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Project-oriented science instruction involving general-education undergraduates serving as mentors to underprivileged middle-school students

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We report results from a novel, project-based science course funded by the NSF for general-education students in the ECU Honors Program and for middle school students. Key aspects of the course are: (1) instruction in the natural sciences adopting a regional context; (2) investigation of the water quality of a local stream involving all portions of a scientific study from planning to data collection and analysis to presentation; and (3) direct mentoring of underprivileged, seventh-grade students by honors students in project activities, including trips to campus for laboratory work and presentations. The course is meant to provide high-quality scientific instruction and serve as an improved model for general-education science courses, while teaching project-based science to all students. Moreover, we train our college students to become self-directed learners by giving them responsibility in engaging and mentoring at-risk, middle-school students while promoting STEM. The deep involvement of middle-school teachers in planning and implementation is crucial.

The course instructs and promotes science at several different levels. We engage honors students using experiments, simulations, and field trips to illustrate fundamental scientific concepts while exploring geological and biological aspects particular to eastern Kentucky. The project is an investigation of the water chemistry and ecosystem of a typical stream, which experiences anthropogenic contamination by nutrients and fecal microbes as determined by land use. We first lead college students through each step of the project over a period of 8 weeks, and then they lead middle school students serially through those same steps. A key aspect of the project is travel to a local stream where every student engages in sampling activities. For our college students, the project culminates in a report written as a scientific paper. The seventh graders form groups and present oral and poster presentations to regional watershed experts and parents.

We use pre- and post-course tests, attitudinal surveys, and focus groups to examine the efficacy of the course in fostering understanding of science concepts, increasing understanding of the environmental problems of a geographic region, and improving attitudes toward science for college and middle-school students.