Kaitlyn Kukula

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EDUCATION

Fort Lewis College, *Durango, CO* **Expected Graduation May 2023**
B.S. General Engineering

Colorado State University, *Fort Collins, CO* **August 2018 – December 2019**
Electrical Engineering Major

PUBLICATIONS

K. Kukula, D. Farmer, J. Duran, Dr. N. Majid, Dr. C. Chatterley, Dr. J. Jessing, and Dr. Y. Li. Rapid detection of bacteria using Raman spectroscopy and deep learning. IEEE CCWC 2021.

PRESENTATIONS

Materials Research Society Partnerships for Research and Education in Materials: "Rapid detection of bacteria using Raman spectroscopy and deep learning" (Poster, Dec. 2021)

FLC Engineering Poster Symposium: "Waterborne bacteria harvesting and identification using PCR" (Poster, Sept. 2021)

IEEE Computing and Communications Workshop and Conference: "Rapid detection of bacteria using Raman spectroscopy and deep learning" (Presentation, Jan. 2021)

AWARDS

Fort Lewis College Engineering Don Rabern Service to the Engineering Department Award Recipient, 2022

Fort Lewis College Engineering Outstanding Student Researcher Award Recipient, 2022

ENGINEERING & BIOLOGY EXPERIENCE

Undergraduate Researcher **April 2020 – present**
Fort Lewis College, Durango, CO
Advisors: Dr. Yiyan Li and Dr. Christie Chatterley

Characterization of Antimicrobial Resistant *E. coli* January 2022 – present

- Utilizing Raman spectroscopy and deep learning methods to achieve phenotypic characterization
- Performing literature review and developing experimental questions, methods, and desired outcomes
- Leading a team of three students: responsible for monitoring progress and delegating tasks
- Sourcing wild-type *E. coli* resistant to three types of antibiotics and producing transformed resistant cells
- Conducting statistical analysis using ANOVA in MATLAB software

Fecal Contamination and Water Quality Monitoring in the Weminuche Wilderness May 2022 - present

Methods Preparation

- Responsible for experiment design for testing water samples for *Bacteroides* spp.
- Implementing EPA Method 1696 for use in FLC Engineering laboratories
- Validating relevant assays using bacteria from local watersheds
- Gaining experience in culturing and working with anaerobes

Student Advisor: Team of Four Students

- Training the team on relevant microbiological methods, including bacteria handling, PCR/qPCR, and experiment design
- Teaching EPA Method 1696 to students
- Advising the team of appropriate laboratory methods and in-field conduct

Droplet Digital PCR for Waterborne Bacteria Identification and Quantification April 2020 - present

Assay Validation and Optimization

- Tasked with designing biological assays with TaqMan probes to identify *E. coli* and *Bacteroides* spp.
- Validated assay concentrations and optimized for use in ddPCR using qPCR assay optimization methods

Droplet Generation

- Developed droplet generation strategies to obtain consistently sized droplets before and after thermocycling

Bacteria Concentration in Water Samples

- Development of a field-deployable water filtration method to rapidly concentrate aquatic bacteria samples
- Researching effectiveness of methods for varied sample concentration and volume

Team Leadership and Advising

- Created entry-level procedures and taught biological techniques to beginners
- Managed team progress and tasks to achieve goals

Bacteria Identification using Raman Spectroscopy and Deep Learning May 2020 – August 2021

Sample Preparation and Dataset Creation

- Prepared samples from local watersheds for signal acquisition, including cell washing and plasmid transformations
- Collected wild-type bacteria and identified using PCR to supplement datasets
- Gained experience in microscope imaging and organizing large datasets

Machine Learning and Statistical Applications

- Developed novel deep learning networks for identification of common bacteria
- Evaluated convolutional neural network (CNN) and residual network accuracy and effectiveness
- Implemented dataset visualization and data preprocessing in Python

RELEVANT EXPERIENCE

Society of Women Engineers Officer **January 2020 – present**
Fort Lewis College, Durango, CO

President September 2021– present

- Planned and executed an event series focused on empowering women in the sciences, including applying for and receiving a $3,000 grant from FLC
- Implemented a high school design sprint outreach event with 30+ high school students
- Delegation and supervision of tasks to a team of four club officers

Secretary September 2020 – May 2021

- Recorded monthly meetings, created schedules, and planned logistics of SWE events

K-12 Outreach co-officer January 2020 - May 2020

- Planned SWE involvement of two STEM outreach events with the Durango School District (postponed due to COVID-19)
- Planned interactive scientific demonstrations appropriate for K-12 students

CHEM 150 Laboratory Teachers Assistant **August 2021 – December 2021**

Fort Lewis College, Durango, CO

CHEM 150: Fundamentals of Chemistry I: Atoms and Molecules

- Tutored students for one 3-hour weekly lab sessions: instructing experimentation and assisting in reports
- Responsible for grading all laboratory assignments for the course

ENGR 103 Mentor **April 2021 – May 2021**

Fort Lewis College, Durango, CO

ENGR 103: Engineering Fundamentals I

- Mentoring freshman students three times a week in their first college-level engineering design project
- Advised students on the engineering process, including designing and communicating

SUPPORTING GRANTS and INTERNSHIPS

NSF Science and Technology Center on Real-Time Functional Imaging (STROBE) Scholar

- Summer internships (2020, 2021, and 2022), 40+hours/week, advised by Dr. Yiyan Li
- Studying Raman Spectroscopy, neural networks, and water quality monitoring

Environmental Protection Agency People, Prosperity, and the Planet (P3) Student Design Competition

- Semester internships (2020, 2021, 2022), 12+hours/week, advised by Dr. Yiyan Li and Dr. Christie Chatterley
- Studying the use of ddPCR for rapid and accurate bacteria identification in the Animas River

TECHNICAL SKILLS

Microbiology

- Culturing aerobic and anaerobic bacteria
- Polymerase chain reactions (standard, real-time, and droplet digital)
- Primer and TaqMan probe design and verification

Water Quality Monitoring

- Water collection and contamination evaluation following EPA guidelines
- Streamflow calculations
- Data analysis for water quality

Raman Spectroscopy

- Substrate fabrication using sputter deposition
- Scanning electron microscope for substrate imaging
- Data processing in Python using machine learning
- Statistical analysis

Photolithography and Microfluidics

- Producing etched wafers for microfluidic chip fabrication
- Mask design for etching wafers
- Microfluidic pumping device prototyping and design

Computer Programming

- Proficient in MATLAB and EES languages
- Familiar with RStudio, Python, Java, and C++ languages

PLANNED COURSEWORK

Fall 2022 (registered)

- ENGR 407 (1 credit): Thermal and Fluid Systems Laboratory
- BIO 260 (3 credits): Genetics
- BIO 427 (4 credits): Advanced Topics: Virology
- CHEM 250 (4 credits): Organic Chemistry I

Spring 2023

- BIO 326 (4 credits): Advanced Human Physiology
- CHEM 251 (4 credits): Organic Chemistry II
- CHEM 311 (3 credits): General Biochemistry I
- CHEM 312 (1 credit): General Biochemistry I Laboratory

Note: 4-credit courses include a laboratory.