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Learning Biotechnology Tools to Conduct Hypothesis-Driven Research on the Presence of Genetically Modified Ingredients in Foods

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Georgia Gwinnett College's 4-year Undergraduate Research Experience provides STEM students the opportunity to conduct course-embedded research at every level of college. Based on this initiative, Biotechnology Laboratory, a senior-level lab course has been redesigned around the theme of genetically-modified organisms (GMO). The goals of the new lab are to implement a curriculum that encompasses leading techniques in biotechnology; strengthen students' understanding of the central dogma of biology; and facilitate hypothesis-driven student research. During the first phase of the course, students acquired skills needed to analyze test foods at the level of DNA (DNA gel electrophoresis, traditional and Real Time PCR), RNA (RT- PCR) and protein (ELISA, SDS PAGE, immunoblotting). In the second phase, student groups designed and conducted experiments to test hypotheses related to the reliability of non-GMO labels and differences between non-GMO versus organic foods. Experiments tested for GMO markers including the 35S cauliflower mosaic virus promoter, genes coding for *Bacillus thuringiensis* crystal proteins and the glyphosate (*Round Up*)-resistant EPSP enzyme. Throughout the course, students presented primary research articles to discuss scientific and ethical questions regarding GMOs. Pre- and post-assessments indicated increased student knowledge of biotech laboratory techniques and understanding of gene expression. Attitudinal surveys demonstrated increased student interest in pursuing graduate school and careers in biotech research as well as confidence in their ability to conduct independent research and discuss the complexities of GMOs. Our curricular design and assessment is presented as a model for incorporating DNA, RNA and protein analytical techniques into a course-embedded, authentic biotech research experience.

Mission, Review Process & Disclaimer

The Association for Biology Laboratory Education (ABLE) was founded in 1979 to promote information exchange among university and college educators actively concerned with teaching biology in a laboratory setting. The focus of ABLE is to improve the undergraduate biology laboratory experience by promoting the development and dissemination of interesting, innovative, and reliable laboratory exercises. For more information about ABLE, please visit **http://www.ableweb.org/.**

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