Toward a Community of Scholars

Undergraduates in research

by Toby Gordon and Richard Moore

Research projects with budgets, equipment, supplies, and—most precious of all—close collaboration with faculty mentors have traditionally been the privileged territory of graduate students. But UNH has recently moved to extend these programs to undergraduates as well.

At the heart of this effort is the new Undergraduate Research Opportunities Program. Undergraduates are exposed to the discipline and independence of research, and faculty benefit from a genuine collaborative relationship with an enthusiastic student. In the fall semester of 1987, 23 students received awards to support their projects. Here, we have profiled three of those students.

ERIK FROBURG

Erik Froburg
Major: Fine Arts
Project: Bachelor of Fine Arts Senior Thesis/Exhibition

Erik Froburg and his teacher, James Charleton, circle around a skeletal steel obelisk in the converted fire station. The sculpture is part of Froburg's work for his senior project, and it was paid for in part by his undergraduate research grant. Charleton is suggesting that Froburg try a much larger version, two stories tall, for the BFA show in the University Art Gallery. "I don't find this very adventurous," says Charleton. "A big piece might not be so successful, so finished. But it would take more risks."

They move in and out, trade places, touch the mild steel rods, rub the concrete base. Unconsciously, they mimic each other's movements: chopping the air with a hand to indicate a logical progression, describing arcs, caressing a finish. They both lock their hands on top of their heads, face each other, and talk about the relationship between a model and a large piece, how a large piece gives a model credibility.

There is a palpable equality in the give and take of two workers in the same media. The professor wears jeans and a sweatshirt; the student wears a tee shirt and fatigues. Both wear cement dust, everywhere.

Froburg wants to add a large sphere to the piece. He calls on the professor's technical expertise. "Where can I get six-foot balloons?" he asks.

"Go to the Fox Run Mall," Charleton says. "There's a balloon stand. She'll have to put it on order, but she can get it. Do you think six feet is big enough?"

"I think so," says the student.

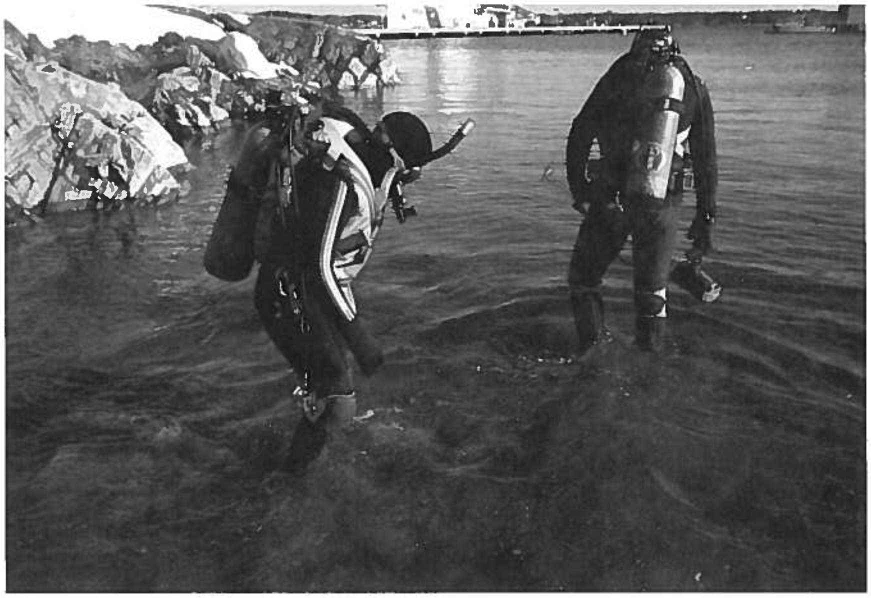
"I don't think so," says Charleton. He has put down his coffee cup and is swinging a wrench. The sculpture has apocalyptic qualities, and Charleton urges his student to think bigger.

The grant money Froburg received has long since been spent on materials, but the grant program is of continuing value. Froburg sees other students thinking differently about their work because they are planning to apply for a grant now. "They are thinking about building something bigger, something worth a grant."

"There's lots of competition among them now," Charleton says. "And I think that's great."

They circle the obelisk once more. The professor backs up to the wall and squats; Froburg perches on a sculpting stand. It looks like the student has become the work. The professor talks about overcoming technical obstacles. "It goes back to ambition. Sure it's a hassle, but you have to know when it's worth it." Charleton shrugs. "Art is a hassle."

Froburg's grant, Charleton says, "opens up possibilities not only for Erik, but for other students. Even if you have ideas you can't make, if you can say, 'Well, I've got a little money,' you'll do more. Ideas are always bigger than what you can do."



Karen Verny

Karen Verny
Major: Biology
Project: Phototactic Responses During Settlement in Marine Fouling Communities

Springtime at the bottom of the sea: for marine biologists, the first signs are not robins on the lawn, but baby barnacles settling onto submerged surfaces. For the last two years, Karen Verny has been watching every season pass on the bottom of the sea. Every month she dives off the Isles of Shoals or the New Castle Coast Guard Station to watch marine organisms collect on plexiglas plates she has moored to the bottom.

The project, supported by her undergraduate research grant, fulfills a long-time interest. When Verny was growing up in Concord, Massachusetts, the only television shows her mother would allow her to watch were Jacques Cousteau and National Geographic specials. Now mom thinks she's crazy to dive all year round, says Verny, but no matter. "I have fun doing research, and I love to dive."

The project explores the effect of light on organisms that build up on the bottom of boats, piers, and docks. These organisms hasten the decay of structures and slow down boats.

Verny places black, gray, and clear plexiglas sandwiches near the ocean bottom off the Isles of Shoals and New Castle Coast Guard Station. Every month, weather permitting, she photographs the build-up, then brings the sandwiches up to identify and count the organisms with her research supervisor, Professor Larry Harris.

The grant has paid for film and processing and has enabled her and Harris to do more sampling. Without the grant, the supplies would have diminished Harris's own research budget.

The results have been dramatic, according to Verny, much clearer than most researchers dare hope for. "Nearly everything seems to like the black," says Verny. The absence of light encourages marine fouling. So if engineers can find ways to introduce light when the organisms are settling—springtime for the barnacles—there could be important economic consequences to Verny's work with Harris.

In the meantime, Verny is diving into graduate school applications. Her grant has given her more contact with graduate students than most undergraduates have. Graduate students accompany her on most of her dives, she says; and now that she is applying to schools, they give her lots of advice.

And she has benefitted from close contact with Harris, an invertebrate biologist with international experience. "He's good at inventing things," she says; he has helped her build sandwiches that do not get carried away by the currents. "He's helped me keep things simple, and not cross my variables," she says. "He helps keep me on track."

Verny has learned that diving is not all like the TV specials. Most research diving, she says, is just sitting on the bottom and watching. She has learned to cope with winter temperatures by putting her wet suit on before she leaves Durham at six in the morning, and not taking it off until she is back in the lab where it is seventy degrees. Still, it is a memorable moment when water that gets below thirty degrees trickles between her suit and her skin. "For the first five minutes," she says, "you shiver like mad."

But in the winter, she says, "the water is clearer. There is not so much microscopic plant life, and it's easier to see around. A lot of people don't get to see that." Karen Verny warms to her work.

Colin Frost
Major: Mechanical Engineering
Project: Crack Growth in an Aircraft Wheel During Roll-on-Rim

A year ago, Colin Frost had just entered Professor James Sherwood's office when he saw a strange-looking object on a table. "When Jim said it was from an exploded aircraft wheel, I said, 'Whoa, this is it.'" He had found the topic for his senior project.

Since then, Frost and Sherwood have been reinventing the wheel. New federal regulations are forcing engineers to design an aircraft wheel so that a plane with a flat tire can roll on the rim for 15,000 feet, usually the distance to the terminal or hanger.

As it is now, a crippled plane may need to be towed off the runway; the runway shut down and swept off; and the flow of traffic, already too heavy at some airports, impeded. There is a danger, too, that if a wheel were to crack under the stress of landing, a fragment could fly into the engine and rip apart turbines; then it could fly out of the engine, damage fuel tanks and the fuselage, and even enter the passenger compartment.

Frost sits in front of a computer terminal in the Computer Aided Design lab of the new science and engineering research center. He taps the keys impatiently, while numbers scroll down the screen. Soon a web of green lines appears, section by section, sketching an aircraft wheel. Developing the mathematical model behind this drawing took the most time, Frost says; there are more than 10,000 elements in the drawing, which is smaller than his hand.

He runs his hand over the screen, slides a finger along a raised portion of the rim. "This is the part I'm interested in," he says. "This is where they usually break, and a little piece like this can fly into a jet engine and ruin it."

Wheels have been designed by trial and error in the past, but engineers are getting away from what Frost calls the "build it-break it" style of design. Frost and Sherwood are using the computer to bypass the destruction of hundreds of test wheels.

Still, the computer testing takes time, even on the research center's mainframe. Frost does most of his work between midnight and three in the morning, when few other users are on the mainframe. During the day, the system, clogged with use, is just too slow. "Sometimes I spend three or four hours just waiting for something to happen on the screen," Frost says, tapping the keys again.

"Now I'll apply a load here," he says; and wedges of color begin to overlay the schematic drawing on the screen. The colors indicate the level of stress in that segment of the wheel. Light blue, dark blue, lavender, red. One side of the raised part of the rim paints itself an apple green. "There's the most stress,"

COLIN FROST WITH PROFESSOR JAMES SHERWOOD

says Frost. "That's where it will break."

Frost used his research grant to buy a terminal emulator that enables him to get a finer visual display than University equipment made available. "Without it," he says, "I'd be presenting raggedy drawings." He

We have brought new life to that most essential of academic community interactions, the relationship between student and professor, by establishing the Undergraduate Research Opportunities Program.

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has seen presentations at the American Society of Mechanical Engineers where "the guys just presented equations, and they lost the audience. With this, I have the graphics. The numbers are there in the back of the report."

Another undergraduate comes by. "How do you get it to do that? What do those colors mean?" Frost explains, still tapping the keys. "I'm impressed," says the visitor.

"You're easily impressed," says Frost.

But Jim Sherwood, Frost's advisor, is impressed, too. Though Sherwood developed the project, Frost is the one who knows the ins and outs of the program, Sherwood says. "It's Colin's job to go out and do the work and try to expand on the fundamentals I show him. He gets things working, comes back, shows me his results, and I try to show him the next direction he should proceed in."

Now, says Frost, "Jim's tempting me to stay on for graduate work." But Frost has some undergraduate course work to finish. He taps the keys, looks at his watch. "I'd like to sit and do this all day, but I've got five other courses...."

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