László Kürti, Ph.D. - Teaching Statement

As a principal investigator, mentor and educator one of my most important duties is to clearly articulate to my undergraduate/graduate students as well as postdoctoral fellows the reasons behind the variety of projects that are being pursued in my laboratory. When research becomes too abstract, it is easy to lose sight of the real world chemistry problems that we intend to solve. Therefore, I make sure that during one-on-one discussions, group-meetings and even undergraduate lectures I emphasize the central role that organic synthesis plays in many critical areas such as the development of pharmaceuticals, flavors, fragrances, agrochemicals and novel materials. I teach at both the undergraduate and graduate level. Next semester (Fall 2017) I will once more be teaching the first semester undergraduate organic chemistry course (Chem 211) that is elected by many pre-medical as well as freshmen students. How one teaches these students strong fundamentals is of *critical importance*, as their future success in other chemistry classes will depend on their ability to grasp the material and continue to build on it. In my first lecture I take great care to illustrate the enormous impact that organic chemistry has had, and continues to have, on the daily lives of humankind. It is really surprising for the students to learn that during past 80 years most medicines were designed by individuals who had a Ph.D. in organic synthesis - these medicines improved life expectancy from 50 to 85 years in just three generations! I also emphasize that today research is truly interdisciplinary and researchers need to have a good grasp of other fields such as biology, biochemistry, supramolecular chemistry and material science. Organic chemistry tends to have a bad reputation among undergraduates because often students just memorize the material without understanding it. The structure of my lectures and discussion sessions ensures that critical-thinking and understanding/application of concepts are emphasized. The problems in quizzes and exams are designed in such a way that a combination of concepts and problem-solving skills must be brought to bear to solve them – memorization of facts alone is not rewarded. Every one of my lectures includes in-class problem-solving exercises which I have been able to make highly interactive by engaging the students – the atmosphere in the classroom fosters “risk-taking” and, as a result, students now routinely volunteer to solve problems in front of the rest of the class and risk being incorrect.

At the graduate-level I teach an advanced organic chemistry course during the fall semesters that takes a close look at the “structure” and “reactivity” of organic compounds. This course can be taken by first- and second year graduate students as well as undergraduates who have completed both semesters of their organic chemistry curriculum. Students have responded extremely well to my approach which emphasizes understanding and discourages mindless memorization as illustrated by excerpts from the end-of-semester evaluations: *“By far - and I really mean by FAR - the best course I've seen at Rice.”* and *“Great organization of the material which led to understanding rather than memorizing material which is exactly how a good class should look like…such a massive positive difference in comparison to other lecturers/classes.”*

The interdisciplinary nature of the ongoing and proposed projects in my laboratory, in combination with the rigorous scientific approach and the *environmentally-friendly*, *safety-conscious training*, will continue to provide an excellent platform to train graduate as well undergraduate students. Research projects in my laboratory already have significantly advanced the field of sustainable organic synthesis by expanding the toolbox of mechanistically well-understood green chemical transformations for the introduction of nitrogen atoms into a wide array of substrates. We continue to develop new carbon-nitrogen bond-forming methods that are expected to have an exceptionally broad impact on society by providing, both directly and indirectly, greener and cheaper access to valuable organic molecules such as novel pharmaceuticals, agrochemicals and highly functional materials.

During the past decade I have co-authored three textbooks that also serve as popular reference books. I am currently working on the development of several new courses based on these books. Within the next two years I plan on offering the course “*Organic Synthesis of Life-Saving Medicines: Case Studies*” geared towards both graduate students and advanced undergraduate students. The mechanism and applications of selected named reactions for the construction of drug molecules, key heterocyclic ring systems and bioactive complex natural products will be covered. The material will be largely based on my book *Strategic Applications of Named Reactions in Organic Synthesis* that is currently being revised and updated to reflect new developments in the field since 2005 when it was first published.

Based on my second book entitled *Molecules and Medicine*, the development of an introductory life sciences course for undergraduates that integrates chemistry, biology, drug discovery and medicine is well under way. Today, when most young people choose to pursue careers outside of science, such a course could renew their interest in science. Since molecular medicine plays a critical role in understanding the biochemical basis of human disease, a thorough understanding of human ailment at the molecular level will be required of future scientists. I already have lectures prepared for a similar graduate-level course, entitled *Biologically Active Small Molecules*, that discusses the milestones in the history of early pharmaceuticals, the stages and challenges of modern drug discovery, including case studies on how structure influences potency, selectivity, pharmacokinetics and the overall drug-like properties of small organic molecules. This course can be expanded with a strong focus on the laboratory as well as industrial synthesis of active pharmaceutical ingredients in the larger context of modern heterocyclic chemistry.

Since the majority of today's pharmaceuticals are prepared as single enantiomers, synthetic methods that allow the installation of one or more chiral centers with nearly complete stereocontrol, including absolute configuration, are in great demand. Given the committment of Rice's leadership to strengthen the field of organic synthesis by hiring more organic faculty members like myself and attracting more graduate students whose focus is on organic chemistry, a course on "*Asymmetric Organic Synthesis*" must be part of the graduate chemistry curriculum. I have already prepared lectures for such a course based on my third textbook/reference book *Enantioselective Chemical Synthesis: Methods, Logic and Practice* that I wrote with Professor E.J. Corey in 2009. This course, that I will offer as soon as we have more organic faculty members in the Chemistry Department, makes accessible to students of synthetic chemistry this vast and still-expanding field in the hope that this fascinating area of chemistry can more readily be mastered.

In all of these courses, the students will examine certain transformations by searching and reading the literature and will communicate their findings effectively in classroom presentations and discussions with their peers. This approach exposes students to a variety of perspectives and allows them to recognize the gaps in current synthetic methodology, which can trigger new discoveries. *This learning process prepares the students to become independent researchers and critical thinkers.*

I consider laboratory research as an integral part of learning for undergraduates. Once their basic laboratory skills have been aquired, I encourage undergraduate students to join my laboratory and engage in project-based discovery. I am able to recruit undergraduate students from both my graduate-level as well as undergradaute classes. Currently I have four active undergraduate students in the lab and each of them is being suprvised by a different postdoctoral fellow. *James Siriwongsup*, a highly motivated junior, is working on using hindred ketomalonates as efficient nitrogen umpolung reagents. *Russell Kielawa*, a sophomore, is learning to prepare frustrated Lewis pair (FLP) catalysts to cleave N-O bonds. *Carlos Barrera*, a junior, recently received the highly prestigious AIR Diversity Fellowship of Pfizer is now studying C-H arylation reactions in the absence of transition metal catalysts. *Zoe Punske*, a junior, is preparing novel hydroxylamine reagents for the rapid preparation of heterocycles from readily available aromatic substrates. As a principal investigator and mentor, my main goal is to enable my students to experience the joys of scientific discovery and prepare them for independent scholarship. I give them freedom to test their own hypotheses, but at the same time, I am there to guide them when research projects run into difficulties. We also regularly attend national and international conferences with group members to present the latest results and take advantage of important networking opportunities (e.g., ACS National Meetings 2011-2016, Pacifichem 2015, Gordon Research Conferences 2012-2016, ACS Green Chemistry Conference 2016 and the Tetrahedron Symposium Europe/Asia 2017. After their training, students will possess the necessary laboratory skills and fundamental understanding of organic reactivity, will be able to think critically, communicate their ideas clearly both orally and in writing, and work effectively and productively in a team environment to solve difficult problems. They will be ready to pursue virtually any scientific career path – they may choose to push the frontiers of our field as academic researchers, work on the development of novel therapeutic agents in the pharmaceutical industry, or become teaching professors in universities and liberal arts colleges.

In conclusion, my passion for Chemistry not only involves research and discovery but the sharing of this passion with other people and inspiring the younger generation to understand the importance of science in everyday life.