Something Nobody’s

A growing number of undergraduates are pushing beyond the lecture and test, into real research that once was the sole domain of those pursuing advanced degrees.

by Darv Johnson '93
Some undergraduates spend their summer vacations painting houses, waiting tables or looking after someone else’s kids. Not Philip Howard. The senior spent the summer between his sophomore and junior years trying to simultaneously image quantum dots with atomic force microscopy and optical microscopy.

Meanwhile, Lauren Hartle was using electrospinning to create a flexible polymer surface on which lung cells could grow.

And Dylan Trettin was in Moscow, working on a little thing he likes to call “A Case Study of the Influence of Russian Scientific Professionals in Shaping Post-Soviet Wetlands Policy.”
Howard, Hartle and Trettin are among the hundreds of Carolina students who are proving that, these days, research isn’t the sole domain of graduate students and faculty. Spurred on by a summer grant program and mentored by faculty and graduate students, these students are trying their hand at real research in everything from physics to dramatic art. Along the way, they’re getting a chance to test-drive careers and face the thrill — and sometimes, the tedium, and the paralyzing uncertainty — of original research.

“We have no bottle washers in the group,” says Richard Superfine, a professor in the physics and astronomy department. “They have a chance to make a real difference, and they also have a real responsibility.”

As director of UNC’s Office for Undergraduate Research, Patricia Pukkila is leading the movement. Through incentives, outreach and assistance, her office encourages faculty to incorporate research components into their undergraduate courses. They offer grants to graduate students to serve as research consultants to undergraduates; they also award some 70 Summer Undergraduate Research Fellowships (SURFs) a year, enabling students to pursue research over the break.

“Our charge is to make research a distinctive feature of the undergraduate experience,” says Pukkila, a biology professor who in December will receive an award from the American Society for Cell Biology for her advocacy of undergraduate scientific research. “It allows students to engage in what the business of the University is.”

This is, as College of Arts and Sciences Dean Holden Thorp ’86 has said, “the opportunity to do something that nobody’s ever done before.”

Plenty of students are diving into the business as if they were born to it. Last year alone, Pukkila says, UNC undergraduates gave 81 presentations at professional conferences and co-authored 355 professional papers, some of which turned up in prestigious journals, including Development, Nature and Proceedings of the National Academy of Sciences.

But undergraduate research isn’t just for hard-core scientists. McKay Coble ’79, chair of the department of dramatic art, said a half dozen of her department’s students have received SURF funding in the
past two years. Recent graduate Madeline Walter ’07, for example, used a grant to write and stage a play, Mary Brigit Poppleton is Writing a Memoir, which was presented at last summer’s New York International Fringe Festival (related story, page 50). Another dramatic arts student used two grants to develop theater projects in the East African nation of Malawi.

Coble says she reminds dramatic arts students early and often about the existence of the grants program: “It really does show students that they’re not up against the brick wall of a department’s economy,” Coble said.

A $3,000 SURF grant sent Trettin, a senior from Mount Pleasant, S.C., even farther east. Trettin, who is majoring in history and international studies with an Asian studies minor, traveled to Moscow two summers ago to research Russia’s wetlands policy. Trettin said that experience was instrumental in helping him return to Russia to intern at the U.S. Embassy’s Office of Environment, Science and Technology last summer.

For that reason, Superfine finds that grades aren’t always a good predictor of laboratory success. Instead, he said, “one of the things we are most concerned with is initiative and a sense of boldness.”

In that environment, Lauren Hartle has thrived. The senior physics major from Charlotte has worked in Superfine’s lab since December 2005 and embraces what she calls the “seat-of-the-pants” nature of research. At the same time, she appreciates the fact that respect in the lab is doled out based on ideas and initiative rather than age or academic standing.

“It’s a totally reasonable expectation for an undergraduate to make a significant impact,” Hartle said. “It was really cool for me to gain standing in the group.”

Hartle also got a chance to try on a future career: She calls her foray into undergraduate research part of a “survey,” a test of whether scientific research might be the career for her. The answer, for her, is a tentative yes. But after his research experience, Philip Howard, the senior statistics major from Elon, decided to go in a different direction.

Howard, who worked with Michael Falvo ’94 (MS, ’97 PhD), a research associate professor in the physics department, found plenty to like about his research. His project, he said, “was something that no one else has worked on before. It was new territory. There wasn’t a textbook answer.”

In the end, however, Howard found that lab work wasn’t for him. He found it too repetitive and the gratification too delayed. Instead of pursuing a career in academic research, he has decided to become an actuary. But he notes that ruling something out is just as useful as ruling it in. “I’ll never have to look back and wonder and think, ‘I never explored that side of things.’”

**Bold step outside the box**

It’s the very open-endedness of research that can prey on confidence and pose problems for even the best undergraduates. Accustomed to the clear goals and easily measured progress of coursework, they can get bogged down in the vagaries of research. “When they do homework, they’re solving a problem that’s been solved 10,000 times before,” Superfine said. “They know there’s a solution. There’s a different psychology. Research isn’t like that. It’s really tough on them.”

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Katie Almirall ’07: 
Lemons to Lemonade

Oak Island native Katie Almirall ’07 traveled more than 1,000 miles, deep into the heart of Oaxaca, Mexico, to reach the site of her undergraduate research project.

The first thing she found out when she arrived was that it wasn’t going to work.

Backed by an undergraduate research grant from UNC and working under the auspices of a Mexican government program, Almirall had planned on traveling to indigenous communities and offering them art classes. “I had a really, really specific idea and proposal,” she said.

But the program, she found out on arrival, had been canceled. And even defining who was indigenous and who wasn’t turned out to be almost impossible.

Her first thought: “I’ve just traveled over 1,000 miles. What do I do now?”

Almirall, an art major with a Spanish minor, displayed the resilience of a seasoned researcher. In a few days, she had tailored her project to the prevailing conditions and launched her art classes in Oaxaca City itself. For three weeks, she taught art fundamentals to a class of 10 students, aged 13 to 23. For their final project, the students proposed and created a giant inflatable sculpture of a hand out of clear plastic and tape. The sculpture, filled with messages and facts about human rights, then went on display in the city’s central park. “It was really nice to finish with a big bang,” she said.

Almirall now lives in New York and works for Teach For America’s national office. Her Oaxaca experience taught her how to navigate the nonprofit world and helped her forge lasting connections in Oaxaca, an area to which she has since returned twice. Undergraduate research, she says, “changed my life.”

Greg Hogan ’05: An Answer 
No One Else Knows

When Greg Hogan ’05 arrived in Chapel Hill, he wanted to be a doctor. But as soon as he began probing genome-wide chromatin structure with small-molecule crosslinkers and DNA microarrays, he changed his mind.

What, exactly, was that research about, again? Well, it’s complicated — and therefore perhaps all the more impressive that the Sarasota, Fla., native embarked on this work when he was still a freshman.

Hogan looked at how DNA is packaged in yeast, paying particular attention to chromatin — structures within cell nuclei where the DNA helix winds itself around spool-like forms called nucleosomes. To do so, Hogan used a technique called Formaldehyde-Assisted Isolation of Regulatory Elements that was developed by his mentor, biology Assistant Professor Jason Lieb ’94.

Hogan calls the successful use of this technique the most important part of the research, in that it offers a simple and effective route to mapping open — which is to say, accessible to regulating molecules — chromatin in any organism.

Hogan credits his undergraduate research with changing his career path for the better. Mentored and motivated by Lieb, Hogan discovered a new passion. “I love research,” he says. “I love exploring the unknown. You can come up with an answer no one else knows.”

The experience catapulted him onto a fast track to a career in research. He graduated in three years; soon after, he published a paper on his undergraduate findings in the journal *PLoS-Genetics* — he was first author — and won a Fulbright Scholarship to do research with a professor in Amsterdam. Now 23, Hogan just started a doctoral program in biochemistry at Stanford; he turned up a few semesters early, of course.

“I really think that the absolute best thing I got out of UNC was this research,” he said. “I wouldn’t have gotten into Stanford without it.”
Ownership of the material

Encouraging exploration — and encouraging student investment in a given course — are among the biggest benefits of undergraduate research, says Clinton Key ’05 (MA), a doctoral student who served as a graduate research consultant to one of Charles Kurzman’s classes in “Sociology of the Islamic World.” In that role, Key helped the students create and conduct a survey to measure attitudes toward Islam.

The default learning mode for undergraduates, he said, is “to take for granted and as givens the words that come out of a professor’s mouth. When they do research, they have to rely on themselves rather than sources. It gives them a deeper understanding and ownership over the material.”

Key, the first graduate student to receive a research consultant grant, now has his own classes to teach. He has made undergraduate research part of his curricula.

The students aren’t the only ones benefiting from the research opportunities. A professor’s graduate students often are tied by grant money to specific projects with very specific goals. Undergraduates have no such strings attached, so scientists can throw them at more speculative problems — putting them into action as a form of scientific venture capital. “You can put them on something that is a little more risky,” Superfine said.

Brian Billman, an associate professor of anthropology who has worked with a number of undergraduate researchers at his field school in Peru, has found them quite helpful as collectors and compilers of data. He also found an unforeseen benefit in the form of the new perspectives they bring to the field. “The interchange always stimulates new ideas,” he said.

For Richard Goldberg, an assistant professor in the biomedical engineering department, the biggest rewards are intrinsic ones. Every summer for the past six years, Goldberg has mentored two undergraduates as they try to develop learning devices for children with disabilities. He says he is always gratified to see the “joy of discovery” in his charges.

“They’re so excited when they get something to work,” he said of his undergraduates. “This is the first time they have applied what they’ve learned.”

The rewards also can be very tangible. His students have developed dozens of devices for impaired kids, with many of them in use across the state. He has applied for a patent on one device developed by undergraduates — a Braille trainer for the visually impaired — and for a small-business grant from the National Institutes of Health to bring another to market.

A factor in the rankings

One drawback for faculty can be the time commitment required. Billman points out that assessment of faculty performance is based on teaching, service and research, a metric that doesn’t account for or reward the mentoring of undergraduates. “Finding the time to mentor a student is difficult,” he says. “This is over and above what we already have going on.”

Ramping up the faculty incentives is high on the priority list for Pat Pukkila at the Office for Undergraduate Research. To that end, she says, the University recently created two Distinguished Term Professorships in research and undergraduate edu-
Madeline Walter ’07: What’s the Audience Think?

You can research brain development, crop yields or the reproductive habits of a tsetse fly. Why not research whether a play you wrote has a satisfying conclusion? That’s what Madeline Walter ’07, a Robertson Scholar from Maplewood, N.J., did with Mary Brigit Poppleton is Writing a Memoir.

Walter wrote the play — a comic look at a teenager who decides to fictionalize the events of her life to make them memoir-worthy — for a class during the spring semester of her junior year; for her senior honors thesis, she wrote a series of short stories involving characters from the play.

That’s where the undergraduate research grant came in. Walter used a small grant to distribute copies of the stories, along with questionnaires, to audience members at the UNC production. The idea was an extension of the workshop method that is integral to creative writing courses. Instead of asking for peer review, however, Walter reached out to the general public, asking for editorial assistance from the people who one day might pick up her play and read it.

She wanted to know whether the audience saw discrepancies and connections between the stories and the play; whether they appreciated and accepted the change in voice; what parts worked and didn’t work. “I got a lot of really thoughtful responses,” she said. “It was a really valuable way to get feedback.”

Next, she put the feedback to use, honing a scene in the second act and adding three scenes to the end of the play to craft a more satisfying conclusion. By all appearances, the process worked: Mary Brigit was such a success in production at the New York International Fringe Festival this summer that it was one of a dozen — out of 200 — plays invited back for an encore run.

Walter is now in Chapel Hill on a yearlong fellowship to help develop the Robertson Scholars program. Her new job and the production of her first play are her priorities for the moment, she says, but she also has her eyes on the next one.

Vishwan Pamarthi: The Business of Medicine

Doctor or entrepreneur? It’s a question with which Vishwan Pamarthi, a senior from Cary, has grappled as he considers his career plans. On the one hand, he is a biology major who does undergraduate research at UNC’s Lineberger Comprehensive Cancer Center; right now, he’s applying to medical school. On the other, he’s an entrepreneurship minor who, at 20, already has started several companies, including one that delivers mini refrigerators and other essentials to the dorm rooms of freshmen.

Fortunately, a 2006 SURF grant, which took him to India for two months, helped provide him with an answer: Why not be both?

Pamarthi used his grant to study the success of the LV Prasad Eye Institute in Hyderabad, in southern India. He was drawn by the institute’s entrepreneurial approach to providing top-notch medical care to an underserved population: In two decades of existence, Prasad has given surgical care to some 250,000 patients — half of them too poor to pay — all while staying out of the red.

While in India, Pamarthi evaluated the institute as he would a franchise — with success measured in numbers of eyes fixed, not in dollars made. Guided by adviser Donald Lauria, a professor in UNC’s department of environmental sciences and engineering, he tried to determine if and how the institute could be replicated to offer medical care in other developing nations.

One key finding was that at LV Prasad, the doctors also ran the hospital, shouldering administrative tasks to a degree not seen in the U.S. While this double-duty could slow decision-making and contribute to burnout, Pamarthi says, it also came with tremendous benefits. The doctor-administrators, he says, “know all about the concerns of the doctors and are willing to do something about them.”

Pamarthi calls the grants a turning point. While he plans to get his medical degree, he also will keep his eyes open for opportunities to capitalize on his entrepreneurial streak. “I saw the entrepreneurial side to medicine,” he says. “That’s right up my alley.”
cation. The professorships, which will be filled for the first time this year, will come with a project budget and course release money; the professors also will be honored at an annual banquet and invited to address the UNC Board of Trustees.

“We keep piecing things together,” said Pukkila, who has a staff of two and a $500,000 annual budget.

Universities across the nation are doing the same. Nancy Hensel, executive officer of the Washington, D.C., nonprofit Council on Undergraduate Research, or CUR, said university membership in her organization has topped 500, a 28 percent spike in the last three years. The growth, she says, has a number of causes, starting with an effort to mold better students. Echoing Clinton Key’s comments about engagement, Hensel noted that research forces students to draw on an array of skills, from lab work to proposal writing and public speaking. Universities, she says, “see the potential for deeper learning.”

Hensel says there’s a strong correlation between students who do undergraduate research and those who both stay in their majors and pursue graduate work. Smaller universities, she adds, can rely on undergraduates to bolster understaffed departmental research teams.

Not surprisingly in the age of hyper-competitive education, there also is a marketing angle: The sharp rise in CUR’s membership roles roughly coincides with U.S. News & World Report’s decision, several years ago, to begin listing institutions that are strong in undergraduate research in its annual guide to colleges (in which UNC currently ranks fifth among public universities, 28th overall). “Any time that something has a benefit, it becomes a marketing issue,” Hensel said.

Back at UNC, the primary issue is how to give as many students as possible the chance to try their hand at undergraduate research. “In some ways, it’s an extra part of college,” says Dylan Trettin, the wetlands policy researcher. “But it has been a very important part.”

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More about UNC’s Office of Undergraduate Research is available online at www.unc.edu/depts/our.

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