Evan Miller

My lab's research interests lie at the intersection of chemical biology and cellular physiology, with an emphasis on neuroscience. We use the methods of synthetic organic chemistry to build molecules that enable us to spy on cellular function. In particular, I am fascinated with the contributions that changes in membrane potential make to the physiology of excitable cells like neurons and cardiomyocytes as well as non-excitable, somatic cells. Our understanding of how membrane potential dynamics influence both physiology and disease at cellular, sub-cellular, and organismal levels remains incomplete, due in part to a lack of tools which can reliably report on membrane voltage in a sensitive, non-toxic, and high-throughput fashion. In this regard, optical approaches to monitor membrane voltage in neurons and other cells are attractive, but remain limited due to insufficient speed or sensitivity. My lab has been exploring a new method for fast, sensitive, non-disruptive fluorescent voltage sensing using small molecule fluorophores that use photoinduced electron transfer (PeT) as a voltage-sensitive switch. These voltage-sensitive fluorophores, or VoltageFluors are amenable to a number of different cellular contexts, including neurons and cardiomyocytes; span a wide range of excitation and emission profiles; and can be targeted to defined cells. We are working to further our understanding of the physical processes underlying voltage sensitivity in VoltageFluors as well as to use these tools to probe the role of membrane potential in living cells and organisms.

References:

1. Deal, P. E., Kulkarni, R. U., Al-Abdullatif, S. H., Miller, E. W., Isomerically pure tetramethylrhodamine voltage reporters. J Am Chem Soc 2016, 138 (29), 9085-8. DOI: 10.1021/jacs.6b05672.
2. Grenier, V.; Walker, A. S.; Miller, E. W., A small-molecule photoactivatable optical sensor of transmembrane potential. J Am Chem Soc 2015, 137 (34), 10894-7. DOI: 10.1021/jacs.5b05538.
3. Huang, Y. L.; Walker, A. S.; Miller, E. W., A Photostable Silicon Rhodamine Platform for Optical Voltage Sensing. J Am Chem Soc 2015, 137 (33), 10767-76. DOI: 10.1021/jacs.5b06644.