

Report of 09-10 OFD Undergraduate Research Grant Project

Title: Examining Estrogenic Hormones and Investigating Their Sources, Transportation and Fate in Buzzards Bay – A Chemical Separation Course Research Project for Undergraduates

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Project Description:

The main objectives of this proposed project are to prepare students for the complex chemical analysis and separation problems that face industrial, governmental and academic chemists and to enhance critical thinking and problem solving skills of our students by providing them with challenging and meaningful research-based laboratory experiences. To accomplish these objectives, I have (1) instilled interest and confidence in students by progressing from planned experiments to more difficult research project assignments that require literature research, separation method selection and development, sample preparations, analysis performance, result interpretation and conclusion drawing, (2) motivated students to explore further principles of chemical separation and analysis through integrated research projects, (3) prepared our students for the intellectual independence and team work skills required for their careers, (4) increased students' competence in analytical science, thus, their employment potential, and their acceptance rates to high quality graduate schools. In this proposed course research project, we have focused on Examining Estrogenic Hormones and Investigating Their Sources, Transportation and Fate in Buzzards Bay, which has been integrated in my Chemical Separation and Undergraduate Research courses in Spring and Fall 2010.

The Results and What Happened:

In the first stage of this project, our research had been focused on developing a Solid-Phase Extraction (SPE) GC-MS analytical method for the separation and quantification of estrogenic hormones and other endocrine disrupting compounds. These included developing a new silylation solution to prevent the formation of undesired multiple derivatization products and conversion of trimethylsilyl derivatives of EE2 formed to their respective E1 derivatives reported in previous studies, and integrating an SPE method into GC-MS analysis, as well as the effects of solvent, temperature, and reaction time on the derivatization of EE2. We have also validated an HPLC method for the simultaneous determination of free and conjugate steroid hormones.

With the newly developed analytical techniques, we have determined the estrogenic hormones in seawater around Acushnet river estuary in Buzzards Bay and examined their possible sources, effluents from wastewater treatment plants. We have also started preliminary assessment on the endocrine disrupting potential of estrogenic hormones to crabs in the concentration range (0.1 to 20 ng/L) observed in Buzzards Bay.

In these research projects, the students were not running experiment by just following the manual as they do in traditional experimental courses. Instead, they actively participated in creative thinking while developing separation methods by themselves. The students got a taste of analytical chemistry research while conducting this experiment. In the process, they feel they are ready for academic, industrial, and government jobs. The students enjoyed working on these research projects. Some of them even worked in the late evening and at weekends. Of course, I had always encouraged students to work hard but avoid working too late in the evenings. The students have presented their research project at local, regional, national and international meetings and at the Annual Sigma Xi Research Exhibit. We have also submitted a manuscript for publication.

How the project (or something similar) could be replicated by other faculty/what other faculty could learn:

Other faculty in any discipline can basically replicates the concept of this undergraduate course research project, integrating real-world research projects into undergraduate curriculum, to increase their students' competence in their fields.