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Curriculum Units by Fellows of the National Initiative
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Introduction

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With concerns about the impact on the environment of our current use of fossil fuels and our national energy security, energy is in the news on a daily basis. Many students are familiar with some of the issues relating to energy use, but they may not know much about the science related to energy. The aim for this seminar was to discuss the science related to current sources of energy and potential future sources of energy. We can learn much about sustainable energy use by studying natural processes. Nature has solved the renewable energy problem through the process of photosynthesis that is carried out by green plants. Plants are amazing chemical factories and provide a working example of renewable solar energy conversion, but this is often not appreciated. By understanding how plants carry out the processes of solar energy utilization, we can obtain some answers to the question of how we can harvest solar energy by using processes of artificial photosynthesis.

My own interest in science stems from my hands-on experiences as a child. Therefore, many demonstrations were included in this seminar – at least one demonstration, and frequently 2-3, in each seminar meeting. These demonstrations were chosen so that they could actively involve the students and at the same time illustrate the scientific principles related to energy.

The books by David Walker entitled “Energy, Plants and Man” and by David J. C. MacKay entitled “Sustainable Energy – without the hot air” were used as the primary technical books for the seminar. We also read Daniel Yergin's “The Quest: Energy, Security and the Remaking of the Modern World,” a fascinating but not highly technical analysis of our energy use. The beginning of the seminar focused on energy, light and photosynthesis. The seminar began with a discussion of how plants use light to convert carbon dioxide and water into sugar and oxygen gas. This included discussions on the nature of light and the fundamental steps by which light is absorbed by plants and converted into chemical energy. Demonstrations of the colors in light using diffraction glasses aided these discussions. A connection was made between natural photosynthesis and the excess production of biomass that has been buried to form the “fossil fuels” that provide most of our current energy. Next, we delved into various forms of energy, including hydroelectric, biofuels, wind, geothermal, solar and nuclear. A highlight of the seminar was the production of biodiesel fuel from cooking oil that culminated in the combustion of biodiesel fuel in an oil furnace burner. The seminar also included a discussion of energy use in the future that included progress in development of systems for artificial photosynthesis and fuel cells.

The curriculum units developed from this seminar are suitable for elementary to middle school to high school students. In all of the units, the science content is integrated with language arts, mathematics and social studies to provide a balanced program that meets the literacy requirements of the school system. The Fellows

have prepared extensive lists of materials that can be used in the classroom or as resources. These materials include books that the students can read, textbooks that the teachers can use, demonstration sourcebooks, suppliers of equipment and many addresses of sites on the world wide web. The Fellows have developed units around a theme or activity related to energy, including units on energy transformations, energy transfer through an ecosystem, the chemistry of batteries, building a wind turbine, sustainable energy production on an island, and the impacts of the coal industry. Other units are related to comparisons of current sources of energy based on fossil fuels with the renewable energy sources, analyses of carbon footprints, and radiation related to nuclear energy and medicine. Information on the responsible use of current sources of energy to lower our carbon footprint, as well as the impact of our energy use on the planet Earth, is also provided in many of the curriculum units. The units include a number of excellent activities that will engage the students' interest and teach them about energy sciences.

I would encourage all teachers of elementary through high school students to review these curriculum units. These materials provide a valuable resource for incorporating topics of science and society related to "Energy Sciences" into the classroom.

Gary W. Brudvig