Symposium on Undergraduate Nano-Education:
"Addressing the Challenges of Nanoscale Science & Engineering Education"

Presentation: "Non-Negotiables in Undergraduate Nanoscale Science and Engineering Education: A Chemist's Perspective"

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Presenter Biography:

Brian H. Augustine is an associate professor in the Department of Chemistry and Biochemistry, a member of the executive committee for the Center for Materials Science and the steering committee for the School of Engineering at James Madison University. He has an active undergraduate research program in the surface characterization of nanocomposite polymer thin films, biodegradable polymers, and the rapid prototype fabrication of polymeric microfluidic devices. He was the principle investigator of an NSF Nanoscience Undergraduate Education (NUE) project in which nanoscience topics have been seeded throughout the undergraduate chemistry curriculum at JMU, and has worked closely with faculty members in the Department of Physics and Astronomy at JMU in nanoscience outreach using AFM technology. He has been serving in the School of Chemistry at the University of KwaZulu-Natal in Pietermaritzburg, South Africa as a U.S. Fulbright Scholar developing a nanoscience lecture/laboratory course for third year chemistry and chemical technology students in 2009. He was a member of the team that developed minor and certificate programs in materials science and an A.C.S. Certified Degree program in Materials Chemistry at JMU, and has developed courses in materials science, micro and nanofabrication, nanoscience and a materials science course designed for non-science majors.

Abstract:

Since nanoscience and nanoengineering are inherently interdisciplinary fields of study, it is not surprising that educators developing curricula in these fields have produced materials of varying focus depending on needs of the program, the expertise of the faculty and interests of the students at a particular institution. In developing a nanoscience program in the Department of Chemistry and Biochemistry at James Madison University, we have made a conscious decision to include nanoscience as one recurrent theme at all levels of the undergraduate chemistry curriculum which we have termed an "evolutionary" approach to nanoscience education. This theme has been introduced into an already crowded chemistry program. Because of this, we have "seeded" nanoscience lecture and laboratory topics throughout the curriculum culminating in an upper-division elective nanoscience lecture/laboratory course. In order to evaluate the effect of seeding topics across the curriculum, we have been assessing the understanding of nanoscience topics from our graduates over the last several years. We have found that there are certain recurring misconceptions which seem to be a fundamental misunderstanding of topics from general chemistry, physics and mathematics rather than specifically from nanoscience. Some of these topics include size/scaling, intermolecular and intramolecular forces, bonding geometries, and understanding of logarithmic scales. Assessment of third-year students in South Africa as part of a Fulbright Scholar program teaching a nanoscience course at the University of KwaZulu-Natal reveals some of the same misconceptions. In this presentation, I will discuss experiences derived from teaching nanoscience at both JMU and UKZN, and open the discussion for developing a "core knowledge curriculum" which is crucial for nanoscience study at the undergraduate level and may require a careful examination of whether these fundamental concepts are actually being sufficiently developed in chemistry, physics, mathematics and engineering.