



**Anthony Allen '18**

*from Redford, MI*

**Major:** Chemistry  
**Minor:** Mathematics, Philosophy

**Other Interests:**  
Football, Weightlifting, Guitar,  
Classic Rock, aspiring Deadhead,  
Chess, Reading.

### **Cucurbituril [9] Synthesis**

*advisor Michael Nee*

Cucurbiturils are macrocyclic compounds composed of linked glycoluril monomers. They resemble pumpkins or barrels and are used in host-guest chemistry including applications in drug delivery, molecular recognition, and supramolecular catalysis. Different sized cucurbiturils (based on the number of glycoluril units used to cyclize) have different host-guest properties due to the size of their inner cavity. The most common cucurbituril size is Cucurbituril [6] but [5], [7], [8], and [10] also have been synthesized. Myself, Hannah Cook, and Karstan Minanov are attempting to synthesize Cucurbituril [9] using strategies for cucurbituril synthesis reported by researchers such as Lyle Isaacs of the University of Maryland-College Park and Marek Stancil of Masaryk University.



**Alyssa Altheimer '19**

*from Greensboro, NC*

**Major:** undeclared

**Other Interests:**  
Trombone, AmericaReads, cats,  
whistling

### **Colorimetric Metal Sensors**

*advisor Jason Belitsky*

Recent events in Flint, Michigan and throughout the US have highlighted the potential for lead exposure through tap water. The ability to test lead concentrations at the point of use with a simple colorimetric assay could be of great value in preventing lead exposure. While working on synthesizing mimics of melanins, the biological pigments, the Belitsky lab found that coatings derived from the oxidative polymerization of catechols change color in response to binding metal ions, such as lead and copper. Currently, these catechol-based coatings are not selective or responsive enough to be practical sensors for lead, but we are working toward that goal. This semester we are working on the synthesis and characterization of new coatings and their optimization as colorimetric metal sensors.



**Zoe Beach '17**  
*from Redlands, CA*

**Major:** Biochemistry & Biology

**Other Interests:**  
Aerial circus and hiking

### **Aptamer Selection for Ovarian Cancer Biomarker HE4 using Magnetic SELEX**

*advisor* Rebecca Whelan

The mortality rate for ovarian cancer is vastly improved when it can be detected in the early stages. Currently, clinical testing for the early stages of ovarian cancer involve the monitoring of biomarker CA-125, however, these tests often result in both false positives and false negatives. Another promising early-stage ovarian cancer biomarker is HE4. We are looking to find ssDNA aptamers, short oligonucleotide sequences that bind to specific regions on a target protein, that have high binding affinity for HE4.

Currently, we are working on optimizing a new procedure of aptamer selection, magnetic SELEX. SELEX, a common procedure used for aptamer selection in this lab, stands for the Systematic Evolution of Ligands by Exponential Enrichment. In my project, SELEX will be used in unison with magnets. The HE4 samples used have a 6-Histidine tail attached allowing for a strong interaction between HE4-6His and Ni<sup>2+</sup> ions. The strong interaction between the HE4-6His complex and Ni<sup>2+</sup> allows for HE4 to be spatially separated upon application of a magnet. A pool of ssDNA aptamers will be added to the tube and upon separation any solution not adhered to the magnet can be pipetted away, leaving only potential aptamers with binding affinity for HE4. Hopefully, the addition of magnets to the SELEX technique will generate high affinity binding aptamers for HE4 that can then be further investigated.



**Eric Bell '17**  
*from Cincinnati, OH*

**Major:** Biochemistry &  
Horn Performance  
(*Double Degree*)  
**Minor:** Computer Science

### **Investigation of Small Molecules as Periplasmic Chaperone Inhibitors using in silico and in vivo Methods**

*advisor* Lisa Ryno

The proper folding of many outer membrane proteins of E. Coli depends on the activity of the periplasmic chaperones SurA, Skp, and DegP. The importance of chaperones in maintaining the periplasmic proteome suggests small molecules that bind to and inhibit the function of these chaperones could result in inhibited bacterial growth. Our goal is to understand the binding mechanism of not only small molecules but also the client proteins with SurA and other periplasmic chaperones through protein-ligand docking. We used these docking predictions to find drug candidates using virtual screening, and we have begun to test these most promising small molecules through assessment of their ability to inhibit bacterial growth in vivo.

## **Galen Brennan '17**

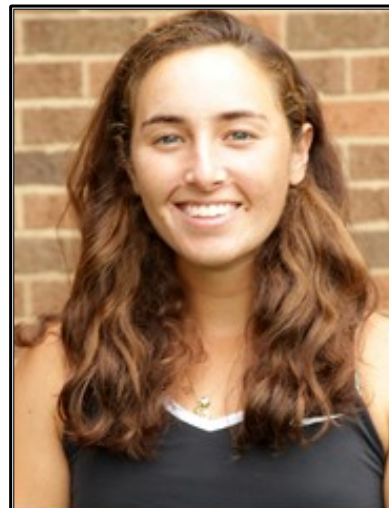
*from Seattle, WA*

**Major:** Biochemistry

### **Mechanisms of Organic Chemical Transformations in the Atmosphere**

*advisor* Matthew Elrod

Organic nitrates are commonly formed within the atmosphere from isoprene. We are working to synthesize these organic nitrates, and then use them to examine their kinetic properties. Nitrates can serve as the pre-cursor to the formation of ozone. By studying their reactive kinetics, we can thereby model how to prevent their reaction to form ozone.



## **Emma Brezel '17**

*from Port Washington, NY*

**Major:** Biochemistry

**Minor:** Religion

**Other Interests:**

Tennis, Cooking

### **Impact of stress responsive transcription factors on the composition on E. coli biofilms**

*advisor* Lisa Ryno

The bacterial stress response is governed by stress-specific transcription factors that change the gene expression and protein activity of the bacteria and allow it to survive a variety of suboptimal conditions. We are interested in over-expressing these transcription factors in E. coli and exploring the effects on biofilm composition in order to better understand the relationship between bacterial stress response pathways and the process of biofilm formation. Specifically, we are extracting the extracellular polymeric substance (EPS), which forms the functional and structural integrity of the biofilm, and determining the concentration of proteins and carbohydrates. By determining how EPS composition changes depending on the presence of particular stress responsive transcription factors, we can potentially develop more effective pathway specific strategies for inhibiting biofilm formation. By disrupting biofilm formation, bacteria will be more vulnerable to antibiotics or immune responses.



**Hannah Cook '18**  
*from Dartmouth, MA*

**Major:** Biochemistry

**Other Interests:**  
Soccer, track and field

### **Cucurbituril Synthesis**

*advisor Michael Nee*

Cucurbiturils are found to exist naturally with 5, 6, 7, 8, 10, and sometimes 14 glycoluril units. We are attempting to synthesize cucurbit[9]uril. Currently, we are working on refining our procedure for synthesizing the trimer, which will have chelated ends that are hopefully easily removable. We were successful in synthesizing the trimer last semester. With this trimer, the hope is to enable it to react with a hexamer that is sitting open around a template molecule to get to the 9-membered cucurbituril ring.



**Diego Cortes '18**  
*from Houston, TX*

**Major:** Chemistry

**Other Interests:**  
Running

### **Atmospheric Chemical Reactions of Aerosols with Biogenic Derived Epoxides**

*advisor Matthew Elrod*

We want to understand how BVOCs, in contribution with human-introduced pollutants, contribute to air pollution (by facilitating ground level ozone production and forming toxic compounds in aerosol particles). Current project focuses on Limonene Oxide, a compound derived from lemon trees as limonene. The goals are to measure the aqueous aerosol phase kinetics parameters and identify products of the epoxides undergoing different reactions: hydrolysis, isomerization, organosulfate formation, and oligomerization.



**Riley Davies '19**  
*from Washington, DC*

**Major:** Chemistry

**Other Interests:**

Separating piles of salt and sand with tweezers, setting alarms on the weekend, crafting jokes that only make me laugh

**Catalysis of Spontaneous Cocrystal Development by Organic Vapors**

*advisor Manish Mehta*

Cocrystal research is one of the newest fields in chemistry and has the potential to change how we think about pharmaceuticals. We are continuing the work that led to our lab's previous findings regarding spontaneous formation of cocrystals in a solid-state caffeine-malonic acid system, namely that the reaction rate can be greatly increased by the addition of an organic vapor as a catalyst. We aim to understand the mechanism by which this catalysis occurs and discover other systems that can be catalyzed by this method.



**Will Dresser '19**  
*from Indianapolis, IN*

**Major:** Chemistry

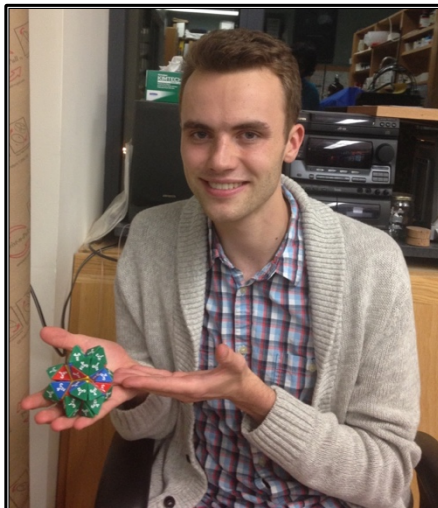
**Other Interests:**

Running, Backpacking, Soccer, Reading, Foosball, Reading, Watching Movies

**Iodide Chemical Ionization Kinetics**

*advisor Matthew Elrod*

Through past research in the Elrod lab it was shown that Iodide ions can be used as a detector element with our Flow Tube Chemical Ionization Mass Spectroscopy instrumentation. It has also been shown through our research that Iodide tends to associate selectively with di- and multi-functional molecules meaning that it is more selective than the traditional proton ionization technique that we tend to use in our lab. Over the Fall I will be looking at the broader potential of Iodide as an ionization detector through the use of kinetics measurements with known compounds and compounds of interest.



**Chris Eckdahl '17**  
*from St. Joseph, MO*

**Major:** Chemistry &  
Materials Physics

**Other Interests:**  
Playing trumpet, science fiction,  
Buddhism

## Computational Exploration of Tetrahedral Packings

*advisor Manish Mehta*

Professor Mehta and I have developed a method to create arrangements of tetrahedra based on repeated face-to-face replications. This approach can be used to generate new structures and to describe and characterize known dense packings. I use this novel computational approach, as well as several others, to generate tetrahedra which can then be subjected to a Monte Carlo compression algorithm to produce new dense tetrahedral packings. Besides revealing fundamental geometrical properties of the tetrahedron, my work could also inform the design of materials composed of tetrahedral sub-units, the properties of which are dependent on tetrahedral packing behavior.



**Josh Elder '17**  
*from Highland Park, IL*

**Major:** Chemistry

**Other Interests:**  
Oberlin College Marching Band/  
percussion, arranging music, video  
games, board games, baking, frisbee,  
movies, and anything Spider-man  
(except Tobey Maguire)

## Analysis of OCPs and PCBs in Soil Samples

*advisor Robert Q. Thompson*

Organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs), while largely banned in the US and Europe years ago, persist in the environment and continue to be concerning toxic pollutants and can be found in water, soil, and food. We will adapt US EPA methods, among others, to quantify the OCP and PCB content in soil samples by transferring the chlorinated compounds from soil into organic solvent, removing interfering matrix components from the liquid extract, and analyzing it by GC with electron capture detection. We will be analyzing local soils (like from the athletics fields, ponds, and river banks in Oberlin). However, since so many exist, we will only be selecting one or two OCPs and PCBs for study (these are yet to be determined).

Additionally, this project deals with design-of-experiment. Typical lab procedures have researchers studying just one variable while holding everything else constant. This method, while widely used, is inefficient and, in the context of optimizing an experiment, inaccurate. We will determine the most important of the many variables in the experiment described above, and optimize them, using screening processes and factorial design. These approaches not only present a more efficient laboratory process, but they also lead to accurate mathematical models that take into account not only experimental factors, themselves, but also the interactions between these factors (something that the typical scientific process tends to overlook).

## Aidan Estelle '17

**Major:** Biochemistry

**Project Advisor:** Michael Nee

## Calvin Gang '17

*from Chicago, IL*

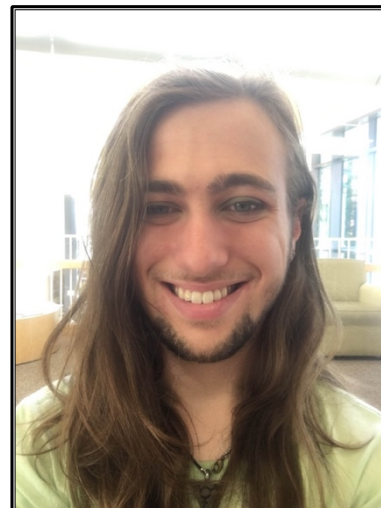
**Major:** Biochemistry & Biology

**Other Interests:**  
Running and breakdancing

### The Synthesis of Lead-Halide Perovskites with Organic Amine Cations

*advisor Catherine Oertel*

Lead-halide perovskite materials are composed of an  $ABX_3$  stoichiometry, where A is a monovalent cation, B is lead(II) and C is a halide anion. These materials exhibit remarkable photophysical properties and are prime candidates for application as solar cell absorbers. However, one shortcoming of lead-halide perovskites concerns their intrinsic instability to moisture, light and heat. Hence, synthetic chemistry research has sought to utilize powerful tools for manipulation of the perovskite lattice in order to overcome this limitation. In one approach, synthesis of layered perovskite structures, in which arrays of organic cations partition anionic metal-halide sheets, allows for opportunities to alter the physical characteristics of the material with the goal of improving stability without hindering its photoelectric properties. Our project seeks to synthesize novel layered perovskite structures by incorporating organic amines into perovskite lattices to partition lead-halide layers. Our methods of synthesis will include hydrothermal synthesis and solid-state reactions. Characterization of synthetic products will largely employ X-ray diffraction, thermogravimetric analysis, IR spectroscopy, and electron microscopy.



## Arden Hammer '18

*from Thousand Oaks, CA*

**Major:** Chemistry & Biochemistry  
**Minor:** Geology

**Other Interests:**  
dogs, bats, geology, the sun,  
nice people, science puns,  
classical music

### Synthesis and Structural Chemistry of Lead Oxide Carboxylate Hybrid Materials with Chiral Organic Ligands

*advisor Catherine Oertel*

Lead oxide carboxylates are hybrid inorganic-organic compounds, some of which occur as corrosion products of lead-rich materials, and some of which exhibit non-centrosymmetric structures that can give rise to novel optical properties. In each compound, distorted edge-sharing  $Pb_4O$  tetrahedra form extended inorganic substructures that are further coordinated by carboxylate ligands. In compounds based on some functionalized benzoate ligands, the lead atoms of the inorganic substructures are arranged in double helices around chains of central oxygen atoms. Our current work involves synthesis and characterization of new lead oxide carboxylate phases with chiral organic ligands in order to elucidate the factors governing the condensation and topology of extended inorganic motifs.



**Mikaila Hoffman '18**

*from Pittsburgh, PA*

**Major:** Chemistry

**Other Interests:**

Club soccer, painting, and reading

### **Using Solid-State NMR to Explore Cocrystal Systems**

*advisor* Manish Mehta

My work this semester will expand on previous work done to explore chemical systems that spontaneously form cocrystal, particularly those that form cocrystals through organic vapor catalysis. The lab has previously focused on using Powder X-ray Diffraction to study these systems, but this semester I'll be using Solid-State NMR to do so.

**Kallie Jiang '19**

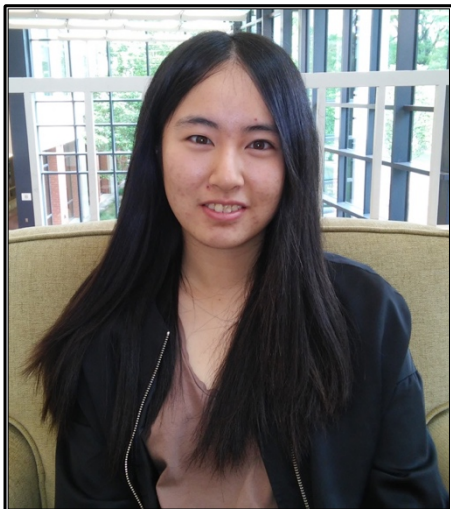
*from Grand Rapids, MI*

**Major:** Biochemistry

### **Oligomerization of Lactones as a Model for the Formation of 2-MG Based Oligomers**

*advisor* Matthew Elrod

We study the structural connectivity of  $\beta$ -propiolactone and  $\beta$ -butyrolactone based oligomers and the conditions at which they form. This information can serve as a model for the formation of 2-Methylglyceric acid based oligomers which are found in aerosol particles and derived from the BVOC isoprene.



**Eve Liu '17**  
*from Hangzhou, China*

**Major:** Chemistry &  
3+2 Engineering  
**Minor:** Mathematics

### **The Chemistry of Attraction? Analysis of Bowerbird Paint**

*advisor Rebecca Whelan*

Satin Bowerbirds are regarded as a model species for studying sexual selection because their mating system is entirely based on a display that serves no other purpose. Male bowerbirds build elaborate bowers: archways large enough for the birds to stand in made out of twigs, furbished with colorful decorations that range from yellow leaves to blue plastic stolen from human neighbors. During the breeding season, males spend most of their time maintaining their bowers: adding and arranging sticks and decorations as well as painting the walls of their bowers. The paint is made of a mixture of chewed up plant material mixed with saliva, and is applied with the beak. Although it has been observed that removal of the paint leads to reduced mating success, the specific function of the paint is unknown.

We are analyzing bower paint in an attempt to identify chemical correlates to mating success. If the paint does function as a chemical signal, we hope we can identify the specific compounds or classes of compounds that directly correlate with increased matings. We are examining samples from a few bowers each at several timepoints. The samples we are working with were collected in Australia by our collaborators in the Gerald Borgia Lab (University of Maryland). Twig samples were sonicated with hexanes to extract any organic compounds. Subsequently, the whole extracts were separated, using four solvents of increasing polarities, into four fractions of differing polarities. By separating the whole extracts into different groups based on their chemical properties, our final data is much easier to read and interpret. The two more polar fractions were TMS derivatized in order to increase volatility and affinity for the non-polar GC column on which they were analyzed. Each fraction was analyzed by GC-MS using a non-polar column. Compounds were identified using m/z data as well as retention indices.



**Daniel Markus '18**  
*from Rockville, MD*

**Major:** Biochemistry

**Other Interests:**  
Purging the word "doggo" from the English vocabulary, serious discussion of nihilism, wokeness as social capital, (still) wearing headphones

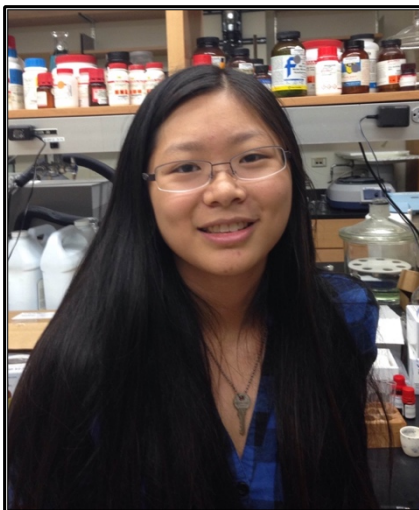
### **Binding Affinity Studies of Aptamers**

*advisor Rebecca Whelan*

Ovarian cancer is the fifth deadliest cancer among women. Though eminently treatable when detected in early stages – the five-year survival rate for cases detected in the earliest stage is 94% – only about one fifth of cases are caught this early, while patients with ovarian cancer detected in stage IV have a five-year survival rate of just 17% (American Cancer Society). Our lab hopes to create clinically relevant diagnostic tools that can detect ovarian cancer in early stages more effectively than current methods.

Previous research has identified two proteins (known as biomarkers), CA-125 and HE-4, that may indicate that someone has ovarian cancer. In the hopes of designing high-affinity and -specificity probes for these molecules, our lab works with DNA aptamers: short, single-stranded oligonucleotides that are easy to replicate, relatively cheap, and stable, with high structure variability depending on their sequence. Our process of selecting aptamers, known as High Throughput Systematic Evolution of Ligands by EXponential Enrichment (HT-SELEX), begins with a random pool of millions of aptamer candidates, and involves three basic steps: selecting, amplifying, and sequencing the best binders from the pool.

This semester, I will continue studying two aptamers for a protein called thrombin, which are frequently referred to in the field as a model aptamer system. This work will be a continuation of work I did in the Whelan lab over the summer that found several experimental parameters – such as sample solution composition and analysis methods – can alter determined binding constants for these model aptamers in a statistically significant way, which has critical implications for the study of aptamers and analytical techniques using them. Further, I will use a technique called Fluorescence Anisotropy to study the binding of two new sets of aptamers for the protein mesothelin and the ovarian cancer biomarker CA-125.



**Lele Mathis '18**  
*from Maryland (DC Area)*

**Major:** Chemistry & Physics  
(Astrophysics)

**Other Interests:**  
Dance, drawing, reading,  
board games, space

## Synthesis of Lead Oxide Phosphonates

*advisor Catherine Oertel*

The corrosion of lead-tin alloys by carboxylic acids gives rise to lead oxide carboxylates, organic-inorganic hybrid materials with noncentrosymmetric properties. They are made up of a central chiral chain of lead tetrahedra with organic ligands coming off it. My project is synthesizing lead oxide phosphonates, analogues to these lead oxide carboxylates with the carboxylic acid ligand replaced by phosphonic acid, using hydrothermal synthesis to discover if they also have interesting noncentrosymmetric properties. Hopefully I will be able to grow crystals large enough for single-crystal X-ray diffraction, which would give information on the structure of the unit cell.



**Kepler Mears '17**  
*from Brookline, MA*

**Major:** Biochemistry, Chemistry &  
Mathematics

**Project Advisor:** Rebecca Whelan

## Development of a Fluorescence Anisotropy/Affinity Probe Capillary Electrophoresis Assays for Analyzing Aptamer Affinity

*advisor Rebecca Whelan*

Aptamers are single stranded Oligonucleotides selected to bind to a target with high affinity and specificity through a process called Systematic Evolution of Ligands through Exponential enrichment (SELEX). The Whelan lab focusing on selecting aptamers for Ovarian cancer biomarker proteins. Several rounds of SELEX has been performed in the Whelan lab for the biomarkers CA125, MUC16 and HE4. To access the affinity to these aptamers to their targets we have used two assays to determine the dissociation constants ( $K_d$ ) of the aptamers. The first being affinity probe capillary electrophoresis (APCE) and the second fluorescence anisotropy. Unfortunately, limitations in the experimental parameters require unique sample preparation for each assay.

With the acquisition of a new HeNe laser, we will be able to use the same sample for both APCE and FA assays, providing a more accurate calculation of  $K_d$ s. My project has been setting up the HeNe laser as well as create the combined APCE/FA assay using a model system. Upon completion we will use this assay to assess the affinity of aptamers selected for the ovarian cancer biomarker MUC16. The SELEX process for MUC16 has been completed previously, but the aptamers have yet to be analyzed with  $K_d$  measurements.



**Sammy Moores '17**  
from San Francisco, CA

**Major:** Biochemistry &  
East Asian Studies

**Other Interests:**  
Cooking, Baking, Scuba Diving,  
Snowboarding, Coloring, Tennis,  
Swimming

### Exploring the Role of N-hydroxy Heterocycles in Synthetic Eumelanin Formation

*advisor Jason Belitsky*

Eumelanin, a black to brown pigment, is one of the chemically distinct forms of melanin. Small molecule modulators can be used to fine-tune the properties of synthetic eumelanin for different applications and provide information about the biological process of melanin formation. Following initial screening results from the Spring 2015 Bioorganic Chemistry (CHEM 254) lab, we decided to focus on four nitrogen-containing heterocyclic compounds: N-hydroxyphthalimide, N-hydroxysuccinimide, succinimide and TEMPO. We are running spectrophotometric kinetic assays to interrogate these compounds in synthetic eumelanin polymerizations. Our preliminary results showed three wavelengths of interest: 475nm, which corresponds to the eumelanin precursor dopachrome, and initially decreases as dopachrome is consumed but increases as the pathway continues, and 375nm and 650nm, where the absorbance increases throughout the polymerization. Our experiments focused on the changes in the presence and absence of the heterocyclic compounds, under different conditions such as shaking and the initial L-dopa and oxidant concentrations. Three of the four heterocyclic compounds tested influence the polymerization in diverse ways. We believe these compounds are reacting through the formation of an N-O radical, however TEMPO, an N-O radical containing compound, seems to have little effect on the rate of dopachrome formation and appears to impact later steps in the pathway. The extent of shaking and amount of excess L-dopa also seem to affect these later steps. We hope to develop a model for the behavior of these N-hydroxy compounds under different synthetic and biomimetic pathways. These studies will inform the lab's development of an easy and cheap water filtration device based on synthetic eumelanin.



**Dom Ogunjimi '19**  
from Dolton, IL

**Major:** Biochemistry

### Characterization of the binding of Aptamers to Mesothelin

*advisor Rebecca Whelan*

Mesothelin is a 40 kDa glycoprotein, that is over-expressed in ovarian cancer cells and is known to interact with another protein, MUC16, to facilitate metastasis to the peritoneum. Aptamers are single stranded oligonucleotides that bind to macromolecules with high specificity. Aptamers have been selected that have the ability to bind with mesothelin from a library using cell-SELEX. Fluorescence anisotropy is now being used to characterize the binding of these aptamers to mesothelin for possible use in diagnostics and anti-metastatic therapy.



**Naviya Schuster-Little '17**  
from Oberlin, OH

**Major:** Biochemistry

**Other Interests:**  
Playing with Corgis, Soccer, Violin,  
Cooking

### Optimization of the Single Stranding Process for SELEX

*advisor Rebecca Whelan*

Clinically, diagnostic tests are used to detect unique biomolecules or biomarkers that many cancers are known to produce. CA-125 and HE4 are two biomarkers used in clinical tests to detect ovarian cancer, which responds favorably to treatment when diagnosed at its earliest stage. These tests however, often produce both false positives, identifying cancer when it is not present, and false negatives, incorrectly not diagnosing a patient with cancer. The Whelan lab aims to create a new diagnostic tool by using aptamers as a new detection method for these biomarkers.

SELEX is one method used to select aptamers, short oligonucleotides, (usually RNA or single stranded DNA) that bind to a target with high affinity and specificity. The selection process requires molecular biology techniques including PCR which creates double stranded DNA (dsDNA) and converting the dsDNA back to single stranded DNA (ssDNA). Single stranded DNA is then used in future rounds of SELEX and as aptamers.

This semester we will focus on optimizing the single stranding process, which is necessary for SELEX. We developed a protocol this summer, based on previous SELEX selections, that uses a streptavidin column and biotinylated primer to separate dsDNA. The biotinylated primer binds to the streptavidin bead, creating a strong, almost covalent bond which keeps one strand attached to the column. We use a base, NaOH, to denature and disrupt the hydrogen bonds between the two strands allowing us to elute a single strand of DNA. This strand is the strand of interest. This protocol will be optimized and used in the next SELEX selection of HE4.



**Jane Sedlak '19**  
from Berkeley, CA

**Major:** Chemistry

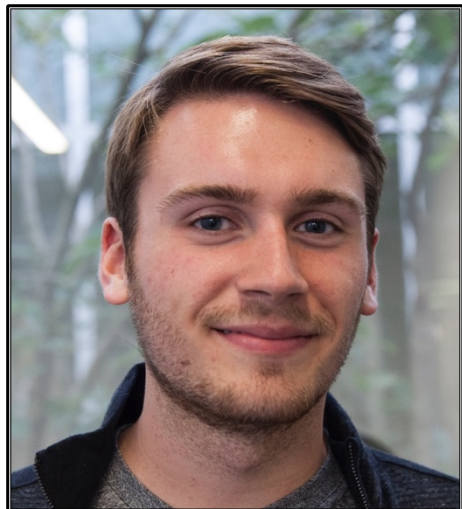
**Other Interests:**  
Reading, backpacking and hiking

### Research Project title: Catalysis of co-crystal formation in the presence of organic vapors

*advisor Manish Mehta*

Being able to understand and manipulate co-crystal formation has the potential to dramatically change the solubility and dosage properties pharmaceutical drugs; however, co-crystal formation can be difficult to study because it takes place on the molecular scale.

To better understand what is happening on this molecular scale, we use powder xray diffraction signatures to examine sample makeup. Students from past semesters have already shown that co-crystal formation can be catalyzed when the crystals are exposed to organic vapors, such as acetone. This semester we are expanding on these previous discoveries by developing a better understanding of factors controlling co-crystal formation, and investigating the formation of co-crystals in the presence of other organic vapors.



**Benjamin Steger '19**

*from St. Louis, MO*

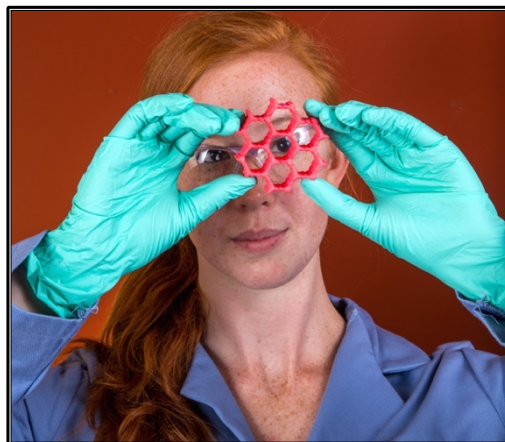
**Major:** Biochemistry &  
Trumpet Performance  
(*Double Degree*)

**Other Interests:**  
Playing and teaching music,  
hiking, skiing

### Synthesis of Eumelanin Analogues

*advisor* Jason Belitsky

Biological pigments known as melanins are ubiquitous but poorly understood biomaterials. Melanins have a range of fascinating properties that impact their biological roles and are beginning to be exploited for non-biological applications such as water purification. Eumelanin, the black to brown human pigment, is composed of oligomers of dihydroxyindoles that self-assemble into nanoparticles. Understanding this self-assembly process is a key challenge that we are addressing through the synthesis of well-defined dihydroxyindole oligomers. The Belitsky group has developed methods for the functionalization and coupling of dimethoxyindoles, utilizing reactions mediated by palladium, iridium, and bromine. This semester we will continue to optimize these reactions and expand their scope to construct dimethoxyindole oligomers with diverse shapes and sizes.



**Molly Steimle '17**

*from Austin, TX*

**Major:** Chemistry

**Other Interests:**  
Dancing, yoga and reading.

### Analysis of Arsenic Content in Rice

*advisor* Robert Q. Thompson

Arsenic content in various rice products will be analyzed by hydride generation atomic absorption spectrophotometry (HG-AAS). The method will be optimized after the most important variables have been identified and analyzed using a design-of-experiments approach.



## **Santino Stropoli '18**

*from Manhattan, NY*

**Major:** Chemistry &  
Violin Performance  
(*Double Degree*)

**Other Interests:**  
Classic rock style guitar and  
flamenco ukulele.

## **Oligomerization Reactions of Isoprene-Derived Epoxides on Secondary Organic Aerosol Particles**

*advisor* Matthew Elrod

A significant portion of the atmosphere's particulate matter consists of secondary organic aerosol (SOA), which has been implicated in human respiratory and cardiovascular disease, visibility loss, and climate modification. Extensive studies of SOA formation in the southeastern United States have identified epoxide intermediates as key species in the formation of isoprene-derived SOA. Recent work has suggested that isoprene-derived dimers constitute a significant part of SOA in the southeastern United States. We use nuclear magnetic resonance techniques to study acid catalyzed oligomerization of the isoprene-derived epoxide IEPOX-4.



## **Alex Vera '17**

**Major:** Anthropology  
**Project Advisor:** Jason Belitsky

## **Karstan Minanov '18**

**Major:** Chemistry & Economics  
**Project Advisor:** Michael Nee



**Anna Weiss '17**

**Major:** Chemistry

**Project Advisor:** Rebecca Whelan



**Yinuo Zhang '17**

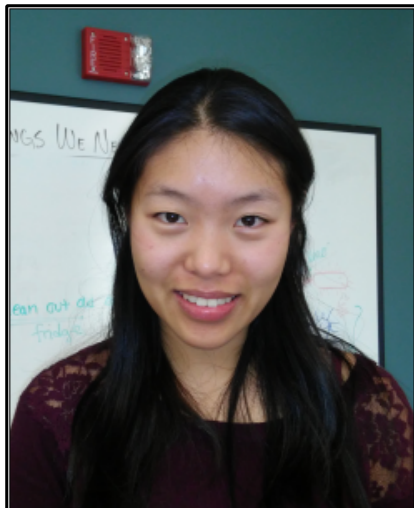
*from Ningbo, China*

**Major:** Biochemistry &  
Environmental Studies

### **Environmental Analytical Chemistry**

*advisor* Robert Q. Thompson

Developing design-of-experiments method to determine the total amount of arsenic and the fractions of inorganic and organic arsenic in commercial rice cakes and rice cereals.



**Erica Zheng '17**  
*from Ottawa, Canada*

**Major:** Biochemistry &  
Flute Performance  
(*Double Degree*)

**Other Interests:**  
Reading, flute, carrot cake

## **Discovering Inhibitors of the Periplasmic Chaperone SurA for Novel Antibiotic Development**

*advisor* Lisa Ryno

A requirement for cell homeostasis is the correct functioning of chaperones, which inhibit the aggregation of other proteins in the cell. The chaperone SurA, present in gram-negative bacteria, prevents the aggregation of outer membrane porins as they traverse the aqueous periplasm. Experiments have shown that disruption of SurA renders the bacterial cell more sensitive to agents that would normally be kept out by outer membrane porins. We aim to develop an in vitro screen to test potential small molecule inhibitors of SurA that could be used to decrease the virulence of bacterial cells. In order to carry out these screens, we need solutions of SurA at high concentrations. Using the gram-negative bacterium *E. coli*, we are optimizing a protocol for the expression and purification of high levels of SurA.