Course Title and Course Description: "Solar Schoolhouse Summer Institute for Educators".

Course Dates, Days, and Times and locations:
June 24-29, 2007 – Los Olivos – Midland School http://www.midland-school.org/index.html

Instructor(s) name, address, phone number-
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Grading: credit/no credit)

Justification for the course: In an era of dwindling fossil fuel supplies and strong evidence of global warming it is important that the current generation of teachers and students develop their awareness of energy production and sustainable energy technologies. The curriculum, activities, and solar technology that the teachers will learn in this course will equip them to teach their students about renewable energy and energy conservation. Furthermore, the activities that the solar energy curriculum provides are especially engaging because they put the actual technology in the hands of students. The curriculum is designed to meet California Board of Education outcome standards in an engaging, often multidisciplinary manner.

Description of Expected Learning Outcomes (describe what students should know or be able to do after taking this course):

What teachers learn:
Learn which state standards are met through teaching solar energy;
Learn sun facts
Learn how to teach about the causes of seasonal temperature changes
Learn how to build instruments for measuring seasonal changes in sun angle, shadow, and solar energy;
Learn how to gather, represent, and interpret seasonal solar angle and temperature data;
Learn principles of solar building design;
Learn principles of solar water heating;
Learn principles of solar electricity;
Learn how to conduct solar electricity laboratories;
Learn how to draw architectural type drawings and build model buildings so that they can lead similar projects in the classroom;
Learn how to set up thermal dynamic experiments in the classroom;
Learn how to lead students in permanent solar electric installations at the school site including solar powered water fountains and stand alone solar electric power stations;
Learn how to conduct a home energy audit and what options there are for saving energy by using more efficient appliances.

What teachers will be able to do:
Design and build model solar homes for their climate;
Assemble solar race cars and conduct a solar race car derby;
Assemble stand alone solar electric power stations;
Install a solar powered water fountain;

Design curriculum using solar technology and meeting their teaching objectives;
Lead lessons in energy efficiency and conservation.
Understand the context of these subjects within their own community.

Assessment Strategies (e.g., group work , examinations, portfolios, student papers, group projects):
Proficiency will be assessed in several ways: for solar home design, teachers will produce a set of four architectural drawings of their design, a description of how the building works to heat itself in the winter and stay cool in summer, produce a model, and give an oral presentation to the class about their solar design; for solar race cars teachers will build a solar race car and participate in a solar derby; for curriculum development teachers will create a curriculum unit for their classroom; for stand alone solar electric systems and fountain installations, teachers will set up both and we will assess how well they are assembled and work; teachers will also complete regular homework assignments to demonstrate their comprehension of the concepts covered in the course and their ability to solve related math and design problems.

For whom is this course being developed? (Select from the following: majors and/or minors in the department, majors of other departments, general education, other):
First and foremost, the course is intended for school teachers from 3rd to 12 grades teaching one or more of the following: science, mathematics, chemistry, environmental science, integrated science, earth science, physics, art, English, economics, ecoliteracy, and occupational courses. Additionally, curriculum developers and/or educational organizations working with k-12 schools will find this workshop beneficial.

Course Outline: Information covered in the Session.

I. Energy Literacy:
- A. Overview of U.S. Energy Production and Consumption
- B. Global Energy Production and Consumption
- C. California Energy Production & Consumption – Electricity Production & Transportation
- D. Environmental Issues

II. California Curriculum Standards and Energy Education
- A. Review standards and links to energy education.
- B. Outline Science, history, math, and language connections.

III. Renewable Energy:
- A. Overview of Solar, Wind, Geothermal, Hydrogen energy technologies
- B. Types of Solar Energy Use
    1. Building Heating and Cooling
    2. Solar Water Heating
    3. Solar Electricity
    4. Solar Cooking
    5. Solar Drying

IV. Project: Build a Solar Oven
- A. Historical Perspective
- B. Thermodynamic properties of Solar cooking
- C. Build and test a simple box or parabolic cooker
- D. Build a higher temperature solar oven using low cost materials.
- E. Extensions.

V. Reasons for the Seasons and Solar Home Design
- A. Project: Building Instruments to measure the changing relationship of the Sun and Earth across the seasons.
- B. Gathering, recording, and representing solar data.
- C. Explaining the data: theory and model building.
- D. Principles of Solar Home Design for space heating and cooling.
- E. How to design a building.
- F. Homework: work on a solar home design.

VI. Prepare food in the solar ovens
- A. Test recipe in oven
- B. Test and record data on heating water using thermometer.

VII. Project: Develop Solar Home Designs
- A. A. Dialogue with classmates about your design and implement improvements.
- B. Show your design ideas to Solar Schoolhouse instructor and implement improvements.
- C. Build model of your solar home design.
- D. Academic rationale for the Solar Home Design Project.
- E. Ways to simplify the project for your classroom

VIII. Solar Electricity:

A. How solar cell works.
B. Solar electric experiments and classroom activities.
    1. Building and testing a simple circuit using solar cells and motors.
    2. Building and testing series and parallel circuits using several solar cells and motors.
    3. Powering water pumps and tape deck using various wiring configurations.
    4. Solar geometry using solar electric module.
C. **Project:** Assemble a Stand-Alone solar electric power station (Flip Cell Kit)
    1. Learn about polarity, rechargeable Lithium-Ion batteries, matching loads, soldering, LED technology.
    2. Using the Flip Cell for class demonstrations.
D. Project: Add solar electric system to model solar home

IX. Comparison of conventional and solar electric generation.

A. Demonstration using a human powered generator.
B. How a conventional generator works.
C. Activity: Competition between generator and solar modules to power various electrical loads.

X. Solar Electric Cars

A. Academic rationale for Solar Electric Cars:
    1. Demonstration of solar electricity;
    2. Opportunities for teaching applied physics.
    3. Design elegance and design trade-offs.
B. Project: Build Solar Electric Cars.
C. Practicum: Setting up Solar Car Derby.

XI. Solar Electric Powered Fountains and Ponds.

A. Academic Rationale for Solar Powered Fountains.
B. How to Build a Solar Powered fountain
C. Project: Build a Solar Powered Fountain.
D. Solar Fountains as a teaching tool

XII. Solar Water Heating.

A. Thermodynamic principles
B. Designs
C. Applications
D. How to build Solar Water Heaters
E. Project: Add solar hot water system to model solar home.

XIII. Home Energy Audits - Energy Efficiency

A. Introduction to the mathematics of energy and power.
B. Teaching station: Incandescents vs. Compact Flourescents
C. Conduct Energy Audit of several rooms at School
D. Use Kilowatt Meter for several Refrigerator loads.
E. Estimate Energy & Dollar Savings using recommended energy saving measures.

F. Design a Solar Power system to power the designated room; before and after retrofitting with energy efficient measures.

XIV. Energy Policy Development

A. Study the implications of adopting different energy policy paths- Status-quo, EE+ RE
B. Using Real World data, evaluate the societal implications of these two energy policy paths
C. Two or more groups will debate the merits of each policy path.

XV. Adapt & Develop Lesson plans for YOUR classroom.

A. Based on your requirements (State Standards?) and grade level.
B. Share with Group.
C. Identify a peer partner to communicate with during the upcoming school year.

Syllabus for Solar Schoolhouse Summer Institute for Educators

Day One: Overview of the course; presentation and slideshow overview of energy issues and renewable energy; build solar oven; overview of measuring the seasons and solar home design curriculum; build instruments for measuring solar angles.
Homework: Read article on solar home design in reader; review solar home design curriculum.

Day Two: Prepare food to cook in solar ovens and set them out to cook; review solar design principles and analyze actual solar home designs; practice gathering data with the solar angle instruments on an hourly basis (for practice); practice representing the data in tabular and graphical formats; presentation on using blocks in the design process and demonstration of how to draw building plans; begin design of solar home.
Introduction to Conventional Electrical Production and Solar Electricity.
Homework: Design a solar home; read articles explaining solar electricity systems. Create lesson plan to teach solar energy using either a solar oven project or a solar home design project.

Day Three: Critique and re-working of solar home designs; presentation on building models; begin building models of solar homes. Solar Electricity continued. Practice leading activities using solar electric cells and modules; assemble a stand-alone solar electric system. Project time to continue work on models.
Presentation: Solar Powered Art and Solar Pond and Fouintain Installations.
Homework: Read materials on energy efficiency and conservation; sketch a design for a solar powered pond or fountain that you could imagine installing with students at your school site; reading: solar ponds and fountains guide book; solar water heating.

Day Four: Set up a solar water heating system; Presentation: solar race cars and boats as teaching tools; Project: build solar race car. Continue working on the solar home models; add solar electricity to the models. Presentation: Energy Conservation; Hands on activities on energy efficiency using a plug-load meter. Discussion: How to implement energy conservation projects for students at the school site and in their homes.
Discussion: how would you implement solar projects and activities into your teaching? What do you see as some of the obstacles? How to re-work the activities and projects so that they will fit your teaching context.
Homework: write up explanation of how your solar home works. Outline a curriculum unit on renewable energy with some sections more fully elaborated into a lesson plan.

Day Five: Presentations: teachers present their solar homes to the whole class. Presentation in sub-groups: share out the curriculum units that you have created. A couple of teachers will present their curriculum plans to the whole group followed by a discussion.
Solar Car Race.
Discussion of where to go from here: additional ideas for projects such as competitions and engineering challenges. Discussion of continuing relationship between teachers, schools, and the Solar Schoolhouse.
Turn in curriculum assignments.
Evaluation
Closing ceremony.