



Curriculum Units by Fellows of the National Initiative  
2009 Volume V: Green Chemistry

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## **Effects of Rates of Change and Accumulated Change in a Throw-Away Society**

Guide for Curriculum Unit 09.05.05, published September 2009  
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This unit integrates calculus techniques with green chemistry content. Calculus deals with the derivative and the integral. Many examples in the typical course come from physics, economics, and biology. This unit expands the applications to include green chemistry. The unit's activities are relevant to residents of an urban center challenged by municipal waste disposal and exposure to persistent bioaccumulative toxins. This unit should take one to two weeks, depending on contact hours and the depth of research. It should be taught after applications of the derivative, at the point of the introduction of the integral.

Green chemistry is environmentally benign chemistry that considers the life-cycle cost of products. A core principle is that products should be designed to degrade harmlessly rather than persist or produce toxins in the environment. In contrast, our society encourages planned obsolescence and repeated purchase and disposal of single-use plastic items.

This unit follows two strands. First, students will learn about the production of municipal solid waste and use historical data to compute the derivative, or rate of change, and consider the effects. Second, students will research environmental toxins and use the integral as a Riemann sum to calculate cumulative exposure to one toxin, lead.

(Developed for AP Calculus AB, grade 12; recommended for Pre-Calculus, grades 10-11, and Calculus, grades 11-12)

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