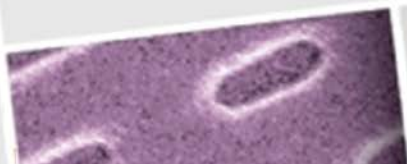
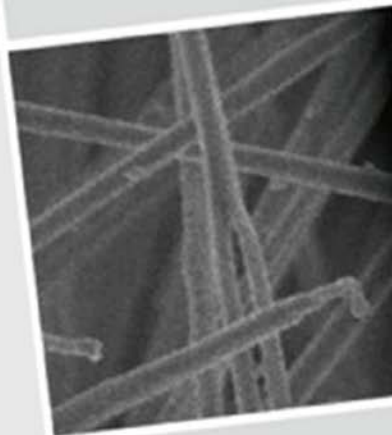
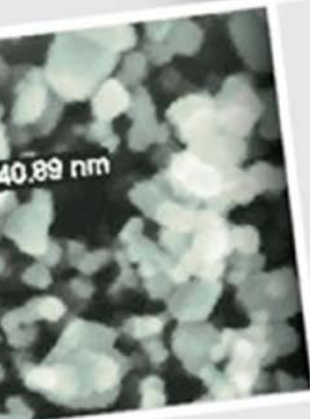
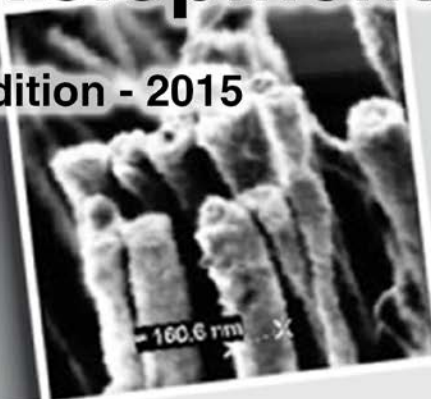


Handbook for Processes and Best Practices for Nanotechnology Workforce Development

1st Edition - 2015



For a catalogue of online resources referenced throughout this book, please visit <http://nano4me.org/handbook/>

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Introduction... Where to Start?

This handbook is intended for new, current and prospective nanotechnology program personnel to familiarize themselves with existing practices of nanotechnology programs throughout the nation. This handbook was developed as a result of survey conclusions and a series of interviews. It is a compilation of outreach and recruitment practices used by nanotechnology and other college programs.

When referencing this handbook, please be advised that the practices found in this resource will need to be modified to fit the needs of individual nanotechnology programs. Each step and process needs to be individualized based on institution, target audience, project goals, and local industry needs.

WHERE TO START?

One of the greatest initial challenges of nanotechnology programs is devoting the time and creative energy needed to structure effective student recruitment activities that align with localized industry needs.

The NACK Network hopes this handbook is used as a reference guide, bringing ideas to the table that may not have been previously considered. As new ideas and practices are tested and proven, this handbook will change and develop; providing a dependable reference guide for nanotechnology programs across the nation.

Enjoy!

The NACK Network
<http://nano4me.org>

Find Your Audience

Providing nanotechnology graduates with jobs is the ultimate goal. Having a nanotechnology program with a job placement or internship collaboration in place helps attract potential students, making the recruitment process less demanding. Although building industry connections takes time, when you consider that they too are a segment of your audience, the time it takes to develop and nurture these relationships becomes an integral part of your program planning and development.

When marketing your program, it is important to design and shape materials, services and activities to attract potential students, industry partners, and community partners. Identifying various audiences provides a better understanding of each segment's specific wants and needs. This provides each nanotechnology program with the opportunity to serve its audience segments uniquely and more accurately.

To identify and segment target audiences, try ATE Central's Audience Segmentation Template. ATE Central supports and promotes the National Science Foundation's Advanced Technological Education programs. ATE Central Outreach Tools offer excellent resources for organizing and planning your outreach and recruitment activities based on the needs of individual audiences.



Audience Segmentation Template



	Description General characteristics	Value What do you think they value most about your ATE project or center?	Contribution to sustainability How do they help support your project or center? (Impact? revenue? content?)	Communications channels How will you reach them?	How Large is the Segment?	Centrality to Mission Rate 0-5
End Users <i>(e.g. students, faculty, partner institutions)</i>						
Industry Partners						
Host Institution						

Figure 1 - ATE Audience Segmentation Template

Additional tools are available from the following organizations:

ATE Central

ATE Central's website has the complete ATE Central Handbook and the ATE Central Outreach Toolkit.

<https://atecentral.net>

Ithaka S+R

Ithaka S+R is a research and consulting service that helps academic communities transition to the digital environment.

<http://sr.ithaka.org>

Part I

Nanotechnology Industry, Outreach and Partnerships

Get Involved

Establishing and maintaining working relationships with industry takes a great deal of dedication, flexibility, and time. What works for one college or university may not work for another. Region, program offerings, and facility capabilities all factor into the successful industry partnership formula. Each program has to find its own unique niche. Industry changes continuously, nanotechnology programs must consistently listen to the needs of industry and subsequently look for ways their programs can fill these requirements.

Academia and industry often address the same science, but their approaches are very different. Once you get involved with industry, you must become familiar with what they are concerned with and what they are looking for. Develop a strong and clear understanding of industry concerns before you talk to them about what your program can do for them. These conversations will eventually, and ideally, help formulate your plan for working with industry as it applies to your program.

According to Herb Finkelstein, retired Director of the Industrial Associates Program, at the LeRoy Eyring Center for Solid State Science at Arizona State University, Trust and accountability are essential in building your relationship with industry. If your program says something will be done, it must get done. Otherwise, there is a risk of losing the progress your program has made in establishing its relationship with industry. It is imperative to maintaining industry relationships that your program demonstrate a real interest in what they are trying to accomplish.

How to Find Your Niche and Establish Relationships with Industry

- Join associations & get involved
 - ✓ Introduce yourself
 - ✓ Ask industry professionals what they need and understand these needs before you focus on what you can give them

- ✓ Once you know what Industry needs, you can introduce methods that will help them fill the void
- ☑ Attend industry open house/events
- ☑ Join industry groups
- ☑ Attend/speak at industry conferences
- ☑ Join a technology council in your state or city
- ☑ Learn industry language
- ☑ Develop a clear understanding of what each industry contact is trying to accomplish
- ☑ Once a clear understanding is established, formulate your plan

Results, when working with industry, are not instantaneous. Your program will benefit in the long term and get a return from its investment, but it takes continuous effort to establish and maintain these relationships.

Cold Calls

When initiating contact with industry, the checklist in the “Get Involved” section of this handbook has recommendations that allow nanotechnology programs the chance to become part of the industry community. Cold calls and emails however are still an important part of connecting with people in industry. Here are some tips and examples that may help you make that initial call.

- ☑ Know your contacts

Who is your contact and what segment of your audience do they represent. Know who it is that you are calling. You may search the company’s website for either the individual or the position he or she may hold. Professional media sites such as LinkedIn may also provide insight into your contact’s professional background and position.

- ☑ Name dropping is not only acceptable but encouraged

If you have a professional connection in common with the industry professional you are trying to contact, you should absolutely mention that connections name and organization. It makes a cold call feel less so. Hearing, “I was referred by...”, or “I have worked with...” immediately provides common ground between you and your industry professional and may make both parties feel more at ease.

- ☑ Voicemail messages should be short and direct

If your first call results in a voicemail message, provide your name, organization, contact information, common connection (if applicable) and

a very brief explanation of the purpose of your call. Avoid jargon if possible; focus only on providing the highlights of your reason for calling.

- First impressions are important

Whether you are leaving a message or speaking to a live individual, if this is your first contact the impression you leave is most important.

Remember to have what you are going to say ready and well-rehearsed. Your time on this initial phone call will most likely be limited, so make the best use of your time and leave a good impression.

- Listen first

Ultimately, the goal of cold calls with industry is to develop long term partnerships. As a result, you must listen to your industry professional before you dive into the benefits of a partnership with your organization. Start with a few simple questions. Use the research you have done on the company and/or the individual you are calling to develop your questions. Once you have your caller thinking about his or her company needs, you can introduce your ideas.

- Community focus

When speaking to an industry professional for the first time, it is critical that your contact relates to your organization's position in the community. This allows the industry professional to consider how a partnership with your program will benefit their business.

Cold Email Sample

Each of the points listed in "Cold Calls", can also be used when sending out cold emails. The added benefit of using email is the attachment. Attachments allow you to provide extra material about your program without taking up space in the body of the email. Additionally, remember to proofread your cold email before hitting the send button and enter a short but descriptive subject in the subject line.

This sample cold email, detailing an internship program, has worked well for Mine Her at Seattle's Hub for Industry-driven Nanotechnology Education (SHINE):

Dear _____,

My name is Mine Her, and I am the Employment and Internship Specialist with the Nanotechnology program at North Seattle College. I'm reaching out to companies to develop Co-Op Internships for my students, who we are training to be Nanotechnicians. As a Co-Op internship, students will be

covered under Seattle College's insurance policy, and hence, any and all injuries that happen during the internship will be covered through Seattle Colleges. Internships can be paid or unpaid, depending on the policy of each site, but please do note that students are receiving class credit. All students are required to sign a non-disclosure and non-compete form with us, as well as any forms from the company they are interning at. We understand and value the site's time and hence have streamlined our required paperwork to just the training site agreement, non-disclosure, non-compete, and evaluation mid quarter and end of quarter.

Most interns are in their final two quarters of either a post-bac certificate (common undergraduate degrees are physics and bio) or an associate's of applied science in nanotechnology. Students take nano/micro fabrication and nano characterization courses concurrently with their internship. Host sites work with students to identify a project or set of tasks to work on for the duration of the internship. Internships can be paid or unpaid, and students are expected to intern for a minimum of 10 hours per week. Our student interns have worked with several WNF client companies, including Silicon Designs, Microvision, and Hummingbird Scientific, as well as in various labs at UW. Student interns are charged reduced fees at the WNF (the outside academic user rate rather than the industry rate) even when doing work for companies.

Thanks for your consideration. If you have any questions, please do not hesitate to contact me. I look forward to hearing from you!

Best,

Mine Her

Surveying Industry

"A lot of times, people don't know what they want until you show it to them."
– Steve Jobs

Seattle's Hub for Industry-driven Nanotechnology Education (SHINE) reminds us that sending out industry surveys helps analyze and identify:

- The skill sets industry is currently utilizing
- What skill sets industry is in need of
- If they are currently using nanotechnology skill sets without realizing it

Possible introductions to the survey:

- We are considering developing a training program that would meet your current and future workforce needs.
- We are in the process of trying to create an educational program that would service industry with high technology skills. We would like your feedback on the skill sets you would like to see.

- We are surveying technology companies to learn more about the skill sets that you will require (both now and later).
- This survey will take about _____ minutes to complete and is designed for technical supervisory/management personnel. We promise we won't spam you if you fill this out.

Keep note of when you send out your survey, it is important to follow-up with industry and provide survey conclusions. In addition, make certain you let them know about the students graduating from your programs with the knowledge and skill sets their company needs.

1. Your contact information

Company name _____
 Your name _____
 Your job title _____
 Street address _____
 City _____
 State _____ Zip _____
 Telephone no. _____ Email _____

For companies with multiple locations, we are asking facility-level managers to complete this survey just for their facility.

2. How large is your company/facility?

49 or less people 50-499 people 500 or more people

3. General information

a) What products/parts/services are provided by your company/facility? In other words, which industry segment is your company/facility providing these products/parts/services for? (Check all that apply)

<input type="checkbox"/> Aerospace/Defense	<input type="checkbox"/> Agriculture/Food	<input type="checkbox"/> Automotive
<input type="checkbox"/> Biological	<input type="checkbox"/> Biotechnology	<input type="checkbox"/> Chemical
<input type="checkbox"/> Communications	<input type="checkbox"/> Electronics	<input type="checkbox"/> Environmental
<input type="checkbox"/> Equipment	<input type="checkbox"/> Industrial processing	<input type="checkbox"/> Machine tools
<input type="checkbox"/> Materials	<input type="checkbox"/> Medical devices	<input type="checkbox"/> Optics
<input type="checkbox"/> Pharmaceutical	<input type="checkbox"/> Other _____	

b) Does your company/facility currently use some aspect of micro- or nano-scale technology (in products, services, processes, tooling, etc.)?
 No Yes (Please provide more information _____)

4. Do you employ technicians/engineering assistants?

No (Jump to Question 7 if you answered "No") Yes

5. What is the approximate number of technicians/engineering assistants you employ? _____

Figure 2 - Industry Sample Survey - Page 1 of 2

6. Do you anticipate hiring technicians/engineering assistants at your company/facility?

<input type="checkbox"/> Need to hire now	<input type="checkbox"/> Within 3-5 years
<input type="checkbox"/> Within 1 year	<input type="checkbox"/> Possibly in 5 years or more
<input type="checkbox"/> Within 3 years	<input type="checkbox"/> No

7. If we could tailor a technician education program to meet the needs of your company/facility, what knowledge and/or hands-on skills would you like them to have upon hiring? (Select all that apply)

<input type="checkbox"/> safety and environmental hazards training	<input type="checkbox"/> optical, e-beam, and ion beam lithography
<input type="checkbox"/> pumps, flow control systems, scrubbers, and sensors: use and maintenance	<input type="checkbox"/> stamping and imprinting lithography
<input type="checkbox"/> vacuum systems: use and maintenance	<input type="checkbox"/> chemical, physical, and/or biological self-assembly
<input type="checkbox"/> plasma generating systems: use and maintenance	<input type="checkbox"/> block co-polymer and self-assembled monolayers
<input type="checkbox"/> furnaces, ovens, rapid thermal annealing equipment: use and maintenance	<input type="checkbox"/> fabricating nanoparticles: various
<input type="checkbox"/> reactive ion etching	<input type="checkbox"/> optical microscopy
<input type="checkbox"/> sputtering	<input type="checkbox"/> scanning probe/atomic force microscopy
<input type="checkbox"/> wet etch and/or lift off	<input type="checkbox"/> electron microscopy (SEM, FESEM, TEM)
<input type="checkbox"/> chemical and physical vapor deposition systems	<input type="checkbox"/> chemical characterization (mass spectroscopy, energy dispersive spectroscopy)
<input type="checkbox"/> statistical process control	<input type="checkbox"/> electrical characterization (C-V/I-V, capacitance)
<input type="checkbox"/> professional/soft skills (team building, problem solving, presentation, project planning, technical reporting/writing, handling intellectual property, etc.)	<input type="checkbox"/> physical characterization (spectrophotometry, profilometry, x-ray diffraction)
	Other (please specify) _____

8. If a program as described in Question 7 exists, would you encourage your current employees to enroll in relevant courses in the program for continuing education?

Yes No

9. Additional comments _____

Figure 2 - IndustrySample Survey - Page 2 of 2

Industry Advisory Board

An Industry Advisory Board is an important resource in strategic planning, guidance and program development. Industry Advisory Boards provide valuable industry perspectives, wants and needs. Once industry connections are established, it is time to form an Industry Advisory Board.

Industry Board Checklist:

- Determine yearly or semi-yearly meetings
- Determine duration (an hour to a day-long event)
- Provide facilities tour
- Serve lunch or dinner
- Create an agenda for next meeting

Sample Advisory Board Documents

The next few pages offer samples of meeting minutes from The University of Puerto Rico at Humacao and Ivy Tech Community College Advisory Board meetings. Discussion topics include collaboration activities, program recommendations, advisory committee mission statements, and more. Review these minutes then develop an agenda that works for your individual project. Advisory boards allow industry to develop a vested interest in your program and program graduates.

University of Puerto Rico at Humacao's Advisory minutes:



UNIVERSITY OF PUERTO RICO AT HUMACAO
CALL BOX 860 • HUMACAO PR 00792
TEL. 787.850.9381 • 787.850.9344 • FAX 787.850.9308
www.uprh.edu



DEPARTMENT OF PHYSICS AND ELECTRONICS

Associate Degree in Electronics Technology Minutes of Advisory Committee Meeting

UPR Humacao – Room CNL240 - 20/May/2014 – 8:00 AM – 9:30 AM

Participants:

- Mr. Victor Amador (Colorcon, Corp.)
- Eng. Rafael H. Aparicio (Model Offset Printing Corp.)
- Ms. Ednaida Cintron (Calibration Validation & Research (CVR), Inc.)
- Dr. Rogerio Furlan (UPRH)
- Prof. Juan Gonzalez (UPRH)
- Prof. Luis Gonzalez, PE (UPRH)
- Dr. Josee Vedrine-Pauléus (UPRH)

Absent:

- Dr. Juan Cersosimo
- Dr. Rafael Muller

Official Discussion began at 8:32 am

1) Recommendations to the AD Program:

- -Committee members approved the summary of results for Student Outcomes for the current cycle, and self-study report. Members will provide further feedback/recommendations to the ABET Self Study sheet presenting Student Outcomes (3a-3k; 9a,b) results & recommendations. Vedrine will make/give access to docs on Google Drive.
- **ABET visit dates:** 10/26/2014-10/28/2014. Please mark your calendars for ABET representatives to meet the Industry members. (If not possible in person, we can reach you by phone/video chat.)
- *A Letter Of Support* from the PRMA and the Advisory committee industry committee members will be provided to the ABET Self-Study. Vedrine will provide a general format for letter.
- Identify a method that can be applied in the practice in the industry course that requires students to participate in seminars/ course certifications. Aparicio mentioned certification such as *OSHA*, which requires 3 contact hours. Furlan suggested that we 'trade' industry practice hrs for these types of certifications. L. Gonzalez mentioned a recent workshop that he attended on *PV Systems & Installations*, which would further emphasize student knowledge in the area of

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Figure 3 - Puerto Rico of Humacao's Advisory Minutes - Page 1 of 2



DEPARTMENT OF PHYSICS AND ELECTRONICS

solar energy (as discussed in the Fall 2013 meeting).

- The discussion on PLC's were again brought to the table, and it was emphasized by L. Gonzalez that our program teaches students the commands from Digital, Microprocessors, and Industrial how to manage the general structures for an imbedded processor; thus it is not recommended that they learn a specific PLCs formatted for a specific industry. Student's breath and depth in a system will allow them to translate their knowledge and be able to configure any PLC system because they have the fundamental background for their design.

2) Further Collaboration with Industry:

- Consider the increased visibility of the aerospace industry in Puerto Rico *into* the Associate Degree Program. As a result of recent updates in the space industry, Rafael mentioned that various other industrial leaders visit to Washington, D.C., many companies will establish themselves in PR (Aguadilla, Ceiba), thus, and it would be a good idea to prepare the graduates for job opportunities that will open; something similar to what is happening with UPRM and their alliance with Boeing on the West coast.
- Identify Funding grants using Companies and University as a Liaison, as commented by Aparicio. Vedrine stated a possible funding source such as the NSF Industry/University Cooperative Research. Aparicio suggested engaging Luis Gonzalez (Torres) from the ADL Consortium into the discussion.
- Implementing Seminars given by the Industrial Personnel based on experience and knowledge in the Quality Control Course. Specific workshop topics such as Lean Six Sigma, Black Belt can be given by industry in this area.
- Visit to local industry was very instrumental in student motivation and retention. We will continue our visits to local companies in the Fall 2014.
- With the support/contribution of Continuing Education, we were able to implement the Industry Open House, which took place on Thursday May 15, 2014 allowed many interactions between industry and faculty; the event was opened to the Natural Sciences. We thank Aparicio for the invitation to become part of the PRMA, and the dynamic Bard Meeting on March 17th where Furlan presented the Programs of the department to PRMA members.
- A Warm Welcome to Mr. Victor Amador, from Colorcon, Inc. to the Advisory Committee. Victor has recruited three students to work at his company this summer. Vedrine will send an official welcome letter.

Meeting Adjourned ~9:40 am

Ivy Tech Community College's Advisory minutes:

Ivy Tech Community College North Central School of Applied Sciences and Engineering Technology Nanotechnology Program Advisory Committee Meeting		07/17/2013 2:30 P.M. Room 1330 Ivy Tech, South Bend
Meeting called by:	Sam Agdasi, Program Chair	Type of meeting: Advisory Committee
Attendees:	Gary Gilot, Gary Bernstein, Marya Lieberman, Robert Dunn, Leslie Ivie, Robert Williams, Sam Agdasi, Christina Arisio, David Brinkruff, Thomas Coley	
Absent:	Shahriar Mobashery, Scott Ford	
Minutes		
1. Welcome & Introductions.		
• All attendees introduced themselves and identified their present occupations.		
2. Review		
• The majority of attendees were new members of the committee, therefore, Sam Agdasi reviewed the program and curriculum, and briefed the attendees on the progresses.		
3. Review Updated Statewide Advisory Committee Handbook		
• Participants were given copies of Advisory Committee Handbook. Sam Agdasi led a review of the handbook.		
3. Appoint Advisory Committee Chair		
• Gary Gilot volunteered to serve as chair. The committee affirmed his offer to serve unanimously.		
• Discussion about meeting frequency ensued. Sam informed members that two meetings per academic year were required according to Ivy Tech rules.		
• Bob Williams suggested 4 meetings per year, which will be decided on the next meeting.		
4. Program Updates		
Sam informed the members that all nanotechnology courses in the curriculum were taught at least once. Members discussed ways for improving the curriculum and fine-tune it based on the input from the industry partners including F Cubed, Indiana Integrated Circuits and Notre Dame Nanofabrication Facility.		
• Intensive summer semester of nanotechnology implementation in Summer 2013 was discussed with the members. The goal of the program is to offer nanotechnology courses to students from other Ivy Tech campuses during the summer.		
• Arrangement for students of intensive program to use Indiana University South Bend dorms in the summer was discussed.		
6. Discuss Statewide ATMAE (Association of Technology, Management, & Applied Engineering) Accreditation Process		
• Sam described ATMAE for attendees as a reputable third-part quality assurance organization for technology education. He also explained that ATMAE provides this quality assurance for students and employers.		
• The statewide effort to have technology programs in the state accredited by ATMAE is underway.		
• Statewide ATMAE audits are scheduled for September 22-25, 2013.		
• David Brinkruff asked the members to be available—one or two—during ATMAE visit and answer their questions.		
7. Program Mission Statement		
Sam reviewed the Nanotechnology Program Mission Statement, which appears below. Gary Bernstein suggested that it become shorter.		
• The impact of nanotechnology embodies virtually every area in modern technology, from the electronics industry to drug delivery in medicine, from biosensors to energy production. This rapid growth demands a skilled		

Figure 4 - Ivy Tech Community College Advisory Minutes - Page 1 of 2

workforce in the form of researchers, engineers, technicians, and entrepreneurs. In response to this demand, Nanotechnology Program at Ivy Tech Community College provides students with deep understanding of nanotechnology concepts, skills in performing nanotechnology processes, and proficiency in operating the equipment. Team building, problem solving, project organization, and research skills are among professional skills which are taught in the Nanotechnology Program.

8. Validation of School of Technology General Outcomes (1-6)

Sam reviewed the School of Technology General Outcomes, which appear below. Attendees would e-mail Sam their input regarding those outcomes.

- 1) *Technology skills – Ability to utilize and leverage technology in ways that add value to an organization.*
- 2) *Math and Science abilities – Apply mathematics and scientific principles as appropriate to one's discipline.*
- 3) *Strategic and Critical Thinking – Ability to link data, knowledge and insight together to provide solution to unsolved problems. Ability to find needed information and evaluates the quality of information and sources.*
- 4) *Communication and Teamwork – Ability to exchange information effectively using appropriate and varied delivery methods, and work effectively with others.*
- 5) *Dedication to Lifelong learning - Continue professional development through ongoing education, certifications, professional society membership, and/or licensing.*
- 6) *Practice of Professionalism, Respect for Diversity, and Ethical Conduct – Promote the understanding of, and respect for, issues of gender, race and cultures other than one's own. Behave professionally and ethically in the workplace.*

9. Validation of Program Competencies (a-i)

Jim reviewed the BCOM Program Competencies, which appear below. Attendees agreed unanimously that they were accurate and appropriate.

- a) *Demonstrate knowledge of the basic and emerging principles and concepts that impact nanotechnology*
- b) *Be able to perform a variety of nanotechnology procedures*
- c) *Competency in operating nanotechnology equipment*

- d) *Teamwork – Function effectively as a member of a technical team.*
- e) *Identify and Solve Problems – Identify, analyze, and solve narrowly defined technical problems.*
- f) *Communication – Apply written, oral and graphical communication skill in both technical and non-technical environments; identify and use appropriate tech literature.*
- g) *Lifelong learning – Understand the need for, and engagement in, self-directed continuing professional development*
- h) *Professional/Ethical/Diversity – Demonstrate understanding of and commitment to address professional and ethical responsibilities, including a respect for diversity.*
- i) *Quality, Continuous Improvement – Demonstrate a commitment to quality, timeliness, and continuous improvement.*

10. Equipment/Industry Needs

- 1) Sam expressed the need for Ivy Tech Cleanroom for nanotechnology program. Currently, Notre Dame's cleanroom is being used by Ivy Tech students. Members made recommendations for possible locations for the cleanroom to be built. Some provided contact information for contractors who can construct cleanroom.
- 2) The need for a chemical hood was expressed by Sam. Gary Bernstein and Maria Lieberman made recommendations on the type of hood.

11. Employment Possibilities, Including Internship Opportunities

- Members were informed that three Ivy Tech students were employed full-time by F Cubed, one secured an internship at Notre Dame Nanofabrication Facility, and one received Nanotechnology Undergraduate Research Fellowship in summer 2013 at Notre Dame.
- Sam asked the members to introduce and bring potential employers to the advisory committee.
- Discovering employment opportunities with companies at Innovation Park of Notre Dame and other local companies were discussed.

12. Public Relations and Marketing

- Gary Gilot pointed to a group of students who can utilize social media to introduce nanotechnology program at Ivy Tech to peers. He will follow up with this idea.
- Les Ivie and Bob Williams offered PR initiatives to make F Cubed-Ivy Tech collaboration known to the general public

13. Adjournment

- Sam adjourned the meeting at 5:00 PM.

Figure 4 - Ivy Tech Community College Advisory Minutes - Page 2 of 2

Aligning Nanotechnology to Industry Needs

If the Nanotechnology industry is not currently in your program's immediate area, consider remodeling a program to infuse nanotechnology. Read about how Chippewa Valley Technical College (CVTC) did this in a presentation by Mark Hendrickson. Link: <http://nano4me.org/handbook/57z.pdf> Mark Hendrickson has also provided, for this handbook, a write up of his Industry Validation of Nano Engineering Technology AAS Redesign, detailing his one-half day validation and curriculum alignment event that reviewed regional employer needs.

Another example of remodeling a nanotechnology program comes from North Dakota State College of Science. The college found that students were more receptive to the term "biomedical." They then built their program around biomedical technology rather than focusing on nanotechnology alone.

BIOMEDICAL TECHNOLOGY

for high school students



Biomedical Technology

Designed to introduce students to the recent advancements in biotechnology and biomedical engineering. Diverse topics range from cancer treatment utilizing nanomaterials to biomedical devices used in prosthetics and implants. The course will cover the future trends and societal, ethical and environmental implications of these technologies.

Earn **High School** and **College** credit.

- No pre-requisite
- Career and Technical Education Elective
- Available for Dual Credit Enrollment - grades 10-12
- Hybrid course - primarily online with hands-on experiments
- Limited space available

For More Information Contact:
Dr. Kristi Jean
kristi.jean@ndscs.edu



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800-342-4325 >> ndscs.edu

Figure 5 - North Dakota State College of Science Biomedical Technology

Half-Day Advisory Meeting

Industry Validation of Nano Engineering Technology AAS Redesign

*Contributed by Mark Hendrickson, Pelikan Crest Consulting and (Retired)
Dean of Manufacturing -Chippewa Valley Technical College*

This one-half day validation and curriculum alignment event was held to review regional employer needs and partnering post-secondary technology and engineering programs. The Nano Science Technician AAS program was in the process of modification into three Engineering Technology programs with a common first year core. New program titles: Manufacturing Engineering Technician, Nano Engineering Technology, and Industrial Engineering Technician

The model used during the event was based on the “Future Search” model as found in the Marv Weisbord book, *Productive Workplaces* (2004 Josey-Bass).

Preliminary work included the completion of three individual DACUM events over a three-year period sponsored through the NSF-ATE NanoLink Center as a partner college. These DACUM events addressed worker duties, tasks, trends, behaviors, equipment, and foundational academic needs. The three DACUM products included nanotechnology workers in the materials sector, biotechnology sector, and characterization and laboratory applications sector. From the validation surveys conducted during post-DACUM events, a prioritized set of competencies was identified. The prioritized set of competencies were then grouped into existing courses at the college as well as clusters of competencies that needed new course development.

Additional work was conducted over a year period to meet with business leaders of the identified businesses within the region that had a most likely fit to the micro and nano technology skill sets. These meetings provided awareness, relationship building, and trust development between college personnel and the business leaders as well as a better awareness of the regional business workforce needs. During the same period new proposed courses were developed for inclusion into the new proposed programs.

The validation and alignment event was preceded by personal phone calls and written invitations by the Dean of Manufacturing to participate in this one-half day event.

As a side note, it was learned in the yearlong business visitation process that the food process industry was in dire need of the skill sets being trained, but there was no awareness of the skill sets of a Nano Science Technician AAS graduate. The core need was based on a non-medical laboratory technician that could conduct all aspects of the job including sampling, conducting laboratory techniques, data analysis, and reporting, as well as all aspects of equipment troubleshooting, operation, and repair. Multiple levels of safety were a baseline need for all of the businesses interviewed. Industry sectors included: microfabrication, entrepreneurs in nano electronics, biotechnology, microelectronics, micro machining, laboratory characterization, food processing, and materials manufacturing. The event was scheduled between noon and 4 pm on the given day.

The event process

1. Introductions:
 - a. College staff and program educators were introduced to the group as well as a brief bio background of the individuals and their roles.
 - b. Each of the business leaders were introduced and gave a brief overview of the business they were involved with and the type of jobs they were seeking to fill.
 - c. Each of the Post-Secondary Education Institutions provided a brief overview of the programs they represented and are available in laboratory sciences and engineering technologies. This also included Management Technology, as a pathway for many of the 2-year graduates have been into business operation management at the lead or supervisory levels.
 - d. Note: A void in the process was identified that secondary education leadership was not involved in this process.
2. Program Proposal
 - a. The modified program was distributed to the participants at the event
 - b. The Compiled DACUM prioritization was distributed to the leaders prior to attendance
 - c. All of the business leaders invited were also participants in the validation survey of the DACUM competency listing.
 - d. Each course within the proposal had a complete listing of the competencies and performance levels expected for successful completion.
 - e. Each of the business leaders were asked to bring posting examples from their respective HR Departments.
3. Event Layout and Design
 - a. Six tables were distributed through a large conference room. A single flip chart was positioned adjacent to each table to capture specific needs not addressed in the breakouts.

- b. A college faculty or staff was assigned to each table to facilitate a curriculum course review. The faculty or staff was also able to answer any specific questions on how the course would operate.
 - c. Each table had an assigned note taker (staff) to record discussion points.
 - d. Each table had an assigned reporter (business/academic representative) to present the discussion points of the curriculum. Each competency was reviewed, approved, or had suggested modifications and additions if gaps were identified.
 - e. Each table had up to six business / academic reviewers to discuss the course curriculum and content.
 - f. Text materials and other supplemental materials of the courses were provided as examples at the tables for reference.
 - g. Three college staff acted as mobile gatekeepers to facilitate timing and progress of the event.
 - h. Refreshments were provided and an introduction to refresh as needed through the afternoon session.
4. Structure of the Event
- a. Each table (group) had 25 minutes to review the curriculum and discuss with the table faculty each of the competencies and overall description of the course. (Six courses were reviewed simultaneously with this method)
 - b. At the end of the time frame, the reporter provided a brief overview of the course; competencies contained, and identified suggestion for approval or modification. The course was open for floor discussion of all the tables for issues, approval, or modification suggestions.
 - c. A maximum 30 minutes was allocated for review and discussion of the first round of six courses.
 - d. Six courses were analyzed and reviewed in 60 minutes.
5. Round two and round three addressed program courses also in the program design for specific needs in the food industry and in the manufacturing engineering technology sector in addition to the nanotechnology specific programming.
6. As the review rounds were completed a discussion and recommendation for acceptance or acceptance with modifications was requested by the business leadership of the ad-hoc advisory group.
7. Additional issues and concerns addressed during discussion:
- a. Engineering requires ABET accreditation so calculus based course options are needed for those students pursuing a direct engineering articulation
 - b. Specific HACCP food safety was needed in addition to the traditional manufacturing safety course
 - c. Project management or supervisory management as a course option would increase the employability of a technology graduate
 - d. Specific recommendations were made regarding sequencing for those interested in transferring to a 4-year program

- e. Course credit alignment modifications were suggested to better align with university transfer
 - f. The communications course change was recommended to fulfill English/communications transferability
 - g. Program name modification and alignment with HR departments in the region was requested to help with competency clarification
8. Recommendation of the program change by the ad-hoc advisory committee



[Date]

[Collaborator name & address]

Dear Collaborator [Name]

Chippewa Valley Technical College is exploring the need for a program in the area of a **manufacturing lab technician** with a focus on **Food Science**. It is important that we receive input from our regional collaborative partners to help us in making these important curriculum decisions.

To accomplish this work, I am inviting you to participate in an advisory meeting on **Friday, April 15, 2011**. The meeting will be from **Noon to 4 pm** (lunch provided) at the CVTC Manufacturing Education Center, 2320 Alpine Road, Eau Claire Wisconsin. (map enclosed)

Our goal is to make a major decision on expanding the job options for prospective students. Please join us with input that will guide the College to best align our instruction with a lab technician, food processing technician, or quality assurance technician.

If you are unable to attend, please consider sending another person from your organization or you may contact me for other options to provide input.

Please **RSVP by Tuesday, April 12th** to **Elaine Miller** on your intent to participate. You can respond by calling Elaine at 715-874-4604 or sending her an email at emiller@cvtc.edu

Your contribution to this decision making process is greatly appreciated.

Sincerely,

A handwritten signature in cursive script that reads 'Mark R. Hendrickson'.

Mark Hendrickson
Dean of Manufacturing

Figure 6 - Industry Meeting Invitation

MINUTES OF NANOSCIENCE ADVISORY MEETING
APRIL 15, 2011, 12:00 p.m.
Room MEC 130, Chippewa Valley Technical College

Present: Andrew Abrahamson (Nestle's), Carolyn Barnhart (UW-Stout), Bill Butsic (ConAgra), Kurt Carlson (CVTC), Naveen Chikthimmah UW-Stout), Mark Hendrickson (CVTC), Mary Hopkins (UW-Stout), Ron Keys (CVTC), Bobbie Jo Kulow (Nestle's), Linda Loew (CVTC), Hans Mikelson (CVTC), Claudeen Oebser (CVTC), Gary Onan (UW-River Falls), Pam Owen (CVTC), Roy Radcliff (Marshfield Clinic), Becky Robertson (Primera Foods), Tim Shepardson (CVTC), John Wagner (CVTC), Trevor Wuethrich (Grassland Dairy), Shamus Funk (CVTC)

Absent: Harold Schraufnagel (Abbyland Foods), Denise Meacham (Associated Milk Producers Inc., Jim Falls Division), Kathy Collins (Bioforward), Bryan Renk (Bioforward), Nancy Haldeman (Bush Brothers & Co., Inc), Jean Finger (Bush Brothers & Co., Inc), Dale Paul (Cloverleaf Cheese, Inc.), Debbie Labs (ConAgra Foods, Inc), Linda Bollinger (CTL Foods Inc), John Buhlman (Eau Galle Cheese), Tony Birkle (Ellsworth Creamery), Paul Bauer (Ellsworth Creamery), Joe Hines (Ellsworth Creamery), Rex Hines (Ellsworth Creamery), Marc Johnson (Ellsworth Creamery), Sandy Martindale (Jack Link), Roger Moore (Jack Link), Allen Dunlavy (Jack Link), Randy Albrecht (Jenny O Turkey Store), Dan McCabe (Leinenkugel Brewing Co), Ron Lesczynski (Marathon Cheese), Marsha Barwick (Marshfield Clinic), Marla Carrol (Mondovì SPF-USA), Sally Lane (Nestle Nutrition), S. Sahl (Quality Liquid Feed Corp.), Prem Girdhari (Radix Laboratories, Inc), Shawn Kapanke (Silver Spring Foods), Bob Rosseau (Silver Spring Foods)

Guests:

Meal was served. The meeting was called to order at 12:30 p.m.

Mark Hendrickson gave an introduction and provided a history and why CVTC is exploring a new or expanded program. Agenda was reviewed.

Claudeen Oebser facilitated break out groups to review the Manufacturing Technology – Lab Technician curriculum, descriptions, and competencies.

Recommendation: A motion was made that CVTC move forward with a modification of the current program and competencies that reflect the collective findings by Trevor Wuethrich and seconded by Roy Radcliff. No discussion. Motion approved.

Meeting adjourned at 4pm.

Linda Loew, recorder

*updated company/organization 9/16/11 lml

Figure 7 - Advisory Meeting Minutes

Determine Nanotechnology Program Needs

Identify a systems approach that works! These resources, recommended by Mark Hendrickson, are designed to help organize and further develop the way your program works. From The “Theory of Constraints” to “Worldwide Industrial Design System”, these approaches have enabled Chippewa Valley Community College to streamline many of their processes.

The Theory of Constraints (TOC)

<https://www.toc-goldratt.com/content/About-TOC>

The Theory of Constraints (TOC) is an overall philosophy developed by Dr. Eliyahu M. Goldratt, usually applied to running and improving an organization. TOC consists of Problem Solving and Management/Decision-Making Tools called the Thinking Processes (TP). TOC is applied to logically and systematically answer these three questions essential to any process of ongoing improvement:

- "What to change?"
- "What to change to?"
- "How to cause the change?"

The Current Reality Tree (CTR) is a tool that is used within the Theory of Constraints (TOC) and answers the question ‘What to Change?’. The CRT is used to discover a core problem. CRTs work backwards by identifying several undesirable effects that all lead to a core problem or cause.

Goldratt Marketing Group (2015). About TOC. Retrieved March 22, 2015 from, <https://www.toc-goldratt.com/content/About-TOC>.

Compression Planning

<http://www.mcnellis.com>

Compression planning is helping key leaders leverage their collaborative time so they make better decisions faster - which leaves more time for strategic thinking and better results. Compression Planning gets everybody heading in the same direction and compresses the planning time for major projects to enable your organization to achieve the results you need.

- Focus groups quickly
- Move from talk to action...fast
- Build consensus and ownership behind plans which have stickiness
- Convert vague ideas into concrete action so leaders can move on them

McNellis (2015). The Strategic Planning Process for People Who Get Stuff Done. Retrieved March 22, 2015 from, <http://www.mcnellis.com>.

DACUM

<http://dacum.osu.edu/workshops/dacum-institute/>

The DACUM process can be used for job analysis, occupational analysis, process analysis, functional analysis, and conceptual analysis.

- DACUM is an abbreviation for Developing A Curriculum
- DACUM is a job occupational analysis performed by expert workers in the occupation
- DACUM is an occupational skill profile which can be used for instructional program planning, curriculum development, training materials development, organizational restructuring, employee recruitment, training needs assessment, meeting ISO 9000 standards, career counseling, job descriptions, competency test development, and other purposes.

CETE | College of Education and Human Ecology (2015). DACUM International Training Center. Retrieved March 22, 2015 from, <http://dacum.osu.edu/workshops/dacum-institute/>.

The Marvin Weisbord Six-Box Model (Weisbord's Model)

http://www.marvinweisbord.com/index.php/organizational_diagnosis/

The six-box model is a framework developed by analyst Marvin Weisbord that assesses how an organization functions. It is a framework that is intended to be used across a variety of organizations. It is described as “A hands-on guide to understanding how Purposes, Structure, Relationships, Rewards, Helpful Mechanisms and Leadership interact in organizations.”

Welcome to MarvinWeisbord.com (2015) Organizational Diagnosis: A Workbook of Theory and Practice. Retrieved March 22, 2015 from, http://www.marvinweisbord.com/index.php/organizational_diagnosis/.

Worldwide Instructional Design System-WIDS

<http://www.wids.org/#&panel1-1>

Put all of your programs and courses under one roof with WIDS. Your WIDS site is a state-of-the-art platform that gives your organization an efficient way to develop, align and manage curriculum. WIDS also provides a full range of consulting services to support the curriculum design process.

WIDS (2015). Worldwide Instructional Design System. Retrieved March 22, 2015 from, <http://www.wids.org/#&panel1-1>.

Inform Industry of Skill Set

Make sure industry is aware of the knowledge, skills set, and competencies your graduates possess. SHINE uses the following sample to identify the skills each student graduates with:

North Seattle College Nanotechnician Skills & Competencies

General:

- Understand the Basics of Chemical and Material Properties—Role of Scale
- Identify Fundamental Aspects of Materials used in Nanotechnology
- Describe concepts of electromagnetic waves, X-rays, UV, radio waves and visible light
- Apply Safe and Environmentally Appropriate Methods to Chemical and Materials Handling, Storage, and Disposal
- Apply safely the information available in Material Safety Data Sheets (MSDS) and Safety Data Sheets (SDS).
- Demonstrate safe handling of acids, bases, flammable. liquids, cryo fluids and compressed gasses
- Classify flammability hazards of solvents such as flash point and explosive potential
- Apply knowledge of chemistry and environmental safety including waste disposal and recycling
- Nanotechnology Health, Safety, and Environmental issues

Nanotechnology Equipment and Processing Skills:

- Chemical Hoods and Glove Boxes: Use and Maintenance
- Cleanrooms: Use and Maintenance
- Pumps, Flow Control Systems, Scrubbers, Sensors: Use and Maintenance
- Vacuum Systems: Use and Maintenance
- Plasma Generating Systems: Use and Maintenance
- Furnaces, Ovens, and Rapid Thermal Annealing Equipment: Use and Maintenance
- Chemical Facilities and Maintenance
- Demonstrate Ability to Enhance Product or Process Quality
- Contamination Control
- Process Integration
- Introduction to Statistical Process Control

Nanotechnology Fabrication Skills:

- Lithography: Optical, UV, e-beam, scanning probe
- Stamping and Imprinting Lithography
- Chemical techniques; e.g., Block co-polymers and SAMs
- Deposition: Chemical Vapor and Physical Vapor Deposition Systems
- Etching: Reactive Ion, Sputter, and Wet chemical
- Ion Beam, Plasma, and Chemical Materials Modification

Figure 8 - North Seattle College Nanotechnician Skills & Competencies - Page 1 of 2

- Thermally assisted oxidation and chemical implantation
- Chemical, Physical, and Biological Self-Assembly
- Nanomaterial synthesis: Colloidal Chemistry, CVD Approaches, Plasma Approaches

Tools/Equipment:

- Optical Microscopy
- Scanning Electron Microscopy (SEM and FE-SEM)
- Transmission Electron Microscopy (TEM and FE-TEM)
- Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM)
- Laser Scanning Confocal Microscopy (LSCM)
- Energy dispersive X-ray Spectroscopy (EDS)
- Mass Spectroscopy
- Fourier Transform Infrared Spectroscopy (FTIR)
- Current-Voltage Measurements
- Capacitance Measurements
- Opto-electronic Device Measurements
- UV-Vis Spectrophotometry
- Profilometry
- X-ray Diffraction (XRD)
- Dynamic Light Scattering (DLS)

Soft Skills:

- Team Building
- Problem Solving
- Project Organization and Planning
- Research Skills
- Assessing Cost of Ownership
- Presentation Skills
- Technical Reporting and Documentation
- Handling and Generating Intellectual Property



Figure 8 - North Seattle College Nanotechnician Skills & Competencies - Page 2 of 2

Nanotechnology Co-Op Internship

According to Mine Her at Seattle's Hub for Industry-driven Nanotechnology Education at North Seattle College (SHINE), offering industry Co-Op internships opportunities helps potential employers see that students are willing to work full-time and are dedicated. Each internship lasts a minimum of six months.

Co-Op internships are traditionally, longer in duration and for class credit. Because students are getting credit, many colleges and universities have insurance policies to cover interns under Co-Op internships. All internships can be paid or non-paid, depending on the employer. If paid, interns must conform to any and all government guidelines for paid employees; including: pay, benefits, hours, and labor and industries coverage.

Internship benefits:

- Industry partners can coach, mentor and help mold a potential employee for industry
- Student's gain real world experience
- Industry partners are generally more confidently connected and more agreeable to co-op internship opportunities
- College programs have a greater opportunity to develop nano programs that meet industry needs

SHINE offers an example:

Lilotree is a growing test lab startup located in Bothell, Washington. Due to the technical skillsets that a technician needs, Lilotree has been unable to find suitable technicians in its lab. After hosting, mentoring, and training a paid SHINE student intern for 6 months, Lilotree is planning on hiring the student full time after graduating from the program. Lilotree has been an immense partner in not only training the next generation of Nanotechnicians, but in providing feedback by sitting on our BILT board, implementing new areas of studies to be taught in class, and suggesting instruments to buy for SHINE's lab to better suit industry usage and better train technicians for future employment.

Steps:

1. Assess your current nano program and identify a goal.
 - a. Are you training nanotechnicians for different fields?
 - b. Are you trying to have industry partners give you feedback as to how to tailor your program?

- c. Are you going to be focus on one field of nanotechnology?
2. Assess your industry environment. For example, biotech, aerospace, environment, materials, and semiconductor are major players in SHINE'S location.
3. Assess what skills are needed for these fields, as each field is very different in needs.
 - a. Companies do not want to take time to train students in basic fundamentals so form will clarify any confusion.
 - b. Provide companies with North Seattle College Nanotechnicians Skills and Competencies form (see figure 8)
4. Create a win-win situation. For example:
 - a. SHINE currently has a company hosting an intern.
 - b. They have requested a piece of equipment in the range of \$50,000-150,000.
 - c. SHINE does not have that kind of budget but has contacts with government agencies that have the know-how on how to achieve this goal.
 - d. SHINE is currently talking to government contacts to see if they have funding to purchase this equipment for this startup to use.
 - e. SHINE will host the equipment on campus as a training tool for students and for industry partners to use for a fee.
 - f. In turn, the government is helping support the growing nano field in SHINE'S region by helping startups grow and training the workforce pipeline of the future.

Part II

Student Outreach and Recruitment

Nanotechnology Educators, Recruiters, and Advisors are among the academic professionals tasked with getting students the education and training needed to prepare them for jobs in the field of nanotechnology. By helping students identify specific career paths, academic professionals are in a better position to also help students land internships and other professional development opportunities before and after they complete their degree or certification programs. To that end, academic professionals must be knowledgeable of the changes in industry, potential earnings, and industry needs.

Nanotechnology Student Career Checklist for Academic Professionals:

Student Career Fields

- Assist students in choosing and developing a career path.
- Provide information on professional opportunities available through their program of choice and teach them how research these opportunities in the future.

Professional Development for Students

- Help students build a strong resume and cover letter
- Stay up to date with resume trends to better help students develop their resumes
- Speak to industry hiring managers; know what they are looking for. As industry needs change, so should your approach to helping your students (See section on developing relationships with industry professionals)
- Help your students develop online professional profiles and teach them to make viable connections and the value of networking

Assist students in developing professionally. A good resume can only take you so far. A professional conduct during the interview and ability to thoughtfully answer questions will help students secure jobs after college.

Potential Earnings

Use the below resources to find information about potential earnings in Nanotechnology.

- Careers in Nanotechnology
<http://www.nnin.org/news-events/spotlights/nanotechnology-careers>
- Salaries
<http://www.simplyhired.com/salaries-k-nanotechnology-jobs.html>
<https://www.recruiter.com/salaries/nanotechnology-engineering-technicians-salary/>

Successful Marketing of Nanotechnology Programs

When marketing your program, it is important to be honest and direct. Provide answers to the most widely asked questions.

Why should students enter the field of nanotechnology?

As potential students seek to choose a major or change a major, they need to know what options a future in nanotechnology may hold for them. Always be able to answer:

- What fields of study are available?
- What types of jobs are available after graduation?
- What is the earning potential?

Ensure your team has all the information necessary to accurately market your Nanotechnology Program

Make sure all nanotechnology educators and staff work together and can provide potential students with the right information. To ensure consistency and accuracy facilitate All Department Outreach Events:

- Hold Educational Luncheons
- Conduct an All Department Open House

- Lead STEM Division Discussions on Nanotechnology

All Department Outreach events should provide important materials and information to the academic professionals who encourage students to enter the field of nanotechnology. Once properly educated, inspired and motivated for the success of the students, attendees will share the nanotechnology passion and authentically refer students into the program.

College of the Canyons hosts STEM Division Discussions to assist in educating faculty who work directly with students in the STEM fields. While SHINE hosts an All Department Open House. The next two pages contain an example of SHINE's Open House of Agenda.

"By working as a team, we are able to meet a common goal and achieve our own program goals as well." – Mine Her, SHINE

Open House Agenda

Who: OCE&E –WorkSource Employment Specialist, JSR

- Workforce Education Department BFET, WRT, Workfirst
- Business Services Team
- WIA partners
- Worksource employment specialists
- DSHS

What: Explain what nanotechnology is, our program here, employment opportunities

When:

Where: NSC Nano Lab

Why: The public as well as direct service workers are unaware of the program here, what it is, and the potential of opportunities

How: Open House

Introduction:

Mine will open and explain what nanotechnology is, while showing videos that show how nanotechnology had, has, and will be used in everyday life, from smartphones to cancer research.

Mine will explain the fields if nanotechnology and what fields are prevalent here in the Pacific Northwest and why there is a need for technicians. Explain what nanotechnicians do.

- SGL for carbon fiber production for BMW
- Torey Composites for carbon fiber production for Boeing
- Neah Power for development of new energy storage
- Seattle BioMed and Fred Hutch for cancer research
- Intel for microprocessors
- Groove Biopharma for medical

Explain current job market and why there is a need.

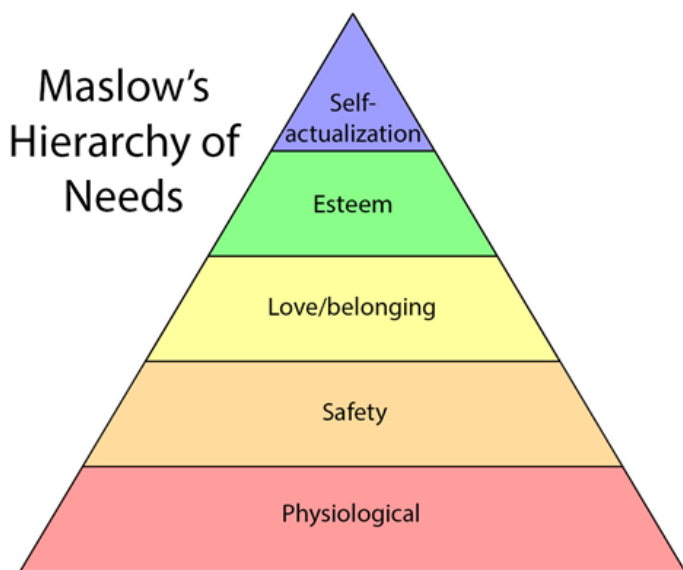
Peter will talk about the program.

Talk to each department in how they can help students in achieving a livable wage position.

- Worksource sees unemployed, underemployed, or career hoppers to discuss what type of work they might want to get into. If STEM is an option, present nanotechnology and the program to them.
- Worksource will refer to WIA or Workforce Education Partners to help with tuition funding. SHINE will provide the necessary documents to show that there is a need for Nanotechnicians in the area to have tuition funding release to potential student.

Figure 9 - SHINE's All Department Open House Agenda - Page 1 of 2

- SHINE will assess new potential students and go over in details the program, and see that all basic needs are met. If they are not, SHINE will refer client back to DSHS and other resources at the OCEE to ensure that basic needs are met before signing up for the program.
- These partnerships are working with Maslow's Hierarchy of Needs:



For a student to succeed and become a viable citizen in a livable wage position as a Nanotechnician, we must first meet basic needs of food, water, housing, income, and safety. DSHS will handle the basic needs as outlined, with Worksource overlapping with employment (temporary) and income and Workforce Education for tuition. This safety net will lead to a love and belonging status where the client feels that they are safe and belong to part of a greater community as a whole. SHINE will work with the client to foster a sense of belonging in the nanotechnology world and build their self-esteem by building technical and soft skills to be employable in the field. As the student graduate from the program, the student should be in a better space than when they first started, which will lead to the student finally reaching the final stage, and boomerang back to mentor and help current students through internships and mentorship. Every department has a very critical piece, and through it all, data will be reported back to respected departments to be able to accurately record success. Current models have us all working independently, and not being able to see or capture the fruit of our labor.

Questions

Tour of the Lab.

Figure 9 - SHINE's All Department Open House Agenda - Page 2 of 2

SHINE Video Recommendations

Nanotechnology Video

This is a cinematic video that gives a brief introduction to nanotechnology and how it is used.

<https://www.youtube.com/watch?v=7hZ5hinf9vo>

Nissan Develops Self-Cleaning Car

Show nanotechnology at work on an innovative consumer product.

<https://www.youtube.com/watch?v=crvEEly4PVU>

A Day in the Life of Otis: An Intel Manufacturing Technician

Meet Otis, a Manufacturing Technician at Intel.

<https://www.youtube.com/watch?v=juKOgtpD7P4>

Nanotech creating Rust Belt jobs for everyone

CBS News correspondent Jim Axelrod reports about the growth of nanotechnology jobs in the Rust Belt.

<http://www.cbsnews.com/news/nanotech-creating-rust-belt-jobs-for-everyone/>

Creative Marketing

Hire someone to guide students towards Nanotechnology programs. City College of San Francisco, through a Department of Labor grant, has successfully developed the new position of Bridge to Biosciences counselor specifically for the Bridge to Biosciences program. This specially funded academic counselor developed a thorough knowledge of the Bridge to Biosciences program, biotech certificates, and the Associate of Science degree in biotechnology.

The program counselor is able to effectively assist students in developing an educational plan with appropriate classes to fulfill requirements. The counselor is also able to highlight and direct students to various certificates and AS degrees in biotechnology. Guidance is offered to help navigate students through financial aid, Learning Assistance Center, Health Center, and special programs such as Veteran Services. As well as Extended Opportunities Programs and Services, Latino Services Network, Asian/Pacific American Student Success, African American Scholastic Program and more. In addition, the Bridge to Biosciences counselor guides students through various biotech-related internships and tracks student and alumnus' educational and career goals.

“Starbucks is not an advertiser; people think we are a great marketing company, but in fact we spend very little money on marketing and more money on training our people than advertising.” – Howard Schultz

Working with Marketing and PR Departments

Program promotion is an ever-evolving integral part of the nanotechnology program. You must promote until the program has full enrollment and then start promoting again.

Connect with Institution's Marketing and Public Relations Department:

- ☑ Send out an announcement to college, college bulletin and student newspaper
- ☑ Prepare news release with Marketing and PR Department for external announcement
- ☑ Call local media and let them know of new program – ask them to do a feature story
- ☑ Prepare communications to send out to counselors/advisors.
- ☑ Contact student life or student services – coordinate an event with them that will complement the nanotechnology program
- ☑ Utilize all promotional materials that institution offers
- ☑ Write a social media strategy to be disseminated through college/universities social media channels
- ☑ Prepare communications to go out to
 - ✓ College supporters/alumni – connect with Director of Development
 - ✓ Current enrollments – connect with Institutional Research
 - ✓ Prospective new students – connect with Recruitment Office
 - ✓ Industry/businesses - connect with Professional Training Department

Tips for Marketing to High School and College Students

Small and direct pieces of information in a variety of communication platforms are beneficial when marketing to high school and college students. Brief and effective communication is imperative. Adults process visuals 60,000 times faster than reading text. Attention spans usually last about 8 seconds. This makes communicating through images and headlines very important. Once you have their attention however, students need to know where to go and who to contact for detailed program information.

Informal interviews with high school students on their communication needs, suggest that high school student's look for both an information page, such as a website, and for direct contact with a live person by email or by phone for more specific career path questions. Incorporating a

variety of communication pathways is indispensable when marketing to youth.

Marketing tips:

- ☑ Create short flyers with effective imagery, website information and contact information
- ☑ Identify a “point-person” that makes it their top priority to be available via phone, text or email to these prospective students
- ☑ On website, clearly post contact information and have a section “For more information, click here” – monitor email daily
- ☑ Remember: Potential students are looking for specific information on the benefits of majoring in a nanotechnology program
- ☑ Highlight earning potential to prospective students along with the types of careers they may go into after graduation
- ☑ Stay engaged
- ☑ Request permission to include them in monthly email announcements
 - ✓ Set up a contact database through services such as Mail Chimp, Constant Contact or iContact
 - ✓ Send out monthly emails that consist of a brief description, appealing image and a “call-to-action” such as “click here to register” or “click here to learn more”, etc.
 - ✓ Link social media to emails
 - ✓ Provide phone number and email to identified point-person for questions/concerns/guidance
- ☑ Use Text Message Marketing – Inexpensive services are available
- ☑ Listen to your target audience – acknowledge needs or concerns by providing straightforward answers and information

On-Campus Outreach

Introduction to Nanotechnology Workshops

The goal of facilitating nanotechnology workshops on campus is to provide potential with the information necessary to allow them to consider entering a Nanotechnology program.

Your presentation should include

- ☑ An interactive presentation
- ☑ Promotional items
- ☑ Printed Materials that highlight the benefit of your program
- ☑ Hand out business cards for students to call with questions

- ☑ Pass around a sign-up sheet for those interested in hearing more about nanotechnology. Request student's name, email and phone number
- ☑ Follow up with students that expressed interest – send them a quick email with contact information immediately after the presentation. Send them another email before next semester registration letting them know what courses are available for them to take.

Recommended flyers to handout:

- **Intro. to Nano Brochure** – available for free at nano.gov
- **Nano in Energy Brochure** – available for free at nano.gov
- **Nanotechnology: Big Things from a Tiny World.** This brochure supplements the presentation materials and explains future of nano in simple terms. This is available at <http://nano4me.org/handbook/QbC.pdf>
- **Summary of Skill Sets Taught in 6 Nanotechnology Courses** – available at <http://nano4me.org/handbook/9LH>
- **A Student Success Story** – available at <http://nano4me.org/handbook/dDU.pdf>
- **Information brochure about program** – available at <http://nano4me.org/handbook/4Mj.pdf>
- **National endorsement on Nano Workforce Programs** – available at <http://nano4me.org/handbook/AGp.pdf>

Encourage student participation by giving away nano pens, chip clips, magnets, etc. for free to anyone who answers questions throughout the presentation.

Ivy Tech Community College does the NACK Network presentation to students every semester that enroll in the “student success elective” course. This presentation is available for download at <http://nano4me.org/handbook/ZKa.pdf>

NACK Network does a student recruitment presentations to as many students as possible in science and technology programs the beginning of each fall semester. In the spring, NACK Network does presentations again to reach freshman in the “undecided” category. *The Nanotechnology Revolution* presentation is available at <http://nano4me.org/handbook/fF5.pdf>

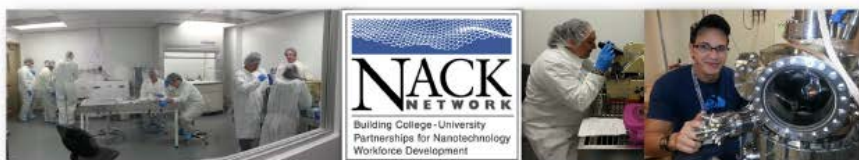
Nanotech Workshop:

University of Puerto Rico does a Nanotech workshop to all biology departments.

Workshop

“Procesos y Aplicaciones de Nanotecnología”

Nanotecnología es un área Multidisciplinaria y de Interés para las Industrias Farmacéuticas, Químicas, Electrónicas, Aeroespaciales, de Biotecnología, etc.



Comenzando el 11 de febrero de 2015

Duración 14 semanas

Miércoles

4:30 p.m. a 7:30 p.m.

4.2 Unidades Educación Continua

INCLUYE PRÁCTICA DE LABORATORIO

●●●●●●●●●● ¡Gratis!

Requisito: Candidat@s a Graduación o Graduat@s en: Grado Asociado en Tecnología o Bachillerato en Ciencias Naturales

Universidad de Puerto Rico en Humacao
Departamento de Física y Electrónica
Programa NACK Network



<https://sites.google.com/site/nackupr>

Inscripción e Información:

Ruby Ann Meléndez Lebrón / Programa NACK Network / Tel. 850-0000, ext. 9798 / ruby.melendez@upr.edu

Prof. Rogerio Furlan / Departamento de Física y Electrónica / Tel. 850-0000, ext. 9006 / rogerio.furlan@upr.edu

Figure 10 - University of Puerto Rico Workshop Flyer

Alumni Colloquium:

Northeast Advanced Technological Education Center (NEATEC) started an Alumni Colloquium series. This is a group of alumni that presents hands-on lectures covering topics in Plasma and Dry Etch, Vacuum Technology, Metrology and more. NEATEC forms this colloquium by contacting recent graduates from their nanotechnology program that have obtained jobs in various industries. NEATEC presents topics not found in depth in the current degree curriculum. These alumni “give back” to their home institution by speaking to incoming freshman on topics that they use daily in the field, share experiences in obtaining employment and what one should expect when working in a cleanroom.



NEATEC SPEAKERS COLLOQUIUM SERIES

TOPIC:

PLASMA/ DRY ETCH

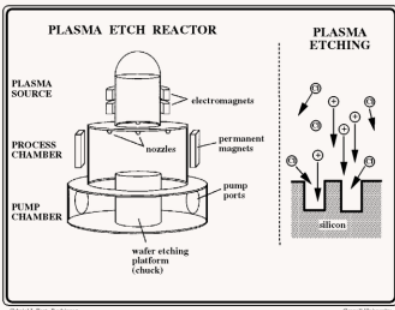
DECEMBER 3, 2012 – 9AM TO 11AM

BULMER TELECOMMUNICATIONS CENTER AUDITORIUM

REGISTRATION/COFFEE BEGINS AT 8AM & NETWORKING/LUNCH AT 11:30

DRY ETCH COLLOQUIUM:

HAVE YOU EVER WONDERED HOW A DRY ETCH ENGINEER IN THE SEMICONDUCTOR INDUSTRY SPENDS HIS WORK DAY? ALOK RANJAN AND CRAIG HUFFMAN INVITE YOU TO JOIN THEM AS THEY OVERSEE PLASMA ETCH PROCESSING FROM WAFER START TO FINISH. THEY WILL UNLOCK THE MYSTERIES OF PLASMAS, GLOW DISCHARGES, WHICH CREATE THE PHYSICAL STRUCTURES OF THE SEMICONDUCTOR DEVICES. IN THE DAILY CLEAN ROOM ACTIVITIES, YOU WILL SEE THE ROLE OF CHEMISTRY AND PHYSICS IN CREATING TRANSISTORS, INTEGRATED CIRCUITS, AND OTHER DEVICES THAT CONNECT YOU TO THE WORLD WIDE WEB. COME MEET AND HEAR FROM TWO OF THE LEADING MINDS IN INDUSTRY TODAY!



©2011 J. Pae-Rodriguez

©2011 University

FUTURE SERIES

FEBRUARY – PHOTOLITHOGRAPHY

MARCH – METROLOGY

EARLY APRIL - ABATEMENT

LATE APRIL - SPC

ABOUT OUR SPEAKERS:

ALOK RANJAN RECEIVED THE B.S. DEGREE IN CHEMICAL ENGINEERING FROM THE INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE, INDIA, IN 2003 AND THE PH.D. DEGREE IN CHEMICAL ENGINEERING FROM THE UNIVERSITY OF HOUSTON, HOUSTON, TX, IN 2008. HIS GRADUATE RESEARCH FOCUSED ON THE INVESTIGATION OF NEUTRAL BEAM ETCHING AND DIAGNOSTICS GEARED TOWARD DAMAGE-FREE ETCHING FOR NEXT GENERATION OF NANOELECTRONIC DEVICES. CURRENTLY, HE IS A PRINCIPAL ENGINEER AT TEL TECHNOLOGY CENTER AMERICA, LLC, ALBANY, NY, WHERE HE LEADS PLASMA ETCHING AND DIAGNOSTICS R&D ACTIVITIES.

IN HIS OVER HIS 25+ YEARS AS AN ETCH GUY, CRAIG HUFFMAN HAS WATCHED DEVICES SHRINK FROM 1250 TO ~20NM WHILE WAFER SIZES HAVE INCREASED FROM 75MM (3IN.) TO 450MM (18IN). UPON GRADUATION FROM HVCC HE PURSUED HIS BS IN ENGINEERING PHYSICS, CRAIG WAS HIRED AT TEXAS INSTRUMENTS WHERE HE WORKED WITH STATE OF THE ART DEVICES, DRY ETCH PROCESSING, AND TOOL MODIFICATION AND FAB DESIGN AND CONSTRUCTION. HE HAS ENJOYED WORKING WITH DRY ETCH TOOL MAKERS INCLUDING TEL, APPLIED MATERIALS AND LAM RESEARCH ON HARDWARE IMPROVEMENTS AT SEMATECH AND WITH STATE OF THE ART ETCH PROCESS DEVELOPMENT AT IMEC IN LEUVEN, BELGIUM. CURRENTLY, CRAIG SUPPORTS ALL ETCH ACTIVITIES AT SEMATECH.


SPONSORED IN PART BY:
THE SCHOOL OF ENGINEERING & INDUSTRIAL TECHNOLOGIES & HVCC'S IEEE CLUB



Figure 11 - NEATEC Speakers Colloquium Series


Student Poster Project:

Forsyth Technical Community College has successfully involved their own students in promoting the program by having them do a graded educational poster describing nanotechnology. After being graded, these posters are hung in the hallways of the institution.



Nanotechnology: Tackling Today's Energy Crisis

Adam M.S. Afifi, Adrian E. Goodwin, Jack D. Landgraf, Charles E. Bettis & Mehrdad M. Tajkarimi Ph.D.
2100 Siles Creek Parkway, Winston-Salem, N.C. 27103



Nanotechnology is the study and fabrication of structures at the Nanoscale (a single nanometer is 1/1000th of a meter). There are many big problems such as energy that we have faced for decades and Nanotechnology can address this issue. According to the EIA (Energy Information Administration) in 2010, 85% of the world's energy came from fossil fuels. Our dependence on fossil fuels has had a major global impact on the environment and economy. To solve this problem, we will demonstrate three different applications of Nanotechnology that address our energy crisis.

Hydrogen Fuel Cell

Fuel Cells have been around since the 1930s. They work using hydrogen and oxygen with an anode to create a flow of electrons. The polymer membrane hydrogen energy getting on an electrical circuit is very important but with the help of nanotechnology we can make the membrane more resistant to fuel leaking (protonic conduct nanomaterials) we can greatly increase the rate the fuel changes to meet with and reduce the amount of platinum needed by over 70%.

© 2011, November 01. The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

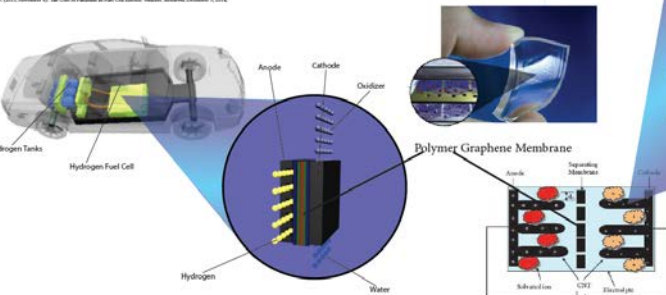
Graphene

One of the newer ways this technology comes together is through Graphene, a thin layer of pure carbon that is made up together to form a one-atom-thick. The one-atom-thick, along with other kinds of nanomaterials in energy. What if we used the most abundant element on earth? Graphene can be used inside the hydrogen fuel cell, and as a filter itself. It is 4% more efficient than regular carbon only cells (Bettis et al. 2012). The graphene acts as a filter that only lets hydrogen in, and also as an anode allowing the electrons to be converted from positive to negative. The application of nanotechnology proves to be cost effective and much more efficient in a hydrogen fuel cell.

Carbon Nano Tubes

Energy storage has always been a challenge. Batteries store less of energy that give out less power with a short shelf life. Nanotechnology researchers have done are increasing the energy storage by using (Carbon Nano Tubes) making them as a tank to output batteries in the future. CNTs have higher power output than the regular batteries. A simple CNT consists of two plates with electrodes on the surface of one plate and positive charge on the other separated plate. An electric field distorts a capacitor unlike batteries that use chemical reactions to flow electrons in their electrodes. The charge stored on the CNT can be increased greatly by growing carbon nanotubes (CNTs) perpendicular to the electrode surface. This increased surface area makes the CNT much more powerful. CNTs are more durable than batteries, and can be charged and discharged thousands of times over quickly (Bettis, 2013).

© 2011, November, The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.



Discussion:
These were only a few examples of what Nanotechnology has for potential applications in energy. The fact that Hydrogen fuel cells are now going to be cost effective and efficient after decades of research is just the icing on the cake. The capability of the Ultra capacitor to fully recharge a smart phone in as little as thirty seconds is amazing. The possibility that solar cells can be more than fifty percent efficient and affordable, really can't come down on electricity costs. There are so many amazing breakthroughs in Nanotechnology that one poster couldn't possibly contain even a fraction of it.


© 2011, November, The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

© 2011, November, The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

© 2011, November, The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.


© 2011, November, The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

Figure 12 - Forsyth Tech Student Posters, Energy



Nanotechnology: Beyond Current Conservation

Adam M.S. Afifi, Adrian E. Goodwin, Jack D. Landgraf, Charles E. Bettis & Mehrdad M. Tajkarimi Ph.D.
2100 Siles Creek Parkway, Winston-Salem, N.C. 27103



Nanotechnology has great prospects for applications that improve agriculture in the future. We will discuss three of the many Nanotechnology applications that will benefit agriculture.

Pest Control

It has been shown that use of pesticides has many negative effects. The seeds of an apple have the ability to release its own poisons when the seed is damaged, through a process called phytoalexins. This occurs when some types of the seed coat that are usually inactive, combine to form phytoalexins (Bettis, 2013). Using nanotechnology we can take this same natural defense and use it to produce long lasting phytoalexins without the excess use of pesticides.

Bettis, E. (2013, December 01)

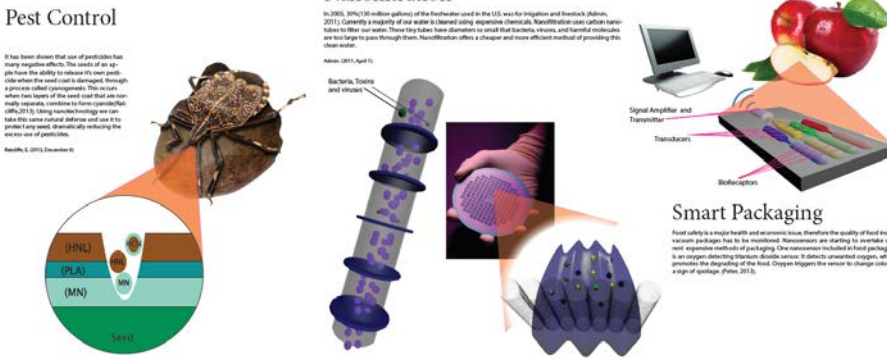
Nanofiltration

In 2005, 10 million gallons of the herbicide used in the U.S. was for irrigation and livestock (Adkins, 2011). Generally a majority of our water is treated using expensive chemicals. Nanofiltration uses carbon nanotubes to filter our water. These filters have diameters so small that bacteria, viruses, and harmful molecules are too large to pass through them. Nanofiltration offers a cheaper and more efficient method of providing this clean water.

Adkins (2011, April 1)

Smart Packaging

Food safety is a major health and economic issue, therefore the quality of food inside consumer packages has to be monitored. Nanomaterials are being used to create new and innovative methods of packaging. One innovation is called a food packaging with an organic electronic circuit. This circuit is made of organic polymers, which promotes the durability of the food. Circuitry triggers the sensor to change color as a sign of spoilage (Bettis, 2013).



Discussion:
From the overview of pesticides to the waste of water and food, agriculture needs many improvements. Using Nanotechnology, our farms can yield more food with less chemical needed to take care of them with water needed to grow them. Nanotechnology in smart packaging to ensure a good on the product and prevent spoilage. All of these things are needed to ensure a good on the food, more so as a better quality life for our food consumers.


© 2011, November 01. The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

© 2011, November 01. The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

© 2011, November 01. The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

© 2011, November 01. The Cost of Platinum in Fuel Cell Electrodes. Retrieved December 5, 2014.

Figure 13 - Forsyth Tech Student Posters, Agriculture



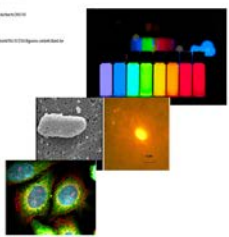
Nano-Medicine: Tomorrow's Medicine Today

Adam M.S. Affr, Adrian E. Goodwin, Jack D. Landgraf, Charles E. Bettis & Mehrdad M. Tajkariami Ph.D.
2100 Silas Creek Parkway, Winston-Salem, N.C. 27103

Medicine is quickly evolving today due to Nanotechnology. Treatment in medical diagnosis is expensive. Nanotechnology can reduce this cost of diagnosis and help provide better treatment for symptoms while improving life quality.

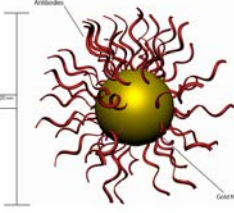
Imaging

Being able to see the inner workings of the body helps us understand what is taking place, whether it is a bacteria or a carcinoma growth. We have better knowledge of how to treat it with a laser or drug. The data currently used for medical imaging have many drawbacks such as toxicity and diminishing luminosity. Nanotechnology has provided a much better way to image the interior of the body called fluoroscopy. Fluoroscopy is like a x-ray, but instead of using x-rays, we use fluorescent dyes that are currently being used which greatly reduce toxicity while increasing the fluorescent quality.



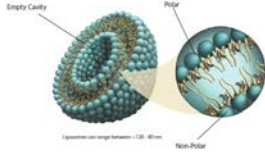
Diagnosis

Septis is a disease caused by bacteria in the bloodstream that results in 1.6 million people being hospitalized every year. In order to diagnose Septis and other disease as very quickly, clinics are starting to use rapid tests to figure out the right antibiotic. Septis is a common bacterial infection that causes many diseases. Gold nanoparticles coated in antibodies work by attaching to a protein of interest. The gold nanoparticles fluoresce when this happens making them detectable for diagnosis.



Treatment

Most prescription medications are delivered into the bloodstream for their medicinal effect. Targeted delivery of drugs is a major challenge of current medicine. Nanotechnology has opened the doorway to more efficient drug delivery systems, one of the most promising ones being liposomes. Liposomes are closed vesicles made up of a phospholipid bilayer, which allows us to load drugs in its center. In some production, we can tailor liposomes to target specific parts of the body by attaching antibodies to its exterior.



Discussion:

Nanotechnology will enable us to better diagnose, more precisely image and more effectively treat diseases. Tests, with effects have changed the pharmaceutical industry because of necessary drug doses, but now that the drug is so small, it can be delivered to the target site. This means that the drug can be delivered to the target site and not to the rest of the body, which is a major advantage.

© 2015 Forsyth Tech. All rights reserved. This is a student poster. It is not to be used for any other purpose without the permission of the author.




Figure 14 - Forsyth Tech Student Posters, Medicine

Promote to existing STEM Clubs:

College of the Canyons promotes nanotechnology programs within the institution by educating various clubs... Chemical Club, Biology Club, Astronomy, Physics, Engineering, etc.

- Research STEM clubs in institution
- Connect with coordinator
- Present Nanotechnology Program to club
- Distribute Nanotechnology information to club

Create a Nano-Club:

Dr. Anura Goonewardene is the founding director of the nanotechnology program at Lock Haven University. Under his leadership a Nano Club was initiated to provide an interdisciplinary STEM forum to increase student engagement, recruit new students into the program and increase retention rates. These Nano students now enjoy the highest graduation rates on campus and the highest graduate school placement rates. The Nano Club started as a faculty dominated club and has now evolved into a student-run club. After recruiting a diverse student body, it was quickly identified that they needed to keep these students together to offer them the necessary support to successfully go through the nanotechnology program and for some to transition into graduate school, hence the

justification for the interdisciplinary forum, the Nano Club.
(Goonewardene. A. March 2015. Phone/Email Interviews)

The Club provides detailed information and presentations such as:

- Having alumni of the nanotechnology program come speak about their jobs.
- Educating students on job availability in this industry and what kind of money can be made.
- Bringing in faculty from other nanotechnology programs so students get an idea of where to go next.
- Providing mentors to students in club. All faculty received credit for mentoring undergraduates in their research. The mentors are a collaborative group of faculty who meet every other week to discuss independent research (this took years to develop).
- Encouraging students to present posters at national conferences in student forums by guiding their abstract writing.
- Annual workshops for students to develop competitive applications for summer internships at research universities and national laboratories.
- Annual workshops for students to develop competitive applications for graduate school at research universities and national laboratories.

The club has turned into a social event. Since the students are from different disciplines... physics, biology, etc., the club provided food, tours, picnics, museum trips, etc. to get collaboration.

Publications on Engaging Undergraduates through Interdisciplinary Programs like Nanotechnology

Engaging Undergraduates through Interdisciplinary Research in Nanotechnology

<http://nano4me.org/handbook/mh4.pdf>

Sustaining Physics Programs through Interdisciplinary Programs: A Case Study in Nanotechnology

<http://nano4me.org/handbook/B62.pdf>

High School Outreach

Inspiring, motivating and encouraging high school students to enter the field of nanotechnology is important for the future of all nano-based programs. High school students are faced with the decisions of choosing their careers and if nanotechnology careers aren't explained, they won't be chosen. Many factors affect career choices such as having high school students understand nanotechnology occupations, motivating them to be able to identify themselves as "a nano person" and giving them confidence that they can become successful in nanotechnology careers.

Initial outreach efforts include:

- Developing an interactive presentation
- Developing relationships with STEM faculty at high schools
- Connecting with staff who organize STEM clubs at high schools
- Introducing nanotechnology program to career counselors at high school
- Offering to volunteer as guest speaker at any STEM events

Some examples of high school outreach efforts:

Field Trips:

College of Lake County successfully engages with high school faculty through the facilitation of faculty field trips to their nanotechnology facility.

Offer High School Internships

The University of the District of Columbia provides internships to high school students. This is a collaborative effort between the high school and the university. The interns spend 60 hours for each semester and are mentored in physics topics through experiential learning process; conduct physics experiments, and fabricate nanomaterials.

Additional examples of high school outreach efforts, including workshops and open houses follow:

November 8, 2013

Name
School
Street Address
City, State Zip Code

Dear (First Name),

Greetings from your neighbors at the College of Lake County – Southlake Campus in Vernon Hills! We would like to thank you for inspiring your students to **“take note of their potential”** as they pursue their educational aspirations.

We invite you to consider the Southlake Campus as you plan class field trips this academic year. Southlake offers a variety of learning opportunities for your students as they relate to your high school curriculum. Options include:

- Participating in an **interactive demonstration combining science and the cutting-edge, emerging field of Nanoscience Technology**. We recently worked with an area high school to design an experiential field trip, partnering with a private company in the biotechnology industry, which includes laboratory time with our CLC Nanotechnology faculty as part of the day’s activities. Students have the opportunity to participate in hands-on experiments related to both science and Nanotechnology during their visit.
- Experiencing Southlake’s green roofing which offers a living venue for students interested in **science, agriculture and natural resources** to demonstrate the benefits of vegetative roofing, sustainability and green education.

If you have other ideas of interest, we are open to customizing your students’ visit in order to meet the specific learning objectives of your class curriculum. Lunch can be provided during your planned visit. Added components to your discipline-specific field trip goals may also include students participating in a discussion about college readiness or college life and/or tour the campus.

We look forward to connecting with you further about future opportunities to collaborate regarding your curricular planning and/or extracurricular events. We welcome the prospect of integrating a student visit as part of your curricular activities. Hope to see you soon!

Best regards,

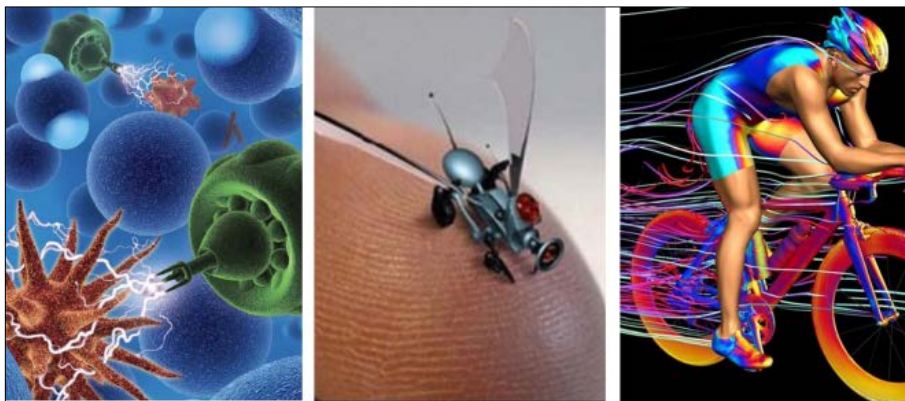
Dr. Viki Cvitkovic, Dean
Southlake Campus
College of Lake County – Vernon Hills
vcvitkovic@clcollinois.edu
(847) 543-6504

Kendra Charts, Manager of Student Services
Southlake Campus
College of Lake County – Vernon Hills
kcharts@clcollinois.edu
(847) 543-6519

Figure 15 - High School Science Teachers Nano Partner Letter

High School Educator Presentations:

College of Lake County invited high school educators to a free Nano-Link Workshop



Free Nano-Link Workshop For High School Educators

Join in a free, customized training workshop designed to help teachers get the most out of Nano-Infusion modules. Participants will learn concepts and applications as well as how to do experiments and how it fits into your curriculum. The workshop will be facilitated by Nano-Link whose primary mission is to provide nanoscience classroom materials to high school educators.

Friday, September 5, 2014

8:30am – 3:30pm

College of Lake County – Southlake Campus

1120 S. Milwaukee Avenue

Vernon Hills, IL 60061

Lunch and materials provided.

Registration required. Please R.S.V.P by Friday, August 27, 2014 to determine interest as 10 participants are required for the event to occur.



Figure 16 - College of Lake County Nano-Link Workshop Flyer

Tuesday Tours:

Chippewa Valley Technical College structured tours every Tuesday. The college scheduled and coordinated with campus department lead faculty/department chairs a one-hour tour on Tuesday morning usually

from 10-11a.m. The tour started in a common area adjacent to the campus entrance and was managed by the college's outreach specialists.

This tour consisted of:

- Introduction to the campus.
- Power point and video of manufacturing technology in the region.
- Safety glasses and introduction of safety protocol.
- Fixed rotation of: Welding, Electromechanical, Industrial Mechanic, Machining, Engineering Technologies (Nano, Manufacturing, and Industrial), and the certificate course areas including the mechanical design and apprenticeships, and a brief presentation of the operational facilities (cleanroom / SEM, Engineering Tech / materials lab), and an incubation center.
- Conclusion of the tour was a presentation using the GoldCollarCareers Website discussing the technology career options and pathways in NW Wisconsin.
- Personalized tours and follow-up recruitment meetings were scheduled with interested individuals with recruitment specialists or the department chairs at this time.
- Promotional items were given away... flyers addressing career pathways, information on technology decision-making, business cards in addition to key chains, pen with micro/nano technology, micro machined honor coin with the college logo, tool and die stamped brass dogtag, laser engraved dogtag, USB flashdrive, etc.
- During tours, students and staff wore Chippewa Valley Technical College's t-shirts and/or polos to show college pride.

Learning Modules:

Northeast Advanced Technology Education Center (NEATEC) creates and provides learning modules.

Learning modules include:

Simple Fabrication of a Super-Hydrophobic Surface

<http://nano4me.org/handbook/Rc4.pdf>

Thin Films

<http://nano4me.org/handbook/KhQ.pdf>

What is Nanoscience

<http://nano4me.org/handbook/qxD.pdf>

Chemistry of Hydrophobic Sand

<http://nano4me.org/handbook/tKf.pdf>

Water Purification

<http://nano4me.org/handbook/Swv.pdf>

APRIL 8, 2015

NEATEC K-12

LEARNING MODULE

WORKSHOP



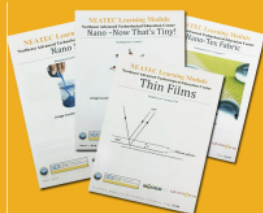
FULL SUBSTITUTE REIMBURSEMENT TO SCHOOL DISTRICT FOR ALL ATTENDEES

Hands-on Activities and Lesson Plan Piece Modules

In cooperation with the University of Bridgeport, Department of Engineer; NEATEC (Northeast Advanced Technical Education Center) funded by The National Science Foundation, is happy to present engagement materials for our students in science, math and technology that will excite, inform and prepare them for the emerging nano-tech and semi-conductor careers that are exploding in our area. The center's mission is to reach out across Greater New England, and to involve public and private educators and students.

Please join us in one of the many Professional Development Module choices to be able to add this to your lesson plans in 2015-16!

FREE FOR ALL EDUCATORS



6th - 12th Grade

Learning Modules

Register At:

<http://www.planetReg.com/>

[NLMConnecticut1](http://www.NLMConnecticut1.com)

Questions?

J.Dempsey@hvcc.edu



National Science Foundation
WHERE DISCOVERIES BEGIN



WHERE

University of Bridgeport
126 Park Avenue, Bridgeport, CT
06604

04 / 08 / 2015

8 AM - 4 PM

LUNCH IS INCLUDED

Figure 17 - NEATEC Learning Module Workshop Flyer

Summer Educator's Workshop:

Northwest Vista College invites high school educators to a four-day summer workshop.

June 16-19 (Monday-Thursday), 2014

[Summer Nanotechnology Educator's Workshop](#)

The workshop was hosted at Northwest Vista College and conducted jointly by [Penn State University](#) and [University of New Mexico](#). Both institutions are leaders in nanotechnology education in the nation and have conducted similar workshops throughout the US and internationally. Click [HERE](#) to see the workshop agenda. Click [HERE](#) to see workshop pictures for [Educators Learning & Teaching activities](#). Click [HERE](#) to see pictures for Lab Tour at [UTSA](#) and Last Day graduation ceremony.

Workshop Highlights:

1. All STEM educators in local High Schools and Community Colleges are eligible to apply.
2. Teaching and Learning Kits will be provided to participants and their classroom for free.
3. Breakfast, lunch, and snacks will be provided.
4. Stipend is available for attending the 4-day workshop in summer 2014.

Workshop Learning Materials are available to be [downloaded for educational purpose](#). All learning materials are contributed by [NACK Center](#) at Penn State University.

Figure 18 - Northwest Vista College Workshop Posting



**2014 Summer Nanotechnology Workshop for STEM Educators
Tentative Agenda—MLH104**

	AM	PM
Day 1	Welcome / follow up assessment / experience sharing / Module 4	Module 5 and Module 4
Day 2	SCME – Hands-on Kit One	SCME – Hands-on Kit One
Day 3	SCME – Hands-on Kit Two	SCME – Hands-on Kit Two
Day 4	Lab Tour (off campus)	Survey and ceremony

Day One (June 16-Monday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast/Registration
8:30 a.m. – 8:45 a.m.	Welcome and Overview of the Workshop (Opening remarks—Heather McCreery, Chair of the Workforce Academics)
8:45 a.m. – 10:00 a.m.	Follow up assessment / Resources Discussion / Experience Sharing (NVC with NACK team)
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	Module 5 (Gummy Capsules) Activity (NACK team)
12:00 p.m. – 1:00 p.m.	<u>Lunch –MLH218</u>
1:00 p.m. – 1:45 p.m.	Module 5 - continued (NACK team)
1:45 p.m. – 2:30 p.m.	Module 4 (Magic Sand) - Activity (NACK team)
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Module 4 - continued (NACK team)
3:30 p.m. – 3:45 p.m.	Q & A

Day Two (June 17-Tuesday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 10:00 a.m.	Hands-on Kit One—Pressure Sensor (PS) Model (SCME Team)
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	Hands-on Kit One—PS Model (SCME Team)
12:00 p.m. – 1:00 p.m.	<u>Lunch –MLH218</u>
1:00 p.m. – 2:30 p.m.	Hands-on Kit One ——PS Model (SCME Team)
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Hands-on Kit One ——PS Model (SCME Team)
3:30 p.m. – 3:45 p.m.	Q & A

Figure 19 - Northwest Vista College Workshop, 2014 Schedule - Page 1 of 2

Day Three (June 18 -- Wednesday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 10:00 a.m.	Hands-on Kit Two--Cantilever (SCME Team)
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	Hands-on Kit Two--Cantilever (SCME Team)
12:00 p.m. – 1:00 p.m.	<u>Lunch –MLH218</u>
1:00 p.m. – 2:30 p.m.	Hands-on Kit Two--Cantilever (SCME Team)
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Hands-on Kit Two--Cantilever (SCME Team)
3:30 p.m. – 3:45 p.m.	Q & A

Day Four (June 19 -- Thursday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 10:00 a.m.	Lab Tour (off campus—back around noon)
10:00 a.m. – 10:15 a.m.	
10:15 a.m. – 12:00 p.m.	
12:00 p.m. – 1:00 p.m.	<u>Lunch –MLH218</u>
1:00 p.m. – 2:30 p.m.	Joint Activity - Module 5 (revisited) with Summer Institute HS students (NACK team)
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Survey and Ceremony for graduation from workshop (NVC) (Closing remarks—Heather McCreery, Chair of the Workforce Academics)
3:30 p.m. – 3:45 p.m.	Q & A

The workshop is partially supported by NVC, NACK, SCME, and NSF Grant No. (1205010).



National Science Foundation
WHERE DISCOVERIES BEGIN

Figure 19 - Northwest Vista College Workshop, 2014 Schedule - Page 1 of 2

Youth Employment Program Outreach

Local Youth Employment Programs get youth on track for education and building a workforce pipeline for the future. Contact City Workforce Investment Board/Workforce Development Council and inquire about a

list of organizations in charge of distributing funds. Many times they are non-profits.

Benefits of partnering with youth organizations:

- Build relationship with workforce councils, as they like to see how you are feeding the workforce pipeline
- Start internships early in high school, and continue their skills set as they enter your college program and graduates
- Recruit from underrepresented populations
- Many government agencies have program to help youth get into a career path, especially STEM

SHINE has successfully partnered with the Seattle Youth Employment Program and hosted their first underrepresented youth in March of 2015. Their hosted student graduated high school in June. He will be interning in SHINE'S lab on campus to pick up a foundation on working on the equipment, lab procedures, protocols and safety.


This internship is paid through the Workforce Investment Act funds. The student will continue the summer with one of SHINE's industry partners, who has agreed to host him and train him in the biotech/nanotech world (paid through their grant). The youth will then enroll into SHINE's program in the fall and continue on his path of nanotechnology, set to graduate in 2017. During his last quarter, he will be doing a co-op internship with his original industry site and hopefully be hired by them when he graduates. This internship would provide the student with lab skills and employer tailored skills. Currently, a lab technician for this industry partner is set to start at \$25 an hour; the internship is paid at WA State minimum wage of \$9.47 an hour.

Open House Outreach

Coordinate an Open House for your facility:

- Select a date
- Create a flyer
- Connect with Institutions Marketing/Public Relations Department:
 - ✓ Internal communications to faculty/staff
 - ✓ News release for media recognition
 - ✓ Post on institution's social media
- Disseminate flyers to all clubs, organizations, associations, non-profits, etc. In electronic and printed forms as needed
- Call local high school connections, invite to open house & deliver flyers for the event and posters for them to hang up.

- ☑ Provide snacks
- ☑ Give tours
- ☑ Have a presentation prepared
 - ✓ Do hands-on experiments. Hands-on experiments are available from <http://www.nisenet.org>
- ☑ Giveaways



You are invited to a
Nanoscience Technology
Open House for Teachers

DATE AND TIME
Wednesday, November 28th
from 3:30-5:30pm

LOCATION
CLC-Southlake Campus
1120 S. Milwaukee Avenue
Vernon Hills, IL 60061
Room R102

TO RSVP
Please call (847) 543-6502 or
email
southlake@clcillinois.edu by
Monday, November 19, 2012
Refreshments to be served

**A great opportunity for
teachers with students
interested in biology,
chemistry, physics,
materials science,
electronics and
engineering!**

Dr. Ahmad Audi, Department Chair of
Nanoscience Technology, invites you to
tour the Nanoscience lab, understand
what Nanoscience is and learn ways to
involve your students in this exciting
field of science.

The CLC-Southlake Campus proudly
houses the Nanoscience Technology
A.A.S. degree program in partnership
with Harper College. By all accounts,
making things smaller will revolutionize
manufacturing processes, create break-
throughs in cancer research, generate
more efficient sources of energy, trans-
form consumer products, and ultimately
change the world as we know it. Accord-
ing to many industry and media reports,
even though nanotechnology is in its in-
fancy, the business of nanotechnology is
booming and nanotech fortunes are
here to be made.

Learn more about CLC's Nanoscience Technology program at
www.clcillinois.edu/programs/nan

Figure 20 - Nanoscience Technology Open House Flyer



NANOTECHNOLOGY OPEN HOUSE

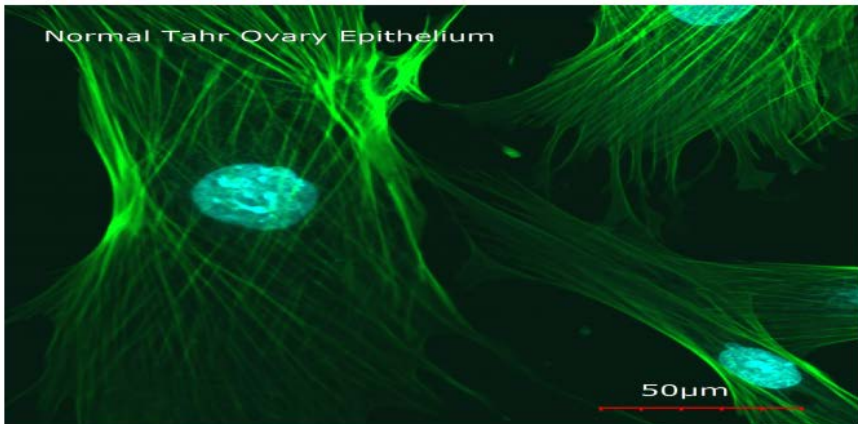


Come see why nanotechnology is the future and how you can be part of it

May 21, 2014

What is Nanotechnology?

- What do people in nanotechnology do?
- Who is using nanotechnology locally?
- What is the outlook for this field?
- How can our department be a part of this growing industry?
- What is in the nanotechnology lab?



The Future is Now. It starts here at North Seattle College.

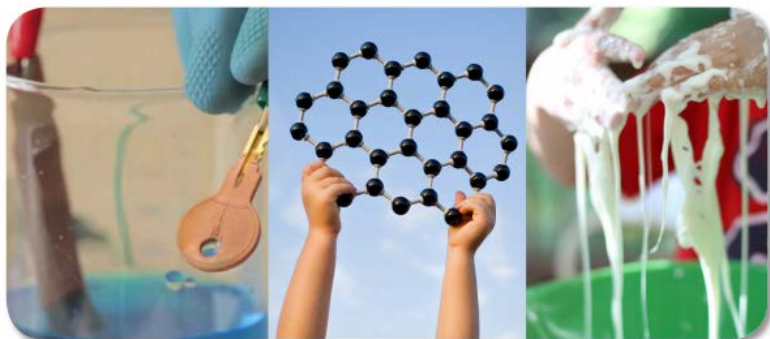
Figure 21 - Open House Flyer

2013-14 STEM Event

Free evening presentations by experts in
SCIENCE | TECHNOLOGY | ENGINEERING | MATH

NanoNight

Nanotechnology Family Festival at CLC Southlake Campus, Vernon Hills
Thursday, March 13, 6:30 – 8:30 p.m.



Bring your family and explore the impact of nanoscale science on the technology of today and potential for continued innovation in the future.

Explore nanoscale science and engineering applications with hands-on activities. Check in at the Atrium and proceed to discover how fabrication, materials, products and properties are influenced.

- Appropriate for all ages
- Watch electroplating in action
- Get your hands on some Oobleck
- Stretch your imagination with memory metal and invisible materials
- Tour the CLC Nanotechnology lab
- Give-aways!

Questions? Email Jan Edwards at jedwards1@clcillinois.edu or call (847) 543-2044 www.clcillinois.edu/STEM

For more information on nanotechnology visit www.whatsnano.org

Southlake Campus
1120 South Milwaukee Avenue
Vernon Hills, Illinois 60061
www.clcillinois.edu/southlake

College  Lake County
Connect to Your Future

CLC Engineering Department www.clcillinois.edu/programs/egr
CLC Biological and Health Sciences Division www.clcillinois.edu/biody

Figure 22 - NanoNight – College of Lake County Flyer

Summer High School Student Workshop

Northwest Vista College invites high school students to a four-day summer workshop.

June 17-20 (Tuesday-Friday), 2014

[Summer Student Nanotechnology Institute](#)

The Nanotechnology Program at Northwest Vista College will provide a unique Summer Student Nanotechnology Institute for High School (HS) students. The 4-day institute is free of charge to students who are accepted to the program. The institute is designed to bring in HS students who are interested in the field of nanotechnology, or STEM in general. Student candidates have to be nominated by teachers/administrators.

The nomination does not guarantee selection to attend the Summer Student Nanotechnology Institute. To be certain there is a good representation across the city of San Antonio, selections are based on area of interest, high school size, and geographic location. Nominating administrators/teachers and nominees will be notified of selection status by April 25 and confirmations of acceptance must be returned by May 02, 2014.

Every High School in San Antonio is encouraged to participate in the Summer Student nanotechnology Institute hosted at Northwest Vista College.

** [Nominations are closed now.](#) Click [HERE](#) to see workshop agenda. Click [HERE](#) to see workshop pictures. Click [HERE](#) to see pictures for Lab Tour at [UTSA](#) and Last Day graduation ceremony. Examples of student's 3-hour "You're Hired!" project that was led by [Dr. Kristi Jean from North Dakota](#):

1. [National Association of Nanotechnology Obstacles](#)
2. [Life Capsule](#)
3. [Eco-Dynamic Co.](#)

** Summer Student Nanotechnology Institute Learning Materials are available to be [downloaded for educational purpose](#). All learning materials are contributed by [NACK Center](#) at Penn State University.

** Additional learning resources for following topics can be found at the [Nano-Link](#):

1. [Magic Sand](#): Free supplies can be provided by the Nano-Infusion project for your school year. It is under the heading Nano-Infusion. A completion survey is required to help with the NSF funding. Insta-Snow and Ringed Polymers are also within the Nano-Link website.
2. [Gummy Capsules](#): Materials can be found at NiseNet for the procedure along with glow-in-the-dark materials.
3. [Gold Nanoshells](#): The video is available either at [YouTube](#) or [NiseNet](#).
4. More interactive learning materials can be found at the YouTube channel at "ndscsSTEM".

Figure 23 - Northwest Vista College Summer Student Workshop Posting



2014 Summer Nanotechnology Institution for HS Students

Tentative Agenda –MLH 219

	AM	PM
Day 1	Module 1	Module 2
Day 2	Module 3	Module 4
Day 3	Lab Tour (off Campus)	Module 5
Day 4	You're Hired!	Project Presentation and Graduation ceremony

Module 1—Gecko Tape
Module 2—Sunscreen
Module 3—Non-Newtonian Fluids
Module 4—Magic Sand
Module 5—Gummy Capsules

Day One (June 17 -- Tuesday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast/Registration
8:30 a.m. – 8:45 a.m.	Welcome and Overview of the Workshop and the NACK (Opening remarks—Pat Fontenot, Dean of Workforce Education & Training)
8:45 a.m. – 10:00 a.m.	Module 1
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	Module 1
12:00 p.m. – 1:00 p.m.	Lunch –MLH218
1:00 p.m. – 2:30 p.m.	Module 2
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Module 2
3:30 p.m. – 3:45 p.m.	Q & A

Day Two (June 18 -- Wednesday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 10:00 a.m.	Module 3
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	Module 3
12:00 p.m. – 1:00 p.m.	Lunch –MLH218
1:00 p.m. – 2:30 p.m.	Module 4
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Module 4
3:30 p.m. – 3:45 p.m.	Q & A

Figure 24 - Northwest Vista College Workshop, 2014 Schedule - Page 1 of 2



Day Three (June 19 -- Thursday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 12:00 p.m.	Lab Tour – Off campus (Back around noon)
12:00 p.m. – 1:00 p.m.	Lunch –MLH218
1:00 p.m. – 2:30 p.m.	Module 5
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Module 5
3:30 p.m. – 3:45 p.m.	Q & A

Day Four (June 20 -- Friday)

8:00 a.m. – 8:30 a.m.	Continental Breakfast
8:30 a.m. – 10:00 a.m.	You're Hired!
10:00 a.m. – 10:15 a.m.	Break
10:15 a.m. – 12:00 p.m.	You're Hired!
12:00 p.m. – 1:00 p.m.	Lunch –MLH218
1:00 p.m. – 2:30 p.m.	Student Presentations (Parents invited)
2:30 p.m. – 2:45 p.m.	Break
2:45 p.m. – 3:30 p.m.	Graduation ceremony (Parents invited) <i>(Closing remarks—Pat Fontenot, Dean of Workforce Education & Training)</i>
3:30 p.m. – 3:45 p.m.	Final Workshop Q & A/Workshop Evaluations/Wrap Up

The workshop is partially supported by NSF Grant No. (1205010).



National Science Foundation
WHERE DISCOVERIES BEGIN

Figure 24 - Northwest Vista College Workshop, 2014 Schedule - Page 2 of 2

Manufacturing Show Outreach

For Chippewa Valley Technical College, the traditional Open House didn't provide the student recruitment needed so Mark Hendrickson, Special Projects/Instructor, decided to think "outside the box" and produced a Manufacturing Show. Hosted the week before spring break, students either had one full semester or their third semester completed. By being newsworthy and attracting representatives of industry, chamber of commerce, etc., the Manufacturing Show provided the outreach needed having over 1,500 people attend.

Manufacturing Show:

- Various manufacturers had booths
- Clubs offered presentations
- Speakers on advanced technology
- Welding program did a raffle
- Poster competition
- Welding competition
- Scholarship drawings
- Demonstrations
- Tours
- Games
- Food

CVTC Manufacturing Show Video

Video highlights from the CVTC Manufacturing Show.

https://www.youtube.com/watch?v=e5BZGaayE_E

CVTC Manufacturing Show Brochure

https://www.youtube.com/watch?v=e5BZGaayE_E

MANUFACTURING SHOW

Thursday, March 7
3–8 p.m.

- Explore manufacturing careers
- Participate in hands-on demonstrations in our manufacturing programs:
 - Electromechanical Technology
 - Industrial Mechanic
 - Machine Tooling Technics
 - Welding/Welding Fabrication
- Meet over 20 local manufacturing employers
- Learn about our NASCAR STEM Camp
- Sign up for door prizes and raffle drawings
- Take in the high school competitions:
 - Junkyard Battle Welding Contest
 - Technology Poster Contest
 - High School Logo Design Machining Contest

> **CVTC Gateway Campus**
Manufacturing Education Center
2320 Alpine Road
Eau Claire, Wisconsin

Chippewa Valley Technical College is an equal opportunity/affirmative action employer and educator. For more information, please visit www.cvtc.edu/eeo.

CVTC. The right choice.



Figure 25 - Manufacturing Show Poster

Engineering Poster Contest – Manufacturing Show 2013

All area high schools are invited to enter a poster in one or both categories listed below:

- A. Research an advanced manufacturing process that employs Science, Technology, Engineering, or Math (STEM) and describe the process.
 - o Example: Feature a product produced locally which might be enhanced through advanced manufacturing and/or nano technology.
- B. Explain and illustrate a core nano concept; such as, self-assembly, surface area to volume ratio, smart systems, photolithography, micro-machines, elemental analysis, or imaging.

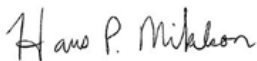
Posters will be 48" x 36" maximum and tacked to a bulletin board (no need to mount). Schools may contact us to apply for help with covering the costs of printing their poster. Please contact Hans Mikelson at the contact below to enter this competition.

Entries will be displayed from 3 to 8 p.m. at the show, and judged by CVTC industry and education partners. Judging will occur from 5 to 6 p.m. Students will be asked to explain their poster during judging. Poster judging criteria will include validity of content, creativity, and presentation/ professionalism.

Prizes in each category will be awarded:

- \$200 first place,
- \$100 second place, and
- \$50 third place.
- Students who help display their posters will be entered into a drawing for stipends to attend a micro/nano conference in Minneapolis Minnesota in May, T-shirts, and learning modules for their school.
- Participants will receive a personalized laser-engraved tag.

Sincerely,



Hans Mikelson
Industrial Engineering Technology Dept. Chair
hmikelson@cvtc.edu
715-874-4638

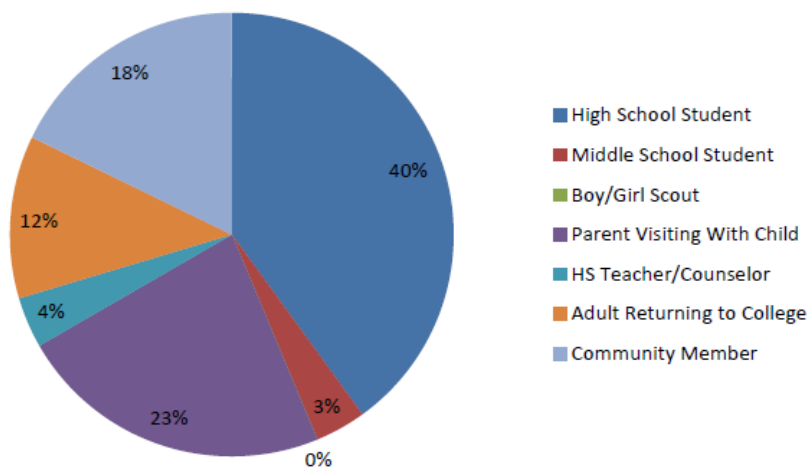


Mark Hendrickson
Special Projects/Instructor-Manufacturing
mhendrickson1@cvtc.edu
715-874-4601

Figure 25 - Manufacturing Show Poster Contest Rules

Manufacturing Show 2013 Data

Tell us who you are

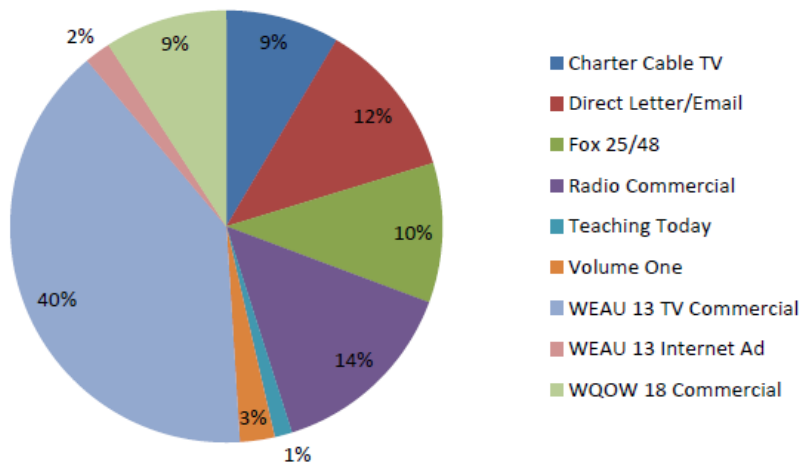


Tell us who you are:	Total	Percentage
High School Student	54	40.0%
Middle School Student	5	3.7%
Boy/Girl Scout	0	0.0%
Parent Visiting With Child	31	23.0%
HS Teacher/Counselor	5	3.7%
Adult Returning to College	16	11.9%
Community Member	24	17.8%
Total Responses =	135	100.00%

Figure 26 - Manufacturing Show Data - Page 1 of 3 - Attendees

Manufacturing Show 2013 Data

How did you hear about the Manufacturing Show?

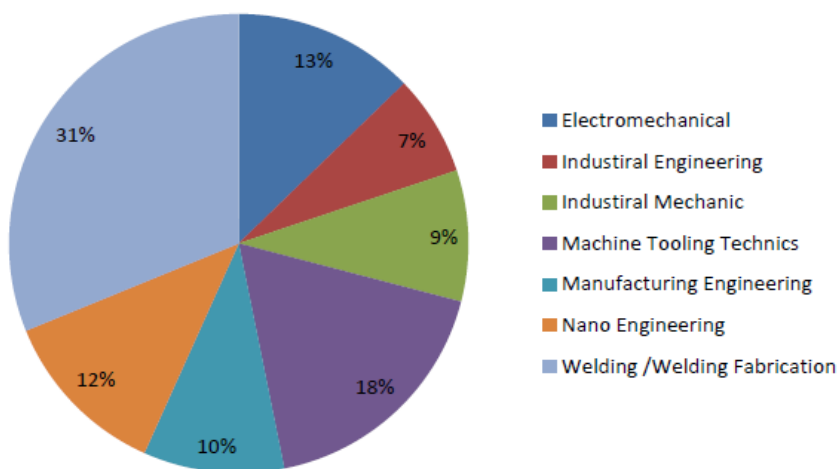


How did you hear about the Manufacturing Show?	Total	Percentage
Charter Cable TV	13	8.5%
Direct Letter/Email	18	11.8%
Fox 25/48	16	10.5%
Radio Commercial	22	14.4%
Teaching Today	2	2.6%
Volume One	4	2.6%
WEAU 13 TV Commercial	61	39.9%
WEAU 13 Internet Ad	3	2.0%
WQOW 18 Commercial	14	9.2%
Total Responses =	153	101.31%

Figure 26 - Manufacturing Show Data - Page 2 of 3 - Referral Source

Manufacturing Show 2013 Data

What program are you interested in?



What program are you interested in?	Total	Percentage
Electromechanical	18	12.8%
Industrial Engineering	10	7.1%
Industrial Mechanic	13	9.2%
Machine Tooling Technics	25	17.7%
Manufacturing Engineering	14	9.9%
Nano Engineering	17	12.1%
Welding /Welding Fabrication	44	31.2%
Total Responses =	141	100.00%

Figure 26 - Manufacturing Show Data - Page 3 of 3 - Program Interest

Advertising and More

“Creativity is Intelligence having fun.” - Albert Einstein

Northwest Vista College has had successes in student recruitment from purchasing street banners in addition to placing local radio and television advertisements.

NEATEC has received free TV commercial spots for sponsoring a local event. To listen to a NEATEC Radio ad, follow this link:

<http://nano4me.org/handbook/xCC.mp3>

Place ads where college kids hang out such as coffee shops, movie theaters, bookstores, etc.

Things to consider when creatively thinking about marketing nanotechnology programs:

Win over Mom and Dad!

Marketing nanotechnology programs to parents of potential students is beneficial as they can help influence student's decision-making process. Targeted marketing to both students as well as parents is more effective for the program.

Word of Mouth!

Keep in mind when working with college students, that if they like the nanotechnology program/instructor, they will talk about it... marketing the program itself! Open communication lines by asking students questions about other programs and offer social opportunities including free food to have students bring their peers to nanotechnology events.

Mobile Advertising!

According to Entrepreneur magazine, by 2016 spending on TV, newspapers, magazine and radio ads are predicted to decline, as billions of dollars will be spent on mobile ads worldwide. Most 18-24 year olds consider smartphones indispensable in their daily lives. Connecting with this target audience through mobile ads can increase nanotechnology program awareness and influence potential student's decision-making process.

Student Surveys

Surveying students is a critical component in determining what marketing techniques are successful and where program improvements need to be made.

Here are some sample surveys:

NANO101
Student Survey

Please help us to improve NANO101! Thank you for taking a few minutes to complete this brief survey. Your responses will remain anonymous.

The first four questions ask about your interest in nanotechnology.

1. How did you find out about the NANO101 course? Mark all that apply.

<input type="radio"/>	Program brochure
<input type="radio"/>	College website
<input type="radio"/>	Nano Days
<input type="radio"/>	Friend/fellow student
<input type="radio"/>	Family member
<input type="radio"/>	Newspaper
<input type="radio"/>	College instructor
<input type="radio"/>	College advisor
<input type="radio"/>	Email/newsletter
<input type="radio"/>	Social media (e.g., Facebook)
<input type="radio"/>	Other (please specify) _____

2. How did you become interested in nanotechnology? Mark all that apply.

<input type="radio"/>	TV program, podcast, or movie
<input type="radio"/>	Magazines, books, the Web
<input type="radio"/>	Presentation(s) made by Nano experts
<input type="radio"/>	Social media
<input type="radio"/>	Counselor or advisor
<input type="radio"/>	Other (please specify) _____

3. Why did you enroll in this course? Mark all that apply.

<input type="radio"/>	Required for Nanotechnology AAS degree or certificate
<input type="radio"/>	Elective for AAS degree or certificate Please identify the degree or certificate: _____
<input type="radio"/>	To explore a possible career interest
<input type="radio"/>	Something to fill in my schedule
<input type="radio"/>	Just for fun
<input type="radio"/>	Other (please specify) _____

4. Are you interested in pursuing a career in the nanotech field?

<input type="radio"/>	Yes
<input type="radio"/>	No
<input type="radio"/>	Possibly
<input type="radio"/>	Undecided

Figure 27 - SHINE Nano 101 Survey - Page 1 of 3

The next four questions ask about your educational background and your comfort level with certain skills.

5. What is your current math level?

- Pre-algebra
- Intermediate algebra
- College algebra
- Pre-calculus
- Calculus or above

6. What is your current chemistry level?

- No chemistry classes taken
- High school chemistry
- College chemistry
- Organic chemistry, quantitative analysis, and/or physical chemistry

7. Which of the following statements most accurately describes your current academic level?

- Some high school
- High school graduate, less than 15 college credits (quarter credits)
- High school graduate, greater than 15 college credits (quarter credits)
- Associate degree (specify field) _____
- Bachelor's degree (specify field) _____
- Graduate degree (specify field) _____

8. What is your comfort level with the following skills?

	Uncomfortable	Somewhat Uncomfortable	Somewhat Comfortable	Comfortable
Taking tests/exams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Making oral presentations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reading a textbook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Writing a report	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Doing homework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asking questions in class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Operating lab instruments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working in groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the Internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using word processing software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using spreadsheet software, e.g. Excel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 27 - SHINE Nano 101 Survey - Page 2 of 3

Finally, we would like to ask some questions about you. **If you feel uncomfortable answering the following questions, please skip any or all of them.**

9. What is your gender? Female Male

10. What is your ethnicity? Check all that apply.

<input type="radio"/> Caucasian	<input type="radio"/> Native American
<input type="radio"/> Hispanic	<input type="radio"/> Pacific Islander
<input type="radio"/> African American	<input type="radio"/> Other (please specify): _____
<input type="radio"/> Asian	

11. Are you currently employed? No
 Yes: Full-time ___ Part-time ___

If your answer is "Yes", what type of work do you do? _____

On average, how many hours do you work per week? _____ hours

12. How old are you?

<input type="radio"/> 18 years old or younger
<input type="radio"/> 19 to 25 years old
<input type="radio"/> 26 to 35 years old
<input type="radio"/> 36 to 45 years old
<input type="radio"/> 46 years old or older

Thank you for completing this survey.

Figure 27 - SHINE Nano 101 Survey - Page 3 of 3



DEPARTAMENTO DE FÍSICA Y ELECTRÓNICA

Survey – Freshman Students - 2012-2015

	Si	No
Participated in the "Open House" of the UPR-Humacao while in high school?	38	23
Visited the Department of Physics and Electronics in the "Open House"?	21	40
Was informed of the visit of the "Open House" while in high school?	34	27
Participated in outreach activities of the Physics and Electronics Department at your school?	14	47
Participated in activity of outreach presented by a Professor of the Department of Physics and Electronics at your school?	9	52
¿ Did you receive information from your high school counselor for on the Physics and Electronics Programs?	19	41
Competed in the "Moonbuggy" race while in high school?	4	57
Participated in the "Moonbuggy" race while in high school?	6	55
Was informed of the "Moonbuggy" race while in high school?	20	41
Participated in activities of the "Astronomical Observatory" while in high school?	9	52
Was informed of the activities of the "Astronomical Observatory" while in high school?	8	53
He participated in the activity "Experiences with PREM"?	9	52
Was informed of the activity "Experiences with PREM"?	11	50
Participated in the activity "Nano days" while in high school?	10	51
Was informed of the activity "Nano days" while in high school?	10	51
Participated in research activities at UPR-Humacao while in high school?	9	52
Was informed of the possibility of participating of research activities at UPR-Humacao while in high school?	15	46
Participated in any Scientific Fair?	29	32
Participated in any other type of recruitment activity, not mentioned before?	4	56

LA UNIVERSIDAD DE PUERTO RICO EN HUMACAO NO DISCRIMINA POR RAZONES DE EDAD, SEXO, RAZA, COLOR, NACIONALIDAD, ORIGEN O CONDICIÓN SOCIAL, NI POR IDEAS POLÍTICAS, RELIGIOSAS, E IMPEDIMIENTOS FÍSICOS O MENTALES O POR CONDICIÓN DE VETERANOS. - PATRONO CON SOLIDARIDAD DE OPORTUNIDADES DE EMPLEO

Figure 28 - University of Puerto Rico at Humacao Freshman Student Survey



Thank you for joining us at HVCC. Now that you have started classes we would appreciate your feedback. Your responses to the following survey will help us improve the program for future students and is for National Science Foundation and HVCC evaluation purposes only. Data will be reported in aggregate, not as individual responses.

Gender: Female Male

Age: _____

Ethnicity: Caucasian Hispanic African American Asian or Pacific Islander

Native American Other, please specify: _____

What year did you graduate from high school? _____

Where did you go to high school? _____

What is your major at HVCC? _____

Are you currently enlisted or a veteran of the US military?

Yes No

If yes, which branch? _____

How did you first hear of this program?

Word of mouth (other student, co-worker, friend, family member, neighbor, etc)

Media (TV, newspaper, radio, Facebook, Twitter, YouTube, etc)

College Website

Guidance Counselor

Teacher

School Administration

Conference, seminar, workshop, please specify: _____

Recruiting/Community Event (Cap Region Career Expo, Shen Science Night, Girls Inc, etc)

Other, please specify: _____

Don't remember

Have you attended college previously?

Yes No

If yes, how many classes have you taken?

Some Courses

Certificate

Associates Degree, Institution: _____ Major: _____

Bachelor's Degree, Institution: _____ Major: _____

Graduate Degree, Institution: _____ Major: _____

Prior to attending HVCC had you heard of the Northeast Advanced Technological Education Center (NEATEC)?

Yes No

If yes, please specify where.

Word of mouth (other student, co-worker, friend, family member, neighbor, etc)

Media (TV, newspaper, radio, Facebook, Twitter, YouTube, etc)

NEATEC website

Conference, Seminar, Workshop, please specify: _____

Recruiting/Community Event (Cap Region Career Expo, Shen Science Night, Girls Inc, etc)

Education Faculty (teacher, guidance counselor, principal, superintendent, etc)

Other, please specify: _____

Thank you for completing this brief survey. Good luck in your classes!

Figure 29 - NEATEC Freshman Student Survey

News-Worthy Nano... Getting Media to Cover Events!

When hosting a nanotechnology, you may consider putting extra effort into getting the media to attend. When media attends, it's the best public relations any college/university could ask for.

- ☑ Write media advisory. This is a one-page notification about the event including WHAT (one-sentence), WHERE (location), WHEN (date & time) and WHY (one to two paragraphs) and WHO (contact information so reporter can call/email questions)
- ☑ Find emails for local radio stations, newspapers and television stations on their websites and email them the media advisory. Do not include it as an attachment... copy and paste advisory into the email. Send advisory out 3 days before the event
- ☑ The day after you send out advisory, make follow-up phone calls between 3-5p.m. Be prepared to speak quickly & get your "pitch" across in an easy to understand manner.

"Hi, my name is _____ and I'm calling in regards to the media advisory I sent out yesterday on _____. This event is being held (date) at (time) and is a potential news event that I thought you might be interested in.... (provide reasons why here). I've sent you a media advisory but would be happy to send it to you again. Are you interested in covering this event?"

Nanotechnology AAS Best Practices - A Reflection

*By Mark Hendrickson
Dean of Manufacturing (Retired)
Chippewa Valley Technical College
Eau Claire, Wisconsin*

As an educational leader taking over responsibility for new and emerging programs such as an AAS in Nanoscience Technology, one is challenged to understand the critical elements of the program as soon as possible to help it grow and develop with a strategic approach. As a new Dean of Manufacturing in 2006, my responsibility and journey to manage a 2005 Nanoscience program startup began. The program included one full-time technologically skilled and knowledgeable faculty; managing a 1000 sq foot clean room, physics based lab, one computer lab, and characterization equipment of an Atomic Force Microscope (AFM) and a Scanning Electron Microscope (SEM). The program had been initiated with two starts of 28 students (classroom capacity) each in the fall and again in January. Everything looked rosey! But was it?

The challenge became apparent as the first graduates started having difficulty finding employment in the region and provided feedback that the employers didn't respond to knowledge of the title of the degree.

Here are the items that quickly became important during this journey to better understand the new program and the environment of this emerging technology.

1. What is the scope of this new technology?
 - a. The technology has formally been developing since 1959 as Dr Richard Feynman described in his paper "Race to the Bottom" in work with electronics. One of the key visible contributors is Buckminster Fullerene and applications of properties of materials at the micro and nano scale.
 - b. With a core set of employers in the region conducting super computer production, hard drive component manufacturer, and microcircuit board manufacturing as well as chemical lab services and a genetics workforce, we felt it was clear the skill and knowledge built into the program was evident to the employers. This was a false assumption.

- c. IBM had major breakthroughs in 1969 in microelectronics with the ability to move atoms to create a nano scale “IBM” logo and continued development of the supercomputer industry in the Chippewa Valley supported a microelectronics workforce.
- d. By 1999 the federal government initiated the NNI legislation (National Nanotechnology Initiative) beginning federal investments in the technologies and skill development linked to nano scale.
- e. 1999-2005 technology expanded at a predictable early stage growth curve to the point that industries in technology application sectors, (Bio, Nano, Electronics, Energy, Materials, Food, and Medical Device among others), and were using primary researchers to perform technologist and technician work activities. Industry leaders began to identify the need for technician level skills in lab preparation, lab reporting, equipment operation and repair, and in general the procedural steps for nanoscience research and nanotechnology applications. There were not enough of these skilled STEM workers available from current educational pipelines at the bachelors level and pursuit of a 2-3 year trained technician began.
- f. In 1998 a semiconductor manufacturing program was started in Pennsylvania in response to the workforce needs of local industry. An education partnership between Penn State and Pennsylvania community colleges was created to satisfy these industry workforce needs. In 2001 the curriculum in this program was modified to meet the foundational skill sets needed by the many industry sectors involved in nanotechnology. The PA Nanofabrication Manufacturing Technology (NMT) partnership was formed which involved the creation of over 20 AS and AAS programs at Pennsylvania community colleges. This capstone semester was delivered to these students at Penn State via a hands-on capstone semester, and credits were proffered at the student’s community college home school program.
- g. By 2005 the next two year AAS programs of study formalized in centers of nanotechnology activity to respond for this nanotechnology workforce need
 - i. DCTC – Minneapolis MN
 - ii. CVTC - Wisconsin
 - iii. SHINE/ Seattle WA
 - iv. SCME – New Mexico
- h. Over a three-year period, three complete DACUM events were completed to identify Duties, Tasks, Competencies and Trends within smaller industry subsets to better understand the scope of technician employment needs in detail. This DACUM effort was conducted by support of the NSF-ATE NanoLink partner regional center. It encompassed business in Minnesota and Wisconsin. Some of those larger technology businesses also had a national reach.
- i. Prior to program re-design, a survey of importance of the competencies was distributed to the regional industry. Statistically based item analysis provided for prioritization of the competencies. Prioritized competencies were mapped into program courses based on the industry response and a direct review of the content.

- j. Key employer leaders and educational leaders were also invited to participate in a review, discussion, and prioritization of their current and future projected technician needs. Equipment, facilities, and procedural needs were reviewed and commented on by the industry and university personnel.
 - k. The competency model survey was archived to allow benchmark shifts in the workforce needs to the future and was also reviewed at the bi-annual program advisory meetings.
2. What role does a 2-year Technical or Community College have with this technology?
- a. Technical Colleges (TCs) and Community Colleges (CCs) generally serve a localized region of a state, generally encompassing a 75 to 100 -mile radius from the college's main campus.
 - b. Statistics from the WTCS Wisconsin Technical College System in 2005 indicated that 87% of the graduates stay within the district and 94% stay within the state. The primary region of students also comes directly from the geographical district unlike destination universities. As a result of this information, we needed to address the local market needs with greater alignment, yet also address the larger regional needs.
 - c. Overall less than 20% of TC/CC students transfer to 4-year programs, yet the Nano program was experiencing 40-50% of the program grads moving on to 4-year programs.
 - d. A significant number of TC/CC students have 4-year or greater degrees indicating additional skill/knowledge development being acquired at the TC/CC post university program study.
 - e. The primary reason for attendance at a TC/CC is a job goal
 - f. 84% of graduates attain a job within 6 months of graduation
 - g. A survey of parents indicated that 90% of parents envisioned their children attending a 4-year educational institution and not a 2-year institution.
 - h. TCs and CCs were not envisioned as a primary educational institution goal for their child. This poses an issue with the college to brand the program with public image as a unique program designed for university transfer, workforce preparation, and post-graduate hands-on skill development or refresher.
 - i. TCs and CCs were not envisioned as a preparatory step at attaining a 4-year degree. (This perception is held by parents and HS aged students and an issue that need long term strategic response)
 - j. Primary influencers of TC / CC students are:
 - i. Parents
 - ii. Family
 - iii. Neighbors
 - iv. Peers
 - v. Friends
 - vi. Teachers
 - vii. Social media resources

- viii. Individual goals and desires
 - ix. As an analysis of the student influencers we needed to address strategies to influence these groups about the program and the benefits it has to offer.
 - k. Program design must be reviewed, approved, and endorsed by regional employers.
 - l. Regional employers must be an active partner in advising and recruiting students and graduates for program entry. The job postings and position skill identifiers must be aligned and replicate the competencies found within the program. Titles, names, and descriptions become very important to HR departments who were screening out applicants even though they had the skills needed for open positions.
 - m. Supplemental information: Report of all PhDs indicates that 12% have attended a 2-year college.
3. What is the academic leadership's view of this program and support for growth and development?
- a. Is it supported and encouraged by academic leadership? With the significant hurdles in front of the new and emerging technology program of Nanoscience or with the program redesign Nano Engineering Technologist, support of the board and college leadership is crucial to continue financial and public image support.
 - b. A newly initiated program may need additional contingent resources during development and early stages. Funding and or resources must be available to support sustaining activity if needed. This emerging program has equipment of a high dollar value with a need to provide ongoing operational maintenance unlike other programs at the college.
 - c. Articulations with the regional 4-year university programs were initiated to identify the transfer needs. Engineering programs required ABET accreditation with a base in calculus. Engineering Technician programs, Management Technology program as well as Education programs did not have the ABET accreditation requirements and were easier to attain articulation agreements. This work resulted in formalized transfer agreements as well as the development of substitution courses based in calculus for engineering degree programs.
4. Teaching skill and techniques
- a. The instructor linkages are a key component to program success.
 - i. Quality curriculum
 - ii. Engages the students
 - iii. Honed teaching skills
 - iv. Current and maintained facilities
 - v. Professional and useful instructional materials
 - vi. Opportunity to highlight student efforts and successes
 - vii. Group identity and cohesiveness of students and faculty
 - viii. Support staff trained to conduct daily support for the program

- ix. Responsive to student issues, concerns, adverse learning situations.
 - x. Responsiveness to curricular changes and industry involvement
5. Who are the leading educational institutions in this technology? These are a listing of the programs that we monitored as benchmarks to help clarify the role of a 2-year AAS program. It was also necessary to identify the similarities, and differences in the mission and scope of the programs.
- a. University Programs
 - i. Penn State
 - ii. Purdue
 - iii. University of Minnesota, Minneapolis
 - iv. University of Wisconsin, Madison
 - v. University of Wisconsin, Milwaukee
 - vi. University of California Berkley
 - vii. Regionally:
 - 1. UW Stout – Applied Science
 - 2. UW River Falls – Tissue Engineering
 - 3. UW Platteville – Nano Engineering
 - 4. UW-Oshkosh
 - 5. UW-Whitewater
 - b. 2-Year AS and AAS Programs to benchmark and model
 - i. Pennsylvania NMT Program at Penn State involving multiple AS and AAS Programs
 - ii. Dakota County Technical College – NanoScience Technician
 - iii. CVTC – Nano Engineering Technologist
 - iv. SCME
 - v. Seattle / Shine
 - vi. Monitored other bio tech (Madison Area Technical College-Madison WI)
 - c. 2-Year colleges with interest in bio, micro, or nano technologies
 - i. Pennsylvania NMT Program at Penn State involving multiple AS and AAS Programs
 - ii. Northcentral Technical College – Wausau WI (Certificate)
 - iii. Minnesota State College – Southeast Technical – Winona MN (Certificate)
 - iv. Waukesha County Technical College – Waukesha WI (Certificate)
 - v. Madison Area Technical College – Madison WI (Bio Technology AAS and Microscopy Certificate)
6. Who are the leading business adopters of this technology?
- a. Electronics and micro chip manufacturers
 - b. Bio-medical device industries
 - c. Plastics manufacturers of medical devices
 - d. Food industry: in lab, testing, safety, and packaging

- e. Chemical testing and characterization laboratories (non-medical labs)
 - f. Genomics and genetics related businesses (Ag, with animal genetics, and seed genetics, tissue engineering.)
 - g. Materials processing companies (metals, plastics, fabrication)
 - h. Micro, Nano, and other processing equipment manufacturers
 - i. Textiles manufacturers
 - j. Automation applications – such as distribution centers with optics and photonics
 - k. By using a DACUM duties, tasks, competency, procedural steps, and equipment profile of three distinct industry subsets, we were able to re-design the program to better meet the industry jobs.
7. Marketing, recruitment, retention, placement, and transfer. Using the redesign model as presented to the 2012 MNT Conference at Penn State / NACK, the following categories of activities were designed to respond to the specific needs of middle school, high school, other post secondary institutions (both 2-year and 4-year) as well as the industry sectors.
- a. Middle school awareness of the technology
 - i. (Conducted technology camps and single day events, some partnered with the regional universities)
 - ii. Provided teacher training and exploration on nanotechnology for middle school and high school teachers
 - b. High school recruitment
 - i. Created transcribed credit courses and certificates to offer to area high schools
 - ii. Provided teacher training and teacher mentoring of the transcribed credit course content
 - iii. Provided presentations to science, math, and career technical education courses
 - iv. Conducted annual Manufacturing Show for on-site visitation and hands on experiences. Also allow peer students to share information with parents and siblings.
 - v. Cable and TV marketing of the program
 - vi. Posters, banners, and flyers promoting the program, transcribed credit courses, and camps
 - vii. Published promotional marketing pieces in local and regional papers addressing rural populations (weekly publication schedules)
 - viii. Published promotional marketing pieces in Teaching Today, a monthly periodical distributed to Wisconsin K-12 and post-secondary institutions
 - ix. Wrote regular promotional pieces addressing equipment, event participation, grants, awards, and upcoming events for regional papers.
 - x. Maintained a Face book page for college and program
 - xi. Created cross links at each of the college's web platforms to additional resources (GoldCollarCareers, NanoLink, NACK-nano4me...etc)

- c. Public Awareness
 - i. Annual presentations to the public were scheduled including an annual Manufacturing Show held each spring to promote program awareness.
 - ii. Annual conferences, school presentations, and career fairs
 - iii. Public periodicals and information pr releases on work activity, outstanding student highlights and scholarship recognition.
 - iv. Social media development of virtual tours of the facilities, a program Face book page, and linkages to the regional effort of technology career promotion, GoldCollarCareers.com.
 - v. Workshops and career fair participation, locally, regionally, and nationally.
8. Costs, FTEs, and organizational performance
- a. FTE: Monitored the following statistics on a regular basis to identify trends, issues, and status
 - i. Program wait list
 - ii. Headcount
 - iii. Break even point of the program from cost position
 - iv. Retention / Graduation
 - b. How many faculty are needed
 - i. Load calculations and assignments for each individual to map annual work load expected
 - ii. The skill and knowledge development was also mapped as to expertise and gaps for development.
 - iii. An additional faculty was hired to provide additional depth of micro and nano technology expertise.
 - c. How much staffing support is needed to maintain and operated? As a result of this assessment, a full time micro and nano technician was hired to maintain the clean room, lab equipment and provide outreach activities in addition to classroom support. This was a significant addition to the success for student recruitment, retention, and placement.
 - i. Equipment support and needs documented for hour per week and month
 - ii. Facility: A maintenance spreadsheet and listing of activities was developed
 - iii. Events and activity: Recruitment, retention, support, and dissemination events were calendared for active participation by the micro and nano technician support as well as program faculty.
 - iv. Is incubation, or some other service level provided with the resources as a revenue generator? The college developed a standard fees and services listing to provide to area industry. Both on site characterization processes were conducted by industry as well as primary research by researchers needing access to equipment not available at their institutions.
 - d. How do we recruit.

- e. How do we retain
 - f. How do we place and track graduates and program alum
 - g. How do we mentor and develop collegial skills
9. What funding mechanisms are available to help sustain and build the program?
- a. State funding
 - i. Submit state requested funding and develop professional relationship with state leaders
 - b. Federal funding
 - i. Actively monitor and pursue NSF, DOL, DOE funding opportunities
 - ii. Support SBIR incubation within the local incubation center
 - c. Partner funding
 - i. Establish professional business relationships with business and education peer groups to seek collaborative funding efforts.
 - ii. This strategy will allow the program/college to seek broader impact efforts
 - d. Private funding
 - i. Seek relationships with specific equipment manufacturers and business entities that can have a cooperative benefit
 - e. Revenue generating activities
 - i. Can the lab/resource center provide business services that would generate revenue and exposure for the program?
 - f. Foundation resources
 - i. Work with the foundation to build a scholarship resource fund to support student participants
 - ii. Work with the foundation to sponsor outreach and recruitment activities
 - g. Collaborative or Cooperative efforts
10. Systems analysis: what should a sustainable program look like
- a. Continue to build a map that outlines what quantifiably is needed to sustain or grow this program.

Using the 10-item outline, the program and college division leadership developed a strategic plan to address each area. While this is an ongoing developmental process, we attempted to establish a foundation in which we created an organizational alignment with each of the sections.

We attempted to attain at least ten middle and high schools as partners so we could expect a minimum of two students per year that would matriculate directly into the program. With the public outreach and alignment with the area industry and partnering educational institutions, we would expect to recruit an additional twenty students per year for a total target of forty students. The time-based challenge is to provide awareness of science and technology in the middle schools, enhance experience and skill development in the high school time frame, and

matriculate program ready students. This would thereby increase the readiness of incoming students, allow for greater retention and success within the program and with placement and transfer.

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Contributions

ATE Central
Bridge to Biosciences (City College of San Francisco)
Chippewa Valley Technical College - Eau Claire, WI
College of Canyons - Santa Clarita, CA
College of Lake County - Grays Lake, IL
Dr. Anura Goonewardene
Forsyth Technical College - Winston-Salem NC
Herb Finklestein
ITHAKA
Ivy Technical College - South Bend, IN
Mark Hendrickson
North Dakota State College of Science - Wahpeton, ND
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Data Collection and Research

Lynn Dohm
Roxanna Montoya

Editing

Robert Ehrmann
Roxanna Montoya
Timothy Suchomski