Sneha Sengupta

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Education

Duke University
Masters of Engineering in Biomedical Engineering- Biomaterials Concentration 2026-Present
Bachelors of Engineering in Biomedical Engineering- Molecular Engineering Concentration 2022-2026

Skills

- **Programming Languages**: Python, MATLAB-Simulink, C
- **Softwares:** SolidWorks, Microsoft Office Suite (Powerpoint, Excel, Word, Outlook), COMSOL
- **Soft Skills:** Leadership, Effective Communication, Teamwork, Organization
- **Wet Lab Skills:** Microscopy, Cell Culture, Quantitative PCR, Collagen Gels, Protein Isolation, Western Blots, Viral Transfection, Gibson Assembly
- **Statistics Skills**: Correlation & Regression, t-tests, ANOVA, Power Analysis

Relevant Coursework

Major:

- General Chemistry
- Organic Chemistry
- Fundamentals of ECE
- Introductory Mechanics
- Modeling Cells & Molecular Systems
- Intro Electricity, Magnets, & Optics
- Signals and Systems
- Mechanics of Solids
- Medical Instrumentation
- Biotech Senior Design
- Drug Delivery*
- Molecular Biology
- Writing
- Computational Methods
- Quantitative Physiology
- Projects in BME-Acoustic Microfluidics
- Transport Phenomena: Biological Systems
- Cellular Engineering
- Biomaterials
- Cancer in Bioengineering
- Medtech Prototyping*
- Tissue Biomechanics*

Additional Courses: Calculus I, Calculus II, Linear Algebra, Multivariable Calculus, Probability & Statistics, Ordinary & Partial Differential Equations, Medical Sociology, Intro to Data Science

Projects

PEGylated Thrombomodulin Coatings for Decellularized Vascular Grafts Fall 2025
- Engineered a bidirectional PEGylated thrombomodulin surface coating for decellularized vascular grafts to improve biocompatibility, reduce thrombosis, and enhance endothelialization.

EMG-Controlled Prosthetic Hand Engineering Design Project Fall 2025
- Designed a forearm-sensing prosthetic hand that captures EMG signals from muscles, processes them through amplification and filtering, and drives motors via a microcontroller to produce motions in a 3D-printed hand.

Low-Cost Microneedle Hydrogel Continuous Glucose Monitoring System Fall 2025
- Designed a low-cost, power-free continuous glucose monitoring system using microneedle hydrogel sensors with GOx- and PBA-based chemistries to provide colorimetric readouts of hypo- and hyperglycemia.

Targeted In Vivo CCR5 Gene Editing for HIV Immunization and Therapy Fall 2025
- Designed a targeted gene therapy strategy using HIV1 pseudotyped lentiviral vector to deliver CRISPR-Cas9 for CCR5 knockout in CD4+ T cells to minimize lifelong treatment burden.

***In vivo* Biosensor for Colorectal Cancer** Fall 2025
- Designed a multiplexed A. Baylyi biosensor for in vivo ctDNA-based colorectal cancer detection, combining CRISPR specificity, homologous recombination sensing, and visible chromoprotein reporting

AAV-TREM2 Gene Therapy Vector Design Fall 2025
- Engineered and conducted plasmid design of an adeno-associated virus (AAV-DJ) vector with a CAG promoter to

*Will be completed by Summer 2026

over express the TREM2 gene in microglia to enhance amyloid-β clearance in Alzheimer's disease models.

Electrocardiogram Biopotential Amplifier Fall 2025
- Built and analyzed a multistage ECG amplifier circuit incorporating an instrumentation amplifier, high-pass and low-pass filters and an isolation amplifier for patient safety and noise rejection.

Baby Incubator Control System Fall 2025
- Designed & implemented a closed-loop temperature control system using a thermistor, relay, and Arduino microcontroller to maintain neonatal incubator temperature within 0.5°C .
- Integrated sensor calibration, hysteresis control, and OLED user interface for autonomous operation.

Breast Cancer Classification-ML Summer 2025
- Applied machine learning techniques (logistic regression, SVMs, neural networks) on the UCI Breast Cancer dataset to classify tumors as benign or malignant. Optimized parameters and evaluated models using accuracy and F1 score. Achieved > 95% accuracy with the tuned SVM and neural network models.

Modeling Radioimmunotherapy of Metastatic Melanoma Spring 2025
- Developed a mathematical model simulating antibody distribution and binding within tumor tissue across varying antigen concentrations.
- Analyzed and interpreted spatial profiles of antibody-antigen complex formation to identify diffusion limitations and binding site barriers to optimize treatment outcomes of therapies using COMSOL.

CFD Modeling of Variable-Height Flow Chamber for Cell Stress Analysis Spring 2025
- Simulated fluid flow in a variable-height chamber using 2D and 3D models in COMSOL to predict shear stress on adhered cells.
- Validated analytical shear stress equations through numerical comparison and visualized fluid acceleration across chamber length given simulation constraints and prompts.

Targeted Immunomodulation of Transplants Using MMF-Nanoparticle Delivery Spring 2025
- Investigated localized drug delivery strategies to suppress immune rejection in organ transplantation using MMF-loaded PEG-PLGA nanoparticles.
- Analyzed molecular immune pathways (IL-6, TNFα, IFNγ, PD-L1, CXCL9/10) contributing to graft inflammation and chronic rejection and proposed "smart" nanoparticle system to regulate immunosuppression based on local inflammatory signals.

Signal Processing for Mimicking Artistic Styles with Filters Spring 2025
- Developed a signal processing pipeline using lowpass, highpass, bandpass, and bandstop filters to transform images into styles inspired by historical art movements in Python.
- Applied Fourier transforms and spatial domain manipulations to simulate Impressionism, Cubism, Baroque, Art Deco, and Art Nouveau from raw image data.

Pharmacokinetics of Drug Treatments for Treating Chicken Pox Fall 2024
- Developed and designed a comprehensive mathematical model that simulates the pharmacokinetics of acyclovir cream and interferon alpha therapy within the immune system.
- Designed algorithms to model movement of T-cells in response to the chickenpox virus, integrating experimental parameters.

Toxicokinetics of BPA on the Human Body Fall 2024
- Developed and designed a comprehensive mathematical model that simulates the toxicokinetics of BPA within the endocrine system, capturing complex interactions between hormones and metabolic processes.
- Designed algorithms to model BPA absorption, distribution, metabolism, and excretion, ensuring accurate representation of its impact on human endocrine function integrating experimental parameters.

Acoustofluidics for Plasmapheresis Fall 2024
- Designing and developing a prototype device for plasmapheresis, creating detailed 3D models of microfluidic channels and integrating acoustic transducers to optimize fluid separation.
- Designed and iterated on multiple versions of the prototype, refining the design to ensure precise control of fluid dynamics and manual operation efficiency for medical use.
- Integrated microfluidic components with biomedical systems to design a functional prototype that identifies immune sensitivity levels with flow cytometry.

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Vegetation Detection Spring 2024
- Conducted a research project where the vegetation of aerial images was analyzed via the Rasterio package in Python and NDVI indexes, then compared in order to make a conclusion.

Electrocardiogram Analysis Spring 2024
- Analyzed electrocardiogram data for five patients with Python, produced JSON files with statistical summaries of each patient's profile including potential diagnosis from data irregularities.

Leadership

CRISP Intern 2025-Present
- Designed and executed a retrospective cohort study of pediatric kidney transplant patients ages 1-23 who were patients at Duke Medical Center between 2016 to 2025 to examine the clinical outcomes for patients treated with IVIG.

Orientation Program Director 2025
- Co-designed a band camp schedule with Duke New Student and Family Programs and the Duke Marching Band director. Handled and oversaw logistics of travel, food, activities, and schedule planning for orientation week.

Undergraduate Research Assistant 2024-Present
- Innovating improvements in immunotherapy regimens for pediatric patients post kidney transplant in Dr. Eileen Chambers Lab of Pediatric Nephrology through the Research Scholars Program.

Progress Period 2023-Present
- Co-President, previously Vice President, Social Media Co-Chair, Education Committee Head (23-24), overseeing and managing Duke University's chapter of PERIOD. a global youth fueled non-profit which strives to eradicate period poverty and stigma through advocacy, education, and service.

Penny Pilgrim George Women's Leadership Initiative 2023-2024
- Volunteer partner with local nonprofit, Keep Durham Beautiful to create a "Wastewise Event Guide" as a resource for hosting sustainable events as part of the City of Durham Strategic Plan.

Duke University Marching & Pep Band 2022-Present
- Section leader enhancing performance quality through detailed attention to musicality and mentorship of fellow students.

Duke On Tap 2022-Present
- Choreographer and Co-President for a tap dancing team. Responsible for coordinating rehearsals and performances, teaching choreography, and forming a creative and supportive environment.

Professional Experience

Service Desk Worker- Duke University Library 2023-Present

Orientation Leader- Duke University 2023-2024

Volunteer Medical Assistant- Women First OBGYN 2023

Retail Sales Associate-Duke University Stores 2022-2023

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