Institutions have developed diverse approaches that vary in effectiveness and cost to improve student performance in introductory science, technology, engineering, and mathematics courses. We developed a low-cost, graduate student-led, metacognition-based study skills course taught in conjunction with the introductory biology series at Miami University. Our approach aimed to improve performance for underachieving students by combining an existing framework for the process of learning (the study cycle) with concrete tools (outlines and concept maps) that have been shown to encourage deep understanding. To assess the effectiveness of our efforts, we asked 1) how effective our voluntary recruitment model was at enrolling the target cohort, 2) how the course impacted performance on lecture exams, 3) how the course impacted study habits and techniques, and 4) whether there are particular study habits or techniques that are associated with large improvements on exam scores. Voluntary recruitment attracted only 11-17% of our target cohort. While focal students improved on lecture exams relative to their peers who did not enroll, gains were relatively modest, and not all students improved. Further, although students across both semesters of our study reported improved study habits (based on pre and post surveys) and on outlines and concept maps (based on retrospectively scored assignments), gains were more dramatic in the Fall semester. Multivariate models revealed that, while changes in study habits and in the quality of outlines and concept maps were weakly associated with change in performance on lecture exams, relationships were only significant in the Fall semester and were sometimes counterintuitive. Although benefits of the course were offset somewhat by the inefficiency of voluntary recruitment, we demonstrate the effectiveness our course, which is inexpensive to implement and has advantage of providing pedagogical experience to future educators.