

Department of Chemistry

# Fumes from the Hood

Winter 2018/19



Oregon State  
University





**Department of Chemistry**  
Head, Mike Lerner

**Editor/Designer**  
Luanne Johnson

**Contact**  
Department of Chemistry  
153 Gilbert Hall  
Oregon State University  
Corvallis, OR 97331  
541-737-2081

**Please send feedback to:**  
[osuchemmedia@oregonstate.edu](mailto:osuchemmedia@oregonstate.edu)

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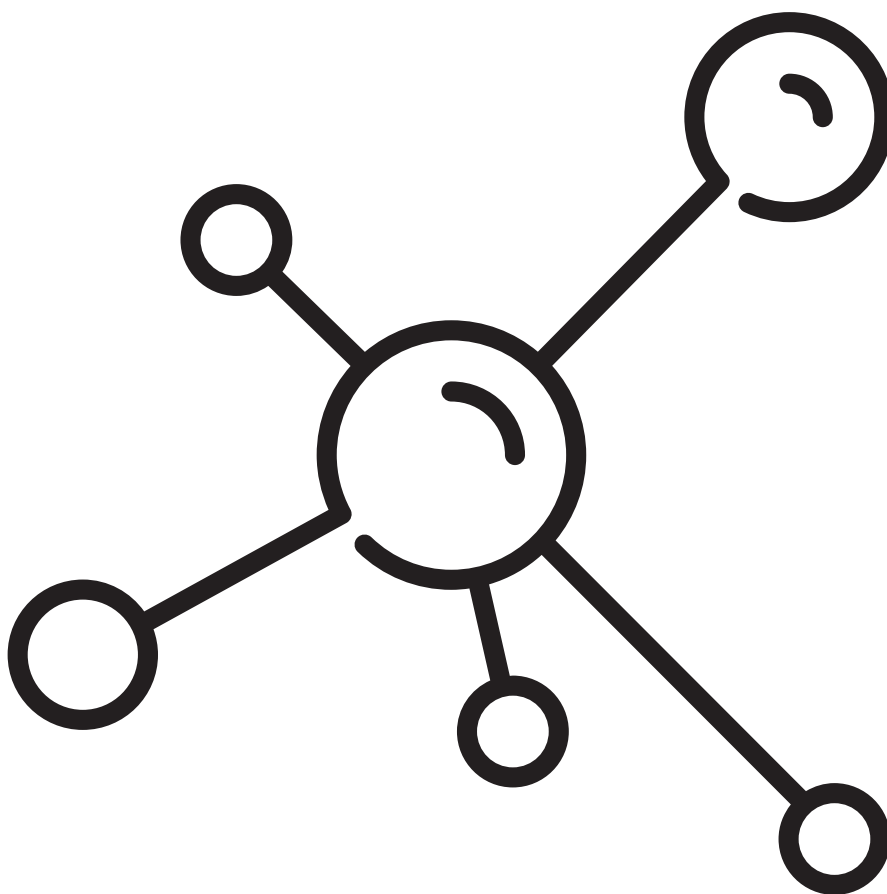


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# A MESSAGE: FROM THE DEPARTMENT HEAD



It's that time of year again! Our Fall term is complete, as are the holidays, so it's time to step back and reflect on the year gone by. It's been a year of hard work and also change for OSU Chemistry.

On the "what's gone right" side, the first thing that comes to mind are the many additions to faculty and staff that have (or will soon) add significantly to our instructional, research, and service capacities. This year has been particularly busy - we've added two instructional faculty and five staff members. To learn a bit more about our new colleagues, check out the "New Faces" section on page 4. There are more additions to come - Chemistry has two tenure-track faculty position searches currently open, with candidates to visit during Winter term. Chairing these TT search committees are **Wei Kong** and **May Nyman** - our thanks to them and all committee members for their significant time and efforts in these tasks.

One more faculty change to announce - **Walt Loveland** retired on December 31 after 52 years at OSU. We still get to see Walt frequently, as he plans to maintain his research efforts here as a courtesy faculty member. Let's all take time to thank Walt for all his contributions to the Department and to OSU.

For those with OSU homes in Gilbert Hall and Gilbert

Addition, and to those who frequent or visit our buildings, you'll have noticed occasional loud noises, some dust, and a lot of rerouting of foot traffic. All of those have come to an end with the on-time and on-budget completion of our major renovation projects for both the large Gilbert auditoria and the 2nd floor of the Addition. Thanks to **Rusty Root** for managing this project from the Department side, and to Fortis Construction Inc. for an excellent experience. It's not easy to accomplish reconstruction on this scale in an active research and teaching building site, and this was really well done with a minimal amount of disruption. See the results on page 6. There are a few other renovation projects completed or underway throughout the complex - entry doors, some painting and other infrastructure fixes.

Our students, faculty and staff have received many awards over the year, as noted in newsletters and on our website and social media. I'd like to mention here some awardees on a pleasant October evening at the College of Science fall banquet - these were **Jie Zhang** (Outstanding Faculty Research Assistant), **Paula Christie** (Gladys Valley Award for Exemplary Administrative Support), **Sandra Loesgen** (Research and Innovation Seed Program Award), and **May Nyman** (F.A. Gilfillan Memorial Award for Distinguished Scholarship in Science). As part of this recognition, May will be presenting the Gilfillan seminar in 2019. The most recent awardee news is that **Mas Subramanian** was elected as an AAAS Fellow.

Congratulations to all!

Regards,  
Mike

Chemistry  
Instructor,  
Margie Haak's  
house, decked  
out for the  
holidays



## NEW FACES: RECENT HIRES



**Cassandra Siler** earned her PhD in Engineering Sciences from Harvard University, studying surface chemistry. Her research focused on fundamental chemical reaction patterns for oxidative coupling reactions on silver and gold single-crystal surfaces in ultra-high vacuum. Since graduating in 2014, Cassie has been teaching—first at Seattle Pacific University, where she taught general and introductory inorganic chemistry, and then at The Cambridge School, a private K-12 school in San Diego, where she designed and taught courses in physical science, chemistry, and physics. Cassie is excited to continue her career with curriculum development and working with students at Oregon State. Her husband, Nick Siler, is an assistant professor in the College of Earth, Ocean, and Atmospheric Sciences. They and their two young children love Oregon and are excited to be a part of Beaver Nation.

**Scott Brown** grew up in Northern Utah. He graduated with a BS in Microbiology and minored in Chemistry and wished by the end of the program that he had just majored in chemistry. To him, chemistry is magic and preparing solutions at his job here at OSU is the closest he'll ever get to brewing potions. In his spare time he likes to explore the outdoors with his wife or go trail running if its not too wet and dark outside. On rainy, cold days they like to stay in and cuddle on the couch with their cat while reading a good book. He's happy to be working at OSU and to help make the chemistry laboratory sessions an educational and fun experience for students.



**Lou Wojcinski** received his B.S. in chemistry from the University of Akron and his Ph.D. in Chemistry from The Pennsylvania State University, studying homogeneous catalysis and polymer synthesis. Following post-doc appointments at Argonne National Lab, North Carolina State University and Kansas State University, he served as a Teaching Professor at Kansas State University for 14 yrs before coming to Oregon State as an Instructor, focusing on the freshman chemistry program. His primary interests are in helping students develop transferrable process skills while learning course content, and in helping students become better problem solvers. When not on campus, Lou spends his time with his wife Suzanne and their two dogs and two cats. He is also an avid runner, with 12 marathon finishes behind him and more to come.

Want to keep up with everything happening in the department? Check out our **social media!**







Hi! I'm **Sierra Hansen**. When not chasing after my two children (an 11 year old daughter and 7 year old son), I enjoy movies; all genres, new and old. I recently graduated from Southern Oregon University with a Bachelor's degree in Chemistry and have worked in the retail business my whole life. So if you are ever passing by Chemstores,

pop in and we can discuss movies, any supplies you may need, or to just to say hi! I look forward to this new career and hope to become an asset to Oregon State University. Thanks!

**Jeff Davis** is the eCampus/ Undergraduate Coordinator for the Department of Chemistry. Distance education provided him with the opportunity to complete his degree while working full time. He is very familiar with the challenges that eCampus and hybrid classes can present in addition to their benefits. When not answering questions, the phone or dealing with registration issues, he enjoys hiking with his husband and his blue heeler or sitting at home with a cup of tea, writing and playing far too many video games.



Hello all! My name is **Tara Stacy**. I'm the new Graduate Coordinator in Chemistry! I'm super happy to be here. I love administrative work and working closely with Faculty & Students. I am a local Oregonian. I was born & raised in Albany (for the most part) and received my BA from Oregon State. I have been married 8 years and I have a 2.5 year old daughter named Cordelia – after Anne of Green Gables. I'm terrible with coming up with hobbies but I do love wine, cheese, reading, flowers & shopping. Please feel free to come say hello! :)

**Chadd Armstrong** grew up in the central valley, the eldest of three children of a single working mother who was at Hewlett Packard for 25 years.

He had an early exposure to electronics and computers. A HP-8x prototype "PC" was brought home when he was six. It had a four inch green phosphor screen, a micro tape drive, and a thermal printer. By twelve or thirteen he was helping with take home work from HP -- wire wrapping prototype boards and soldering.

His first real job was at a computer aided engraving shop, after that he worked for Acres Gaming, a former Corvallis electronics company. Spending more than half a decade there, he worked his way up from production to that of systems engineer before relocating to San Francisco for the dot com startup era as a back end systems architect, remaining in the bay area for a number of years.

Eventually, after a colorful career in industry and to continue innovating, he decided to pursue a degree in science. Starting at LBCC, he was enticed into Chemistry by something his genchem instructors, Ron Backus, said - "Chemistry is the Physics of the small".

He completed an ACS undergraduate with OSU's own Chemistry Dept. while doing research into microfluidics and then a graduate degree from the University of Washington in nanomaterials -- an empiricist primarily developing instruments and methods for studying nanoscale electrochemistry of small surfaces and of nanoparticles.

He now lives outside of Lebanon, helping with a disabled elderly step-dad while also working for the family business, a small parts supplier for Trimble. For fun he enjoys table top games during the winter and disc golf during the summer.

Chadd joined the department part-time, employing his innate analytical problem solving skills as the new Development Engineer, managing the Electronics shop and happily providing technical services for his home University.





# RENOVATION WRAP-UP: THE FINAL PRODUCT

By: Rusty Root

**Dr. Jeff Walker** held the inaugural class in the newly renovated Lecture Halls. The Gilbert Renovation Project is a \$2.3 Million remodel of Gilbert Hall and Gilbert Addition. Beginning the Monday after Spring Term's Final Exams, in June of 2018, the renovation touched both Gilbert Lecture Halls (124 & 224), Gilbert Lecture Prep Room (026), as well as the 2nd-floor teaching Lab in Gilbert Addition (209). The purpose of the remodel was to modernize the antiquated facilities that had, in Gilbert Hall's case, been around since the building was built in 1939. There was an emphasis on improving student comfort, student and presenter's accessibility, presenter's teaching aids, and overall student and staff safety.



The lectures halls were gutted; removing everything except the casework in the front of the rooms. The single main door and aisle were replaced with two access doors and two aisles. The circa 1939 seats were replaced with a more modern ergonomic style including a foldable tablet-style desk.

For better temperature control, cooling coils were added to the new air ducts. Also, several ceiling fans were added to provide air movement and equalize the temperature throughout the room.



For accessibility, there is a new ADA lift in Gilbert 224 allowing students and presenters with mobility issues access to the front of the classroom. The upper ADA area is expanded from a table and a few chairs to an entire counter spanning most of the upper deck. Handrails were added for the aisle ways.

New lecterns with a sit/stand desk, upgraded Audio-Video, new Periodic Tables, new paint scheme, new LED dimmable







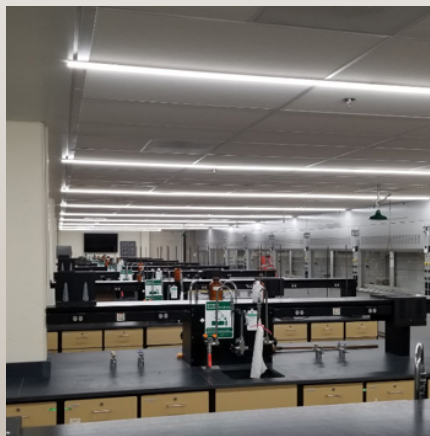
lighting, and whiteboards were added. A fume hood was incorporated in GILB 224, and even the front entry was improved with color, depth, bulletin boards, recycling/trash cubbies, and display cases.

In Gilbert Addition the old 1980's fume hoods were removed and replaced with new modern fume hoods. There are now two ADA lab benches as well as two ADA fume hoods. A new chiller was installed to improve air conditioning for summer term classes. A drop ceiling with new dimmable LED lighting was installed. For teaching, there are five new electronic displays and a sit/stand teaching station.



The lecture prep facility behind the lecture theaters was completely renovated to provide a significant upgrade in safety for the preparators.

The Lecture Halls re-opened on January 7, 2019. The teaching lab re-opened January 15, 2019 being used by Professor **Kevin Gable's** class. While it's been a long and twisty road, Fortis Construction, their sub-contractors, and OSU Project Managers have worked together to get this project complete and ready for Winter Term 2019.



# CHEMICAL MICROENVIRONMENTS: A NEW APPROACH FROM DESIGNING NEW MATERIALS TO UNDERSTANDING BIOFILM INTERACTIONS

**By: Assistant Prof. Dipankar Koley**

We are involved in a highly interdisciplinary research program that works at the interface of electrochemistry, biology, and bioengineering. We aim to use our expertise in designing and fabricating electrochemical sensors to assist life scientists in studying and diagnosing various human diseases, as well as in using preventive measures to intervene in them.

## MAPPING LOCAL CHEMICAL ENVIRONMENT PRODUCED BY BIOFILM:

In nature, bacteria are rarely found in isolation but instead coexist with other bacterial species. They are in constant communication with their own and other species, producing a wide variety of small signaling molecules or peptides, and continually reshaping the biofilm landscape on the basis of these interactions. These bacterial chemical communications ultimately influence the pathogenicity of certain bacterial species in human diseases and the efficiency of certain microbial-mediated biochemical processes. Hence, we are interested in studying real-time metabolic interactions among these bacterial species located 1 to 100  $\mu\text{m}$  apart. This investigation will also aid in determining the minimum distance required to induce any metabolic effect on another species in a single experimental setup.

## REAL-TIME MICROBIAL METABOLIC EXCHANGE BETWEEN SG AND SM:

We developed 25- $\mu\text{m}$  diameter pH and  $\text{H}_2\text{O}_2$  sensor probes to map these parameters above the alginate hydrogel-encapsulated Sg (major  $\text{H}_2\text{O}_2$ -producing commensal species) and Sm (major lactic acid-producing pathogenic species) dual biofilm. We discovered that the production



of  $\text{H}_2\text{O}_2$  by Sg was suppressed by the immediate presence of the acid-producing bacteria Sm. Using a dual-biofilm setup with Sm surrounding Sg, we detected an initial increase in the local  $\text{H}_2\text{O}_2$  concentration of 70  $\mu\text{M}$  above Sg, followed by a gradual decrease in the  $\text{H}_2\text{O}_2$  concentration (after >30 min addition of 1 mM glucose and 29 mM sucrose) to almost zero as lactate production and the subsequent lowering of pH by Sm became more dominant. This result suggests that  $\text{H}_2\text{O}_2$ -producing bacteria such as Sg are dominant while the buffering capacity of saliva is still valid ( $\sim\text{pH}$  6.0), but then Sm metabolites gradually override and slowly start decreasing the local pH to 5.0 or lower by producing lactic acid. Elucidating the microbial metabolic interactions in 3D space, especially the larger pH profile distribution over that of  $\text{H}_2\text{O}_2$  and their corresponding roles in determining the pathogenicity of Sm in the presence of beneficial Sg, was only possible by SECM because of its unique capabilities in quantitative chemical mapping with high spatial resolution. In addition, the  $\text{H}_2\text{O}_2$ -producing *spxB* gene of Sg has been observed to be downregulated when the local pH shifts from 7 to 6. Traditional genetic assays at

initial and final time stamps were incapable of detecting the transient local chemical conditions resulting from the metabolic activities of the individual species within this microenvironment. Only through the use of SECM were the dynamic metabolic interactions ( $\text{H}_2\text{O}_2$  and pH) of these bacterial species revealed. The bacterial species Sg and Sm were provided by my collaborator Jens Kreth (oral microbiologist, Oregon Health and Science University), and we are currently preparing the study for publication.

## CHEMICAL APPROACH OF DESIGNING NEW BIOMATERIALS:

We designed and fabricated pH and  $\text{Ca}^{+2}$  microsensors as SECM probes to map the local pH and  $\text{Ca}^{2+}$  release profile above a BAG pellet. The BAG pellets were prepared and provided by our collaborator Jack Ferracane (Restorative Dentistry, Oregon Health and Science University). The BAG particles were pressed under high pressure to form a pellet and then surrounded by resin composites (1-cm diameter). The exposed BAG surface was then covered by Kapton tape to produce a 1.6-mm diameter exposed surface for SECM experiments. First, an SECM approach curve was



performed by using the redox sensor to fix the sensor–substrate distance of 20  $\mu\text{m}$  above the BAG with a 2 mM ferrocyanide solution. The solution was later replaced by artificial saliva (pH 4.5) and the pH sensor was turned on to map the pH profile at a constant distance of 200  $\mu\text{m}$  above the BAG surface. A similar chemical mapping image was obtained for  $\text{Ca}^{+2}$  release from the BAG surface. The z-direction pH profile allows us to map the neutralization zone produced by BAG and to elucidate the chemical microenvironment to which the bacteria would be exposed when grown on these composites.

We aim to further our studies by using the same electrochemical sensors (pH and  $\text{Ca}^{+2}$ ) to aid in designing a new dental composite (BAG particles and resin) based on quantitative measurements of the chemical microenvironment (i.e., amount of  $\text{Ca}^{+2}$  released). This

bottom-up approach will aid us in predicting more efficient composites in influencing the biofilm grown on these composites. This same system will be then further extended to other metal ion-releasing composites.

#### REAL-TIME MONITORING OF BIOFILM/BIOMATERIALS CHEMICAL INTERFACE:

The bacteria–biomaterial interface is one of the most important interfaces, as it has a direct impact on our health in relation to biomedical devices, implanted prosthetics, antimicrobial surfaces, and dental fillings. The latter is a complex problem involving bacterial metabolism in the very small, confined space inside cracks/crevices within dental filling composites and the surrounding oral salivary environment, and it requires significant resources to fix these secondary dental cavities. The main challenge in studying this complex

and dynamic biofilm–composite interface is the lack of a noninvasive analytical technique to monitor these chemical processes in real time. To address this problem, we have begun developing new types of microsensor probes to be used with scanning electrochemical microscopy (SECM) to quantitatively map the release profile of the metal ions and bacterial metabolites. SECM is a technique that allows precise (within 10  $\mu\text{m}$  distance) positioning of the electrochemical probe over the substrate of interest (e.g., biofilm, composite) without touching or destroying it, thus making it a real-time, noninvasive method. In the following study, we demonstrate the capabilities of our SECM-based electrochemical methods to quantify and map the local chemical environment above bioactive glass (BAG)-based dental composites.

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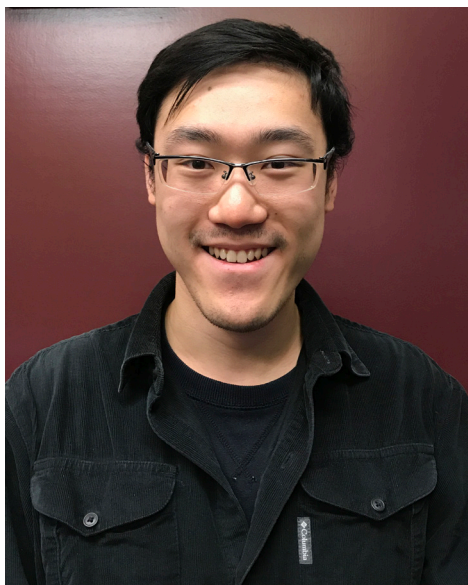
## CHEM ED STUDENTS: ATTEND BCCE 2018

Five chemistry majors pursuing the chemistry education option and one recent chemistry education graduate attended the 2018 Biennial Conference on Chemical Education (BCCE) held at the University of Notre Dame. BCCE 2018 was an environment where future teachers could facilitate meaningful connections among like-minded peers. Daily workshops created an engaging and thoughtful atmosphere. There were discussions about learning styles along with lectures on specific teaching techniques. Meeting other students pursuing similar career path made it an incredible, well-rounded experience for all involved. We feel this event is a valuable investment for these bright future educators, which is just one of the many reasons, OSU Chemistry will be hosting BCCE 2020.





# UNDERGRADUATES: OF THE QUARTER - FALL 2018



By: Yasmine Rifai

**Yitong Qi** has been named

undergraduate of the quarter for fall term 2018, and we are so pleased.

Yitong grew up in Xi'an, the capital city of the Shaanxi Province in China. He then moved to Salem where he attended Sprague High School.

An initial interest in sustainable energy and materials drove Yitong to pursue Chemical Engineering in his undergraduate work. He discovered that engineering was less about the materials than the process, and decided to switch to Chemistry to work first hand with the chemicals. He found research interest, so joined **Dr. David Ji's** lab, where he works with graduate students and post docs on projects related to battery materials.

Projects in the lab involve making and applying carbon materials to battery use and the chemistry behind them.

In his spare time, Yitong enjoys watching movies, hearing stories, and eating guacamole.

After graduating from Oregon State University, Yitong plans to attend graduate school.

Students like Yitong are just some of the reasons we're so proud of our Undergraduate Majors. We wish him great success in his future endeavors.



By: Yasmine Rifai

**Tanner Aldous** has been named one of the Fall 2018 Undergraduates of the Quarter, and we couldn't be more pleased. Tanner grew up in Drain, Oregon, where his North Douglas High School graduating class was no larger than twenty students. Relative to Drain, Corvallis was a big move for Tanner. He was happy that Oregon State University was in a bigger town, but still felt small like his home town.

Tanner wanted to pursue chemistry because of the great influence from his high school chemistry teacher, and because he knew he wanted to stay in Oregon for college, OSU was the school of choice. Oregon State University seemed to choose Tanner, rather than the other way around. The campus in the fall with the leaves changing colors, was something that the other Oregon institutions couldn't compare to.

An interest in the medical field combined with a passion for chemistry made it so Tanner's major choice was pretty simple: Chemistry with a Premed option. Once he graduates, Tanner plans to go to medical school.

Currently, Tanner is working in **Dr. Sean Burrow's** lab. He got started in this lab by asking professors if they had any openings in their lab, because he wanted to see if research was something he would be interested in. Now, Tanner is working with nanoparticles, specifically nanostars. He aids a graduate student, **Lixia Zhou**, by making nanostars from nanoseeds. He also performs data collection and analysis for this project.

Outside of school, Tanner likes to hang out with friends, and get to know new people, especially if they are also chemistry students. He finds collaboration on school work to help transition into friendships. He is also

a part of the professional chemistry fraternity Alpha Chi Sigma. The fraternity is fairly small right now, but Tanner hopes to see it grow by the end of his time at Oregon State.







# IN MEMORIUM: KENNETH HEDBERG (1920-2019)



Ken Hedberg

Dear Colleagues,

I am deeply saddened to share the news of the death of **Ken Hedberg**, one of our most accomplished scientists, alumni and Distinguished Professors of chemistry. Ken died on January 5, 2019, just a month shy of his 99th birthday. He is survived by his wife and collaborator Lise, daughter Katrina, son Eric and grandchildren. A celebration of Ken's life was held at the OSU Foundation on Saturday, February 2nd at 2pm.

Ken truly lived a life of science, spending more than seven decades advancing science while at OSU with 30 of those years coming after his retirement in 1987. He was a familiar and warm presence in Gilbert Hall since he joined our faculty in 1956. He was a remarkable person and for those of you who knew him, lived every moment to the fullest. Even up until this fall, he came to the office every week or two and always had time for colleagues, students or a friendly game of poker with current and former chemistry faculty.

Ken trained and mentored generations of scientists. He conducted fundamental research, collaborated with and hosted dozens of visiting researchers from around the world since the 1950s, and was a caring and dedicated mentor to students.

Ken was a native Oregonian, and an OSU alumnus ('43). A physical chemist who completed his doctorate with Linus Pauling in 1948, Hedberg established a research program at OSU that focused on the structural analysis of various compounds using an electron diffraction apparatus

that he designed and built himself. With research focused on molecular structure and intramolecular dynamics, Hedberg determined the structure of dozens of molecules.

An internationally recognized scientist and scholar that spanned more than seven decades, Ken wrote his first science publication in 1943 one of his latest in November of 2018. He received both a Fulbright grant and a Guggenheim fellowship and dozens of other honors and awards. Ken was a Fellow of the American Physical Society, the Royal Norwegian Council for Scientific and Industrial Research, and the American Association for the Advancement of Science, among others.

When honored with the College's Lifetime Achievement Award in Science in 2016, Ken said that "Science is about people, collaborations, relationships and connections." He was absolutely right. His wisdom, hard work, passion for science and friendship will be greatly missed.

**Roy Haggerty**  
Dean of Science

## ECAMPUS: WOULD YOU LIKE TO KNOW MORE?

**By: Jeff Davis**

The Department of Chemistry Ecampus classes represent a new paradigm in on-line learning. We offer cutting edge virtual labs and new approaches to on-line learning in each of our classes. It's not just for distance learners either! Ecampus courses are built to work around your schedule. With all the tools you need to succeed and unparalleled flexibility, it's an amazing opportunity for any student. Fit a Gen Chem class into your evening and free up your days for study. Take our condensed 26X lab offerings over summer to focus on your other classes during Fall Term. We offer a variety of Gen Chem courses for both science and non-science majors, but we're not stopping there. New innovations in technology and techniques mean we can expand our offerings. Find out more on the Chemistry department website at [chemistry.oregonstate.edu](http://chemistry.oregonstate.edu). Click on Courses -> Ecampus to see what we offer throughout the year. Have any questions about an Ecampus class? E-mail us at [chemistry.ecampus@oregonstate.edu](mailto:chemistry.ecampus@oregonstate.edu). We'll keep you informed about the new developments in on-line and distance learning.





# Oregon State University

Department of Chemistry  
153 Gilbert Hall  
Corvallis, OR 97331



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