

## **Using Zebrafish to implement a Course-Based Undergraduate Research Experience (CURE) to study Teratogenesis in Two Biology Laboratory Courses**

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**Abstract:** Two related course-based undergraduate research experiences (CUREs) were introduced into a freshman introductory biology and a sophomore level cell biology class. In fall 2013, first semester freshman students were introduced to scientific research in an introductory biology laboratory course. Students were mentored to develop and execute original research projects investigating embryonic nicotine and caffeine exposure effects on development, particularly on heart development and function, using zebrafish embryos. In spring 2014, sophomore level cell biology students extended these studies and analyzed the effects of nicotine and caffeine at precise times in gastrulation. The freshman research experience was repeated in fall 2014 where a new group of students expanded the earlier research to investigate effects of additional toxicants on development. Students designed new protocols, made measurements, documented data, presented results and generated novel, high quality preliminary data that will be further studied in successive semesters. Student researchers identified novel effects of nicotine exposure on gastrulation and heart morphogenesis. Student surveys showed the greatest gains in ability to (1) design experiments, (2) analyze data, and (3) make scientific presentations. This CURE approach generated excitement and engagement that translated into high student satisfaction and enhanced learning.