a trait in that plant;

(E) calculate transformation efficiency to determine the success of a bacterial transformation experiment; and

(F) describe methods used to produce transgenic plants.

(24) Foundations of Math and Engineering Science. The student demonstrates a working knowledge of various sources of energy and their environmental and economic impact. The student is expected to:

(A) identify and measure the amount and types of energy that students use in their daily lives;

(B) compare the burning of fossil fuels with the burning of biofuels in terms of the short and long-term effects on the atmospheric carbon cycle;

(C) explain the similarities and differences between biofuels and fossil fuels; and

(D) explain the differences between renewable and non-renewable sources of energy and provide examples of each.

(25)Foundations of Math and Engineering Science. The student applies stoichiometric principles to the process of photosynthesis to predict and then compare experimental results of oxygen and carbon dioxide production and consumption. The student is expected to:

(A) explain how photosynthesis captures energy and CO2, and describe how this energy is stored in algae and plants and is the ultimate source of energy for both fossil fuels and biofuels;

(B) explain how cellular respiration a planetary balancing process with photosynthesis is; and

(C) interpret a biological growth curve by identifying and explaining each of the main phases of growth.

(26)Foundations of Math and Engineering Science. The student uses simulations to make predictions. The student is expected to analyze the results of software simulations and models that vary the amounts and types of energy used to predict future energy needs.

(27)Foundations of Math and Engineering Science. The student debates the positive and negative attributes of using algae and biological fee stocks as a fuel source. The student is expected to:

(A) explain how algae that grew millions of years ago are the original source of most of the fossil fuels used today; and

(B) explain the characteristics necessary for certain algae and feed stocks to be used as a fuel source.

(28)Foundations of Math and Engineering Science. The student demonstrates efficient fuel production methods from renewable sources. The student is expected to:

(A) perform a full life cycle analysis of a biofuels production facility;

(B) identify the variables and the methods for completing a life cycle analysis of a biofuels biomanufacturing operation;

(C) outline a sequence for scaling up a biomanufacturing process to commercial production capacity;

(D) explain how enzymes function to promote more efficient chemical reactions;

(E) describe and compare the systems used to cultivate algae; and

(F) outline the process and products of fermentation.

(29)Foundations of Math and Engineering Science. The student plans various upstream and downstream processing methods to effectively design a biofuels manufacturing plant. The student is expected to:

(A) identify the main types of algae used in biofuels production;

(B) design a series of downstream processes for separating a product using an online simulation tool;

(C) explain how different downstream separation and purification processes are used to separate a product from a mixture of components;

(D) describe the two main phases of the biomanufacturing process; and

(E) analyze liquid paper chromatography results to identify the pigments in ink and plant samples and calculate the retention factor.

(30)Foundations of Math and Engineering Science. The student discusses and analyzes some of the persistent global engineering challenges to sustain growing populations and improve quality of life. The student is expected to:

(A) explain why some engineering challenges are persistent such as providing access to clean water, providing a sustainable food supply, energy, sanitation, and health care to growing populations; and

(B) identify and describe the "Grand Challenges" defined by the National Academy of Engineering as current, global engineering challenges and describe their implications for society.

**Recommended Resources and Materials:**

Sigma-Aldrich. (2015). Enzymes for Plant Cell Lysis. Retrieved from http://www.sigmaaldrich.com/life-science/metabolomics/enzyme-explorer/learning-center/lysing-enzymes.html

Newman, S. (2008). How Algae Biodiesel Works. Retrieved from http://science.howstuffworks.com/environmental/green-science/algae-biodiesel2.htm

U.S. Energy Information Administration. (2011). International Energy Statistics. Retrieved from http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=45&aid=2&cid=regions&syid=2005&eyid=2011&unit=MBTUPP

World Energy Council. Energy Trilemma Index. Retrieved from http://www.worldenergy.org/data/trilemma-index/

Plant and Soil Sciences eLibrary and the University of Nebraska Institute of Agriculture and Natural Resources. (2014). Crop Genetic Engineering  Animation and Lesson Series. Retrieved from http://passel.unl.edu

U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). (2014). Genetically engineered varieties of corn, upland cotton, and soybeans, by State and for the United States, 2000-13. Retrieved from http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx#.Ux9XIlxQg3I

United States Department of Agriculture (USDA). (2014). Definitions of food security. Retrieved from http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx#.U1Zvm_k7u-0

TeachEngineering. (2015). Lesson: Human Water Cycle. Retrieved from https://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_humanwatercycle/cub_humanwatercycle_lesson01.xml

Home Science Tools. (n.d.) Oil Spill Cleanup Experiments. Retrieved from http://www.hometrainingtools.com/a/oil-spill-cleanup-science-projects

EPA. (2014) Drinking Water Contaminants. Retrieved from http://water.epa.gov/drink/contaminants/

World Health Organization. (2015). Water. Retrieved from http://www.who.int/topics/water/en/

National Academy of Engineering. (2015). NAE Grand Challenges for Engineering. Retrieved from http://www.engineeringchallenges.org/

The most recent Project Lead The Way teacher and student resources can be retrieved from https://my.pltw.org/login

The most recent Project Lead The Way software and technology requirements can be retrieved from https://pltw.org/pltw-software

**Recommended Course Activities:**

- Students examine current global problems and look specifically at world hunger, a lack of clean water, and the need for renewable energy sources. They complete a design challenge to build a device out of recycled materials.
- Students explore the consequences resulting from a lack of a clean water supply by preparing a case study of a country or region in a water crisis.
- Students investigate the possible contaminants found in water from their case study country and research the adverse effects they have on the human body if consumed. Students conduct chemical and biological tests to measure water quality of locally available drinking water, a local polluted water source, or a contaminated water sample formulated by the teacher.
- Students design, build, and test a gravity-fed water filtration system that removes silt.
- Students investigate how bacteria can be used to accelerate the biological degradation and cleanup of oil spills from water systems. Then they complete an experiment to test different variables such as temperature, agitation, and sunlight that affect bacteria's ability to consume and degrade the oil.
- Students design a small-scale water purification system that can produce potable water from a contaminated source in a natural disaster zone. The system must be able to be deployed within a short period after the disaster. The solution needs to include at a minimum one physical and one biological mechanism.
- Students learn to determine whether familiar food items contain genetically modified organisms (GMOs). They investigate various molecular biology techniques while working through the steps necessary to create genetically modified plants. Through laboratory activities and simulations, students explore Polymerase Chain Reaction (PCR), DNA sequencing techniques, restriction enzyme action, ligation, gel electrophoresis, bacterial transformation, and plant transformation.
- Students grow biologically engineered soybeans and test both plants and seeds for the introduced gene using a protein-specific immunoassay. Use of genetically modified plants in mitigating food security issues is evaluated.
- Students are introduced to a series of labs where they assemble a real recombinant plasmid containing a resistance gene to the antibiotic kanamycin. Students analyze the results of specific digestion of both linear and plasmid DNA and demonstrate how restriction analysis can be used to gauge the success of genetic engineering and gene cloning. They use logic to interpret and assemble plasmid maps.

- Students explore current global energy consumption patterns and then examine futuristic energy consumption models that utilize types of energy other than fossil fuels. Students conduct a household energy audit to contextualize their energy consumption patterns.

## Suggested methods for evaluating student outcomes:

PLTW supports a balanced approach to assessment for all programs. Assessment methods include:

- Formative assessments, such as:
    - written responses to questions,
    - checklists, and
    - journal assessments.
- Diagnostic assessments, such as:
    - whole group, small group, and individual discussions and observations.
- Summative assessments, such as:
    - project rubrics,
    - interim or unit assessments, and
    - end-of-course assessments.
- Skill assessments, such as:
    - the successful completion of activities and labs
        - examples: Technical drawing for a solution, Lab Reports

## Teacher qualifications:

- Legacy Master Science Teacher.
- Mathematics/Physical Science/Engineering: Grades 6-12.
- Mathematics/Physical Science/Engineering: Grades 8-12.
- Physical Science: Grades 6-12.
- Physical Science: Grades 8-12.
- Physics/Mathematics: Grades 7-12.
- Physics/Mathematics: Grades 8-12.
- Science: Grades 7-12.
- Science: Grades 8-12.
- Science, Technology, Engineering, and Mathematics: Grades 6-12.
- Secondary Industrial Arts (Grades 6-12).
- Secondary Industrial Technology (Grades 6-12).
- Secondary Physics (Grades 6-12).
- Secondary Science (Grades 6-12).
- Secondary Science, Composite (Grades 6-12).
- Technology Education: Grades 6-12.
- Legacy Master Mathematics Teacher.
- Mathematics: Grades 7-12.
- Mathematics: Grades 8-12.
- Secondary Mathematics: Grades 6-12
- Agriculture, Food, and Natural Resources: Grades 6-12
- Agricultural Science and Technology: Grades 6-12
- Any vocational agriculture certificate
- Life Science: Grades 7-12

- Life Science: Grades 8-12
- Secondary Physical Science (Grades 6-12)
- Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.
- Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.
- Trade and Industrial Workforce Training. Grades 6-12. This assignment requires appropriate work approval.
- Vocational Trades and Industry. This assignment requires appropriate work approval.

**Additional information:**

PLTW's Core Training for Environmental Sustainability requires approximately 90 hours of instruction led by PLTW approved Master Teachers (80 hours of class time plus 10 hours of prerequisite work). It is offered year-round with multiple options to allow teachers to select dates and pacing of their training session. Course proficiency is demonstrated by the submission and approval of a course portfolio that meets PLTW's requirements. After successful completion of Core Training, teachers receive access to the National PLTW Engineering Professional Learning Community, course-specific student and classroom instructional resources, and Ongoing Training resources through the PLTW Content Management System.

Current details, such as pricing and listings for all PLTW professional development, can be found at https://www.pltw.org/our-programs/professional-development/core-training. At the time of this application submission, the course cost is *$2,400.

Note: Currently, PLTW offers a training guarantee to schools. The PLTW Training Guarantee protects a district's investment in PLTW programs by guaranteeing if a teacher leaves within four years of earning a PLTW credential, PLTW will provide a grant in the amount of the training fee for the district to train a teacher in the same course, replace the credential(s), and support continued student learning.

* PLTW Professional Development Fees are subject to change annually. Changes are communicated via email from PLTW Communications and on the PLTW website at least 90 days prior to the effective date for the upcoming school year. There are no changes for the 2023-24 school year.

Please contact Project Lead The Way directly for questions about these requirements:
Project Lead The Way
Solution Center
Toll Free: 877.335.PLTW (7589) solutioncenter@pltw.org