Introduction to Energy Course Overview

Background

This course is one of a series of four courses, developed in response to AB 519, in which the California legislature called for creation of academies focusing on clean technology and energy businesses and provision of skilled workforces for technologies that improve the environment and stimulate the economy. The intent of the program is to keep California competitive as a leader in advanced transportation and technology driven transportation and energy industries.

Homes, cars, schools, and office buildings all use energy. Approximately 40% of energy used in the United States is from residential and commercial buildings. Another 28% is energy used for transportation. The remaining percentage is used by industry.

More than two-thirds of the fuel used to generate power in the U.S. is lost as heat. The majority of electric generation in the U.S. does not make use of this wasted heat. As a result, the average efficiency of utility generation has remained at about 34% since the 1960s. The energy lost in the U.S. from wasted heat in the power generation sector is greater than the total energy use of Japan.

Most of the world's energy comes from fossil fuels. Although the demand for fossil fuels has been growing, for example, in the case of crude oil, the quantity of crude oil produced in the U.S. has been declining annually. More than 50% of the crude oil and petroleum products used in the U.S. in 2008 came from other countries.

These conditions call for more education about energy and energy use. The aim is to motivate Americans, both individually and collectively, to take action to change behaviors that will dramatically impact our society, economy, environment, and government in positive ways, by gaining a greater understanding of the implications of our current energy use.

About the Course

Introduction to Energy is a survey of the basics of energy and is a foundation for the series of Green Academy courses. It provides an introduction to energy concepts, energy efficiency, green building, and alternative fuels and supports the detailed material in the other three courses on these topics. Students will also be introduced to green building practices and the methods used in construction to improve the energy efficiency of homes, businesses, schools, governments, and industries, which consume more than 70% of the natural gas and electricity used in the U.S.

Subject matter of this course:

- Covers the subject of energy, its form, and how it transforms.
- Explains introductory concepts of the laws of physics that rule energy.
- Describes the principles of energy, the various forms, how they are derived, and how they are used.
- Reviews some of the laws and regulations impacting energy.
- Introduces how energy is distributed from one location to the end user.
- Explains what global warming is and its effect on climate change.
- Defines and discusses the forms of renewable energy.

- Explains energy efficiency and conservation.
- Defines green building and discusses its best practices.
- Reviews the types of alternative fuels and their uses.

Target Grade Levels

The Introduction to Energy course is designed as a stand alone course or for integration into existing tenth grade high school classes. The curriculum is written keeping in mind the wide range of students' and teachers' knowledge and ability in energy. Teachers from different disciplines and levels of knowledge of the subject matter may teach this curriculum, so it was designed in a way that it can be modified and adapted to meet the specific needs of the indivdual teachers, students, and schools.

Program Overview

The Introduction to Energy Course consists of six units. The material may be used in sequence or teachers may modify the curriculum as is appropriate for their classrooms and schools.

1. *Introduction to Energy Concepts*
   This unit covers the subject of energy, its form, how it transforms, and the laws of physics that rule it. The principles of the various forms of energy, how they are derived, and how they have been used will also be covered. Other topics that are discussed include: laws and regulations impacting energy and how energy is distributed from one location to the end user.

2. *Global Warming and Climate Change*
   In this unit, students will be introduced to the science behind global warming. They will learn why carbon is the foundation of all living organisms, why it is an important element, and its importance to the environment and climate change. They will also learn about greenhouse gases and the global warming potential of these greenhouse gases.

3. *Renewable Energy*
   Students will learn about renewable energy sources, what renewable energy is, and the types of renewables available. Those sources are, but not limited to, solar, wind, biomass, geothermal, and hydroelectric. The benefits and drawbacks of the fuels are also covered.

4. *Energy Efficiency*
   This unit introduces the subject of energy efficiency and energy management. The students will learn the principles of energy efficiency and the methods and application of these principles to commercial and residential buildings. Also covered are simple energy efficiency solutions for the home and workplace.

5. *Green Building*
   This unit introduces the students to green building practices and the methods used in construction to improve the energy efficiency of homes, businesses, schools, governments, and industries.

6. *Introduction to Alternative Fuels*
   This unit provides background information about alternative fuels, including the properties, applications, environmental benefits, and distribution of the fuels, as well as the types of vehicles powered by each of the fuels.

Tips for the Instructor

The curriculum content is divided into six sections: Introduction to Energy Concepts, Global Warming and Climate Change, Renewable Energy, Energy Efficiency, Green Building, and Alternative Fuels. These course materials provide lecture information, a glossary, activities, evaluation tools, and supplemental materials.

Since the course was designed for a broad audience of teachers from a variety of disciplines and students with a diverse knowledge and skill base there was the need to provide course materials at different levels. Some of the materials may either be more or less complex than expected, depending on the individual's level of expertise in the subject matter. The course was developed to use the material as is or adapt it to specific student and/or classroom needs.

A podcast series provides professional development workshops to prepare instructors to deliver this curriculum. There are four videos, one for each of the four courses. The series consists of: Introduction to Energy, which is divided into six units, Energy Auditor, Green Building, and Introduction to Alternative Fuels. A recording of PowerPoint slides and teach the teacher sessions can be listened to or watched online through the Four Energy website at http://www.fourenergy.org/.

The intent of the podcasts is to introduce teachers, to the curricula, instructional materials, and activities. The hope is that these curricula will provide teacher resources that will support an effective and engaging learning process that teachers and students will find both educational and practical.

Assessment

Teachers may evaluate student performance as appropriate for their particular class and school. Sample test questions are available for each of the units. These can be used as is or changed as desired. The lessons have additional opportunities for student performance evaluation built into them and are found in each of the lessons. Before developing student learning assessments determine the expected level of performance in advance of the assignment. Explaining expectations up front with students will help them understand what they need to accomplish to be successful in the course. Teachers may assess student performance based on:

- Homework and other assignments
- Engagement in class discussions and small group work
- Activities
- Tests and quizzes
- Presentations

- Reports
- Self-evaluation conducted by the students

Teachers may want to facilitate instructional discussions and inquiry by engaging students in conversations focused on the content area. As students express their thoughts on a particular subject, the teacher can guide the conversation toward higher levels of comprehension. These facilitated discussions may be conducted at any point throughout the curriculum. Use questions and answers to pique student interest and to encourage development of critical thinking skills and deeper understanding of the content.

Course Text & Materials

The textbook that accompanies the Introduction to Energy Course is:

Len S. Litowitz and Ryan A. Brown, (2007), *Energy, Power, and Transportation Technology*, The Goodheart –Wilcox Company, Inc.

A *Student Activity Manual* is also available.

The textbook and activity manual can be used as a source for background material and for reading assignments throughout the course. In addition there are fill in the blank knowledge tests and activities at the end of each chapter.

Instructors should contact the publisher for information on desk copies and/or bulk educational discounts for students.

Program Development

The pedagogy applied to this course is the Socratic Method and experiential learning methodology. The course is meant to be a hands on practical learning process, based on a form of inquiry and dialogue that encourages individuals with differing points of view to ask and answer questions to generate critical thinking and innovation. Additionally, the use of interactive based curriculum is used to appeal to the different learning styles of students. These teaching methodologies were integrated into the curricula to develop students' knowledge, skills, and abilities in the area of energy. Listed below are some of the teaching techniques used:

Interactive based curriculum

- Activities and experiments
- Research
- Role plays
- Discussions
- Teamwork
- Case studies

Develop knowledge, skills, and abilities

- Problem solving
- Critical thinking – inquiring minds
- Collaboration and communication
- Global appreciation
- Imagination and inventiveness

Many different sources were used to develop the Introduction to Energy curriculum. Please check the References section for these sources.