USING CONTENT MASTERY ACTIVITIES AS A MECHANISM FOR INTEGRATING COGNITIVE AND METACOGNITIVE SKILLS TO ENHANCE THE LEARNING OF EARTH SYSTEM SCIENCE

David C. Gosselin, Ronald J. Bonnstetter and Sara Yendra

LABORATORY EARTH OBJECTIVES

- Improve K-12 teacher's knowledge, understanding of content connections, ability to teach science in the context of the Earth as a system.
- Enhance and accelerate the transfer and utilization of data, information, and high-quality educational curriculum materials from NASA's Earth Science Enterprise to educators.
- Increase the sense of community using various levels of networking.

LABORATORY EARTH

A part of NESEN's on-going effort to provide professional development for K-12 Educators

MODULAR COURSE DESIGN

LABORATORY EARTH 1:

EARTH AND ITS SYSTEMS

Spheres: Linking Science and Society
Earth's Matter and their Interaction
Weather and Climate
Earth in Space

LABORATORY EARTH 2:

EARTH'S NATURAL RESOURCE SYSTEMS

Natural Resources and Civilization
Rock and Mineral Resource Systems
Water Resource Systems
Soil Resource Systems

LABORATORY EARTH 3:

EARTH'S CHANGING SYSTEMS

From the Universe to the Earth and Everything in Between
The Environment: Yours, Mine and Ours
Changes Through Geologic Time
Cycling in the Earth System

DESIGNED TO MEET MULTIPLE LEARNING STYLES

Visual | Aural | Read/Write | Kinesthetic

- Audio-Enhanced PowerPoint Presentations
- Field Activities | Group Discussions | Kitchen Labs
- **Use Multiple Learning Strategies**
- Simulated Experiments | Group Projects | Individual Assignments
- Open-ended Questioning & On-line Writing

STUDENT ASSESSMENT

Bloom's Taxonomy

From: http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy

Goals

1. Intrinsically motivate participants to learn
   Reduce the need of point accumulation as a motivator
2. Master course content and move upward on Bloom's Taxonomy
   Participants work until they have the required concept knowledge and understanding
3. Provide opportunities for students to enhance their learning skills and intellectual abilities
4. Reflect and improve our educational practice

Funding Provided by:

National Aeronautics and Space Administration

QUESTION

How can we document content knowledge, help motivate participants to learn and enhance their learning skills and intellectual abilities?

ANSWER

Content Mastery activities

WHAT ARE CONTENT MASTERY ACTIVITIES?

- Document students ability to synthesize and apply knowledge and understanding learned in module.
- Provide opportunities for students to use creativity.
- Provided at end of each module.
- Feedback / resubmission process focuses on learning.
- Feedback to students provide framework for modification and resubmission.
- Students choose presentation format.
- Based on learning outcomes for each module.

COMPONENTS OF A CONTENT MASTERY ACTIVITY

Problem Scenario, Issue, Question

PART 1. In the movie, Civil Action, the groundwater resource that provides the drinking water for Woburn, MA has been contaminated by tetrachloroethylene (TCE), which is a solvent for greases, oils, fats, waxes, and tars in the textile processing industry to scour cotton, wool, and other fabrics. You are the only member of the jury who has any knowledge about groundwater and its movement. This has led the other members of the jury to ask you to explain to them the factors that influence the rate of groundwater flow; how wells and pumping influence groundwater; and 3. the relationship between groundwater and surface water. They are particularly interested in you using the terms recharge, discharge, infiltration, percolation, porosity, permeability, saturated zone, unsaturated zone, and water table. They also need clarification about the use of hydrographs and how they might be used to understand the influence of pumping on the groundwater system.

PART 2. Using the terms from the Water Language Journey and your understanding of the hydrologic equation, to what extent do you think water resources can be used sustainably.

Multiple Presentation Options

Concept Map: Take main concepts and put them together with a concept map to show connections and relationships.

Photo essay/scrapbook: Use photos that illustrate concepts. Add captions to explain your pictures and tell the story.

Oral journal: Keep an oral journal of what you have learned and how it applies to your life.

Song/Movie: Show what you know through the creation of a song or video. You can turn this in on a CD or DVD.

Narrative Essay: The more traditional approach to demonstrate your understanding.

Newspaper article: Use your writing skills to tell the story of our content. You might write this from a historical perspective.

Power Point Presentation: Use graphics and pictures with captions to explain your understanding of the material.

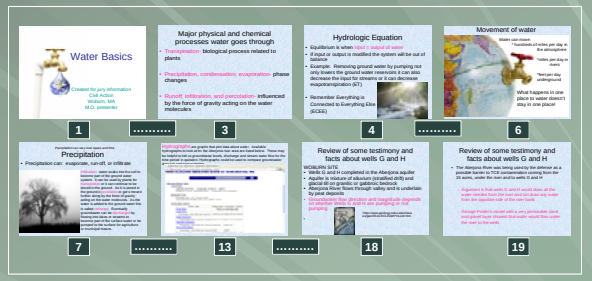
Content Mastery Project Summary - Lab Earth 2
Fall 2007 and Fall 2008

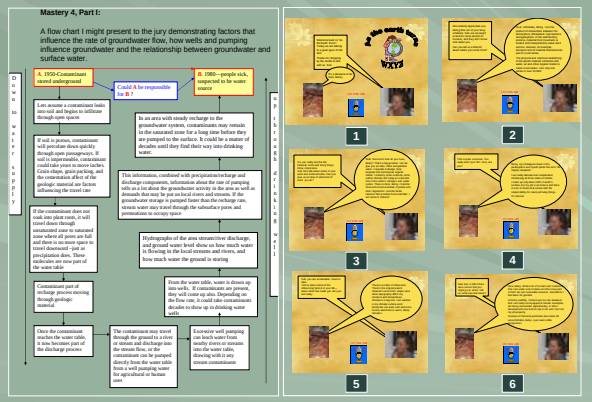
Project Type	Number	Percentage	Mean Score (Max Score =)
Power Point	31	41.0%	6.7
Narrative Essay	15	20.0%	7.4
Newspaper Article	6	7.9%	7.5
Development Report	5	6.5%	7.4
Report to the Jury	5	6.5%	7.2
Concept Map	5	6.5%	7.2
Brochure	3	3.9%	7.7
Photo Scrapbook	2	2.6%	7.3
Poem	1	1.3%	8
Play	1	1.3%	7
Game	1	1.3%	5.5

Pre- to Post Content Knowledge Test Comparisons
Basic Knowledge Score = 14
Maximum Score = 28

Scale	Pre Mean	Pre SD	Post Mean	Post SD	Z	Sig.
Content Knowledge Test	10	5	18	4	4.01	.000

EXAMPLES





CONTACTS

David C. Gosselin - School of Natural Resources, University of Nebraska–Lincoln, 150a Hardin Hall, Lincoln, NE 68583-0931, dgosselin2@unl.edu, 402-472-8919

Ronald J. Bonnstetter - Teaching, Learning, and Teacher Education, University of Nebraska–Lincoln, 211A HENZ, Lincoln, NE 68588-0355, rbonnstetter1@unl.edu, 402-472-2443

Sara Yendra - School of Natural Resources, University of Nebraska–Lincoln, 149b Hardin Hall, Lincoln, NE 68583-0931, syendra2@unl.edu, 402-472-8823