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Modification of Nanoscience Educational Content to Reach a Greater Number of Educators

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Deb Newberry is the director of the Nanoscience Technology program at Dakota County Technical College in Rosemount, MN where she created 8 college level nano specific courses and the 2 year, AAS degree Nanoscience Technologist program. Deb also is the Director and Principle Investigator of Nano-Link, Center for Nanotechnology Education which spans 38 states and 4 countries in Europe (NSF funded). After 23 years of experience as a researcher and executive in the corporate world, she became a nanotechnology consultant and writer, coauthoring, The Next Big Thing is Really Small, a bestselling book on nanotechnology and is also the author of ten chapters in nanotechnology and educational books. Deb has spoken to multiple organizations, including the U.S. Senate, IEEE, ASME, BIO, ATMAE, NCPN and others. A member of the editorial board of the Journal of Nano Education, she has published a number of articles in business magazines and professional journals.

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The focus of the National Science Foundation (NSF) Advanced Technology Educational (ATE) Division is to create technician level employees to meet the needs of today's workforce.

Acknowledging that students often make career decisions before entering college, ATE programs include an aspect of career path development and outreach to students in grades 7 through 12. Nano-Link: Center for Nanotechnology Education has chosen to focus on educators in these grade levels as the conduit to the student population. For use by educators, since 2008, Nano-Link has created modularized content for the infusion of nanoscale science, applications, technology and career options into traditional curriculum (Ref 1). From 2010 to 2012 modifications were made to the modularized approach as well as the educator training that positively impacted the use of the modules by educators. This modification in approach has resulted in module use by over 500 educators in 38 states and 4 countries – with a reach to over 32,000 students. Figure 1 is a representation of locations within the United States using modules.

Figure1. Nanoscale modularized content is being used by educators in 38 states.

Benefits and Application of Modularized Educational Content:

Infusion of nanoscience content into traditional K-12 courses creates an awareness of career path options. It is critical to create a flow of students into STEM fields in general and nanoscience specifically in order

to meet industry needs in the years to come. The modules are adaptable to multiple grade levels and address not only nanoscale concepts but also concepts in traditional science. The materials are provided to the educators at no cost (free) and background information, Power Point files, worksheets and other content are downloaded from the website. Module content is being aligned with the Next Generation Science Standards (NGSS) and the Common Core Science Standards. These alignments allow educators to effectively integrate the nanoscale content and enhances the use of the material to convey required concepts.

Some of the recent modifications include adding a flow chart to the modules. The flow chart is used as a vehicle to present various modifications that are possible with the module activity. Suggestions for use as critical thinking, problem based learning or after school events.

The Educator Workshops provide training for teachers in the use and myriad applications of the modularized content. Nano-Link provides 6 to 8 hour workshops – at the educator's location – to provide the hands-on experience of using the modules. These workshops are provided at no cost to the educators or their schools and often provide the catalyst for infusion of the modules into multiple courses.

The modules are designed to provide multi-disciplinary educational content. The multi-disciplinarity of nanoscience is addressed and emphasized in both the courses and the modules created by the Nano-Link Center alliance of high schools, colleges and universities. The courses cover nanoelectronics, nanomaterials and nanobiotech as well as manufacturing, quality assurance, control systems, agriculture, energy and the food industry. This Center has partnered with three other NSF funded Centers (Bio-Link, MatEd and Op-Tec) to create modules that merge nanoscience concepts with micelles, lasers, concrete and more.

The modular approach expands the Nano-Link reach to minorities inside and outside of the classroom. Nano-Link content is not "just" for the classroom. Modules have been used in multiple summer camps and after school activities reaching underrepresented minority students all over the country including African American populations and Girl Scouts in multiple locations and Native American students in North Dakota. Nano-Link is also creating "culturally relevant" module activities to enhance the applicability of nano- content to under-represented minorities.

Conclusion:

By modularizing nanoscale educational content, aligning the material to NGSS and Common Core Standards the reach of this educational content is growing significantly. The content is reaching over 32,000 students in four countries. Distribution continues to grow with module use not only in classrooms but also in after school and summer programs. The activity based content is designed to be completed in one classroom period and therefore can be used in a variety of ways. Modules are available on the Nano-Link website (www.nano-link.org).

Acknowledgement:

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References:

1. Modularizing Emerging Technology Education: Two Case Studies, D. Newberry and M. Barger, ASEE 2013