

## Studying Sugars

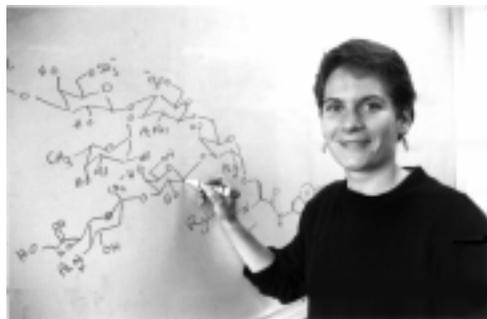
### Newest faculty member's research examines carbohydrates in the cell

Combining the scientific perspectives of a synthetic chemist and a biomedical researcher, new Assistant Professor of Chemistry Carolyn Bertozzi promises to help bridge the gap between traditional organic chemistry and biological science.

As a recent College alumna, Bertozzi has had no trouble adjusting to life at Berkeley, where her Latimer Hall laboratory is already bustling with life. Bertozzi, who officially begins her duties on January 1, earned her Ph.D. studying the synthesis of carbohydrate-based molecules in former chemistry professor Mark Bednarski's group.

As a postdoctoral fellow for the past two years in a UCSF immunology laboratory, Bertozzi made the transition from the world of small molecules to that of biological systems.

"At the time, a lot of people considered that a radical move..." Bertozzi said. "Actually, it turns out that biologists and chemists are not as different as we think. We have a lot in common once you break down the lingo barriers."



At UCSF, Bertozzi learned how to address scientific problems starting at the level of an animal, working down through the animal's organs, to the cells within the

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## Faculty Strikes a Chord

### National Chemistry Week event thrills Berkeley High School students

Four College professors enthralled more than 40 Berkeley High School students November 9 with a vigorous mixture of demonstrations and discussions, as part of UC Berkeley's celebration of National Chemistry Week. The event was a joint effort of the College and the campus' chemistry fraternity, Alpha Chi Sigma.

Presentations ranged from Professor Angelica Stacy's awe-inspiring demonstrations of chemical reactions to Professor Paul Bartlett's comparatively serious discussion about the role of chemistry in AIDS research.

Assistant Professor Susan Muller introduced students to polymer dynamics, creating a gooey compound that the students found irresistible. Professor Jeff Reimer then wheeled his Yamaha motorcycle into the classroom to demonstrate the ways in which chemistry and chemical engineering contribute to everyday life.

"We wanted them to go home with an idea of the pervasive applications of chemistry," said Alpha Chi Sigma Chemistry Week Chair Dita Gratzinger. "Chemistry is in what they wear and what they drive, it's in the newspapers and it's an integral part of a wide variety of occupations."

According to Monica Jackson-Tribble, the College's Outreach Program Coordinator, the event was inspired by the American Chemical Society's mission of increasing awareness of chemistry in the community.

"We thought the best way to educate the public would be to start with young people, particularly students," said Jackson-Tribble, adding that the event was also a chance to show the high schoolers that there are "great opportunities in the field."

For their part, the students appeared genuinely inter-

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# Making the Most of Multimedia for the Classroom

Virtual chemistry laboratories, electronic lab journals and improved tools for molecular visualization are a few of the cutting-edge teaching innovations being forged at MultiCHEM, the College's educational multimedia facility.

The half-year-old facility has been instrumental in developing material for the ModularCHEM Consortium (MC<sup>2</sup>), a group of 17 schools, including UC Berkeley, pioneering a modular system for undergraduate chemistry instruction.

"We are well underway with module development and will begin class-testing some of the modules in the spring and fall of 1996," said MC<sup>2</sup> Project Director Susan Kegley. Of the ten modules now approved for funding, Berkeley is developing three.

With a wealth of technical expertise and teaching know-how at hand, members of the MultiCHEM facility are busy producing the information age's version of the chemistry curriculum—and you can see, hear and interact with many of the results.

A computer-simulated laboratory, for example, allows students to react chemical compounds safely under variable environmental conditions. Although originally intended for use in an instructional module about airbags, the program is easily adaptable.

"[The laboratory] was engineered to be open-ended so that it could handle other reactions," said MultiCHEM Director Marco Molinaro. "I'm very interested in allowing maximum flexibility for the user to change the chemical content [of the program]."

This philosophy was certainly in mind when the facility created a new, more powerful version of Rasmol, a public

domain program used for viewing three-dimensional representations of molecules.

"Rasmol is a tool. The viewing of molecules small or large is something that is useful throughout the chemistry curriculum. We're just making it very user-friendly," Molinaro said.

The new program has already been used by students around the country to view molecules stored in databases on MultiCHEM's World Wide Web server (<http://hydrogen.cchem.berkeley.edu:8080/MultiCHEM/>).

"I'm very happy to see other schools are using the material," said Molinaro. "We're receiving feedback from them to evaluate the feasibility of having course material on the web."

Testing this concept, project leaders worked with Chemistry 1A Head GSI Barbara Reisner to make a practice midterm available on the internet for introductory chemistry students. The electronic exam provided instant feedback to students' answers.

"Student response to the practice midterms in Chemistry 1A was overwhelmingly positive," said Kegley. "Many students looked at the exam and nearly half the 1,300-student class actually submitted it for grading."

Experience with such projects will be pivotal in creating on-line teaching modules, such as a solar energy tutorial now under development. The computerized tutorial checks students' fundamental understanding of the topics before allowing them to proceed.

"What we're avoiding, at this point, is giving the student a detailed answer," said Molinaro. "If you give them a detailed answer, they won't try to find it themselves."

Instead, the computer asks more and more basic questions

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## Event

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ested, audibly approving the professors' demonstrations and posing thoughtful questions throughout.

"I think for high school students to remain interested through a two-hour lecture and participate in a lively discussion up to the end demonstrates the amount of interest and excitement that was coming through," said Jackson-Tribble.

Berkeley High School Chemistry Teacher Jaime Marantz also rated the event a success, emphasizing that the presentations brought chemistry to life for her students.

"I want them to realize that there really is something that they can do with chemistry," said Marantz.

Many students said they left with a better sense of the importance of chemistry and the role it plays in their world.

"I feel like you can do interesting stuff with [chemistry]," said Berkeley High School student Alexandria Leckliter. "It's not just something on paper."

"All of [the presentations] were really awesome," said classmate Louanne Boemio. "The last one about AIDS is a topic that we face every day. We're actually getting somewhere through chemistry."

The success of the event has prompted organizers to pledge further cooperation for future outreach efforts and

to make National Chemistry Week a tradition in the College.

"Outreach to a school like Berkeley High is particularly opportune because it exposes groups underrepresented in chemistry, namely women and minorities, to the opportunities available to them," said Gratzinger.

Alpha Chi Sigma also created several posters featuring information about the College's history, Nobel Laureates, and women scientists, which were displayed in Latimer Hall during National Chemistry Week.

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## MultiCHEM

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in order to subtly direct the student to relevant information.

"We've come up with what we feel is a really improved way to use the computer," said Molinaro, adding that such innovations need to be tested before they are implemented.

"We're dealing with new technologies here. We need to have an idea of how people use them and what they find useful."

That responsibility falls into the hands of Eileen Lewis, Director of Assessment and Evaluation for MC<sup>2</sup>, who is in charge of comparing students' responses to the modular curriculum versus traditional approaches.

Lewis, who has a master's degree in chemistry and a Ph.D. in chemistry education and cognition, is designing tools that will be used by consortium members to evaluate the effectiveness of the program.

Collection of data related to students' views of chemistry has already begun, and dozens of hours of taped interviews are now being evaluated.

"Ultimately, we will look at students' knowledge of chemistry, their beliefs about the nature of science, their scientific literacy, and their critical thinking skills," Lewis said.

Lewis is also responsible for studying the experience of module authors, particularly in terms of module development and its effects on faculty members' ideas of learning and teaching.

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## Bertozzi

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organs and finally to the molecular interactions that guide the cells.

Bertozzi said her research at Berkeley will continue some of the work she started at UCSF, using discoveries at the molecular level to approach larger biological concerns. One key issue she will examine is the role of sulfated carbohydrates in the body's inflammatory response.

"The chemistry of sulfate as it pertains to sugars is the key to chronic inflammation," she said, adding that research has shown that specialized endothelial cells significantly increase production of sulfated carbohydrates at sites of inflammation.

Bertozzi is aiming to characterize the molecules involved in this response, particularly "sulfotransferases," which are the enzymes responsible for linking sulfates to carbohydrates.

Another area of interest in her group is the use of organic synthesis to define the chemical properties of the plasma membrane—properties that govern key interactions such as cell-cell adhesion and drug transport.

"We're trying to move beyond the level of how biological molecules interact with each other," Bertozzi said. "We're looking at cells and multicellular systems. How do small molecules control the behavior of a whole cell, and how do they dictate the way a cell behaves within tissues and organs?"

To answer these questions, Bertozzi and her group will manipulate the biosynthesis of carbohydrates in the cell to produce unnatural sugars, which will ultimately reside on the cell's surface.

"Basically what we're doing is dialing in new information to the surface of the cell," said Bertozzi. "We can direct how that cell then interacts with other cells in the body or with small molecule drugs."

As with carbohydrates, the synthesis of complex glycoconjugates is also a relatively unexplored area in which Bertozzi is interested. Glycoproteins, for example, are the most ubiquitous of nature's complex molecules, but methods to obtain defined structures have so far eluded both synthetic chemists and molecular biologists.

"There's a molecular weight glass ceiling that we have

yet to break through," said Bertozzi, referring to the fact that glycoproteins are more structurally complex than readily synthesized biopolymers, such as non-glycosylated proteins and nucleic acids.

"If you're a protein chemist or you're a sugar chemist, it's a bit of tunnel vision if you don't study the other field," she said. "I think we're in a position to make a contribution to new synthetic methodology for generating biologically active glycoproteins."

Bertozzi's group is also examining a class of enzymes responsible for cleaving the sugars from such peptides. Bertozzi suspects that the enzymes are mechanistically related to proteasomes—biological molecules that play a central role in a variety of regulatory processes. The Bertozzi group will produce synthetic compounds which they will use to probe the enzymes in order to better understand their mechanism and function.

"The trouble with this job is there are so many fascinating problems to study," Bertozzi said with respect to the variety of projects her group is tackling. "At a place like Berkeley, where you have the opportunity to work with some of the best students in the country, you feel like you could do everything."

Bertozzi also credited the department's faculty, particularly Professors Paul Bartlett and Peter Schultz, for laying a strong foundation for biologically oriented organic chemistry at Berkeley.

"Historically, our chemistry department has defined the new directions of bioorganic chemistry worldwide," she said. "Without that reputation, it would have been very difficult for me to bring in my immunology background."

## Briefly...

The College of Chemistry was recently awarded a Recognition of Distinguished Achievement for its business affirmative action accomplishments by the Office of Small Business Development, a campus unit.

Marcia Bogart and Barbara Harris, of the College's Purchasing Department, led the effort to use small, underrepresented businesses in providing services to the College.