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# Sustainability Modules for Algebra Courses

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Metropolitan State University offers the course *Mathematics of Sustainability* as an alternative to Intermediate Algebra to serve students with above-average mathematical skills who have been away from mathematics for some time. The course curriculum includes a series of modules spanning a range of sustainability-related topics which reinforce mathematical content throughout the course. Though developed for use in a non-standard mathematics course, the modules are self-contained, portable units appropriate for use in College Algebra, PreCalculus, and Liberal Arts Mathematics courses as well. The following modules are new additions to the curriculum:

***Milkweed: What about it?*** and ***The Monarch and the Milkweed:*** This two-part module explores disappearing milkweed populations in the U.S. and the potential impact on Monarch butterfly populations. Mathematical content emphasized: quantitative literacy topics (scientific notation, units, density, percent change, reading graphs), exponential and logarithmic functions.

***How much energy does a Wind Turbine Produce?*** and ***Wind Energy: What does it cost?:*** The first part of this two-part module introduces students to the basic concepts of energy and power and their units of measurement, and goes through the derivation of a mathematical model for the power generated by a wind turbine over small periods of time which students use to estimate energy generation. The second part of this module explores a range of scenarios impacting the profitability of wind energy development. Mathematical content emphasized: quantitative literacy topics (units and unit conversion), derivation and evaluation of multivariable functions.

***Liquid Fuel Comparisons:*** This module, co-authored with Metropolitan State University math education student Jodin Morey, explores greenhouse gas emissions associated with different automotive fuels; in particular conventional gasoline, ethanol blends, diesel, and biodiesel.



Figure 1: “Monarch Butterfly in Nominingu” by Michael Charron-Plante (<https://flic.kr/p/3zZs4>). CC BY-NC-ND 2.0, no changes were made. License: <https://creativecommons.org/licenses/by-nc-nd/2.0/legalcode>.

Mathematical content emphasized: quantitative literacy topics (unit conversion, percent change, rate of change), derivation and evaluation of multivariable functions.

***Exploring Carbon Dioxide Emissions in the United States:*** This module explores the interplay between population growth in the U.S. and declining per capita carbon footprints. Modeling both of these trends using linear functions creates a quadratic model for total carbon emissions in the U.S. which appears to fit recent trends well. This model may be used for short-term extrapolation, but becomes problematic farther out in time as per capita emissions reach impossibly low levels and linear population growth becomes questionable. Mathematical content emphasized: quantitative literacy topics (reading graphs, units, and unit conversion), linear and quadratic functions, extrapolation issues.

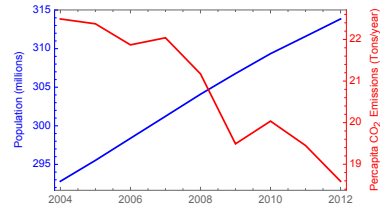


Figure 2: U.S. population and per capita carbon dioxide emissions from energy consumption for the period 2004-2012.