Greetings UM Chemistry and Biochemistry Department alumni and friends

It has been my honor to serve as the Department Chair for just over five years. The department has sustained high productivity and standards during an exceptionally challenging period for UM. I am fortunate to work with highly dedicated faculty and students whose efforts and contributions make the department an exceptional place for learning and discovery. It is also a pleasure to meet our many dedicated alumni and friends, who provide important feedback and support to the department.

In 2017 and early 2018, Chemistry and Biochemistry undergraduate and graduate programs went through a university-wide review and prioritization process. During the process, we were presented with data regarding the performance of our programs. I am pleased to report that the data and reviews confirmed what we already knew: Chemistry and Biochemistry programs are highly efficient and productive in comparison to other UM programs and national benchmarks. The Department is “The Little Engine That Could.” More recently, UM has implemented a plan to reduce annual instructional expenditures by $5 million. As part of that plan, Chemistry and Biochemistry is making significant reductions in instructional staff. As a result, the Department has streamlined its course offerings and curricula so that we can continue to provide comprehensive and outstanding instruction in chemistry and biochemistry and prepare our graduates for further study and careers in the field.

Research activity continues to be strong. Chemistry faculty continue to compete for and earn grants from national funding agencies including the NSF and the NIH. Chemistry graduate students have been awarded grants to study for extended periods in Australia and France.

The Department continues to experience important changes in personnel. Professor Ed Rosenberg and long-term Instructor Holly Thompson both retired in June of 2018. Ed was an active instructor, researcher and mentor for many years. He moved to UM in 1993 and served as Department Chair from 1998-2004. Holly was a very effective and admired instructor in chemistry for more than 30 years. Through her teaching and mentoring she impacted thousands of students. At the same time, we welcome the addition of Assistant Professor of Environmental Chemistry, Lu Hu, who arrived in January of 2017.

Recent financial support from our alumni and friends is gratefully acknowledged. We are fortunate to have received several significant financial donations for scholarships and program support. We have recently established the Dr. John M. Stewart and Gayle Stewart McKellar Scholarship to support graduate students studying environmental chemistry, the Ralph and Joan Fessenden Endowed Chemistry Scholarship for students of organic chemistry, and the Fred Shafizadeh Memorial Scholarship in Chemistry for students studying wood or fire chemistry. We also established the John and Geneva Stewart Department Opportunity Endowment for program support. We appreciate these major gifts, as well as numerous other donations, which allow us to provide financial support for students and maintain program quality.

We enjoy hearing from you about happenings and successes in your lives, as well as about your experiences with the Department. Please contact me (christopher.palmer@umontana.edu) or the department (chemistry@umontana.edu) with news, updates, and feedback that we can include in future newsletters. Please also consider liking us on Facebook, where you can keep up with Department news, or connecting with us on LinkedIn.

Regards,
Chris Palmer
The 2017 Nobel Prize in Physics was awarded to Barry C. Barish, Kip R. Thorne and Rainer Weiss in recognition of their 2015 detection of gravitational waves, which are propagating ripples in what has come to be called space-time, the fabric of the Universe. The gravitational waves so far observed were generated by rotation of a pair of massive stellar objects, e.g., black holes or neutron stars, around their center-of-mass.

Albert Einstein’s 1916 Gravitational-Field Equation (GFE) results from his General Theory of Relativity and is a set of nonlinear partial differential equations describing the evolution of a gravitational field in time and the three spatial dimensions: x, y and z. Nonlinear partial differential equations typically have traveling wave solutions, e.g., the waves resulting from dropping a stone into water. Complete solutions to the nonlinear GFE itself are not known. However, a linearized version of the GFE was known to Einstein that allowed him to predict the existence of gravitational waves traveling at the speed of light. The search for gravitational waves finally ended Sept. 15, 2015 with their detection by two enormous Laser Interferometry Gravity-wave observatories (LIGO) operating in tandem, one in Livingston, LA and the other in Hanford, WA. A LIGO measures very tiny changes in apparent distance between two points as a gravitational wave space-time distortion passes. Experimental-noise is minimized because signals that do not appear simultaneously at both LIGOs are discarded.

A sense of the generation of gravitational waves may be gotten by analogy to the generation of electromagnetic waves. Recall the Bohr model of the hydrogen atom in which a negatively charged electron was proposed to orbit a positively charged proton in a stable orbit. Unfortunately, it seemed on the basis of classical mechanics, such an orbit would be unstable because the oscillating electrical dipole (\(+ \leftrightarrow -\)) generated by the orbiting electron would cause the emission of electromagnetic waves that would carry away the rotational energy of the electron; it would eventually fall into the proton. Fortunately for hydrogen atoms, the de Broglie wavelength as expressed in quantum mechanics causes certain favored electron-orbit radii to be stable.

Fortunately for the generation of gravitational-waves, black holes and neutron stars are governed by classical mechanics. Consider the case of two approaching, strongly attracting, super-dense neutron stars, each typically having a radius of about seven miles and about the mass of two suns. They are not likely to directly crash into each other, but will instead tend to enter an unstable decaying orbit around their center-of-mass during which their kinetic energy is lost as oscillating disturbances of space-time, gravitational waves.

This scenario can be seen intuitively. Consider an observation point in a plane also containing at a distance two rotating neutron stars of significantly unequal masses. The heavier and lighter neutron stars (a mass dipole) will alternately be closer to the observation point as they rotate, and an observer will perceive the passage of gravitational waves.
PROFESSOR LU HU JOINS THE DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

Lu Hu joined the University of Montana as an assistant professor in January 2017. Prior to UM, Lu obtained his Ph.D at the University of Minnesota in 2014, and then completed postdoc training at Harvard University. He went to college in Beijing and experienced serious air pollution issues. Since then he has decided to study atmospheric chemistry and contribute scientific knowledge for people to achieve and breathe clean air.

At UM, Lu is establishing a joint experimental and modeling research program to study atmospheric chemistry and air pollution. The overarching goal is to improve understanding of the chemical composition of the atmosphere and how it is influenced by human activities and natural processes. His group uses a combination of field observations, satellite data, and atmospheric modeling to investigate the origins, chemistry and transport of key air pollutants such as ozone and particulate matter, and their implications for environment and climate.

Lu’s group is currently setting up supercomputing capabilities at National Center Atmospheric Research’s Cheyenne high-performance cluster, for big data analysis and global chemical transport modeling. The initial modeling project is to study the impacts of oil and gas activities over the U.S. on the ambient air toxics levels such as benzene, a known carcinogen.

Two other on-going projects, both funded through National Science Foundation, will bring Lu and his group to some sensitive areas vulnerable to enhanced air pollutants. In 2019, his group will go to Alaska North Slope for a field study to investigate the influence of Arctic warming on atmospheric oxidant chemistry through anticipated increasing emissions of biogenic volatile organic compounds from tundra. Lu’s group partnered with four other universities and NSF NCAR, spending more than 100 hours inside a flying research aircraft to sample and study the emission and chemistry of Western US wildfire plumes. One state-of-the-art instrument Lu brought to this collaborative airborne field campaign is a proton transfer reaction time-of-flight mass spectrometer, which measures the full mass spectrum of volatile organic compounds in real time at 10 Hz. This instrument completed testing in the NSF NCAR C130 aircraft, to then fly straight into wildfire smoke this past summer, and is helping answer questions like how chemical processes in fire plumes affect air quality, nutrient cycles, weather, climate and the health of millions of people exposed to smoke in the Western U.S.

ASSOCIATE PROFESSOR KLARA BRIKNAROVA RECEIVES A 5-YEAR NATIONAL INSTITUTE OF HEALTH GRANT

Fibronectin is essential for embryonic development and also plays a role in the recovery of tissues from injuries and in remodeling and angiogenesis (formation of new blood vessels) that accompany the growth of solid tumors. Fibrils assembled from soluble fibronectin are important components of the extracellular matrix, a macromolecular meshwork that surrounds cells and provides them with structural support and signaling cues. Professor Klára Briknarová takes advantage of the nuclear magnetic resonance, macromolecular crystallography and biospectroscopy facilities at the University of Montana to investigate the conformation of fibronectin in solution and the molecular basis of its conversion to fibrils in the extracellular matrix.

ASSISTANT PROFESSOR ORION BERRYMAN JUNIOR FACULTY CAREER AWARD

It’s been a busy six years for the Berryman lab! New instruments, new lab space, new classes and new research grants. Professor Orion Berryman has built a research program at the interfaces of supramolecular chemistry, environmental remediation and chemical biology. Berryman is director of the small molecule X-ray diffraction facility at UM which was made possible by a 2013 grant from the National Science Foundation. In addition to serving as a service instrument for the Rocky Mountain Northwest. This instrument is used by the Berryman lab to determine molecular structure at atomic resolution. This research capability was critical for helping Professor Berryman recently obtain the National Science Foundation’s most prestigious award for junior faculty—the CAREER award. This five year grant from the NSF is funding the Berryman lab to develop a new strategy to catalyze reactions involving sulfur and other polarizable substrates. To meet their goals the Berryman lab is employing halogen bonds which are directional attractive noncovalent interactions that have drawn similarities to hydrogen bonding. In addition, the NSF support is funding UM’s first color 3-D printer which the Berryman lab is using to teach crystallography, improve outreach experiences and explain concepts like chirality and point group symmetry in formal course work. Come visit the department and see the 3-D printer in action.
In 2015, Chemistry and Biochemistry Professor Sandy Ross, director of the BioSpectroscopy Core Research Laboratory, and Staff Scientist Michelle Terwilliger received a major instrumentation grant from the National Science Foundation for $323K. The BioSpectroscopy Core is supported by the Center for Biomolecular Structure and Dynamics and the Office of UM Vice President for Research and Creative Scholarship. The NSF award was supplemented in 2016 by a grant from the J. Murdock Charitable Trust ($191K). Combined, the NSF-Murdock awards supported acquisition of a PicoQuant MicroTime 200 time-resolved confocal microscope uniquely configured for single-molecule biophysics (e.g., fluorescence correlation spectroscopy—standard-focus and dual-focus—and Förster resonance energy transfer) and materials science applications (e.g., fluorescence lifetime imaging). The J. Murdock Charitable Trust also provided funds ($22K) for pilot projects using the MicroTime 200.

Also in 2016 Ross and Terwilliger received another major instrumentation grant, this time from the National Institutes of Health ($555K). The NIH award was leveraged by funds ($127K) from UM Vice President for Research and Creative Scholarship, Scott Whittenburg, which facilitated acquisition of a Zeiss 880 inverted laser-scanning confocal fluorescence microscope integrated with an upgrade by PicoQuant to enable time-resolved fluorescence microscopy; the features of the Zeiss 880 make it particularly well-suited for live-cell imaging experiments using time-resolved fluorescence techniques.

The two new time-resolved confocal microscopes are now available in the BioSpectroscopy Core Research Laboratory.

http://hs.umt.edu/cbsd/facilities/biospectroscopy/default.php or email sandy.ross@umontana.edu.
RYAN PARKS
(B.S. CHEMISTRY, CLASS OF 2014)
spent the summer working for the EPA’s wetlands program and is now at Duke University pursuing a Master of Environmental Management degree with a Water Resources focus.

JESSICA WURZEL
(B.S. CHEMISTRY, CLASS OF 2015)
is currently at the University of Wyoming, working in a post-baccalaureate graduate program for a secondary chemistry education certification. She will be student teaching in Cheyenne, Wyoming in the spring and will begin teaching (Chemistry!) next fall.

TED MUNSELL
(B.S. BIOCHEMISTRY, CLASS OF 2013)
is working as an enologist, running the analytical lab at the Rutherford Wine Company in Napa, California. His long-term goal is work his way up to lead winemaker.

KAITLIN CAREY
(B.S. BIOCHEMISTRY, CLASS OF 2014)
is working towards a master’s degree in computer science at UM with a focus on genomics and bioinformatics.

DAN CLUCAS
(B.S. CHEMISTRY, CLASS OF 2015)
is employed in Missoula doing both information technology and equipment maintenance at a home healthcare company.

JULIE McGETTRICK
(PHD CHEMISTRY, CLASS OF 2017)
Dr. Julie McGettrick is now working as a scientist for Teleflex, a company that makes medical devices, in Reading, Penn. She runs the Advanced Analytical Laboratory where she does testing and validation on both current and new products.
Our Department graduates from 10-20 chemistry and biochemistry majors each year. Most of the students shown above were active in undergraduate research projects. This on-the-job experience makes our students very competitive for jobs, graduate programs and professional schools.