*Advances in Biology Laboratory Education*, A Publication of the Association for Biology Laboratory Education
Volume 46, Article 50, 2026

# Are CUREs enhanced by returning to a familiar model system? A case study using Lake-in-a-Tube microcosms

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**Extended Abstract**

Since the establishment of formal criteria for Course-based Undergraduate Research Experiences (CUREs) (Auchincloss *et al*. 2014) and implementation of CUREs in more curricula, several studies have found positive responses with dosage (number of CUREs experienced) in student familiarity with, and attitudes about, conducting research (Buchanan and Fisher 2022; Rodenbusch *et al*. 2016). Within biology curricula, use of model organisms and systems has offered support for CUREs (Burmeister *et al*. 2023). Newest among these is the Lake-in-a-Tube (LIAT) microcosm system (Figure 1) (Swisher 2025) that provides a broadly accessible way to study complex biological systems like those that create algae blooms in lakes (Ho *et al*. 2019).

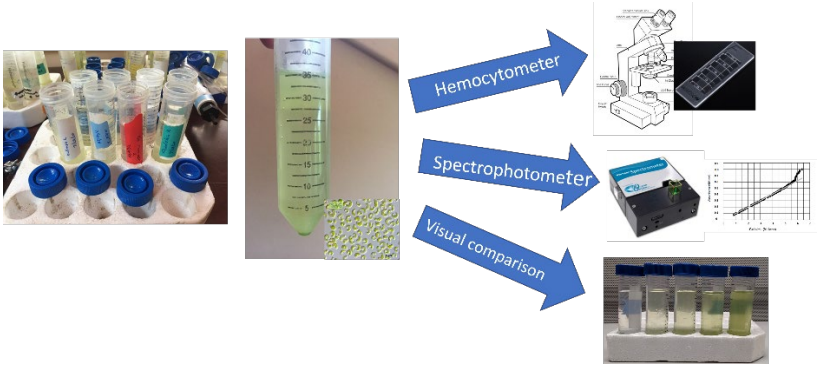



**Figure 1**. The LIAT system is comprised of plastic 50 mL centrifuge tubes, the green alga *Raphidocelis subcapitata*, COMBO algae media (or other aqueous solutions), and a method for measuring algae cell density (e.g. microscopy with a disposable hemocytometer, or spectrophotometry, or visual comparison).

The curriculum in Biology and Health Science at Saint Michael's College features unique CUREs across 17 different courses from 100 to 400 levels (Figure 2). Among these, ecology students' coursework may include up to three CUREs that use Lake-in-a-Tube (LIAT) microcosms in addition to independent CUREs. Data from a previous two-year curricular assessment showed that student attitudes about conducting research and gaining skills increased with dosage of the number of CUREs completed over time (Center for Program Design & Evaluation 2023). Recent implementation of LIAT in upper-level courses provided an opportunity to test the possible enhancement of this dosage effect when students use a familiar model system- a Cross-Curricular CURE.

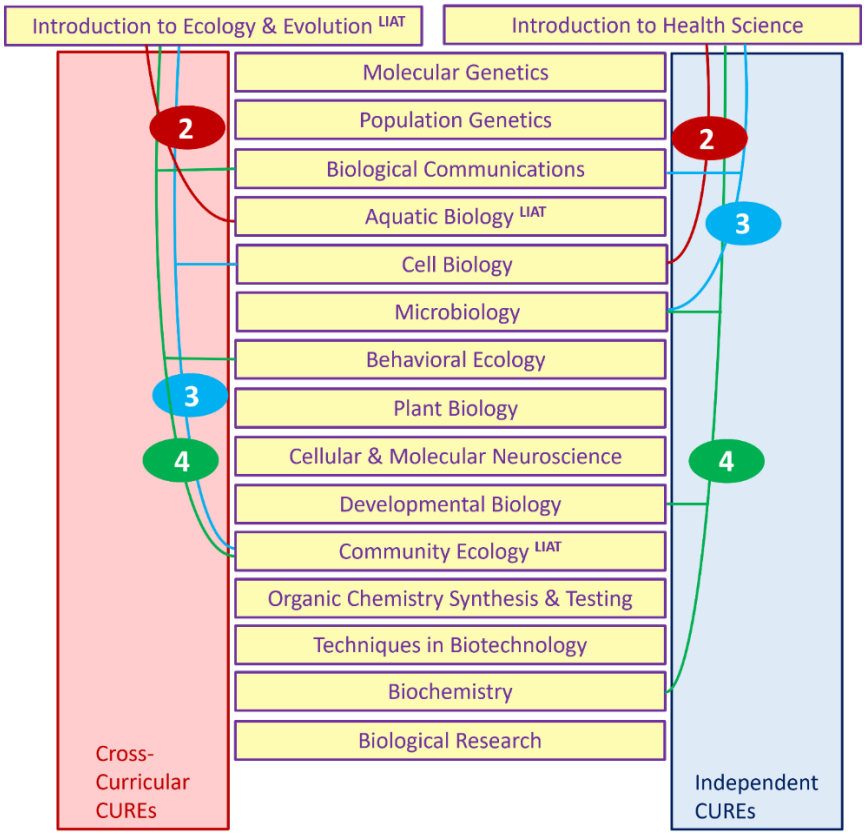



**Figure 2.** Examples of student experiences with CUREs within the Biology and Health Science curricula at Saint Michael's College. Students may use LIAT microcosms for CUREs in up to two courses (noted with "LIAT" superscripts) beyond an introductory course (see example Cross-curricular CUREs experience in red on the left) while other students may not (see example Independent CUREs in blue on the right). Colored lines connecting courses are examples of possible CURE dosages.

During the 2023 and 2024 fall semesters, students in CURE courses voluntarily participated in a 21- question five-point Likert-scale survey (Center for Program and Evaluation, 2023) for which they responded to statements regarding their attitudes towards two main constructs: skills acquired via CURE participation (10 statements) and conducting original research (11 statements). Responses to each statement were coded as numeric scores from 1 (descriptive statement is not true at all) to 5 (descriptive statement is extremely true). For each respondent, average scores across the statements pertaining to each construct for were used as the two response variables in relation to dosage and CURE type.

Data were used to test the following hypotheses:

1. Scores of student attitudes about conducting research and acquiring research skills through CUREs increase with "dosage" of number of CURE courses taken.
2. Increases in student attitudes regarding research are larger with dosage for those completing Cross-Curricular CUREs than for those completing wholly independent CUREs.

I predicted that both types of CUREs would show increases in student attitudes with dosage, and that the Cross-Curricular CURE group would report higher average Likert scores than students in the independent CURE group as dosage increased.

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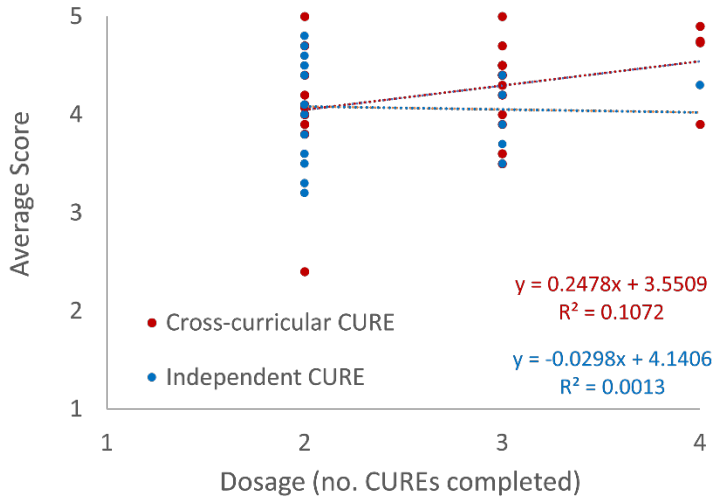



**Figure 3**. Relationships between dosage and average Likert scores among eleven survey questions regarding conducting research for participants in Independent (n = 21) and Cross-curricular (n = 30) CUREs.

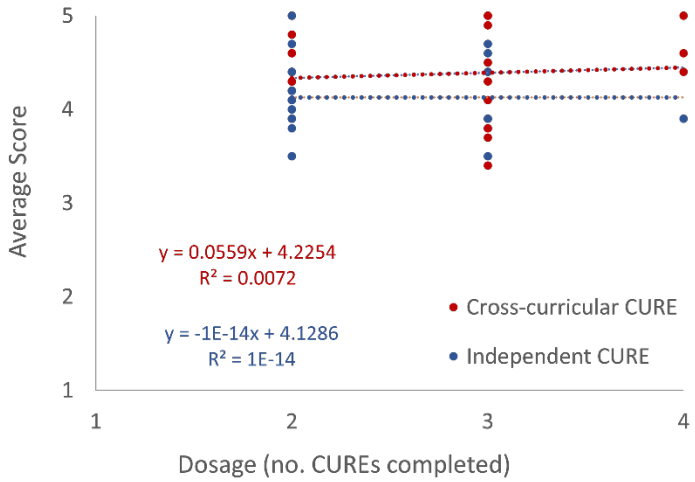



**Figure 4**. Relationships between dosage and average Likert scores among ten survey questions regarding research skills acquisition for participants in Independent (n = 21) and Cross-curricular (n = 30) CUREs.

Average Likert scores of attitudes towards conducting research among Cross-Curricular CUREs participants increased with dosage (slope = 0.25 Likert points per dose) (Figure 3). Average Likert scores related to skills acquisition among Cross Curricular CURE participants showed negligible increases with dosage (slope = 0.06 Likert points per dose) (Figure 4). No dosage related changes in average Likert scores for Independent CURE participants were observed for either construct (slopes ~ 0.00 Likert points per dose).

Comparison between CURE types showed support for hypothesis 2 but not hypothesis 1, with scores on questions regarding both student attitudes toward conducting research and for attitudes about research skill acquisition increasing with dosage only for Cross-Curricular CUREs. Furthermore, initial overall student attitudes regarding CUREs were positive (y-intercepts > 3.5 Likert points) (Figures 3 & 4).

My results from LIAT-based CUREs suggest that Cross-Curricular CUREs hold unique benefits beyond repeated experiences in CUREs alone, with gains in student attitudes toward research occurring by returning to a familiar model system. Instructors considering this approach should carefully weigh the benefits (i.e. increased dosage-related positive attitudes toward conducting research and acquisition of research skills, time saved teaching a model system) with potential drawbacks (lower breadth of student experiences, possible lack of enthusiasm for a particular model system). The Cross-Curricular CURE approach holds promise; confirmation of its effects could be readily tested using the variety of model systems currently in use (Burmeister et al. 2023). Furthermore, future investigations of Cross-Curricular CUREs should evaluate both attitudinal responses as well as well-calibrated assessment of student learning in relation to particular course goals.

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**Keywords**: biological model system, CURE, student research, student self-efficacy, curriculum

**Link to Original Poster File:** https://doi.org/10.37590/able.v46.poster50

**Citation**: Swisher, BJ. 2026. Are CUREs enhanced by returning to a familiar model system? A case study using Lake-in-a-Tube microcosms. Extended abstract 50 in: Cole M and O'Brien J, eds. *Advances in biology laboratory education*. Volume 46. Publication of the 46th Conference of the Association for Biology Laboratory Education (ABLE). DOI: https://doi.org/10.37590/able.v46.extabs50

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