

Project Summary

In the UCLA AICHE-BOOTUP Program, we aim to engage middle school and high school students in alternative energy technology and environmental education through a 4-series workshop. The concept of our curriculum is the consequences of using alternative energy. On our first visit, we will first introduce why it is necessary to use alternative energy such as solar power and fuel cell. On our second workshop visit, we will look at how we drive the need for alternative energy. The third workshop will consist of a detailed look into the science and economics of solar power by teaching the students about the underlying principles of the solar cell. Each of these visits will also include demonstrations and activities as well as homework and student run presentations. We will conclude our program with a field trip that shows how alternative energy technology is applied- we propose a trip to the Natural Resource Council in Santa Monica. Finally, we will ask the class to prepare a follow-up presentation in which we will revisit these schools a month later to assess their progress. After participating in our program, we hope the students will have a better understanding about why we need alternative energy and how it will change the way we live.

Goals

Short-term

Our immediate goal is to teach the causes and effects of alternative energy resources. We also hope that our curriculum is beneficial to them in accordance with the K-12 standards.

Long-term

After participating in our program, we hope that the students will make a conscientious effort in changing the way they use energy. We also hope to spark their interest in this field where they will enter this field of science and technology in the future. Furthermore, we hope that the success of this program will encourage the educators to incorporate this topic into their curriculum for the future generations.

Target Schools

For this program, our target schools are those that are underprivileged and are in need of resources for their students. The two schools that are participating in our program are John Burroughs Middle School in Los Angeles and Mar Vista Central High School in Culver City.

John Burrough Middle School is a Title I School.¹ The demographic of JBMS consists of students who are African-American, Latino-American, and Asian-American. We were contacted directly from a science teacher at JBMS regarding the urgent need for additional technology-related resources. Up until this year, the school's computer lab consisted of 40 computers that were only capable of running Windows 98; the teacher was able to replace only 14 of these units.

We have been discussing different ways in which we can support their science and

¹ US Dept Ed Title I—Improving The Academic Achievement Of The Disadvantaged
<http://www.ed.gov/policy/elsec/leg/esea02/pg1.html>

education program. We expect that having an innovative and engaging alternative energy program series will help engage the students in several types of applied sciences as well as the social/environmental responsibility issues that alternative energies and technologies are addressing.

Central High School is located in the Mar Vista Projects, a low-income housing development in Mar Vista/Venice, California. The school is comprised of a single classroom with one instructor, who is very excited at the prospect of a science and alternative energy program for his students.

Central High School is a continuation facility that accepts students who have been expelled from previous high schools in the area. The students are underprivileged, minority populations, with an estimated 95% being from Latino-American families out of 20-30 students. We have worked extensively with Central High School for the past year and have encouraged several of them to apply to the Center for Embedded Networked Sensing Research Center at UCLA for summer internships (2 of 4 were accepted). Our project as well as the instructor both understands the value of science and technology in addressing pressing global concerns.

We also have an arrangement with the instructor that if the students participate in this program (attendance, completion of assignments) that they would receive high school credits that can count towards their science requirements. Therefore, this education workshops series not only provides a fresh perspective on how to approach and engage our community in alternative energy and environmental issues, but helps the student participants directly in their path towards graduating high school.

Workshops

We plan to have weekly workshops for 4 weeks starting mid-February, where the final workshop is a field trip. Each workshop, except for the field trip will last about two hours. Below is a detailed outline of the workshops as well as the desired outcomes.

Visit One:

Theme: The theme for the first visit will be the basics in alternative energy and the effects that cause us to be more environmentally friendly.

Topics:

We will discuss the causes that led to new developments in energy: global warming, air pollution, acid rains, climate changes, and dependence on crude oil. We will present this information using a poster, with all of the causes connected at the center, and to simulate class participation, keep the sections covered with a piece of paper until the students list each specific cause. With each cause, we will go through a life cycle of the origins of the waste that harm our environment.

The remainder of this workshop will be a presentation on the wide range of methods that industries are applying. Such methods include biofuels, wind and water turbines, solar energy, and generators. We want to expose to the students the general ideas behind the environmental movement that the industries are moving towards. To demonstrate these ideas we will divide the students into groups to assemble a model that

applies the technology we have discussed. They will present their model to the class. Models include:

- 1) Generator/Tic Tac Project (Grades 6-12)
- 2) Water Turbine Project² (Grades 6-12)
- 3) Fuel cell and solar car³ (Grades 7-12)

To conclude this visit, we will ask review questions and hand out prizes as incentives.

Objectives:

The objective of the first visit is to grasp the students' attention and interest. We want them to ask questions, participate, and look forward to our next visit.

Homework Assignment/Activity:

Pick the alternative energy you feel is the most effective. Then, find a current event article from the provided magazines and articles about the alternative energy resource. Do a summary and share your article with the class.

Visit Two

Theme: Visit two further expands on the "consequences of new technology" theme first introduced in the first visit through the discussion of region suitability of alternative energy.

Topics:

During the second visit, students become personally involved in the project by exploring their own carbon footprint or by monitoring their energy usage. We begin by establishing the methods used to estimate emissions and electricity use. One of the following activities can be performed to illustrate how these methods are applied to determine which is the best option:

- 1) Decision tree (Grades K-5)
- 2) Energy and economics comparison (Grades 6-12)
 - Incandescent lamp v. compact fluorescent lamp
- 3) Life cycle analysis (Grades 6-12)
 - Paper bags v. plastic bags
- 4) Fuel economy: MPG (Grades 6-12)

Results from these studies often lead to behavior change or implementation of new technology. Returning to solar energy, students will conduct an analysis of their own lifestyle to be used in the next visit to gauge how much pollution or energy solar

² Fuel Cell Car. Home Schooling Supplies.

<http://www.homeschoolingsupply.com/thames-and-kosmos/science-kits-tk628710.htm>

³ Water Turbine Demo

<http://www.youtube.com/watch?v=x8xowR0YRI>

energy can offset. Also, based on their results, they can suggest other solutions to reduce their emissions or consumption.

At the end of the visit, we will have a current event discussion. Some possibilities are:

- Article: “University Acts on Energy Audit⁴” (Grades 6-12)
- Presentation by researcher involved with Personal Environmental Impact Report (PEIR) Project (Grades 9-12)

We can also distribute copies of “Energy Savers⁵,” a pamphlet published by the U.S. Department of Energy to help them with their assignments.

Objectives:

- Develop logical methods to evaluate the pros and cons of various options
- Make solar energy relevant to the students
- Present behavior change as another alternative

Homework Assignment/Activity:

- 1) Energy Action List⁶ (Grades K-5)
- 2) Carbon footprint online calculator⁷ (Grades 6-12)
- 3) Kill A Watt device application⁸ (Grades 6-12)
- 4) Energy audit (Grades 9-12)
 - a) Online calculator⁹
 - b) Home energy audit¹⁰
- 5) PEIR device application¹¹ (Grades 9-12)

Visit 3

Theme: Visit three will focus on the science of solar panels and the practicality of using solar power.

Topics

Before we go into the details of the photovoltaic cell, we will present some

⁴ University Acts on Energy Audit

<http://media.www.webujournal.com/media/storage/paper245/news/2008/10/02/News/University.Acts.On.Energy.Audit-3469893.shtml>

⁵ Energy Savers

http://www1.eere.energy.gov/consumer/tips/pdfs/energy_savers.pdf

⁶ Energy Action List

<http://www.eere.energy.gov/kids/pdfs/EnergyActionList.pdf>

⁷ Carbon footprint online calculator

<http://www.carbonfootprint.com/calculator.aspx>

⁸ Kill A Watt Energy Monitor

http://www.amazon.com/P3-International-P4400-Electricity-Monitor/dp/B00009MDBU/ref=pd_bbs_sr_1?ie=UTF8&s=electronics&qid=1225232057&sr=8-

⁹ Online Calculator

<http://hes.lbl.gov/>

¹⁰ Home energy audit

http://www.ase.org/uploaded_files/educatorlessonplans/audit.pdf

¹¹ PEIR device application

<http://peir.cens.ucla.edu/>

background knowledge about protons, electrons, and neutrons. With this knowledge, we can go on to explain what exactly a photovoltaic cell is and how it converts sunlight to energy we can use. We will use the aid of the Elenco Solar Deluxe Educational Kit¹² to help explain the function of the solar panels.

The latter part of the lesson will focus on how using solar energy will help us economically. We will go through a life cycle assessment of solar power where we evaluate the energy it takes to produce the system to produce energy to the actual energy the system generates and its energy payback time (BPBT)¹³. This will lead to the discussion about the practicality of solar power. Is it worth installing solar panels in our own home?

To conclude this session we will have a brief review of the material covered and take answer any questions the students may have. We will also give a brief description of the Natural Resources Defense Council.

Objective:

- To teach the students about the fundamentals of chemistry and the concepts of solar power.
- To analyze the practicality of solar power

Homework Assignment/Activity

- 1) Share what you learned today about solar power with a family member or friend and ask how they feel about solar power. Write a 1 page report on the pros and cons of solar power. Also include a brief discussion about the feasibility of installing solar panels in your home.
- 2) Prepare at least two questions to ask at next week's field trip. You may partner up, but everyone must ask at least one question.

Visit Four:

Theme: Real life applications of alternative energy technology

Topic:

Throughout the program, we have seen many possible solutions to our limited energy resource. We have also learned about the consequences from using these other technologies. Now it is time to see how others have implemented these alternative energy technologies into their everyday life. We are off to the Natural Resource Defense Council (NRDC) where they have created one of the most sustainable and economical buildings. This field trip will take up at least half the school day. The possible activities during the field trip include:

- 1) A tour of the NRDC building in which we discuss what technology is applied
- 2) NRDC's environmental learning center

¹² Elenco Solar Deluxe Educational Kit

http://www.amazon.com/Elenco-Solar-Deluxe-Educational-Kit/dp/B00008S2V6/ref=pd_bbs_sr_2?ie=UTF8&s=toys-and-games&qid=1225474926&sr=8-2

¹³ Solar Energies Technology Programs

http://www1.eere.energy.gov/solar/pv_cell_light.html

We conclude this field trip with questions from students for the guide as well as a quick quiz about the building. Those who answer correctly will receive a prize.

Objectives :

- To demonstrate real life applications of some of the technologies discussed in the program.
- To show that applying these technologies to our own home is practical

Homework Assignment/Activity:

- 1) Write a 1 page report about what you learned today and what do you think about solar power as an alternative energy. For instance:
 - What are some technologies that the NRDC uses?
 - How does using this technology help save them money and energy?
 - How does this building use solar energy?
 - How else do you feel this building can improve?
- 2) Write 1-2 page follow-up about the program including what you learned from the program and how have you changed from it. For instance:
 - Recall each visit and what you learned from it.
 - What is the importance of alternative energy for the economy as well as the environment?
 - How are some ways I can help conserve energy?
 - After learning about so much technology and seeing solar power being applied, do you think solar is the best solution to our fuel issue? Explain. If not, what do you feel is a better choice? Explain.
 - What have I done since the program to help save energy?
- 3) Complete the survey about our alternative energy program. Questions include:
 - Which visit was your favorite?
 - Which visit did you learn the most from?
 - What can we do to improve the program?

Follow-up visit

We will have a follow visit approximately a month after the field to observe the effectiveness of our program. Here we will collect the last assignments and ask that the students share how they have implemented lessons from the workshop into their lives.

Budget

The proposed budget reflects the estimated costs for one school, even though we have two schools participating in our program. Some items in the budget will be reused for the second school, especially those used for demonstrations. Due to varying number of students, the Tic-Tac box generator estimate cost is above the cost of the individual components. The final cost will vary depending on which demonstration, Tic-Tac box generator or flashlight kit, we use.

Item	Quantity	Price per unit	Total Cost
Bus to NRDC	1	\$500.00	\$500.00
Construction Paper, poster boards, glue, etc. (for presentations)		\$100.00	\$100.00
Prizes		\$200.00	\$200.00
Energy monitor (Kill A Watt)	25	\$20.00	\$500.00
Fuel Cell Kit	1	\$120.00	\$120.00
Water Turbine Demo Components: <ul style="list-style-type: none"> • 2 liter bottle- \$2 • Skewer- \$2 • Cork- \$2 • String/weight- \$3 	1	\$9.00	\$9.00
Tic –Tac box generator kits Components: <ul style="list-style-type: none"> • 150 ft. 30 gauge enamel-coated magnet wire- \$17 • 4 1/8" rare earth magnets - \$30 • 4 rectifier diodes (IN4007 MIC) - \$3 each • Resistor (22 ohm) - \$1 each • White led - \$2 each • Switch - \$2 each • Some sort of small rechargeable batteries - \$15 for four • Ballpoint pen - \$5 • 2 plastic washers or doodads - \$3 • Tic-Tac container - \$1 each • Epoxy - \$10 	1	\$150.00	\$150
Assemble you own flashlight kits	25	\$10.00	\$250.00
Elenco Solar Deluxe Educational Kit	1	\$20.00	\$20.00
Solar Car Assembly Kit ¹⁴	1	\$44.00	\$44.00
Total Costs			\$1643 - \$1743

Contact Information

¹⁴ Solar Car Assembly Kit

[http://www.amazon.com/Solar-Car-Assembly-Kit-](http://www.amazon.com/Solar-Car-Assembly-Kit-TAM76001/dp/B00061HIGW/ref=pd_bbs_5?ie=UTF8&s=aps&qid=1225474926&sr=8-5)

[TAM76001/dp/B00061HIGW/ref=pd_bbs_5?ie=UTF8&s=aps&qid=1225474926&sr=8-5](http://www.amazon.com/Solar-Car-Assembly-Kit-TAM76001/dp/B00061HIGW/ref=pd_bbs_5?ie=UTF8&s=aps&qid=1225474926&sr=8-5)

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