TEXAS EDUCATION AGENCY

Course: Introduction to Renewable Energy
PEIMS Code: N1120042 *Abbreviation: RENEWEN* *Grade Level(s): 9th*
Number of credits that may be earned: 1

Brief description of the course (150 words or less):

This course provides the foundation for a deeper understanding of the problems, issues, perspectives, and developments in the areas of bio-fuels, solar and wind energy. A significant focus of the course will be on critical and creative thinking, problem solving, and communication of ideas relating to renewable energy.

Essential Knowledge and Skills of the course:

Knowledge and Skills:

(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials;

(C) demonstrate safe practices during laboratory and field investigations, including appropriate first aid responses to accidents that could occur in the field such as insect stings, animal bites, overheating, sprains, and breaks; and

(D) uses school's technology and information systems in a wise and ethical manner.

(2) Scientific processes. The student identifies and uses scientific methods to design and complete experiments such as, how photovoltaic cells are used to harness the sunlight and convert it into energy, how wind turbines are used to harness the wind's energy and convert it into electricity, how various sources of bio-fuels are broken down chemically and the resulting energy is harnessed to produce electricity. The student is expected to:

(A) plan and implement investigative methods including asking questions, formulating testable hypotheses and selecting equipment and technology;

(B) perform background research with respect to an investigative problem;

(C) identify and manipulate the independent variable in an experimental process;

(D) use a control in an experimental process;

(E) design procedures to test hypothesis;

(F) construct data tables to organize data using equipment and technology;

(G) collect data by observing and measuring in various ways;

(H) record observations and measurements using appropriate units and make measurements with precision and accuracy;

(I) perform calculations using dimensional analysis, significant digits and scientific notation;

(J) organize, analyze, evaluate, make inferences and predict trends from data; and

(K) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, constructing models, and technology-based digital portfolio.

(3) Science processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, review and critique issues about wind, solar and bio-fuels as to their strengths and weaknesses using scientific evidence and information;

(B) evaluate the impact of implementing “Green” technology utilizing wind, solar and bio-fuels systems; and

(C) gather information about future careers in wind, solar and bio-fuels using a variety of sources.

(4) Science concepts. The student knows the foundations for a safe work environment as related to the industries of wind, solar and bio-fuels. The student is expected to:

(A) define the purpose of Occupational Safety and Health Administration (OSHA) as applied to the employer and employee;

(B) list the ways OSHA affects the employee;

(C) explain what OSHA expects from an employer;

(D) identify the “OSHA Focus Four”;

(E) define how to avoid the “Focus Four”;

(F) describe the steps taken if one of the “Focus Four” occurs;

(G) describe different ways to contact OSHA; and

(H) summarize the distinctive information that may be obtained from OSHA.

(5) Science concepts. The student knows the different components of wind, solar, and bio-fuels energy systems, and understands that these systems may be used together to produce energy. The student is expected to:

(A) define general wind terminology;

(B) describe various components of wind turbines;

(C) analyze major components of modern wind turbines, solar photovoltaic systems, and bio-fuels systems;

(D) analyze hybrid combination systems that integrate wind, solar, and bio-fuels system;

(E) describe the evolution of wind turbine, solar, and bio-fuels technology; and

(F) defines different types of wind turbines, solar energy sources, and bio-fuel sources.

(6) Science concepts. The student understands and can apply the factors that influence wind and solar efficiency. The student is expected to:

(A) investigate, analyze, and explain air flow and blade efficiencies;

(B) analyze environmental impacts on both wind resources and blade efficiencies;

(C) investigate the efficiency of solar parallel and series circuit energy systems;

(D) design, construct, test, and analyze the impact of voltage multipliers;

(E) design, construct, test, and analyze the impact of voltage stabilizers; and

(F) analyze load demands and loop protection design.

(7) Science concepts. The student is able to define the anatomy of a wind farm, parts of a turbine and plant, and components of the team. The student is expected to:

(A) analyze the anatomy of a wind farm, and wind turbine site;

(B) list and explain the parts of a wind turbine and how it works;

(C) list and explain the parts of a wind turbine plant (park);

(D) discuss aspects of wind turbine control; and

(E) analyze operational issues, the components of an operations and maintenance team.

(8) Entrepreneurship/Business Concept. The student is aware of the natural existence of business models, supply and market products with an appeal to the intended consumer.

(A) describe and examine site construction, foundations, roads, and substation development;

(B) investigate, study, and compare differences in tower foundations; and

(C) analyze substation development.

(9) Entrepreneurship/Business Concept. The student understands the environmental, ethical, and legal obligations of wind and solar farms. The student is expected to:

(A) define environmental, and ethical aspects on locations of wind and solar farms; and

(B) identify and describe the legal obligations of wind and solar farms.

(10) Entrepreneurship/Business Concept. The student knows the importance of business strategies, methodologies, policies and procedures used by wind, solar and bio-fuels manufacturers, farmers and owners/operators of wind and solar farms. The student is expected to:

(A) Identify and demonstrate use of various tools to formulate business plans;

(B) explain and evaluate business planning processes;

(C) define, apply and demonstrate use of quality management tools, such as sigma-six methodologies in planning;

(D) define, apply and demonstrate use of root-cause analysis;

(E) identify and demonstrate use of Strength Weaknesses Opportunity Threats (SWOT) analysis methodology;

(F) define and explain inventory control, materials and supply chain management;

(G) define and describe the process of contract management;

(H) describe liabilities and contract fulfillment to landowners and manufactures;

(I) describe wind business policies related to environmental concerns; and

(J) identify and describe business procedures and practices to include environmental safety and public relations.

Description of the specific student needs this course is designed to meet:

- Students need to be aware of the energy supply and demand and the critical role that bio-fuels, wind and solar energy play in sustaining our society.

- Students need to understand how they are both a part of the problem and also to be inspired to become a part of the solution.

- Students need to be adaptive learners who are better prepared to use their minds to solve problems about renewable energy.

- Students need to learn how to develop the skill of planning and implementing projects that will inform and contribute to larger bodies of knowledge relating to wind energy, solar energy and bio-fuels.

Major resources and materials to be used in the course:

- Access to the use of the laboratories and faculty at the Energy Institute at Houston Community College-Northeast.

- Field trips to visit sites that are traditional fossil fuel based power plants and wind/ solar farms.

- Field trips to refineries, petrochemical plants, waste water treatment facilities, metro transportation, etc.

- Published materials from the Department of Energy.

- Guest presentations by industry and business experts.

Required activities and sample optional activities to be used:

The activities of this class will fit into project based learning that will be captured in a digital portfolio. The work process for a project refers to pupils choosing a knowledge area, delimiting it, formulating a problem or posing a question. In addition, project work involves pupils investigating and describing what is required to solve a given problem, or answer a specific question through further work, materials and knowledge. Project work is an opportunity for becoming aware of and reflecting over different methods of solving problems. In project work an experienced teacher follows, discusses and assesses the work in all its different phases. Project work takes place individually or in groups.

Possible projects for this course:

- Impact of Kyoto Treaty
- Energy Consumption
- Impact of global warming on energy needs
- Potential solutions to energy problems and ethical considerations
- Air and water quality standards
- Citizenship and participation in advocacy groups
- Scientific communications versus media as a means of reporting to the public
- Global warming or solar flares
- Individual rights versus responsibilities for our society

Methods for evaluating student outcomes:

Student mastery of knowledge and skills will be evident in their digital portfolios. They will focus both on their process for developing the project, the actual results from their project work and a reflection on their learning. There will be a specially designed rubric as the basis for grading. Students will be evaluated every six weeks consistent with the district's grading cycle.

Teacher qualifications:

- Texas Teacher Composite Science Certification
- Bachelor's Degree in Science
- Microsoft Office Suite
- Use of Multi-media equipment
- Project Management
- Open to Continuous Learning
- Evidence of Success with Team Work
- Preferred minimum of 3 years of experience

Additional information (optional):