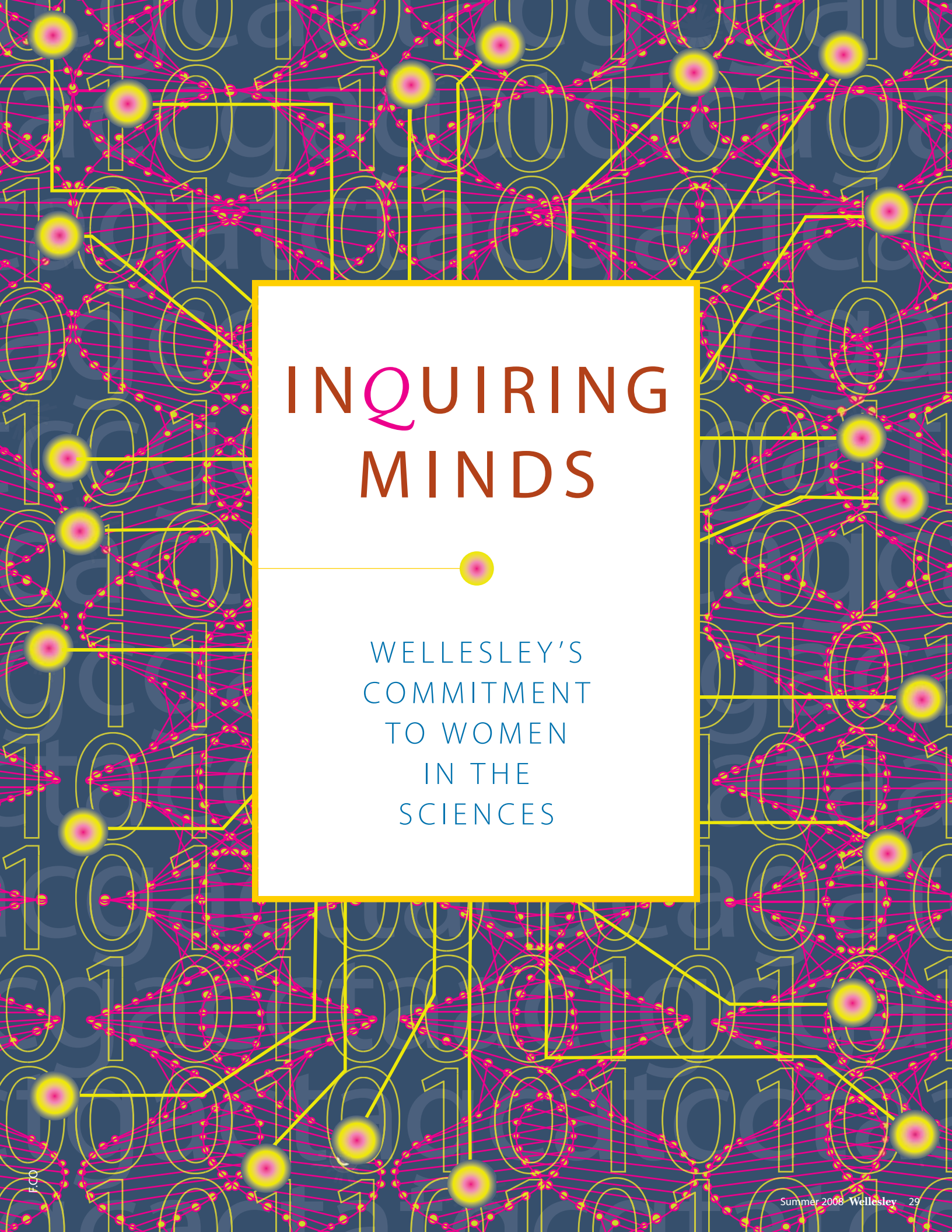

INQUIRING MINDS

WELLESLEY'S COMMITMENT TO WOMEN IN THE SCIENCES

NOLAN FLYNN *CHEMISTRY*

MARY ALLEN *BIOLOGICAL SCIENCES*

DAN BRABANDER *GEOSCIENCES*

BEVIL CONWAY *NEUROSCIENCE*

BARBARA BELTZ *NEUROSCIENCE*

MARC TETEL *NEUROSCIENCE*

NANCY KOLODNY '64 *CHEMISTRY*

ADELE WOLFSON *CHEMISTRY*

BRIAN TJADEN *COMPUTER SCIENCE*

OUTSIDE THE BOX

Today's research in the labs at Wellesley often blurs the traditional boundaries of scientific disciplines

BY LISA SCANLON '99

PHOTOGRAPHS BY RICHARD HOWARD

IN EVERY SCIENTIST'S CAREER, there are moments that make all the long hours in the lab, the inconclusive data, and the botched experiments worth it. For Thea Stewart '07, one of those moments happened the day her tiny bouncy beads turned green.

Stewart, a rangy blonde who's as happy in the Alaskan wilderness as she is behind a lab bench, was figuring out how to get *Chlamydomonas reinhardii,* a kind of green algae, to live inside beads of hydrogel. A year earlier, she had wondered whether she could use the algae, which are good at sucking up harmful heavy metals, to clean up polluted lakes and rivers. But first, she had to embed them into some sort of substance that could be easily taken in and out of the water. Hydrogel, a Jell-O-like substance she learned about from her chemistry advisor, Nolan Flynn, looked

Mary Allen (above left), Thea Stewart '07, and Nolan Flynn collaborated on an environmental remediation project.

promising. After scouring the literature, she found an Italian-made variety that seemed like it might be algae-friendly. She formed the algae-hydrogel mixture into beads 2 millimeters in diameter, put them in her lab's light room, and waited.

"The big day came . . . and the beads were green," meaning that the algae was happily growing inside them, she explains. "And that was like, honestly, the most exciting moment in my research. And I was running around trying to find someone to show my green beads to." She finally found Mary Allen, the Jean Glasscock Professor of Biological Sciences and an expert in blue-green algae. Soon Allen was whooping along with Stewart. "She was freaking out and running around showing people, and it was this crazy moment," Stewart remembers. A third faculty member cheering Stewart on was Dan Brabander, associate professor of geosciences, who was an invaluable sounding board as she took on this complex project spanning biology, chemistry, and environmental science.

Interdisciplinary research like Stewart's is becoming more and more commonplace in Wellesley's Science Center. And it's not just the students. There are also many faculty collaborations across departments, sparked by students like Stewart, or chance conversations over lunch, or shared laboratory equipment. "The Science Center is like that. People bump into each other and come up with an interesting idea and then move forward with research," says Adele Wolfson, the Nan Walsh Schow '54 and Howard B. Schow Professor in the Physical and Natural Sciences and associate dean of the College. At the moment, for example, Wolfson is collaborating with assistant professor of neuroscience Marc Tetel to figure out if an enzyme in rodent brains, involved in processing peptide hormones, is regulated by steroids.

Other faculty members' work inherently blurs boundaries between disciplines—take Brian Tjaden, assistant professor of computer science, who creates programs to help analyze the growing flood of data about organisms' genetic material. "If you want to make transformative advances in science, if you want to transform disciplines, in many cases . . . it helps to use different people's expertise from other disciplines and different ideas," says Tjaden. "It's hard to achieve, and there are some hurdles and obstacles, but I think that the field of science is moving in that direction."

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>
> —*Nolan Flynn, assistant professor of chemistry*

Apart from allowing faculty to tackle big questions and move their fields forward in exciting ways, interdisciplinary research makes a lot of sense at a liberal-arts school like Wellesley. Students who have two or more advisors in different departments have that much more creative input. Busy faculty members are able to move their research forward much more quickly if they're working with

colleagues. Students benefit from seeing professors challenging and questioning each other.

But really what it comes down to is creating more moments like the one Stewart had with her tiny green beads—moments when the stars align, the algae thrive, and students and faculty expand the boundaries of scientific knowledge.

A Meeting of the Minds

IT'S EASY TO GET LOST looking for Mary Allen's office. It's not on the old Sage Hall side of the Science Center, where most of the professors' offices are—it's tucked away down a corridor near the labs on the modern side of the building. But Allen likes her digs; indeed, she fought hard to get them. When the expansion of the Science Center was being planned in the 1970s, Allen tried to get the faculty offices relocated closer to the labs. "There were people who really fought that," Allen says. Back then, she adds, there just wasn't much research going on at Wellesley, never mind interdisciplinary research, and a lot of the faculty were far more interested in the classroom than in the lab.

How times have changed. Now, professors are both enthusiastic researchers and teachers, and students are encouraged to get their feet wet in the lab doing research as early as their first year. "I feel that undergraduate research is the best way of teaching," says Allen, voicing a sentiment echoed by many science professors. And Allen believes that professors who keep active in their field of research naturally pass on that excitement to their students, and are more likely to stay engaged with their work.

Over the past couple decades, more and more professors have been talking to each other about their research, finding common interests, and working together on projects. In fact, one of the earliest cross-departmental faculty collaborations was between Allen and Nancy Harrison Kolodny '64, the Nellie Zuckerman Cohen and Anne Cohen Heller Professor of Health Sciences and a professor of chemistry.

Kolodny, like Allen, has a long history of research at Wellesley. When she was a sophomore, she was one of the rare students to get research experience, after the College received one of the first National Science Foundation (NSF) undergraduate research-participation grants. (These days, chemistry majors are *required* to get research experience.) It was her time in the lab that led her to pursue a Ph.D. in chemistry, an unusual choice in those days. "If I hadn't come [to Wellesley] at all, I probably would have been a lawyer. *Blech!*" she says with a laugh.

But Kolodny did continue on with research, becoming an expert in nuclear magnetic resonance (NMR) spectroscopy, a technique that can be used to

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—Brian Tjaden, assistant professor of computer science

Brian Tjaden uses computer programs to analyze genetic data.

study the structure of molecules. For many years, she took students from Wellesley to MIT and Harvard to do research with her in labs there. Then, in the late 1980s, she and Allen happened to be on a faculty committee together. Walking between Green Hall and the Science Center, they got to talking about their work. Since Kolodny had worked with ophthalmologists to study tumors, she had some experience studying living cells. "We thought that we could use the techniques I knew how to do to study [blue-green algae]," says Kolodny. "And we've been collaborating ever since." After a number of years, the results and papers that came out of their work helped them win a grant from the NSF to get Wellesley a new NMR spectrometer.

Later, Kolodny decided to pursue another NSF grant to get another choice piece of scientific equipment—a micro-MRI accessory for their NMR spectrometer. But first, she started talking with other professors who might benefit from the equipment. And thus, two more successful collaborations were born. Kolodny and Joanne Berger-Sweeney '79, the Allene Lummis Russell '46 Professor of Neuroscience and professor of biological sciences, both use the micro-MRI to study Rett syndrome in mice. Kolodny also began working with Barbara Beltz, the Susan M. Hallowell and Ruby Frances Howe Farwell Professor of Biological Sciences, to study neural activity in crayfish brains. These collaborations have also provided invaluable research experience for dozens of students over the years. "I think we have the only micro-MRI system at an undergraduate institution," Kolodny says. "When we take our students to meetings, people think they're graduate students."

Nancy Kolodny '64 and Olivia Hendrick '08 study crayfish neural activity with a micro-MRI.

A New Kind Of Science Major

AT THE SAME TIME that these collaborations are becoming more common, Wellesley students are also embracing boundary-blurring majors.

Perhaps the best example of this is the neuroscience program, which began as the psychobiology major in the '70s. Since it was replaced by the neuroscience major in 2001, its popularity has steadily increased. There are currently 35 to 40 neuroscience majors in each class, making neuroscience one of the most popular majors in the sciences. As a result of this,

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—Olivia Hendrick '08, neuroscience and psychology major

the program began a curriculum overhaul last fall, introducing more core neuroscience courses. There will also be five dedicated neuroscience faculty members who "live in the program," as director Beltz explains, and don't split their time between, say, chemistry and neuroscience. "No other college has created a program like this," she says. "We're all terribly excited. Really tired, but excited about getting this curriculum off the ground."

Olivia Hendrick '08 is a good example of this new wave of neuroscience majors. She was drawn to the subject because of the variety of courses she could take. "With biology or chemistry, you spend a lot of time in the department," she says. "With neuroscience, I would be taking biology, chemistry, physics, and psychology, and it really brought all the sciences together so I could get a broader feel of what was out there."

But what really turned her on to the subject was her experience in the lab, where she worked with Kolodny and Beltz to develop a method that will allow them to study crayfish neural activity in the micro-MRI, a technique called functional MRI. Functional MRI usually works by tracking a molecule called hemoglobin that is found in blood. But crayfish don't have hemoglobin, so Kolodny and Beltz have been trying to see if manganese can be used to flag neural activity. As part of this effort, Hendrick tried to create a light stimulus that would cause a crayfish's brain to react in a way that would show up on Wellesley's MRI. She worked on the project all through her junior year, and through the following summer. By the end of the summer, Hendrick had developed a successful technique, a huge milestone for the project. Her senior year, she used this stimulus on manganese-injected crayfish in the MRI to see if she could track neural activity. "That was one of the best experiences of my college career. That was when I decided that I wanted to go into the sciences instead of going to medical school," she says. This fall, Hendrick will start a Ph.D. program in neuroscience at Yale University.

Marc Tetel and Adele Wolfson collaborate to study enzymes in rodent brains.

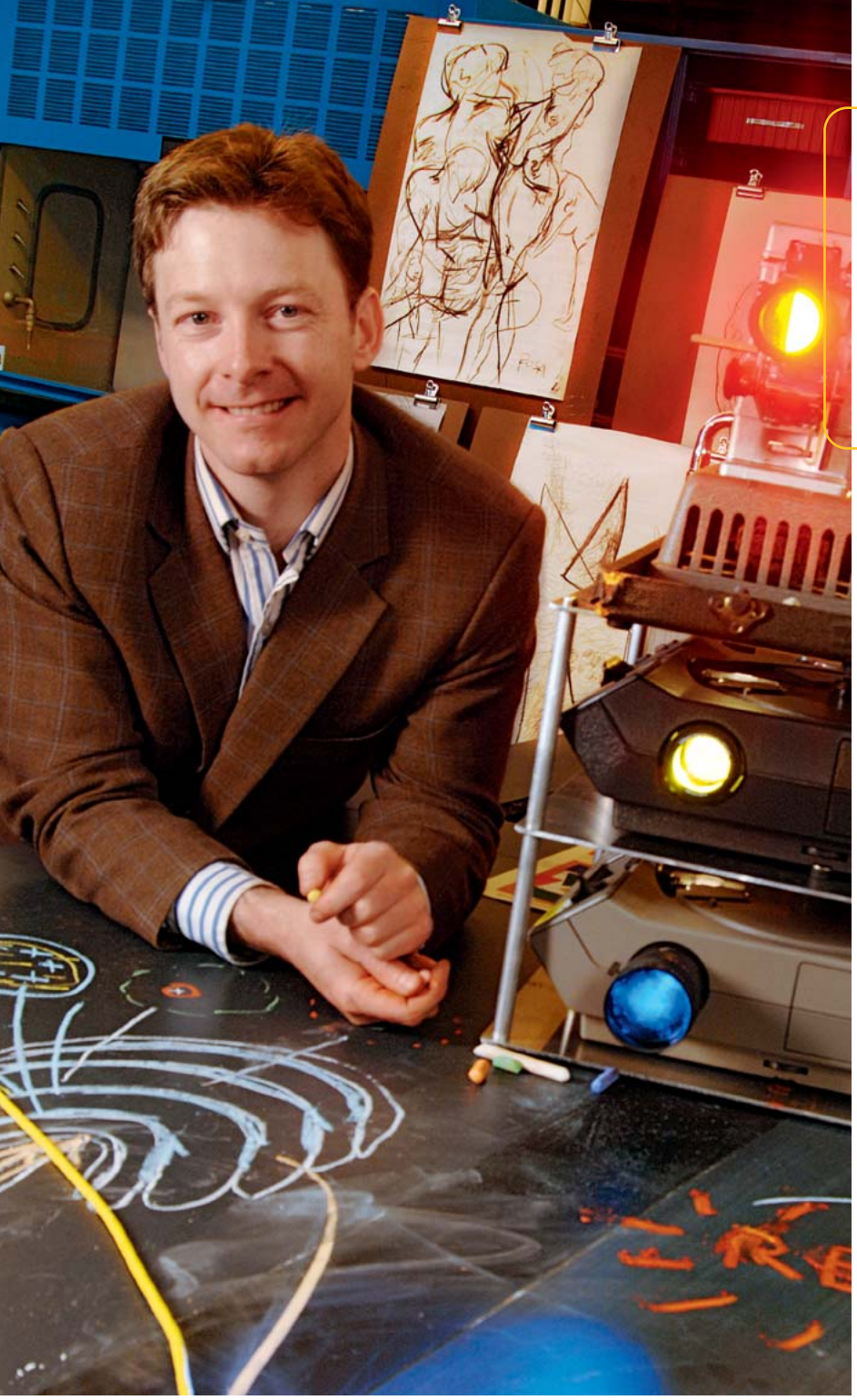
Build Your Own Major

SOME STUDENTS ARE SO COMMITTED to interdisciplinary work in the sciences that they build their own majors, like Kathleen McCarthy '08. After high school, McCarthy spent a year working with a nongovernmental organization in the Dominican Republic that was focused on nutrition. The experience got her interested in public health, and also made her think that she would major in anthropology. But when she came to Wellesley, she was surprised to find herself falling head over heels for chemistry. While taking a geosciences class with Brabander, she talked to him about all her varied interests—and he told her that he had the perfect project for her. Soon, McCarthy was collaborating with Brabander and colleagues of his at Harvard's School of Public Health on a study of the Tar Creek Superfund site in northeastern Oklahoma.

Over three years, McCarthy made many trips to Tar Creek to study how dangerous heavy metals in the former mining community spread and pollute the environment. After one of her trips out there in 2007, disastrous floods struck the community: McCarthy quickly hopped a plane back to Oklahoma so she could study how the flooding moved mining waste around Tar Creek. The experience inspired McCarthy to create her own major, environmental chemistry. In addition to working with Brabander, she got a lot of help from Nolan Flynn, assistant professor of chemistry, and Britt Argow, assistant professor of geosciences. She says her experience in Tar Creek was very gratifying because while it involved hard-core chemistry and geosciences research, it also had relevant, urgent public-health implications. "Whatever your findings are, you know they will have an immediate impact on people," McCarthy says.

Many Disciplines in One

EVEN WITHIN INDIVIDUAL FACULTY members' research interests, many disciplines are crossed. Take Knafel Assistant Professor of Natural Sciences Bevil Conway, a neuroscientist and practicing artist who studies vision and perception, and how they are related to creating and viewing art. "My interests have always been one interest. . . . I've never really seen them as being terribly separate," says Conway. When he was 2 or 3 years old, he would sit by the window on his parents' tea and coffee farm in Zimbabwe watching spiders build their webs. "I have very, very early memories . . . of just scrutinizing. . . . I would go detach [the webs] carefully and then go watch to see the new ones regrow. So I got very curious about the natural world," he says. Later, when he received a set of professional watercolors from his aunt, he brought this curiosity to his work as a budding artist.



Bevil Conway is a neuroscientist and a practicing artist.

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When he was an undergraduate at Montreal's McGill University, Conway originally thought that he should study physics or engineering. "Optics and physics are the tools for observing the world, and you can increase the range over which you can observe things through telescopes or microscopes. Plus optics carries with it all of the fun things you can do with color and wavelength," he says. But he quickly found that he was in the wrong place. He began to pursue a biology degree, and a serendipitous conversation with a neuroscientist friend led him to a University of British Columbia researcher who studied the neural mechanisms in vision. He spent a summer in her lab in Vancouver, and finally felt as though he had found his niche.

Now Conway is sharing his interests with Wellesley students. In his class this spring, Vision and Art: Physics, Physiology, Perception, and Practice, students studied the human visual system through art. There were no prerequisites for the course—something that was very important to Conway, who wanted it to be open to students from a variety of backgrounds. The 10-person course included neuroscience majors, film-studies majors, and chemistry majors, among others. "It's a real smattering across the board. There are some lovely discussions that come out as a result," says Conway.

The course included some hard-core neurophysiology, but the students also visited the Straus Center for Conservation at Harvard to get a better sense of how art is created, and even created some life drawings of their own, which were then critiqued by Bunny Harvey, Elizabeth Christy Kopf Professor of Art. The course culminated in a term project; Conway was impressed with the students' creativity. Ilang Guiroy '09, for example, used an eye tracker to determine whether people with an art-history background read images differently than people without that training. Rachel Schoenfeld '08, a dancer, was interested in the kinds of visual cues dancers use to inform their pieces, and whether these cues are more accessible to trained dancers than to untrained dancers.

In a way, Conway created in his classroom a microcosm of what's happening throughout the Science Center, among both students and faculty: people with different backgrounds and interests working together to think outside the traditional bounds of a discipline. According to Nolan Flynn, who worked with both Stewart and McCarthy on their senior theses, this is exactly what Wellesley students need more of. "A chemistry major or a biology major here might have a very good understanding of chemistry or biology, but not understand how chemical concepts can extend to the biological realm and how strong of an influence chemistry has in biology, or how much of chemistry is grounded in physics," says Flynn. "And I think that by working on a project like this, a student can start to see those connections and start to draw from disparate experiences in her educational background to think about bigger-picture issues." Whether that bigger picture is cleaning up lakes, understanding how neurons are born, or figuring out how dancers know how to move in perfect concert.

Lisa Scanlon '99 is an associate editor of Wellesley *magazine.*