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Learning biology through mathematical modeling

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Recent advances in technology and access to big data require that current biology students have a strong foundation in mathematics. The requisite mathematics does not always have to be taught as a separate discipline and students could benefit in multiple ways by experiencing an integrated approach. Unfortunately, instruction in biology at the introductory levels typically avoids mathematics, even though mathematical modeling has been an accepted part of scientific practice for a long time and is central to understanding certain biological concepts. The field of science education is exploring how to make students' experiences in classrooms more grounded in scientific practices, because such an approach offers the potential to develop better understanding of both scientific practice and scientific content. Further, when the scientific practices that are incorporated include other disciplines, such as mathematics, there is a potential for maximizing instructional time, as well as a better understanding of the applicability of other disciplines to science. However, there are few instructional models for interdisciplinary practice based science curricula and little research on student learning effects. This talk will provide a description of a unit in biology that leverages active learning by students through mathematical modeling to support student learning of inheritance. Quantitative and qualitative analyses will be presented showing how active participation in mathematical modeling of biological phenomena benefits student understanding of biological processes and their ability to solve complex and unfamiliar quantitative problems in the domain. The instructional principles presented in this talk are broadly applicable across the biological sciences.

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Effect of cold plasma on the characteristics of DPPC liposomes

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Recent progress in atmospheric plasmas has led to the creation of cold non-thermal atmospheric plasma (CAP). CAP is an ionized gas that has tremendous applications in biomedical engineering and is used as a possible therapy in dentistry and oncology. The aim of plasma interaction with tissue is not to denature the tissue, but rather to operate below the threshold of thermal damage and to induce chemically specific response or modification. Liposomes are used as models for artificial cells. This report therefore investigates the effect of cold plasma on 2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) liposomes prepared by thin film hydration method which are used as a model for lipid bilayer membrane. DPPC liposomes were exposed to cold plasma 2, 3 and 5 minutes, respectively. The effect of cold plasma on DPPC characterization parameters such as size, charge, FTIR absorption spectrum, UV spectrum and phase transition temperature were investigated. The present study revealed that CAP could alter the molecular structure for DPPC liposomes as depicted in the change in FTIR absorption peaks at 3439 and 1687 cm-1. In addition, CAP affected the phase transitions for the DPPC by shifting it to higher temperatures. Moreover, CAP led to the increase of DPPC liposome size. 2 min exposure to CAP resulted in rapid coagulation of liposomes as depicted from the low zeta potential value obtained. However, the UV absorption spectrum for DPPC liposomes was not altered by CAP exposure. Hence, this work highlighted that CAP may modify the physical and chemical characteristics of DPPC liposomes.

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