**A. Briefly describe overall research program at your laboratory.**

My research goal is to find strategies to reduce the adverse effects of opioid treatment. My lab currently focuses on investigating the modulatory activities of Heat shock protein 90 (Hsp90) on inflammatory responses associated with chronic morphine treatment. Hsp90 is a ubiquitous and highly expressed chaperone protein that regulates signal transduction. However, the role of Hsp90 in pain and opioid analgesia remains poorly understood, with only a few papers directly linking Hsp90 to Mu-Opioid Receptor (MOR) signaling, pain, and analgesia. Recently, we found that systemic treatment with an Hsp90 inhibitor strongly reduced opioid tolerance. This opens up a fascinating new field for the modulation of opioid side effects by Hsp90. We are working on determining how Hsp90 modulates inflammatory signaling pathways, which will provide us insight into the mechanism behind the impact of Hsp90 on opioid-induced signaling and behavior. We will identify the Hsp90 isoforms and co-chaperones responsible for regulating the morphine tolerance using novel selective inhibitors and/or CRISPR/Cas9 gene editing in adult mice. We will also investigate the contribution of Hsp90 to the inflammatory responses associated with morphine tolerance in the spinal cord via quantitative proteomics and phosphoproteomics. These findings will reveal a pattern of the Hsp90 molecular machinery that regulates opioid response in the spinal cord, providing evidence for selective manipulation of the MOR signaling machinery to reduce the side effects of morphine treatment. My lab is also interested in investigating novel compounds targeting opioid receptors and complementary/alternative medicines for pain management with fewer side effects.

**B. Briefly describe specific project(s) for your teacher:**

The project for the teacher(s) is designed to investigate the modulatory activities of Hsp90 on opioid-induced inflammatory responses. By using cell models, we will investigate the impact of Hsp90 inhibitors (i.e., 17-AAG, KU-32, and isoform-specific inhibitors) on inflammatory responses associated with opioid treatment. We will measure the production/expression of nitric oxide (NO) and several inflammatory cytokines. The activation of cyclooxygenase-2 (enzyme for producing PGE2) and inducible nitric oxide synthase (enzyme for producing NO) will also be investigated after the treatment. For the determination of mechanism, we will determine the impact of kinases on the activation of nuclear factor kappa B (NF-κB), Nrf2, and mitogen-activated protein kinases (MAPKs).
C. Will any other people (post docs, grad students, undergraduate students, colleagues, etc.) be involved directly with your teacher?

Yes, I will have pharmacy and/or undergraduate students working on projects related to the ones assigned for the teacher(s).

D. Will you require any advanced reading/preparation for the teacher? If yes, please briefly describe.

A prospective teacher will be required to read to provide background knowledge related to the project and laboratory techniques.