

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

Presentation: "Rational Design of an Undergraduate Certificate Program in Nanoscience/Nanotechnology"

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Presenter Biography:

Thomas O. Mason is professor of Materials Science & Engineering and Director of Higher Education & Degree Programs for the National Center for Learning & Teaching in Nanoscale Science & Engineering (NCLT). He maintains an active research program in electroceramics for energy conversion, including transparent oxide conductors and semiconductors for photovoltaics and transparent electronics, and nano-ionic ceramics for solid oxide fuel cells. Professor Mason is a highly cited researcher (by the Institute for Scientific Information) and a highly reputed educator, having won both campus-wide and national teaching awards. His textbook, *Materials in Today's World*, 3rd Edition (with Peter Thrower, McGraw-Hill) is "an equation-lean, but content-rich" exposure to the world of materials science and engineering for non-experts, and is used in his popular course for non-science majors, "Modern Materials & Society," which enrolls approximately 100 students each offering. Through his involvement with the NCLT, Professor Mason has been instrumental in development of the Processing-Nanostructure-Properties-Applications or P-N-P-A Rubric for the design and evaluation of course materials and degree programs in nanoscale science & engineering education. He has also played an important role in organizing and promoting faculty workshops and symposia in the area of nanoscale science & engineering education.

Abstract:

Based upon a set of "big ideas" identified by recent workshops and a study report, a broad curricular framework for degree programs in nanoscale science & engineering (NSE) has been established, built around four essential areas or nodes in NSE—Processing (how nano-entities are fabricated), Nanostructure (how the resulting nano-entities can be imaged and characterized), Properties (their consequent size-dependent and surface-related properties), and Applications (how nanomaterials and nanodevices can be designed and engineered for the benefit of society), hereafter referred to as the "P-N-P-A Rubric." An analysis of emerging NSE degree programs in the U.S. suggests that improvements need to be made in programmatic balance (among the P-N-P-A nodes), with particular attention to essential features, e.g., the inherent interdisciplinarity of NSE and its societal impact (e.g., safety, ethical issues). A significant challenge for NSEE is how to provide student access to the necessary advanced instrumentation (i.e., the Nanostructure node). In this presentation, a prototype undergraduate certificate program is developed, which provides balance across the P-N-P-A nodes, while also providing for interdisciplinary exposure and student access to advanced NSE instrumentation (i.e., hands-on laboratory experience). Although this certificate program has yet to be approved, it provides a model for how campus-wide certificate programs can be developed at colleges and universities, where strong programs exist in traditional disciplines, but which can be augmented by targeted coursework in nanoscience/nanotechnology, leading to the NSE certificate in addition to the B.S. or B.A. degree in the traditional discipline of choice to the student.