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| **TEXAS CTE LESSON PLAN**  [www.txcte.org](http://www.txcte.org) | |
| **Lesson Identification and TEKS Addressed** | |
| **Career Cluster** | Agriculture, Food, & Natural Resources |
| **Course Name** | Advanced Energy and Natural Resources Technology |
| **Lesson/Unit Title** | Biofuels and Renewable Energy Production |
| **TEKS Student Expectations** | **130.12. (c) Knowledge and Skills**  (12) The student learns the processes for producing energy and green products from agricultural, biomass, fossil fuel, wind, solar, and geothermal sources. The student is expected to:  (A) identify agricultural and silvicultural crops and bio-products suitable for renewable production  (B) discuss production processes for agricultural- and silvicultural-based bio-products |
| **Basic Direct Teach Lesson**  (Includes Special Education Modifications/Accommodations and  one English Language Proficiency Standards (ELPS) Strategy) | |
| **Instructional Objectives** | * Identify agricultural crops and bi-products suitable for renewable energy production * Discuss production processes for biofuels |
| **Rationale** | This lesson introduces students to wind, solar, and geothermal energy. Through this lesson, students will be expected to analyze the advantages and disadvantages of wind energy, explain geothermal energy and locate areas of potential, and identify and describe solar energy systems. |
| **Duration of Lesson** | Teacher’s Discretion |
| **Word Wall/Key Vocabulary**  *(ELPS c1a, c, f; c2b; c3a, b, d; c4c; c5b) PDAS II (5)* | * Biofuel * Biomass * Renewable Energy * Agricultural bi-product |
| **Materials/Specialized Equipment Needed** | Power Point: Biofuels and Renewable Energy Production |
| **Anticipatory Set**  (May include pre-assessment for prior knowledge) | 1. Link: Where do we get our Power? 2. Motivation: Where did you get your power today to turn on the lights at home and at school, in the vehicle you drove to school? 3. Overview: Today we will Identify agricultural crops and bi-products suitable for renewable energy production, and Discuss production processes for biofuels |
| **Direct Instruction \*** | Open the PowerPoint, progress through the slides and teach the material from the slides to the students and allow time for discussion on each slide.   1. Renewable Energy    1. The United States currently relies heavily on coal, oil, and natural gas for its energy.    2. Fossil fuels are nonrenewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging to retrieve.    3. In contrast, renewable energy resources—such as wind and solar energy—are constantly replenished and will never run out. 2. Types of Biomass    1. Wood    2. Crops    3. Garbage    4. Landfill Gas    5. Alcohol Fuels 3. Biomass Energy Basics    1. We have used biomass energy, or "bioenergy"—the energy from plants and plant-derived materials—since people began burning wood to cook food and keep warm.    2. Wood is still the largest biomass energy resource today, but other sources of biomass can also be used.    3. These include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes.    4. Even the fumes from landfills (which are methane, the main component in natural gas) can be used as a biomass energy source. 4. Converting BioMass to Liquid Fuels    1. What do you think the future is of biofuels? 5. BioFuel Basics    1. Unlike other renewable energy sources, biomass can be converted directly into liquid fuels, called "biofuels," to help meet transportation fuel needs.    2. The two most common types of biofuels in use today are ethanol and biodiesel. 6. Two main types of biofuels– Ethanol    1. Ethanol is an alcohol, the same as in beer and wine (although ethanol used as a fuel is modified to make it undrinkable). It is most commonly made by fermenting any biomass high in carbohydrates through a process similar to beer brewing. Today, ethanol is made from starches and sugars, but NREL scientists are developing technology to allow it to be made from cellulose and hemicellulose, the fibrous material that makes up the bulk of most plant matter.    2. Ethanol can also be produced by a process called gasification. Gasification systems use high temperatures and a low-oxygen environment to convert biomass into synthesis gas, a mixture of hydrogen and carbon monoxide. The synthesis gas, or "syngas," can then be chemically converted into ethanol and other fuels.    3. Ethanol is mostly used as blending agent with gasoline to increase octane and cut down carbon monoxide and other smog-causing emissions. Some vehicles, called Flexible Fuel Vehicles, are designed to run on E85, an alternative fuel with much higher ethanol content than regular gasoline. 7. Two main types of biofuels– Biodiesel    1. Biodiesel is made by combining alcohol (usually methanol) with vegetable oil, animal fat, or recycled cooking grease.    2. It can be used as an additive (typically 20%) to reduce vehicle emissions or in its pure form as a renewable alternative fuel for diesel engines.    3. Research into the production of liquid transportation fuels from microscopic algae, or microalgae, is reemerging at NREL. These microorganisms use the sun's energy to combine carbon dioxide with water to create biomass more efficiently and rapidly than terrestrial plants. Oil-rich microalgae strains are capable of producing the feedstock for a number of transportation fuels—biodiesel, "green" diesel and gasoline, and jet fuel—while mitigating the effects of carbon dioxide released from sources such as power plants. 8. Crops used in producing biofuels    1. While the most common crops used for ethanol throughout the world are certainly corn and sugarcane, there are an increasing number of crops being investigated and used in the industry.    2. Amongst sugar/starch crops, sugarbeet and sweet sorghum have been the focus of much attention;    3. Cellulosic crops such as switchgrass, miscanthus, corn stover, poplar, and grass are the subject of increasing interest.    4. Currently, rapeseed (canola) is the dominant feedstock for biodiesel in Europe, and soybeans are the dominant feedstock for biodiesel in the United States.    5. Warmer countries such as Malaysia often use palm oil for biodiesel production. Other promising crops for biodiesel production include mustard, camelina, and jatropha.   *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  NONE |
| **Guided Practice \*** | Students will create a foldable after watching the Power Point.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  NONE |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | 1. Interview Biofuel IQ    1. Interview your friends, neighbors, teachers, or others you know.    2. Ask them their perceptions of biofuels.    3. Can they name some of the agricultural crops utilized to produce biofuels?    4. How likely would they be to use a biofuel if it were available in your community?   *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  NONE |
| **Lesson Closure** | 1. Pick individuals or ask the entire class these questions Summary: Today we 2. Identify agricultural crops and bi-products suitable for renewable energy production 3. Discuss production processes for biofuels   *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  NONE |
| **Summative / End of Lesson Assessment \*** | *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  NONE |
| **References/Resources/**  **Teacher Preparation** | * Energy Kids: <http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics> * Biomass Production and Consumption Data: <http://www.eia.gov/renewable/data.cfm#biomass> * Biomass technology basics: <http://energy.gov/eere/energybasics/articles/biomass-technology-basics> |
| **Additional Required Components** | |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** | |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy**  **Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies**  **Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication**  **90 Second Speech Topics** |  |
| **Other Essential Lesson Components** | |
| **Enrichment Activity**  (e.g., homework assignment) | * Determine the biofuels available in your community. Have students compare the cost of tradition fuel versus the biofuel based on fuel efficiency and price per gallon. * Determine the crops in your community that could be utilized for biofuels. Invite producers in to discuss the pros and cons of producing for that use and the impact on livestock feeds, the economy, etc. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | FFA |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)