Kettering University
Green Chemistry Initiative
"Industrial Organic Chemistry"

In September of 2008, Kettering University was awarded a grant by the Department of Environmental Quality for their application of a new course, Chemistry 145, "Industrial Organic Chemistry." The university has already had two successful semesters with enrollment totaling over 80 students, mostly mechanical and industrial engineering students along with business majors. Over the duration of the grant period, the course has been developed into two modules.

Module 1: Introduction of Green Organic Chemistry:

In this section, students are taught the 12 principles of green chemistry through the application of pollution prevention in relation to the life cycle analysis of products. Students are introduced to a number of organic compounds and molecules that contain carbon, hydrogen, oxygen, and nitrogen. Students then apply this knowledge to how these compounds are cycled within the environment. Also introduced in Module 1 is the topic of Nomenclature through the use of an active learning exercise which incorporates the Toxic Release Inventory (TRI), available through the EPA. Upon completion of Module 1, students are able to identify the major functional groups present in organic compounds. They are able to name the important classes of organic chemicals, including: alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, and carboxylic acids through TRI and CES activities, and they understand the general relationships between the structure of organic materials and their physical properties, including: melting points, boiling points, and solubility. This is taught using lecture material and lab exercise.

Module 2: Organic Pollutants and Pollution Prevention:

In the second Module, students are introduced to various contaminants, hydrocarbons, polymers, halogenated hydrocarbons (CFCs and HCFCs), dioxins, pesticides, and detergents. Students examine the contaminants individually and relate their impact to their effect on the environment. At the same time, relevant concepts are being introduced, for example, bioaccumulation and the destruction of the ozone layer. The 12 principles of green chemistry are reiterated, this time in relation to green engineering.

From there, students are given the opportunity to implement their knowledge of green chemistry at each of their individual co-ops – a program that fosters a relationship between students and companies that potentially will hire them. The University offers unique programs that incorporate a co-operative learning atmosphere that pairs eleven weeks of in-class lecture and class participation with twelve weeks of work in the industry.

A "Pre and Post Perception of Knowledge" test is given at the start and end of each semester to gauge student's awareness of the topic, and, to this point, the implementation of this course has proven so far to surpass expectations as well as set forth greater awareness of the topic as a whole.

Kettering University is consistently ranked among the top specialty schools in the nation for their undergraduate engineering degrees. Kettering University has devoted their efforts to green chemistry and recognizes the growing demand for products, materials, and business activities to convert to “green” technology. Dr. Jennifer Aurandt, a senior investigator for the National Sciences Foundation grant and a professor at the University, has devoted her time to the implementation of additional curriculum for their engineering programs. As the University begins to “green” their engineering curriculum, students are being introduced to various engineering aspects of alternative energy and green technologies; among those requirements is the new “Industrial Organic Chemistry” course, which is team taught by Dr. Aurandt and Dr. Rabago-Smith. Offered as a three credit hour course, “Industrial Organic Chemistry” abides by six learning objectives:

Objective 1: To recognize the major functional groups present in organic compounds.
Objective 2: Name the important classes of organic chemicals, including alkanes, alkenes, alkynes, aromatics, alcohols, amines, aldehydes, ketones, and carboxylic acids.
Objective 3: Understand the general relationships between the structure of organic materials and their physical properties, including melting point, boiling point, and solubility.
Objective 4: Identify the important chemical relationships that organic materials undergo, including addition, elimination, subtraction, oxidation, and reduction.
Objective 5: Understand the origins and uses of important feedstock chemicals used for industrial syntheses of fuels, lubricants, customer products, and polymers.
Objective 6: Be familiar with chemical, physical, and instrumental methods used to analyze and identify organic materials.

With the implementation of this course and their enthusiastic interest in green chemistry, Kettering University hopes to instill in their students an education that inspires them to be innovative and interested in the development of “green” technology for our future.