



## Hyun Beom Lee

Fourth-year undergraduate, Chemistry

## Hyun-Soon "Joy" Chong

Assistant Professor of Chemistry

### DEVELOPING RIT CANCER DRUG

Professor Chong has received two grants from the National Institutes of Health (NIH) for her work in cancer diagnostics and therapeutics. This summer, Hyun (a student from South Korea) was able to assist Professor Chong in developing a drug for cancer treatment and imaging called radioimmunotherapy (RIT) and positron emission tomography (PET). In RIT and PET, scientists genetically engineer antibodies designed to target cancer cells, link the antibodies to radioactive atoms, and send this "package" into the patient's bloodstream. The antibodies seek out and attach themselves to specific proteins in the cancer cells, delivering the cancer diagnostic or therapeutic radiation, signaling the body's own

immune system to act, and imaging or killing the cancer cells. Hyun is developing a new organic compound that can hold radiation tightly while being attached to an antibody. "It's very challenging," said Hyun. "There are about 10 to 12 steps to make the final product. You need to be very careful. Sometimes your reactions do not go well. But by your failures, you learn. And there is joy when your reactions go well."

This summer, Hyun sometimes worked until 4 a.m. or 5 a.m. if a reaction was running and came back to the lab later that morning. But he feels it was worth it. "I really wanted to learn," said Hyun, who will present a poster on his research at an American Chemical Society meeting and continues to work with Professor Chong. "Seeing the progress of the research, getting nearer to the objective, is wonderful. And it's a huge experience for me as an undergraduate." Professor Chong said, "Sometimes organic chemistry is a really tough job. It's not like other jobs where you can come in at 9 and leave at 5. You have to be on site when there's a reaction to make sure it's going." But the payoff may be the ability to help millions.

*Hyun assists Professor Chong with her NIH-funded cancer research.*

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## CSL Undergraduate Summer Research Scholarships 2007

This report presents the research of CSL undergraduates and their faculty mentors during Summer 2007.

## Chris Ruszczak

Fourth-year undergraduate, Molecular  
Biochemistry and Biophysics

## Nick Menhart

Associate Professor of Biology

### CHARACTERIZE THE ROD REGION OF DYSTROPHIN

Chris is a transfer student from Rock Valley College in Rockford, IL, who met Professor Menhart through IPRO 302, Synthetic Biology: Engineering Novel Organisms. This summer, Chris assisted Professor Menhart with his dystrophin research, which is funded by the National Institutes of Health (NIH), National Institute of Arthritis and Musculoskeletal and Skin Diseases. Dystrophin is the protein whose defect underlies Duchenne muscular dystrophy (DMD). It is the largest human gene, with 2.4 million base pairs. Dystrophin is a very long, modular rod, the most common module being the spectrin type repeat or STR. An important question is the nature of this rod: is it floppy like a string, or rigid like a girder – or modular, like a bicycle chain, or a carpenter's rule? The answer is crucial, since a repair strategy for DMD is to splice over defective

parts of dystrophin, and the junctions have to match up. Chris helped to study several of these modules, finding out "where the stiff parts and the bendy parts are," as Professor Menhart put it, with the ultimate goal of identifying the right place for the splice – making gene therapy for DMD more precise

"Originally, I thought about doing medicine; but now I'm more interested in doing research," said Chris. "It's like the difference between a service provider and an innovator. Both sectors help people – just differently." He added, "I'd also like to teach." Professor Menhart, who did research as an undergraduate at the University of Waterloo in Canada, believes strongly in it ("It's crucial for people interested in going to graduate school"). He also believes in basic research. "Applied research is like the guy who catches the pass in the end zone at the last minute – he gets the glory," he said. But the team also needs "the guy who sets up the plays. That is basic research, and that's what most people do."

**“Originally, I thought about  
doing medicine; but now  
I'm more interested  
in doing research.”**

*Chris' work may improve gene therapy for Duchenne muscular dystrophy.*



**Minseung Kim**  
Third-year undergraduate, Computer Science

**Shlomo Argamon**  
Associate Professor, Computer Science

## DATA MINING APPLICATION FOR PREDICTING CAREER DEVELOPMENT

A student from South Korea, Min says, "I like thinking of things that were not thought about by other people before." Last semester, he was researching graduate schools and looking at people's resumes online when he had an idea. Could you mine information in resumes and create a program that would look at a person's employment history and interests, and predict what he or she would do professionally? Professor Argamon, whose research interests include machine learning, computational linguistics, stylistics and information retrieval, encouraged him to try it. So Min is using data mining and predictive modeling to look at text in resumes, find correlations between employment history and career development, and create a tool that

can forecast likely career paths. Potential users are employers as well as individuals who want professional feedback, e.g., "Here's my resume. I'd like to be doing such-and-such in five years. What should I be doing now?"

"The project has many interesting technical problems in terms of processing the data – taking the text from resumes and turning it into structured data that computers can use," said Professor Argamon. More sophisticated natural-language processing and knowledge modeling will be needed to capture subtle issues; for

**"I'm really enjoying it because I suggested the research myself."**

*Professor Argamon reviews Min's work.*



example, how do you compare and weigh things? Is the general manager of a division in a Fortune 500 company greater or lesser than the CEO of a small startup? Min's project also crosses disciplinary lines, embracing not only computer science and linguistics, but also potentially organizational psychology.

"I'm really enjoying it because I suggested it myself," said Min. Besides producing the tool, he also may publish a paper on the project, and both should help him as he applies to grad schools this year.

The College of Science and Letters at the Illinois Institute of Technology believes strongly in research experience for undergraduates. Research allows students to explore their interests, solve problems, advance knowledge and prepare for the next step – whether graduate school, medical school or the workplace.

Research opportunities for CSL undergraduates:

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- Guided by world-class faculty who have received national and international recognition in their respective fields

**Alex Bunce**  
Third-year undergraduate, Biology

**Jialing Xiang**  
Assistant Professor of Biology

## STUDY OF Bax $\Delta$ 2 IN PROSTATE CANCER CELL LINE



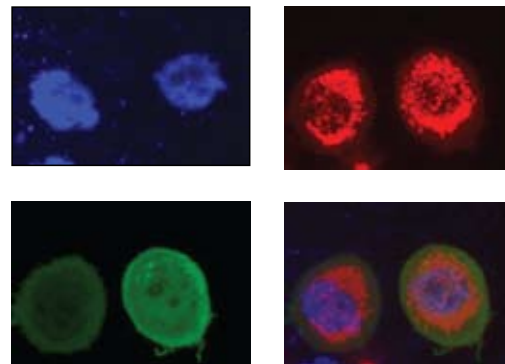
Prostate cancer is the most common cancer in men in the United States, touching nearly one in five men, typically after age 50. In 2005, nearly a quarter of a million men were diagnosed with it, and 30,000 died of it. In research that has been cited worldwide, Professor Xiang focuses on the development of cancer at the molecular level and specific therapy for it. One part of her research looks at cell death using prostate cancer as the model. This summer, Alex, a student from New Lenox, IL, researched a new isoform, Bax $\Delta$ 2, in the prostate cancer cell line. He created constructs with Bax $\Delta$ 2 and green fluorescence protein and delivered them to prostate cancer cells; he then looked at the cells with an immunofluorescence microscope to monitor cell death and compare Bax $\Delta$ 2 with the original form of Bax (Bax $\alpha$ ). "It did turn out to be much more virulent," noted Alex.

The lab's work "hopefully will one day help with the treatment of cancer," he said "Something's going to have to happen soon." He plans to become a physician and feels his research experience will help him be a better one. He also liked the camaraderie and collaboration in the lab. "I was able to work alongside the

graduate students in the lab," he said. "I learned essential molecular biology techniques that will be very useful in my future. And most importantly, I had fun!"

**Alex plans to become a physician and feels his research experience will help him be a better one.**

*Prostate cancer cells as seen using an immunofluorescence microscope.*



*Alex worked on prostate cancer, the leading cancer in men in the United States.*



Professor Stark and Alayna in the lab.

**Alayna George**  
Fourth-year undergraduate,  
Molecular Biochemistry and Biophysics

**Ben Stark**  
Professor of Biology

## VITREOSCILLA HEMOGLOBIN STUDIES

A native of Kennewick, WA, Alayna remembers visiting a marine biology lab as a second grader and seeing a lot of “cool organisms.” But keepers couldn’t show the class an octopus because one got out of his cage the night before and munched a technician’s arm. “I think it broke the bone,” Alayna said. She wasn’t scared; she was fascinated and wanted to know all about it.

That curiosity has stayed alive and helped propel her research work this summer with Professor Stark, who shares her view about the world. “I always felt like I wanted to know how everything works,” he said. Stark is a leading researcher in the molecular biology, biochemistry and physiology of *Vitreoscilla* hemoglobin (VHb), a novel bacterial hemoglobin, and its use to genetically engineer improved biochemical properties of diverse bacteria for biofuels, plastics

and other uses. In a nutshell, VHb appears to help things grow, likely by carrying oxygen, as well as offering potential other benefits. “But VHb likely has other roles in the cell,” he said. “The more we know about it, the better. If we want to optimize its benefits in genetic engineering applications, we have to know as much as possible about how it works.” In her work this summer, Alayna studied how hemoglobin is affected by reactive oxidants, growing it in a small concentration of hydrogen peroxide. She also helped to oversee the work of an even younger student intern in Stark’s lab, from Lincoln Park High School. Alayna has one more year of study at IIT before heading off to graduate school to earn her PhD.

“Even as an undergraduate, I’ve been treated like a graduate student,” said Alayna of her research experience. “Professor Stark will say, ‘Go read this 50-page article and figure it out.’” (He says, “I always know Alayna can figure it out.”) “I would definitely recommend this to other undergraduates,” Alayna said, especially “with a professor who will help you get the most out of it.” After IIT, Alayna hopes to return to the West to get her PhD, preferably in California or Arizona, and then be a professor. “I like the challenge and reward of teaching those who are motivated to learn for learning’s sake,” she said.

CSL Undergraduate Summer Research Scholarships provide \$5,000 for 10 weeks of focused research under faculty guidance for undergraduate students.

**“Working full-time, they can make big progress. When they go to graduate school, they don’t have to start from scratch – they know what to do.”**  
– Professor Joy Chong

**“We should support and increase the availability of research experience for undergraduates as much as possible.”**  
– Professor Shlomo Argamon

**Jeff Cecil**  
Fourth-year undergraduate, Physics

**Carlo Segre**  
Professor of Physics

## NOVEL ELECTROLYTE MEMBRANES FOR HYDROGEN FUEL CELLS

Someday, energy stored as hydrogen may be our primary energy source. Jeff worked toward that future this summer.

Jeff is a CAMRAS scholar from Morton Grove, IL, who loves the breadth of physics and has explored many areas in it. He had an internship at Los Alamos Laboratory last summer, for example, and one at an industrial firm prior to that. This summer, he had the opportunity to do research at Michigan State University, Purdue University or Texas A&M. But he chose to accept the CSL Undergraduate Summer Research Scholarship so he could assist Professor Segre with research into a material that has the potential to be used as an electrolyte membrane in fuel cells.

Jeff spent most of the summer in a quiet basement lab in Wishnick Hall, making

indium-doped tin phosphate samples. He mixed tin oxide, indium oxide and phosphoric acid and heated it until it became a paste in which some of the tin was replaced by indium, and heated that at even higher temperatures in a furnace until it became a solid. He then checked the samples’ structure on an x-ray diffractometer to see if they were correct and had no impurities. Ultimately, he’ll also check them at Argonne.

“Working this summer has definitely shown me the challenges of being an experimental physicist as opposed to a theorist,” he said. “Theorists are focused on the complex details of the physics, while experimentalists have to use ingenuity to deal with practical problems. I had never worked on such a hands-on project before, and it has given me a good perspective.”

**Someday, energy stored as hydrogen may be our primary energy source. Jeff worked toward that future this summer.**

*Jeff makes indium-doped tin phosphate samples.*



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Science and Letters  
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**Andrew Mehr**  
Second-year undergraduate,  
Political Science and Psychology

**Thor Hogan**  
Assistant Professor, Political Science

## TRACKING DOE ENERGY R&D SPENDING

Energy spending is one of the top research and development (R&D) priorities of the federal government. As issues like global climate change and peak oil take center stage, where the Department of Energy (DOE) allocates its resources becomes more important.

This summer, Andrew researched federal energy-related spending using the Research and Development in the United States (RaDiUS) database. Managed by the RAND Corporation for the White House Office of Management and Budget, RaDiUS reports R&D spending by department, project and other parameters. Andrew found that between 1993 and 2006, DOE spending on defense-related nuclear research far outpaced spending on renewable energy or fossil-fuel research. Throughout the summer, Andrew worked from his hometown

of Brainerd, MN, accessing RaDiUS from his computer and communicating with Professor Hogan by email and cell phone. "He was a 'virtual adviser,'" said Andrew, a CAMRAS scholar. Andrew will develop a poster about the research for a meeting of the Midwest Political Science Association and may write a scholarly article about it. Professor Hogan ultimately will produce a report on it for policymakers.

If he hadn't received a summer research scholarship, Andrew said, he may have worked as a lifeguard or at a golf course. Instead, he developed real research experience that will help him stand out when he applies to graduate school. "It's a very good opportunity for undergraduates," he said. "It gives you a much deeper understanding of a topic within a field, and it lets you know if you want to pursue academia as a field. It definitely did that for me."

**“ This opportunity gave me  
a much deeper understanding  
of a topic within a field.”**

Andrew Mehr



**Research is critically important to advances in health,  
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the joy of inquiry and discovery, experience that's  
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**Melissa Lee**  
Third-year undergraduate, Biochemistry

**David Mogul**  
Associate Professor, Pritzker Institute  
of Biomedical Science and Engineering

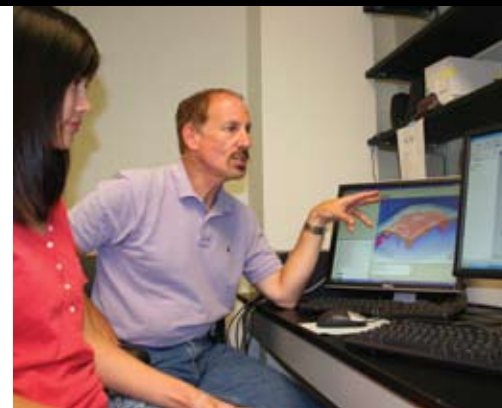
## SEIZURE PREDICTION

Melissa, who comes from Schaumburg, IL, and whose father, Gregory, is an IIT alum (EE 79, MS 83), plans to go to medical school and be a medical or clinical researcher. She is fascinated

with the brain. "It's so complex, and so little is known about it," she said. "It is the central organ that controls everything." This summer, Melissa kicked off a research project on an enduring mystery of the brain: what causes seizures, specifically in epilepsy patients? Are there warning signs? "People have been trying to figure out if there are any signposts that seizures are coming," said Professor Mogul. "If people with epilepsy knew this, they could put themselves out of harm's way – pull over to the side of the road if they're driving, for example."

Seizures and novel treatments for them are key parts of Professor Mogul's research.

A specialist in the electrical properties of the brain, he is exploring, among other things, how transcranial magnetic stimulation (TMS) – a non-invasive method for stimulating the brain to treat seizures and other disorders – might be improved through



Computer modeling of the brain.

computational analysis. Melissa's work includes developing a computer program to analyze electroencephalogram (EEG) recordings of seizures of epilepsy patients while they were in a hospital. Epileptic seizures usually come without warning. Ultimately, her work may provide the ability to predict seizure onset which could have a profound effect on the quality of life for epileptic patients and may provide neuroscientists and biomedical engineers with a key to preventing future seizures before they begin.

Melissa and Professor Mogul in his lab.

