

Energy & Natural Resources Programs of Study				
Sustainable Energy Alternatives Course #5229				
Course Description: Sustainable Energy Alternatives broadens a student’s understanding of environmentally friendly energies. In this course students will use a combination of classroom, laboratory, and field experiences to analyze, critique, and design alternative energy systems. Class content and activities center on renewability and sustainability for our planet. Topics covered in this course include the following types of alternative energies: solar, wind, geothermal, biomass and emerging technologies. Leadership development, supervised agricultural experiences, and career exploration opportunities are explored in the field. Sustainable energy is also included.				
Lesson Number	Number of Days of Instruction	Lesson Title	Lesson Objectives	Indiana Next Level Program of Study (NLPS) NLPS: Competency Domain
UNIT A. RENEWABLE ENERGY				
Problem Area 1.				
A1-1	8	Fuels and Energy: A Comprehensive Study	<ol style="list-style-type: none"> 1. Describe various forms of energy, and explain how each can be harnessed for human use. 2. Explain common energy classifications, including sustainable, renewable, and nonrenewable. 3. Identify key sources of energy, and distinguish between inexhaustible and exhaustible sources. 4. Differentiate fuels from energy, and describe how fuels function as energy carriers. 	5229.D1.2 Differentiate renewable fuels and renewable energy. 5229.D1.3 Differentiate renewable, non-renewable, sustainable, and exhaustible. 5229.D1.4 Identify natural sources of kinetic, thermal, and light energy. 5229.D1.7 Compare appropriate energy sources per setting. 5229.D1.10 Identify and describe various forms of energy.
A1-2	9	Alternative Energy and Their Environmental Impact	<ol style="list-style-type: none"> 1. Explain how the green movement has influenced the development and use of renewable energy sources. 2. Define greenhouse gas and identify sources of both naturally occurring and human-produced greenhouse gases. 3. Explain the concept of “net zero” as it relates to atmospheric carbon levels. 4. Distinguish between green energy and renewable energy. 5. Describe positive environmental impacts associated with alternative energy sources. 6. Describe negative environmental impacts associated with alternative energy sources. 	5229.D1.1 Students apply knowledge of renewable resources to the management of those resources. 5229.D1.5 Evaluate the impact of alternative energy sources on the environment. 5229.D1.6 Explain the “green” movement. 5229.D1.8 Identify advantages and disadvantages to alternative energy sources. 5229.D1.9 Evaluate the impact of alternative energy sources on the environment. 5229.D8.5 Acquire the skills necessary to positively influence others.

A1-3	8	The Role of Green Energy in Modern Agriculture	<ol style="list-style-type: none"> 1. Identify energy inputs used by producers in agricultural production. 2. Explain the potential benefits of using green energy in agriculture for both producers and consumers. 3. Discuss economic and practical challenges that agricultural producers may face when adopting green energy technologies. 	<p>5229.D1.11 Explain how converting to green energy would affect the agriculture industry. 5229.D1.12 Explain how converting to green energy would affect costs to producers and consumers.</p> <p>5229.D8.2 Acquire and demonstrate communication skills such as writing, public speaking, and listening while refining oral, written, and verbal skills.</p>
UNIT B. SOLAR ENERGY				
Problem Area 1.				
B1-1	10	Introduction to Solar Energy and Its Applications	<ol style="list-style-type: none"> 1. Define solar energy and explain how it is collected and converted into electricity or thermal energy for practical use. 2. Describe potential advantages of using solar energy. 3. Discuss potential disadvantages of using solar energy. 	<p>5229.D2.1 Students apply concepts of renewable resources to solar energy. 5229.D2.6 Describe solar energy and how it is harnessed. 5229.D2.8 Evaluate the advantages and disadvantages of using solar energy. 5229.D8.3 Recognize and explain the role of the FFA in the development of leadership, education, employability, communications, and human relations skills.</p>
B1-2	6	Passive Environmental Systems	<ol style="list-style-type: none"> 1. Describe key components of passive environmental systems that can be used to regulate the indoor climate of a structure. 2. Analyze how material properties affect energy absorption and thermal performance in buildings. 3. Describe how passive solar design can be used to help heat and cool structures. 4. Compare and contrast passive and active solar heating. 	<p>5229.D2.1 Students apply concepts of renewable resources to solar energy. 5229.D2.2 Investigate passive environmental systems. 5229.D2.5 Demonstrate solar heat systems performance. 5229.D2.7 Explain the difference between passive solar and active solar. 5229.D7.4 Identify how key organizational structures and processes affect organizational performance and the quality of products and services.</p>
B1-3	6	Introduction to Photovoltaic Systems	<ol style="list-style-type: none"> 1. Explain the purpose of a photovoltaic cell, and describe how one works. 2. Compare and contrast stand-alone and grid-connected photovoltaic systems. 3. Describe the fundamental components of any photovoltaic system. 	<p>5229.D2.3 Contrast photovoltaic system performances. 5229.D2.4 Monitor a photovoltaic system output to effective lumen ratio. 5229.D2.11 Describe how a photovoltaic solar cell works.</p>

B1-4	7	Impact of Movement, Position, and Environmental Factors on Solar Energy	<ol style="list-style-type: none"> 1. Explain how the earth's axis rotation and its revolution around the sun affect the intensity of solar energy hitting the earth. 2. Describe the earth's positioning relative to the sun when it is nighttime. 3. List and describe several environmental factors/conditions that impact the amount of solar radiation available on Earth. 	<p>5229.D2.9 Describe basic solar movement and effect of the Earth's tilt.</p> <p>5229.D2.10 Predict solar position using solar path diagram.</p> <p>5229.D2.12 Identify factors that reduce/enhance solar irradiation.</p> <p>5229.D8.1 Students validate the necessity of leadership skills development in conjunction with participation in The National FFA Organization (FFA) as a critical component to a well-rounded agricultural education.</p> <p>5229.D9.1 Students validate the necessity of a Supervised Agricultural Experience (SAE) program as a critical component to a well-rounded agricultural education.</p> <p>5229.D9.2 Explain the nature of and become familiar with those terms related to an SAE program.</p>
UNIT C. WIND ENERGY				
Problem Area 1.				
C1-1	6	Introduction to Wind Energy Systems	<ol style="list-style-type: none"> 1. Explain how wind energy is used to generate electricity. 2. Describe the basic components of a wind turbine.1 3. Identify different types and designs of wind turbines. 	<p>5229.D3.1 Students apply concepts of alternative energy resources to wind energy. 5229.D3.2 Research varying wind energy systems.</p> <p>5229.D3.3 Design small wind blades using common materials. 5229.D3.5 Describe wind energy and the way it is harnessed.</p> <p>5229.D7.2 Define and explore environmental and natural resource agriculture and environmental and natural resource agribusiness and their role in the economy.</p> <p>5229.D7.3 Evaluate and explore the environmental and natural resource career opportunities in agriculture.</p> <p>5229.D8.2 Acquire and demonstrate communication skills such as writing, public speaking, and listening while refining oral, written, and verbal skills.</p> <p>5229.D8.4 Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.</p>

C1-2	8	Wind Energy Expansion: Site/Weather Issues and Optimization Strategies	<ol style="list-style-type: none"> 1. Identify and explain key factors that influence wind farm effectiveness. 2. Describe environmental impacts associated with wind energy development. 3. Analyze land-use considerations involved in planning and constructing wind energy projects. 	<p>5229.D3.4 Investigate site issues for wind energy systems.</p> <p>5229.D3.6 Explain why farmers and ranchers are amenable to wind technology. 5229.D3.7 Evaluate the advantages and disadvantages to wind technology.</p> <p>5229.D3.8 Compare topography of different quadrangles and geographical features that could affect wind conditions.</p> <p>5229.D3.9 Evaluate short-term weather conditions and their implications on wind turbines.</p>
UNIT D. GEOTHERMAL ENERGY				
Problem Area 1.				
D1-1	8	Geothermal Energy: A Comprehensive Overview	<ol style="list-style-type: none"> 1. Define geothermal energy, and identify its source within Earth's structure. 2. Describe how geothermal energy is harnessed and utilized. 3. Discuss the practical applications of geothermal energy. 	<p>5229.D4.1 Students discover geothermal energy as an alternative energy resource. 5229.D4.2 Differentiate geothermal power and geothermal heat.</p> <p>5229.D4.5 Evaluate the advantages and disadvantages of using geothermal energy. 5229.D9.3 Explore the numerous possibilities for an SAE program which a student might develop.</p> <p>5229.D9.4 Develop an individual SAE program and implement record keeping skills.</p>
D1-2	10	Geothermal Energy Applications	<ol style="list-style-type: none"> 1. Describe how a geothermal system operates to heat and cool a residence. 2. Evaluate the advantages and disadvantages of using geothermal energy in residential and commercial settings. 3. Identify and explain natural phenomena that illustrate geothermal activity. 	<p>5229.D4.3 Describe geothermal heat set-up parameters. 5229.D4.4 Describe geothermal energy and the way it is harnessed. 5229.D4.6 Analyze a diagram of a geothermal power plant.</p> <p>5229.D7.3 Evaluate and explore the environmental and natural resource career opportunities in agriculture.</p> <p>5229.D9.2 Explain the nature of and become familiar with those terms related to an SAE program</p>
UNIT E. BIOMASS SYSTEMS				
Problem Area 1.				
E1-1	10	Introduction to Biomass Energy	<ol style="list-style-type: none"> 1. Define the term biomass, and describe its role in energy production. 2. Explain why biomass sources are valuable for producing renewable energy and fuels. 3. Describe how technological advancements have improved and diversified biofuel production. 	<p>5229.D5.15 Explain biomass and sources of biomass.</p> <p>5229.D5.16 Assess the characteristics of biomass that make it useful for biofuels production. 5229.D5.17 Evaluate the technologies used to create biofuels from biomass.</p> <p>5229.D9.1 Students validate the necessity of a Supervised Agricultural Experience (SAE) program as a critical component to a well-rounded agricultural education.</p> <p>5229.D9.2 Explain the nature of and become familiar with those terms related to an SAE program</p>

E1-2	11	Biomass Feedstocks	<ol style="list-style-type: none"> 1. Identify and describe common types of biomass feedstocks. 2. Evaluate the energy production potential of different biomass feedstocks. 3. Analyze how seasonal patterns and geographic factors influence the availability and cultivation of biomass feedstocks. 	<p>5229.D5.1 Students evaluate various aspects of biomass systems as alternative energy resources.</p> <p>5229.D5.2 Compare potential biomass feedstock.</p> <p>5229.D5.3 Identify limiting factors of the use of biomass for energy.</p> <p>5229.D8.6 Develop a skill set to enhance the positive evolution of the whole person.</p>
E1-3	8	Biochemical Processes and Their Applications	<ol style="list-style-type: none"> 1. Compare and contrast the biochemical processes involved in aerobic and anaerobic digestion. 2. Describe the beneficial outcomes associated with closed-loop anaerobic digestion systems. 3. Explain the biochemical steps involved in producing ethanol from a biomass source. 4. Identify and explain common products derived from the biochemical process of fermentation. 	<p>5229.D5.4 Describe anaerobic digestion.</p> <p>5229.D5.5 Model a small scale anaerobic digestion closed-loop system.</p> <p>5229.D5.6 Describe the process used in producing alcohol from biomass. 5229.D5.7 Produce alcohol and co-products from biomass.</p> <p>5229.D5.10 Explain the process of fermentation.</p>
E1-4	10	Production of Biodiesel from Biomass	<ol style="list-style-type: none"> 1. Describe what materials are used and what substances are produced during the transesterification process for making biodiesel. 2. Identify common sources of feedstocks that can be used to produce biodiesel. 3. Explain how biodiesel is chemically produced from biomass sources. 	<p>5229.D5.8 Explain the process of transesterification.</p> <p>5229.D5.9 Diagram the process used in producing biodiesel from biomass.</p>
E1-5	11	Methane Production and Composting Systems	<ol style="list-style-type: none"> 1. Describe how methane is generated from biomass through anaerobic digestion and identify the role of bacteria in this process. 2. Explain the key steps and conditions involved in aerobic composting, including how oxygen and temperature affect decomposition. 3. Analyze the chemical and microbial processes involved in anaerobic composting and distinguish them from aerobic methods. 	<p>5229.D5.11 Explain the process of methanogenesis.</p> <p>5229.D5.12 Illustrate the process used in producing methane from biomass. 5229.D5.13 Produce methane and co-products from biomass.</p> <p>5229.D5.14 Describe the scientific principles related to composting.</p> <p>5229.D8.3 Recognize and explain the role of the FFA in the development of leadership, education, employability, communications, and human relations skills.</p>

UNIT F. EMERGING TECHNOLOGIES				
Problem Area 1.				
F1-1	7	Emerging Renewable Energy Resources	<ol style="list-style-type: none"> 1. Identify and describe emerging renewable energy resources. 2. Evaluate the feasibility of emerging renewable energy resources. 3. Compare the potential benefits and challenges of emerging renewable energy resources. 	5229.D6.1 Students research emerging renewable energy resource technologies. 5229.D6.2 Research other renewable sources of energy. 5229.D6.3 Critique viability of other systems. 5229.D6.4 Research storage issues and possibilities. 5229.D6.6 Discuss the feasibility of new and emerging energy resources.
F1-2	10	Hydroelectric Power Systems and Biogeochemical Cycles	<ol style="list-style-type: none"> 1. Identify and explain the essential components common to all hydroelectric power systems. 2. Analyze factors that affect the feasibility of hydroelectric power systems, including environmental, economic, and social considerations. 3. Diagram and explain the water, carbon, nitrogen, and phosphorus cycles, highlighting key processes within each biogeochemical cycle. 	5229.D6.5 Describe hydroelectric generation techniques and procedures. 5229.D6.7 Discuss emerging and alternative electric power generation technologies and fuel sources. 5229.D6.8 Diagram biogeochemical cycles and explain the processes.
Unit G. NUCLEAR ENERGY				
Problem Area 1.				
G1-1	10	Nuclear Energy Processes	<ol style="list-style-type: none"> 1. Compare and contrast nuclear fusion and nuclear fission. 2. Explain the role of deuterium and tritium in the nuclear fusion reaction. 3. Describe the general process of electricity production using nuclear fission. 4. Explain what makes the isotopes of uranium different from one another. 	5229.D7.1 Students examine the scope of career opportunities in, and the importance of, agriculture to the economy. 5229.D7.5 Demonstrate those qualities, attributes, and skills necessary to succeed in, or further prepare for, a chosen career while effectively contributing to society. 5229.D1.10 Identify and describe various forms of energy.
G1-2	7	Nuclear Energy Implications	<ol style="list-style-type: none"> 1. Compare the energy output and efficiency of nuclear fission with that of coal combustion. 2. Describe potential environmental impacts associated with uranium mining. 3. Identify and describe types of radiation associated with nuclear energy. 4. Explain the concept of half-life and its role in radioactive decay. 	5229.D1.1 Students apply knowledge of renewable resources to the management of those resources. 5229.D1.5 Evaluate the impact of alternative energy sources on the environment. 5229.D1.10 Identify and describe various forms of energy.