

MAA MATHFEST

August 5-8, 2015

Poster Session
Abstracts

Classroom Activities and Projects within the Context of Environmental Sustainability

Thursday, August 6, 3:30 PM – 5:00 PM, Marriot Wardman Park, Exhibit Hall A

Humanity continually faces the task of how to balance human needs against the world's resources, while operating within the constraints imposed by the laws of nature. Mathematics helps us better understand these complex issues that span disciplines: from measuring energy and other resources, to understanding variability in air and water quality, to modeling climate change. Moreover, these and other real world driven sustainability topics have the potential for motivating students to pursue STEM courses and fields of study more deeply.

This poster session will highlight sustainability-focused projects and activities that have been developed for use in mathematics courses; a number of which have been developed recently at NSF and MAA PREP supported Undergraduate Sustainability Experiences in Mathematics (USE Math) workshops. The format of the session will provide presenters and attendees the opportunity to discuss effective strategies for introducing sustainability themes in the classroom. Information about presenters and their projects will appear on the SIGMAA EM website.

Ben Galluzzo, *Shippensburg University*
Corrine Taylor, *Wellesley College*

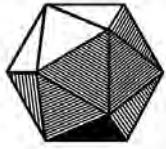
Sponsored by SIGMAA EM

Concurrent to the poster session, in the same room, SIGMAA EM will host a reception

A Carbon Emissions Game

We developed a carbon emissions game that has been played in classrooms at the U.S. Coast Guard Academy and U.S. Military Academy. The game is based on real-world electric power markets having a CO₂ emissions cap. Players own power plants and must offset any emissions from their fossil fuel plants using carbon credits purchased through auctions. Among the goals are for students to understand how regulatory policy can induce environmental benefit and to derive mathematically-based strategies, all in a fun setting. While straightforward and easy to implement, the game can lead to surprisingly interesting results, some of which we quantify through the use of metrics we introduce.

Ian Frommer, *U.S. Coast Guard Academy*
Bob Day, *University of Connecticut*



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Climate Change, Tipping Points and TED-Ed

We present our TED-Ed animated video: The mathematical concept of a bifurcation point, referred to as a tipping point in everyday parlance, is crucial to understanding the possibility of climate change. This video attempts to convey this concept by analogy with billiard systems.

Victor Donnay, *Bryn Mawr College*

Group Project on Sustainability in College Algebra

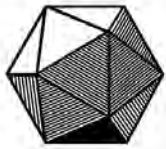
My institution strongly encourages finding appropriate ways to incorporate issues of social justice into courses; not always an easy thing to achieve in a first semester math class for non-majors. This poster presentation describes a sustainability themed project that was implemented in a college algebra class. In particular, we will share how the problems were selected, what worked and what could be improved in the future.

Monika Kiss, *Saint Leo University*

Group Projects for a Sustainability-Related Liberal Arts Mathematics Course

As a newer member of Salisbury University's Department of Mathematics and Computer Science, I recently taught for the first time our Liberal Arts Mathematics course. I chose to teach the course based upon mathematics as it applies to sustainability-related and environmental issues, using Langkamp and Hull's text, *Quantitative Reasoning and the Environment: Mathematical Modeling in Context*. Group projects were a central part of the course, and I assigned a numerous variety of them. Some of the projects I wrote myself; the rest came from the text and the website SISL: Sustainability Improves Student Learning (serc.carleton.edu/sisl). For the final project of the semester, I allowed students to choose their own topics. In this presentation, I will discuss several of the projects including their content, implementation, and students' reactions.

Lori Carmack, *Salisbury University*



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Mathematical Modeling of the Water Quality of Lake Erie

Lake Erie was previously declared “dead” because of its poor water quality, and, even after steps toward restoring the water quality to its correct state, the great lake continues to be an environmental concern. Lake Erie is affected by a process called eutrophication. High levels of agricultural pollution from the Detroit River have caused nutrient loading. This nutrient loading resulted in eutrophication, which involves drastic phytoplankton blooms. As these phytoplankton die, they are broken down by aerobic decomposers, which deplete dissolved oxygen. The model displayed on the poster models the eutrophication of Lake Erie, demonstrates the secondary consequences of eutrophication on the pollution tolerant and pollution sensitive species living in the lake, and predicts the changes in the effects of eutrophication if the amount of nutrients added to the lake is increased or decreased. Finally, the results of the model demonstrate a need for responsible uses and disposal of resources. For this reason, the model uses numbers retrieved from scientific studies and research on Lake Erie and eutrophication where possible in order to make the results applicable and useful to considering environmental sustainability.

Amy Wells, *Lee University*

Danielle Lin, *Lee University*

Drew Cannon, *Lee University*

Jonathan Clark, *Lee University*

Measuring Sustainability, a First Year Seminar Course

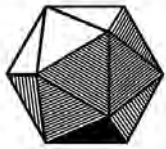
I taught a First Year Seminar called “Measuring Sustainability” at Ramapo College of New Jersey. I used group projects, data collection, data analysis, and peer-reviewed writing assignments exploring sustainability topics to help students develop and refine academic skills required for success at Ramapo. We introduced students to sustainability initiatives at Ramapo from a quantitative perspective to measure the true impact of our choices. This course began developing at the USE Math MAA PREP workshop in Shippensburg University in summer 2013.

Amanda Beecher, *Ramapo College of New Jersey*

Sustainability, Community Based Learning and Mathematics

We present examples of projects students have done for community partners in which they use their math skills to analyze problems in sustainability. These projects were done as part of an upper level course on Math Modeling and Sustainability.

Victor Donnay, *Bryn Mawr College*



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Sea Level Change and Function Composition

Although climate change is mostly caused by wealthier industrial societies, poor people will be impacted by global climate change first and worst. One example of this is the dramatic impact sea level rise is expected to have on subsistence fisher folk living on low lying islands. A classroom module was created in which, groups of students work with a linear function and a quadratic function for sea level in the Maldives and a simplified model of the geography of the Maldives (a triangular prism) to study the effects of sea-level rise on the area of the Maldives. After the students have computed the geographical effects of sea-level rise, they will be asked to research and write about how this impacts livelihoods and society in the Maldives and similar island nations. Students will need to use and understand function composition, slopes, unit conversions, and similar triangles. The module is designed for a pre-calculus/college algebra course, but variations for calculus students are suggested. A sample poster created by students will be displayed. Copies of the module will be available.

Dawn Archey, *University of Detroit Mercy*

Using Indices to Perform a Cost-Benefit Analysis on Sustainably Raised Eggs

Sustainably raised food is often substantially more expensive than conventionally raised food. In this single-class period project, first year college students create an index in Excel to compare the cost differential with the nutrient differential between eggs raised in different environments. Students learn basic Excel functions, and witness the purpose of creating indices. Additionally, the students may find an appreciation for sustainable agriculture, which many of them may have not considered previously.

Caira Bongers, *Bryn Athyn College*

USE Math: Undergraduate Sustainability Experiences in Mathematics

Solid quantitative reasoning skills (logic, mathematics, and statistics) are at the core of understanding and interpreting many sustainability concepts and are required for making sustainability-related decisions. The USE Math project develops and disseminates classroom-ready activities that engage students in authentic experiences within the context of sustainability. At this session we'll share tools for creating your own sustainability themed projects, access to classroom ready resources, and information about how to get involved with the USE Math community.

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Corrine Taylor, *Wellesley College*