

The Carbon Cycle: Teaching Youth About Natural Resource Sustainability

Abstract

The carbon cycle was used as a conceptual construct for organizing the curriculum for a youth summer camp on natural resource use and sustainability. Several studies have indicated the importance of non-traditional youth education settings for science education and understanding responsible natural resource use. The Sixth Grade Forestry Tour, a long-standing youth natural resource education summer camp in Idaho conducted by Extension, was used to test the efficacy of this approach in 2013, with positive results that suggest continued development of this concept for future years and in other settings.

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Introduction

There is a considerable literature addressing the need for youth environmental and science education. Youth lack basic understanding of science, with impacts on their future ability as citizens and success in the work force (Micron Foundation and University of Idaho, 2013; National Center for Education Statistics, 2011; National Academy of Sciences, 2007). There is a need for more youth interested in science careers, including agriculture and natural resources, to fill national needs for these professions (Roesch, Neuffer, & Zobrist, 2013; Canadian Institute of Forestry/Institut forestier du Canada & Society of American Foresters, 2004). There is a need for youth to understand basic ecological concepts to promote better stewardship of natural resources (Ballantyne & Packer, 2002; Gupta, Grant, & Strauss, 2012). Finally, there is a need for youth to appreciate and understand natural resource industries, so they gain greater appreciation of where their "food and fiber" come from, and providing these societal necessities can be done responsibly without harming the land and even contributing to environmental benefits (Brooks, Hart, & Church, 2009; USDA Forest Service, 2012 & 2013).

One of the recognized ways that Extension can address these needs is through providing youth experiential education in non-traditional settings, such as youth summer camps (Bell, Lewenstein, Shouse, & Feder, 2009; Heck, Carlos, Barnett, & Smith, 2012; Bourdeau, 2004). The Sixth Grade Forestry Tour (Tour) is one such attempt.

The Tour is a Clearwater County tradition instituted and directed by University of Idaho Extension, with the critical assistance of many community partners and agencies. Since 1961, Clearwater County sixth graders spend 3 days each July camping in the forest and learning about natural resources. Presenters from Extension and 20 partnering agencies and private firms provide learning experiences regarding soils, forestry, logging, grazing, wildlife, fisheries, water quality, wildland fire, natural resource careers, and other related topics.

While the Tour has had a long history, and student evaluations of the Tour indicate they enjoy the experience, we sought to improve the Tour by developing a focused curriculum that directed the various presentations toward explicit learning objectives, as well as providing an overriding conceptual framework to help youth see the interrelationships between the various natural resources and experiences they encounter on the Tour. Essential components of learning experiences include teaching to defined learning objectives that can be measured and providing a conceptual framework of basic principles that help students organize and interpret facts, creating knowledge (National Research Council, 2000; Bourdeau, 2002; Mengak, Rutledge, & McDonald, 2009).

Explaining how the environment works using simple unifying themes could enhance understanding and retention of environmental knowledge rather than expecting participants to remember facts. (Mengak, Rutledge, & McDonald, 2009, p. 1)

Goals and Methods

Our primary goal was to organize Tour presentations toward reinforcing the primary learning objective categories of—sustainability, natural resource economics, and basic science—as well as tie them together with an overarching conceptual framework to increase learning. In summary, we wanted to achieve greater learning of basic principles to accentuate rather than replace the "that's cool" experiences the students have observing a logging operation or touring a lumber mill.

Learning objectives were developed in consultation with presenters and local educators that were consistent with Idaho Content Standards for 6th Grade Science. Other Extension programs employing learning objectives were also used as models (e.g., Western SARE, 2012 Pasture Management Professional Development Workshop). The carbon cycle was chosen as a conceptual scheme that would not only link the various natural resources, but also serve as a way of understanding the rationale behind sustainability, and increase the basic STEM education value of the Tour.

The carbon cycle has gained prominence in recent years due to the issue of global warming. However, there is nothing new about the carbon cycle. It is perhaps the most fundamental of the bio-geo-chemical processes maintaining the biosphere and is a result of the two most fundamental biochemical processes that govern ecosystems, natural resource utilization, and agriculture—photosynthesis and respiration. Because all living things, and products derived from them, are made of carbon, the carbon cycle provides a means of linking the various natural resources—forest products, fish and wildlife, range lands, energy—as well as a scientific grounding for the core concept of sustainability. Because carbon can only be assimilated by living systems at a given rate, our use of carbon resources cannot exceed this rate without threatening the future availability of the resource (whether trees, grass, fish, wildlife, etc.).

Presenters were given a common set of learning objectives, including using the carbon cycle framework, and asked to demonstrate how their particular presentation related to one or more of the learning

objectives. In addition, presentations on the learning objectives and the carbon cycle were given at the beginning of the Tour, each morning before the day's events, and at the introduction of each sequence of presentations to set the context for what the students would be presented. Learning objectives were further reinforced at the end of the day by educational games, such as "Jeopardy" (e.g., "The biochemical process that plants use to assimilate carbon from the atmosphere." Answer: "What is photosynthesis?"). Students were also provided with a camp booklet that included the camp schedule as well as figures and statements reinforcing the learning objectives and illustrating the carbon cycle. Finally, a carbon cycling game ("The Carbon Cycle Game," National Center for Atmospheric Research) demonstration was conducted to further reinforce the concept.

In conformity with learning theory, the approach was one of continual repetition of the major themes over the 3-day Tour, explaining how the learning objectives were illustrated by the individual presentations and relating them to the carbon cycle.

Evaluation and Outcomes

To test the efficacy of this approach and achievement of the learning objectives a pre- and post-evaluation was conducted with questions directly related to the learning objectives. Students were given the pretest at the beginning of the Tour prior to the introduction and receiving their camp booklets, and the post-test was given at the end just prior to students being transported home. The pre and post tests were identical.

Overall student performance on the test increased by 33%. The average score on the pretest was 60.9%, which increased to 80.9% on the post-test. Forty-one sixth graders took the pre- and post-tests. In addition, eight teen leaders, three college interns, one high-school exchange student, four teachers, eight volunteers, and 34 presenters participated in the Tour in 2013 and were exposed to these concepts and participated in their presentation.

Student evaluations of the Tour were overwhelmingly positive, with a strong preference for "action" education experiences, such as touring the lumber mill (probably the most popular activity on the Tour). As one student commented: "Less talking, my legs got tired." This is a sentiment that we've taken to heart, and we are planning for more active, and participatory, activities for the 2014 Tour.

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