

## Some Small Schools Are Big On Manufacturing Scientists

When science students at St. Olaf College, a small college in Northfield, Minnesota, feel overwhelmed, help seems omnipresent. Faculty are not only present in the lab, for example, but students who fall behind often get the chance to separate lab work from the lecture portion of the course. "I couldn't have handled p-chem lab and lectures together," acknowledges Amy Roos, a St. Olaf graduate now doing advanced work in theoretical chemistry at Northwestern University. "So my faculty adviser suggested that I take the lab a year later." Even its introductory lecture courses allow for feedback during or immediately after class.

Is such concern unique to the Midwest, or to schools without lofty reputations? Hardly. Jim Quallen, a chemistry major at the California Institute of Technology (Caltech), also knows where to turn when things get harried. "This is a small school, and you can always find someone who's already taken the course you're having trouble with," he says. "Also, the professors are understanding about extending deadlines. The students work hard and the faculty try to accommodate us."

While St. Olaf and Caltech may differ in many ways, what they have in common is their small size. And that quality pays enormous dividends to science. When the U.S. Office of Technology Assessment tracked baccalaureate graduates who won their Ph.D.s between 1950 and 1986, it discovered that small colleges like Caltech and St. Olaf, per capita, yielded more Ph.D.s than most large schools. Last year, a study by the Higher Education Data Sharing Consortium in Lancaster, Pennsylvania, came to the same conclusion: Starting with Caltech and the Massachusetts Institute of Technology (MIT), the list of institutions that graduate the highest percentage of students who go on to receive doctorates in science and engineering includes the University of Chicago; Reed, Swarthmore, Carleton, Pomona, Haverford, and Oberlin colleges; and Princeton University. Only Chicago, Princeton, and MIT have undergraduate student bodies that exceed 2500, with Princeton the largest at 4600.

What makes these places—many of which are known as liberal arts schools—produce such a rich diet of scientists? The answer, at first, may seem counterintuitive: Most of these schools are principally dedicated to the training of ... undergraduates. "Everything that happens here is because of undergraduates," says Reed chemist Arthur Glasfeld. "They are the focus for the entire energy of the faculty."

The consequence, say educators, is a bond between faculty and students that works better than size and power. "Mentoring, mentoring, mentoring is what we do well," says Wellesley chemist Adele Wolfson. "The absence of graduate students is a positive influence on the attention our undergraduates receive."

Introductory courses in small schools typically enroll only

30 to 100 students—a pittance compared to what most freshmen must endure. More advanced courses often contain fewer than a dozen students. Glasfeld says, "I know every student in the introductory chemistry course and every junior and senior chem major."

The second big advantage of many small schools may again at first seem counterintuitive: Although big schools can afford fancier facilities, small schools often offer more hands-on research experience. "At large universities, only the most assertive get research opportunities," explains St. Olaf biologist Kathleen Fishbeck. "We have solid B and B+ students who, if they get the chance, can excel in the lab. At large schools they would be lost."

What's more, students are more likely to be able to pursue a project of their choice, "instead of being a cog in the research machinery of their supervisor," says Glasfeld. And they don't have to play second fiddle to grad students in gaining access to lab equipment. At Reed, for example, undergrads use automatic x-ray diffraction and nuclear magnetic resonance equipment, plus a variety of lasers—apparatuses that would make most small and midsized universities proud.

It's worth noting that small size doesn't necessarily mean poverty, too. Grinnell and Swarthmore colleges—each with only about 1250 students—have endowments of more than \$400 million, with a per capita figure higher than that at Harvard or Yale universities. And less fortunate schools are savvy about winning grants from organizations that support undergraduate education, such as the National Science Foundation, the Howard Hughes Medical Institute, the Pew Charitable Trust, The Research Corporation, and the Keck, Noble, Mellon, Ford, and McKnight foundations. "We have had to work very hard to get funds to support our undergraduate

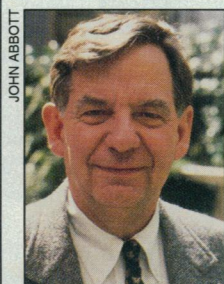
instruction," says St. Olaf chemist Gary Meissler. "But that's what smaller schools do."

To be fair, even well-financed small schools have some liabilities—among them, fewer course offerings and smaller libraries. And then there's tuition and fees—as much as \$25,000 a year compared with \$6000 for a large, state-supported school. Faculty members at small schools acknowledge making personal sacrifices to sustain their commitment to teaching. Glasfeld, for example, studied structural enzymology at Harvard and MIT; now, he says, most of his research is done during the summer because "only cracks of time" are available for such work during the academic year.

But that trade-off may benefit tomorrow's scientist. And Glasfeld speaks for thousands of his colleagues at small undergraduate institutions when he says he wouldn't trade places with a colleague at a major research university. "I always knew I wanted to teach," he says. "At Reed I get rewarded to teach."

—Anne Simon Moffat

### But Caveat Emptor for Small Grad Schools



William Bowen

JOHN ABBOTT

While small may be beautiful in teaching science to undergraduates, it is not so good for training graduate students. Very small programs lack the critical mass to do the job well, says economist William Bowen, president of the Andrew W. Mellon Foundation and co-author, with Harvard president Neil Rudenstine, of *In Pursuit of the Ph.D.*

Bowen says there's been "an excessive proliferation of Ph.D. programs that graduate only a few students each year." The trend is fueled by the status associated with operating a doctoral program. The problem, according to Bowen, is that programs granting fewer than four Ph.D.s a year often fail to offer top-quality training. In addition, they draw time and talent away from undergraduate teaching. Although Bowen is equally critical of graduate programs so large that students become lost in them, he believes that some universities would be wise to offer fewer graduate programs, or none at all in the case of predominantly undergraduate institutions.

He also practices what he preaches. A graduate and trustee of Denison University in Granville, Ohio, he offers straightforward advice whenever the discussion turns to broadening the school's academic portfolio. "I tell them to continue to do what they do so well, teach undergraduates."

—A.S.M.