

MAJOR ACCOMPLISHMENTS FOR YEAR ONE

EXECUTIVE SUMMARY

The Midwest Regional Center for Nanotechnology Education (Nano-Link) builds upon the success of Dakota County Technical College's ATE MnNANO project in partnership with the University of Minnesota. This partnership developed a pioneering multidisciplinary AAS degree program designed to prepare graduates for markets where the broader field of nanoscience is emerging. Since 2004 over 30 Minnesota companies have participated in the development of this new and evolving curriculum and many have employed graduates in nano-related technician positions. However, these companies indicated a need for many more technicians with nanoscience knowledge and skills than DCTC's program could provide.

The Nano-Link Center was developed to provide resources and support to colleges along the Midwest corridor from North Dakota to Michigan as they develop similar nanoscience programs. The graduates of these new programs will be prepared to provide a skilled nanoscience technician workforce that will foster economic growth in nanoscale science and technology in the region. Six two-year colleges in North Dakota, Minnesota, Wisconsin, Illinois and Michigan have partnered to develop Nano-Link along with support from the University of Minnesota and Northwestern University.

Mission

The Nano-Link Regional Center builds public awareness and institutional capacity for nanotechnology education programs that prepare skilled nanoscience technicians to work in the emerging fields that drive the economy across the Midwest Region.

Partners

Chippewa Valley Technical College, Eau Claire, Wisconsin

Dakota County Technical College, Rosemount, Minnesota

Harper College, Palatine, Illinois

Lansing Community College, Lansing, Michigan

Minnesota State Community and Technical College, Moorhead, Minnesota

North Dakota State College of Science, Wahpeton, North Dakota

University of Minnesota, Minneapolis, Minnesota

Major Accomplishments for Year One for the Nano-Link Goals

1. Establish a Midwest Regional Industry Advisory Board

The chair of the Industry Advisory Board has been selected; industry membership is being confirmed; the first meeting is scheduled for September. Materials have been developed to

recruit industry participation in Nano-Link. All partner colleges have active local Industry Advisory Committees for their nanoscience programs.

2. Develop multidisciplinary nanoscience programs

Nanoscience programs and courses have been developed and are being offered at all partner colleges. Discussions with potential affiliate colleges have begun. The nano core curriculum instructor guides have been disseminated. The second of three DACUMs is scheduled for Year Two. Nano-Link is collaborating with other organizations and institutions in the development of curricula and identification of best practices.

3. Partner with the University of Minnesota to provide remote access delivery for nanoscience experiences in pre-capstone and capstone courses

The gold standard capstone semester was offered to nanoscience students at the University of Minnesota the spring of Year One. Two summer workshops for nanoscience faculty are scheduled for the summer of 2009. Educational material resulting from the workshop will be initially disseminated in synchronous and asynchronous modes to the partner institutions. In early 2010, materials will be made generally available.

4. Partner with NCLT at Northwestern University to provide professional development for secondary educators and college faculty

Four Nano-Link regional high school instructors have been identified to attend the NCLT Summer Institute at Purdue University. DCTC, CVTC and NDSCS have all scheduled summer academies for high school teachers as well.

5. Establish a clearinghouse infrastructure for undergraduate instructional materials

NDSCS has taken the lead in developing the infrastructure for the new Clearinghouse for nanoscience curricula. Equipment has been purchased, staff has been hired, and processes have been designed and vetted with the partner colleges. Analysis of the first course (Nanomaterials) has begun.

6. Develop outreach activities to enhance recruitment of students into nanoscience programs, with an emphasis on underrepresented students

Nano-Link has designed a new logo and is in the process of developing the website. Nano-Link partner colleges have shared best practices for recruiting students for their programs--especially underserved students. Nano-Link has also collaborated with Penn State's NACK program to develop the Alumni Network.

7. Provide venues for dissemination including an annual nanoscience conference for faculty, students, alumni, and industry.

Nano-Link's first annual conference is scheduled for November 2009 in partnership with the University of Minnesota's annual Nanotechnology Conference. Nano-Link partners have

presented at numerous regional, state, and national conferences and workshops to promote the Nano-Link Center as well as the new nanoscience programs.

RESEARCH AND EDUCATION ACTIVITIES

1. Industry Collaboration

Industry Advisory Board

Tom Wyrobek, President of Hysitron in Minneapolis, Minnesota, has agreed to serve as chair of the Nano-Link Industry Advisory Board (IAB). He has attended several of the Nano-Link Partners Leadership meetings during Year One and is working closely with the partner colleges to confirm the membership of the Industry Advisory Board. Each partner college is submitting the two names they would like to represent their region on the IAB. Tom Wyrobek has visited several of the partner colleges and is assisting them with industry connections. The first meeting of the Nano-Link Industry Advisory Board will take place in September 2009.

Increasing Industry Involvement

Tom Wyrobek has also offered to help identify additional industry partners who will be either resources or employers aware of Nano-Link. Deb Newberry has developed a packet, introductory letter and PowerPoint presentation for industry representatives.

Partner Colleges Local Industry Advisory Committees

The partner colleges have developed local Industry Advisory Committees for their nanoscience programs. The following companies are actively serving on these committees:

HC: Abbott, OhmX and Motorola

LCC: LCC has sent letters to over a dozen nanotechnology companies in Michigan inviting them to become part of Nano-Link. LCC has received three positive responses to date.

CVTC: Honeywell, Hutchinson Technologies, TTM Technologies, Pdonco, and 3M

DCTC: 3M, Hysitron, SynovisLife, BioE, RJA Dispersions, Entegris, Bergquist, Nancopeia, Goodrich, Isurtec, Boston Scientific, MN Wire, and Optomec.

NDS/MSCTC: Packet Digital, Alien Technology, NDSU Center for Nanoscale Science and Engineering, Cetero Research, Cargill Sweeteners, Aldevron, ComDel Innovation, MeritCare Health Systems.

In addition to industry participation, many of the Nano-Link partners have professional and government organization participation. These participating groups include government labs (Argonne), professional societies (IEEE, ACS, ASME etc.), professional organizations (MHTA, MnNano, BioBusiness Alliance, Red River Research Corridor et.al.) and government/economic development (Greater Fargo Moorhead Economic Development Corp., North Dakota Department of Career and Technical Education, Minnesota Department of Economic and Educational Development, etc.).

Nanoscience Program Development

New Programs and Expansion of Affiliate Members

DCTC's multidisciplinary AAS degree program in Nanoscience Technology was developed by Deb Newberry in partnership with Dr. Steve Campbell at the University of Minnesota in 2004. CVTC replicated this program in 2005. NDSCS and MSCTC began a joint similar program in 2006. HC began its program in 2008. And LCC has added several nanoscience courses to existing curricula. The partner colleges have begun discussions with other regional institutions who are interested in establishing nanoscience programs and becoming affiliate partners in Nano-Link: College of Lake County in Grayslake, Illinois; Elgin Community College in Elgin, Illinois; South Suburban Community College in South Holland, Illinois; Century College in White Bear Lake, Minnesota; Minnesota State College-Southeast Technical in Red Wing and Winona, Minnesota; North Seattle Community College in Seattle, Washington; Fergus Falls Community College in Fergus Falls, Minnesota.

Dissemination of Core Curriculum

DCTC has developed (with editing and formatting support from the SCATE ATE Center of Excellence and National Resource Center for Engineering Technology Education) instructor guides for the two core courses (Fundamentals of Nanoscience I and II) which have been shared with all partner colleges and will be shared with affiliate colleges. Nano-Link will use these guides as a foundation for the consolidation of material in basic Introduction to Nanotechnology courses.

Development of DACUM's

Partner colleges have already participated in the development of the first of three planned DACUM's to identify skill standards and implement these standards into their curricula. The first of three DACUM's was completed on the topic of nanomaterials. Two more DACUM's are planned in the areas of nanoelectronics and nanobiotechnology. The nanobiotechnology DACUM is scheduled to be completed in 2010.

Curriculum Collaboration

Nano-Link is collaborating with the following organizations and institutions in the development of nanoscience curricula and identification of best practices.

- Nano-Link is interfacing with Penn State and Purdue University with plans for broad distribution of linkages of curriculum material.
- Nano-Link is interfacing with the University of Michigan Educational Research Personnel for the Nanoconcepts and Standards (Big Ideas of Nano).
- Deb Newberry has been invited to participate in the SUNY NCLT Symposium at Albany, New York August 5-8, 2009.

Curriculum Development

While development of new curriculum is not a task of the Nano-Link Center, consolidation and vetting of existing content is a Nano-Link task. In order to accomplish the consolidation task, a methodology document has been developed by Nano-Link. This document includes:

- The methodology to be followed by Nano-Link partners as existing course content is sorted, categorized, consolidated, reviewed and placed into the public domain.
- An educational module template that shows the compartments to be included in each module. NOTE: Not all compartments will be populated at the initial content offering. Compartment content, for example, correlation of nano concepts to national educational standards, will be added as Nano-Link and the modules mature.

Follow-up Placement Data

Follow-up placement data on graduates from nanoscience programs throughout the Midwest region will be gathered and tracked at the end of Year One.

3. Nanoscience Faculty Development and Remote Access Delivery

Gold Standard Capstone Semester

The University of Minnesota offered its 15-credit “gold standard” capstone experience to nanoscience students during the spring of 2009. Students from partner colleges were invited to attend but only the students from Dakota County Technical College participated.

Summer Workshops for Nano Faculty

The U of M recognizes the prohibitive cost of instrumentation, professional staff and infrastructure associated with a “gold standard” capstone experience—especially in the areas of nanofabrication and materials characterization. Thus, the U of M has scheduled two summer courses for 2009 for six faculty members from partner institutions: Electron Microscopy and Lithography. The intention is to familiarize the group with the simplest tools to the point of being a competent new user. The group will be trained in the basic principles of operation, sample preparation, operation and measurement and data gathering. Each short course is expected to produce three lab modules to be used in the fall.

Video Instrumentation Modules

Participants in the summer training sessions will work with the U of M faculty to assist with the development of video modules for the instrumentation covered. The instrumentation modules will then be used by the partner and affiliate colleges in their capstone as well as pre-capstone curricula. The first two of these will be developed in 2009-2010 and will be made available in the NANO-LINK Clearinghouse website.

University of Minnesota/Penn State Collaboration

The above modules are intended to be down-loadable videos that show complex instrumentation, how it operates and is used and include an experiment performed using the equipment. There is also a desire to provide “remote” access to the equipment which resides at

various research institutions. This remote access capability would allow dispersed students to synchronously control and interact with the equipment – after their sample had been loaded into the equipment by University Lab personnel. This level of interactive remote access is in its infancy but has the potential to provide a powerful learning environment to many students. University of Minnesota and Penn State, both predominant nanoscience research institutions, are working together to develop, test and provide a set of interactive experiments .

4. Professional Development for High School and College STEM Faculty

The original plan was for the National Center for Teaching and Learning (NCLT) to offer 4-day educator training workshops to which Nano-Link partner colleges would send high school instructors from their region. NCLT cancelled these offerings. However, the NCLT two-week summer institute offered at Purdue University was not cancelled and became the default program for professional development for Year One. Due to these circumstances, the partner colleges decided to promote the summer institute at Purdue University as well as our own local teacher workshops and the workshops for teachers at Penn State. Nano-Link will invite all of the participants over the summer of 2009 to meet with Nano-Link to identify best practices and help develop curriculum for regional local teacher workshops.

Purdue University Summer Workshop

Four regional high school faculty members have indicated they plan to attend the NCLT 2009-2010 Summer Institute on Nanoscale Science and Engineering on July 13-24 at Purdue University. Harper College has three teachers planning to attend the Purdue Summer Academy. One instructor from North Dakota State College of Science has committed and been accepted for this training. Other colleges have had trouble with information and logistics, including getting timely and accurate information about the program, and the timing was not ideal for teachers in some cases as well. The long length of the training was also a deterrent.

Dakota County Technical College Summer Workshop

DCTC is offering 22 hours of lecture and lab on nanotech fundamentals in August 2009. Most of the lectures are online, followed by an all-day hands-on lab.

Chippewa Valley Technical College Summer Academies

CVTC plans to offer two Nano STEM Academies for Math, Science and Technical Education instructors the summer of 2009. Introduction to Nanobiotechnology will be offered July 15-17, 2009; Introduction to Micro- and Nanofabrication will be offered June 18-19, 2009.

North Dakota State College of Science Summer Academy

NDSCS has scheduled a June 10-11, 2009 Emerging Technologies Academy for high school educators. Twenty educators have already registered. The content will be educator choice with four subject modules covered.

5. Clearinghouse

The purpose of the establishment of the Nano-Link Clearinghouse infrastructure is to produce and archive best practice undergraduate instructional materials in nanoscience education

programs at two-year colleges. A regional directory of articulation agreements will be established; modules and courses will be reviewed for posting; lecture and lab curricula will be converted to online format when feasible. North Dakota State College of Science has been designated as the partner college responsible for the development and oversight of the Nano-Link Clearinghouse activities.

Dr. Mike Burke of NDSCS has reported that the following activities have been accomplished during Year One.

1. Researched, requested bids, purchased and installed 1 terra byte Nano-Link server. (Completed.)
2. Requested bids and contracted for Private Partners Working web site. (Construction completed and site is up and operating.)
3. Advertised and hired curriculum specialist (0.5 FTE). (Completed.)
4. Designed Clearinghouse web site and requested bids and contracted for construction. (Development underway.)
5. Started analysis of first nano course--Nanomaterials. Requested partner programs to begin sending course materials for Clearinghouse review. (Began February 2009 and in process.) Once the NDSCS group has developed a framework, the partners will review materials for completeness, standards, compliance, etc.)

In addition, the Curriculum Clearinghouse organizational structure was developed and vetted through the PI and Co-PI's in January 2009. The process and procedure for course/module review and comparison was also developed and vetted through PI and Co-PI's.

The Clearinghouse is designed to serve as key conduit for dissemination. Intellectual property will basically only be acknowledged by the identification of authors. This is consistent with the language in the subcontract Intellectual Property section.

The Nano-Link Clearinghouse will have connectivity with other educational content providers: Penn State; NanoInc; University of Michigan; SRI Stanford Research Institute, Purdue University, and NCLT.

6. Outreach Activities

Nano-Link has developed a logo for the new Regional Center and is in the process of designing the website. The website will contain links to all partner colleges in order to promote nanoscience education opportunities throughout the Midwest.

Nano-Link has also been collaborating with Penn State's new National Center for Nanotechnology Applications and Career Knowledge (NACK) . Dr. Steve Fonash and Dr. Paul Hallacher presented at the winter 2009 Nano-Link meeting in Phoenix, Arizona and led a discussion on strategies and activities for collaboration. Nano-Link will be working closely with Penn State on the development of the NACK Alumni Network.

In addition, several strategies have been implemented by partner colleges to recruit students to the nanoscience programs in the Midwest region, especially the underserved students.

Examples of best practices for recruiting students are listed by partner college:

DCTC: Targeted recruitment activities have been used at DCTC. For example, three DCTC students presented a nanotechnology exhibit at the Rochester, Minnesota STEM event in the fall of 2008 for approximately 1,000 students. They created a video of the event and posted it on YouTube: <http://www.youtube.com/watch?v=t7BRJFTf91>. Deb Newberry served as a presenter and hosted a nanotechnology booth at the Minnesota Science Teachers Association in Minneapolis, Minnesota. She also finds that attending STEM-related events pays significant dividends. DCTC has been awarded NSF S.STEM scholarships for nanoscience students. This program provides individual scholarships of \$8,000 to 15 eligible STEM students on an annual basis for the next four years. Targeted "New Student" recruitment scholarships also attract students to the nano program, and the DCTC Foundation offers \$10,000 in scholarships for nano students each year. DCTC also offers High School Summer Nano Classes.

CVTC: Multiple K-12 school outreach activities have successfully recruited students at CVTC. The nano faculty regularly deliver high school and middle school nanoscience tour presentations at the college, offer a one-credit high school exploratory nanoscience course, and offer a summer nanoscience 'technology camp' experience. CVTC also works closely with the Eau Claire Children's Museum by providing a scientist representation on board and collaborating in plans for a future nanoscience exhibit. CVTC also offers a dual path for its nano students. They can choose between transferring to a four-year degree or direct job placement. CVTC also promotes nanoscience courses to students on waiting lists for college-level science courses. The marketing is focused on the prospective students' ACT or COMPASS scores. CVTC is also looking for grants to pay high school teachers to teach at CVTC as a way to build partnerships with area high schools.

HC: HC recruiters go directly to high school science teachers to promote their nano program. HC has also developed a flyer ad promoting a Nano Day for prospective students and their parents.

LCC: LCC has developed a partnership with the Impression 5 Science Center in Lansing. LCC presented their third annual NanoDay at the Science Museum in March 2009. Over 800 young people and their parents attended this event. Each NanoDay is registered with and receives benefits from participating in the NSF NISENET Center for Informal Education in Nanotechnology.

NDSCS/MSCTC: NDSCS finds bringing students directly to their science and nano labs is effective in promoting the program. They give many tours throughout the year and offer a summer academy for high school students.

7. Dissemination

Nano-Link Fall Conference

Planning is in place to partner with the University of Minnesota's Nanotechnology Conference which is scheduled for Nov 10-11, 2009. Nano-Link is planning to hold its annual conference the day and evening prior to the U of M meetings. The existing meeting provides a large number of speakers on a variety of topics with speakers from academia and industry. Nano-Link is planning various activities for the Nano-Link portion of the meeting--a poster session for students and alumni, industry panel, alumni panel, mixer, and dinner. Participants will be

invited to attend the U of M Conference the following two days. The Nano-Link Conference will focus on current students and alumni and encourage both to present posters at the poster session.

Website

The Nano-Link website is under development at this time. Draft design and content plans are included in the addenda.