

Department of Chemistry

# Fumes from the Hood

Winter 2016

**Oregon State**  
UNIVERSITY





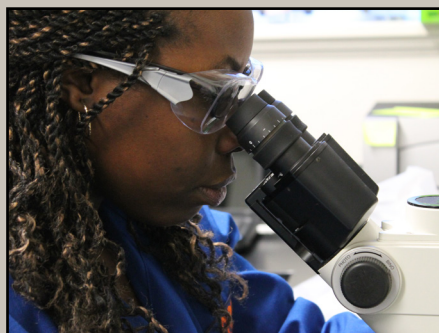
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**On the cover:**



OSU Chemistry Graduate Student,  
Elizabeth Kawessa (Loesgen Lab)  
working in her lab.

**Expanded stories available online:**  
[blogs.oregonstate.edu/erlenmeyer](http://blogs.oregonstate.edu/erlenmeyer)

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# A MESSAGE: FROM THE CHAIR

OSU Chemistry Alumni and Friends,

The Winter 2017 issue of Fumes from the Hood continues our thematic approach to the Departmental newsletters – focusing this issue on our exciting innovations in the classroom. It is important to remember that the most important output from our Department is the students we train. Chemistry is the Central Science and the impact of our students and graduates is far reaching. These classroom innovations include guided inquiry-based labs in our General Chemistry lab sequence (Page 4-5), enhanced classroom approach to engaging freshmen chemistry majors (Page 10), flipped classrooms (Page 11), supplemental instruction (Page 15), our First Year experience course (Page 16) and our CH 199 program to help at risk students (Page 17). Our commitment to education extends well beyond the undergraduate classroom. One illustration of this commitment is the Lens of the Market® program developed by **Judy Gordian** (OSU Chemistry Professor of Practice) and now supported through a National Science Foundation Graduate Research Traineeship – Innovations in Graduate Education Grant (Page 9). The Department is also focused on producing the next generation of educators through our CH 607 – Teacher Mentoring Program (Page 16).

I am particularly proud of the fact that our achievements in education have been recognized consistently by the University and beyond. For example, GTA's have been

recognized multiple times with campus-wide awards for their teaching (Page 8-9). In addition, six of our faculty have received Action Research Fellowships (Page 18). Most recently, our own **Rick Nafshun** just received the 2017 Oregon Academy of Science Higher-Ed educator award.

This newsletter also represents my last “Chair’s message” as I will be stepping down as Department Chair in March 2017. It has been my tremendous honor to serve in this role over the past 5+ years. I am so proud of what we have been able to accomplish together and I offer my sincere gratitude to our alumni and friends for your support and partnership on this journey. I am confident that Chemistry is well-positioned to continue to maintain its leadership role within the College, University and beyond for many years to come. I look forward to continuing to interact with OSU Chemistry alumni and friends through my role as professor. Thank you for your continued support of OSU Chemistry!

All the best,

Rich



**Oregon State University | Department of Chemistry**



# GUIDED-INQUIRY BASED LABS: A NEW APPROACH



A favorite lab is one in which students are tasked to find the types of dyes and their concentrations in a sample of Gatorade, with the ultimate goal of regenerating the color profile from stock dyes in the laboratory. Students are given background information on Beer's law and dilution and shown how to use the spectrophotometers in the laboratory. From there, they need to develop their own procedures. It can be very gratifying for a laboratory group when they are able to use their data to make a mixture that exactly matches the color of the Gatorade sample.

Laboratory students have always followed our procedures, done exactly what we told them to do and subsequently got good scores. The problem, however, was that afterward, students often still had no real idea of the basic concepts we were trying to teach them. This was not anything the students were doing wrong—it was an issue with our pedagogy.

What exactly are guided-inquiry laboratory projects? A goal is provided and students are tasked to get there without explicit instructions, although they definitely get background information and guidance from their TA. This is much more akin to what happens in an actual research environment.

Before the start of the Fall term, all incoming graduate students and most undergraduate students who will be TAs attend a mandatory 10-day orientation program designed to help them transition from their long-held student role into the role of effective teacher. During this program they are introduced to a variety of methods to encourage their students to become actively engaged in the education process. They practice using these new methods by teaching several mini-lessons and they receive feedback from the other new graduate students, several experienced GTAs, and faculty. They also experience the guided-inquiry laboratory format by doing the experiments, while the experienced GTAs fulfill the role of the laboratory TA. Thus, the new graduate students observe firsthand that to be effective facilitators they will need to ask their students questions and give them suggestions, rather than simply telling them what to do. This helps the new GTAs understand where their students may have questions, and provides time to think about how to guide their students in a productive direction before they are actually faced with leading their own laboratory session.

The 2014–2015 academic year marked the first in which our entire CH 26X laboratory sequence used the guided-inquiry format. We were very excited about how well it went, and we are working to make additions and improvements.





This requires getting input from TAs, LPSC Issue Room staff, and students.

Although students seem unanimous in their belief that the guided-inquiry format requires more effort, overall their response has been positive about their laboratory experiences. This feedback has been reassuring. There were several instances where students asked if their group could come into the laboratory later, outside of their scheduled time, to put in additional work on their projects. Seeing this level of enthusiasm and engagement was definitely encouraging—this is not a request usually made when we taught under the old model. On another note, grade averages have stayed about the same. This is good news, because it clearly shows that students can be just as successful (with respect to their course grade) with the guided-inquiry format, even though we no longer provide step-by-step instructions. And although students do not get those instructions, there are many more possibilities as to how the laboratory requirement can be met—oftentimes several different approaches can work. Knowing that there is not necessarily one “right” way to do the laboratory takes a lot of pressure off the students since they are graded more on the

process, not the end result.

For TAs, teaching is clearly an important part of their lives since it entails a significant time commitment, and in addition to the obvious teaching experience they gain it has also been shown that teaching benefits a TA's own research. Thus, it is important to consider how TAs perceive their teaching duties in the laboratory and what pedagogical techniques they feel best about. Data from a survey of TAs recently conducted, showed that overwhelmingly TAs feel that the guided-inquiry method is better for both themselves and their students.

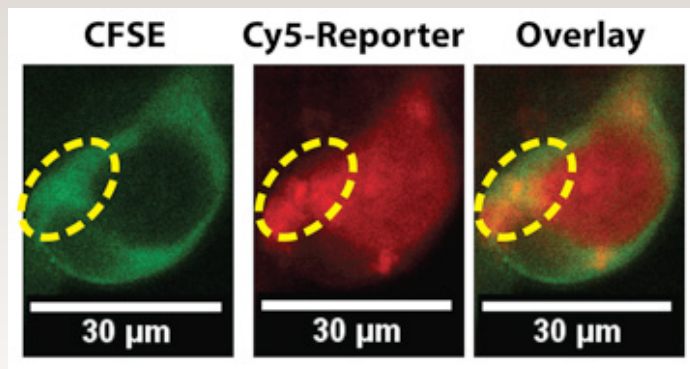


**In previous general chemistry lab courses, students were asked to follow a set of instructions for each lab, where their grade in the course only reflected their ability to copy the desired results whether or not they were absorbing any information on the subject. Through the current guided inquiry method of teaching, students are challenged to think for themselves and complete labs that they design. This fosters an environment in which students can experiment and fail, all the while learning more about the science than ever before.**

**– Bella Giampaoli, Head TA**

# BURROWS' LAB: BEAVERS BUILDING BIOTECHNOLOGY

by: Prof. Sean Burrows and Shan Lansing



Diseased tissue contains diverse collections of cells, each defined by unique biological processes. Collectively, each cell's biological process contributes to the overall disease. The ability to reveal biomolecular differences between cells is important to identifying cell types that are the most aberrant in nature. Analysis of different processes between cells will help us learn how cells influence (and are influenced by) one another.

Although analysis techniques that extract biomolecules from cells provide some insight to their role in biological processes, these techniques do not reveal differences between cells. Intracellular imaging is one approach to reveal biomolecular differences; however, current technologies are limited. Specifically, bottlenecks associated with biosensors and instruments limit the efficacy of intracellular analysis.

Our goal is to address the challenges that face both biosensor and spectroscopic instrumentation based tools to advance intracellular analysis. These technologies will enable novel scientific advances to better understand biological processes at the cellular level.

The tumor microenvironment is a diverse collection of cancerous and cancer-associated cells. The diversity is a result of both the microenvironment and mutational landscape changes associated with the quickly proliferating tumor mass. Typically, changes in biological processes result from changes in the expression of hundreds of genes; however, not all of these genes are regulated in concert and contribute to a change in disease state. One way cells post-transcriptionally regulate protein expression is by producing microRNAs that disrupt translation by binding to messenger-RNA.

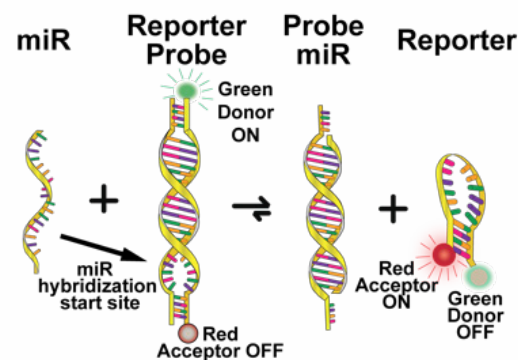
The current model suggests that specific combinations of

microRNA play a role in biological processes like hypoxia, Wnt, and insulin. In order to reveal and validate proposed links between particular microRNA combinations and particular biological processes, we need tools that show the microRNA combination actually exists within a given cell. Identifying a cell's specific microRNA combination is a challenge because the combination will vary both temporally and spatially across cells and tissue. RNAseq can identify global changes in microRNA expression, but cannot easily distinguish true differences between single cells because large numbers of cells must be lysed and the contents combined prior to analysis.

Technologies that identify multiple microRNA are needed to reveal the different expression profiles in various cells that are linked to changes in the microenvironment and mutational landscape. These technologies will evaluate microRNA expression to truly understand the underlying biological processes that drive disease progression.

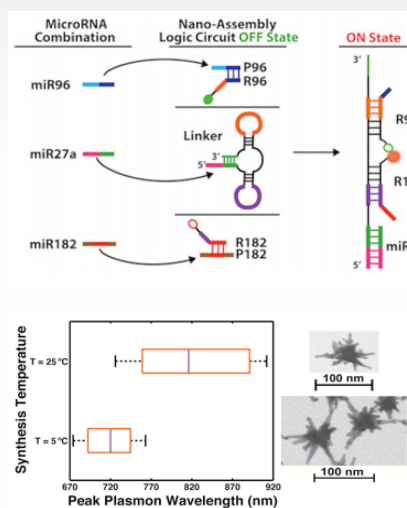
Sensor technology developed in the Burrows Lab addresses the following hurdles present in current microRNA analysis technology: (1) lack of in situ sensors that respond to more than two microRNA at a time, (2) lack of sensors that measure dynamic decreases in microRNA concentration, and (3) lack of sensors that resist false signals from degradation and poor selectivity.

Many challenges reside in the biosensor's chemical make-up, molecular architecture, and conformational changes. To address the challenges associated with microRNA biosensors, the Burrows Lab has pioneered new molecular architectures and types of conformational changes. In one design, a conformational change induces energy transfer interactions that reduces false signals by ~50% over current technology. Sequence discrimination reached ~90% with pico- to nanomolar detection of let-7a and microRNAs: -26a, -27a, -29b, and -146a. Recently, our work was highlighted in a review article on emerging microRNA



biosensor technology (Bailey, Anal. Chem., 2016).

To address the need for sensors that measure microRNA combinations, we established a design with a multi-hairpin motif that serves to detect a larger number of microRNA. The multi-hairpin motif also provides a place to generate Fluorescence Resonance Energy Transfer based signal enhancement. Currently we are addressing how to implement chemical modifications that will further: 1) increase the number of inputs per sensor, 2) improve selectivity, and 3) reduce false signal from unwanted species that bind to and/or degrade the sensor. In addition to standard fluorescence methods, we conduct research on the potential for plasmonic induced signal generation.



We are actively pursuing how a nanostructure plasmon reproducibility influences Metal Enhanced Fluorescence and Surface Enhanced Raman Scatter. The biological roles of species like proteins, RNA, and small molecules depend in part on their level of co-expression and subcellular location (e.g. vesicles and organelles). Advances in fluorescence analysis techniques are needed to accurately visualize each biological species and their location with respect to one another. These tools will be vital to understand each biomolecule's role in cellular processes. Furthermore, these tools will provide information to better reveal how various interrelated processes change during disease development and progression.

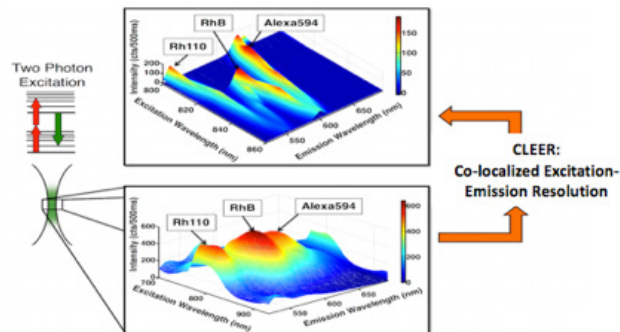
Unfortunately, fluorescence techniques are limited in the number of co-localized emitters that can be resolved. If we could spectrally resolve more co-localized fluorescently labeled biomolecules in situ than currently possible, then our understanding of biology can be greatly improved. Poor spectral resolution is problematic because many biomolecules can interact at spatial resolutions less than a microscope's objectives can handle.

Problems with spectral resolution from just two co-localized fluorophores are due to broad spectra that cause cross talk between detector channels. Thus, accurate

signal differentiation from co-localized emitters is difficult. Currently, less than 30% spectral overlap is acceptable to mitigate cross-talk. Acceptable levels of spectral overlap need to be increased in order to increase the number of co-localized emitters we can simultaneously analyze.

Recently, we pioneered an innovative multiphoton technique to resolve co-localized fluorescence, termed Co-Localized Excitation-Emission Resolution (CLEER). Preliminary work demonstrated CLEER's ability to reduce spectral cross-talk from three co-localized dyes in a mixture that had over 30% spectral overlap. The technique relies on empirically derived dye-specific excitation-emission coordinates (DyeSEECs) for each dye. Compared to conventional filter approaches we demonstrated a 3 to 25 percentage point decrease in cross-talk among three emitters. Thin-film Linear Variable Spectral Filters (LVFs) were leveraged as a novel optical material to create an emission bandpass filter that was tunable in both the bandpass and central wavelength passed.

To resolve more than three dyes, we are developing several types of computer models to predict each dye's DyeSEEC based on empirical data of the dyes in the mixture. Other areas of active research include creating custom DyeSEEC inspired emission filters with the LVFs to better resolve more dyes.





# HERBERT F FROLANDER AWARD: WINNING IN & OUT OF THE CLASSROOM

by: Kayla Shearer

Success in the classroom typically makes us think about our students' success - getting good grades, completing difficult labs, and successfully assimilating into life beyond college - but what about those people that helped our students get there? There is no doubt that without the brilliant faculty, research assistants, and graduate students here in the Department of Chemistry, our students would not be as successful as they are today.

So, what role do these parties play in our students' success? They excite, explain, and encourage students to take chances, try new things, and seek out opportunities to learn and grow in the sciences.

In the past two years, the Department of Chemistry has been proud to claim two awardees of the Herbert F. Frolander Award who embody all of the aforementioned characteristics and more. The intent of this award is to recognize outstanding teaching and professional involvement with both faculty and students by a graduate teaching assistant at OSU. The recipient receives an engraved plaque and an award in the amount of \$1,000. This extremely competitive award considers all graduate teaching assistants throughout the entire university; revealing just how impressive our graduate students are.

In 2015, **Maduka Ogba** became the first graduate student of Chemistry to receive the Herbert F. Frolander Award. Maduka explains that the most rewarding part of teaching for him is when, "I spot opportunities to elevate the conversation

to a much higher level than originally anticipated. Then, the rare moment occurs, I notice the spark of a light bulb on one of my student's face. I see it - it is the "a-ha" moment! And then I smile because I know the job has been done."

Maduka attributes much of his success to his plethora of mentors within the department or in his words, "all the people who did not have to help me succeed, but did anyway." He goes on to name just a few of the department's faculty members who helped him get where he is today, "**Margie Haak** helped me develop the many iterations of my teaching philosophy. She set me up to explore all of my teaching passions. **Michael Burand** was instrumental in helping me think more deeply about designing chemistry lab modules. Through his guidance, we published a manuscript in the Journal of Chemical Education. **Rick Nafshun** challenged me to think through all the logistics of a course. **Paul Cheong** gave me the platform to develop and teach an entirely new graduate-level course. **Paula Weiss, Kristin Ziebart, Daniel Myles**, as well as the above mentioned people all helped me prepare my teaching portfolio as I was about to leave the nest, so to speak. I express gratitude for the people who paved the way for my success as a teacher."

It was a bittersweet moment for the department when Maduka graduated

from OSU with a PhD in Chemistry in 2016. Maduka played in integral role not only in bringing enthusiasm and innovative thinking into the classroom but beyond the classroom as well. It is no surprise that Dr. Ogba continued on to a career in teaching - in a slightly warmer climate - as the Robbins Postdoctoral Fellow in Chemistry at Pomona College.

**Kyle Almlie**, our most recent Herbert F. Frolander awardee explains, "I think that the fact that chemistry has won it twice in the past couple years shows that statistically we do a lot of teaching but I think we do a lot of great teaching too."

Kyle's love for teaching began during his undergraduate studies at California State University, Chico where he was a peer tutor through the Chico State chemistry. "For the most part, I was pretty ready to go when it came to teaching," Almlie recalls of his first days of graduate student orientation for the Department of Chemistry. "Still, every time you walk into a classroom the first time, you are still super nervous, but it goes away after that." Almlie is continuing his graduate education at the Department of Chemistry under the supervision of Professor **Sean Burrows**. He says he likely sees himself teaching in the future, although he explains that he may want to take a step outside of academia for a while, just to see what it is like.

As you can see, our undergraduate students are not the only ones experiencing great success in the classroom; both our faculty and graduate students rely on our GTA's for new ideas, inspiration, and their promise of





bringing even greater success to the Chemistry Department in the future. We are proud of the achievements of

all of the Department's affiliates and we encourage you to stay up to date by following our blog, the Erlenmeyer

Flask to be the first to hear about our successes and achievements.

## EXPERIENCE REQUIRED: A LENS OF THE MARKET STORY

OSU Chemistry is committed not only to our students' success in the classroom and research laboratory, but also to their professional development for their chosen career path. Funded by the National Science Foundation, under the Graduate Research Traineeship Innovation and Graduate Education (NRT IGE) program, the Lens of the Market® (LOM) program provides our students with a platform for integrating professional development skills and innovation training into their graduate degree. **Rich G. Carter** is the PI and **Judith Giordan, Michelle Dolgos** and **Martin Storksdieck** are the co-PI's for this three year, \$500,000 grant.

**History of Lens of the Market® (LOM).** Dr. Judy Giordan, the creator of LOM in 2010 and Chemistry Professor of Practice at Oregon State University, first became engaged with providing scientists with the skills they need to more effectively deliver research innovations that would provide market value while in industry. This focus on creating T-shaped professionals (deep in their core discipline while being able to engage across multiple disciplines with experts in other areas) or M-shaped professionals (deep in multiple core disciplines) has become key to excelling in the 21st century workforce. Judy's experiences as a program officer with the National Science Foundation (NSF) further informed her knowledge that this skill set may be one of the missing pieces in developing a STEM graduate that is prepared for a successful career in industry, academia, national labs or startups. She founded ecosVC to enable the delivery of LoM – bringing the power of training and investing to science and engineering innovators and enabling the translation of research into commercial innovations to meet the needs of people and the planet.

**NRT IGE at OSU.** The 2015-2018 NRT IGE grant enables OSU to pilot a first-in-the-Nation application of this LoM program across the entire STEM discipline. Previous LoM programs have focused on research efforts within a specific research topic. In fact, LoM first came to OSU through Distinguished Professor **Doug Keszler** and the NSF Center for Sustainable Materials Chemistry. Professor

Rich Carter explains, "What we're doing with this NRT grant is we're really flipping this model on its head. Instead of being in a single research focus, we're really opening it up broadly to anyone across the STEM discipline."

Key to this program is integrating an informed understanding of what Society (through the market) needs with basic STEM research to fully realize the maximum impact of the science. Faculty and students continue to do basic science – simply from an informed lens of the market. "We want to engage students while they are still working in the lab on the fundamental science" says Carter. The program operates in three stages, the first of which is a single day workshop where students learn the vocabulary of the market and how their research can become an innovation. The second stage (6 months) involves conducting "quick screens" on multiple market application pairs before identifying a star market where they do a "deep dive" to determine the potential viability of a new application to that market. The third and final stage (6 months) provides the skills for developing aligned business models, and forming simultaneous research and funding plans to successfully go to the next steps. Not all students complete all three stages and the students can tailor their level of training with their personal interests. The output of this program is the development of the students so they not only find the job they want after graduation, but they succeed as leaders and innovators throughout their careers. Licensing of technologies and new companies are simply by-products of that process. "Our greatest product from OSU is our graduates" Carter says.

The long-term goal for this program is to create an innovation degree option for graduate students at OSU – unlocking a shift in the approach to research within the university system. Carter states "We continue to position OSU as the Pacific Northwest Innovation University. This LoM program will provide a competitive advantage for our graduates and our faculty. We are excited about the potential to positively impact the amazing basic STEM research being done already at OSU."

LENS OF THE MARKET<sup>SM</sup>

Research2Innovation

Innovation2Market

Market2Scale-Up

INVEST/SALES

# CH 23X ENHANCED: ENHANCING EDUCATION FOR ALL

by: Luanne Johnson

The Chemistry Department instructs seven sections of Chemistry 231 which is General Chemistry for Science Majors. Seven sections; all day long, Monday, Wednesday, and Friday. When we decided to create the Chemistry 23X Enhanced class, we reached out to advisors in what we considered to be “related disciplines.” These are students that would do research similar to what our undergraduate chemistry students would be doing; similar in the sense of the undergraduate experience. They informed us they would be excited to place their students in this enhanced class.

The enhanced class basically compresses the curriculum of general chemistry by about 15%. We do 100% of the curriculum, as prescribed in 85% of the time. The other 15% is shared with guest speakers that are experts in research. It is also shared with undergraduates, graduates, and others who came in to show the applications of general chemistry and chemistry in research. The learning outcomes are the same as for general chemistry, the exams are the same, we would like to think that we are not giving anything up. The student experience is the same, but it is a little more.

So, now, instead of students asking, “Why am I taking this class?” the

students are asking, “What am I going to be able to do when I leave here?”

This program was started because the Teacher Mentoring Group recognized that this department is extremely passionate about student success and many of the existing programs have been facilitated to increase student success. But many of these programs have been devoted to students who are struggling. The mentoring group felt that maybe we were not giving our top students an experience where they can thrive. They wanted to address those students and give them something to keep them motivated, to show them the possible applications of chemistry and give them something of additional value to their undergraduate experience.

**Richard Nafshun**, the lead instructor for the CH 231 Enhanced classes has said, “it’s a smash by all metrics.” The student response has been fabulous: they have been very complimentary of the set up and have been appreciative, feeling as though, “this is my major,” and it does contain more



chemistry than perhaps students that are not in the enhanced section. Parents of students in the enhanced section have come up to us and have said, “This is of value to my son/daughter.” And advisors have asked if we are continuing the program and if we would be expanding it to more than one section.

Since this is the first year for this course, there are always changes to be made. As of right now, the mentoring group is focused mostly on making it through this first one-year sequence. They feel like they are ahead, though, because they are already developing material for next term. The goal is to not go off-sequence until they complete an entire year; to see how the whole thing goes.

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





# FLIPPED CLASSROOMS: LESS CLASS TIME, MORE LEARNING

by: **Melanie Carle**

The Department of Chemistry has been flipping its General Chemistry (CH 23X Trailer Series) courses for four years and is now implementing it into the CH12X Series. Faculty members, Dr. **Michael Burand**, **Margie Haak**, and **Paula Weiss** have been spear heading this change in the program and it has been proven effective with increased exam scores and a drop in drop/fail/withdrawal (DFW) rates.

Compared to a class that meets three times a week for 50 minutes, a flipped classroom meets two times per week for 80 minutes and there are no recitations. Class sizes may also be smaller, 160 students, with two instructors and four teaching assistants. A flipped classroom reverses the typical lecture and homework elements of the course becoming more of a hybrid class. Short video lectures about 15 minutes each, created by the instructor, are viewed by the students before class. The videos are not of lectures but shows material that will supplement the students reading assignments. During class students work on problems in their groups with support from the instructors and TAs. The typical class period consists of: students arriving and one group member picking up the problem sets (5 min), announcements as needed (5 min), students working on problems in their group (45 min), and then full class discussion of the solutions to the day's problems (25 min). The set-up of the classroom is conducive to group work as students are assigned to groups of four based on math placement scores and previous chemistry experience creating a mix of genders, majors, and international/domestic students. One example of an In-Class Problem set is: A 1-kg cylinder of aluminum and a 1-kg jug

of water, both at room temperature, are put into a refrigerator. After one hour, the temperature of each object is measured. Are both items the same temperature? Justify your choice. If you think they are different temperatures, which one is colder? Explain your reasoning. In class work is supplemented with online quizzes, outside of class, as well as homework and guided-inquiry laboratories.

In CH231 General Chemistry (Winter Term 2014), Exam 1 showed a median score that was 9% higher than previous years and 12% fewer students scored below 60%. Exam 2 did not show a higher or lower median score but 8% fewer students scored below 60% and the Final Exam showed a median score that was 7% higher than previous classes and 10% fewer students scored below 60%. The (DFW) numbers dropped by 12 students. These numbers have stayed fairly consistent for the four years Flipped Classes have been implemented.

A change in a course required by numerous majors came with a learning experience for the instructors and the teaching assistants. Flipped classrooms are a different style of teaching as you have to give students good “non-answers,” meaning

to give hints but not give the full answer. It's a way of getting students to think for themselves. Let them struggle, and show the students that what they ‘want’ is usually not what they need because having instructors present solutions to problem sets is counterproductive. Students' reactions varied to the flipped classroom with some saying, “I was a little weary about the hybrid course but I found it to be exceptional. The group work with all the TAs and professors' help was awesome and effective” and “I really enjoyed this course and that I was able to learn so much more; I received my first A on a chemistry test! YAY!” and other dramatics, claiming, “This course has caused me mental, physical, and emotional harm...” Flipping a classroom is productive and students are learning and understanding chemistry better than before. Margie Haak, Dr. Michael Burand, and Paula Weiss plan on keeping this teaching style in practice and hope to show other instructors this teaching method as well.





# INTO INDUSTRY... AND BEYOND: A STORY OF BLUE

by: **Kayla Shearer**

Success in the classroom is great; but it is a student's success beyond the classroom that truly proves the value of their education. In the case of Dr. **Andrew Smith**, that value is nearly priceless.

If that name doesn't ring a bell with you, it should. We first mentioned Smith in the Summer 2016 issue of *Fumes from the Hood* for his important contributions to the discovery and commercialization of YInMn Blue. Now we're back to find out what exactly led to Smith's academic and professional success in chemistry.

Originally interested in biology and material science, Smith first came to Oregon as an undergraduate student participating in an NSF-sponsored internship program at the Hatfield Marine Science Center in Newport, Oregon. "Through that experience, I fell in love with Oregon, [and] I learned that they had a pretty nice materials science chemistry department."

So, Smith applied to the Materials Science Chemistry Ph.D. Program at Oregon State University and participated in a graduate recruiting visit to Oregon State, where he met Dr. **Mas Subramanian**.

"We hit it off right away," Smith says of Subramanian, "He just had this passion that I could grasp on to. . . So [Subramanian] decided to take me on as a graduate student and [we] began working on structure-property relationships of transition metal oxides."

Smith didn't mention until later that he was Subramanian's first student at Oregon State, that Dr. Subramanian didn't even have a lab or office set up at the time that he accepted Smith as a graduate student. "I think this is one of the things that allowed us to connect. We were both learning and setting up the lab together," Smith recalls.

Interestingly, Smith's research did not originally encompass chromophores and their interactions within structure-property relationships. "At the time, we were researching multiferroic materials for electronic applications. Generally, those materials aren't highly colored [or] highly chromatic; they're generally a black or a dark colored material. So the fact that [the YInMn compound] came out as a blue material was certainly interesting."

Smith explains that his research did not take a completely different trajectory upon this

discovery. Instead, Subramanian and Smith shifted the focus of his research to understanding the Yttrium, Indium, and Manganese materials and their color properties.

After a series of tests, reproducing the compound, and discovering that the brilliant blue color was no mistake; Smith, Subramanian; fellow researchers Mizoguchi, Delaney, Spaldin; and Chemistry Department Emeritus professor **Arthur Sleight** published their findings in the *Journal of the American Chemical Society*.

Following the publication of the discovery in November 2009, several local news outlets began sharing the news. Less than a month after Smith, Subramanian, and colleagues published their discovery, the *New York Times* published a piece regarding the "New Blue."

"Shepherd Color then became aware of the research," says Smith. "Jeff Peake, who is the research and development manager at the Shepherd Color Company, called Oregon State with interest in the material; and later, travelled to Oregon State to talk to us about the pigment. During that visit, Mas mentioned that I was finishing up my degree at Oregon State and it just so happened that Jeff Peake

was hiring for an R&D chemist. He said that if I was interested in it, I should apply. So everything just happened to work out and the rest is history."

Ok, it wasn't all history. Smith now works in the research and development group under Peake, where their team works on an array of new product development projects. "In addition to that, I've also started to manage our analytical laboratory where we are performing analytical tests to assess a material's composition and performance."

To put things in layman's terms, Smith's laboratory runs tests to determine the chemical composition, crystalline structure, color classification, and weather performance of each particular pigment. "We want to be sure that the pigment is durable and will perform well over an extended period of time. So some of those weathering tests, for instance, will take several years before we can really assess a material's performance." YInMn Blue was no exception to these tests, which explains the mystery behind what went on in those seven years between its discovery and its impending commercial sale at Shepherd Color Company.

So Smith is living nearly every scientist's dream: "I







was able to find a job doing research directly related to my thesis research.” But perhaps it was not all so serendipitous. What was it that made Andrew such a success in the classroom, lab, and beyond?

“I would say that one of the biggest factors in [my] success at OSU was having Mas as an advisor who not only pushed me to be better at what I was doing, but [who] also had the knowledge and background from an industrial side to help guide

the research to make it more successful... [He] just pushes the research towards functional utility, [towards] research that can be impactful beyond the lab.”

Smith, like many other graduate students of Subramanian’s, developed a close relationship with his advisor during his time at Oregon State. “Mas was more than just an advisor. He was and still is a mentor and friend. We regularly met for coffee in the morning, and stayed in

the lab until late in the evening talking about life, family, news, and of course, chemistry. I think this regular and casual interaction really helped me to learn more about chemistry and progress in my research.”

So what can our next generation of great chemists learn from this success story?

Smith suggests, “whatever area of science or research that you’re interested in, fully devote yourself to it. I think part of my success



was that I had a drive and passion for my work. And because of that, it meant more to me.”

## A PATHWAY TO EXCELLENCE: EMBRACING A NEW COHORT OF CHEMISTS

by: Sarah Burton

Entrance into the Graduate Program in Chemistry at Oregon State University stands as a goal for many. Sadly, it has remained out of reach for a cohort of bright, talented, scientifically gifted people for the simple reason that they lack the English language skills needed to succeed in the program. Now, thanks to the INTO Graduate Pathways Program in Chemistry, that is changing, and we are granting greater opportunity to more international students than previously.

Under normal circumstances, admission into the Graduate Program in Chemistry is a highly competitive process that, at minimum, requires a 3.0 GPA, and, for international students, requires a TOEFL score of at least 80, with a subscore of no less than 18 in every category except speaking, in which a score of at least 22 is required for those planning to TA. From that point, a complex process of selection occurs through the Graduate Recruitment Committee. The Graduate Pathways Program changes all of this. Instead of 3.0 minimum GPA, a 2.75 minimum GPA is required, and instead of a TOEFL score of 80 or an IELTS score of 6.5, a TOEFL score of 70 or an IELTS score of 6.0 is required for entrance into the program. This is because the Pathways Program serves as a combination of training program and proving ground, readying students to become fully fledged members of the Graduate Program in Chemistry.

Once these benchmarks are met, students enter into a three term program focusing either on Organic, Materials, or Physical Chemistry. During these terms, they will study English intensively, as well as taking chemistry courses. It is during this time that students will acquire the English language skills required to succeed in the Graduate Program, while deepening their understanding of their chosen division of chemistry.

In completing these three terms, and in further English language testing, the students have to meet further goals in order to insure that they are adequately prepared for the Graduate Program. For example, they must maintain a 3.0 GPA while in the Pathways Program, and receive no grade below a C-. In order to insure that they meet English language skill requirements, they must exit the Pathways Program with either a B or higher in all English language courses, a TOEFL of at least 80 with subscores of at least 18, or an IELTS score of at least 6.5; essentially, the same English language skills that a person competing to enter the Graduate Program would need.

After the three terms in the Pathways Program, if the students meet these benchmarks, they are automatically and smoothly transitioned into the Graduate Program in Chemistry, where they become Master’s students. In this way, we increase the opportunities that are granted to overseas students, and give promising chemists-to-be a much-needed chance to prove themselves.

# INTO OREGON STATE UNIVERSITY

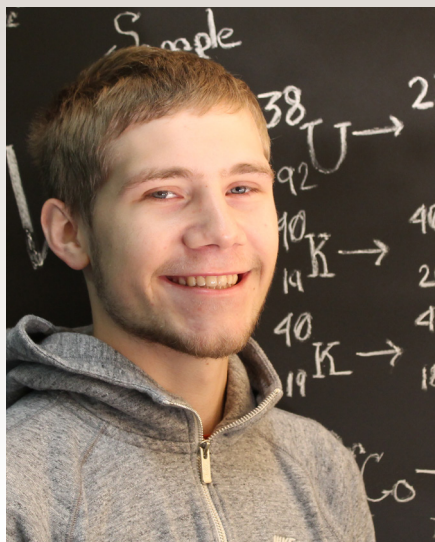
OREGON STATE UNIVERSITY

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# UNDERGRADUATES: OF THE QUARTER - FALL 2016

## Jason Sandwisch



**Born:**  
Vancouver, Washington  
**High School:**  
Liberty HS, Banks, Oregon  
**Hobbies:**  
Swimming, Baseball, Science  
**Favorite Professor(s):**

- Paul Blakemore
- Chris Beaudry
- Chong Fang

During the summer of 2015, Jason also did research in Dr. **John Simonsen's** lab in the College of Forestry. He worked with **Johnny Hergert** (Fall 2015 UGQ), conducting research on new polymer blends using cellulose nanocrystals. Other research projects with Prof. John Simonsen had Jason working for a local start-up called EcNow Tech. Here, Jason helped develop plant-based plastic material. His favorite part of all his various research has been being able to apply physical chemistry principles and problem solving aspects. "I took physical chemistry last year and before that I was working with all these experimental instruments such as FTIR, but never realized the basis for how they actually worked."

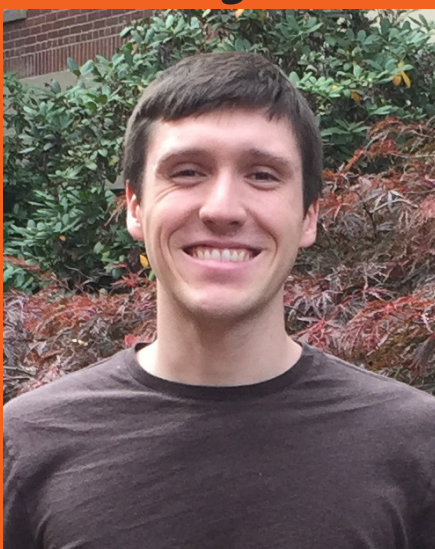
During Jason's first term, Dr. **Neal Sleszynski** mentored him and suggested that he pursue the URSA Engage undergraduate research grant, which led him to conduct research for Dr. **Kenneth Hedberg**. Throughout this experience, he studied gas phase electron diffraction on 1,1,3,3-tetramethylcyclobutane. More recently, he studied spiropentane alongside Dr. **Joseph Nibler** and his undergraduate researcher, **Blake Erickson** (Winter 2016 UGQ).

His favorite class was CH 421 – Analytical Chemistry taught by Dr. **Sean Burrows**. "He's just a great person. He was funny, understanding and really wanted you to learn the material. He didn't make it hard, but stressed the important points. Being taught Analytical chemistry by him was an awesome experience."

After graduation, Jason wants to pursue a Ph.D. in physical chemistry by studying excited state chemistry. He is interested in the University of Washington due to the broad selection of potential faculty focused in his area of interest. He is also excited about the wide array of options that are available to him after graduate school. His summer internship with EcNow Tech really opened his eyes to what was available after school. "At this point, I'm unsure about my specific career path, but four years ago I wasn't sure about my major. I just want to go to graduate school and then find my path."

Students like Jason are a huge part of what makes our Department so great. We wish him well with graduation, graduate school and beyond.

## Nate Coddington



**Born:**  
Eugene, Oregon  
**High School:**  
Eugene HS, Bethel SD  
**Hobbies:**  
National Honor Society for Collegiate Scholars (NSCS)  
**Favorite Professor(s):**

- Vince Remcho

Nate chose OSU because he did not want to go to an out-of-state school, and because his brother was already here, studying Nuclear Engineering. He moved to Corvallis to live with his

brother while he was transitioning into college life – commenting "it was great having someone who understood his sense of humor while relating to the struggles of college life." While Nate admits he started as a BB major to support his goal of ultimately becoming a dentist, upon entering the program it quickly became apparent to him that Chemistry was the better choice for his interests and his career path. So, he re-declared, with the premed option, and never looked back.

Nate told us that his favorite class was,



# OLD-SCHOOL STUDY HALL: NEW AGE WORLD

Nineteen months ago, Dr. **Richard Nafshun** was awarded a \$10k grant to start a Supplemental Instruction Program for Chemistry. The money was used exclusively to pay the salaries of five undergraduates who helped instruct these supplemental sessions. Chemistry Supplemental Instruction is different from the Mole Hole in that study help is provided on topics in-line with but outside what they are teaching in the classroom. If a student is having trouble understanding their homework problem, they would go to the Mole Hole. If they are having a problem with a concept from class, they would go to Chemistry Supplemental Instruction.

Supplemental Instruction is set up “old-school study hall” style. Large tables and wandering teachers help students to understand concepts. Open ended review questions are created, vetted by course instructors, printed, then handed to students who walk into the room. No paying, no registration, no grades. The students who needed help, walked in and received it. Students do not even need to be registered in a Chemistry class to use this service. Since no attendance is taken, Chemistry Supplemental Instruction has also become a great way for some to get

a bit of a refresher before delving back into the graded side of Chemistry courses.

The Chemistry Supplemental Instruction program was independently assessed to show improvement in student grades. This is not surprising, as not only is it proven that providing additional material for students increases their understanding of course material, but, it is a self-selected program. The students who utilize this program are the students who want to do better and get good grades.

Chemistry’s support of students has been a great success, and the Academic Success Center (ASC) will take on the role of study table coordination in winter term. The ASC’s Supplemental Instruction program is based on a peer education model developed by the University of Missouri-Kansas City. It emphasizes active learning and collaboration in group study tables led by peers who have previously succeeded in the series and completed a pedagogy course. The ASC provides dedicated FTE for program coordination and support of SI Leaders’ professional development. Supplemental Instruction is piloting support of CH 23X this year and excited for this new opportunity to support student success.

hands down, Organic Chemistry. “It was just so full of great professors,” he said.

Currently, Nate is doing research in Dr. **Sandra Loesgen**’s lab. Her research group focuses on natural products, specifically bio-active compounds like penicillin. Nate’s research is a spin-off of Dr. Loesgen’s PhD thesis on epigenetic modifications. He’s hoping his research will result in unlocking new genes to produce previously unseen compounds. He’s hoping to be able to obtain some usable results very soon so he can

start writing his honors thesis on this topic.

Nate still plans to enroll in dental school after graduation. His mother is a hygienist and he says he loves working with and helping people. Dentistry, he says, has always just clicked with him. “It’s so revered in our culture and I’ve always just thought, ‘I want to be this.’” He would like to do some job shadowing before graduation but says it is been difficult finding a slot due to doctor/patient confidentiality. He is not giving up yet though.

In his spare time, Nate is the President of the OSU Chapter of the National Society for Collegiate Scholars (NSCS), a community service and professional development based society that is currently working toward being recognized as an Honor Society.

Students like Nate are part of what makes our Department so great. We could not be more proud of him and wish him nothing but success in his future endeavors!



## CHEMISTRY 607: TEACHER MENTORING PROGRAM

In 1994, **Richard Nafshun**, a young PhD student went to work with Prof. **James Krueger** to create what would come to be known as CH 607, the Teacher Mentoring Program. Rick had an interest in becoming a faculty member; so, he approached Dr. Krueger and Dr. **Mike Schuyler**, two men he had always considered mentors about the opportunity to teach. That spring, he taught three weeks of Mike Schuyler's CH 130 class. 20 plus years later, and the class is still going strong, mentoring some of the best and brightest so they can go on to teach the best and brightest.

The Teacher Mentoring Program works with our graduate students earning PhDs or Master's degrees that know that they want a career in academia and to be in the classroom. It is holistic. They are involved from the very beginning;

from creating curriculum, followed by textbook selection, there are even involved in maintaining a classroom. They are also involved in the administration, pedagogy, how to score exams, and how to manage teaching assistants. One component of the course is extremely hands on where the graduate student goes into the classroom and teaches a unit. Once per year, the current students are taken to Portland to meet with the alumni from the program. Alumni are considered an executive board. The main reason for meeting with the currents students is so they can have a candid conversation with those who have been through the program and started their careers. Students get tips that are current, hands on, and from different perspectives. They learn how to teach from those who came before and are successfully doing it now.

## CHEMISTRY 220: FIRST YEAR EXPERIENCE



Chemistry 220 is a first-year experience class for new chemistry majors. Research shows that students who have a sense of belonging to their department tend to persist in their chosen major. CH 220 was designed with that purpose.

Fall 2017 will be the seventh year that CH 220 has run and so far, it has been a great success. Every year at the Graduation Forums, students express how much they enjoyed the class. Some report that thinking back on this

class in later years, made it easier to keep going when their coursework was at its hardest.

For the most part, the class consists of a weekly guest speaker from the Chemistry profession, either from academia or industry who talk to the students about what it is like to work in their chosen field. CH 220 Instructor, **Margie Haak** says she'd like to see the class take more field trips. "It would be good to visit an outside lab, let the students see what it's really like to work as a chemist."

Margie says there are no plans to discontinue this class in the future, but confesses what she'd really like to see is a companion course, "maybe in the Spring of their Sophomore year or Fall of their junior year," where students can regroup with their peers and discuss their progress so far as majors. This time frame is also when many chemistry majors think about undergraduate research, being an undergraduate TA, and plans after earning a bachelors degree. This second course could provide support and guidance as our majors begin the transition from undergraduate college student to being a working professional or beginning a graduate or professional degree program.





# CHEMISTRY 199: SUCCESSFUL STUDENT SKILLS

"There are a lot of students who struggle mightily with General Chemistry. So, CH 199 was started (nearly 4 years ago) to give those students a little more support so they could be successful in their classes."

– Margie Haak

Students register for the general chemistry sequence as well as CH 199 concurrently. While attending the 199 section, students get help with Chemistry issues, as well as some introduction to what has been termed, "Successful Student Skills:" How do you study? How do you prepare for class? How do you learn to be a better problem solver? According to Margie Haak, they have seen, on average, an increase of about one letter grade from students enrolled in CH 199 along with a general chemistry course, compared to a student with similar background who did not take CH 199 along with their general chemistry course. "This is a way for students who want/need the extra help to get it. But, like anything else, it doesn't work if they're not willing to put in the

effort."

In addition to CH 199, which is for students currently in a general chemistry course, a second course, CH 101, has been developed and was first offered in Fall 2016. CH 101 is designed for students to take prior to beginning general chemistry, and works to develop a student's mathematical skills and problem-solving skills, as well as introducing some basic chemistry concepts and general "successful student" skills. It is unclear as to whether CH 199 will remain an active course, but as Instructor, Margie Haak points out, "they would be serving two very distinct populations of students, both of whom need help, sure, but still,

two distinct populations.

Margie says if she could make any changes to the courses, she would start by finding a space specifically designed for these types of programs. "We don't have one, currently, and logistically, that's a big problem." Neither of these classes can be run effectively in a classroom designed for a traditional lecture format. These are active-learning classes and need a room designed to support this type of pedagogy. It is astonishing how large an impact room design has on the classes taught in them.



**The Teacher Mentoring Program is a very pragmatic grassroots effort. Student will come out with the skills needed to hit a home-run at the interview and show that they are ready to teach right out of the can; because they are. – Richard Nafshun**

# ACTION RESEARCH FELLOWS

The purpose of this fellowship is to support instructors already using EBIPS in lower division science, mathematics or engineering courses to take the next step in educational innovation through action research; that is, asking and answering questions about practice and collecting evidence in their own classroom to inform practice. Fellows are supported in three ways: 1) participation in an interdisciplinary community of instructors with similar goals to apply what research tells us about learning in the classroom; 2) partnership with a member of the ESTEME@OSU research team with expertise in education research and classroom practice to support research design, data collection and analysis; and 3) financial support.

## MICHAEL BURAND

Being chosen as an Action Research Fellow means that I can better commit to identifying and working towards specific teaching and learning improvements. It also means that I have the opportunity to collaborate and share ideas with other Action Research Fellows across different disciplines.

## CHONG FANG

To build content into the abstract concepts and complex math of physical chemistry issues, I will research into the facets of interactive engagement to elevate student interest and accountability as a doer, stimulation of student inquiry-based conceptual understanding, and cooperative learning models.

## MARGIE HAAK

Being an Action Research Fellow means that you are intentionally changing some aspects of how you teach a class and studying the effect of that change. Usually, the goal is to increase student achievement or engagement.

## RICK NAFSHUN

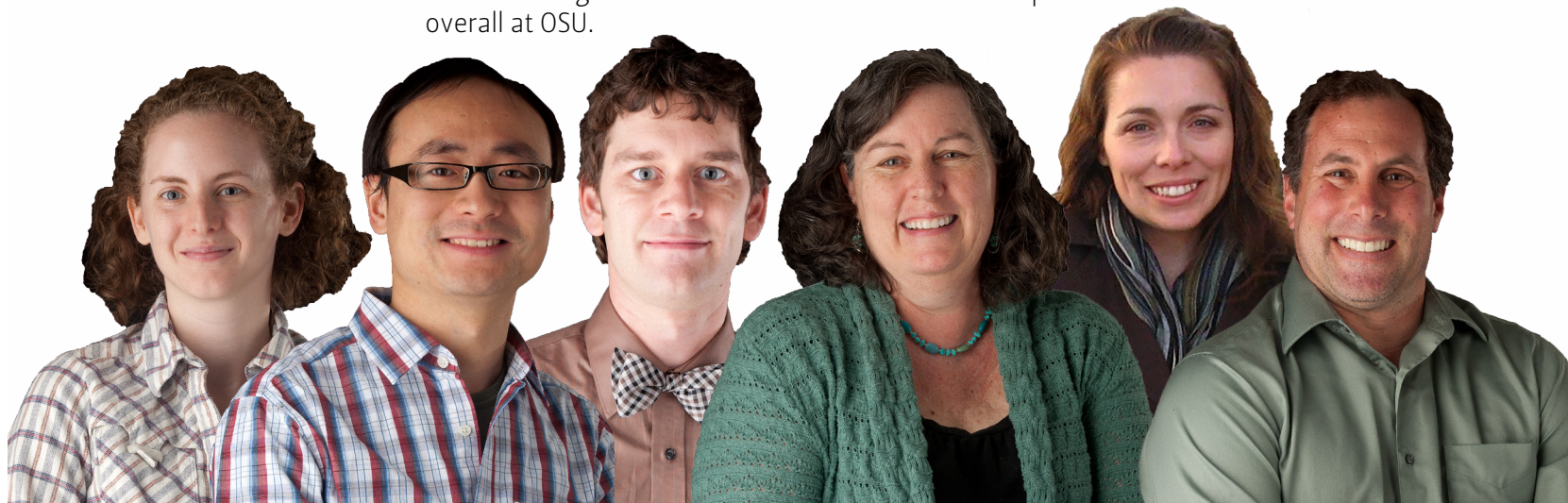
As a Fellow, I am participating in an interdisciplinary community of instructors with similar goals to apply what research tells us about learning in the classroom. I am partnering with Kathy Quardokus Fisher who has experience in education research and classroom practice to support research design, data collection and analysis.

## PAULA WEISS

As an Action Research Fellow I am conducting research in my classroom to inform my teaching. This allows me to better educate the students at OSU. The Fellowship itself gives me access to educational researchers who support my data analysis and collection.

## KRISTIN ZIEBART

The best part of this fellowship is that I get to have frequent contact with education research specialists and the 11 other fellows who come from all over campus. It's great to be surrounded by people who are passionate about instruction and to have opportunities to exchange ideas and encourage one another as we seek to improve our teaching practices. The ultimate goal is that our efforts will lead to an improvement of STEM education overall at OSU.





# IN MEMORIUM: ROMAN SCHMITT

## NOV. 13, 1925 - SEPT. 29, 2016

**originally printed in: Corvallis  
Gazette-Times, Oct. 3, 2016**

Roman Augustine Schmitt, 90, of Corvallis passed away Thursday, Sept. 29, at the Samaritan Evergreen Hospice House in Albany from complications after a bacterial infection.

One of five brothers, Roman was born on a farm in Johnsburg, Illinois, on Nov. 13, 1925. He served in the Army during World War II. He studied at Illinois College and then completed his masters and Ph.D. in chemistry from the University of Chicago. In 1953, he enjoyed reminiscing about his student days with such notables as Enrico Ferme, Harold Urey and Nathan Sugarman.

He was a founding staff member of the company General Atomic in 1956. In 1969 he was invited to become a full professor in the department of nuclear chemistry at Oregon State University where he taught and performed research for more than 30 years. Roman was one of a handful of scientists picked to study

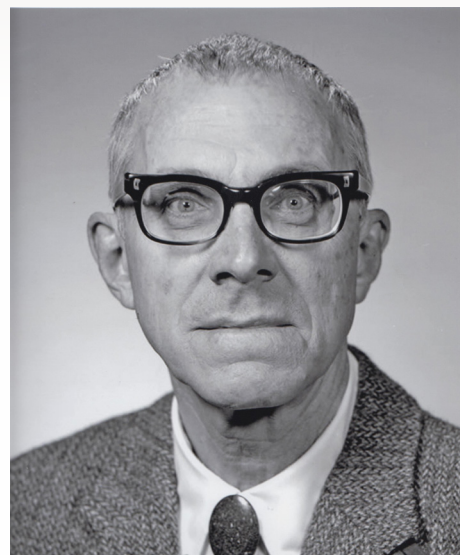
the lunar samples brought back by the Apollo missions, and in 1972 he won the George P. Merrill Award by the Council of the National Academy of Sciences for his pioneering work on the determination of rare earth elements.

Roman enjoyed geology, and his office and home were filled with mineral samples and rare elements. He enjoyed golfing, biking, hiking and his daily walks. He was a prolific photographer. Later in life he was an avid golf watcher and was a big fan of the Oregon State baseball program.

A longtime member of St. Mary's Parish and the People of Praise Community, Roman spent many years as a volunteer chaplain at the Oregon State Penitentiary, driving from Corvallis to Salem every week until he felt he could no longer do so. He enjoyed visiting the homebound and aging as a Eucharistic minister and friend.

Roman was married to his wife, Jean Marie Vertovec for 62 years.

In addition to his wife, Roman is survived by four children, Joseph Schmitt of Corvallis, Mary Schmitt of Salem, Peter Schmitt of Blodgett and Katherine Harvey of Forest Grove; four grandchildren, Kathrynne MacVicar Geisler of Salem, Emiliana MacVicar of Salem, John MacVicar Jr. of Salem and Kahlie Haney of Philomath; six great-grandchildren; and many, many other friends, colleagues and former students.



## OnlineChemLabs

**by: Mike Lerner & Rick Nafshun**

OnlineLabs designs and offers virtual science experiments for instructors to use in high school or university classes.

Online chemistry course Instructors at OSU saw first-hand the need for quality lab experiences that could be offered online. So, they set about creating the OnlineLabs program. This venture was completely self-funded by the creators from the very beginning. And they do not regret for a second starting their business this way.

The business and products are still evolving, and depending on how you measure success, yes, you could say they have been successful. Financially the business is profitable, but it is also resource demanding because of the need for continuous improvement and the upgrades

that are inherent to software products. But they have been able to offer better experiences to thousands of students, so that part is gratifying.

When asked if they would start another business if given the chance, **Mike Lerner** responded, "Probably not. That would be too much for me to handle, so my answer would probably be no."

Dr. Lerner's advice for someone thinking of starting their own business is, "Do something you enjoy, you will hopefully be doing it for years! Also, calculate as best you can, the amount of time and money that this venture is going to need. Then multiply by 2. Then decide if those larger numbers would still be feasible and if you still want to begin."



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Students in the chemistry department receive scholarships thanks to **Charles "Ted" McMurdo '37**, who gave OSU his Portland home, which he built himself.

