

UPGEN 778A-F Schedule Fall Term 2018
MWF 2-3:30p

Module A Aug 27– Sept 7 Tentative MGM Retreat Date Sept 7	Section 1 Raphael Valdivia Intro to Bacterial Genetics C336 LSRC	Section 2 Simon Gregory Genomic Technologies 4002 GSRB 1	Section 3 Andy Alspaugh “Genetics and Genomics of Infectious Disease” 208 CARL	Section 4 John Willis Genomics of Adaptation 4002 GSRB II
Module B Sept 10– Sept 21	Section 1 Hiro Matsunami Genetic Switches 208 CARL	Section 2 Danny Lew The Logic of Genetics C336 LSRC	Section 3 Greg Crawford “Epigenomics” 4002 GSRB II	Section 4 John Rawls and Lawrence David “Exploring the Microbiome” 4002 GSRB 1
Module C Sept 24– Oct 5 Tentative UPGG Retreat Oct 5	Section 1 Danny Lew The Awesome Power of Yeast Genetics 208 CARL	Section 2 Dave McClay Gene Networks During Development 4002 GSRB 1	Section 3 Dave Sherwood Basement membranes- formation, functions, and human disease 4002 GSRB II	
Module D Oct 10– Oct 22 Fall Break on Oct 8	Section 1 Blanche Capel “Mouse Genetics and Genomics” 209 Nanaline Duke	Section 2 David Tobin Zebrafish Genetics & Genomics 4002 GSRB II	Section 3 Jack Keene and Debby Silver Mechanisms of RNA Regulation C336 LSRC	Section 4 Raluca Gordan Modeling protein- DNA interactions in vitro and in vivo 2240 CIEMAS
Module E Oct 24– Nov 5	Section 1 Robin Smith “Science Communication” 4002 GSRB II	Section 2 Tim Reddy “Computational Genomics” 4002 GSRB 1	Section 3 Philip Benfey “Entrepreneurship in the life sciences” BioSci 139	Section 4 Kris Wood Tumor heterogeneity and evolution 208 CARL
Module F Nov 7– Nov 19	Section 1 Don Fox “Critical skills in scientific presentation” 4002 GSRB 1	Section 2 Yong-Hui Jiang Genomic imprinting- disease and evolution perspective 208 CARL	Section 3 Allison Ashley- Koch “Genetic Analysis of Human Disease” 4002 GSRB II	Section 4 Amy Bejsovec “Drosophila developmental genetics” 4219 French Science

Module Descriptions for Fall 2018:

Session 1

Introduction of Bacterial Genetics (Raphael Valdivia)

This module will cover basic aspects of bacterial genetics including mechanisms of DNA exchange by conjugation and phages and how these natural events have been harnessed to perform genotype-phenotype associations in bacteria. We will also review classic papers on the generation of molecular genetic tools and their application to generate complex mutant libraries and perform targeted screens based on reporter genes. Finally, we will revisit these techniques in the context of the post-genomic era.

Genomic Technologies (Simon Gregory)

In this module, students will learn about and discuss the practical and technical application of various state-of-the-art genomic tools. Class will include didactic lectures, paper reading, oral presentations in genomic technologies and online resources to uncover novel insights into biological processes and disease states.

“Genetics and genomics of infectious disease” (Andy Alspaugh)

Microorganisms undergo dramatic cellular changes in order to adapt to the harsh environment of the infected host. These adaptations often require coordination of metabolism, stress responses, and the expression of specific “virulence factors”. Investigators have used many experimental techniques to define factors that favor microbial survival in this setting. This module will explore the use of classical and molecular genetics techniques to study the pathogenesis of human infectious diseases. We will also discuss genome-wide evaluative tools in microbial pathogens. Most class-time will involve group discussion of specific articles related to the topic of each session.

Genomics of Adaptation (John Willis)

Contemporary studies of how populations and species evolved adaptations to their ecological habitats. Focus on modern methods of genome mapping and sequence data and analysis in wild populations that can identify genetic changes that contributed to ecological adaptations. Emphasis on case studies of genomics of adaptation in plant and animal systems, including humans and our adaptations to environments that our ancestors encountered as they colonized diverse habitats throughout the world. Examples will also illustrate how speciation and hybridization can contribute to adaptive biodiversity

Session 2

Genetic Switches (Hiro Matsunami)

Cells in our body are specialized; each cell expresses a specific set of genes. How do gene switches control expression in different cell types or even individual cells of the same cell type? This module will cover elements that regulate gene transcription including structure of genes, gene regulatory regions, epigenetic modifications and/or subnuclear localization of genes, all in concert guide the initiation of transcription of specific genes in eukaryotes. Various modes of gene expression controls will be discussed mainly based on careful readings of recent literatures

The Logics of Genetics (Danny Lew)

This module will focus on how to apply haploid/diploid genetics to solve a biological problem (we use signal transduction as an example). Yeast is used as the example system, and we discuss the design and implementation of genetic screens, complementation, linkage, and epistasis to order genes into pathways. The first week we will do problem sets covering classical genetics and the second week we will read papers covering molecular genetics and genomics approaches to understand the same pathway

“Epigenomics” (Greg Crawford)

Many biological processes, such as tissue-specific gene expression, X inactivation, and development, are control by sequence-independent (epigenetic) mechanisms that are heritable yet reprogrammable. Aberrant changes in chromatin structure that impact the function of genes or nuclear or developmental pathways can be the basis for many diseases. In this module, students will acquire a basic understanding of experimental chromatin-based techniques used to create functional maps of the genome. Topics will include identification and mapping of chromatin accessible sites, transcription factor binding sites, histone modifications, DNA methylation, long range chromatin looping, and tools to modify the epigenome to empirically test function.

“Exploring the Microbiome” (John Rawls & Lawrence David)

Recent advances in genomic technology have led to spectacular insights into the complexity and ubiquity of microbial communities (the microbiome) throughout our planet, including on and within the human body. The microbiome is now known to contribute significantly to human health and disease, regulate global biogeochemistry, and harbor much of our planet’s genetic diversity. Consisting of lectures and reading of primary literature, this module is designed to provide students with a foundational understanding of microbiome science. Enrolling students are expected to have a background in general microbiology. For more information, please contact John Rawls john.rawls@duke.edu

Session 3

The Awesome Power of Yeast Genetics (Danny Lew)

This module will focus on using genetic interactions to identify and dissect new players in a pathway (we use cell polarity as an example). Along the way, we will discuss the generation and utility of various kinds of mutants, genetic suppression, synthetic lethality, and newer genomic methodologies including synthetic genetic arrays. Prerequisite: The Logic of Genetics.

Gene Networks During Development (Dave McClay)

This module focuses on early cell diversification. Production of the many cell types of an organism occurs through signaling and networks of transcription factors that collectively increase the complexity and number of cell types in a developing organism. The goal of the module is to gain an understanding of these networks and to learn how knowledge of them can be attained.

Basement membranes-formation, functions, and human disease (Dave Sherwood)

Basement membranes are a thin, dense, sheet-like extracellular matrix that underlies all epithelia and surrounds most tissues. Basement membranes emerged at the dawn of animal multicellularity and are thought to have been essential for the formation of tissues. Although generally thought of as a static scaffolding that supports and segregates tissues, recent studies are revealing dynamic, diverse, and crucial roles for basement membranes in nearly every aspect of tissue function. The course explores these diverse roles (e.g. differentiation, polarity, tissue shaping, tissue connection) and the growing evidence of basement membrane dysfunction in numerous human diseases as well as its important role in aging.

Session 4

Mouse Genetics & Genomics (Blanche Capel)

This module covers the history, nomenclature, basic tools, and emerging technologies of mouse genetics. Lectures cover the concept of inbred strains and their uses, experimental genetic approaches used to make and analyze models of human disease (including various forms of transgenesis and ES cell technology), quantitative trait loci, and emerging resources that facilitate the use of the mouse to study human variation, environmental impacts, and disease susceptibility.

Zebrafish Genetics & Genomics (David Tobin)

We will explore the unique attributes of the zebrafish that make it a powerful and rapid system for understanding vertebrate biology. We will cover classic forward genetic screens and mapping, genome editing, transgenesis, cell

transplants and chimera analysis, as well as newly emerging techniques and approaches. Finally, we will examine ways in which findings in model systems have been used to understand human biology. The class will also include problem sets that use the zebrafish to explore fundamental genetic principles

Mechanisms of RNA Regulation (Debby Silver & Jack Keene)

In this module, we will describe both specific and global regulatory processes and mechanisms that govern gene expression post-transcriptionally. As there are several steps between transcription and translation, it will be necessary to focus on particular examples that include pre-messenger RNA splicing, nuclear RNA processing, RNA subcellular localization, and RNA stability and translation. These processes are both coupled and coordinated in eukaryotic cells; moreover, they are interdependent and feed backward and forward to balance protein production in the face of environmental and cellular signals. In some cases, dynamic changes in RNA responses will be considered as well as how these processes maintain homeostasis and multicellularity in tissues and organs during development. We will highlight the importance of all of these processes by discussing how mutations in factors critical for splicing and RNA localization cause disease.

Modeling Protein-DNA interactions In Vitro and In Vivo (Raluca Gordan)

In this module, the students will acquire Python programming skills through the use of computational models and methods for characterizing the DNA binding specificity of transcription factors. Topics will include: identification of DNA motifs from CHIP-seq data, alignment of DNA sequences, identification of transcription factor binding sites across the human genome, computing enrichment of DNA motifs in genomic data. (Basic coding skills are useful, but not required).

Session 5

“Science Communication” (Robin Smith)

In this six-part workshop, we'll share some techniques that will help you communicate your work more effectively with a variety of audiences beyond your colleagues. We will have you practice telling your scientific story in several ways, from tweets and radio interviews to science cafes, blog posts and crowdfunding campaigns. Effective communication can help you get noticed by potential mentors and search committees, earn higher marks on your job and postdoc applications and advance your academic career. This module will include hands-on, active learning, so please bring writing materials or a laptop.

Genomic imprinting-disease and evolution perspective (Tim Reddy)

My module covers the basics of analyzing data from high-throughput sequencing studies of gene regulation and genomic activity. The class provides students with hands-on experience analyzing data from published manuscripts where they reproduce figures from those papers. Upon completing my module, I expect that students have the ability to perform routine genomic analyses on their own, and will have the foundational skills needed to learn about more advanced analyses.

“Entrepreneurship in the life sciences” (Philip Benfey)

This module will cover various aspects of entrepreneurial activity in the life sciences. These include setting up, securing funding and working in a start-up company as well as protecting and licensing intellectual property. We will discuss how best to prepare for life in the start-up ecosystem. Students will be evaluated on class participation and will write an executive summary of a business plan for a start-up of their choice.

Tumor heterogeneity and evolution (Kris Wood)

Genomic instability is a hallmark of cancer. Over time, this instability gives rise to heterogeneous, subclonal mutation patterns within tumors that serve as a reservoir for evolution. In this module, we will discuss the mechanisms governing intratumoral genetic heterogeneity and its implications for tumor evolution during disease progression and therapy resistance.

Session 6

“Critical Skills in Scientific Presentations” (Don Fox)

Do you hope to obtain a job in science after graduate school? Are you terrified of public speaking? Are you tired of sitting through hard-to-follow seminars by your peers, but don't know how to help them give clearer talks? If you answered yes to any of these questions, this module is for you. The goal of this module is to help you to effectively and confidently communicate your science to other scientists. Topics covered will include: designing better presentation slides and posters, developing a 2-minute “elevator speech” to give to your colleagues, and mastering the do's and don'ts of a short scientific presentation. This module is meant to compliment the Solutions module on Science Communication (which focuses on communicating science to the public) by focusing on communicating science to your scientific peers. Each class is group discussion-based, and each student will have several speaking opportunities. This module is for 2nd yr and above students.

Genomic imprinting-disease and evolution perspective (Yong-Hui Jiang)

Genomic imprinting is a special and fascinating form of epigenetic regulation for the gene expression in biology. The expression of the genes in the offspring is depending on the parental origin. More than 100 genes in mammals are subjected to the genomic imprinting and disruption of more than dozen of imprinted genes are implicated human diseases. The historic perspective related to the discover of imprinting genes and their implications in human diseases and during evolution will be discussed

“Genetic Analysis of Human Disease” (Allison Ashley-Koch)

This module will introduce students to key concepts in human genetic analysis. We will focus on dissecting qualitative and quantitative traits using a variety of family-based and population-based methods including GWAS, rare variant analysis, transcriptomic analysis, as well as identification of differential methylation and metabolomics signatures. A basic understanding of Hardy Weinberg Equilibrium, and linkage disequilibrium is required.

“Drosophila developmental genetics”(Amy Bejsovec)

During development, cells acquire positional information and deploy it to differentiate correctly. Genetic analysis in the fruitfly *Drosophila melanogaster* revolutionized our understanding of this process by identifying the key molecules that generate body pattern in all animals. Learn how these classic screens were conducted, how the molecules they identified act to promote patterning of the body, and how more recent techniques such as Gal4/UAS transgenic expression, FLP/FRT mosaic analysis, multicolor GFP tagging, and CRISPR/Cas9 gene editing have enhanced our ability to dissect developmental processes in the fly model system