The goal of my lab group is:

Development of novel technologies to identify and optimize novel therapeutics.

My Project objective is: (*title of your paper*)

Develop a machine learning approach to rank synthetic antibodies by their selectivity to a protein target.

My Project sub-Aim 1 is: (*Section title in your paper*)

Create a neural network architecture to learn peptide sequence motifs.

My Project sub-Aim 2 is:

Identify the optimal encoding for the input peptide sequences.

My Project sub-Aim 3 is:

Perform in-vitro validations of predicted antibodies.

Sub-aim implementation steps (circle steps that are milestones)

- **Select appropriate neural network framework (convolutional, recurrent)**
- **Train neural network on test datasets**

Sub-aim implementation steps (circle steps that are milestones)

- **Test different biological encoding matrices, including one-hot encoding, BLOSUM, UniRep**
- **Determine additional features (physicochemical, biological) to add to dataset**

Sub-aim implementation steps (circle steps that are milestones)

- **Generate IgGs of synthetic antibodies**
- **Perform flow cytometry on target protein to determine antibody selectivity against negative targets**
- **Perform ELISA and BLI to get quantitative data about antibody binding efficiency**

My Research Deliverables

- **Publications**
- **List of top synthetic antibody designs**
- **Code for a machine learning ranking algorithm**

The goal of my lab group is:

Applying optimization methods to solve problems in healthcare.

My Project objective is: (*title of your paper*)

To determine whether mathematically optimized automated external defibrillator placement locations improve out-of-hospital cardiac arrests (OHCAs) outcomes compared to existing AED placements.

My Project sub-Aim 1 is: (*Section title in your paper*)

Develop tractable AED placement optimization model.

My Project sub-Aim 2 is:

Assess the feasibility of a prospective trial to compare the optimization intervention against the existing AED placements (control).

My Project sub-Aim 3 is:

Validate model assumptions and results with clinical experts.

Sub-aim implementation steps (circle steps that are milestones)

- **Identify appropriate clinical outcomes of interest**
- **Examine existing methods to compute retrospective trials and simulated prospective cohort studies**
- **Ensure out-of-sample validation and perform sensitivity analyses to determine stability of results**

Sub-aim implementation steps (circle steps that are milestones)

- **Determine source of clinical (OHCA and AED) data to use**
- **Collect covariate data to estimate clinical outcomes from cardiac arrest coverage**

Sub-aim implementation steps (circle steps that are milestones)

- **Design an experimental procedure that measures difference in cardiac arrest coverage and clinical outcomes of interest**

My Research Deliverables
- **A conference presentation disseminating research to medical community**
- **A publication describing the model formulation, experimental methods, and results**
- **The code containing the developed model**

The goal of my lab group is:

Assess the impact of air quality on human health conditions.

My Project objective is: (*title of your paper*)

Develop a method to assess the impact of automotive exhaust volatiles on the properties of human lung cells.

My Project sub-Aim 1 is: (*Section title in your paper*)

Optimize a method to expose human cells to exhaust volatiles.

My Project sub-Aim 2 is:

Optimize method to measure reactive oxygen species using a chemical assay.

My Project sub-Aim 3 is:

Measure the reactive oxygen species levels in human lung cells exposed to exhaust volatiles using a chemical assay.

Sub-aim implementation steps (circle steps that are milestones)

- **Generate mixtures of exhaust volatiles in the lab**
- **Characterize mixtures of exhaust volatiles**
- **Establish a protocol to incubate cells with the exhaust mixture**

Sub-aim implementation steps (circle steps that are milestones)

- **Demonstrate chemical assay can detect oxygen species in a test solution with a known concentration of the species present**
- **Generate a calibration curve for different oxygen species levels**

Sub-aim implementation steps (circle steps that are milestones)

- **Expose cells to the chemical exhaust**
- **Collect samples with and without exposure and assess oxygen species levels using the chemical assay**
- **Treat cells with different compositions of exhaust to demonstrate see expected variation in assay readout**

My Research Deliverables
- **A report making public health recommendations related to the compound levels that likely impact human cells**
- **An established protocol to expose human lung cells to volatiles**

The goal of my lab group is:

Use biological processes to break down environmental contaminants.

↓

My Project objective is: (*title of your paper*)

Develop an expression system in *E. coli* for the production and purification reductive dehalogenase enzymes.

My Project sub-Aim 1 is: (*Section title in your paper*)	My Project sub-Aim 2 is:	My Project sub-Aim 3 is:
Design an expression system to produce reductive dehalogenases.	**Demonstrate expression and activity of various reductive dehalogenases.**	**Purify a reductive dehalogenase enzyme and assess the quality of the expression.**

Sub-aim implementation steps (circle steps that are milestones)	Sub-aim implementation steps (circle steps that are milestones)	Sub-aim implementation steps (circle steps that are milestones)
• **Clone and transform the enzyme of interest** • **Compare activity of the enzyme in various expression conditions** • **Establish optimized expression protocol for reductive dehalogenases**	• **Select several reductive dehalogenases to clone and express** • **Use optimized protocol to express these enzymes** • **Test the activity of these enzymes to determine if system is generalizable**	• **Scale up expression and purify an enzyme with affinity chromatography** • **Assess the purity and concentration of the enzyme** • **Quantify the cofactor occupancy of the purified enzyme**

My Research Deliverables

- **An established protocol for expressing and purifying reductive dehalogenases in *E. coli***
- **A manuscript outlining the expression system and comparing it to previous systems**
- **Conference presentations**

The goal of my lab group is:

Develop in vitro models of the human heart to study cardiac physiology, disease, and regeneration.

My Project objective is: (*title of your paper*)

Investigating the role and mechanisms of extracellular vesicles (EVs) in human cardiac tissue-on-a-chip models.

My Project sub-Aim 1 is: (*Section title in your paper*)

Engineer heart-on-a-chip for EV analysis.

My Project sub-Aim 2 is:

Create cardiac injury-on-a-chip to study EV dysregulation.

My Project sub-Aim 3 is:

Analyze the effects of delivering EVs from different sources to tissues.

Sub-aim implementation steps (circle steps that are milestones)

- **Differentiate stem cells into three cardiac cell types**
- **Seed cells in 'Biowire' platform, mature with electrical stimulation**
- **Isolate secreted EVs, characterizing concentration and molecular composition**

Sub-aim implementation steps (circle steps that are milestones)

- **Simulate cardiac injury by culturing tissues in hypoxia and ischemic culture media**
- **Assess tissue functional and physiological impacts**
- **Isolate and characterize changes to secreted EVs post-injury**

Sub-aim implementation steps (circle steps that are milestones)

- **Isolate and characterize EVs from 2D cultures of four cardiac cell types**
- **Apply each type of EVs separately to injured tissues**
- **Assess regenerative potential of different EV populations in the injured heart**

My Research Deliverables
- **A model for simulating and studying ischemic cardiac injury in vitro**
- **A publication outlining the application, sourcing, and functional implications of EVs as a regenerative cardiac therapy for heart patients**