UNIVERSITY OF OREGON

Chemistry News

COLLEGE OF ARTS AND SCIENCES · DEPARTMENT OF CHEMISTRY · 2011

INSIDE

Geri Richmond Elected to the National Academy of Sciences

University of Oregon chemist Geraldine "Geri" Richmond has received one of the highest honors in science: she is among seventy-two U.S. scientists elected into membership of the National Academy of Sciences (NAS) in 2011.

The NAS was established by an act of Congress and signed into law by President Abraham Lincoln in 1863. Since that time, our nation's leaders at the highest levels have relied on NAS members to advise on scientific and technology issues that affect their policymaking. Although six other UO faculty members are among the academy's roster of 2,000 members, Richmond is the only member that is not retired, is the first to be elected since 1986, and is the only woman among them. She is one of only eight women out of the 200 members in the NAS chemistry division, a fact that has a lot of meaning for Richmond, who has spent decades promoting women in science.

Richmond received a bachelor's degree in chemistry in 1975 at Kansas State University and

Geraldine Richmond

a doctorate in chemical physics in 1980 at the University of California at Berkeley. She joined the UO faculty in 1985

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Chemistry Resource Center Dedicated to Ralph Barnhard

On April 8, Klamath Hall's new Chemistry Resource Center was named in honor of Ralph Barnhard, who taught UO chemistry students for thirty-four years. A crowd of faculty and staff members, former students, and family members gathered for the dedication, and enjoyed a tour of the newly completed general chemistry teaching labs as well as cake and champagne.

Barnhard, his wife, LaVern, his two daughters and their husbands, and his four grandchildren were in attendance at the ceremony. His surprise

Ralph Barnhard, left, and Bill Herzog at the Barnhard Chemistry Resource Center dedication

and gratitude at the honor were summed up in one word: "Wow!" Over the course of the years that Barnhard taught at the University of Oregon, he estimates that 10 percent of the UO's students passed through his classroom. "This is a dream come true," he said. Barnhard began his teaching career in 1959, after graduating from Otterbein College in Ohio. In 1963, under the advisorship of Virgil Boekelheide, Barnhard began his master's work at the University of Oregon, and though he left for the Bay Area and a couple of other jobs, he returned to give our students thirty-four years of service.

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Chemistry Resource Center Dedicated to Ralph Barnhard

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A great crowd for the dedication of the Ralph Barnhard Chemistry Resource Center

The new Ralph Barnhard Chemistry Resource Center comprises a multipurpose classroom in 107 Klamath Hall as well as suite of smaller rooms in Room 103, dedicated for peer tutoring and teaching assistant office hours. The thirty-person classroom is equipped with state-of-the-art electronic instructional tools and trapezoidal tables that can be arranged in any fashion, for small group instruction or collaborative projects.

As the classroom continued to fill up, department head Mike Haley spoke: "This is dedicated to Ralph for being an excellent teacher for thirty-four years, having taught tens of thousands of students. It's great to be able to honor him for that instructional service. We often get lots of awards that celebrate research efforts but sometimes the teaching component goes by the wayside, so it's really great to be able to recognize one of our very own for doing an outstanding job."

That "outstanding job" was especially appreciated by donor and alumnus Bill Herzog, who took general chemistry and organic chemistry from Barnhard in 1966 and 1968. At the time, Herzog was enrolled in a pre-med and pre-dentistry major that required extensive biology and chemistry classes. A different instructor started out teaching Herzog and his classmates, but the consensus among the students was that this was "a very brilliant" person who had a hard time "gearing down" to first-year students. Herzog was really worried about how he would progress in his major without a solid chemistry foundation. When it came time to begin the second term, Ralph Barnhard stepped in and took over. "We showed up the following term and, to our surprise, there was Ralph standing there," says Herzog. "I didn't know anything about him but I knew it had to be better! He had to basically teach two terms of chemistry in one. I was looking at taking a year of gen-chem and having no clue about what was going on. Ralph came in and rescued us."

Herzog recalled that Barnhard came in at night to give the students extra instruction. "By spring term, we were back on track," Herzog says. "I understood it and did really well. I even said at the time that if I didn't like dentistry, I was going to come back and get my master's in chemistry, but when I got out of dental school, I was so far in debt I couldn't do anything else. I had to go to work!" Ralph Barnhard chimed in: "Apparently, he got the right grade. I can't tell you how relieved I am that he did so well."

Both Barnhard and Herzog have a sense of humor, but Herzog's thirty-eight-year career as a dentist in Portland and his dedication to funding the University of Oregon is anything but a joke. Over at least ten years of donating to the university, Herzog has given equally to academics and athletics. While the chemistry department received funding to completely relocate and reconstruct the general chemistry teaching lab to the first floor of Klamath Hall, the money allowed the department to build only the lab, but did not allow for funds to equip the lab or improve ancillary space. The Chemistry Instructional Space Improvement Fund was created to allow for private donations, which was how Bill Herzog jumped onboard.

Herzog recalls, "When I discovered that my donation allowed me to name the resource center after someone of my choosing, I thought back to 1966 when Ralph rescued our general chemistry class. Without his dedication, I firmly believe there would have been an entire class of students starting organic chemistry two years later with no clue what lower-division chemistry entailed. At that time, organic was the most influential grade evaluated by medical and dental school acceptance committees. It was one of the most difficult upper division science classes on campus, and, thereby, a good indicator of how an applicant would perform if admitted. I don't recall how involved Ralph was with organic instruction that year . . . but the preparation he provided two years earlier was already above and beyond the call of duty." Herzog continues, "The naming of the resource center is well deserved appreciation

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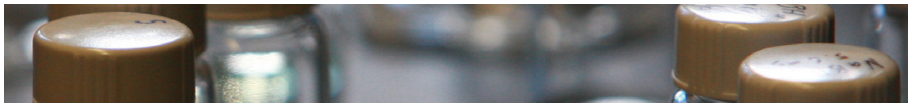


Department Head's Perspective

What? Time to write another department head's statement?

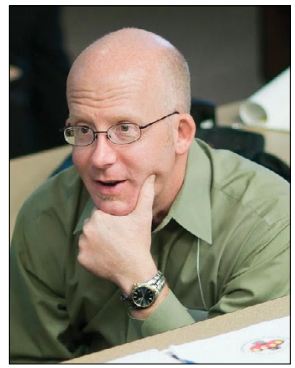
It seems like I just finished the last one . . . and that is the way many of us in chemistry feel about the last twelve months—they're a bit of a blur. That is a good thing, though, as there is much to tell you about. We opened last year's newsletter with the great news regarding the pending replacement of the general chemistry laboratories. The labs were completed in May in time for a trial run with the summer lab classes. The new space exceeded all our expectations and now we have gone full throttle, serving a record 840 gen-chem lab students this fall! In fact, we are seeing record enrollments for nearly all of our courses and a record number of majors. Thus, completion of the new labs as well as the new Chemistry Resource Center (named after long-time instructor Ralph Barnhard at a wonderful celebration in April) could not have happened at a better time. We are not done yet, as more changes are in store with additional instructional renovations as well as new research lab space. For a taste of the latter, visit isci.uoregon.edu/facilities/lewis . . . but more on that in next year's newsletter.

Our faculty, from the internationally known investigators to the up-and-coming stars, continues to receive accolades. The biggest accolade, and one of our leadoff stories, is Geri Richmond's well-deserved election to the National Academy of Sciences, our first new NAS member in twenty-five years. The awards and honors to Shannon Boettcher, Deborah Exton, Darren Johnson, Dave Johnson, and Brad Nolen just this past year recognize the continued research and teaching excellence of our faculty. Well done, everyone!

On the research front we are doing extremely well. The Center for Sustainable Materials Chemistry, helmed by UO's Dave Johnson and OSU's Doug Keszler, just received funding for $20 million over a five-year period for phase two of the center, beating out competition from some big name schools back east. As you will read in the associated article, the center has some big things planned, from their pioneering inorganic materials research to K–12 educational outreach programs within the state of Oregon. Knowing Dave's enthusiasm (and tenacity!), I have no doubt about the center's continued success.

On the organic side of things, the UO hosted the Fourteenth International Symposium of Novel Aromatic Compounds in July, organized by yours truly with assistance from Darren Johnson and Shih-Yuan Liu. We had more than 250 attendees from twenty-one countries worldwide, making this the largest ISNA ever in North America. Alums from the Boekelheide-Klemm years may recall that UO chemistry was world-renowned for its research programs on aromatic hydrocarbons and aromatic heterocycles. The great international attendance and high number of UO participants (more than twenty) illustrates that, indeed, this is once again the case. Of course, it did not hurt that we held the meeting during summer—the weather in Eugene was sunny with daytime temperatures in the low 80s, yet all the while the rest of the U.S. and Europe baked.

Finally, a note of thanks! In spite of the bad economy at home and abroad, donations to the department exceeded $150,000 last fiscal year, of which more than half was earmarked for instructional space improvements. The faculty, staff, and students cannot thank enough all of you who gave. Know that these contributions were well spent, from helping complete the Ralph Barnhard Chemistry Resource Center, where peer-led learning groups meet and teaching assistants hold office hours, to outfitting the new gen-chem labs with equipment such as computers, projectors, vacuum pumps, and ultraviolet spectrophotometers. We're not done yet! As I already alluded, more changes and renovations are planned and we can still use your help. Giving is as easy as ever—just fill out the form on this secure website: https://supportuo.



Mike Haley

uofoundation.org/index.php, or use the enclosed envelope, being certain to specify either the Chemistry Achievement Endowment Fund or the Chemistry Instructional Space Improvement Fund. Every little bit helps and is greatly appreciated.

We hope you enjoy the newsletter, new and improved in color no less. As always, please stop by campus for a visit the next time you are in the Eugene area. We would love to give you a tour and a chance to see all the changes for yourself. I know you will be quite impressed!

Cheers,
Mike Haley

P.S. Drop us a line and let us know what you are up to! Send your details in the enclosed envelope, fire off an e-mail at chem@uoregon.edu, or use the online form, pages.uoregon.edu/chem/alumni.html?update. ◘

Geri Richmond Elected to the National Academy of Science

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and is the UO's Richard M. and Patricia H. Noyes Professor of Chemistry. Thirty years of experimental and theoretical research by Richmond and her group has led to a greater understanding of the fundamental behavior of surfaces, with relevance to important issues in the environment, technology, biology, and energy resources. Awards for her scientific accomplishments include the American Chemical Society Garvan-Olin Medal (1996), the Oregon Scientist of the Year by the Oregon Academy of Science (2001), the Spiers Memorial Award of the Royal Society of Chemistry in the UK (2004), a Guggenheim Fellowship (2007), the Bomem-Michelson Award (2008) and the American Chemical Society Joel Henry Hildebrand Award in the Theoretical and Experimental Chemistry of Liquids (2011). She is a fellow of the American Physical Society, the American Association of the Advancement of Science, the Society for Applied Spectroscopy (2008), the Association for Women in Science (2008), and is a member of the American Academy of Arts and Sciences (2006).

While Richmond is exceedingly proud of her scientific accomplishments, she is also proud of the work that she has done in the area of women in science. She has been honored for these efforts by the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring from the White House (1997), the American Chemical Society Award for Encouraging Women into Careers in the Chemical Sciences (2005), and the Council for Chemical Research Diversity Award (2006). "I have spent my whole career working on issues of women in science. The perception is that to be elected to the NAS, one must be singularly focused on your science and extraneous activities impede career progress," she says. "That my science has achieved the stature of election to the NAS while I have also been working on issues of women in science that I am equally passionate about is very gratifying."

Richmond is also quick to acknowledge the critical role that her students and postdoctoral associates have played in her election. "The election says that Oregon has students and postdocs that are doing work that is comparable to the best institutions in the country, where most NAS members reside," she says.

Richmond says she awoke early one May morning and had a "flood" of congratulatory emails and phone calls from NAS members who had learned of her election at 9:00 a.m. on the East Coast. Though she said that she had "some sense" that she was being considered for membership, she really didn't know this was coming. "It's a very, very secretive process," she explains.

The seventy-two new members will be inducted into the academy next April during its 149th annual meeting in Washington, D.C. "The NAS is the premier institute for science in the world. When the National Academy puts out reports, those are the ones that people listen to. I couldn't be happier. You hope that your colleagues respect your work enough to allow you to achieve this level of success, so I am surprised, delighted, honored, thrilled," she says. ◘

Chemistry Resource Center Dedicated to Ralph Barnhard

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from all the years of chemistry students—especially those of 1966–68."

Anyone familiar with the chemistry department is likely to recall a life-size cutout of a young woman sitting on a chair by the periodic table down in the lobby. That's one of Barnhard's daughters, Darcy. She's been sitting there a long time, and continues to draw the attention of each new group of students who enters the department for their chemical education. But while some things stay the same, the department continues to look for ways to improve and grow.

Long-time donor Marion Hill, who received his BA and MA from the Department of Chemistry in 1948 and 1950, was also in attendance at the dedication. When he began attending the university shortly after World War II, there were only a handful of professors in the chemistry department. Today, there are thirty-two instructional and research faculty members. He was pleased to be able to share in the good tidings of the improved chemistry facilities. "It shows newcomers, new students, that the department is always going to provide good facilities, as best we can, and also reassures the old ones that they spent very good years here," Hill says. "It demonstrates the constant improvement of the chemistry department. It means a lot to the department and the faculty to see all of these advances."

Reception after the Barnhard Chemistry Resource Center dedication

Mike Haley echoed that sentiment as he wrapped up the ceremony, addressing not only Bill Herzog for his donations and Ralph Barnhard for his years of service, but all of the donors who continue to make a difference: "The chemistry department thanks you." ◘

NEW GENERAL CHEMISTRY LABORATORIES DEBUT

All Agree New Space Is Quieter, Brighter, Better

The department's new general chemistry instructional laboratories welcomed its first batch of students over the summer. Everyone agrees that the labs are as good as they knew they would be—and, most would say, as good as they knew the labs needed to be.

"It's been great. The students all really like it," says Stephen Robinson, who has taught the lab course the past two summers. "It's nice and bright, it's quieter. The students are working in smaller groups, which allows a lot more interaction. We haven't had any problems going in to the new lab, which is unusual."

"We wanted to take the new labs out for a proverbial 'test drive' this summer before we ramped things up in the fall," says chemistry department head Mike Haley. "Getting out the kinks and fixing problems is easier to do with sixty students than with 800. We all have been extremely pleased how well the transition has gone—it's been essentially trouble-free."

Roger Leonard, the coordinator of the chemistry teaching labs, is in charge of setting up the equipment and preparing materials for the general chemistry lab. "They've been running three sections of twenty students all summer long, and it's been going fine," he says. "It's all been running extremely smoothly. I don't think the new batch of students knows how much better it is," he says. "The TAs like it and I know that the students are getting a better educational experience." He echoes Robinson's sentiments, that it's quieter and brighter.

Students in the new general chemistry laboratory.

It's likely that most anyone reading this newsletter remembers how dismal the basement lab facilities used to be. It was one large open space with lines of sight blocked, and the teaching assistants had to compete to be within hearing range of their students. "If three TAs were all talking at the same time, they had to have students huddle around them," Leonard says, "and if you had one guy with a loud voice, his would carry over everyone else. But if you had a meek person,

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Michael Pluth Joins Chemistry Faculty

Michael Pluth

Mike Pluth has joined the chemistry department as assistant professor of organic, supramolecular, and inorganic chemistry and chemical biology. Pluth earned his BS in chemistry and mathematics from the University of Oregon in 2004, then earned his PhD at Berkeley in 2008. Pluth followed that with a postdoctoral position at MIT, which ended this past summer after he made the decision to return to Eugene. "I really liked the department, I certainly like the West Coast," says Pluth, who grew up in the Eugene area and ran cross-country here. "The UO chemistry department is excellent. My research is very interdisciplinary and that meshes well with the department's values."

Pluth's research has two main focuses: fluorescent probes for important biological analytes, and the self-assembly and allosteric regulation of transition metal catalysts for performing selective organic transformation. "Hydrogen sulfide is an important molecule for signal transmission in the brain," he explains, "so we're trying to make tools to better understand how this molecule functions. The other point is making catalysts that can self-assemble and basically become active when they sense a substrate, so that's a goal for making systems that are more efficient."

Some of Pluth's research is funded by the National Institutes of Health as part of the Pathway to Independence program. "It's a new program for the NIH that provides funding for postdocs and the first part of an independent career," Pluth says. The NIH issues about 150 of these awards each year, which are intended to support independent research in the health fields. We welcome Mike Pluth (back!) to the department. ◘

ISNA-14 attendees at one of the poster sessions in the Willamette Hall atrium

UO Hosts Fourteenth International Symposium on Novel Aromatic Compounds

The Fourteenth International Symposium on Novel Aromatic Compounds (ISNA-14) (www.isna14.org) was held July 24 through 29 on the UO campus. More than 250 participants from twenty-one countries were present, making this gathering the largest-ever ISNA conference in North America. "We are very proud that this was the biggest ISNA on American soil," says Shih-Yuan Liu, assistant professor of organic and organometallic chemistry, who was on the UO's organizing committee.

The ISNA symposium series was initiated by Professor Tetsuo Nozoe, who hosted the inaugural conference in Sendai, Japan, in 1970. In the years since, the series has flourished and is now held biennially at locations across Europe, Asia, and North America. The focus of ISNA is to highlight recent advances in the area of aromatic chemistry, including the synthesis and properties of novel aromatic compounds, applications of π-conjugated systems in materials and devices, and new experimental and theoretical studies of the fundamental concept of aromaticity. By bringing together the top researchers from across the globe, along with a cadre of young professors and PhD students, ISNA aims to be a catalyst for the generation of new ideas, insights, applications, and directions in this exciting and growing field of chemistry.

The UO has a long history of innovation in the field of arene chemistry. Virgil Boekelheide, who spent more than forty productive years in the chemistry department, was the first UO faculty member elected to the National Academy of Sciences, in 1962. His research centered on non-benzenoid aromatic systems, and his 1964 paper describing the synthesis of 15,16-dihydropyrene is considered a classic in organic literature. Boekelheide's remarkable advances resonate to this day. "It was absolutely fitting that the UO played host to ISNA," says Michael Haley, professor, department head, and lead organizer of the conference. "The UO has a fifty-plus-year history of research in the area of novel aromatic molecules. Virgil Boekelheide was an ISNA pioneer and participated in every ISNA meeting until 1995. He was one of the undisputed leaders in the synthesis and study of theoretically interesting aromatic hydrocarbons in the 1960s and 1970s. In a similar vein, many of the aromatic heterocycles that LeRoy Klemm studied during his UO career have begun to find use as organic electronic materials, which is a very active area within the ISNA community. For the UO to host this meeting was a great way to honor their legacy."

"In addition to being a fantastic showcase of our department and impressive facilities, the ISNA meeting highlighted the resurgence in aromatic chemistry at the UO," says the university's Darren Johnson, who was also on the organizing committee. "While I never had the pleasure of meeting Virgil Boekelheide firsthand, my research group is making self-assembled analogs of some of the intricate organic molecules he pioneered—Virgil is even acknowledged posthumously in one of my group's papers! This conference was an excellent way to honor the memory and inspiration provided by my former colleagues in this important area of organic chemistry."

Shih-Yuan Liu is developing novel boron-containing aromatic heterocycles. "It was very exciting to have the University of Oregon host ISNA-14 and to have so many international experts on arene chemistry visit our campus," Liu says. "All my students participated in the conference, and it was a great learning experience for the entire group. I personally am very proud to be in a department with such a long history of arene chemistry, and it is very exciting to see new research activities in this area coming out of this department."

The scientific program of ISNA-14 included eleven plenary lectures and twenty invited lectures from internationally renowned scientists, along with twenty-nine contributed lectures and 160 posters presentations. "Attendance of the meeting was far better than we expected," say Haley. "We planned for 175, hoped for 200, and ended up with

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All Agree: New Space Is Quieter, Brighter, Better

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you could stand right next to them and not hear them."

Not anymore.

"The TAs close the doors between the modules to give students their safety points and technique highlights, and then send them to work," Leonard says. "And the TAs, from their vantage point, can see everyone in the room." While mishaps in the old lab were rare thanks to hypervigilance, the potential for a serious accident was high. Again, not anymore. "The TAs can preempt some mistakes because of clear lines of sight, which we did not have in the basement," Leonard explains. "The setup and arrangement of the new labs gives students a whole lot better and safer learning experience." That's the happy consensus among everyone involved in this lab area: it's just better . . . and the department has many of our alumni to thank for it.

"Our alumni, faculty and staff really stepped up to the plate last year, as I had hoped," says Haley. "We received over $80,000 in donations to the Chemistry Instructional Space Improvement Fund. That allowed us not only to complete the Chemistry Resource Center in honor of Ralph Barnhard, but also to equip and outfit fully all four of the new gen-chem lab modules . . . and that is a good thing, as again we have record enrollments this fall. My expectation is that with these excellent new instructional facilities, we will serve more students with a greater retention in the introductory chemistry lab courses, which should ultimately translate into more chemistry majors. This is a win-win situation for the students and the department." ◘

UO Hosts 14th International Symposium on Novel Aromatic Compounds

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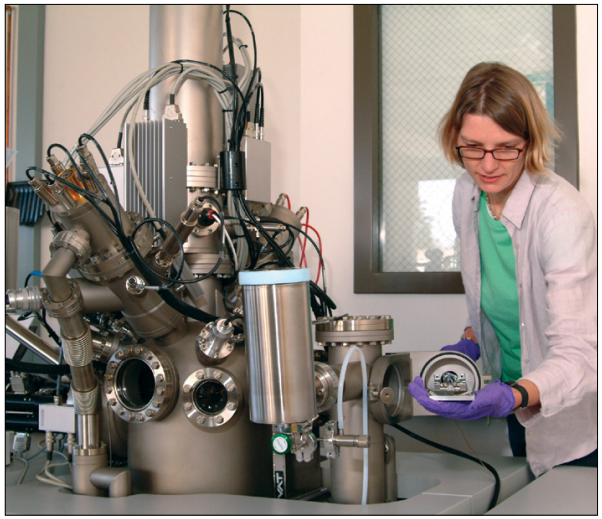
over 250. I am particularly proud of the fact that more than twenty of the participants were UO faculty members and students, which illustrates the strength of our research programs in novel aromatic chemistry."

The organizers of ISNA-14 made a special effort to emphasize the contributions of young scientists working in the field of aromatic chemistry. To that end, several assistant professors and early career associate professors were featured as invited lecturers. "We intentionally targeted young investigators as well as professors from primarily undergraduate institutions," says Haley. "Over one-third of the oral presentations came from these individuals. In addition, ISNA has undergone a renaissance over the past decade with the move towards a more materials science emphasis. With this shift in direction, it is absolutely essential to introduce and include the younger crowd within the ISNA community, for the continued vitality of ISNA series of meetings. The fact that each of the last three meetings has set attendance records for each of the three host continental regions I think bodes well for the future of ISNA."

The scientific highlight of the meeting was the talk of Professor Peter Baeuerle from the University of Ulm, Germany, who was chosen as the 2011 Nozoe Lecturer. The ISNA Nozoe Lecture, established at ISNA-9 in 1998 and held at every meeting since, honors the memory of the late Professor Nozoe. An international committee for the Nozoe lectureship selects an individual from the leading scientists in the aromatic community. Professor Baeuerle has been active in the field of aromatic chemistry for many years and has published more than 240 peer-reviewed scientific papers. His recent research has focused on the development of novel organic semiconducting and conducting materials based on thiophene. In his lecture, Baeuerle discussed recent progress his group has made on the synthesis and characterization of macromolecular dendridic oligothiophenes, and presented exciting data which indicate that these conjugated materials could find application in high-performance organic solar cells.

Professor Reg Mitchell presenting his lecture at ISNA-14

Another highlight was the lecture of Professor Reg Mitchell (University of Victoria in British Columbia, Canada), who was a postdoctoral associate with Boekelheide in 1968–70. No stranger to the UO community, Mitchell has been active in the field of aromatic chemistry for more than four decades and has been a fixture at nearly every ISNA gathering. 2010 marked his retirement from the University of Victoria, and he delivered a stirring lecture at ISNA-14 summarizing his lifetime accomplishments studying dimethyldihydropyrene. His enthusiasm and charisma are contagious and his scientific prowess second to none. Happy retirement, Reg! ◘



Center For Sustainable Materials Chemistry Enters Phase 2

An NSF grant provides funding for five years

The University of Oregon's science research and outreach program took another giant leap forward recently. The National Science Foundation announced in September that they had awarded the joint UO-OSU Center for Green Materials Chemistry with $20 million over a 5-year period.

The center had already received a 3-year grant for Phase 1; this new funding will broaden and enhance their collaborative mission of education, research, and outreach into Phase 2. The expanded programs will also come with a name change—to the Center for Sustainable Materials Chemistry.

The UO's Associate Professor Darren Johnson is one of the center's principle investigators and serves on its executive council. He says the center's mission is almost equal parts education, research, and outreach. The NSF funding is awarded through its Centers of Chemical Innovation Program. The intention and hope is to support efforts that will translate into new and sustainable technologies.

"What we're really doing on the research side is developing solutions in organic chemistry to make inorganic materials for electronic device applications," says Johnson. "My group works on the basic science to develop the inorganic precursors to clusters that are solution stable and soluble, yet still reactive enough to form thin films for device applications."

The UO's David Johnson is at the forefront of materials fabrication and patterning of inorganic materials. Johnson has been able to pattern features down to the 15-nanometer size. The lab of Oregon State University's Doug Keszler works to make the thin films, and engineering collaborators at OSU work on device fabrication. In addition to numerous industry partners, other collaborators include Sophia Hayes, professor of chemistry at Washington University in St. Louis; and Eric Garfunkel, professor of chemistry and chemical biology at Rutgers University. At the UO, collaborating researches have utilized our world-class facilities, including the Lorry I. Lokey Laboratories, which houses CAMCOR, and ONAMI. A main office and lab space will likely be based in the Robert and Beverly Lewis Integrative Science Building, now projected to open in Fall 2012.

Some of the programs were implemented with the $1.5 million the center received for the Phase 1 funding, and will be continued and expanded with the Phase 2 funding. For instance, the center had previously been sending graduate students to elementary schools, but David Johnson says the grant will now put graduate student fellows into Oregon high school courses to help implement green chemistry education into general chemistry. They will start in a high school in Hermiston and hope to expand into other schools across the state. "At the undergraduate level we would really like to emphasize research early on and recruit some of the top high school seniors in the state who might not go to the UO—certainly many do but some don't know what we have to offer here—and give them cutting edge research that freshman year." With summer camps to get them up to speed, the students will be ready to enroll in organic chemistry their first year of college. This year-long head start on curriculum will help them get into a research group faster so they can do a research internship faster. "They can either go overseas or work with one of our industrial partners to see what industrial research is like," David Johnson says. "That's one of the best ways to get a job after you graduate. If you've worked in industry for three months your senior year you're in pretty good shape."

At the graduate level Johnson says they will continue to work with industrial partners on the internship level, but the intention is to

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Faculty Awards and Announcements

Shannon Boettcher

Shannon Boettcher Selected as DuPont Young Professor

New chemistry faculty member Shannon Boettcher has been selected as part of the 2011 group of DuPont Young Professors. Boettcher joined the faculty in 2010, and had only been with the University of Oregon chemistry department about nine months before applying for the award. "We've just started our research here in Oregon," Boettcher says. "The goal of the DuPont Young Professors program is to support and build relationships with faculty members just starting in their academic career. This is incredibly useful from my perspective, as I can use these funds to help build my research program and make it more competitive for winning major federal awards."

That research program centers on solar energy conversion and storage. "We are working on designing solid-state inorganic materials that can absorb sunlight and use the energy in that sunlight to drive chemical reactions," he explains. "The simplest reaction we want to drive is the splitting of water into hydrogen and oxygen gas. The hydrogen could be burned like natural gas or used in a fuel cell to generate electricity. In both cases it would be recombined with the oxygen to yield water as a final product, releasing energy on demand." In time, Boettcher and other researchers working in this area hope that being able to perform these reactions would allow us to shift away from burning carbon-based fossil fuels to using renewable fuels that are part of a closed cycle. "Our planet is full of water and we have an essentially unlimited supply of sunshine," Boettcher says. "The key challenge is developing the materials needed. They need to be inexpensive, simple, scalable, and efficient. There is a lot of fundamental research needed to make this a reality."

DuPont is interested in funding promising untenured researchers that are working in fields related to the company's long-term business ventures, such as solar energy, biomolecular, and polymer science. The researchers each receive $75,000 over three years. "This is an honor for me and it comes with money to accelerate my research program," Boettcher says.

Boettcher graduated from Oregon's Creswell High School in 1998 and earned a bachelor's degree from the UO in 2003 before earning a doctorate in 2008 from the University of California at Santa Barbara, where he was an NSF graduate research fellow. Before joining the chemistry faculty at Oregon, he was a Kavli Nanoscience Institute Prize postdoctoral fellow at the California Institute of Technology.

Deborah Exton

Deborah Exton Receives ACS-CEI Award

Deborah Exton's work to develop a "green" general chemistry lab program has been honored with an ACS-CEI Award for Incorporating Sustainability into Chemistry Education, sponsored by the American Chemical Society's Committee on Environmental Improvement (CEI). The award program seeks to recognize those individuals and organizations that have made exemplary contributions to the incorporation of sustainability into chemical education. Exton received the award at the American Chemical Society spring 2011 meeting in Anaheim, where she also presented her work as part of a symposium sponsored by the Committee on Environmental Improvement.

Exton, a senior instructor, has been at Oregon since 1993. In collaboration with John Thompson from Lane Community College in Eugene, she received a grant in 2008 from the Meyer Fund for a Sustainable Environment for continued support of their work to develop a green general chemistry laboratory curriculum. As part of this project, Exton developed new experiments as well as evaluating each of the existing experiments for opportunities to incorporate the principles of green chemistry and sustainability into the curriculum.

"Green chemistry practices are critical features of a sustainable economy," explains Exton. "Given green chemistry's central role, it is vital that all science students have a thorough exposure to green chemistry concepts. An ideal venue for implementing this is the gateway General Chemistry Laboratory course."

Brad Nolen Named 2011 Pew Scholar

University of Oregon biochemist Brad Nolen was named a Pew Scholar in the biomedical sciences in June 2011. The award, administered by the Pew Charitable Trust, recognizes scientists early in their careers whose research could lead to significant medical breakthroughs and treatments.

Nolen's research focuses on a protein complex called Arp2/3, and how this complex can stimulate the formation (nucleation) of cellular polymers called actin filaments, which are critical for applying forces on the cellular level, and are involved in cell motility, cell division, and other processes. "For the Pew application, we proposed to use x-ray crystallography to determine how all of the thousands of atoms in Arp2/3 complex are arranged in 3-D space," Nolen says. "More specifically, we want to know how proteins that activate the complex bind to its surface and how that changes the 3-D arrangement of its atoms. This, we hope, will tell us a lot about how these proteins activate the complex. Since the complex has to be turned off and on at just the right times in the cell, we think this information will be critical in under-

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Faculty Awards and Announcements

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standing how complicated cellular processes like cell motility are orchestrated."

Nolen is a member of the UO Institute of Molecular Biology. He earned his doctorate in 2003 from the University of California at San Diego. As a National Institutes of Health postdoctoral fellow under the Ruth L. Kirschstein National Research Service Award, he conducted research at Yale University before joining the UO in 2008. "I was very happy to hear the news about the Pew award," he says. "It's an honor and a privilege!"

Brad Nolen

This year, 136 eligible nominations for the scholarship were received from 175 invited institutions, and only twenty-two nominees were honored with the rigorously competitive award. Nolen will receive $240,000 over four years to pursue his research without restriction. Nolen's group plans to use some of the money to purchase a supersensitive microscope camera that can be used to observe single actin filaments growing in real time, and to follow their interactions with individual Arp2/3 complexes. "This type of experiment is pretty cutting edge and we think it will provide exciting new insights into how Arp2/3 complex works as a molecular machine," he says. The money may also be used to hire an additional researcher.

To date, the Pew Charitable Trust program has invested more than $125 million to fund more than 500 scholars. UO assistant professor of biology Hui Zong, who researches the early emergence of cancer, received the award in 2008.

RCSA Scialog Award Funds Darren Johnson Collaboration

Since 1912, the Research Corporation for Science Advancement (RCSA) has provided grants to support researchers at early stages of their careers as well as innovative and integrated research. Among the most recent researchers funded by the RCSA and their new program, Scialog, is the chemistry department's own Darren Johnson.

Johnson and Richard Taylor, of the University of Oregon's physics department, were funded for a joint study of fractal materials with solar energy applications. The name Scialog is a combination of "science" and "dialog," and one criteria of the program's funding is to enhance fundamental scientific knowledge related to solar energy conversion.

Neither Johnson nor Taylor have worked in the area of solar energy before, but they each have researched materials and theory which they hope can be successfully applied to this area. Taylor is an expert in the nature of fractals—he is noted for his analysis of fractal patterns in Jackson Pollack paintings. Johnson's group researches toxic metals removal, for instance, from potentially contaminated drinking water, as well as how anions react with electron-deficient aromatic rings, which, for instance, could allow living systems to sense anionic contaminants.

With this new direction of research, Jonhson's group is seeking to develop inorganic precursors that could be useful for solar materials. In nature, patterns of tree branching are fractal, so the best solar capture materials may in fact have fractal properties. "The dream outcome of this project would be a merging of those two fields using our precursors, which we suspect would lead to good solar capture materials, and Richard's designs for making materials with fractal dimensions, to make a new material of fractal dimension capable of solar capture," explains Johnson. The pair received funding in July of this year, so the project is just getting off the ground, but Johnson believes there is a lot of potential to this research. "We do think we have some leads on the inorganic precursor end," he says, "so even if we don't reach our dream outcome of making fractal materials with solar applications, the materials we come up with within the funding period of the project we think will be useful to other researchers in this field." Currently, the Johnson-Taylor team is exploring self-assembling thin films with fractal properties. The challenge is to make that material both optimal for solar capture as well as three-dimensional.

Taylor is currently the director of the University of Oregon's Materials Science Institute, and Johnson is the associate director. They are both also Cottrell Scholars, which is a research and teaching fund endowed by the RCSA. At the recent Cottrell Scholars annual meeting in Tucson, RCSA officials announced the Scialog project for the first time. Both Johnson and Taylor were at that meeting, and immediately began planning how they might collaborate (funding is higher for collaborations than for individual research). The Scialog program only funds researchers within five years of having received tenure—Johnson and Taylor meet that requirement, and since they both had received funding as Cottrell Scholars, thought that their "wild idea" had a chance. "Renewable energy and clean drinking water are two of the biggest issues we face for the future," Johnson says. Plus, they are looking forward to the second annual Scialog meeting, scheduled for October 11 at the Biosphere 2 in Arizona, which will bring in a panel of experts at all stages of their careers studying solar energy development.

David Johnson Wins Research Innovation Award

David Johnson's work as director of the UO's CAMCOR facility (Center for Advanced Materials Characterization in Oregon) led to his being honored with the Research Innovation Award. The sixth annual UO Research Innovation Awards ceremony and reception was held June 1 at the Jordan Schnitzer Museum of Art in the heart of campus. The Research Innovation Award honors outstanding achievement by members of the university faculty.

Johnson is a professor of solid state and inorganic chemistry with the department since 1986. In 2007 he was named the Rosaria P. Haugland Foundation Chair in Pure and Applied Chemistry. He is a member of the Materials Science Institute and director of that organization's educational outreach, as well as director of CAMCOR.

Known as Oregon's "high-tech extension service," CAMCOR is a full-service, comprehensive materials characterization center that the University of Oregon maintains for both local research and for use by private individuals and companies throughout the world. "This equipment costs money to operate and maintain," says Johnson. "Our goal is to keep the instruments in use as close to 24-7 as we can. It's good for Oregon and it's good for the university because it builds ties to people outside of our community." This world-class facility has attracted a lot of attention and research money to Oregon. Researchers from MIT, for instance, come to CAMCOR rather than use the facilities at their own university. "We've doubled the business volume over the last couple of years from $200,000 to $400,000 to over $800,000 of business," Johnson says. "Hopefully next year we'll break a million."

CAMCOR has become known as the place to find answers. It is staffed by knowledgeable and skilled directors who provide infrastructure and equipment for research in chemistry, geology, archaeology, nanoscience, materials science, bioscience, and optics. Remote access allows users to send in samples, for instance, and interface with the equipment and the directors in real time. The flip side is that the university has never led with a research facility like this before, so Johnson notes that the learning curve for staff members has been interesting as well. "We had to learn mundane practical things such as invoicing for time spent on the equipment," he says.

David Johnson

Johnson credits the staff of CAMCOR with the center's success. "The award to me was about the staff of CAMCOR," he says. "As the director I wouldn't be able to accomplish anything without such a highly skilled group of people managing it."

The center houses a surface analytical lab, nanofabrication and imaging facility, microprobe facility, NMR spectroscopy facility, photovoltaic characterization lab, x-ray crystallography facility, and polymer characterization facility. ◘

Center For Sustainable Materials Chemistry Enters Phase 2

CONTINUED FROM PAGE 8

enhance the student's "eye toward innovation." Not every graduate student wants to start their own company, but those that do need skills to do so, and those that may not know how can be moved in that direction. Plans include intellectual prop and networking workshops partnered with NCIIA (National Collegiate Inventors and Innovators Alliance). "We're trying to get our students to think about the innovative areas of their research, where is their intellectual property on the basic science that can be protected," Johnson says, "because that can lead to them starting a company after they graduate."

The Center for Sustainable Materials Chemistry also supports graduate students through a transition pathway from the UO's industrial masters internship program, so students can go away for their masters degree and come back for their Ph.D. "The center will help with that transition period, to fund them until they choose a research group to get a Ph.D.," Johnson says. "We have lots of great students that go through that masters program and some of them want to come back for that Ph.D. at some point, so this will give us a transition."

The CSMC's outreach program also has lofty goals. "The biggest thing we'll do and the hardest thing to pull off," says Johnson, "will be to visit every Oregon county every two years." This means someone from the center— a graduate student, postdoctoral associate, or faculty member—will visit about 50 counties every two years. Planned "Discovery Days" will involve visiting a high school and meeting with students to talk to them about opportunities at the CSMC for research.

While the science is serious, Johnson and the other leaders of CSMC hope to have some fun, too. "We'll meet with radio stations and newspapers, whatever we can set up," says Johnson, "and cap off the day with a Science Pub." In fact, Johnson and the other CSMC leaders are in discussion with the organizers of Science Pub—which invites leading scientists to give basic scientific talks in casual, public settings—to make the outreach efforts an official part of the Science Pub program. Johnson also hopes to use the NSF funding to set up a series of "how stuff works" pages. "The thin film technology that we're working on is in all of our smart phone and laptops and cell phones," he says, "so I thought we needed to have a 'how stuff works' page to explain things like how you get a couple of million transistors into an iPod, because it's not that big."

Policymakers and industry leaders from throughout Oregon went on record voicing their support for the center. Oregon Gov. John Kitzhaber said that the time was right for the establishment of this center. "Not only will the innovation and outreach activities contribute to job creation, the green materials emphasis helps ensure that Oregon is looking forward in meeting the challenges of the 21st century economy with fresh ideas and a well-trained workforce," he said. U.S. Sen. Ron Wyden, D-Oregon, heralded the center as it moved into its second phase: "It is through grants like these that the United States is able to pursue the development of new and safer technologies that will drive job creation." Wyden also praised the collaborative model, saying that it "plays a vital role in the innovation that will bring about economic recovery." ◘

Visit pages.uoregon.edu/grnchem/index.html for more information on the CSMC.

Alumni News from All Over

1960s

Gordon Gribble, PhD '67, received his doctorate in organic chemistry with Lloyd Dolby in the area of indole chemistry. Following a National Cancer Institute postdoctoral fellowship at UCLA with Frank Anet, Gribble started his career at Dartmouth College, where, since 2005, he has held the Dartmouth Professor of Chemistry endowed chair. In 1998, three years into a project involving the synthesis and biological evaluation of hundreds of novel triterpenoids from the ubiquitous, naturally occurring plant products oleanolic, ursolic, and betulinic acids, Gribble and his students synthesized "TP-155." This compound, now named Bardoxolone methyl, displays unprecedented antiinflammatory activity and has just entered phase three clinical trials for the treatment of chronic kidney disease in patients with advanced diabetes. Bardoxolone methyl is an orally available, first in class "antioxidant inflammation modulator" and is the most potent known inducer of the Keap1-Nrf2 pathway to enter clinical development. It works to suppress both oxidative stress and inflammation, which are responsible for several chronic diseases in addition to renal disease. Gribble has also recently published his second monograph on naturally occurring organohalogen compounds in the series Progress in the Chemistry of Organic Natural Products.

Catherine Smith '69 wrote us that she is an independent consultant to pharmaceutical and medical device industries in California.

Bernard White, MA '61, PhD '63, graduated from the chemistry department with Ray Wolfe as his advisor. He ended up at Iowa State University's biochemistry department as assistant, associate, and full professor, as well as serving a five-year stint as department chair. White writes that he retired in 2000 but went back to teach biochem courses for a few years. "Now, I try to help the newly named biochemistry, biophysics, and molecular biology department raise money to support undergraduate education," he tells us.

White writes that he understands the need for continued funding and that he appreciates the UO's "obvious commitment" to undergraduate education. He says he was fortunate to have been funded for many years by the National Science Foundation and the Howard Hughes Medical Institute in their biological science education programs, and that his colleagues at Iowa State valued his work. White has family in Portland, Oregon, and his daughter writes for *The Oregonian* (Portland's daily newspaper) covering mainly education at the secondary level. He writes, "Keep up the good work!" Thank you for writing, Bernie!

1970s

Robert Pinschmidt, PhD '71, wrote to let us know that he is deputy director of the Institute for Advanced Materials Nanoscience Technology at the University of North Carolina at Chapel Hill. He did his graduate level studies with us during the years 1968–71, and worked as an independent postdoc in 1973–74.

1980s

Linda Smith (Warren) '81 received her BA majoring in chemistry. She then went on to get her MD at Oregon Health and Science University. During her time at OHSU, she married the man she met in her first month at the University of Oregon, Kevin Smith. Linda did an internship at Good Samaritan Hospital in Portland, then followed that with a residency at Providence. In 1988, Linda and Kevin moved to Pacific Grove, California, where they live with their three children. They run the family motel, Andril Fireplace Cottages, and Linda practices medicine at a local urgent care clinic.

Paul Yager, PhD '80, is currently the chair of the Department of Bioengineering at the University of Washington, where he has been teaching and doing research since 1987. Paul's research interests include microfluidic devices for chemical and biochemical measurement; development of point-of-care diagnostic instruments; microfabrication technologies for microfluidics; and development of microfluidic-specific methods of analysis of biological samples. Please visit faculty.washington.edu/yagerp for more about Paul's research in microfluidics.

1990s

Gary Burgoine '94 wrote that he got his MD from OHSU in 2000, finished residency there in 2004, and has since worked in private practice in Portland. Gary and Anne Lesch have been married since 2000 and have two little girls. Anne got a BA in music and a BA in English in 1994, then received an MAT from Lewis and Clark College in 1998. She taught at Portland public schools until 2005.

Matt Fry '93 wrote us a few years ago about his experiences before and after he came to the UO. At that time he was a group leader in the production department of Cell Signaling Technology in Boston. After being a group leader he was then promoted to head of the department, and Matt has now been promoted to director of products. He and his wife have also been expanding their family and now have a three-year-old daughter named Kayla as well as a new daughter, Maria, who was born in May 2011. It has now been nine and a half years since Matt and his wife moved to the Boston area. He says they are still busy and happy with their success here, although they miss the Northwest, but they make it back from time to time to visit family and friends. Here's what Matt had to say about his decision to earn his undergraduate degree with us:

"My pre-med biology degree took an unexpected turn while in Eugene, which I am quite thankful for today. After my first year of undergrad studies at Washington University in Saint Louis I moved back to the Northwest to be closer to my family. As a work-study student in Saint Louis I was fortunate enough to be exposed to work in a cancer research lab. When I reached the UO, I worked hard to continue this experience and tried to find any lab that would take me. I found time in my schedule to work in various labs, including with Russ Fernald and Bill Roberts in the neuroscience department.

"The turn of events came with a biochemistry lab course taught by Mike Reddy, who was working in the Von Hippel lab. In this lab I found what I love most about working in the lab and doing research. Mike was instrumental in inspiring me and getting me a spot in Tom Stevens' lab. This also convinced me to continue my education to get the biochemistry degree in addition to my biology degree. As a biology major I had never imagined that I would be taking physical chemistry, but I did and survived. In Tom's lab I learned an incredible amount of hands-on lab techniques. I learned from both graduate students and postdocs in the lab as well as from Tom and everyone in the lab by participating in regular lab meetings. I have very fond memories of these days, as does my daughter, who would travel with me to campus by bus from graduate student housing to go to the day care available on campus.

"I went on to finish my undergraduate degrees in 1993 and got my first full-time job as a lab technician in Portland, Oregon, at Oregon Health and Science University in the Gary Thomas lab. This led to my second position running the research lab for Dr. Murdoch as part of the pathology department studying Alzheimer's disease. This would then lead to a surprising move to follow my wife in her work to obtain a postdoctoral position here in Massachusetts at MIT. Our drive across America from Oregon is quite a story in itself. I have been very fortunate to find a job here with a new up-and-coming company called Cell Signaling Technology, which was spun off from New England Biolabs. Here, we focus on production of specialized antibodies to be used in research to study cellular signaling as well as cancer biology.

"I have been very fortunate to be able to expand my opportunities as the company has grown, and my wife has also been quite successful with her research and is now at Brigham and Women's Hospital as part of the Harvard Medical campus. I also have had the chance to both produce and provide technical support to the scientists that use some of our most popular products. I now manage both a group of fellow product managers as well as help manage our product-packaging department. We now have been here on the East Coast for more than five years and certainly miss many things about the Northwest, but we have found great things about the Northeast as well.

"Sorry to be so long winded, but I just can't say enough about the great opportunities I found at the UO and how it helped me get to where I now am. I only hope that undergraduates at the UO realize how much great and influential research is going on on campus by many of their professors. They really should take advantage of the great opportunities that are right there on campus. Special thanks to the financial aid office and the many memorable chemistry professors, such as Griffith, Long, Keana, and especially Stevens, who gave me the chance and the freedom to work on independent projects in his lab."

Thank you for writing, Matt!

Kyle Gano '94 is currently the vice president of business development at Neurocrine Biosciences Inc. His work focuses on business partnering activities, including product and technology evaluation, in- and out-licensing, collaborative R & D agreements for both neurocrine- and externally derived candidates on a worldwide and/or regional basis. He received his BS in chemistry from the University of Oregon (1994), BS in biochemistry from the University of Washington (1996), PhD in organic chemistry from UCLA (2000), and his MBA from the Anderson School at UCLA (2002). Kyle wrote to say, "I hold my experience at Oregon in high regard and give credit to the chemistry department for my academic success by providing a solid foundation from which to build."

Jon Marshall, Alex Kendall, Jon White, and Jacob Ishibashi prepping the beef and pork for Septemberfest 2011.

Laurie Jones '92 received her BS in biochemistry. She was an undergraduate research assistant with Warner Peticolas and Jerry Thomas in physical chemistry. Since leaving the UO, she has stayed in Eugene, Oregon, working at Molecular Probes, which was acquired by Invitrogen and is now named Life Technologies. Her current position is senior staff scientist in the manufacturing sciences division of Life Technologies' operations team. Two of her three children are Ducks—her oldest daughter, Sarah, received her BS in human physiology in 2009, and her youngest daughter, Heather, preparing to graduate with BS in biochemistry in 2012. In fact, they both started their elementary education at the UO at the old Moss Street Children's Center and watched her graduate from the UO.

2000s

Orion Berryman, PhD '08, studied supramolecular chemistry with his advisor, Darren Johnson, and collaborator, Mike Haley. Orion is currently a postdoc for Julius Rebek Jr. at the Scripps Research Institute working on two projects: light responsive cavitands and encapsulating the uranyl ion.

Andrea Jones '00, MS '01, graduated from the University of Oregon with a double major in chemistry and Japanese. While at the UO, she spent two years researching in the lab of Catherine Page, and defended her honors college thesis on work she did there. After a year's study abroad in Japan, Andrea moved on in 2000–2001 to the UO's Materials Science Institute master's program, focused in semiconductors. She went to Intel, where she worked until 2004, then attended the Massachusetts Institute of Technology's Leaders for Manufacturing (now called Leaders for Global Operations) program, where she obtained an MBA from the Sloan School of Business and a master's degree in engineering from MIT. Upon returning to Portland, she started her own consulting company for project management and process improvement. She did this through March 2010 (taking time out to have two daughters), when her family moved to China for one year through her husband's job (also with Intel). They returned from China in March of this year, and Andrea is now networking again to rejuvenate her consulting practice in the Portland area. Andrea and her husband are expecting their third baby, a son, at the end of November.

Christopher Sweeney, MS '01, received his MS in chemistry from the UO. He is now a patent attorney in the Seattle office of Knobbe Martens Olson & Bear, the third largest patent law firm in the country. Since the publication of the last UO chemistry department newsletter in 2010, Christopher made partner at Knobbe Martens and has been expanding his work in the chemical and medical device fields.

2010s

Payam Amin, MS '10, wrote that he is currently a failure analysis engineer at Intel, working on technology development.

Honor Roll

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Richard Moulton '61
Kathleen McCartan Myers and
Stanley Myers '86
Nancy and Daniel Olson '72

Students chowing down at Septemberfest 2011

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Jennifer and Keith Peters '88
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Katherine Walstrom and
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Leona Phifer Borchers
Pamela Brown
Barbara Burke Budweg and
Howard Budweg '77
Paul Burkhardt '62
Jeffrey Cina
Dana and Eric Cluxton
Scott Dahlberg '77
Kelly Davis '90 and Rutger Puts
Paul Eckler '70
Gordon Ellis '07
Kathy and Glen Frerichs '77
Helen and Lenhart Gienger
Sally Gienger
Thomas Gienger
Pamela Goodwin '96 and Roger Leonard
Jean Halling '48
Christine and Marvin Hanson '88
Jesse Jenkins '08
Sara Kortum and Frank Jones '04
Lois Ashley Kennedy '61
Joelle Kenney
Leesa Klepper '82
Justin Kulongoski '96
August Lins '04
Wendy and Bradford Little
Buck MacGillivray
Karrie and Bervil Marsh Jr. '01
Leland Mason Jr. '01
Georgy Nazin
Colleen and James Noble '58
Bradley Nolen
Silvia '56 and Juris Orle '59
Heathre and Kenneth Prehoda
Matthew Rail '06
Alexander Rajeff '99
Katherine '66 and Chester Ramey '68
Geraldine Richmond and Stephen Kevan
Lola Hennies Roper '62 and Phillip Roper
Susan Sauter
Pauline Seebach
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Kelly and Craig Stolarczyk '99
Joshua Thompson '03
Rebecca Turner '97
Kathryn and Michael Uhler '82
Alice Warner
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Organic study session in the new Barnhard Chemistry Resource Center.

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