National Center for the Biotechnology Workforce
www.biotechworkforce.org

Forsyth Technical Community College, NC
NH Community Technical College, NH
Indian Hills Community College, IA
Bellevue Community College, WA
Miracosta Community College, CA

Combining strengths of five premier community colleges from around the nation for new learning models to build our biotech workforce

Profile of a Biotech Workforce Innovative Training Partnership Prototype

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

The President's High Growth Job Training Initiative supports visionary life science sector development sparking action at regional levels. Companies, educators, researchers, entrepreneurs and governments all work together to achieve new levels of innovation.

High school and middle school educators from all over the country, a total of 24, flew in to Piedmont Triad Airport in Greensboro, N.C. on Wednesday, Oct. 17 for the first ever "National Biotech Teachers Fly-In." Together, they explored a series of workshops and events designed to advance their pursuits of a highly skilled, 21st century biotech workforce.

In Partnership with Bio-Link
www.bio-link.org

With biotech production facilities opening in every region, offering more jobs in a burgeoning American industry, schools seek ways to bring potentially lucrative biotech skills to people in their own communities now.

"Our grant partners have always wanted to get a sense of what high school teachers need for the teaching of biotechnology," said Russ Read, National Center for the Biotechnology Workforce (NCBW) Executive Director. The National Science Foundation's Center of Excellence for Biotechnology - known as Bio-Link - was eager to cooperate. "Bill Woodruff, South East Director of Bio-Link, got very excited when we met and we both said, "we can do this together!" They approached Lucas Shallua at Forsyth Tech and Terry Howerton at the Atkins Academic & Technology High School and started to work on the 'Fly-In' program. "One ground rule was to have it be something teachers could learn and take back to their labs at their schools to their students without fancy or expensive equipment."

Teacher interest was high for this innovative training event sponsored jointly by NCBW and Bio-Link - along with other stakeholders (*see sponsor list on back cover*).

The three day event assembled regional education leaders who are working to start up their own biotech programs. Group interactions helped cross-fertilize emerging strategies and growing solutions to meet biotech industry needs. This profile captures the experiences and some of the lessons learned.

Biotech Teachers Fly - In Group 2007 (see names on back cover)

To harness the power *of biotechnology industry potential – with a skilled, ready workforce – the U.S. Department of Labor Employment and Training Administration created the National Center for the Biotechnology Workforce in 2004. Because community colleges are actively involved in meeting the needs of workers and industries in their communities, the National Center focuses energy and investments on five community colleges with different but congruent strengths in the biotechnology industry to create new curricula and infrastructure models that can easily be shared and replicated.*

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Tour bus makes travel time learning time

Teachers get acquainted aboard a chartered bus traveling the North Carolina countryside.

Climbing aboard the travel bus chartered for the event, the teachers enjoyed learning more about each other and the challenges they share.

Welcoming the airborne educators, Russ Read, director of the NCBW, said: "You're all going to go home with new contacts, new resources and new ideas, as well as knowledge and kits you can use for biotech education in your schools."

"My administration is very supportive of adding a biotech program," said Tammie Schrader of the Cheney Middle School, with about 900 students in Cheney, Washington. "I thought: 'fire em up in middle school and they will continue.' I want to learn new things to bring back to other teachers in my school, bring them home to kids. We need to make the coursework relevant. I want a good answer when my students ask me, 'why study cells?' Why, Mrs. Schrader?'"

The bus pulled in and the group walked in to the brand new biotechnology laboratory at Alamance Community College. Rolling up their sleeves amid the professional laboratory facilities they engaged in hands-on workshops in DNA extraction – activities focused on youth. The first session in a series of industrial strength, cutting-edge biotech experiences arranged for the visiting teachers, answers to those questions about the relevance of biotech training would become provocatively clear.

Strawberries and DNA Necklaces with Bill Woodruff at Alamance

The first people to conduct an experiment here, the lab had a "new-car" smell as the Fly-In teachers entered. "We haven't had any students in here yet, it's brand new," said Bill Woodruff, Alamance's Biotechnology Department Head and the SE Regional Director for Bio-Link – one of the event's organizers.

"The Fly-In has a two-fold impact," said Woodruff. "The first addresses the need for bench-level workers that's grown most rapidly in the biotech industry. Middle school is not too soon to introduce the concept of a career in this rapidly advancing field. The other is so teachers can make contacts with other teachers and mentors who, just like them, want to learn and do this for their students. Plus, it's always a revelation that many of the same problems exist all across the nation, not just in your own backyard."

Bill Woodruff

Bio-Link enhances and expands biotechnology education programs by providing professional development for instructors, improving curriculum, and by making use of technologies to promote information sharing. The Bio-Link National Center is in City College of San Francisco with Dr. Elaine Johnson, director. Regional Bio-Link Centers across the country - in Seattle, WA; San Diego, CA; Austin, TX; Madison, WI; Graham, NC; Portsmouth, NH - develop relations with local industry and educational institutions. In addition, each regional center spearheads a different element of the program.

The strawberries are mashed and mixed with alcohol, processed for DNA extraction

"To extract DNA from strawberries, I bought all we need for today for $15, strawberries, detergent, alcohol," Woodruff addressed the group, holding up a single red strawberry. "We're going to break up the cells - they are made only of proteins, carbohydrates and DNA – and isolate the DNA."

Before starting the workshop, Woodruff (who's been teaching biotechnology for more than 20 years) showed slides and gave a quick overview of biotechnology. "It's discovering uses for the natural processes," he said. Illustrating how DNA could be marked he showed slides with experimental mice *(continued on next page)*

glowing green.

Woodruff commented on the popularity of the TV crime drama *C.S.I.* with its spectacular scenes of forensic science. "The fact is you need a law enforcement background for that, it's better to concentrate attention on the jobs that are really there. In fact, many of the skills we teach can overlap into other fields."

A cheek swipe is part of the process to create a necklace containing your own DNA

With bioproduction increasing in North Carolina, Alamance has activated a 15 liter capacity bioreactor, the only community college presently operating at this scale in the state. "Downstream chromatography in biotech production is concerned with measuring how much protein, in what concentration and purity, has been produced," said Woodruff, linking the needs of industry with the hands-on work the Fly-In participants were about to do. The teachers broke up into small groups and took their places around the lab's slate-top benches.

Alamance Community College offers the oldest Associates Degree program in Biotechnology in the US, and has built on extensive experience with cutting edge theory and skills training. Students learn basic skills, including lab safety and concepts of cGMP, to prepare them for work. Advanced training includes aseptic and sterile techniques (clean room), microbiology, cell culture, immunology, genomics, and bioprocess skills.

Students have been hired from this program in a wide variety of jobs, including research and laboratory assistants at universities, hospitals and production facilities; and employed as bioprocess operators, department supervisors in chemical and diagnostic labs, plus in municipal water treatment positions.

For more information about the Alamance Community College Biotechnology program, visit: http://www.alamance.cc.nc.us/newsite/curriculum_courses_programs/courses_programs/programs_of_study/programs/prog.php?curr=A20100

The process began by placing strawberries in a zip lock baggie and then enthusiastically smashing them with fists for two minutes. The extraction buffer (detergent) was added to the bag. Then it was time to mush again before filtering through cheesecloth. When the filtrate was combined with alcohol in a test tube the group could see the DNA precipitate out of solution and float to the top. Spooling this precipitate DNA can be done on a glass rod or pipette tip.

Carolyn Preyar

Extracting DNA includes centrifudge on the capsule for a certain period of time, pippetting, observing and recording.

After a break, Woodruff led the group through a fun and exciting laboratory activity for isolating human genomic DNA while creating intriguing necklaces. The exercise began with teachers extracting crude DNA from their own cheek cells. Then cheek cell samples were "lysed." The teachers watched as wispy white strands of their own DNA precipitated out of solution in the presence of ethanol. After transferring the DNA to plastic tubes the teachers continued isolating the DNA with a microcentrifuge. Finally the heart-shaped tubes of DNA were fashioned into pendant necklaces using string.

Laughing and congratulating one another, the group was now looking stylish in pendants - with a new teaching trick - and ready for lunch.

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Terry Howerton gives overview of Atkins High School biotech program after lunch

Terry Howerton

Smiling students Sean Nelson, Samantha Spencer and others working the line at the Alamance Community College cafeteria served freshly baked chicken pot pies and other treats to the teachers filing through. Doris Schomberg, chair of the Alamance Culinary Institute, greeted them. "We started 30 years ago out of the trunk of my car with three students, today we have more than a hundred," she said proudly.

Enjoying lunch in a private room, the participants viewed slides and listened to an informative presentation given by Terry Howerton, biotechnology academy coordinator at the Simon G. Atkins Academic & Technology High School Complex.

"We're trying to get kids to understand what biotech is - it's tough," said Howerton. "If you ask 'what is biotech?' you get five different answers. Science is intimidating to kids. With support from the Bill and Melinda Gates foundation we've had our first graduating class this year."

A Winston-Salem, Forsyth County Magnet School, Atkins Academic and Technology High School is unlike any other high school in the county. It has the unique composition of three autonomous high schools - biotechnology, pre-engineering and computer technology - housed under one roof. Partnerships among universities, community colleges, and businesses help provide focused environments; students can explore their interests before college.

Each of the three Atkins components was developed in cooperation with concerned business, industry and community leaders to represent desired economic directions of the community. Members of the school's advisory committee include representatives from North Carolina Baptist Hospital, BellSouth Telecommunications, Cisco Systems, and the N.C. Biotechnology Center. To prepare for careers and college-level work, Atkins' students participate in mentoring, job shadowing and internships programs.

"We are tough on our lab skills – you can get either an A or a B, a D is not good enough, you have to do it over again. There will be no second chances on the job," said Howerton. "We had a student do an internship at Targacept. He stuck it out and achieved. It's a success story – one we need – we're still in the beginning stages."

Howerton explained how they used Ellyn Daugherty's plans and suggested "packages" to help outfit new labs. He also spoke about the Triad BioSummer – a program for students with $50K support by industry. "The kids love it, it's a great experience,"said Howerton. "And we hope they end up in our biotech culture here in Winston-Salem."

for more information visit: http://winstonsalem.nc.schoolwebpages.com/education/school/school.php?sectionid=128&sc_id=1180106116

On to Research Triangle Park

Back aboard the bus after the DNA workshops at Alamance, the teachers were excited. "I was expecting to find something I can bring back to class," said Sandra Loy of Southern Alamance High School. "It's amazing what I can do with strawberries now!"

Her Southern Alamance colleague Brenda Graves was also enjoying the Fly-In. "It's great to interact with people from all over the country. I hope it continues so others can have the opportunity to come and have the experiences we're having." She feels the biotech industry is really starting to grow. "Look how far it's come – it will be doubling by 2014. I want more information for my students, including options in two year and four year programs."

She also approved of the mix represented in the group. "It's a great idea having people from middle schools here, I'm getting ideas I can follow up on."

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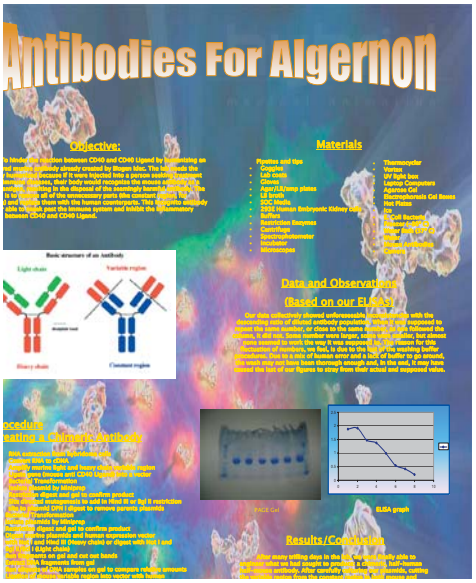
Biogen Idec Tour brings biotech processes to large-scale life

Assembling in the spacious and impressive lobby of Biogen Idec, the visiting teachers were welcomed by public affairs manager Mike McBrierty. He explained how the company was one of many research-dependent operations located here in North Carolina's famous Research Triangle Park (RTP). Founded in January 1959 by a committee of government, university and business leaders, RTP, with 157 companies operating on 7,000 acres, is the largest and oldest continually operating park of its kind in the U.S.

Biogen Idec (headquartered in Cambridge, Mass.) produces therapeutic commercial products, including AVONEX the most prescribed multiple sclerosis product in the world with close to 130,000 people on therapy. In 2006, sales generated revenues of $1.7 billion worldwide. The biopharmaceutical company also partners with Genentech on RITUXAN for treatment of non-Hodgkin's lymphomas as well as rheumatoid arthritis. In 2006, RITUXAN generated U.S. net sales of $2 billion.



Surrounded by gleaming glass and imposing walls of the plant that employs 770 people, McBrierty emphasized the human dimensions of their work. He pointed out displays on the wall. One read "Your Ideas Make a Difference."

"Many of our processes and operations have been improved by individual line employees' ideas," said McBrierty. "One was having convenient holsters for hand sanitizers, for example." Another image showed a grateful employee expressing her thanks to her colleagues for their work. She has MS, and TYSABRI – another therapy made at the very plant where she works – has changed her life. "When the FDA was reviewing TYSABRI for approval, we heard patients tell how they went from being unable to walk before therapy to regaining that ability after therapy," said McBrierty.

The group nodded and the large-scale manufacturing facility began to seem friendlier and less imposing.

In response to a question about training, McBrierty said the company operates community labs available to schools and groups for workshops in Cambridge and San Diego. In addition to financial support and partnerships to promote science education in North Carolina, Biogen Idec hopes to open a community lab in RTP.

With security badges in place and following instructions on how to proceed through the plant, the group passed through automated doors and into a glass-walled spine. Massive stainless steel tanks, tubing, devices, computers and equipment could be seen in a sterile environment through windows. "Oohs" and "ahhs" were heard as many of the educators took in their first looks at such a state-of-the-art facility.

Information about the Biogen Idec Community Lab program is at http://www.biogenidec.com/site/community-lab.html including scientific posters like this one from actual experiments conducted by high school students in the Biogen Idec Community Lab

"For AVONEX production, we use Chinese hamster ovary (CHO) cells, an industry standard that has desirable qualities for protein production: they're hearty, are productive in a bioreactor environment and are recognized by regulators. The cells multiply and produce the target protein in these bioreactors. We then harvest and purify the protein using microfiltration, centrifugation and column chromatography technologies," said McBrierty, explaining operations as the group kept walking.

"**I just saw one of my former students**," said Bill Woodruff, peering through the glass at workers busy with their tasks. "Is this Star Trek?" asked one of the teachers as the tour passed shining silver air lock controls. "These air locks are part of a system that constantly pulls impurities out of the air in the areas where product is being made," explained McBrierty.

"We have standard operating procedures on everything imaginable, including gowning. We follow them absolutely and document that fact every step of the way," said McBrierty. "We monitor our processes with real time visibility and even use predictive analytics to ensure batch productivity. The time and expense involved if a batch goes bad can be in the millions of dollars. We're an industry leader with success rates at this facility exceeding 90% for commercial products in a large scale environment."

Returning to the lobby where the tour began, the teachers were buzzing with thanks and appreciation for this experience that made the biopharmaceutical manufacturing processes real and tangible.

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Let's head back to the hotel

Fly-In Teachers board the bus at Biogen Idec

Cathy Stone, a teacher at Merrimack High School in New Hampshire, was pleased with the Biogen-Idec tour in helping to understand the equipment and how it was being used in industrial settings. Among the common challenges the teachers discussed – how to attract and motivate the students was in the lead - another was not knowing where to begin to outfit a lab or get an initial program going.

Claire Handy, a teacher at Somersworth Tech high school in N.H., appreciated learning more about the equipment as well. "The head of my department wants to set up certified student labs, this will help me get them ready for my classroom."

Well-equipped labs are useful in attracting students. Tailoring subject matter to student abilities and interests is another. Jacob Dahlke, a teacher at Seattle Lutheran High, said, "We survey kids find out what they want, of course they all want C.S.I. – hey I could see my kids pipetting."

Jocelyn Broemmelsiek of San Dieguito Academy in Encinitas, said "We offer three courses, one is very easy, we lure them in, then try to add them in to the next class." The conversation continued. "I'm very interested," said Dahlke. "Tell me more...

Dinner speaker Tim Bertram of Tengion details amazing powers of regeneration

Tim Bertram

Enjoying dinner together at the Greensboro Airport Marriott, including authentic North Carolina pulled pork barbecue and some tasty coleslaw, the teachers heard a friendly presentation from Craig Gallimore of the Carolina Biological Supply Company, sponsor of the reception. This company offers a full catalog of exciting teaching products designed to help spark student interest in biotechnology. Attendees were happy to learn they would be returning home with DNA necklace kits presented to them by Carolina.

Then Dr. Tim Bertram of Tengion was introduced and delivered an eye-opening program on the latest in regenerative medicine.

Tengion's patented technology harnesses the body's ability to regenerate. Starting with a patient's own cells, Tengion technology regenerates human tissues for "neo-organs." This breakthrough has the potential to help anyone with organ failure to regenerate a functioning organ custom built from his or her own cells. This could bring healthier lives without the need for donor transplants, which are in limited supply, and, hopefully, eliminate adverse effects of rejection.

Bertram began his informative powerpoint presentation looking all the way back to the 1500s, tracing ways humans have replaced body parts with wooden legs and other implements. Curiously, Charles Lindbergh, the pioneer aviator, was among the first to speculate about possibilities in regenerative medicine during the 1930s.

"We are harnessing the body's innate ability to recreate new tissue, as there is a power to regenerate in each of us; genes signal the cells with proteins and tell them to grow," Bertram explained to the group as he displayed illustrative slides. "Repair occurs, we know muscles cut during surgery will heal, and the plasticity of the brain, for example, can enable stroke victims to bounce back."

Bertram talked about issues involved with "immunosuppression" - reducing the activation or efficacy of the body's immune system. It is a difficult procedure that must be done deliberately to prevent the body from rejecting an organ transplant. "Immunosuppression can cost up to $150,000 a year," said the doctor of veterinary medicine. "But if we can take cells from you and expand and grow them into a new organ that we give back to you – we should be able to eliminate the need for it. Your body knows itself, there should be no rejection."

Tengion's biotechnology of creating a "neo-organ," such as a new bladder, starts when a surgeon sends in a biopsy from the patient. Tengion's scientists identify and multiply the patient's own healthy progenitor cells and then place these cells

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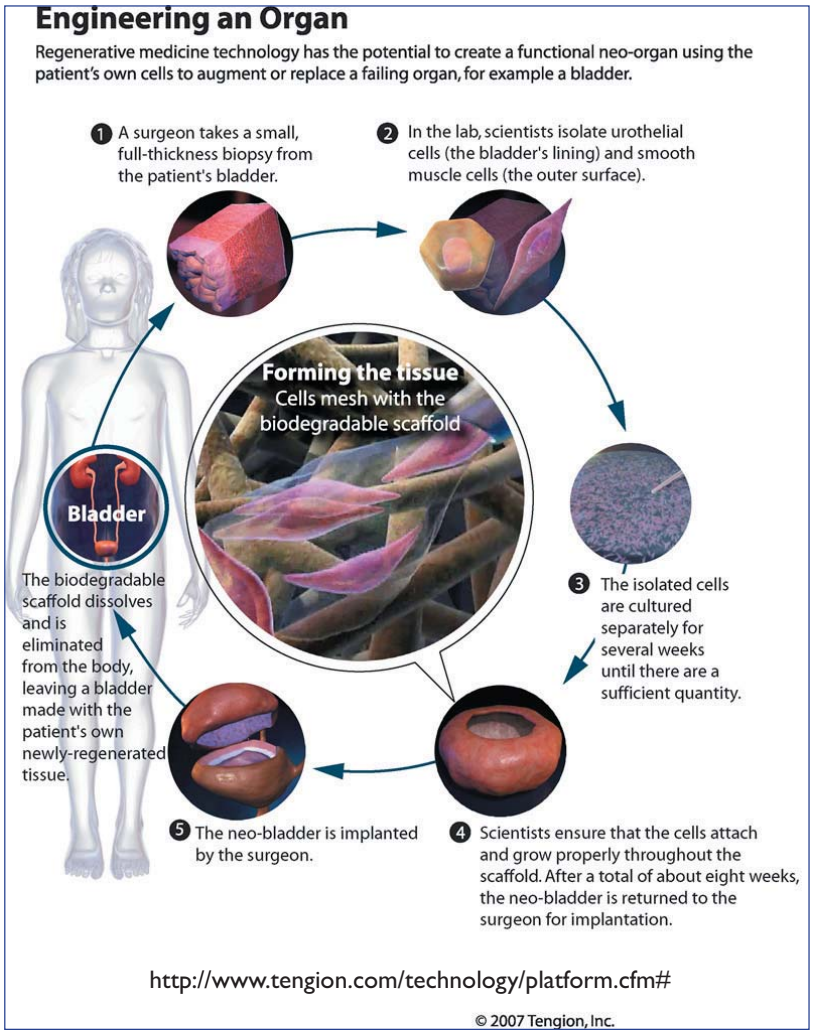
Tengion regenerates (cont.)

on a structure that is shaped like the needed organ, a "bioresorbable scaffold." When ready, the surgeon implants this neo-organ into the patient's body. It then integrates with the rest of the body and, over time, becomes functional. By contrast, current therapy for urinary bladder reconstruction uses a piece of colon and is associated with frequent acute and chronic risks and complications.

Employing technology licensed from Dr. Anthony Atala and researchers at M.I.T., Tengion started only four years ago in East Norriton, Penn. and then opened research offices, a development laboratory and a pilot manufacturing facility in Winston-Salem, N.C. It has made remarkable progress in taking an organ "from the bench to the body." The company has two ongoing phase 2 trials and is working with the FDA to establish standards for the approval and manufacture of such organs.

"It's great to talk about science, but where is the business reality?" asked Bertram as he moved into Tengion's plans for the future. "There are about 26,000 organ transplants every year with more than 90,000 on waiting lists, obviously there is a large medical need."

In response to a question, Bertram discussed how the process is part of the product. "We grow it specifically for you," said Bertram. Taking other questions, Bertram estimated that, once perfected and approved, they could produce a new organ in six to eight weeks. New breakthroughs are in the pipeline focusing on cardiovascular and renal applications.



In conclusion, Bertram thanked the biotech educators for their efforts and dedication. "I want to thank Forsyth Tech, we've hired fifty percent of our workforce through their program," said Bertram. He urged the educators to pass along the knowledge they were gaining during the Biotech Teachers Fly-In. "You can energize and motivate the students of today with the promising discoveries and innovations we are making here."

Exploring more biotech on a bus

With some of the group still clutching paper cups filled with coffee, the teachers boarded the bus for another series of events on Friday. Challenges facing America's science educators were discussed between sips of cold water around the bus seats and tables.

Teresa Alsept of Eckstein Middle School in Seattle was asked if the classes preceding high school were too early to start biotech. "No, we need to start, many students make the choice of what to pursue by high school," she said.

Terrianne McKeon of New Hampshire agreed. "A lot of the world is not involved in sciences, students need to be made aware of it," said McKeon. She noted a lack of science seriousness in the culture. "Only two years of science in high school are required by our state, but meanwhile, our leading university, the University of New Hampshire, requires four years. We need to teach more science."

Teachers ready for a new day

The issue was familiar to others on the bus. "Seattle now requires three years of science, it had been two years," said Alsept. Another recurring issue of public perception, or misperception, of biotech opportunities came up. "Students don't know what to take in middle school, they follow their favorite sports stars," she said, observing a barrier teachers deal with.

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Hands-on gel electrophoresis workshop at Forsyth Tech with Lucas Shallua and Alan Beard

Refreshed and happy, the enthusiastic teachers re-grouped in the Marriott lobby at 8 a.m. on Friday morning, after checking out. Boarding the bus, including luggage (with Driver John cheerily helping out) the Fly-In participants headed to the next hands-on workshop scheduled at Forsyth Tech.

With welcome rain falling in the region, campus security maneuvered the bus right up to the front door of Forsyth Tech's gleaming science/technology building, only a couple of years old. Riding the elevator to the fourth floor, the group entered a spacious and well-equipped biotechnology laboratory.

Dr. Lucas Shallua, director of biotechnology at Forsyth Tech, welcomed everyone with opening remarks about the program and its facilities. Responding to the teachers' obvious admiration for the advanced lab and its state-of-the-art tools, Shallua was encouraging. "We started very small, if you have the will to do it, you can do it," said Shallua. "We applied for grants, some were denied, but the Department Of Labor opened a door for us and we made the best of it. We went from 22 students to 40, then to 70, then a hundred and now, today, we have four working labs and about 240 students involved in the program." The key to success, said the doctor of veterinary medicine, is attaining partners. "We have partnerships in the community, industry and with other community colleges," he said. "We train for jobs that are around the area, and beyond. We try to link students to employers and guide them in finding a job, it's extra work but we enjoy it."

Alan Beard (left) and Lucas Shallua

Alan Beard, Forsyth Tech lead biotechnology instructor, was introduced and began to direct the morning's workshop. "Industry labs must always be in compliance with strict federal guidelines so they are not fun and games. It's serious. If you make a mistake, you mix the wrong thing or don't follow instructions, there are expensive consequences.

"**We work here** as if we are in an actual workplace," said Beard. "You can't teach maturity, so we want all our students to complete an internship in an actual workplace so they will be ready when they graduate."

Then it was time to get busy - hands-on.

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Marla Jones, Mike Santos, Jocelyn Broemmelsiek, Christina Dely

Forsyth Tech is one of the largest community colleges in North Carolina and serves growing segments of the population seeking to acquire career-oriented education. The college offers 156 programs of study in a variety of fields that lead to an associate's degree, a certificate or a diploma. The biotechnology curriculum, which emerged from molecular biology and chemical engineering, meets demands for skilled laboratory technicians in various fields of biological and chemical technology.

Curriculum objectives are designed to prepare graduates to serve in three distinct capacities:

1) research assistant to a biologist or chemist
2) laboratory technician/instrumentation technician,
3) quality control/quality assurance technician.

One biotech partner Forsyth Tech works with - the Wake Forest Institute for Regenerative Medicine - offers an internship program to students at Forsyth Tech who choose an associate degree in applied sciences in Biotechnology. This internship gives practical research laboratory experience and complements courses offered in Basic Lab Techniques, Bioprocess Techniques, Cell Culture, Immunological Techniques and Biotech Lab Experience. For more information: http://www.forsyth.tec.nc.us/degree/biotech.pd

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Forsyth Tech hands-on workshop with Lucas and Alan *(cont.)*

"This morning we will be working with gel electrophoresis and cleavage of DNA with restriction enzymes," said Beard. "DNA is negatively charged, it will run across the gel toward the positive charge and leave deposits that can be read." The teachers divided into small groups and began working on the benches.

Tammie Schrader, Jacob Dahlke, Lisa Chaloner, Michael Holst, Julia Sloan

The separation of DNA using gel electrophoresis involves knowledge of the apparatus, the specific techniques involved and the safety measures that accompany the use of these materials and techniques. Electrophoresis involves five components: the driving force, which is the electric current; the sample to be separated (e.g., DNA); the support matrix (e.g., Agarose gels); the buffer (e.g., Tris EDTA [ethylene diamine tetraacetic acid] buffer); and the detecting staining system (e.g., methylene blue and ethidium bromide).

Sandy Kent, Sandra Loy, Lara Schoener, Brenda Graves, Claire Handy, Terrianne McKeon

Susan Armbruster, Susan Munn, Teresa Alsept (with pipette), Lara Schoener (behind her), Cecilia Serrano, Nancy Farmer, Cathy Stone

Both DNA and RNA migrate through the gel toward the positive pole of the electric field. Since the gel acts as a sieve, it normally impedes the movement of larger molecules. So smaller molecules migrate faster along the gel toward the positive electrode (anode). Rates at which these molecules travel are inversely proportional to their molecular weight.

Electrophoretic mobility of DNA through agarose gel is dependent on the molecular size of DNA. For example linear DNA travels through the agarose gel matrix at rates inversely proportional to its molecular weight. In order to determine accurately the molecular weights of the unknown fragments, all samples that are being analyzed using gel electrophoresis are usually run in parallel with known standards or DNA ladders (i.e. DNA fragments of known molecular weights).

The action in the lab started and was fast and furious. Some groups caught on quickly, others ran into difficulties; helpful consultations were ongoing. Finally, after an hour of lively activity, results of the experiment, seen in the tell-tale bands of successfully mapped DNA, were posted and lit in a darkened lab. The teachers filed passed, enjoying thses visible results of their work.

Then it was back on the bus to head into Winston-Salem for lunch.

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

On to Piedmont Triad Research Park

As the visiting teachers rolled across the North Carolina countryside, Cecelia Serrano of the National Hispanic University, spoke with her colleagues. "Biotech is difficult, there are no resources. Our students are missing out. I want to offer them more, but we have to fight," said the experienced West Coast educator. "I'm excited about being here and getting to talk to other teachers."

Serrano wants more people to know about her school. The National Hispanic University is 25 years old, private, with about 700 students. "We also run a charter high school. We bring bright students up to grade, demand parents cooperate and are involved with their students. We have a waiting list." Serrano talked about a popular misconception about the National Hispanic University. "We don't teach in Spanish, we teach in English. We have other minorities. Most haven't had a chance or are not prepared enough – we have out reach."

Engaging and intriguing young people in science requires awareness and concrete incentives - like a good job with good pay. "A student may be interested in math but it is difficult. I encourage them, tell them: 'come on, spend a few hours - learn this! You can have a better job!' Biotech and nanotechnology are industries of the future. We need to change the mentality of the public and the administration, they see us as competition for resources. I've had to search externally, I've had to set up a program for no charge."

THE NATIONAL HISPANIC UNIVERSITY

Lunch with an Overview and Tour of Targacept

The bus pulled up to the curb near an entrance to the Piedmont Triad Research Park in downtown Winston-Salem. Surrounded by shining glass of new office and research buildings, the visiting teachers walked past the soaring stainless steel helix sculpture and entered the biopharmaceutical company Targacept. A selection of sandwiches and iced tea awaited; everyone was soon seated in the comfortable chairs of the meeting room. Debra Perret, community affairs and grants specialist for Targacept, conducted a lively and informative session as the participants enjoyed their lunches.

Targacept building in the Piedmont Triad Research Park

Spun out of tobacco giant R.J Reynolds (RJR) in 2000, Targacept is headquartered in Winston-Salem, N.C. and is following through on early research into the brain's so-called neuronal nicotinic receptors or NNRs. Though association with nicotine gave these receptors their name, they respond to numerous agents. They act as volume knobs in the central nervous system (CNS); their primary function is in regulating the release of a variety of neurotransmitters in the brain, including acetylcholine, which controls excitatory actions in the CNS. "Published studies showed that smokers had lower incidence of Alzheimer's disease and Parkinson's disease," said Perret. "Those findings indicated that this receptor group was a potential therapeutic target."

Debra Perret

Targacept's goal is to discover and develop a new class of drugs, called NNR Therapeutics™, that promote therapeutic effects and limit adverse side effects. The company spent many years creating a proprietary drug discovery engine called Pentad™. Targacept uses it to efficiently analyze thousands of compound candidates in vitro and select the most promising for synthesis and testing in its laboratories.

"Mathematical models enable us to increase our understanding of how molecules will interact with various NNR subtypes," Perret told the group. "And whoever has the best model will be well positioned to develop new molecules. This is where Pentad comes in."

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National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Lunch with an Overview and Tour of Targacept *(cont.)*

Perret was also very enthusiastic about Targacept training and internship programs. "Taking on interns is labor-intensive, but we've had more than thirty in five years. We urge other companies to develop internship programs," said Perret.

Teachers learn about biotech developments at Targacept

'We must provide spaces and opportunities for young minds in this field," she continued. She then described how the company selects its candidates for full-time, paid internships during the summer. Throughout the year, when possible, Targacept also provides job shadowing and student tours to involve them in understanding the actual work of the company. Internships provide a tangible benefit to Targacept since interns contribute to work objectives.

"Students find it a 'real world' full-time work experience," said Perret. "And I love it when our CEO or another executive comes up to me and says, 'Hey these interns are great; what a productive summer they've had!' The war for talent in this industry is real, and our internship program helps us discover new talent."

During a tour of Targacept, the educators were impressed by the artwork on the walls. Inside the office complex, a huge glass-walled room filled with large-scale computer processors reflected the company's bioinformatics approach to research and development. On another floor, the laboratory facilities included the more typical safety hood work areas filled with glassware and high tech machines.

"Will the molecule bind to the receptor?" asked Dr. Craig Miller, intellectual property director and a chemist, who conducted the laboratory tour. "That is one of the main questions we try to answer," he continued. "Understanding a molecule's purity, absorption and effects requires painstaking chemical processes. It's hard and difficult work, but it is important work for health and humanity."

Completing the tour, the group was also impressed by the well-appointed and comfortable break room, with its beautiful outdoor deck. "We have great people here, who work very hard. We also have many from different parts of the world, so we have provided gathering spaces where they can connect, create and refresh. It is an exciting place to work, one with teamwork, energy, vision and focus," commented Perret.

TARGACEPT

With a $45 million public offering successfully completed in April 2006, new alliances with pharmaceutical giants AstraZeneca and GlaxoSmithKline, plus 400 issued or pending patents in the NNR space, Targacept is well positioned to compete. The company has five clinical-stage product candidates, with others in various stages of preclinical development. The most advanced are in development as treatments for Alzheimer's disease and cognitive deficits in schizophrenia, depression and anxiety disorders, and pain.

Another distinguishing characteristic of the company is its proprietary drug design platform called Pentad. It combines sophisticated, computer-based molecular design methodologies and extensive biological data from a library of diverse compounds developed and collected over more than twenty years to identify and prioritize NNR modulators with a greater likelihood of clinical success.

The company is most proud of its people, claiming them as the source of its success and competitive advantage. A multinational and cross-cultural fabric is a strength that Targacept values as it grows. And with nearly 27 million[1] people in the world already struggling with Alzheimer's disease—a number expected to quadruple by 2050—the need for potential new treatment options such as Targacept's NNR Therapeutics is clear.

For more information, visit http://www.targacept.com

[1] Brookmeyer R et al, Forecasting the Global Burden of Alzheimer's Disease, Dept. of Biostatistics, Johns Hopkins Bloomberg School of Public Health, 2007.

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Seeing medicine's future at the Wake Forest Institute for Regenerative Medicine with Dr. Benjamin Harrison

Having learned about the exciting breakthroughs in regenerative medicine pioneered by Anthony Atala, M.D. and being applied by Tengion with useful, commercial "neo-organ" products, the Fly-In teachers were somewhat prepared for the next and final visit of the program. This time it led to the Wake Forest Institute for Regenerative Medicine. But when the group actually got inside and saw the work underway on laboratory benches here, it still seemed astonishing – including an actual human aortic valve alive in a glass container.

Located a short walk across the Piedmont Research Park from Targacept, the group was oriented by Karl-Erik Andersson, M.D., Ph.D. and Benjamin Harrison, Ph.D. Connected to Wake Forest University (WFU) Health Sciences, the Institute encourages crossovers and collaborations among scientists, students and professionals. Dr Atala, for example is a surgeon in the area of pediatric urology and W.H. Boyce Professor and Chair of the Department of Urology at the WFU School of Medicine as well as a researcher and director of the Wake Forest Institute for Regenerative Medicine.

Teachers learn about advanced biotech at Wake Forest Institute for Regenerative Medicine

"We have a lot of open space here, we're set up like a biotech start-up, there's lots of sharing and intermingling," said Dr. Harrison. "An internist could be working next to a urologist. There's synergy in these interactions, socially then technically. We have high school student interns working side by side with Ph.D. scientists."

All of this work is focused on accelerating the development of clinical therapies for replacement and regeneration of diseased tissues and organs. "We restore functions in the body, we discover innovative tricks to get the body to regenerate," said Dr. Harrison. He talked about how they could take a postage stamp size biopsy and in 60 days grow enough cells to cover a football field. "By using autologous cells – your own - there is no rejection. The donor becomes the recipient."

Dr. Benjamin Harrison discusses regenerative biotech techniques with Donna Oakley of Atkins

The process of creating a new organ requires much more than new cells though. "The scaffold apparatus, the frameworks we build the organs with, require new innovations and technologies. For example, we use biodegradable plastics which last only long enough to regenerate to organ," explained Dr. Harrison. So the institute combines experts from many different fields, including cell biology, engineering, materials sciences, surgery and more to advance its results in the awakening regenerative medicine field. "We are constantly cross training students in many areas because the field is so new," said Dr. Harrison.

In addition to the human aortic valve living on one of the benchtops, the touring teachers saw other remarkable innovations - like science fiction coming to life before your eyes. "We were working on ways to get the cells on to the scaffold and someone came up with the idea to use an ink jet printer," said Dr. Harrison.

Everyone was amazed to see a standard desktop inkjet printer set up in the lab - only insted of ink this one was loaded with cells. "It turns out the nozzle of the printer is the perfect size for dispensing cells," said Dr. Harrison. "Then we took it a step further and built a little elevator to descend as it prints out the cells, so we can create a three dimensional object."

As the now-tiring teachers filed out at the end of their program, no one doubted they had just stepped into and witnessed an amazing future - with hope - for humanity.

And everyone felt excited about being part of it.

National Biotech Teachers Fly-In, Oct. 17-19, Piedmont Triad, NC

Finally, back to the airport to fly out

Ready for next time!

Buzzing with wonder after seeing advancing biotechnology in action - the intrepid teachers gratefully boarded the bus one more time as driver John Powell pulled it up to the curb and opened the door. It was time to head back to the Piedmont Triad International Airport and fly out. Time also to see if the questions for Mrs. Schrader - "why study cells?" - were answered.

"When we learn about these things, like regenerative bladders, we are current, we know what we can do with this knowledge," said Shrader, who was grateful for the unique Fly-In experiences. "I know about multiple sclerosis in our area, the Pacific Northwest. I liked seeing that poster in Biogen Idec of the woman thanking the workers for making the medicine that was saving her life. It's not only research, kids have MS in their lives, they know about it. And the strawberries: that was awesome! The kids will love it."

The teachers fly in, the teachers fly out.

Schrader, who teaches at the Cheney Middle School in Cheney, Washington, tallied more benefits of the experience. "I write grants so I took pictures of the equipment, now I know what to buy. I sit on a team that writes and evaluates state proficiency tests. Now I can help look for elements to put in there for biotech. I also collaborate every week on Fridays for an hour with high school teachers and others. We are working together to reach those kids who say, 'I hate science.' Plus I teach the gifted and talented and these workshops gave me some great ideas about teaching DNA."

Ultimately, the purpose of this fly-in partnership prototype is to get the word out to people who most need it and can immediately use it in the front line battles for the biotech workforce of the future – in today's classroom. Bringing active, motivated people together and giving them support and resources to become more active and more motivated has a multiplier effect on the program's dissemination.

"I'm not a traveler, but this is worth it," said Schrader who was ready to get on a plane and head back home. "What you bring back is so powerful. It's worth the three days of teaching I missed."

Partners made the National Biotech Teachers Fly-in possible. Thanks go to:

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Piedmont Triad Research Park
Targacept
Tengion, Inc.
The Research Triangle Park
Wake Forest Institute for Regenerative Medicine

National Biotech Teachers Fly-In Participants as shown on front cover, from left to right:

Donna Oakley, Atkins High School Winston-Salem, NC; Russ Read, NCBW; Marla Jones, Merrimack High School, Merrimack, NH;Teresa Alsept, Eckstein Middle School, Seattle WA; Sandra Loy, Southern Alamance High School, Burlington NC; Julia Sloan, Travis High School Austin, TX; Jocelyn Broemmelsiek, San Dieguito Academy Encinitas, CA; Lara Schoener, Post Falls High School, Post Falls, ID; Brenda Graves, Southern Alamance High School, Graham NC; Tammie Schrader, Cheney Middle School, Cheney, WA; Terry Howerton, Atkins High School, Winston-Salem, NC; Susan Munn, Carlsbad High School, Carlsbad, CA; Cecilia Serrano, National Hispanic University, San Jose, CA; Bill Woodruff, Bio-Link; Jacob Dahlke, Seattle Lutheran High School, Seattle, WA; Susan Armbruster, All Saints School Middle School, Puyallup, WA; Sandy Kent, Educational Consultant, Deering, NH; Cathy Stone, Merrimack High School, Merrimack, NH; Mike Santos, San Dieguito Academy, Encinitas, CA; Christina Dely, Oak Grove High School, Campbell, CA; Carolyn Preyar, School of Biotechnology, Winston-Salem, NC; Terrianne McKeon, Merrimack High School, Merrimack, NH; Lisa Chaloner, Merrimack High School, Merrimack, NH; Nancy Farmer, Our Lady of Mercy School, Winston-Salem, NC; Claire Handy, Somersworth High School, Somersworth, NH; Michael Holst, W. F. West High School, Chehalis, WA; Mike McBreirty, Biogen Idec

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