DEPARTMENT OF BIOLOGY
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2019-2020

All colloquia are in Wege Auditorium at 1:10pm on the dates below (except where noted).

Date TBD in early September - Norm Bell, Safety talk for all students working in labs. **This is mandatory!!**

September 13, 2019 - "Strategies for designing and delivering a scientific presentation" (by Matt Carter, Associate Professor of Biology)
It takes time, effort and skill to design and deliver an engaging scientific talk that audiences understand and remember. In this one-hour presentation, we will discuss three aspects of designing an outstanding scientific talk: (1) organizing complex scientific information into a clear narrative; (2) using PowerPoint or Keynote software to visually communicate scientific concepts; and (3) improving verbal and nonverbal delivery during a presentation. This seminar is open to anyone and is especially applicable to senior thesis students.

September 20, 2019 - Amy Rosenzweig (BIMO Class of 1960 Scholar), Northwestern University
"Biological methane oxidation"
Methanotrophic bacteria oxidize methane to methanol in the first step of their metabolic pathway. Whereas current catalysts that can selectively activate the 105 kcal mol^{-1}C-H bond in methane require high temperatures and pressures,methanotrophs perform this chemistry under ambient conditions using methane monooxygenase (MMO) enzymes. In most methanotrophs, this chemically challenging reaction is catalyzed by particulate methane monooxygenase (pMMO), a copper-dependent, integral membrane enzyme. pMMO is composed of three subunits, PmoA, PmoB, and PmoC, arranged in a trimeric complex. Despite extensive research and the availability of multiple crystal structures, the location and nature of the pMMO copper active site remain controversial. Studies are further complicated by issues with retaining enzymatic activity and uncertainties regarding the possible involvement of additional protein components. Progress towards addressing these questions using biochemical, biophysical, and genetic approaches will be discussed.

September 27, 2019 - Jason Andras, Mt. Holyoke
"Learning the steps of the host-parasite dance: Molecular genetic insights into the ecology &

evolution of an invertebrate-bacterial pathosystem"
Reciprocal selection between parasites and their hosts is thought to be one of the strongest, most dynamic, and most pervasive evolutionary forces - putatively responsible for such fundamental features of life as the existence of sex and the ubiquitous occurrence of genetic variation. Models of host-parasite coevolution are typically predicated, either explicitly or implicitly, on specific assumptions regarding the genetic architecture of parasite infectivity and host resistance, yet the genetic basis of interaction is not known for most host-parasite associations. In this talk I will discuss my research groups' contributions to recent advances in one of the host-parasite systems we understand the best: the waterflea *Daphnia magna*, and its obligate bacterial parasite *Pasteuria ramosa*. Specifically, I will discuss our use of population genomics and other tools to identify loci of host-parasite interaction, as well as our efforts to examine patterns of spatial and temporal variation at those loci in natural populations to test key predictions of coevolutionary theory.

October 4, 11, 18, 2019 - Thesis Talks two of these dates, depending on Mountain Day

October 25, 2019 - Sigma Xi Lecture featuring Professor Manuel Morales at 4:15pm

November 1, 2019 - Matt Walsh, University of Texas, Arlington
*"Why are organisms (and their offspring) phenotypically plastic in response to environmental change?***"**
It has long been known that changes in environmental conditions can induce phenotypic changes in organisms. Such 'phenotypic plasticity' has been documented across a wide array of taxa in response to numerous environmental stressors. Furthermore, it is now well established that environmental signals can induce phenotypic changes that span multiple generations. This 'transgenerational plasticity' is equally widespread. This seminar will highlight model predator-prey systems in lakes in Wisconsin and Connecticut and stream communities in Trinidad to address longstanding and contemporary questions regarding how and why plasticity (including transgenerational plasticity) evolves and the role that plasticity plays in the ability of organisms to adapt and persist in changing environments.

November 8, 2019 - Jennifer Raymond (BIOL Class of 1960 Scholar), Stanford University
"Neural Learning Rules in the Cerebellum"
The research in my lab investigates the algorithm the cerebellar circuit uses to learn. This algorithm is defined by the rules governing the local "decisions" each synapse makes on a moment-by-moment basis about whether to alter its strength, based on its pattern of input. I will describe recent progress we have made in understanding synaptic learning rules in the cerebellum. Neuroscientists have generally viewed learning as being implemented by a few, generic synaptic plasticity rules, with the specialization for specific behavioral tasks arising from the circuit architecture. In contrast, we recently discovered that the synaptic plasticity rules themselves can be precisely tuned to functional requirements.

November 15, 2019 - Lisa Leon, US Army Research Institute of Environmental Medicine
"Prior viral illness as a risk factor for heat stroke in mice"
This talk will provide experimental data that confirms recent epidemiological findings that prior illness is a significant risk factor for heat stroke. The experimental data demonstrate that even in the absence of overt clinical symptoms of illness, mice with previous viral illness experience more

severe heat stroke compared to naïve animals that never experienced a prior illness. Importantly, heat stroke severity was increased despite no effect on the thermoregulatory response to heat exposure, but was related to dysfunction of inflammatory and coagulation pathways. Presentation attendees will gain a better understanding of the impact of prior illness on heat stroke susceptibility and how physiological and immunological pathways can interact to mediate the systemic inflammatory response to these stressors.

February 7, 2020 - Scott Kanoski, University of Southern California
"Western diet consumption and memory impairment: what, when, and how?"
Habitual consumption of a "Western diet", containing higher than recommended levels of simple sugars and saturated fatty acids, is associated with cognitive impairments in humans and in various experimental animal models. Emerging findings reveal that the specific mnemonic processes that are disrupted by Western diet consumption are those that rely on the hippocampus, a brain region classically linked with memory control and more recently with the higher-order control of feeding behaviors. Our laboratory has recently established a rat model in which excessive consumption of sugar-sweetened beverages during the juvenile and adolescent periods of development (but not during adulthood) impairs hippocampal-dependent memory function without concomitant increases in total caloric intake, body weight, or adiposity. Thus, consuming individual components of a Western diet in excess (e.g., sugar) early in life has deleterious effects on memory function independent of obesity. Moreover, memory deficits due to early life sugar consumption are long-lasting into adulthood even when sugar access is removed at the end of the adolescent stage. Our ongoing work is investigating neurogenic changes and alterations in the gut microbiota as potential underlying neurobiological mechanisms linking early life sugar consumption to adverse neurocognitive outcomes.

February 21, 2020 - (BIOL Class of 1960 Scholar Event) Alumni Reunion - The purpose of the reunion is to provide our students a window on the process of finding and gaining admission to graduate Ph.D or MD/Ph.D programs. The reunion has two parts. First, a panel discussion will be led by our visiting alumni who are now in Ph.D, MD/Ph.D or post-doctoral programs (in Wege @ 2pm). Second, the panel will be followed by a poster session where students can talk individually with the panelists about their current research and about other topics related to moving forward towards a career in basic or medical research (in TBL 211 @ 3pm). This year's returning alumni will be Achala Chittor '15, Hector Trujillo '16, Rachel Essner '16 and Jonathan MacDougall '17.

February 27 & 28, 2020 - (Joint Seminar with Math, PH Class of 1960 Scholar Event) Leah Katzelnick '10, UC Berkeley
Dr. Katzelnick's talk on Thursday, February 27 at 7pm in Griffin 7
"The danger zone: dengue viruses and the search for a protective vaccine"
While we have developed protective vaccines against many viral diseases, the search for a vaccine that protects against the mosquito-transmitted dengue virus has been particularly challenging. Dengue is a debilitating and sometimes lethal disease that can cause hemorrhagic manifestations, vascular leakage, and shock. The unique biology of dengue viruses makes it so that a suboptimal vaccine may cause the very disease the vaccine was designed to prevent. Three years ago, 800,000 children were vaccinated in the Philippines with a dengue vaccine later shown to increase dengue disease severity. This seminar will describe collaborative projects with researchers in dengue-affected countries to understand how the immune response to dengue viruses and the closely

related Zika virus can either protect against or enhance future disease severity. The goal of this research is to improve the design of dengue and Zika vaccines and inform how such vaccines can be safely introduced into vaccination programs.

Dr. Katzelnick's talk on Friday, February 28 at 1:10pm in Wege

"The shadow of the virus: measuring antibodies to track viruses as they move across populations"

To combat viral infection and protect against future disease, the body generates antibodies, proteins that specifically target each pathogen. By carefully measuring antibody responses to a given virus across individuals, we are able to map how viruses evolve to escape immunity, identify which people are protected against disease and for how long, and look into the past to measure how intensely a virus has transmitted in a given population over time. We will see how the quantitative methods of 'seroepidemiology' have provided insights into the complex immune interactions between the four closely related dengue viruses and their 'cousin' Zika virus. These viruses, all members of the Flaviviridae family, cause debilitating disease ranging from hemorrhagic disease and shock to severe congenital and neurological complications, often by taking advantage of the body's antibody response.

March 6, 2020 - Jessica Malisch, St. Mary's College of Maryland

"Should I Stay Or Should I Go Now? Predictors of Facultative Altitudinal Migration in Mountain White-crowned Sparrows (Zonotrichia leucophrys oriantha)"

Bird population density has notably declined over the last 40 years and this decline has caught the attention of conservation physiologists. Although a single explanation has not been identified, both climate change and habitat loss have been implicated because both events can diminish available resources. Migratory birds have high energetic needs and depend on resources from multiple habitats for annual survival and reproduction. Additionally, birds that breed in regions with high environmental variability, such as high elevation, must cope with sudden shifts in climatic conditions during the breeding season. These birds exhibit a behavior, Facultative Altitudinal Migration (FAM), a temporary movement from an area of high elevation to low elevation, presumably following resource availability. FAM presumably is an adaptation that promotes survival in areas with steep elevation gradients. However, FAM requires resources from yet another habitat and may come at a cost to reproduction through the loss of territory or abandonment of a nest at the breeding site. White-crowned sparrows (Zonotrichia leucophrys oriantha) that reside in Tioga Pass Meadow, CA (elevation 3,030 m) arrive in early May when snow cover is 100%, late spring snow storms are not uncommon and lower elevation refugia in the Mono Basin (~2,000 m elevation) are readily available. Therefore, this is an excellent system to study the causes, costs and benefits of FAM behavior. In this talk I will review research on this population and synthesize recent findings in a framework that includes environmental variables, physiological variables, and reproductive success in regard to FAM behavior. Understanding how environmental conditions interact with physiological parameters to determine annual reproductive success and year to year survival is key to understanding how bird populations are negotiating resource challenges.

March 13, 2020 - Joseph Lachance, Georgia Tech - CANCELLED

"Ancient DNA, Neanderthals, and the evolution of human health"

The evolutionary history of our species is complex. In addition to encountering novel

environments and pathogens, our ancestors mated with other hominins (including Neanderthals, Denisovans, and individuals from so-called "ghost populations"). The past has left a genetic legacy that continues to shape human health and disease. Applying precision medicine approaches to ancient genomes, we were able to "predict" the health of many individuals who lived in the past. On a broad scale, hereditary disease risks are similar for ancient hominins and modern-day humans. In addition, there is evidence that ancient pastoralists may have had healthier genomes than ancient hunter-gatherers and farmers. We also observed a temporal trend whereby genomes from the recent past are more likely to be healthier than genomes from the deep past. This calls into question the idea that modern lifestyles have caused hereditary disease burdens to increase over time. Focusing on individual genomes, we found that the overall genomic health of the Altai Neandertal was worse than 97% of present-day humans and that Otzi, the Tyrolean Iceman, had a genetic predisposition for gastrointestinal and cardiovascular diseases. Neutral and selective processes can alter the allele frequencies of disease-causing loci, and ancient samples allow us an unprecedented look at how our species has changed over time. By analyzing a time series dataset of ancient and modern genomes, we were able to identify disease-associated loci that have been targets of recent natural selection. We found that the majority of GWAS variants that impact health have negligible effects on fitness. As expected, we found that protective alleles are more likely to be positively selected than alleles that increase the risk of complex diseases. However, risk alleles at many disease-associated loci have increased in frequency over the last 10,000 years. This may be due to pleiotropy, recent relaxation of selection, and/or genetic hitchhiking of disease variants. Focusing on individual diseases, we found that alleles that protect against asthma are enriched for signatures of positive selection. Overall, these results demonstrate the potential of ancient DNA to improve our understanding of recent human evolution.

April 10, 2020 - Robert Unckless, Kansas University - CANCELLED
"The causes of balancing selection on immunity genes: from populations to molecular interactions"
Immunity is an enormously important topic for human health with economic costs of infectious disease eclipsing $100 billion in 2014. At the same time, the evolution of the immune system is fertile ground for the study of evolutionary processes because a) natural selection on immunity is intense since the outcome of infection is often life or death and b) pathogens have the ability to respond to host adaptation leading to rapid evolution through an evolutionary arms race. Since insects lack an adaptive immune system, they are excellent models to understand the molecular genetics and evolution of innate immunity. An important component of innate immunity is the complement of antimicrobial peptides (AMPs) that are produced and secreted by host cells upon infection and directly inhibit pathogens. Variation in the genes encoding these AMPs is often maintained by balancing selection, the process by which multiple alleles are maintained at the same locus through various mechanisms. While instances of balancing selection are being reported more and more frequently, we lack a comprehensive understanding of the mechanistic basis of balancing selection in most examples. The ability to connect broad scale patterns of DNA sequence diversity to mechanistic differences in protein function is innovative and would provide a comprehensive view of balancing selection. Furthermore, the identification of particular amino acid polymorphisms that are maintained by balancing selection facilitates the mechanistic study of balancing selection because the presumptive causative mutations are known a priori. Our use of Drosophila as a model system also

allows for study of AMP variation in both in vitro and whole organism in vivo study. These peptides are ideal for the functional study of balancing selection because a) genetic variation in several peptides is maintained by balancing selection, providing replication, b) AMPs are effectors and thus interact directly with pathogens and c) AMPs are small and can be easily studied in vitro.We find that as a whole, antimicrobial peptides in *Drosophila* evolve in patterns consistent with balancing selection. We will focus on two particular case studies of AMPs under balancing selection and focus on the tradeoffs that drive this balancing selection.

April 17, 2020 - Stephanie Padilla, UMass, Amherst - CANCELLED

April 24, 2020 - Mary Gehring (BIMO Class of 1960 Scholar), Whitehead Institute - CANCELLED

May 8, 2020 - Thesis Poster Presentations from 1:00-2:30pm - **CANCELLED, due to COVID-19 presentations were done virtually**
Thesis students will present a poster on their research project, starting with a short, one-minute presentation about their work to a general audience in **Wege Auditorium at 1:00pm**. The purpose of this presentation is to succinctly summarize their thesis projects so that they can be understood by all faculty, students and friends in attendance. This will be followed immediately by a poster session on the 2nd floor of the south science building students will talk about their research and findings.