

APPENDIX 16: UNIVERSITY OF WISCONSIN MADISON/NSEC PROFILE

I. Description

Institution: University of Wisconsin-Madison

PI: Paul Nealey

Co-PIs: Robert Hamers, Franz Himpsel, Mark Eriksson, Padma Gopalan, Nicholas Abbott, Sam Gellman, Shannon Stahl, Sean Palacek, Arun Yethiraj, Juan de Pablo,

David Schwartz, Michael Graham, Susan Coppersmith, Wendy Crone, Franco Cerrina,

Clark Miller, Daniel Kleinman, Eric Schatzberg, Karin Ellison, Linda Hogle, Mark Suchman, Sarah

Pfatteicher, John Moore, Joseph Bisognano, Luke Mawst, Thomas Kuech

Title: Templated Synthesis and Assembly at the Nanoscale

Proposal: 0425880

Program Officer: Thomas P. Rieker

Education Outreach Director: John Moore, jwmoore@chem.wisc.edu

II. Research Agenda

Research Focus: The UW-Madison NSEC has four interdisciplinary research thrusts that explore complementary concepts around a central theme of self-assembly at the nanoscale. The thrusts are **Thrust 1:** *Directed Self-Assembly and Registration of Nanoscale Chemical Architectures*; **Thrust 2:** *Templated Chemical Synthesis of Sequence Specific Heteropolymeric Nanostructure*; **Thrust 3:** *Driven Nano-Fluidic Self Assembly of Colloids and Macromolecules*; and **Thrust 4:** *Research in the Societal Implications of Template Synthesis and Assembly at the Nanoscale*. Multiple cross-Thrust activities and interactions further capitalize on our multidisciplinary environment, which is essential for successful completion of our research mission. As of April 2005 the entire project has involved 27 faculty from science, engineering, and public policy departments, 8 postdocs, 35 graduate students, and 3 undergraduates.

III. Education Activities within the University

Description of activities

- ◆ **Institute for Chemical Education Chemistry Camp:** A week long half day camp for 5th-8th grade students. Camp included a nanoscience day with activities developed by NSEC graduate students and presentation by NSEC postdoctoral associate.
- ◆ **Online Nanotechnology Teacher Education Course:** The UW-NSEC is developing an online continuing education nanotechnology class. The course will be a broad overview of current nanotechnology topics with a focus on implementing nanoscience into K-12 classrooms.
- ◆ **Educational Fellowships:** The UW-NSEC funds two teachers per summer to join the education and outreach staff to aid in the development of nano related educational materials. Teachers serve as educational consultants through out the school year to help keep developed materials at grade appropriate levels.
- ◆ Program staff and expertise
- ◆ **Diane Nutbrown:** Director of Chemistry Camp. NSEC graduate student and Institute of Chemical

Education Outreach Specialist

- ◆ **Janice Hall:** Online Nanoscience Course Developer. NSEC graduate student.
- ◆ **Andrew Greenberg:** Educational Fellows Supervisor. NSEC Postdoctoral Associate
- ◆ Goals and objectives
- ◆ **Chemistry Camp:** The goals of the chemistry camps are to provide hands on inquiry based science experiences for 5th-8th grades students. The camps are developed to excite and teach campers about current science topics.
- ◆ **2 Online Nanotechnology Teacher Education Course:** The course aims to provide resources for teachers to use in their classroom and clearly show how the topic can relate to current curricula.
- ◆ **Educational Fellowships:** The fellowship program strives to provide an exciting and rewarding nanoscience professional development experience for K-12 science teachers.
- ◆ Target audience (educational levels, number of students at each level, etc.)
- ◆ **Chemistry Camp:** Students entering 5th-8th grade. Summer 2005 120 campers.
- ◆ **Online Nanotechnology Teacher Education Course:** High School Science Teachers
- ◆ **Educational Fellowships:** High School Science Teachers. Summer 2005 two teachers.
- ◆ Current activities (Deliverables)
- ◆ **Chemistry Camp:** Camp curriculum manual to be sold via the Institute for Chemical Education.
- ◆ **Online Nanotechnology Teacher Education Course:** Course webpage containing nanoscience classroom content and laboratory exercises.
- ◆ **Educational Fellowships:** Three nanoscience based educational kits available for purchase through the Institute for Chemical Education, each kit will contain a demonstration and/or lesson based on research being conducted in NSEC Thrusts.
- ◆ Nano S&E content focus
- ◆ **Chemistry Camp:** Products of nanotech, Gold nanoparticles, and Nickel nanowires
- ◆ **Online Nanotechnology Teacher Education Course:** Broad overview of current nanotopics
- ◆ **Educational Fellowships:** Societal impacts, Molecular architecture, Self assembly, and DNA elongation.

IV. Education Activities Outside the University

Description of activities

- ◆ **SPICE (Students Participating In Chemical Education):** NSEC graduate students present nanoscience and chemistry demonstrations shows for K-12 classrooms and local community events.
- ◆ **Sciencounters:** A collaboration between the Madison area Boys and Girls Clubs and the UW-NSEC to provide hands on science activities for underrepresented groups in science and engineering.
- ◆ **Independent Laboratory Access for Blind and Visually Impaired Students (ILAB):** A collaboration between Penn State, Truman State, The Indiana School of the Blind, and the UW-NSEC to develop, test, assess, and market instruments and course materials for blind and visually impaired students to work independently in science laboratories. The UW-NSEC is responsible for the assessment and adaptation of current nanoscience experiments for use in K-12 classrooms with blind and visually

impaired students.

- ◆ **Today's Science for Tomorrow's Scientists (TSTS):** A website containing innovative tutorials designed to teach current research being conducted within the Department of Chemistry at UW to the K-12 community. Included are tutorials on NSEC research being conducted in the Department of Chemistry.
- ◆ Program staff and expertise
- ◆ **Diane Nutbrown:** Director SPICE and Sciencounters
- ◆ **Andrew Greenberg:** ILAB evaluation and nanoscience adaptations
- ◆ **Caroline Pharr:** TSTS developer. NSEC graduate student
- ◆ Goals and objectives
- ◆ **SPICE:** SPICE aims to excite the general public and K-12 community about science and engineering.
- ◆ **Sciencounters:** Sciencounters provides opportunities for underrepresented groups to explore science in a fun relaxed atmosphere in the hopes of exciting students to pursue careers in science and engineering.
- ◆ **ILAB:** ILAB seeks to raise the expectations of blind and visually impaired high school and college students, as well as educators of these students, with the goal of encouraging them to consider careers in science, technology, engineering, and mathematics professions.
- ◆ **TSTS:** The goals of TSTS are to make young people more aware of cutting edge research in chemistry and related sciences. Illustrate why researchers receive funding and how their findings impact people. Show that research is done by real people working together in a group environment. Provide an interactive way to learn modern chemistry while meeting national science education standards.

Target audience (grade levels, number of students at each level, school districts, etc.)

- ◆ **SPICE:** K-12, 2. **Sciencounters:** Teenagers, 3. **ILAB:** 9-16, 4. **TSTS:** Grades 5-12
- ◆ Current activities (Deliverables)
- ◆ **SPICE:** Demonstrations shows.
- ◆ **Sciencounters:** None
- ◆ **ILAB:** Instrumentation and adapted laboratory exercises.
- ◆ **TSTS:** Web based tutorials.

Nano S&E content focus

- ◆ **SPICE:** Memory metal and Amorphous metals
- ◆ **Sciencounters:** Memory metal and Amorphous metals
- ◆ **ILAB;** To be determined
- ◆ **TSTS:** Self assembly

Nano S & E content consultants

High School Teachers, Vin Crespi (Penn State Center for Nanoscale Science), NSEC faculty.

V. Education Outreach Materials

Describe and provide examples of materials, outlines, demonstrations, etc. developed for outreach activities for the K-12 and/or informal audiences

- ◆ Chemistry Camp Manual: Camp manual to be published and sold through the Institute of Chemical Education
- ◆ Demonstration Kits: Nanoscience demonstration kits on DNA elongation and Molecular architecture to be sold through the Institute for Chemical Education.
- ◆ Online Nanotechnology Teacher Education Course: Materials including laboratory activities available via course webpages.
- ◆ TSTS: Web based tutorials and games available for classroom and personal use,
- ◆ ILAB Lab modifications available for download from project webpage and instrumentation to be sold through science educational catalogues.

Describe a recent successful education outreach activity

Chemistry Camp: The summer 2005 chemistry camp which had 120 participants from Madison area highlighted inventions from chemistry and nanoscience. Campers spent two hours a day running inquiry based laboratory activities including making gold nanoparticles and nickel nanowires.

VI. Education Outreach Evaluation

Summarize outreach evaluation plan

Evaluation of ILAB began in August with data collection of the control group for a study to determine if developed instruments help to increase blind and visually impaired students' attitudes toward science. The evaluation plan includes case studies of students using the instruments as compared to a control group doing the experiments in the traditional format with sighted helpers.

UW-NSEC has hired an evaluation consultant to help develop appropriate evaluation plans for other NSEC programs. Evaluation will start in the upcoming months on Chemistry Camp and TSTS.
Summarize outreach evaluation results

No results have been collected to this point all the NSEC programs are in their first year of existence.

VII. Lessons Learned

List 2-3 lessons learned to share with others embarking on a nano education outreach effort.

1. When developing nano education products it is important for the lessons to be at the appropriate educational grade level of your target audience.
2. Working with programs that have fluid participation, The Boys and Girls Clubs, causes difficulty to maintaining continuity of a program.