GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

PATHWAY: Engineering

COURSE: Foundations of Engineering and Technology

UNIT: Fuel Cells

INTRODUCTION

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

In this unit students will develop a basic understanding of fuel cell technology including the way it works, its uses, its environmental, social, and economic impacts, and the pros and cons of fuel cell implementation. They will observe the basic chemical processes involved in this technology and will be given resources to conduct further exploration on their own.

Grade(s):

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

Time:

5 Hours

Author:

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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 is an optional less that teachers may choose to incorporate into their classes.

FOCUS STANDARDS

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

- ENGR-FET-4 – Students will apply mathematics and science to the solution of a technological problem
- ENGR-FET-5 – Students will describe the essential systems and processes involved with invention, innovation, and entrepreneurship
- ENGR-STEM-1 – Students will recognize the systems, components, and processes of a technological system
- 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:

- ELA11LSV2: The student formulates reasoned judgments about written and oral communication in various media genres. The student delivers focused, coherent, and polished presentations that convey a clear and distinct perspective, demonstrate solid reasoning, and combine traditional rhetorical strategies of narration, exposition, persuasion, and description.
- MM3P. Students will solve problems (using appropriate technology).
- SCSh3. Students will identify and investigate problems scientifically.

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 understand the relevance of fuel cells in the automotive and power industries.

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?

- What are the benefits of fuel cells? What are the problems?
- What do fuel cells run on and what do they produce as waste?
- What are the different uses of fuel cells?
- How can fuel cells change our daily lives on a local and global scale?

Knowledge from this Unit: Factual information.

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
- X 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
- X 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:

Group Discussion

Assessment(s) Description/Directions:

Educators should assess the student's understand of the material through contributions to a discussion that answers the Essential Questions.

Attachments for Assessment(s): Please list.

- Discovering the Principle of the Fuel Cell at home or school
- Fuel Cell Report
- Basic Fuel Cell Animation

LEARNING EXPERIENCES

Sequence of Instruction

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

- ENGR-FET-4 – Students will apply mathematics and science to the solution of a technological problem
- ENGR-FET-5 – Students will describe the essential systems and processes involved with invention, innovation, and entrepreneurship
- ENGR-STEM-1 – Students will recognize the systems, components, and processes of a technological system
- ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts
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- 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.
- ELA11LSV2: The student formulates reasoned judgments about written and oral communication in various media genres. The student delivers focused, coherent, and polished presentations that convey a clear and distinct perspective, demonstrate solid reasoning, and combine traditional rhetorical strategies of narration, exposition, persuasion, and description.
- MM3P. Students will solve problems (using appropriate technology).
- SCSh3. Students will identify and investigate problems scientifically.

2. Review Essential Questions.

- What are the benefits of fuel cells? What are the problems?
- What do fuel cells run on and what do they produce as waste?
- What are the different uses of fuel cells?
- How can fuel cells change our daily lives on a local and global scale?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

1. Preparation
    a. Review "Fuel Cell Report" to understand economic impact of Fuel Cells
    b. Purchase and construct an Intelligent Fuel Cell Car
2. Introduction
    a. Show class pre-built Fuel Cell Car
        i) Ask what they think is powering it
    b. Perform "Before Viewing" exercises at NOVA scienceNOW: Fuel Cells Viewing Ideas
    c. Watch NOVA scienceNOW Fuel Cell Video
    d. Review the basic chemical interaction that occurs in a Fuel Cell
        i) Have students act the process out as demonstrated in film
3. Demonstration (select alternative appropriate to available resources)
    a. Alternative I – Observing Electrolysis
        i) Refer to Observing Electrolysis for further details
    b. Alternative II – Intelligent Fuel Cell Car Lab
        i) Purchase Kits and have students work in groups of 3-4 to construct cars as described in the included instruction manual.
    c. Alternative III – Build Your Own Band-Aid Fuel Cell
        i) Follow instructions on site to build Band-Aid Cells
        ii) Ask students to:
            1) See what modifications (pressing down, changing surface areas or applied liquid, etc) affect the power output
            2) Diagram the reaction taking place in the Band-Aid
4. Review
    a. Draw a chart on the board and have students fill in the pros and cons of fuel cells. (Some answers given on "After Watching" Question #3 on NOVA scienceNOW: Fuel Cells Viewing Ideas)
    b. Ask what effects fuel cells will have on overall automobile prices (higher purchase price but lower fuel costs).
    c. Ask whether students believe fuel cells will ever completely replace combustion engines.
    d. Ask how many uses students can come up with for fuel cells.

Attachments for Learning Experiences: Please list.

- Discovering the Principle of the Fuel Cell at home or school
- Fuel Cell Report
- Basic Fuel Cell Animation

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

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Observing Electrolysis

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

See Observing Electrolysis for specific instructions.

Attachments for Culminating Performance Task: Please list.

UNIT RESOURCES

Web Resources:

- NOVA scienceNOW: Fuel Cells Viewing Ideas
- NOVA scienceNOW: Clickable Car
- NOVA scienceNOW: Fuel Cell Video
- HowStuffWorks "How Fuel Cells Work"
- Build Your Own Band-Aid Fuel Cell
- Intelligent Fuel Cell Car Lab Kit

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		