A. Briefly describe overall research program at your laboratory.

Role of Vascular Biomechanics in Cardiovascular Disease

My research focuses on failure biomechanics of vascular tissues in multiple pathological conditions, including atherosclerosis, arterial dissection, and aortic aneurysm. I am currently co-investigator on an NIH grant that seeks to develop a novel, non-invasive approach to assess the rupture risk of abdominal aortic aneurysms using theranostic nanoparticles. I also have NSF funding to examine more basic questions related to extracellular matrix reorganization during aging and its effects on stiffening of the arteries. Research in my lab aims to understand both biomechanical and biological factors leading to pathological blood vessel failure. We also collaborate with several faculty in Mechanical Engineering to identify material parameters of normal and diseased arterial tissue, and to perform computational simulations of vascular remodeling and arterial failure. I also have expertise in analyzing clinical imaging data, focusing in particular on analysis of vasculature in CT scans. I currently collaborate with several faculty in the Dept. of Surgery on studies of carotid artery stenosis and peripheral arterial disease (PAD) in human patients.

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

The main focus of the project will be using fluorescence microscopy and multiphoton-second harmonic generation microscopy (MP-SHG) to look at changes in collagen fiber organization with aging in the aortas of normal (wild type) mice and mice that are deficient in endothelial nitric oxide synthase (NOS3), the enzyme mainly responsible for producing nitric oxide in blood vessels. We hypothesize that loss of endothelial nitric oxide increases the contractile force generated by cells in the artery wall, leading to collagen fiber reorganization and increased vessel stiffness. The teacher will have the opportunity to learn histology, fluorescence microscopy and digital image analysis. Animal studies include measurements of blood pressure, blood flow rate, and aortic diameter in mice. The teacher will have the opportunity to learn how to analyze images obtained with small animal Doppler ultrasound. S/he will also have an opportunity for hands-on training in this technique if desired.

C. Will any other people (post docs, grad students, undergraduate students, colleagues, etc.) be involved directly with your teacher?
The teacher will be trained in some specific techniques by one of my graduate students who is working on this grant. I also expect to have a rising second-year med student in the lab over the summer, and I generally have one or more undergrads working in the lab at any given time.

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

There will be some advance reading, such as the original grant proposal explaining the basis of the ongoing work, as well as some primary literature articles. If the teacher wishes to participate directly in animal studies, s/he would need to complete on-line IACUC training modules ahead of time in order to be added to our animal protocol.