

Allison Been (OPS) and Roxi Kellar (UNO)

Project Title: *Effect of Light Wavelength on Phototropism*

Alli Been teaches biology and chemistry courses at Central High School. In 2020, she partnered with Dr. Kellar, a botanist and Biology faculty member, for the second year in a row. Together they conducted an experiment to test if/how plants respond to different wavelengths of light. Their overall focus was to develop a replicable experiment to better understand a biological phenomenon (photosynthesis) that is often challenging to visualize and is



associated with student misconceptions (that plants do not move in response to their environment). The pair constructed light boxes with varying light sources positioned along the sides of the boxes to test whether tomato plants would lean towards absorbable light. They hypothesized that plants would lean (via phototropism) towards absorbable wavelengths over wavelengths that are reflected. Their results supported their hypothesis, wherein plants leaned towards white and blue light, but not toward green light, including when blue and green were both present. Ms. Been plans to implement experiment-based student exploration of photosynthesis, where students will develop hypotheses about plant pigments and light absorption, build light boxes, and complete experiments to test their hypotheses. Students will then share, collaborate, and build arguments cooperatively as a class to support their findings.

Kristoff Berzins (OPS) and Claudia Rauter (UNO)

Project Title: *Resource Type Determines Immunity of Eggs in Carrion Beetles*

Kristoff Berzins and Claudia Rauter, of Omaha Central High School and the UNO Biology Department, respectively, have partnered in every year of the TRPP since its inception. In 2020, the pair built on previous collaborations to further investigate the immunocompetence of carrion beetle eggs. During this 6th iteration of participation, they drafted a manuscript based on data collected over previous years of their partnership, engaged high school students to perform a literature review and develop an annotated bibliography, and used the software ImageJ to take and analyze measurements from digital images of carrion beetle eggs. They found greater levels of immunocompetence in burying beetle eggs than have been proposed in the literature, with carrion preparation playing a potential role. Moreover, they developed and implemented an online exercise in which eight Junior IB Biology students used ImageJ to collect and statistically analyze data to investigate the correlation between carrion preparation and the amount of parental care provided in burying beetles. Additional translation plans for spring 2021 include deployment of laboratory experiments in Berzins' freshman/sophomore Biology and Senior IB Biology classes, which will engage students in hypothesis testing, data collection, and statistical analysis and data visualization in Excel. At the end of Fall 2020, Berzins reported many positive impacts of the TRPP, such as:

- Expanded networking opportunities, and access to materials, subject matter experts, and lab spaces to enable student-driven laboratory activities
- Continued and broadening engagement of additional teachers within the school, increased numbers of students engaged (estimates increase from 250-1000), and teachers training other teachers in open inquiry labs
- Shift to student-driven experimentation inclusive of the entire scientific process from hypothesis development, to design, experimentation, and analysis following Course-Based Undergraduate Research (CURE) practices
- Increased student participation in local science fairs (from 23 to 50 students between years)
- Impacted 87 other students within the context of OPS student engagement as estimated by Mr. Berzins and OPS colleagues.

Beyond group experimentation, a subset of Mr. Berzins’ students have participated in more immersive research experiences directly engaging with the TRPP:

Impact on High School Students Who Participated in TRPP:

Student	TRPP Participation	Role in TRPP Project	Where are they now?
Student 1	2017, 2018	Data collection	Biochemistry major at Creighton University; currently conducting graduate level research
Student 2	2018	Data collection	Enrolled in 6-year medical program at the University of Kansas Medical Center
Student 3	2018	Data collection	Biology major at UNL
Student 4	2019	Data collection	Georgetown University, major undeclared
Student 5	2019	Data collection	Biochemistry major at Loyola University Chicago
Student 6	2019, 2020	Data collection, Literature Review, Annotated Bibliography, Manuscript Writing	Biology major at Emory University
Student 7	2019, 2020	Data collection, Literature Review, Annotated Bibliography, Manuscript Writing	IB program at Central High School
Student 8	2019, 2020	Data collection, Literature Review, Annotated Bibliography, Manuscript Writing	Biology major at UNL

LaKresha Clark (OPS) and Michaela Schenkelberg (UNO)

Project Title: *Steps for Exploring School Teachers and Administrators Readiness to Implement Schoolwide Physical Activity Surveillance*

Middle School Counselor Ms. LaKresha Clark and Dr. Michaela Schenkelberg, of the UNO School of Health and Kinesiology, were both new members of the TRPP in 2020. They partnered to design and deploy a survey to gauge perceptions, readiness, and capacity for implementing

schoolwide physical activity surveillance. While they were unable to deploy the survey due to restrictions brought on by the current pandemic, they cooperatively worked to design survey questions that were informative but placed minimal burden on the respondents, and could be completed entirely online via Qualtrics. Clark and Schenkelberg then developed and implemented an engagement activity for middle school students. After wearing activity monitors over a given time period, students received individualized and classroom aggregate activity reports generated from the data, then participated in an additional activity and video lesson emphasizing physical activity. This research team hopes to expand these activities to allow students to download and analyze their own data in the future.

Shawn Graham (OPS), Sara Myers (UNO), and Hafizur Rahman (UNO)

Project Title: *Outreach and Earth Science mapping connections to Biomechanics*

Shawn Graham teaches high school physical science, chemistry, and physics with the OPS Accelerate program. In 2020, he partnered for the second consecutive year with UNO Biomechanics researchers, Dr. Sara Myers and Dr. Hafizur Rahman, on a study to develop an assistive device – i.e. exoskeleton footwear (EF) - to improve walking performance in patients with peripheral artery disease (PAD). The team used OpenSim software to develop a lower limb EF model, which will be used analyze gait dynamics in people walking with and without the exoskeleton footwear by leveraging previously collected gait kinematics and kinetics data. Moreover, the team sought to integrate aspects of the project to emphasize relevant Next Generation Science Standards (NGSS) in Mr. Graham’s science courses. As of December 2020, Mr. Graham had engaged 75 students in outreach activities referencing the exoskeleton footwear.



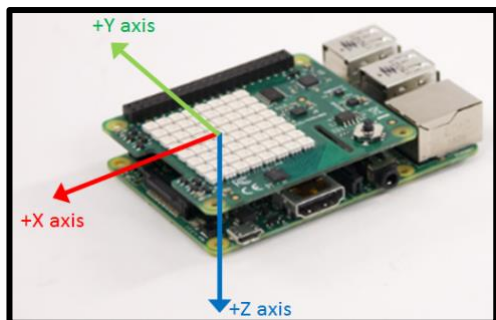
Terri Gulick (OPS) and Song-Young Park (UNO)

Project Title: *Impacts of Prolonged Sitting With Mild Hypercapnia on Cardiovascular Function in Healthy Adults*

Terri Gulick returned to the TRPP for the second time in 2020 after first participating in the inaugural cohort in 2015, this time in a new role at the UNMC High School Alliance/OPS Career Center. There she teaches a range of subjects at the high school level, including Pathology, Genetics/Biomedical Research, Biology and Prevention of Cancer. Fittingly, Terri partnered with first-time mentor Dr. Song-Young Park, from the School of Health and Kinesiology at UNO, on a project aimed at investigating the effects of prolonged sitting on heart health in healthy adults. They used a randomized crossover design and measured central and peripheral arterial stiffness, endothelial function, and microvascular function with respect to



hypercapnia (elevated CO²; a condition common in offices and classrooms where prolonged sitting often occurs). They found that prolonged sitting did not affect central and peripheral arterial stiffness, regardless of CO level, but did significantly impair endothelial and microvascular function – and hypercapnia worsened these effects. Gulick and Park intend to translate their work to the K-12 environment via a student-led journal club and experimental design in the short term, with long-term goals of supporting student-designed clinical research projects. Additionally, Ms. Gulick’s students will visit Dr. Park’s lab and/or engage in projects with UNMC researchers in the UNMC College of Allied Health.



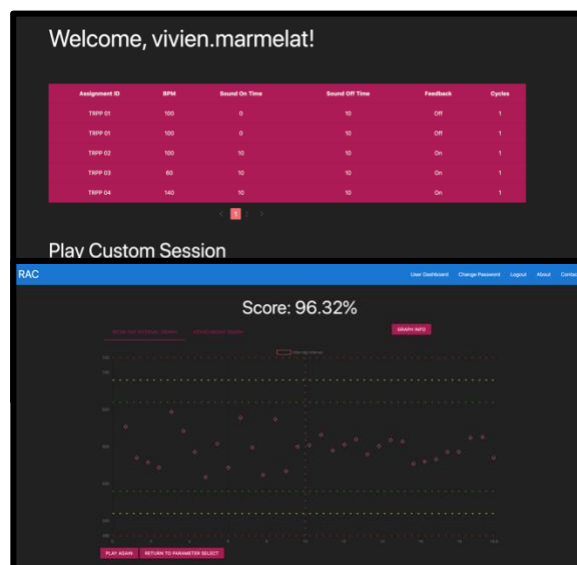
Randall Henderson (OPS) and Derrick Nero (UNO)
Project Title: *High-Altitude Balloon: A Study in Low Cost Solutions for Flight Computers and Sensors in Near Space Experiments*

Randall Henderson from Omaha North High Magnet School and Dr. Derrick Nero from the UNO Teacher Education Department completed a high-altitude ballooning (HAB) project. This was a first-year partnership. Their project is part of the larger Near Space

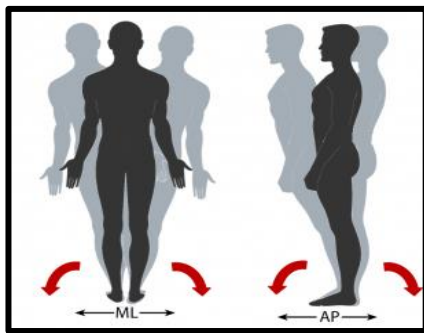
Testing & Experiments Using High Altitude Ballooning Instrumentation Technologies (NSTE HABIT) project, which provides K-12 science teachers a venue to address Nebraska College and Career Readiness – Science (CCR-Science) Standards for topics that require either Engineering Design and/or Engineering, Technology, and Applications of Science Connections. Dr. Nero and Mr. Henderson developed innovative HAB near-space experiments (NSEs) utilizing commercially available microcomputers (i.e., Raspberry Pi) and sensor platforms (i.e., PocketLab Voyager and Air) for data analysis during HAB flights. The figure here shows a Raspberry Pi board with sensors that collect data such as altitude and temperature. An evaluation of these materials, equipment (i.e., hardware and software) and data transfer during HAB flights was completed. The program also aligned directly with many of the OPS Science efforts in the district related to expanding high-altitude experiments for OPS students, under the direction of curriculum supervisor, Dr. Schaben.

John Huber (OPS) and Vivien Marmelat (UNO)
Project Title: *Timekeeper: a web-application to improve motor timing and rhythm*

In his first year with the TRPP, John Huber, a middle school science teacher at McMillan Magnet Center, partnered with 2-year veteran mentor Dr. Vivien Marmelat, of UNO Biomechanics, to test the usability of a new web application designed (by undergraduate students in spring 2020) to improve motor timing and rhythm. The long-term goal of their project is to improve non-pharmacological interventions to improve motor and cognitive function in patients with Parkinson’s Disease (PD). The researchers deployed a synchronization-continuation task (i.e. finger tapping to a



metronome and then maintaining the rhythm after the metronome stops) via the Timekeeper web app to summer 2020 TRPP participants and an additional participant with PD. Their results suggested that the web app was effective at capturing participant's responses to the task and that participants' performance improved with practice. The data also demonstrated a typical result that has been described in the sensorimotor neuroscience literature, wherein the only musician in the group performed with more precise and consistent timing compared to the rest of the group. Though this was their first formal TRPP partnership, Dr. Marmelat and Mr. Huber have been collaborating since 2018 (an indirect result of a past TRPP partnership between Dr. Marmelat and OPS Science Coach Mr. Justin Andersson), and past efforts have resulted in students conducting experiments to compare rhythmic accuracy using previously available software and presenting their projects at the Metro Science and Engineering Fair. The team plans to continue their collaboration when conditions allow by bringing students to the Biomechanics Research Lab at UNO to conduct experiments, and/or by meeting remotely to discuss student questions and provide feedback.

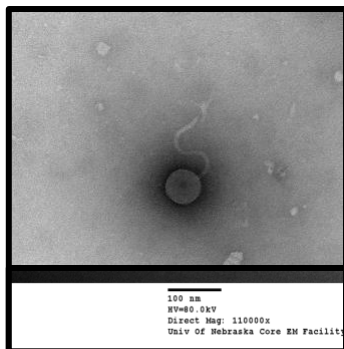


Robyn Jernigan (OPS) and Adam Rosen (UNO)

Project Title: *Does physical activity correlate to ankle instability in CAI (Chronic Ankle Instability) patients?*

After a successful first partnership for both researchers in 2019, Robyn Jernigan and Dr. Adam Rosen returned to build on their efforts in 2020. Ms. Jernigan teaches within the Health Professionals Academy at Benson High School, and Dr. Rosen is an Associate Professor in the School of Health and Kinesiology. They aimed to determine activities that contribute to episodes of chronic ankle instability (CAI) by

supplying participants with wearable fitness devices to track activity, and deploying questionnaires following episodes of instability. Data were collected from a small group (n=4) of participants to compare data between participants with and without a history of CAI. Though no CAI episodes occurred during data collection, the pilot data confirmed that the methodology would be scalable to a larger group of participants over an extended period. Long-term, Robyn intends to translate her work by developing a student driven in-class research project wherein students will design experiments, collect & analyze data, and present their results in a poster. Thus far, Dr. Rosen has presented guest lectures in Ms. Jernigan's classrooms and will welcome her students to visit his lab on campus when conditions allow.



Shannon Johnson (OPS) William Tapprich (UNO)

Project Title: *Characterizing Novel Bacterial Viruses*

Shannon Johnson from Omaha South High School and William Tapprich from the UNO Biology Department – in addition to six of Ms. Johnson's students - worked on a viral discovery project. With the assistance of Connor Eastman, an undergraduate research student in Dr. Tapprich's laboratory, Ms. Johnson and her students characterized the genomes of bacterial viruses (bacteriophages) isolated from local bodies of water. While the original plans had students collecting water samples and isolating their own

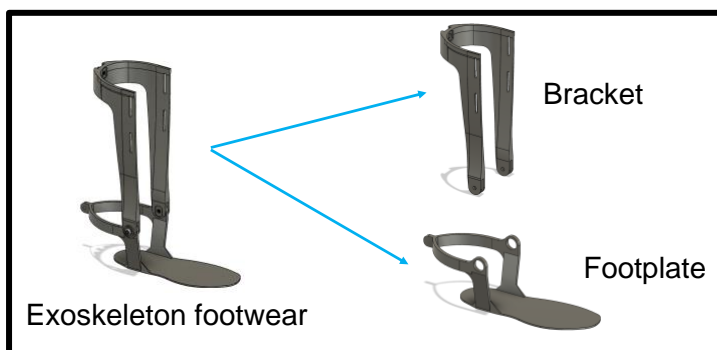
bacteriophages, the project was changed to focus on viruses that were previously isolated in Dr.

Tapprich's laboratory. The figure at right shows one of the viruses studied during the TRPP project. The viruses were characterized using bioinformatics analysis of results from next generation sequencing (NGS) of viral genomes. The analysis began by assembling NGS fragment sequencing data to produce the sequence of the entire genome. This sequence was then used to produce a fully annotated map of the genes that are expressed during viral infection. The genome sequence was also used to learn the evolutionary relationships between the newly isolated viruses and other viral isolates.

Alexis Madsen (OPS), Sara Myers (UNO), and Hafizur Rahman (UNO)

Project Title: *Chemical Composition of Exoskeleton Footwear*

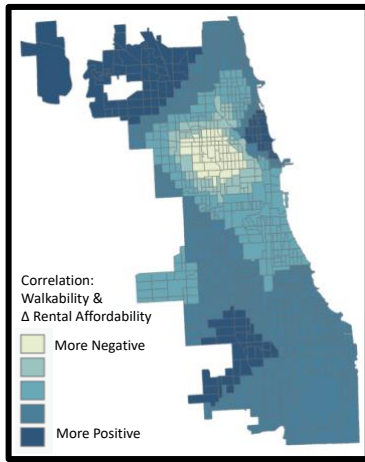
Alexis Madsen teaches Physical Science, Chemistry, and Physics at Central High School. This year, she joined veteran TRPP co-mentors Dr. Myers and Dr. Rahman, of UNO Biomechanics, and veteran TRPP teacher Shawn Graham, to contribute to their overarching goal of optimizing 3D printed exoskeleton footwear (i.e. assistive devices) to improve walking performance in patients with peripheral artery disease (PAD). Madsen's project focused on identifying the right 3D printing materials to build the device. The ideal material would balance weight, cost, and user compliance with strength and effectiveness. They printed pieces of the Exoskeleton footwear using different materials, and tested the strength of each footplate during treadmill walking.



Tests showed that a footplate printed in an inclined orientation with Polylactic Acid (PLA) material outperformed footplates made from a PLA/Polyethylene Terephthalate Glycol (PETG)/Polycarbonate (PC) alone when printed either in horizontal or vertical directions (bottom image), as footplates broke upon testing. The team plans to continue evaluating the PLA model with additional assembly components and testing in healthy adults. Following the summer research period, Alexis's International Baccalaureate (IB) Chemistry students performed an inquiry-based task involving chemical analysis of compounds used for 3D printing.

Megan Munro (OPS) and Bradley Bereitschaft (UNO)

Project Title: *Walkable but un-rentable? Neighborhood walkability and rental housing stress in the 2010s*



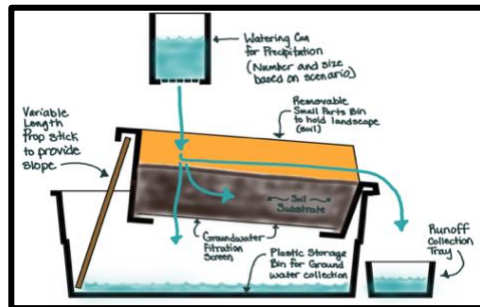
Megan Munro, a Science teacher at Blackburn Alternative High School, joined the TRPP in 2020. She partnered with 2nd-time faculty mentor Bradley Bereitschaft from the UNO Geography/Geology Department, on a project focused on neighborhood walkability and affordability following the Great Recession. They used walkability data from a free online Walk Score metric and U.S. Census Bureau American Community Survey (ACS) data to compare walkability and rental housing affordability and their variation among cities of different sizes. Their analysis included a case study from Chicago. After controlling for other confounding variables, Munro and Bereitschaft found that as neighborhood walkability increased, so did rental housing unaffordability for households earning the

median income in a given metropolitan area. Beyond the research project, Munro and Bereitschaft developed a lesson plan to inform students about geography as a career path, and plan to engage students in a project to assess neighborhood walkability and livability, and use Google Earth to explore urban design.

Elizabeth Seckman (OPS) and Zachary Suriano (UNO)

Project Title: *Rain-on-snow (ROS) melt events in Nebraska: Forensic Hydrology Applications*

Elizabeth Seckman and Zachary Suriano, of Omaha Burke High School and the UNO Geography/Geology Department, respectively, were a 2nd-year returning research pair in 2020. Their research aimed to quantify the spatial and temporal frequency of rain-on-snow (ROS) melt events across the state of Nebraska. They found that statewide ROS events were relatively infrequent, peaked twice annually (with a larger peak in fall and secondary peak in spring), and have decreased in frequency over time. To translate their work to the K-12 environment, Seckman and Suriano developed learning experiences and water models that will enable student teams (about 80-90 students) to develop and conduct experiments to investigate how water interacts with the environment. Dr. Suriano assisted with acquisition (and future install) of new weather monitoring instrumentation at Burke High School, which students will use to periodically collect measurements on snowfall, snow depth, and snow density upon return to in-person learning. In addition, the researchers plan to demonstrate how students can collect snowfall data independently using common household items. Seckman and Suriano have co-authored two papers, and their research has contributed to two grant proposals.



Lee Ann Stover (OPS) and Kelly Deuerling (UNO)

Project Title: *Characterizing the groundwater system at Glacier Creek Preserve: the effect of land use on groundwater quality and transport*

Lee Stover teaches high school Environmental Science and Biology at Burke High School. She began her fifth year of the TRPP by partnering with a new mentor, Dr. Kelly Deuerling of the UNO Department of Geography/Geology. Lee previously completed four years with Dr. Deuerling's post-doc advisor, Dr. Ashlee Dere. Thus, despite this being the first time Lee and Kelly had formally partnered, they built on Lee's previous four years in the program by characterizing the groundwater system at UNO's Glacier Creek Preserve in relation to land use. While much of their data is still being analyzed, they have detected differences in groundwater characteristics among land use types, including higher saturated hydraulic conductivity in prairie vs. agricultural land uses, and differing silica values among water reservoirs. Despite challenges of the pandemic and relocation, Ms. Stover and Dr. Deuerling remain in contact and committed to translating their work to the K-12 environment. TRPP funds have provided equipment that will enable Lee's students to design and conduct experiments at Burke High School to test their own hypotheses by performing water filtration/quality analyses. The pair is developing lesson plans, complete with guest lectures by Dr. Deuerling, to guide these activities in spring 2021.