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2012-2013 Colloquium Schedule

September 14: Dr. Joel Sachs, University of California, Riverside
"Evolutionary origins and stability of proteobacterial mutualisms"
Mutualist bacteria infect most eukaryotic species in nearly every biome. Nonetheless, the evolution of these bacterial mutualisms is poorly understood. Two key dilemmas remain unresolved: how do mutualist phenotypes first arise in bacterial lineages and to what degree are these traits resistant to mutants that parasitize hosts or abandon host-association entirely? I use two parallel approaches to examine these questions. Firstly, I study natural rhizobial populations using a combination of experimental and phylogenetic techniques. Rhizobia are nitrogen-fixing bacteria that infect leguminous plants. These symbionts are particularly interesting because they are widespread in soils, phenotypically variable, and have large effects on host that are both environmentally and economically important. Secondly, I have mine genomic and phenotypic data from diverse lineages of bacteria. I Use these datasets to test hypotheses about bacterial mutualist evolution over deep time.

September 21: Dr. Mark Tanouye, University of California, Berkeley
"Drosophila as a model for human epilepsy: suppressing seizures by mutation and by drugs"
Despite the frequency of seizure disorders in the human population, the genetic and physiological basis for these defects has been difficult to resolve. Although many genetic contributions to seizure susceptibility have been identified, these involve disparate biological processes, many of which are not neural specific. The large number and heterogeneous nature of the genes involved makes it difficult to understand the complex factors underlying the etiology of seizure disorders. Examining the effect known genetic mutations have on seizure susceptibility is one approach that may prove fruitful. This approach may be helpful both in understanding how different physiological processes affect seizure-susceptibility and in identifying novel therapeutic treatments. We review here factors contributing to seizure-susceptibility in Drosophila, a genetically tractable system that provides a model for human seizure disorders. Seizure-like neuronal activities and behaviors in the fruitfly are described, as well as a set of mutations that exhibit features resembling some human epilepsies and render the fly sensitive to seizures. Especially interesting are descriptions of a novel class of mutations that are second-site mutations that act as seizure-suppressors. These mutations revert epilepsy

phenotypes back to the wild-type range of seizure susceptibility. The genes responsible for seizure suppression are cloned with the goal of identifying targets for lead compounds that may be developed into new anti-epileptic drugs.

September 28 (BIMO Class of 1960's Scholar): Dr. David Page, Whitehead Institute
"Rethinking the Rotting Y Chromosome"
For many decades, the male-specific chromosome was understood to be a genetic wasteland of little import. I will describe how recent genetic and genomic studies have revealed the Y chromosome's architectural beauty, evolutionary dynamism, and critical role in male fertility.

October 12 and 19: Thesis Talks

October 26: Summer Research Presentations and Science/Med School Opportunities
This is a three part seminar; first we will hear Samanthan Teng '13, Rebecca Shoer '13, and Elizabeth Hwang '13 briefly talk about the research they did over the summer. They will tell us how they got involved in their research program and whether or not they'd recommend it to others. Next, Stephanie Albin, a postdoctoral fellow from Janelia Farm will give a brief talk about science opportunities for undergrads at Janelia. Lastly, Dr. Dean Li from the University of Utah will talk about navigating through the medical school application process. There will be opportunities for questions after each presentation.

November 2 (Class of 1960's Scholar): Dr. Andy Feinberg, Johns Hopkins University
"The Epigenetic Basis of Common Human Disease"
We have been developing new measurement and statistical tools for genome-scale epigenetic research, integrated with novel epidemiological designs for the study of human disease. Our array-based approach (CHARM) led to the discovery of CpG island shores, that shores that show frequent variation in normal development and cancer (Irizarry et al, Nature Genetics 2009, Ji et al, Nature 2010, Doi et al, Nature 2010), and we have worked with others to provide an easily-accessible format for non-epigenetic laboratories to incorporate these sites, as well as Hidden Markov model-defined CpG islands, on the Illumina 450K array. At the same time, we have developed new statistical approaches to methylation-based DNA sequencing, substantially reducing cost and increasing the sensitivity of methylation estimation. Using these approaches, we discovered loss of stability of epigenetic domains across cancer types, which may explain, in a relatively universal way, tumor heterogeneity and its relationship to stochastic variation in normal development (Hansen et al, Nature Genetics, 2011). I will also discuss a surprising convergence of two lines of evidence from the laboratory, large hypomethylated blocks that are disrupted in cancer, and large organized chromatin lysine (K) modifications, or LOCKs, that are reversible during epithelial-mesenchymal transition (McDonald et al, Nature Genetics, 2011). These results suggest a potential structural basis for differentiation and its perturbation in predisposition to common disease.

November 9: Dr. Iruka Okeke, Haverford College
"Colonization is not just adherence: Interplay of bacterial surface proteins of enteroaggregative Escherichia coli*"*
Enteroaggregative *Escherichia coli* are a category of diarrhea-causing *E. coli* defined by their characteristic stacked-brick pattern of adherence. Our laboratory uses EAEC strains as models for exceptional colonization. The EAEC strains we study express aggregative adherence fimbrae, outer surface agglutinins and an anti-aggregative factor. These three factors have, as is traditional, been studied separately. We find that optimal colonization by EAEC is produced by the interplay among these and potentially other factors.

November 16: Dr. Alvaro Sagasti, University of California, Los Angeles
During development neurons elaborate axonal and dendritic processes to make contact with the environment or other neurons. Proper development of these processes is crucial for the assembly of circuits that allow animals to sense their environment and respond appropriately. The peripheral axons of somatosensory (touch-sensing) neurons in zebrafish provide an accessible setting for studying how the nervous system assembles during development. Using molecular approaches and live imaging techniques we have discovered a molecular guidance system that attracts sensory axons to the skin. Reciprocally, once in the skin, axons signal to skin cells, inducing them to remodel their apical membranes and cytoskeleton to accommodate axons within tunnel-like sheaths. These results attest to the extensive cell-cell communication that is required to form a properly functioning nervous system.

February 8: Biology Class of 1960s Scholar Reunion with Devin Schweppe '07, Natalie Stephens '03 and Malin Pinsky '03

February 15: Winter Carnival

February 22: Dr. Gary Gillis, Mt. Holyoke College
"Do toads have a jump on how far they hop: The neuromuscular control of landing in anurans"
Coordinated landing from a step, fall or jump requires a suite of muscle actions that must be put in place before impact. For example, in the legs of humans or forelimbs of monkeys and cats, activity in limb muscles during a jump begins in mid-air, prior to landing, and is scaled to the expected time and magnitude of impact. In other words, animals recruit more and more limb muscle to resist impact when jumping down from greater and greater heights (at least within a reasonable range of heights). In this talk I will provide evidence of similar results in anurans (frogs and toads), and will show that these changes in muscle recruitment patterns correlate well with muscle actions that may be important for preventing over-stretching and injury in those muscles.

March 8 (Class of 1960's Scholar): Dr. Sarah Tishkoff, University of Pennsylvania
"Human evolutionary genomics: Implications for human origins and disease"
Africa contains the greatest levels of human genetic variation and is the source of the worldwide range expansion of all modern humans. And yet relatively little is known about genomic variation in ethnically diverse African populations. Knowledge of genetic structure within Africa has important implications for the design and implementation of disease association studies in Africans and African Americans, and for reconstructing modern human origins. Additionally, studies of genetic adaptation in Africa have important implications for identifying genes that play an important role in human evolution and disease. The African populations included in this study practice diverse subsistence patterns and have diverse diets (hunter-gatherers, pastoralists, agriculturalists, and agro-pastoralists), and live in diverse environments with differing pathogen exposure (tropical forest, savannah, coastal, desert, low altitude, and high altitude) and, therefore, are likely to have experienced local adaptation. In this talk I will discuss results of analyses of genome-scale genetic variation in geographically, linguistically, and ethnically diverse African populations in order to reconstruct human evolutionary history in Africa as well as the genetic basis of adaption to diverse environments.

April 5: Dr. Evan Preisser '93, University of Rhode Island
The hemlock woolly adelgid Adelges tsugae ('HWA') is an invasive herbivore that poses a major threat to eastern hemlock (Tsuga canadensis) in eastern North America. High-density HWA infestations can kill even mature trees in 4-10 years; as a result, substantial hemlock mortality has occurred from VA to MA. Despite fears that HWA would remove hemlocks from southern New England, however, stand-level mortality in this area is occurring much more slowly than predicted. Although overwintering mortality of HWA has played a role in reducing hemlock mortality, another potential (but non-exclusive) explanation involves the recent rapid range expansion of a second introduced insect, the elongate hemlock scale Fiorinia externa ('EHS'). While EHS can reduce hemlock growth and may be capable of killing stressed trees, its impact on tree health is minimal compared to that of HWA. Neither HWA nor EHS possess natural enemies capable of substantially limiting their population growth in the invaded range, and both are now abundant in southern New England. My lab has explored the interactions between these two insects and their common hemlock host, and the herbivores' individual and joint impact on hemlock physiology. Understanding the interaction between these two invasive pests, both directly and indirectly through their shared host plant, may provide information important to controlling both threats.

April 12 (BIMO Class of 1960's Scholar): Dr. Henry Wortis, Tufts School of Medicine
"Using genetics to understand age-related loss of immune resistance to infection"
People are living longer. As they age many become more susceptible to infections. Why this happens is not well understood. We are studying an infection that is usually mild in young people but is often fatal in people over the age of 50. By studying mice infected with this same organism we hope to understand the genetics differences that make the infection mild and brief in some old mice and long-lasting and chronic in others. We hope that insights from these studies inform our understanding of human immunity.

April 19: Dr. Helen White, Haverford College

"The impact of oil on deep-water ecosystems"

The *Deepwater Horizon* disaster released ~5 million barrels of oil into the Gulf of Mexico impacting numerous ecosystems including deep-sea coral communities. Deep-sea corals are typically isolated from anthropogenic disturbances such as oil spills and the widespread signs of stress observed in corals at a depth of 1370 meters underscores the unprecedented nature of the spill. The quantity and composition of oil has been determined for corals and surrounding sediments that were exposed to oil from the *Deepwater Horizon* disaster and a preliminary examination of the microbial communities associated with these samples provides additional insight into the ability of resident microbes to metabolize oil. Findings from this research will enhance our understanding of intrinsic oil degradation in the environment and enable the development of molecular assays that will be able to rapidly monitor the progress of oil biodegradation in theaftermath of an oil spill.

April 26: Dr. Richard Harrison, Cornell University

"On the origin of species: from Darwin to the 21st century"

Although Darwin described the origin of species as "that mystery of mysteries," modern evolutionary biologists are making substantial progress in understanding how new species arise. I discuss the nature of species and argue that the central question that demands our attention is how barriers to gene exchange arise between diverging lineages. Using case histories of recently diverged taxa, I examine the nature of such barriers and consider how modern genetic and genomic approaches can provide insights into the speciation process.

May 3: Thesis Poster Presentations, TBL Lobby 1:00 - 3:00