Research in the Ludwig Lab:

Less than a century ago, common diseases such as syphilis, dysentery and cholera were often deadly. These bacterial infections are now quite treatable thanks to the development of antibiotics, which started with the discovery of penicillin (**figure 1**) in the 1950's. Over the last several decades, dozens of new antibiotics have been developed, a necessity as bacteria have evolved with an increasing ability to evade antibiotic treatments. The necessity for the development of new classes of antibiotics won't fade, but as chemists, we remain limited in our ability to build these increasingly diverse and complex molecules.

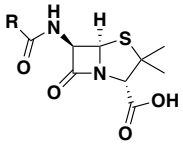


Figure 1: Penicillin, class of betalactam antibiotics

Nature has often been the source or inspiration for new pharmaceuticals. Plants and microorganisms are incredibly skilled chemists, building intricate structures from simple starting materials. Our lab is interested in harnessing the synthetic skillset of nature to build new bonds that are not currently possible with traditional methods. It is not uncommon to look to nature to help with chemistry. Many important pharmaceutical drugs are currently synthesized, in part via chemical reactions facilitated or catalyzed with enzymes from nature. But is there more possible? We know that nature can build diverse molecules and our lab has set out to identify new, biocatalyzed transformations.

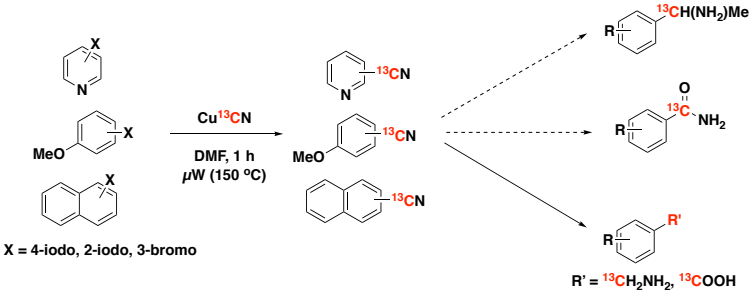


Figure 2: Sample synthetic strategies to labeled compound library.

To do this, we have developed a variety of strategies to first introduce an isotope label onto organic substrates. The label acts like a tracking device for organic molecules. We can follow a specific molecule through a sea of other organic material, monitoring any changes that occur. Isotope labeling strategies are limited by the reagents available, but the applicability of these labeled, traceable compounds doesn't end with our research. Labeled substrates are important in mechanistic studies and even drug trials!

With labeled compounds in hand, we search. We have a diverse library of marine-derived bacteria that are really known for their organic chemistry skills. We know they produce a plethora of secondary metabolites for communication and defense purposes, so we know that they are capable of some really interesting chemistry. We give them labeled substrates, and track the changes that take place!

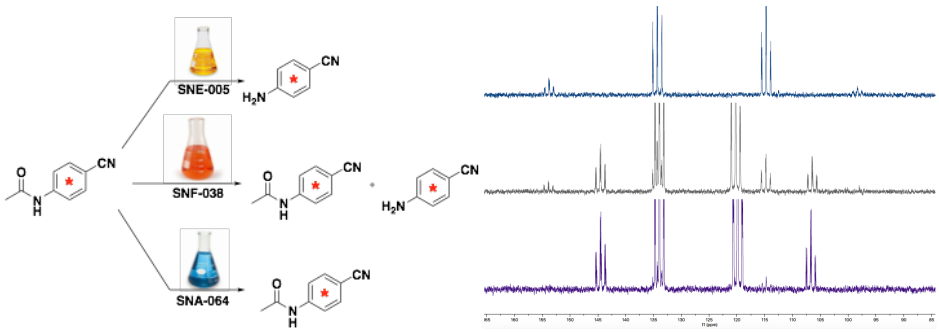


Figure 3: Selective enzymatic hydrolysis with labeled aromatic cyano acetamide.

Current and Former Lab Members:

Connor Szwetkowski

In the Ludwig Lab, Connor worked on developed a Fisher Indole Synthesis to ultimately incorporate a carbon-13 label directly on the heteroaromatic ring. Connor graduated from Rider in the spring of 2017 with a BS in Chemistry and is now studying organoboranes in the Santos lab at Virginia Tech.

John Lisowski

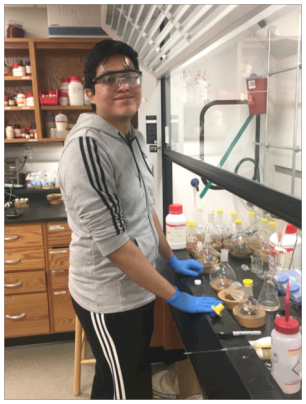
John completed a BCH 490 with the Ludwig lab where he worked on optimizing an indole synthesis. John is now an analytical chemist with Johnson and Johnson.

Brianna Bernard

Brianna was interested in the synthesis of a chalcone derivative while in the Ludwig Lab. This unique scaffold is an important biosynthetic precursor to a family of

natural products called the ammonificans. Brianna was looking to synthesize this intermediate as a way of working toward precursor-directed biosynthesis of the natural product. The idea is that if you give the bacteria an important precursor, they can utilize that material and save time and energy *en route* to the final product. Brianna has since moved on to a PhD program at the University of Miami and this project is waiting patiently for a new set of research hands!

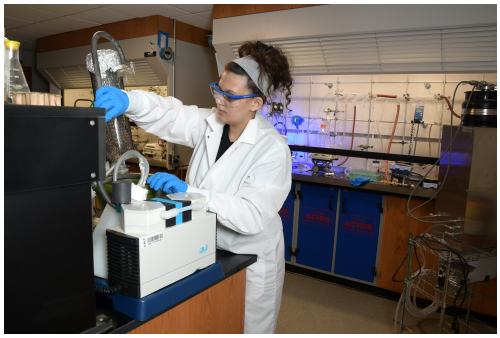
Jonnathan Marin



Jonnathan's work in the Ludwig lab involves a combination of organic synthesis and microbiology. He worked to build a small library of carbon-13 labeled compounds and is now focused on "feeding" those substrates to whole-cell cultures of bacteria. Utilizing carbon NMR, he maps changes to the molecules and has recently identified a selective hydrolysis reaction. Jonnathan was offered the Illinois Platinum Fellowship in Chemistry and will start at the University of Illinois, Urbana-Champaign in the fall of 2019.

Morgan Ballard

Morgan is busy studying the natural product, ajoene for its anti-quorum sensing properties in the fight against antibiotic resistance. By targeting quorum-sensing mechanisms in bacteria, the hope is that the bacteria can be made more vulnerable to other therapies, without prompting the development of resistance. Morgan hopes to couple a sulfonamide to ajoene to improve its anti-quorum sensing abilities. She plans on continuing on to graduate school to pursue similar research.



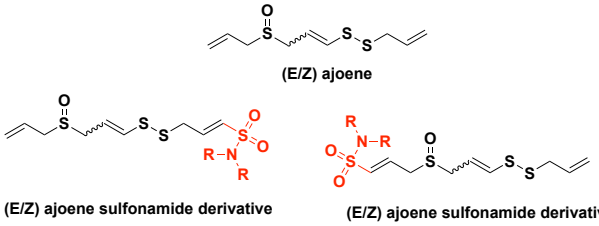
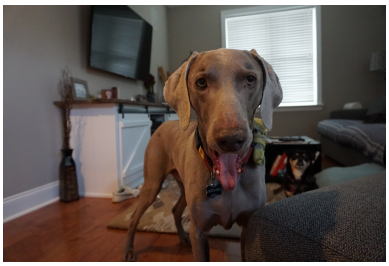


Figure 4: Ajoene and suggested sulfonamide derivatives

Corky and Boomer



Corky and Boomer have not done a single chemical reaction in their combined 26 years, but they are great lab mascots, cheering us on in our endeavors.