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Abstract

This article describes the Energy Transformation 4-H school enrichment curriculum. The curriculum addresses energy efficiency and conservation while meeting sixth-grade science essential standards requirements. Through experiential learning, including building and testing a model home, youth learn the relationship between various technologies and building practices and the influence those items have on energy use. Additionally, youth learn the impact that their individual behaviors on overall energy use and conservation.

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Introduction

North Carolina's end-of-grade tests scores in science and math are among the lowest in the nation. The National Assessment of Educational Programs (NAEP) provides assessment statistics about U.S. students in various subject matter areas. In 2011, North Carolina end-of-grade tests for 8th grade science show that 61% are at or above the NAEP basic level and that 26% of the students are at or above the NAEP proficient in science level (National Center for Education Statistics, 2011). In order for North Carolina students to compete in the global economy and in order to address the environmental issues facing society now and in the future, it is critical that youth develop a mastery of science, technology, engineering, and math skills.

One method of enhancing learning is through school enrichment curricula. Enrichment curricula build upon existing school curriculum while augmenting and expanding learning with additional concepts, activities, or experiences. School enrichment programs allow access to more students and a greater diversity of students than other techniques provide (Tochterman, Carroll, & Steele, 2004). A unique feature of enrichment programs is that they involve collaboration and planning with teacher and school administrators. They are offered in cooperation with educators, conducted during school hours, and support and enhance the standard curriculum. For many years, 4-H has employed school enrichment programs to teach youth important life skills and use a variety of instructors including teachers, volunteers, or Extension educators (Diem, 2001).

Addressing Energy Concerns

The Energy Transformation curriculum was designed to meet the need to increase student proficiency in science and math education, while addressing an important society concern of energy efficiency and conservation. Energy efficiency and conservation is an area that lends itself well to school enrichment opportunities. First, it aligns well with the standard course of study for most middle school curricula. Second, it is a timely topic. Energy prices, energy independence, and energy generation are important issues for the United States. As young citizens and future decision makers, middle school youth have a significant stake in the future of energy. Focusing energy education on youth audiences is important in that their attitudes and values are not fully formed and can still be shaped; they have enormous influence on their peers; and they are the future consumers and leaders of the world and need to have a solid foundation on which to base their future energy decisions (Clinard & Farkas, 1978).

North Carolina Cooperative Extension 4-H and Family and Consumer Science faculty collaborated to create a sixth grade school enrichment curriculum titled "Energy Transformation." The curriculum helps youth discover the social, economic, and environmental benefits of energy efficiency and further their understanding of how individual decisions and actions affect their community, nation, and world. This curriculum serves a dual purpose. First, the curriculum aligns with the North Carolina Department of Public Instruction's (NCDPI) science essential standards. The standards the curriculum supports are a) energy transfer and interactions of matter and energy; b) effects of electromagnetic waves on various materials, including adsorption, scattering, and change in temperature and conduction, radiation, and convection heat energy transfer; and c) material suitability for use in technological design related to heat and electrical energy. The second purpose of the curriculum is to teach principles of energy efficiency and conservation to students and their families, the idea being that important concepts learned in the classroom should be applicable to specific actions to be taken in their own home.

Energy Transformation Curriculum

Focusing on the scientific principles involved in the Energy Transformation curriculum is essential for North Carolina students. Additionally, the curriculum offers science educators the opportunity to collaborate with math or language arts instructors, because it includes a number of common core level activities found in language arts and math. The curriculum was piloted, and data was received from 21 sixth grade teachers and 455 students in four North Carolina counties. Student pre- and post-test results discovered the greatest knowledge increases occurred in understanding the purpose of weather stripping, the concept of conduction heat transfer and insulation R-values. Teachers assessed student comprehension gains averaging almost two and a half points on a five-point scale in the areas of energy use, heat transfer, phantom energy, weather stripping, energy sources, and energy efficient light bulbs. The lowest pre-test average was in phantom energy knowledge; the highest post-test average in the area of energy efficient light bulbs. Additionally, teachers reported that students participated in energy-saving behaviors at home, including reducing energy waste, turning off lights, and installing energy efficient light bulbs, (Helton, Silliman, Chilcote, & Kirby, 2010a; Helton, Silliman, Chilcote, & Kirby, 2010b; Silliman, 2009).

In addition to knowledge gains of students, teachers also provided recommendations related to improving curriculum content, training, and evaluation. The curriculum was revised based on input

from piloting agents and teachers. In the summer of 2012, the curriculum was introduced for statewide implementation. Currently, 35 agents have been trained in its use and are implementing the curriculum. Evaluation data from this revised curriculum is currently being collected.

The goal of the Energy Transformation is to have students conduct investigations and examine models and devices to build an understanding of the characteristics of energy transfer. Six modules make up the curriculum: Energy Makes the World Go Round; It Just Makes Cents; The Heat is On; Power Up, Power Down; Don't Lose Your Cool; and It's a Wrap. Each module addresses a specific objective that meets the science essential standards and extends knowledge and application beyond the standard.

For example, the It Just Makes Sense module addresses the essential standard objective related to explaining the effects of electromagnetic waves on various materials to include absorption, scattering, and change in temperature and the suitability of materials for use in design based on a response to heat and electrical energy. The module goes beyond basics and applies these standards to energy efficient light bulbs. Students learn about incandescent and compact fluorescent and LED light bulbs and conduct experiments calculating heat transfer and radiation from each bulb. Students also calculate the cost of running each type of bulb over time. The advantage is that students understand the academic standards necessary to meet science objectives, while providing students with 21st century (life skills) applicability.

Energy Transformation allows teachers to engage students with interactive activities, and many include opportunities for experiential learning. Students work together in teams to construct, improve and test the energy efficiency of a model "home." Through various experiments, students learn about heat transfer and flow, air movement, air sealing, and insulation. Students gain an understanding of the relationship between behaviors and building practices and the impact of these on energy efficiency. In addition to testing their homes, students are also given specific activities to implement in their real homes with their families.

Summary

Energy Transformation is an engaging, hands-on, science curriculum that demonstrates the effects of energy use in the world. Middle school youth use scientific inquiry to make abstract concepts concrete and applicable in their daily lives. Connecting this understanding to their own lives, youth will be better prepared to make future decisions for themselves and their world about energy efficiency and conservation.

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