



ENGINEERING & TECHNOLOGY

PATHWAY: Engineering

COURSE: Foundations of Engineering and Technology

UNIT: Alternative Fuels



INTRODUCTION

Annotation: Briefly describe the unit topics, tasks, methods, etc.

Students will learn the different types of alternative fuels and their uses. The students will also discuss the pros and cons of using alternative fuels.

Grade(s):

X	9 th
X	10 th
X	11 th
X	12 th

Time:

5 Hours

Author:

Eve Felton

Additional Author(s):

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

Notes to the Teacher:

This area of instruction is constantly and rapidly changing. Teachers should research alternative fuels and the alternative fuel industry and verify that the information contained in this lesson plan is still valid.



FOCUS STANDARDS

GPS Focus Standards: Please list the standard and elements covered.

- ENGR-FET-2 – Students will describe the history of technological advancement.
- ENGR-FET-3c – Describe the role of time, capital, people, tools and machines, energy, materials, and information within the universal systems model
- ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts
- 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.
- ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems
- 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

GPS Academic Standards:

- ELA12LSV1. The student participates in student-to-teacher, student-to-student, and group verbal interactions.
- SPS6. Students will investigate the properties of solutions.

National / Local Standards / Industry / ISTE:



UNDERSTANDINGS & GOALS

Enduring Understandings: Enduring understandings are statements summarizing important ideas and have lasting value beyond the classroom. They synthesize what students should understand – not just know.

Students will develop a broad understanding of the importance and future of alternative fuels and their uses.

Essential Questions: Essential questions probe for deeper meaning and understanding while fostering the development of critical thinking and problem-solving skills. Example: Why is life-long learning important in the modern workplace?

- Why is it important to develop alternative fuel sources?
- What is the future of alternative fuels?
- How can alternative fuels be defined?

Knowledge from this Unit: Factual information.

- Students will be able to list the benefits of alternative fuels.
- Students will be able to explain the pros and cons of using crops for fuel production.
- Students will be able to list five examples of biofuels.

Skills from this Unit: Performance.



ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

- ☐ Pre-test
- ☒ Objective assessment - multiple-choice, true- false, etc.
 - ☐ Quizzes/Tests
 - ☐ Unit test
- ☐ Group project
- ☐ Individual project
- ☒ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
 - ☐ Self-check rubrics
 - ☐ Self-check during writing/planning process
 - ☐ Journal reflections on concepts, personal experiences and impact on one's life
 - ☐ Reflect on evaluations of work from teachers, business partners, and competition judges
 - ☐ Academic prompts
 - ☐ Practice quizzes/tests
- ☐ Subjective assessment/Informal observations
 - ☐ Essay tests
 - ☐ Observe students working with partners
 - ☐ Observe students role playing
- ☐ Peer-assessment
 - ☐ Peer editing & commentary of products/projects/presentations using rubrics
 - ☐ Peer editing and/or critiquing
- ☐ Dialogue and Discussion
 - ☐ Student/teacher conferences
 - ☐ Partner and small group discussions
 - ☐ Whole group discussions
 - ☐ Interaction with/feedback from community members/speakers and business partners
- ☐ Constructed Responses
 - ☐ Chart good reading/writing/listening/speaking habits
 - ☐ Application of skills to real-life situations/scenarios
- ☐ Post-test

Assessment(s) Title:

Alternative Fuels Exam

Assessment(s) Description/Directions:

The exam for this unit can be found at the end of this lesson plan.

Attachments for Assessment(s): Please list.



LEARNING EXPERIENCES

Sequence of Instruction

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

- ENGR-FET-2 – Students will describe the history of technological advancement.
- ENGR-FET-3c – Describe the role of time, capital, people, tools and machines, energy, materials, and information within the universal systems model
- ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts
- 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.
- ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems
- 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
- ELA12LSV1. The student participates in student-to-teacher, student-to-student, and group verbal interactions.
- SPS6. Students will investigate the properties of solutions.

2. Review Essential Questions.

- Why is it important to develop alternative fuel sources?
- What is the future of alternative fuels?
- How can alternative fuels be defined?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

1. What is an alternative fuel?

Alternative fuels- are derived from resources other than petroleum. They have desirable energy efficiency and pollution reduction features.

2. Research Opportunity:

Biofuels- is any fuel that derives from biomass. Products of living organisms such as fat from animals or any **cellulose** material from plants is considered **biomass**. There are three primary motivators for biofuels in today's society: (1.) environmental, (2.) economy, and (3.) energy security. With biofuels there are 1st generation and 2nd

generation fuels. The 1st generation biofuels are produced from crops such as corn, wheat, and sugar cane. All first generation fuels consist mainly of bioethanol and biodiesel. Ethanol is made by fermenting and distilling the plant material from the crops. Second generation biofuels are made from feedstock containing cellulosic biomass. This cellulosic biomass is from plant materials such as algae, woodchips, or corn husks.

Electricity- Runs on a power grid to power plug-in hybrid vehicles. The car has no emissions while running. Electricity is a good option for short-range driving. Hybrid cars also fall into this category.

Hydrogen- On the periodic table hydrogen is the lightest of all elements and has been looked at for many years as a fuel-source. Most hydrogen is made of natural gas but can also be produced through electrolysis using water (H₂O). Hydrogen in gas form can be compressed and stored in cylinders. One problem with hydrogen is the size of the fuel tanks. Hydrogen in equal sized tanks contains less energy than gasoline and ethanol. Hydrogen in liquid form is very expensive. Hydrogen is also used in fuel cells. Fuel cell vehicles turn hydrogen fuel and oxygen into electricity. The electricity then powers an electric motor. Spacecrafts for many years have used hydrogen fuel cells to power equipment. A fuel cell is an electrochemical cell that derives its energy from combustible substances such as hydrogen, methane, propane, methanol, diesel fuel or even gasoline.

Methanol- is methane with one hydrogen molecule replaced by a hydroxyl radical (OH). A synthesis gas is formed from steam. The gas is then fed into a reactor vessel in the presence of a catalyst. This process then produces methanol and water vapor. A variety of feedstocks can be used to create methanol. The most common seen is use of natural gas. Methanol can be made into hydrogen. This would be beneficial for future work with hydrogen cells.

Natural Gas- is a mostly methane gas, but may contain ethane, propane, and mixture of other gases. It has a very high octane rating and works well in spark-ignited internal combustion engines. It is non-toxic, non-corrosive, and non-carcinogenic. In the United States 25% of the energy used is from natural gas. The United States uses less than one percent of natural gas for transportation needs.

Propane- liquefied petroleum gas (LPG or LP-gas). Propane is stored in a pressurized tank. It is a colorless, odorless liquid. As pressure is released, the liquid propane vaporizes and turns into gas that is used for combustion. It is non-toxic and has a high octane ratings. Propane is a by-product of crude oil and natural gas. Propane is called bottled gas because it is portable in small tanks, such as those used on BBQ grills. Propane is widely used in indoor forklifts because of the lack of emissions. It has been used for lawn equipment and other small motorized vehicles.

Alternative Fuels Exam

1. What alternative fuel is store in pressurized portable tanks?
2. An alternative fuel that derives from biomass is known as what?
3. List three pros to using bioethanol and biodiesel as an alternative fuel.
4. List three cons to using bioethanol and biodiesel as an alternative fuel.
5. 25% of what alternative fuel is used as an energy source in America?
6. Which alternative fuel uses a synthesis gas formed from steam?
7. The hybrid car runs on which type of alternative fuel?
8. What is 2nd generation fuels?
9. What is a fuel cell?
10. What is the lightest element on the periodic table?

Attachments for Learning Experiences: Please list.

Notes & Reflections: May include notes to the teacher, pre-requisite knowledge & skills, suggestions, etc.



CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Different Forms of Alternative Fuels

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

With this performance task, students should choose a form of alternative fuels to research and create a report. In the report they should include what is used to make the fuel, the history of this alternative fuel, and the environmental and economic benefits. The student should then place all this information into a power point presentation. Each student should make a short presentation to the class on their alternative fuel. After all presentations have been made a discussion should be held on what the students feels is the future of alternative fuels. In the discussion they should also talk about which alternative fuels would have the best economic and environmental impact on our society.

Fuels defined as alternative fuels by the Energy Policy Act 1992.

- Biodiesel
- Electricity
- Ethanol
- Hydrogen
- Methanol
- Natural Gas
- Propane

Alternative Fuels that are still under development

- Biobutanol
- Biogas
- Ultra-Low Sulfur Diesel
- Biomass to liquids
- Coal to liquids
- Fischer-Tropsch Diesel
- Gas to liquids
- Hydrogenation- Derived Renewable Diesel
- P Series
- Fuel Cell

Rubric for Performance Task: Please list.

Scoring Rubric for Alternative Fuels Project

Criteria	Superior	Excellent	Good	Fair	Poor
Accuracy of Information	5	4	3	2	1
Clarity, Quality, and Accuracy of Power Point	5	4	3	2	1
Presentation to class	5	4	3	2	1
Participation in Discussion	5	4	3	2	1
Overall Effort	5	4	3	2	1



UNIT RESOURCES

Web Resources:

- <http://www.eere.energy.gov>
- <http://www.epa.gov/oms/consumer/fuels/altfuels/altfuels>

Attachment(s): Supplemental files not listed in assessment, learning experiences, and performance task.

What 21st Century Technology was used in this unit:

☐	Slide Show Software	☐	Graphing Software	☐	Audio File(s)
☐	Interactive Whiteboard	☐	Calculator	☐	Graphic Organizer
☐	Student Response System	X	Desktop Publishing	X	Image File(s)
☐	Web Design Software	☐	Blog	☐	Video
☐	Animation Software	☐	Wiki	☐	Electronic Game or Puzzle Maker
☐	Email	X	Website		