Starting in the mid-20th century, an explosion of scientific knowledge and its application drastically altered the landscape of science education. Faculty and students face increasing volumes of information, data, and methodologies that have spurred advances across society. Advancements in the classroom, however, have not kept pace. For students, a common consequence is that “classroom science” may not align well with the practice of science. Scientists develop new ideas, test hypotheses using experimentation or field study, debate their interpretations and brainstorm with colleagues. Some new findings are serendipitous and completely unexpected. Too often in science courses, however, students test hypotheses developed by others, achieve predictable results, and absorb content passively. In such situations students neither invest intellectually in outcomes nor achieve (a) deep understanding of content, (b) understanding of the nature of science, (c) mastery of key concepts or (d) insight into the creativity of research careers. As a consequence, the ever-changing and open-ended nature of scientific knowledge and research process remain hidden from many STEM-interested undergraduates, and general-education science students may leave college with the same negative conceptions about science/scientists that they had when they enrolled.

A shift to teaching/learning based on scientific literature has potential to address many of these problems. Primary literature reveals the process of scientific investigation in an authentic language spoken by scientists. Close analysis of such literature need not be reserved for graduate students. The CREATE (Consider, Read, Elucidate hypotheses, Analyze and interpret data, Think of the next Experiment) strategy guides undergraduates in achieving fluency in the universal language of data analysis. CREATE challenges students to consolidate content understanding, apply this knowledge as they analyze data, learn to formulate and defend ideas, and think creatively about study design. CREATE builds transferable reading/analysis skills that can be applied to any new analytical challenge, while stimulating student understanding of, and interest in, science research careers. CREATE benefits faculty as well as students, leveraging their sophisticated research expertise and freeing faculty to bring their insider understanding of research process to the undergraduate classroom.

CREATE has been tested successfully in both upper-level capstone and first-year cornerstone courses, and at minority-serving and research-intensive universities, private liberal arts colleges, large public universities, and community colleges, generating cognitive and attitudinal gains in all cohorts. I will discuss the original CREATE design as well as a variety of modifications and the potential for novel interdisciplinary CREATE approaches that could deeply integrate students’ understanding of physics, chemistry and biology.