

Research Experience for Teachers 2009

Energy Project # 2

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Energy Project Lesson Report
RET 2009
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1. This lesson is part of an Integrated 6 week unit in which science social studies and English will all be interwoven into one unit with common goals, subject matter, and assessments.
2. The lessons presented on the next few pages will be only part of the teaching to be done in this unit
3. The over arching question will drive many lessons the two present here are just samples of them....
4. The over arching question is **How do we (the U.S.) achieve energy independence?**
 - a. This is a good overarching question because there can be many answers to this question. Students will be free to choose a plan that makes sense to them and that they can defend.
 - b. This gives students the opportunity to choose how they would go about solving the problem.
 - c. The teacher is not just standing up there and giving information that students will give back to him on a test.
 - i. Students will have to use the scientific and social knowledge they acquire to construct and defend the argument they are trying to make.
 - d. Students will be required to hypothesize an answer and then collect information to defend their position.
 - e. For this reason this lesson will yield greater amounts of learning...
5. Schedule for development
 - a. Determine the objectives to be taught;
 - i. ODE Science Standards
 1. Earth Space grade 10 B/M 4,5,6-
 - a. 4. Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere.
 - b. 5. Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life.
 - c. 6. Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers).
 2. Life science grade 10 B/M 9,10,11

- a. 9. Describe how matter cycles and energy flows through different levels of organization in living systems and between living systems and the physical environment. Explain how some energy is stored and much is dissipated into the environment as thermal energy (e.g., food webs and energy pyramids).
 - b. 10. Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation).
 - c. 11. Explain that living organisms use matter and energy to synthesize a variety of organic molecules (e.g., proteins, carbohydrates, lipids and nucleic acids) and to drive life processes (e.g., growth, reacting to the environment, reproduction and movement).
3. Physical science grade 9 B/M 10,15, 18, 27,
- a. 10. Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity.
 - b. 15. Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.
 - c. 18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum
 - d. 27. Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology).
4. Scientific ways of knowing
- a. 1. Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines.
 - b. 2. Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science.
 - c. 3. Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to more adequate explanations of natural phenomena.
 - d. 7. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue.
5. Scientific Inquiry
- a. 1. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g. OSHA, MSDS, eyewash, goggles and ventilation).
 - b. 2. Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps and available technology.

- c. 3. Use mathematical models to predict and analyze natural phenomena.
 - d. 4. Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations.
 - e. 5. Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected.
6. Scientific Ways of Knowing
- a. 1. Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need to meet human needs and solve human problems.
 - b. 2. Describe examples of scientific advances and emerging technologies and how they may impact society.
 - c. 3. Explain that when evaluating a design for a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced and disposed of in addition to who will sell, operate and take care of it. Explain how the costs associated with these considerations may introduce additional constraints on the design.
 - d.
- ii. ODE Social Studies Standards
- 1. 10HistoryB1: Explain the effects of industrialization in the United States in the 19th century including changes in work and the workplace, immigration and child labor, urbanization, emergence of a middle class.
 - 2. 10HistoryB2: Analyze the impact of industrialization and the modern corporation in the United States on economic and political practices with emphasis on laissez-faire policies, monopolies, standard of living.
 - 3. 10HistoryB3: Analyze the reasons for the rise and growth of labor organizations in the United States.
 - 4. 10HistoryB4: Explain the goals and outcomes of the late 19th and early 20th century reform movements of Populism and Progressivism.
 - 5. 10GeographyB2: Describe how changes in technology, transportation and communication affect the location and patterns of economic activities and use of productive resources.
 - 6. 10EconomicsB3: Demonstrate how United States governmental policies, including taxes, antitrust legislation and environmental regulations affect individuals and businesses.
 - 7. 10CitizenshipRightsandResponsibilitiesA1: Describe the ways in which government policy has been shaped and set by the influence of political parties, interest groups, lobbyists, the media and public opinion. (You can add this one, but it doesn't really apply to town meetings. It's a bit out of context, but does include environmental legislation.)
 - 8. 10SocialStudiesSkillsAndMethodsA1: Determine the credibility of sources.
 - 9. 10SocialStudiesSkillsAndMethodsB3: Analyze one or more issues and present a persuasive argument to defend a position.

- b. Find resources for information
- c. Develop web quest for how Energy is used
- d. Develop list of experiments needed to understand the concepts of energy
 - i. Duke energy use web based assignment
 - ii. Evaluation of world energy use by country Web based
 - iii. Evaluation of their family energy use
 - iv. Solar cell production
 - v. Hydrogen Fuel cell Car experiment
 - vi. Develop rubric for evaluation of the final presentation
- e. Develop worksheets
- f. Develop test
- g. Decide which experiments we can use in class which we cannot. That should become demonstrations

Title

Grade Level: 9
Duration: 1 week

Subject: Energy :
Home Made Solar Cells

Prepared By: Philip Mercatili and Jon Souders

Materials Needed

TiO₂ solar cell kit, Web access, Multi Meters,

Analyze Learners

Overview & Purpose

Energy Independence is one of the most important scientific and social problems of the 21st century.
How do we go about achieving it?

Overview:

- A: Students will be asked to apply concepts they learn in this lesson to propose an energy system for their fictional community. They will have to use scientific information to defend their proposal.
- C: Students will learn the role of scientist and engineers in helping to solve both environmental and societal problems.
- S: Students will learn how decisions get made in a democratic system.

Education Standards Addressed

ODE Science Standards ,
Earth Space grade 10 B/M 4,5,6-
Life science grade 10 B/M 9,10,11
Physical science grade 9 B/M 10,15, 18, 27,
Scientific ways of knowing all B/M
Scientific Inquiry all B/M

Select Goals and Objectives

Scientific concepts to be learned

Students will understand the concept of electrochemical energy, how it is produced and why it is efficient.
Students will learn why it is important to follow instructions, and how small changes in procedure can have a large impact on the efficiency of the cells they produce.

Teacher Guide

- Direct instruction:
- Electromagnetic spectrum
 - Solar energy
 - Solar radiation
 - Laws of thermodynamics
 - Energy
 - Basics of Electrochemical energy
- Lab experiment: understanding electricity
- Test batteries
 - Test volts
 - Test amps
- Direct instruction
- Solar cell technology
- Lab Experiment : Homemade solar cell
- TiO₂ DSSC
- Hypothesis development research
- Lab experiment :
Homemade Solar cells with a twist

Student Guide

- Students will take notes and participate in classroom discussions
- Students will : Test various circuits and learn to measure Current and voltage.
- Students will take notes and participate in classroom discussions
- Students will build and test DSSC
- Students will complete a web search to find ideas for how to improve the DSSC
- Students will test their Hypothesis for building a better DSSC

Assessment

- Students review notes and take a checkup quiz.
- Students will write a mini lab report listing dependant and independent variables and the results of their experiments.
- Students review notes and take a checkup quiz.
- Students: will write a preliminary Lab report.
- Students will write a research proposal for the factor they will test.
- Students will complete a formal Lab Report for their experiments so far.

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<p>Select Instructional Strategies – Information</p> <p><i>Future development needed</i></p> <p>Lesson scaffolding and enrichment activities will need to be developed in order to differentiate based on student skill level.</p>	<p>This lesson will include: Direct instruction of background concepts, lab experiments, an internet search, and a formal lab report.</p>	<p>Students will build and test a TiO₂ Dye Sensitized Solar Cells (DSSC) according to the lab procedure given to them by the teacher.</p> <p>Students will research, using the internet, to students will then alter the design/ construction process in order to improve efficiency and test to evaluate the effect of their change.</p> <p>Students will complete a formal lab report.</p>	
<p>Utilize Technology</p>	<ul style="list-style-type: none"> • The teacher will post lecture notes on Share point site for student access. • The Teacher will use PowerPoint to deliver direct instruction. • The teacher will use the web server to set up a search page to expedite student research. 	<ul style="list-style-type: none"> • Students will use the internet to research TiO₂ DSSC to hypothesis ways to improve the process and increase efficiency. • Students will use Multi Meters to measure cell output. 	

<p>Require Learner Participation</p> <p>Activity Students will be placed in small groups in order to discuss changes they intend to make to the design and production process.</p>	<p>Give students presentation and proposal rubrics</p>	<ul style="list-style-type: none"> • Students will use this information to support their proposal for the unit final assessment. Students will have to develop and have a hypothesis approved. 	<p>Other Resources (e.g. Web, books, etc.)</p> <ul style="list-style-type: none"> • Need to develop a list of web sites that will help students understand way to improve cell efficiency.
<p>Evaluate (Assessment)</p>	<p>Give students the lab report rubric, and example reports.</p>	<ul style="list-style-type: none"> • Formal Lab Report 	<p>Additional Notes</p>

Title

Grade Level: 10
Duration: 1 week

Subject: Energy:
Hydrogen Fuel Cell Car

Prepared By: Philip Mercatili and Jon Souders

Materials Needed

H₂ Fuel Cell Car Kit. Multi Meters, Solar Panel, Variable Light Source, Lux Meter

Analyze Learners

Overview & Purpose

Energy Independence is one of the most important scientific and social problems of the 21st century.
How do we go about achieving it?

Overview:

A: Students will be asked to apply concepts they learn in this lesson to propose an energy system for their fictional community. They will have to use scientific information to defend their proposal.

C: Students will learn the role of scientist and engineers in helping to solve both environmental and societal problems.

S: Students will learn how decisions get made in a democratic system.

Education Standards Addressed

ODE Science Standards ,
Earth Space grade 10 B/M 4,5,6-
Life science grade 10 B/M 9,10,11
Physical science grade 9 B/M 10,15, 18, 27,
Scientific ways of knowing all B/M
Scientific Inquiry all B/M

Select Goals and Objectives	Teacher Guide	Student Guide	Assessment
<p>Students will understand the scientific principles of</p> <ul style="list-style-type: none"> • Energy • Thermodynamics • Electrochemical energy • Chemical bonding • <p>Students will understand the scientific principles of</p> <ul style="list-style-type: none"> • Electricity <ul style="list-style-type: none"> ◦ Load ◦ Resistance • Membrane Technology <ul style="list-style-type: none"> ◦ Selectively permeable • Operation principle of H₂ fuel cells 	<p>Direct instruction:</p> <ul style="list-style-type: none"> • Review Electromagnetic spectrum <ul style="list-style-type: none"> ◦ Solar energy ◦ Photo Reactive solar radiation ◦ Laws of thermodynamics ◦ Basics of Electrochemical energy ◦ Review Basic Multi Meter use. • Work • Chemical bonding <ul style="list-style-type: none"> ◦ Endothermic ◦ Exothermic ◦ Activation energy ◦ Catalyst <p>Lab Experiment</p> <ul style="list-style-type: none"> • Use solar panel to Electrolyze water <p>Direct instruction</p> <ul style="list-style-type: none"> • Proton Exchange Membranes <p>Lab Experiment</p> <ul style="list-style-type: none"> • Fuel cell car 	<p>Students will take notes and participate in classroom discussions</p> <p>Students will learn to measure Current, Volume of a gas, and Light.</p> <p>Students will take notes and participate in classroom discussions</p> <p>Students will calculate the work potential of a</p>	<p>Students review notes and take a checkup quiz.</p> <p>Students will complete a Lab worksheet</p> <p>Students review notes and take a checkup quiz.</p> <p>Students will complete a lab</p>

<ul style="list-style-type: none"> Students will understand the scientific principles of <ul style="list-style-type: none"> Energy 	<ul style="list-style-type: none"> 	given amount of H ₂ .	report
<p>Select Instructional Strategies –</p> <p>Future development needed Lesson scaffolding and enrichment activities will need to be developed in order to differentiate based on student skill level.</p> <p>Information (Catch, give and/or demonstrate necessary information, misconceptions, etc...)</p>	This lesson will include: Direct instruction of background concepts, lab experiments, an internet search, and a formal lab report.		
<p>Utilize Technology</p>	<ul style="list-style-type: none"> The teacher will post lecture notes on Share point site for student access. Teacher will use PowerPoint to deliver direct instruction. 	Students will use Lab equipment and computers to test and evaluate results.	
<p>Require Learner Participation</p> <p>Activity (Describe the independent activity to reinforce this lesson)</p>		Students will use this information to support their proposal for the unit final assessment. Students will have to develop and have a hypothesis approved.	<p>Other Resources (e.g. Web, books, etc.)</p>
<p>Evaluate (Assessment)</p> <p>(Steps to check for student understanding) – See Objectives above</p>	Give students the lab report rubric, and example reports.	Students will complete a Lab Report	<p>Additional Notes The culminating assessment for the unit will also include evidence for understanding this topic.</p>

Important Attachments:

1. Pre-Post Assessment We will complete these after the objectives are complete
2. Worksheets Web quest and web based lessons will likely replace these
3. Reflection after lesson To be completed after teaching.