Scientific Discoveries

Faculty-led undergraduate scientific research is thriving inside Gilbert Science Center.

ABOUT THE IMAGE: A confocal microscope image (1000x magnification) taken by students in BIOL 234 (Cell Biology). A layer of breast cancer cells was stained with a probe that fluorescently illuminates the location of a cell surface protein called E-cadherin. This protein is necessary for cell to cell adhesion, as illustrated by the fact that there is bright green fluorescence found in the boundary between cells, but not in places where the cell is not in contact with another cell (see the upper left space).

Students conduct chemistry lab work inside Gilbert Science Center.

When Dr. Maureen Diggins arrived at Augustana as a new faculty member in 1979, she made her way through the halls of the Gilbert Science Center (GSC) with a lump growing in her throat.

At a monstrous 85,550 square feet, GSC was widely considered the cutting-edge science facility of the upper Midwest. Officially dedicated in 1966, it was barely 13 years old when Diggins arrived, and its whopping $2 million price tag was still a much-talked-about figure.

After finding her office, Diggins, at the time the only female tenure-track faculty member within the Natural Sciences Division, made the rounds to meet her new colleagues.

Among the first to shake her hand was the legendary Dr. Gil Blankespoor, a biology professor with thick, dark sideburns and square glasses.

"Welcome, colleague," Blankespoor said.

The rest of "the guys" as Diggins calls them – icons like Dr. Sven Froiland, Dr. Larry Tieszen, Dr. Lee Johnson, Dr. Lansing Prescott, Dr. Milt Hanson, Dr. Arlen Viste, Dr. J.D. Thompson and Dr. Karl Vander Lugt – all provided warm welcomes and valuable guidance during her early days on campus.

Looking back, Diggins, a professor emerita of biology specializing in human physiology and endocrinology, says that while a lot has changed since 1979, a good number of things haven't – namely GSC's dedicated faculty, each of whom are committed to excellence in teaching and continued scientific discovery through research.

Dr. Maureen Diggins

"Students have always come first – we're proud of our open office door policy. We've also always believed that faculty members need to be involved in research and that we need to involve our students in it as well."

Momentum

In partnership with the National Science Foundation (NSF), those same "guys," Diggins says, were the pioneers behind some of Augustana's first research initiatives – first through the Undergraduate Research Participation (URP) Program and later through the Research Experience for Undergraduates (REU) Program.

The framework they built, Diggins said, paved the way for the unprecedented research projects students and faculty members are involved with today.

As of mid June, 91 students will be participating in summer research projects on- and off-campus – an increase of 54 percent from a year ago.

Dr. Mark Larson, assistant professor of biology and the Biomedical Research Infrastructure Network (BRIN) coordinator for Augustana, attributes the increase in researchers to sheer momentum.

"It's easier for me to make the case for a grant when I can show that I can do the research, that I have the equipment necessary, and that I have skilled and competent students to assist me. When grants are approved, they lead to more discoveries, more equipment, and, ultimately, more opportunities to make cases for additional grants," he said.

In 2001, in collaboration with the USD Sanford School of Medicine, Diggins helped write the original proposal to the National Institutes of Health for the first BRIN grant, a program designed to draw students into biomedical research.

Today, major grants funded through agencies such as the National Institutes of Health (NIH), NSF, the U.S. Department of Agriculture (USDA), NASA and others have paved the way for the purchase of scientific equipment and have helped support a number of research projects across the Natural Sciences.

Dr. Mark Larson

In addition to the explosion of research-related grants, Diggins says Augustana's "seeds of association" with medical staff and scientists at Sanford Research and Avera McKennan Research have paved the way for students to participate in active, cutting-edge scientific laboratories while learning valuable real-world experience.

"Many of the physicians and researchers are alumni and/or friends of Augustana. They're willing and excited to collaborate with us, both on research projects and by providing opportunities for our students to shadow and/or work with physicians and researchers."

"Thanks to the BRIN grant, we can go to Sanford or Avera and say, 'We have some gifted students. We also have a grant that will pay them. Can they research under your mentorship?'"

The 'Ah Ha' Moment

For Diggins, there's no greater joy than seeing students at the time of their "ah ha" moment.

"It's when they realize, 'Hey, this is it for me. I could spend my life doing this.' It's incredible to witness that moment of discovery. It's also why labs are so critical. Students can't learn science without seeing it happen. It's the same way an artist can't really be an artist without an art studio."

Larson agrees.

"We're called to teach. We're better teachers when we're immersed in our scholarship. I can talk about cell biology because I've been researching it and reading about it myself. I can call upon a bigger bank of knowledge that I'm constantly refreshing," he said.

"I can tell them the raw knowledge, or I can show them 'here's how we've really come to know this.' At its core, science is never done. If we don't continuously come up with more questions, then our conclusion probably isn't right."

"Ultimately though, it's fun to be at the forefront of discovery. It's fun and exciting to learn something no one has ever known before. It's an amazing thing to put students in the middle of trying to describe the natural world."

Larson's own research, which students assist with, has two arms.

He's spent the last five years collaborating with Sanford Health's Dr. William Harris to study the role omega 3 fatty acids play in heart health. Specifically, the two are examining the effects of fatty acids on platelets.

He's also conducting research that examines the factors behind platelet-biogenesis. Ultimately, what makes platelets?

Both initiatives, Larson says, interface with medicine.

"It's easy to say we're trying to find and understand what makes us healthier. This research might someday lead doctors to recommend that people factor more omega 3 into their diets."

Prior to her retirement in 2008, Diggins dedicated nearly 20 years studying the links between obesity and infertility. Using the lethal yellow mouse, she collaborated with Dr. Nels

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Granholm from South Dakota State University, conducting experiments to determine why obesity impairs fertility, specifically examining the effects of the hormone leptin.

For nearly a decade, she also worked closely with Dr. John Brannian, head of the Fertility/In Vitro Fertilization Laboratory at Sanford Health. The goal, she says, was to improve quality of life.

"The purpose behind bio-medical research is to determine results that could improve someone's life – that's why we do what we do."

Dr. Paul Egland, associate professor of biology, is also an active researcher.

His current project, which students assist with, examines the interactions between bacteria on teeth.

"It began based on some observations I had as a grad student. I studied interactions between bacteria – one could swim independently while others were 'hitchhikers,' riding on the backs of others."

Dr. Paul Egland

"I wanted to study the result of bacterial interactions. Ultimately, how do bacteria of one species communicate with bacteria of another species?"

Egland says the ability for students to participate in his lab is priceless.

"One of the things that makes Augustana unique is that students get to apply what they learn in class in a hands-on lab – they get to do experiments and test ideas. That hands-on work is what helps students learn – it cements the ideas they learn about in the classroom. They're being exposed to ideas they haven't had before. Ultimately, they're being exposed to being scientists."

Like his colleagues, Dr. Jared Mays, an assistant professor of chemistry, is also engaged in research which students assist with. His lab studies how dietary sources can reduce cancer risks. Specifically, he's studying how the molecular system present in broccoli could teach us how to selectively activate drugs in certain tissues within the body.

"At some point, this work may provide another method to deliver drugs to a site and, in turn, minimize the effects of the drug on the rest of the body."

While real-world experiences are vitally important, Diggins says advisers also play a key role in helping students get to the point where they can experience their "ah ha" moment.

"Advising is so essential – it helps students find their right path and, eventually, the right career. It helps them discover where their gifts are. And, it also really allows a faculty member to get to know a student. I can typically write a two-page letter of recommendation for my advisees."

By the Numbers

The number of students pursuing majors within the Natural Sciences has been steadily on the rise. In 2005, the College reported 169 biology majors, 60 chemistry majors and 26 physics majors.

In comparison, for the 2010-2011 academic year, the College reported 265 biology majors (a 36 percent increase); 84 chemistry majors (a 28 percent increase); and 41 physics majors, (a 36 percent increase).

While student numbers within the Natural Sciences continue to grow, their professional accomplishments after graduation are also mounting.

Dr. Jared Mays

According to an analysis of 206 students who majored in the Natural Sciences and graduated between 2004 and 2008, 70 reported that they were enrolled in medical school; 26 were enrolled in Ph.D. programs; 31 were working toward a master's degree; 15 were enrolled in dental school and eight were enrolled in physician's assistant training programs.

Liberally Educated Scientists

In addition to teaching, Egland also serves as Augustana's chief health professions adviser, providing support to other advisers and serving as the direct adviser for pre-med and pre-dental biology and chemistry majors.

Specializing in microbiology, he conducted his post-doctorate work at the National Institutes of Health at the National Institute of Dental and Crainofacial Research.

Like Larson, Egland is also a proponent of engaging students in scientific research. Beyond the labs though, Egland is also an advocate for a foundation in the liberal arts. He calls education in the liberal arts beneficial for every college student, but says it's particularly valuable for science majors.

"Interesting enough, the American Association of Medical Colleges (AAMC) is doing a review of the Medical College Admission Test (MCAT) and its preliminary recommendation is that the test should include more humanities. The future reality is that people who are competitive for medical school won't be the most skilled scientists but rather, they'll be liberally educated scientists."

"What we learn in college affects how we live our lives. The reality is that liberally educated students approach questions in a different manner; they approach issues differently."

Larson agrees, explaining that Augustana's liberal arts curriculum empowers students to think broadly and to be discoverers.

"Here, we want students to experience more than just science. We want students to learn about language, culture, art and politics so they'll be poised to understand the implications of their work. We often say to students that 'we'll give you the tools to specialize, but we won't specialize you.' For medical students in particular that's so important. They need to have the capacity to appreciate beyond how to fix the patient. They need to connect with their patients emotionally; they need to be able to understand their patients' background, their cultures."

Dr. Dan Swets

For Mays, a foundation in the liberal arts is essential for students pursuing a career within the sciences.

"You can learn all the science in the world but, science is only a part of the world – it fits into every other aspect of life. Think about the development of drugs. In addition to understanding how they work on the body, so many other factors come into play. Economics – how much will they cost; what are the political ramifications; the ethical ramifications? The more students can understand that these 'divisions' are only man-made parts of the whole, the more they'll be able to understand the world and make it better."

Beyond the biology, chemistry and physics labs, Dr. Dan Swets, associate professor of computer science, is also conducting research inside GSC. This summer, he will work with 11 students on computer science-related research, studying efficiency models to determine how computers can process scientific images at faster speeds.

Like his colleagues, Swets recognizes the value of a liberal arts education. And, he says, employers within the computer science industry recognize it as well.

"An employer once said to me, 'I'd rather hire a computer scientist who knows Shakespeare than one who can build the best computer operating system. The one who knows Shakespeare knows how *people* think. That understanding will lead to the ability for him or her to build better computers that *people* will use.'"