

### **FYRE Projects (Singh Lab)**

The Singh Lab is interested in combining the power of biochemistry and organic chemistry to provide access to novel organic molecules. We are reprogramming natural product biosynthesis pathways to make new drug analogs or for diversification of antibiotics and anti-cancer scaffolds. To do this, we leverage enzyme engineering, biocatalysis, structural biology, organic chemistry, and synthetic biology to access and diversify the structures of natural products.

**Project 1** (Biochemistry focus): Isoprenoids are a large class of natural products that display a diverse range of biological activities (antimicrobial, antiviral, antiparasitic, anticancer) along with various utilities as biofuels, commercial feedstocks, and food and cosmetic additives. Currently, our lab is involved in evolving enzymes for the generation of novel isoprenoid precursors for drug diversification. Students with biochemistry focus will learn cloning, mutagenesis, overexpression, and purification of enzymes. In addition, students will have the opportunity to learn enzyme assays using HPLC or high throughput spectrophotometric methods, and protein crystallization for structural studies.

**Project 2** (Organic Chemistry focus): A major aspect of Biocatalysis involves combining organic chemistry skills with enzymatic reactions for the chemoenzymatic synthesis of unique natural product analogs. Currently, our lab is involved in exploring the utility of isoprenoid enzymes for drug diversification. The major focus of this project is to synthesize unique substrate analogs for chemoenzymatic diversification of drugs. Students with organic chemistry focus will learn different techniques in organic synthesis, silica-gel and/or ion-exchange resin purification, and characterization of compounds using Nuclear Magnetic Resonance (NMR) spectroscopy. Students will have the opportunity to test their synthetic compounds in enzymatic reactions using HPLC-based assays.