

Bridging High School Science and First-year Engineering Through the Preservice Teachers' Science Methods Course [RESUBMISSION]

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GIFT: Bridging High School Science and First-year Engineering Through the Preservice Teachers' Science Methods Course

Faculty in the college of education, science departments, and first-year engineering program at The Ohio State University have collaborated for nearly 10 years to offer a team-taught version of the science teaching methods course for students working toward a secondary science teaching license. An education faculty member is the instructor of record and coordinates the course; faculty from biology, chemistry, earth science, physics, and engineering lead segments of the course blending content with pedagogical approaches appropriate to their disciplines. A typical segment is four to six two-hour class periods.

The engineering portion is structured primarily to help the pre-service teachers explore how they can incorporate elements of engineering into existing science classes. It also helps them solidify their understanding of what engineering is and serves as an opportunity for them to learn about key elements of a first-year engineering experience. The materials and activities are a combination of those used in the first-year engineering courses and others that have been developed elsewhere. In recent years, the engineering segment has consisted of four class periods. A brief description of each is provided below.

Day 1 - Introduction to Engineering; Algorithms: This class meeting consists almost entirely of presentations and activities selected from the first few weeks of the first-semester engineering fundamentals courses. Major topics of the presentation include the goals of first-year engineering, engineering as a pursuit of improving the human condition, and the kinds of activities engineers engage in. Student groups are then asked to write directions for how to perform a common household task; these algorithms are then "broken" by the instructor, resulting in much laughter and learning.

Day 2 – Engineering in the Context of Science Standards; Design Matrices: Students discuss how design is the primary element of engineering within state content standards and the Next-Generation Science Standards, then spend most of the class participating in several activities to show the utility of design matrices in guiding group decision-making.

Day 3 – Engineering Design Activity; Identifying K-12 Engineering Projects: To explore the engineering design process, students work in small teams on a design project that is completely contained within the class period. Constraints, including budget, are included, and the wrap up discussion explores possible variations to the project if teachers wished to make more explicit connections to iteration, technical writing, or specific science topics.

Day 4 – Adaptation of Common Science Projects: Each student gives a short presentation based on their investigation of a common secondary science hands-on project. Students address how well the selected project includes engineering elements, modifications to it that might strengthen the engineering content of the project, and potential adaptations they might make for their anticipated classroom setting. The final discussion ties the segment back to considerations for how secondary science classes can help students consider engineering as a major and how teachers of those classes can help prepare students for the first-year experience.