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Three-dimensional molecular representations to enhance students' learning and engagement in lower and upper-level courses

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A clear understanding of the structure and function of macromolecules is essential in a variety of lower and upper-level chemistry and biology courses. The three-dimensional visualization of, for example, proteins and nucleic acids, can be achieved through the use of physical or digital models. The advantage of using digital models relies on accessibility and easy implementation in a wide variety of course formats including remote (synchronous and asynchronous), hybrid, and face-to-face in both, the four-year University and community college context. The three-dimensional molecular viewer iCn3D is a free, easily accessible, web-based, and menu-driven viewer that can be used to explore (see, rotate, and visualize intramolecular interactions) and manipulate (color) the structure of macromolecules. In this mini-workshop, two sample assignments will be presented. The first assignment, appropriate for a lower-chemistry course, explores the structure of nucleic acids and the intermolecular forces that determine their shapes. The second assignment, appropriate for an upper-level biology course, is designed to teach students how to use the iCn3D visualization program to create a variety of images that illustrate the different levels of protein structure and their relationship to their function. Both assignments can be implemented as directed (classroom or laboratory) or self-paced (homework) activities, depending on the particular learning objective and time available for their completion. Workshop participants will learn the basic features of the iCn3D viewer and embark on the completion of their chosen assignments. Presenters will share the assignment instructions, rubrics, and other assessments used to evaluate students' learning and engagement.

Keywords: protein structure, biochemistry, molecular visualization, iCn3D

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