



## **2020 Participating Bloomberg Distinguished Professors**



*Participating faculty are listed alphabetically by last name:*

**Rexford Ahima:** Endocrinology, Diabetes, & Metabolism, SOM; Epidemiology, BSPH; Community-Public Health, SON

**Project:** Impact of Lmo4 knockout in brain on time-restricted feeding and energy metabolism. Knockout of Lmo4 in brain correlates with gain in body weight. We are studying the effects of restricting access to food during certain time of the day to determine the kinetics of weight gain and energy metabolism. Undergraduates will work on mouse breeding, coordinating food access to animals, measuring body composition, gene expression analysis and isolation of tissues.

**Preferred (or required) skills and/ or experience:** Basic knowledge in biology, chemistry, math and physics.

**Positions available:** 1

**Work location:** Bayview Medical Center, Asthma and Allergy Center, 5501 Hopkins Bayview Cir, Rm 2A62

**Chuck Bennett:** Physics and Astronomy, KSAS; JHU Applied Physics Lab (APL)

**Project:** The research project relates to the Cosmological Large Angular Scale Surveyor (CLASS) telescope array that Johns Hopkins University operates high in the Andes Mountains of northern Chile. The research group builds new instrumentation, improves existing instrumentation, operates the telescope system to survey the sky, and analyzes data from the survey. The overall two major goals of the research are: (1) to determine, via measurement, the detailed process that led to the first stars forming; and (2) to determine, via measurement, the nature of the first fraction of a second of the creation of the universe. To achieve these goals, CLASS conducts a survey of the polarized cosmic microwave background radiation (the remnant glow from billions of years ago) over most of the sky.

Undergraduates assist experienced graduate students and postdocs in carrying out CLASS instrument development and survey data analysis, as described above. Specific problems will be assigned for the students to solve. This will often require writing software to analyze laboratory test data or portions of the survey data. Sometimes the undergraduate assists in carrying out laboratory instrument development functions.

**Preferred (or required) skills and/ or experience:** Prior knowledge of a programming language, such as python, is desired but not required.

**Positions available:** 2

**Work location:** Homewood campus, Bloomberg Center for Physics & Astronomy, 2<sup>nd</sup> floor

**Christopher Cannon:** English and Classics, KSAS

**Project:** My current project is on the history of meter and grammar and focuses on the work of Geoffrey Chaucer. I have two databases that I'm trying to coordinate, one containing all of Chaucer's vocabulary tagged grammatically, another containing all of Chaucer's poems scanned for meter. I also have a new edition of Chaucer's poems that regularizes Chaucer's meter in new ways. The hypothesis of the project is that Chaucer's meter acts like a recording of his voice, showing us which sounds were pronounced and which weren't. Putting the scanned text next to the grammatically tagged text often tells us new things about grammar: we can learn, for example, that sounds represented by letters were never pronounced but that other sounds were made that aren't fully represented orthographically. The goal of the project is to see if our understanding of grammar in Chaucer's period (the fourteenth century) is right and preliminary investigations suggest that it is not. Understanding how Chaucer's poetry sounded will change how we understand his grammar to have worked.

The new edition of Chaucer emends (or changes) manuscript readings to regularize meter. This means that this text differs from the text of Chaucer in both databases (which were compiled from old editions of Chaucer). The database must be adapted to the new edition. Undergraduate responsibilities would include comparing the new edition to the database to correct the latter. Once this task is completed the accuracy of the scanning needs to be checked as well. A graduate research assistant has begun this process and it is somewhat technical so will require a little training. But it is rule-bound to a great extent and so would not be particularly difficult training.

**Preferred (or required) skills and/ or experience:** Experience with Middle English would be a boon but is not necessary. Similarly some experience reading and scanning English poetry (or scanning poetry in any language) would also be a boon but is not necessary.

**Positions available:** 2

**Work location:** My office is in Gilman Hall but work could be done at any study location in Homewood or even at home. Access to a computer with a Wi-Fi connection will be necessary.

**Arturo Casadevall:** Molecular Microbiology & Immunology, BSPH; Infectious Diseases, SOM

**Project:** While there are many areas of research exploring fungal pathogens in the laboratory there are two that will be the focus of summer research projects.

1. The form and function of catalytic antibodies. While most catalysis is thought to be carried out by enzymes, our lab and others have shown that antibodies can also carry out catalysis of the antigens that they bind.

(Bowen 2016) We are working to characterize this catalysis and the kinetics against different types of targets (i.e. peptides, polysaccharides, nucleic acids). Current open projects include screening of antibodies for catalytic activity, and determining the pH at which catalysis is most efficient.

2. The *C. neoformans* polysaccharide capsule. The capsule is an essential virulence factor for *Cryptococcal* species yet we understand very little about its assembly and structure. Current work focuses on basic properties of the capsule to characterize this important virulence factor.

i. The structure of the capsule. The capsule of *C. neoformans* is required to cause disease and is a frequent target for diagnostics and vaccine therapies. We apply multiple biochemical and biophysical techniques (i.e., NMR, DLS, Mass Spec.) to understand capsule morphology, both at the micro and macromolecular level. (Casadevall, 2018)

ii. Capsule assembly. Recent experiments have revealed new tools for examining the capsule. In these experiments we will utilize chemical biology tools (a reducing end probe, a monosaccharide mimetic, divalent cation chelation) along with vesicle isolation to elucidate how the capsule itself is put together.

iii. Capsular polysaccharide characteristics. The secondary and tertiary structure of polysaccharides is important for antibody binding and can depend on a number of factors. For *C. neoformans* the hydration state and O-acetylation pattern are critical for secondary structure. This project uses new tools to characterize hydration state and O-acetylation pattern.

iv. Polysaccharide vaccine development targeting *C. neoformans*. Utilizing our current understanding of the capsular polysaccharide (PS) structure we have identified two *C. neoformans* PS, one native and one synthetic. This project will further characterize the hybridoma lines that have been produced from mice immunized with these vaccines including purifying the monoclonal antibodies for further study.

Participating undergraduates will work with Dr. Maggie Wear to develop an independent project on the capsule of *Cryptococcus*. Work will also include some lab housekeeping tasks like filling tip boxes and autoclaving media. Experiments include ELISA, HPLC, Mass Spectrometry, NMR, plate assays, and tissue culture.

**Preferred (or required) skills and/ or experience:** While no skills or experience are required, a familiarity with microbiology and biochemistry will be very helpful.

**Positions available:** 2

**Work location:** East Baltimore campus, Bloomberg School of Public Health

**Nilanjan Chatterjee:** Biostatistics, BSPH; Oncology, SOM

**Project:** Our group develops and applies methods for analysis of very large-scale genome-wide association studies to inform disease etiology/ biology, causality and genetic risk prediction. The studies involve discovery of new loci, understanding biology through integration of various molecular phenotypes and integration of information with epidemiologic risk-factors for the development of models for risk-stratification with the ultimate goal of developing strategies for precision medicine for disease prevention. Participants will learn and implement new tools into the current analysis pipeline, conduct simulation studies and data analysis and prepare presentations and posters on their project.

**Preferred (or required) skills and/ or experience:** Strong background in computing is needed. Some background in genetics and statistical inference will be desirable.

**Positions available:** 3

**Work location:** East Baltimore campus, Bloomberg School of Public Health E3612

**Christopher Chute:** General Internal Medicine, SOM; Community-Public Health, SON; Health Policy & Management, BSPH

**Project:** TBA

**Preferred (or required) skills and/ or experience:** Familiarity with Python is required. Experience with R statistical package, clinical classifications, or FHIR would be desirable, but can be learned in the role.

**Positions available:** 2

**Work location:** East Baltimore campus, 2024 E. Monument Street, Suite 1-200

**Lisa Cooper:** General Internal Medicine, SOM; Health, Behavior & Society, BSPH; Community-Public Health, SON

**Project:** Under the direction of the Principal Investigators and Research Program Managers, the student will assist in the coordination of activities that support the overall work of and a specific research study at the Johns Hopkins Center for Health Equity. The Center works to promote equity in health for at-risk populations through advancing scientific knowledge,

promoting sustainable changes in practice and policy, partnering with communities, raising public awareness of health inequities, and training scholars. The research study is a pragmatic cluster randomized trial in which we will compare the effectiveness of clinic-based standard of care plus audit, feedback and education to an intervention that uses a collaborative care team, a community health worker and specialist consultation to deliver contextualized, appropriately stepped care (CC/Stepped Care) for reducing disparities and improving patient-centered outcomes among patients with hypertension. Thirty primary care clinics, including Federally Qualified Health Centers, across Maryland will recruit patients.

Undergraduate researchers will assist with manuscript preparation and maintenance of reference library; work with study staff on data entry, data analysis, and general summaries of research findings; participate in research team meetings; assist with preparation of study materials (e.g. flyers) and PowerPoint presentations; perform literature reviews; assist in the coordination and participates in study meetings, including the preparation of agendas and taking of detailed meeting minutes; and assist with community engagement activities, including engagement with Community Advisory Board Meetings.

**Preferred (or required) skills and/ or experience:** none

**Positions available:** 2

**Work location:** Bayview and East Baltimore campuses

**Jessica Fanzo:** Global Food & Agricultural Policy and Ethics, SAIS; Berman Institute of Bioethics; International Health, BSPH

**Project: Rural Landscapes, Rural People, Rural Reinvigoration**

Rural populations experience significant health disparities as compared to urban populations. Health disparities are differences in health status when compared to the population overall, often characterized by indicators such as higher incidence of disease and/or disability, higher rates of undernutrition or overweight and obesity, increased mortality rates, lower life expectancies, and higher rates of pain and suffering. Rural risk factors for health disparities include geographic isolation, lower socioeconomic status, higher rates of health risk behaviors, limited access to healthcare specialists and subspecialists, and limited job opportunities.

One of the great debates in international development is how to help the rural places and people – how to we invigorate rural development. In the United States, it is about how to help forgotten towns, the former coalmining and manufacturing hubs with quaint Main Streets that haven't changed much for half a century. However, most of the world's focus and investment is on urban places also known as the "urban bias."

Considering the current state of rural places, it is important to understand the modern challenges that rural places and people face – declining extractive industries, rural brain drain of youth, addiction, poverty, food insecurity and unhealthy, unaffordable diets, and climate change.

We will undertake research to shed light on how rural development can be improved through greater socio-economic equity and human capital using a food systems lens. This research will focus on in-depth ethnography and empirical research on the (de)investment of rural people and places across the United States, and across a few key countries in rural sub-Saharan Africa. The entry point will be through agriculture and food systems because most rural people are tied to their lands and are rooted in agrarian societies, and most rural places are still growing much of the world's food. However, there will be a greater focus on the undermining of capabilities and empowerment of rural peoples and the declining natural, social, and political support systems.

Undergraduate students will perform literature reviews on rural health, rural nutrition in the US and sub-Saharan Africa; pull together key documents on rural development; assist in research design and research plan for 4 country study work; and travel to 1 or 2 rural places.

**Preferred (or required) skills and/ or experience:**

- Some experience doing literature searches and establishing a compendium and bibliography.
- Have some basic understanding of agriculture, food and diets.

**Positions available:** 2

**Work location:** SAIS, 1717 Mass Ave NW, Room 730, Washington, DC 20036

**Andrew Feinberg:** Oncology, Molecular Biology & Genetics, Psychiatry & Behavioral Sciences, SOM; Mental Health, Biostatistics, BSPH; Biomedical Engineering, WSE

**Project:** The lab is investigating the role of gene-environmental interaction in normal development and disease. Our research and publications are described in detail at: <http://feinberglab.jhu.edu>. Current student projects address the epigenetics of aging, computational analysis of DNA methylation in leukemia, epigenetic entropy and phenotype in the collaborative cross mouse, and epigenetics of neuropsychiatric disease. A summer project would involve computational and

some laboratory analysis of epigenomic data, in collaboration with a grad student or postdoc. Tasks may include coding in R, UNIX-based computational analysis of epigenomic data, hypothesis generation, and experimental testing using ordinary molecular biology tools at bench.

**Preferred (or required) skills and/ or experience:** Laboratory experience in molecular biology is required, preferably from prior research. UNIX-based computing and facility in R programming is required. The student must commit to attendance in the lab and at laboratory meetings.

**Positions available: 2**

**Work location:** Homewood campus, Clark 101 and/ or East Baltimore, Rangos 5.

**Paul Ferraro:** Carey Business School; Environmental Health & Engineering, WSE and BSPH

**Project:** There are three projects in which undergraduate students can participate:

(1) A field experiment aiming to induce behavioral change in third-party inspectors who are supposed to certify residential rental properties in MD as safe from lead hazards;

(2) A field experiment aiming to induce behavioral change in polluting facilities that discharge into rivers and other water bodies in the mid-Atlantic; and

(3) A field experiment that explores how best to measure an individual's "patience" and how that patience affects the individual's behaviors and outcomes.

In project (1), the student will be tasked with data collection, processing and analysis using MD Dept. of Environment databases. Some literature review activity and writing may also be necessary. In project (2), the student will be tasked with data collection, processing and analysis using US EPA and state environmental agency databases. Some literature review and writing activity may also be necessary. In project (3), the student will be tasked with literature review and writing activity.

**Preferred (or required) skills and/ or experience:** Some familiarity with R or Stata desirable, but not required.

**Positions available: 4**

**Work location:** Homewood campus, Ames Hall (lab meetings only), otherwise remotely.

**Rachel Green:** Molecular Biology & Genetics, SOM; Biology, KSAS

**Project:** There are a number of ongoing translation-related studies in the lab, interest in this fundamental process in biology is important. Undergraduate researchers will work a consistent schedule under supervision of a grad student or post-doc in the lab. Students will be required to keep an accurate notebook of all research and data, follow protocols closely, ask questions (don't guess), comply with Institute policies and follow safety procedures.

**Preferred (or required) skills and/ or experience:** Introductory lab course (pipetting etc.) is beneficial, but will be covered.

**Positions available: 2**

**Work location:** East Baltimore campus, PCTB 714, 725 N. Wolfe St

**Taekjip Ha:** Biophysics & Biophysical Chemistry, SOM; Biophysics and Physics & Astronomy, KSAS; Biomedical Engineering, WSE

**Project:** During the research internship period, the student will learn basic concepts and laboratory skills in single molecule biophysics. The Ha laboratory develops and applies advanced single molecule fluorescence and mechanical measurement technologies. Scientific topics include chromatin biophysics, nucleic acid remodeling and cellular mechanics. Technologies include single molecule imaging, FRET, single molecule pull-down, fluorescence-force spectroscopy using hybrid instruments combining single molecule fluorescence and optical tweezers, tension gauge tether technology and super-resolution imaging. The student will participate in the weekly group meetings and all four subgroup meetings for the first week, and will write one page synopsis of a main project of every group member. The student will then identify a project to participate in and spend the remaining weeks to assist a group member in acquiring and analyzing the data. At the end of the training, the student will write a ten page term paper on the research performed and will give a group meeting presentation.

**Preferred (or required) skills and/ or experience:** none

**Positions available: 2**

**Work location:** Homewood campus, Mergenthaler Hall or East Baltimore campus, Wood Basic Science Bldg.

**Richard Haganir:** Neuroscience, SOM; Psychological & Brain Sciences, KSAS

**Project:** TBA

**Preferred (or required) skills and/ or experience:** Previous experience in a laboratory. Preferred interest in neuroscience.

**Positions available: 2**

**Work location:** East Baltimore campus, Hunterian 1008, 725 N Wolfe St

**Patricia Janak:** Psychological & Brain Sciences, KSAS; Neuroscience, SOM

**Project:** Students will collaborate with graduate students or postdocs on their ongoing projects. We are a behavioral neuroscience lab. We investigate brain processes of reward using rats trained to respond to cues or to press levers to get food reward, or alcohol, or addictive drugs. To understand the brain processes involved, we use single unit electrophysiology, calcium imaging, pharmacology and optogenetics during the behavioral performance of the rats. Students will learn to conduct daily behavioral training for rats, and will assist graduate students/postdocs in applying one or more of the above approaches to understand the brain processes involved in the behavior. Students may be trained in surgical procedures and will learn to conduct brain histological procedures. These studies typically require consistent hours, Monday – Friday.

**Preferred (or required) skills and/ or experience:** No skills and experience are required, but classes in neuroscience are a big help.

**Positions available:** 2

**Work location:** Homewood campus, Dunning Hall, 2<sup>nd</sup> floor

**Matthew Kahn:** Economics, KSAS; Economics and Business, CBS

**Project: The New Urban Economics of Old City Revival,** This is a book manuscript for Hopkins Press. This book examines the economic circumstances and quality of life dynamics for nine U.S cities (including Baltimore) that over the last 4 decades have experienced a large drop in manufacturing jobs, declining population and thus a large share of poor residents with many of them being African-American. In these aging Northeast cities, the poor tend to live in isolated high poverty neighborhoods and this further contributes to the challenges that their children face. This dynamic hurts this group's quality of life but also poses challenges for other residents who face greater challenges of crime, weak schools and higher taxes to pay for services used by the urban poor. This book focuses on the economic forces at play that could lead to an economic revival in these cities. There will be basic statistical work and background research that needs to be done this summer.

**Preferred (or required) skills and/ or experience:** An interest in urban economics is beneficial; knowledge of statistical analysis is helpful.

**Positions available:** 2

**Work location:** virtual, communicating via Skype and email.

**Rong Li:** Cell Biology, SOM; Chemical & Biomolecular Engineering, WSE

**Project 1:** Our research goal is to characterize genes that when deleted in budding yeast lead to increased rates of chromosome missegregation in a process known as chromosome instability (CIN). Following a screen using a yeast quantitative chromosome transmission fidelity assay developed in our lab, we identified a potentially interesting novel hit and uncharacterized protein, SNO1, that when deleted increases the CIN rate up to 40-fold compared to the control sample. Upon further investigation, we found that the CIN-inducing effect of the SNO1 deletion may be related to perturbing the mRNA of a neighboring gene, CTF13, which is involved in kinetochore function. These two genes are arranged in a "tail-to-tail" (also referred to as a convergent) orientation in which genes may have overlapping 3' untranslated regions. As a result, the drug resistance marker used to delete the SNO1 gene in the yeast knock-out collection (YKOC) may result in cryptic short transcripts from the CTF13 gene being transcribed from the opposite DNA strand. Given that a large portion of budding yeast genes are arranged convergently and many labs study gene knockouts using the YKOC, we are interested in understanding if this phenomenon is observed at other convergently arranged gene pairs. This finding has the potential to shape the future of how we approach studying convergent gene pairs and would serve as an important resource for the yeast community to more accurately tease apart effects of individual gene deletions while avoiding any undesirable "neighbor gene effect". Finally, although the SNO1 protein may not have an uncharacterized role in maintaining chromosome segregation fidelity, this project can help us further understand the mRNA dynamics of CTF13, an essential kinetochore gene. Undergraduate tasks include: 1) Use computational biology to characterize a whole genome list of all the yeast genes arranged in a convergent orientation and measuring the distance between the stop codons of each gene. 2) Learn yeast genetic techniques and generate several yeast gene deletion strains based off of candidates from the list. 3) Isolate RNA to generate cDNA from deletion strains and control strains. 4) Design and validate quantitative polymerase chain reaction (qPCR) primer sets for all of genes chosen. 5) Characterize the mRNA abundance level of the partner gene using qPCR 6) Analyze qPCR data and transform into mRNA expression level plots. 7) Perform statistical analysis to determine if gene expression is statistically altered in any of the studied mutants.

**Preferred (or required) skills and/ or experience:** passion and enthusiasm for basic research and ability to ask further questions/demonstrate curiosity regarding our project. Molecular biology knowledge about basic techniques such as PCR is required, and some wet-bench skills are preferred (pipetting, making buffers, etc.). High level of organization is required

**Positions available:** 2

**Work location:** East Baltimore campus, Rangos Research Building 440

**Project 2:** The goal of this project is to make site-directed edits to mitochondrial DNA (mtDNA). Several inherited diseases result from mitochondrial mutations, and disorders of aging are correlated with increased somatic mtDNA mutations in the affected tissue. No methods to revert these mutations have been reported to date. Furthermore, the basic molecular

biology of mtDNA replication and gene expression are poorly understood, in part due to the technical challenge of making targeted mtDNA mutations. Current gene editing technologies require nucleic acid delivery to the genome. CRISPR/Cas-based systems depend on an RNA guide to direct site-specific cleavage and use DNA templates to introduce base substitutions and insertions. We propose to engineer genetically directed RNA delivery to mitochondria to facilitate mitochondrial genome editing. Our first approach will be to fuse a selectable marker gene to tRNA genes that are known to be imported into mitochondria. The marker gene uses the mitochondrial codon system, and thus can only be translated on mitoribosomes. We will express this tandem fusion as an mRNA in the budding yeast *Saccharomyces cerevisiae* and assess RNA delivery to mitochondria by selecting for marker gene expression. Our second approach will be to exploit the intrinsic reverse transcriptase and recombinase activities of yeast mitochondria and induce RNA-mediated gene conversion catalyzed by a synthetic mRNA expressed from the nucleus. We will test a variety of mitochondrial membrane disruption protocols to deliver the cytosolic mRNA to the mitochondrial matrix. Lastly, we will test the mtDNA efficiency of “prime editing”, a recently reported technique that uses a small RNA to specify base substitutions and does not require introduction of a DNA template. The student will be responsible for constructing the proposed systems and assaying their success in transforming mitochondrial DNA. The student will also search the literature for alternative techniques that may be more effective and compile a list of the most useful applications of these methods in basic and industrial research.

**Preferred (or required) skills and/ or experience:** Competitive candidates will be highly motivated to develop synthetic biology techniques, skilled in conducting collaborative projects and documenting research, and have a sound understanding of molecular and cell biology. Experience with wet lab research, especially molecular cloning, will be useful.

**Positions available:** 2

**Work location:** East Baltimore campus, Rangos Research Building 440

**Ellen MacKenzie:** Health Policy & Management and Biostatistics, BSPH; Orthopaedic Surgery & Physical Medicine & Rehabilitation, SOM; Dean, Bloomberg School of Public Health

**Project:** Major Extremity Trauma and Rehabilitation Consortium (METRC), a national network of trauma centers that collaborate on studies designed to improve treatment and outcomes for both service members and civilians who sustain major Orthopaedic trauma ([www.metrc.org](http://www.metrc.org)). Johns Hopkins serves as the data coordinating center for the Consortium, and coordinates over 20 studies in collaboration with our clinical partners throughout the country. METRC studies are designed to produce evidence for establishing best treatment practices for patients who have experienced severe Orthopaedic trauma, and cover topics related to acute management, preventing infection, managing pain, addressing psychosocial consequences of trauma, and rehabilitation practices to optimize outcomes. The Consortium is also focused on developing methods and best practices for conducting clinical trials in this population.

Most METRC projects are mid-way through completion. The undergraduate(s) working with this team would have the opportunity to learn about clinical trial management from the perspective of a data coordinating center. Students would be paired with specific study teams and would engage in activities such as 1) reviewing data collected for accuracy and completion; 2) communicating with centers around data quality; 3) performing literature reviews and summarizing results; 4) updates study administrative databases with grants and contracts information; 5) potentially assisting with drafting memos, procedures, or manuscripts; and 6) potentially shadowing research coordinators to learn about consent and follow-up procedures.

**Preferred (or required) skills and/ or experience:** Proficient office computing skills - Word and Excel are required, Access would be preferred. Strong written and verbal communication skills. Experience with synthesizing evidence from medical journals preferred.

**Positions available:** 2

**Work location:** East Baltimore campus, Public Health Bldg., 415 N Washington St

**Kathryn McDonald:** SoN; Armstrong Institute for Patient Safety & Quality, Internal Medicine, SoM; BSPH; CBS; WSE

**Project:** Patient safety and health care quality research focusing on understanding patient experiences in getting a diagnosis. One project involves interviewing patients and family members about how age, sex and race/ethnicity may have contributed to a problem in diagnosis. The other project aims to assess ways to measure patient experiences and outcomes related to their diagnostic journeys. Undergraduates will complete literature reviews, stakeholder/expert engagement, patient/family interviews, data analysis, writing briefs, creating visuals, and other research tasks depending on needs of the projects, student interests and specific skills

**Preferred (or required) skills and/ or experience:** none required, but interested in students who want to engage deeply in the topic

**Positions available:** 2

**Work location:** East Baltimore Campus, School of Nursing and possibly Medicine, TBD.

**Steven Salzberg:** Biomedical Engineering and Medicine, SOM; Computer Science, WSE; Biostatistics, BSPH

**Project:** Interns in the Salzberg lab work on computational analysis of genomes. We have a variety of projects that include genome assembly, gene expression analysis from RNA sequencing, and metagenomics (or microbiome) analysis. We work on genomes ranging from viruses and bacteria to plants and animals, including the human genome. For more on our projects, see the lab page at <http://salzberg-lab.org>. Undergraduate interns will work under the direct supervision of a graduate student or senior lab member, developing programs (usually in Python, Perl, or R, but sometimes in C/C++) to analyze genomic data sets. Projects vary from year to year, but if you are interested we will tell you more specifics when you interview.

**Preferred (or required) skills and/ or experience:** Knowledge of either Python, Perl, or C/C++ (any one of the three) is required. We strongly prefer students who are familiar with the UNIX operating system as well, because nearly all of our software development is currently done under UNIX.

**Positions available: 2**

**Work location:** Homewood, Wyman Park Bldg.

**Michael Schatz:** Computer Science, WSE; Biology, KSAS; Sidney Kimmel Comprehensive Cancer Center, SoM

**Project:** My lab's main research interest is in understanding the structure and function of genomes, especially those of medical or agricultural importance. The core strength of our research is in developing novel algorithms and computational systems for large-scale biological sequence analysis, including leading algorithms for de novo genome assembly, variant detection, and related -omics assays. Using these advances we have contributed to the de novo genome assemblies of dozens of species; probed the sequence variations in autism, cancer, and other human diseases; and mapped the transcriptional and epigenetic profiles of tomatoes, corn, and other important plant species. Please see my lab website for current research (<http://schatz-lab.org>).

Undergraduate researchers will develop novel computational methods and/or perform novel data analysis of genomics data. You will work closely with Dr. Schatz and other lab member to define the specific project based on your research interests and experience. Possible projects include analysis of DNA, RNA and other genomics data from healthy & diseased human samples, agricultural samples and/or environmental samples. Many of the project will involve working with new Oxford Nanopore long read sequencing systems and other advanced genomics technologies. Analysis methods will focus on the algorithms, data structures, and machine learning approaches for large-scale comparisons of biological sequence data.

**Preferred (or required) skills and/ or experience:**

- Required: Completed Data Structures course (600.226) or equivalent
- Desired: UNIX scripting and/or python programming
- Experience with biological sequence data is preferred but not required

**Positions available: 2**

**Work location:** Homewood, Malone, 2<sup>nd</sup> floor

**Jeremy Shiffman:** International Health, BSPH; School of Advanced International Studies (SAIS)

**Project:** What exactly is a 'non-communicable disease' (NCD)? What does the term 'neglected tropical disease' (NTD) refer to? How did the field of global health manage to create such an unwieldy concept as 'RMNCAH-N' (reproductive, maternal, newborn, child and adolescent health and nutrition), when the original concept was much simpler: maternal and child health (MCH)? Which problems get included in these now widely used categories? Which get excluded? Why? How do these decisions shape the levels of global attention and resources these issues receive? Delineating the boundaries of a global health problem--what might be termed the 'problem of problem definition'\*--is a highly contested social process, involving advocacy groups, scientific communities, foundations, NGOs, international organizations and other organizations. This research project will investigate the politics of problem definition with respect to NCDs and 'RMNCAH-N' with a view to generating one research paper on each concerning how such politics have affected the rise of global attention to these issues.

\*See: Rochefort, David A., and Roger W. Cobb. "Problem definition, agenda access, and policy choice." *Policy Studies Journal* 21.1 (1993): 56-71.

Under the careful guidance of the research team, the undergraduates will be responsible for gathering and reviewing documents to put together reports on the rise of global attention to NCDs and 'RMNCAH-N', with particular attention to the politics of problem definition. One undergraduate will primarily be responsible for a report on NCDs and the other for a report on 'RMNCAH-N' but the two will collaborate on both. They will also collaborate with a third researcher presently embarking on a similar study pertaining to neglected tropical diseases. Documents will include but not be limited to published scholarly articles, grey literature, media reports, and reports from international organizations, funders and NGOs. The final reports will include a historical narrative, a timeline of major developments, and a list of potential key individuals to interview in each of these areas as identified in the key documents collected.

**Preferred (or required) skills and/ or experience:** Some research experience, especially collecting and/or analyzing qualitative data. Undergraduate coursework in political science, sociology, anthropology, communications, history of medicine, or other social sciences a plus but not required. Applicants should describe any relevant research experience in the application. Track record of conscientiousness and reliability in past work, both professional and academic.

**Positions available: 2**

**Work location:** Documents can be uploaded to Drop box, so there is no need to conduct this work in a particular place, although access to Johns Hopkins library and other libraries via web to gather documents will be crucial. I and others on the research team will exercise close supervision to ensure that the undergraduates learn and gain skills from the work, and perform the work carefully.

**David Sing:** Earth & Planetary Sciences and Physics and Astronomy, KSAS

**Project:** This project will involve the characterization of exoplanets using the transit technique. Both observation and theoretical modeling projects are available, working with data such as the Hubble Space. Overall goals include detecting atomic and molecular species in the atmospheres, and constraining the temperatures and abundances of the atmosphere. Preparatory projects as part of the Early Release Science Program for the upcoming James Webb Space Telescope are also available. The responsibilities will include tasks such as working with time series CCD data to extract exoplanet spectra, and/or using radiative transfer models to optimize spectral retrieval on planetary transmission or emission spectra.

**Preferred (or required) skills and/ or experience:** Prior experience or proficiency in a programming language is preferred but not required.

**Positions available: 2**

**Work location:** Homewood campus, Bloomberg Physics Building and Olin Hall

**Alex Szalay:** Physics and Astronomy, KSAS; Computer Science, WSE

**Project:**

- (A) Predict the behavior of the velocity effects in the general galaxy population as a function of redshift, and make predictions for observable differences between the nearby galaxy populations and those at a redshift of 2.5, to be observed by the Subaru PFS survey of which JHU is a partner. Interpret the results in terms of a halo model. Undergraduate will Develop Python code to characterize the relative motions of galaxy halos in various cosmological simulations, and repeat the experiments over several hundred realizations as well as two or three different redshifts.
- (B) Use machine learning techniques to classify galaxy properties based upon low signal to noise spectra, using various distance estimators to existing and model spectra of galaxies at high redshifts. Undergraduates will measure empirical correlations between low signal to noise spectra and various models and use this to improve signal to noise. The computations would involve Python coding and the use of various machine learning packages.

**Preferred (or required) skills and/ or experience:** Experience in Python, some background knowledge of astronomy and classical mechanics and some knowledge in statistics.

**Positions available: 2**

**Work location:** Homewood campus, Bloomberg Physics Building

**Michael Tsapatsis:** Chemical & Biomolecular Engineering, WSE; Research & Exploratory Development, APL

**Project 1:** Process Design and Mathematical Modeling: Develop a process-scale assessment (techno economic analysis) of novel energy-efficient membrane separation processes. The student will formulate equation-based mathematical models of the new technologies to compare with the current industrial practice like distillation. Students will formulate mathematical models of membrane performance and process. Solve the equation-based models using numerical methods and interpret the results. Prepare a written report and present the findings and recommendations for future work.

**Preferred (or required) skills and/ or experience:** Experience with Matlab and/ or ASPEN is required.

**Positions available: 1**

**Work location:** Homewood campus, Croft Hall

**Project 2:** Crystal Growth and Dissolution: This is an experimental project to study the stability of a class of porous materials (metal-organic-frameworks *MOF*) in various solvents including water. The student will perform *MOF* crystal growth and dissolution experiments using microscopy. Students will set up a flow device allowing observation of crystals as they grow or dissolve in a solution containing various solvents. Collect and analyze rate data. Prepare a written report and present findings and recommendations for future work.

**Preferred (or required) skills and/ or experience:** Experience with optical microscopy and inorganic synthesis is required.

**Positions available: 1**

**Work location:** Homewood campus. Croft Hall



**Vesla Weaver:** Political Science and Sociology, KSAS

**Project:** Our research team will continue ongoing research for a book project, *The State From Below*, based on the largest collection of narratives about the police collected to date. To see the project's scope, ambitions, and technology, go to [www.portalspolicingproject.com](http://www.portalspolicingproject.com). There are two central projects the BDP summer researchers will participate in. The first is a digital humanities project that involves curating searchable content for the website. Second, the researcher(s) will work on structural topic modeling of 450 hours of conversation using R and Python.

**Preferred (or required) skills and/ or experience:** Knowledge of text analysis, R Software and experience with quantitative analysis.

**Positions available:** 2

**Work location:** Homewood campus. Mergenthaler 272

**Ashani Weeraratna:** Biochemistry & Molecular Biology, SBSPH; Oncology, Sidney Kimmel Comprehensive Cancer Center, SoM

**Project:** The laboratory focuses on melanoma metastasis, Wnt signaling, and aging, and the effects of the tumor microenvironment on metastasis and therapy resistance. Our primary research focus is on melanoma and how changes in the tumor cell's microenvironment, which include changes in normal cells, blood vessels, and secreted molecules might initiate the disease's spread to other parts of the body and also make it resistant to treatment. We are specifically interested in how age-related changes drive the progression of cancer.

Learn new techniques, usually by shadowing senior students or post-doctoral fellows. Design a research project together with Dr. Weeraratna and the post-doc/ senior student that can be accomplished in the time frame available. Prepare a presentation on the project, and present it to the lab at the end of the summer.

**Preferred (or required) skills and/ or experience:** none.

**Positions available:** 2

**Work location:** East Baltimore campus, Public Health W3700

**Carl Wu:** Biology, KSAS; Molecular Biology & Genetics, SOM

**Project:** An intensive research project on single-molecule, live-cell imaging of chromatin factors designed for undergraduate students with interests in biochemistry, molecular, cellular and computational biology. Students use advanced fluorescence microscopy to visualize the single-molecule dynamic behaviors and spatial distributions of important nuclear proteins and chromatin factors in living cells of *Saccharomyces cerevisiae* as a model for epigenetic factors conserved in humans. Students will learn and apply imaging and computational tools to localize and track single protein molecules in real time and calculate their diffusive parameters. Students are expected to interpret and integrate data to acquire conceptual insights on chromatin functions, e.g. how chromatin proteins, enzymes, and very large protein complexes are organized in nuclear space and time. Students will also gain practical experience in yeast molecular genetics by engineering protein tags on designated nuclear and chromatin factors, and evaluating protein functionality under natural levels of expression. Potential for contribution of results for publication.

**Preferred (or required) skills and/ or experience:** Preference for students who have completed Advanced Cell and Molecular Biology Research Course on live-cell single molecule imaging, or courses in biochemistry, cell biology, biophysics, and genetics.

**Positions available:** 2

**Work location:** Homewood campus, UTL-382

**Alan Yuille:** Cognitive Science, KSAS; Computer Science, WSE

**Project:** Please refer to <https://ccvl.jhu.edu/projects/> for all possible projects and responsibilities

**Preferred (or required) skills and/ or experience:** Students MUST have taken at least one of the following courses: "Probabilistic Models of the Visual Cortex," Dr. Alan Yuille; "Machine Learning: Deep Learning," Dr. Gregory Hager; or "Computer Vision," Dr. Haider Ali. Students should be proficient with "Python, TensorFlow, PyTorch." Students should also have an interest in at least one of the six topics listed on the CCVL link listed above.

**Positions available:** 2

**Work location:** Homewood campus, Krieger 147