Implementation date
Fall 2008

PROGRAM CONCENTRATION: **Engineering and Technology**
CAREER PATHWAY: **Energy Systems**
COURSE TITLE: **Appropriate and Alternative Energy Technologies**

This course will help students develop an understanding of the differences between nonrenewable, renewable, and inexhaustible energy sources and how these energy sources affect their world. Alternative energy sources will be researched to include the regional implications and economic, environmental, and sustainability issues. Students will evaluate the positive and negative impacts of nuclear power and its relevancy to various situations in today's society. Students will explore future trends of energy, power, and transportation. Students will develop, through research, an alternative energy system that will demonstrate their understanding of a unique, as well as appropriate, approach to energy generation.

ENGR-AAE-1. Students will understand the differences between nonrenewable, renewable, and inexhaustible types of energy sources and how that affects their world.

a. Define nonrenewable, renewable, and inexhaustible energy sources.
b. Provide examples of nonrenewable, renewable, and inexhaustible energy sources.
c. List appropriate uses of each of these forms of energy in specific geographical locations.
d. Detail the positive and negative impacts of nonrenewable, renewable, and inexhaustible energy sources on the global environment, society, and the individual.

ACADEMIC STANDARDS:

SEV1. Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society.

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

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MM3P3. Students will communicate mathematically.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

MM3P5. Students will represent mathematics in multiple ways.

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

ENGR-AAE-2. Students will define alternative energy and list several alternative sources as well as discuss the regional implications of each, including, but not limited to, economic, environmental, and sustainability issues.

a. Explain the existing and future need to develop alternatives to fossil fuels as our primary source of energy.
b. State how the wind, the earth, oceans, and waste (biomass) products can be used to supply energy.
c. Discuss how alternative energies that utilize the wind, the earth, the oceans, and waste (biomass) were developed.
d. Compare and contrast various locations throughout the world which would be best suited for utilization of the wind, the earth, the oceans, and waste as alternative energy sources.
e. Develop a spreadsheet that details the economic, environmental, and sustainability issues of at least five alternative energies.

ACADEMIC STANDARDS:

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.

SP2. Students will evaluate the significance of energy in understanding the structure of matter and the universe.

SES5. Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

SES6. Students will explain how life on Earth responds to and shapes Earth systems.

SCSh3. Students will identify and investigate problems scientifically.

SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P3. Students will communicate mathematically.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

MM3P5. Students will represent mathematics in multiple ways.

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4. The student establishes a context for information acquired by reading across subject areas.

ENGR-AAE-3. Students will define nuclear power and discuss it in terms of its positive and negative impacts as well as its relevancy to various situations in today's society.

a. Define terms relating to nuclear energy, including but not limited to, the following: fission, fusion, breeder reacting, boiling water reactors, pressurized water reactors, plutonium and plutonium 239, proliferation, isotope, electron, plasma, Nuclear Waste Policy Act, Kyoto Protocol, control rod, half life, uranium 235 and uranium 238, Nucleus, Proton, Neutron, plasma, radioactivity and shipping cask.
b. Create a flow chart that details the Nuclear Fuel Cycle.
c. Discuss supply and demand for nuclear power.
d. Create a technical report that includes international use, restrictions, and regulations of nuclear power including inequities of regulations and policies throughout the world.
e. Develop an outline that provides information regarding present and future uses of nuclear power in the world.

ACADEMIC STANDARDS:

SP3. Students will evaluate the forms and transformations of energy.

SP6. The student will describe the corrections to Newtonian physics given by quantum mechanics and relativity when matter is very small, moving fast compared to the speed of light, or very large.

SCSh3. Students will identify and investigate problems scientifically.

SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.
ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4. The student establishes a context for information acquired by reading across subject areas.

ENGR-AAE-4. Students will discuss the future trends of energy, power, and transportation.

a. Define energy, power, and transportation systems.
b. Outline the relationship between present and future trends in terms of energy, power, and transportation systems.
c. List current organizations committed to the development of new sources of energy, power, and transportation.
d. State future land, water, air, and space transportation technologies.
e. Define nanotechnology and state its implications in relationship to the future of energy, power, and transportation technology.
f. Identify careers related to the development of innovative power, energy, and transportation technologies.

ACADEMIC STANDARDS:

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.

SP2. Students will evaluate the significance of energy in understanding the structure of matter and the universe.

SP3. Students will evaluate the forms and transformations of energy.

SP6. The student will describe the corrections to Newtonian physics given by quantum mechanics and relativity when matter is very small, moving fast compared to the speed of light, or very large.

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.
ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4. The student establishes a context for information acquired by reading across subject areas.

ENGR-AAE-5. Students will develop, through research, an alternative energy system that will demonstrate their understanding of a unique, as well as appropriate, approach to energy generation.

a. Provide a research paper that lists innovative alternative energies.
b. Design a system, either via computer model or prototype, which will produce power for a specific need.
c. Submit an engineering notebook which includes a daily journal, spreadsheet, and photos that show the development of this product.
d. Document the need for this product within the community.
e. Present data and prototype, or computer model, to a group of peers and/or school staff/community members.

ACADEMIC STANDARDS:

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.

SP2. Students will evaluate the significance of energy in understanding the structure of matter and the universe.

SP3. Students will evaluate the forms and transformations of energy.

MM1P1. Students will solve problems (using appropriate technology).

MM1P3. Students will communicate mathematically.

MM1P4. Students will make connections among mathematical ideas and to other disciplines.

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills data and developing reasonable scientific explanations.

SCSh6. Students will communicate scientific investigations and information clearly.

SCSh7. Students analyze how scientific knowledge is developed.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P3. Students will communicate mathematically.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

MM3P5. Students will represent mathematics in multiple ways.

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4. The student establishes a context for information acquired by reading across subject areas.

STEM Standards (Common to all Engineering &Technology Courses)

Nature of Technology

ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.

a. Describe the core concepts of technology.
b. Identify the relationships among technologies along with connections to contemporary issues.
c. Apply lifelong learning strategies necessary to understand the characteristics and scope of technology.

ACADEMIC STANDARDS:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Technology and Society
ENGR-STEM-2. Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

a. Describe the social, economic, and environmental impacts of a technological process, product, or system.
b. Demonstrate ethical and professional behavior in the development and use of technology.
c. Explain the influence of technology on history and the shaping of contemporary issues.

ACADEMIC STANDARDS:

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Design
ENGR-STEM-3. Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

a. Demonstrate fundamental principles of design.
b. Design and conduct experiments along with analysis and interpretation of data.

c. Identify and consider realistic constraints relevant to the design of a system, component, or process.

ACADEMIC STANDARDS:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

Abilities for a Technological World

ENGR-STEM-4. Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

a. Work cooperatively in multi-disciplinary teams.
b. Apply knowledge of mathematics, science, and engineering design.
c. Demonstrate strategies for identifying, formulating, and solving technological problems.
d. Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

ACADEMIC STANDARDS:

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6. Students will communicate scientific investigations and information clearly.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

The Designed World

ENGR-STEM-5. Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

a. Use common tools correctly and safely.
b. Describe strategies for selecting materials and processes necessary for developing a technological system or artifact.
c. Demonstrate fundamental materials processing and assembly techniques.
d. Evaluate the interdependence of components in a technological system and identify those elements that are critical to correct functioning.
e. Apply analytical tools to the development of optimal solutions for technological problems.

ACADEMIC STANDARDS:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

Reading

ENGR-STEM-6. Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

a. Read in all curriculum areas.
b. Discuss books.

c. Build vocabulary knowledge.
d. Establish context.

ACADEMIC STANDARDS:

ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.
ELAALRC4. The student establishes a context for information acquired by reading across subject areas.

Leadership Development
ENGR-STEM-7. Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

a. Demonstrate effective communication skills.
b. Participate in teamwork to accomplish specified organizational goals.
c. Demonstrate cooperation and understanding with persons who are ethnically and culturally diverse.

ACADEMIC STANDARDS:

MM3P3. Students will communicate mathematically.

MM3P5. Students will represent mathematics in multiple ways.

SCSh6. Students will communicate scientific investigations and information clearly.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and

postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.