Syllabus - Advanced Genetics - PCB 5065 - Fall 2009

Section 2191; 4 credits; 2318 Fifield Hall; MTWR 5th Period

http://www.hos.ufl.edu/ctdcweb/pcb5065home.htm

Genetic analysis is explored with a team of instructors who use genetic approaches in their research programs. The objective of PCB 5065 is to strengthen students' comprehension of genetic concepts, so that they can read and interpret classical and current literature in the field of genetics and apply genetic analysis to their own research problems. PCB 5065 is designed to establish a strong foundation for advanced specialty courses in genetics and to complement advanced courses in molecular biology.

Prerequisite: Introductory (undergraduate) genetics. We assume students are familiar with basic Mendelian genetics and that they understand the nature and functions of DNA, RNA and proteins.

Sitting in: Graduate and undergraduate students cannot "sit in" on the course. Our philosophy is that the "no pain no gain" axiom is particularly relevant to genetics.

Reading: There is no required text for the course.

An optional paperback book that students might find helpful for the beginning sections of the course: Advanced Genetic Analysis, 1st ed., R.S. Hawley and M.Y. Walker, John Wiley & Sons

Required reading in the form of review and research articles from the primary literature will be provided in electronic format (or in hard copy if they pre-date electronic format). Each section of the course concludes with a discussion paper from the current literature. Discussion papers, along with questions for class discussion, will be provided one week prior to the scheduled discussion. Students are expected to read the paper and discussion questions in advance and to actively participate in the class discussions.

Exams: The course is divided into five sections with an exam following the completion of each section (***see schedule***). Exams are scheduled for evening periods 11 and E1 to allow adequate time for solution of problem-based questions. Students may bring two 8.5 x 11 pages of ***hand-written*** notes to each exam. If a student has another exam scheduled for the time of a PCB 5065 exam, or a PCB 5065 exam falls on a religious holiday that a student traditionally observes, an alternate time will be arranged for that student's exam. ***Please notify the instructor of these conflicts in advance of the exam. Students who cannot take a scheduled exam due to illness or last-minute emergencies should contact the instructor prior to the exam if at all possible!***

Grades: Final grades will be based upon the sum of exam scores: 450-500 = A; 425-449 = A–; 400-424 = B+; 350-399 = B; 325-349 points = B–; <325 points = C+ or lower. Class attendance and participation will be considered in assigning grades to students with exam averages falling near a cut-off point. Information on current UF grading policies for undergraduate and graduate students can be found at:
http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html
https://gradschool.ufl.edu/catalog/current-catalog/catalog-general-regulations.html#grades,

Academic Honesty: The University of Florida requires all members of its community to be honest in all endeavors. Cheating, plagiarism, and other acts diminish the process of learning. When students enroll at UF they commit themselves to honesty and integrity. Your instructor fully expects you to adhere to the academic honesty guidelines you signed when you were admitted to UF. As a result of completing the registration form at the University of Florida, every student has signed the following statement: "I understand the University of Florida expects it students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University." Furthermore, on work submitted for credit by UF students, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." It is to be assumed all work will be completed independently unless the assignment is clearly defined as group project, either verbally or in writing by the professor. This policy will be vigorously upheld at all times in this course.

Software Use: All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

UF Counseling Services: Students experiencing crisis or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. Both the Counseling Center and Student Mental Health provide confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal or lacking clear career and academic goals, which interfere with their academic performance. The Counseling Center is located at 301 Peabody Hall (next to Criser Hall). Student Mental Health is located on the second floor of the Student Health Services in the Infirmary.

1. University Counseling Center, 301 Peabody Hall, 392-1575; personal and career counseling: www.counsel.ufl.edu
2. Student Mental Health, Student Health Care Center, 392-1171, personal counseling: http://www.shcc.ufl.edu/smhs/
3. Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161, sexual assault counseling
4. Career Resource Center, Reitz Union, 392-1601, career development http://www.crc.ufl.edu/

Services for Students with Disabilities: The Dean of Students Office coordinates the needed accommodations of students with disabilities. This includes the registration of disabilities, academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services, and mediating faulty-student disability related issues. Dean of Students Office, 202 Peabody Hall, 392-7066, www.dso.ufl.edu

Instructors: Contact information for all course instructors is provided below; Instructors are available to assist students on an individual basis by appointment.

Dr. Christine Chase (Course Coordinator), Professor - Horticultural Sciences Department, Graduate Program in Plant Molecular and Cellular Biology (PMCB Program), Graduate Program in Genetics
Ph.D. in Biology/Genetics, University of Virginia
Office – 2215 Fifield Hall; Tel – 392-1928 ext 316; Fax – 392-5653; ctdc@ifas.ufl.edu
http://www.hos.ufl.edu/ctdcweb/index.htm
Research interests – Plant mitochondrial biogenesis and function Mitochondria, the cellular site of the TCA cycle, respiratory electron transfer and ATP synthesis, are essential to higher eukaryotic life. Mitochondrial function depends upon the coordinate action of mitochondrial and nuclear genomes. The molecular-genetic dissection of mitochondrial function presents a challenge in higher organisms because mutations disrupting mitochondrial function are lethal in obligate aerobes. The cytoplasmic male sterility (CMS) systems of higher plants provide a solution to this dilemma. The mitochondrial genome encodes CMS, the maternally inherited failure to produce functional pollen. Nuclear fertility restoration genes block or compensate for the expression of CMS genes in the mitochondria, resulting in a male-fertile phenotype. We investigate molecular and genetic mechanisms of CMS and nuclear fertility restoration systems to understand the mechanisms by which nuclear genes influence the organization, inheritance and expression of mitochondrial genomes.

Dr. Dean Gabriel, **Professor - Plant Pathology & PMCB Program**
Ph.D. in Genetics/Botany/Plant Pathology, Michigan State University
Office – 2559 Fifield Hall; Tel – 392-7239; Fax – 392-6532; gabriel@biotech.ufl.edu
http://plantpath.ifas.ufl.edu/People/Faculty/Gabriel/gabriel_1.htm
Research interests – Genetics of host/parasite interactions The most experimentally tractable host/parasite interactions involve plants and microbes, simply because it is much easier to perform genetic analyses (crosses, genetic transformations) on plant hosts and their microbial pathogens, than on animal hosts and their microbial pathogens. This work involves making transgenic plants and microbes, and the techniques involve understanding the physical details (at the molecular level) of recombination. Most recently my work has taken us into the realm of host/parasite signaling (how does the parasite get the host to do things it does not naturally want to do?), the discovery of signal delivery systems (as a part of microbial virulence) and research on parasite protein signals targeted to host cell nuclei.

Dr. Curt Hannah, Professor - Horticultural Sciences, PMCB Program, Graduate Program in Genetics
Ph.D. in Genetics, University of Wisconsin
Office – 2211 Fifield Hall; Tel – 392-1928 ext 315; Fax – 392-5653; hannah@ifas.ufl.edu
http://www.hos.ufl.edu/LCHweb/
Research interests – Molecular-genetics of starch biosynthesis in higher plants; effects of introns and transposons on gene expression The corn seed represents an ideal experimental playground. Major components are starch (70% by weight), protein (15% by weight), lipids and other macromolecules. Because corn seeds are large and easy to examine, genetic differences are easily observed. Interesting studies have focused on the huge collection of mutants that change the size, shape and texture of the seed. We have focused on the mutants affecting the synthesis of the major seed component, starch. Our research is multifaceted. We study adenosine diphosphoglucose pyrophosphorylase, a rate limiting enzyme in the starch biosynthetic pathway. We use transposable elements as site-specific, *in vivo* mutagens to alter the regulatory properties of the enzyme, and we use conventional site-specific mutagenesis and expression in bacteria to fine-tune interesting mutants first found in the corn plant.

We also study the molecular basis of spontaneous mutations. Currently we are testing the hypothesis that a major role of transposable elements is the formation of introns and that introns benefit the organism by increasing gene expression.

Dr. Matias Kirst, Assistant Professor, Forest Resources & Conservation, PMCB Program, Graduate Program in Genetics
Ph.D. in Genetics and Functional Genomics, North Carolina State University
Office – 367 Newins-Ziegler Hall; Tel – 846-0900; Fax – 846-1277; mkirst@.ufl.edu
http://www.sfrc.ufl.edu/KirstLab/
Research interests – Fundamental and applied genomic research; Technology and genomic tool development We study the genetic architecture of transcript level variation, and partition of additive, dominance, epistatic, and non-genetic sources of variation that affect transcriptional regulation. These studies define sites that regulate the level of transcripts for individual genes, which can be the location of the gene coding sequence (*cis*-regulation), or its *trans*-regulator. We use classical approaches (QTL analysis and association genetics) to identify genetic loci associated with quantitative traits. These approaches are complemented by integrating other levels of genomic information (transcriptome and metabolome), creating a powerful platform for identification of specific genes that control quantitative variation. The rationale is that a significant component of the quantitative variation arises as a consequence of quantifiable variation at the transcription and metabolic level. By integrating information from different genomic platforms we have identified specific genes, as well as regulatory and physiological networks implicated in variation in growth and wood quality in forest tree species. We work on the development of methods for discovering SNPs from EST databases and other sources. For genotyping we use two microarray platforms (NimbleGen and Combimatrix, which allow high flexibility in probe design). We develop hybridization methods for genomic DNA hybridization to genotyping arrays of some of the most complex plant genomes, including the pine megagenome (~ 21,000 Mbp) and maize.

Dr. Don McCarty, Professor - Horticultural Sciences, PMCB Program, Graduate Program in Genetics
Ph.D. in Biochemistry, University of Wisconsin
Office – 2237 Fifield Hall; Tel – 392-1928 ext 322; 392-6479; drm@ufl.edu
http://pgir.rutgers.edu/endosperm.org/EndoSperm.html
Research interests – Physiological and molecular aspects of development in seeds Nowhere is the challenge of analyzing the functions of many interacting genes more evident than in the genetics of seed development. Seed mutants have contributed greatly to our understanding of key biological processes in the plant seed, including the starch pathway, the anthocyanin pigment pathway, storage protein synthesis, and embryo development, pattern formation, maturation and germination. In spite of these recent advances, much remains to be done. The vast majority of mutants that have seed phenotypes are not yet molecularly characterized. Maize is uniquely suited for genetic analysis of the seed as seed mutants are easily identified and studied in this plant. Such mutants also link fundamental studies in seed growth and development to potentially valuable aspects of grain yield. Current research efforts exploit the *Robertson's Mutator* transposable element for the development of an enhanced through-put approach to the cloning and characterization of maize genes affecting quantitative and qualitative aspects of seed development.

Dr. Gloria Moore, Professor - Horticultural Sciences, PMCB Program
Ph.D. in Agronomy, University of Kentucky
Office – 1523 Fifield Hall; Tel – 392-1928 ext 221; Fax – 392-5653; gamoore@ufl.edu
http://www.hos.ufl.edu/mooreweb/

Research interests – Application of molecular genetics (gene isolation, genetic mapping and genetic transformation) to citrus improvement

Citrus is an important fruit crop both world-wide and in Florida. Because of large plant size, long generation time, and features of reproductive biology, it is difficult to produce new citrus varieties using conventional plant breeding techniques. It is now possible to transform citrus genetically. This allows one or few desirable genes (a disease resistance gene for example) to be inserted into the genome of an established variety without changing other characteristics of the plant. The challenge now is to identify, characterize, and clone the desirable genes to be used in transformation experiments. We are characterizing citrus genes involved in disease resistance and ones that are up-regulated in response to abiotic stresses such as cold and salt and using promising genes in transformation experiments.

Schedule – Advanced Genetics - PCB 5065 - Fall 2009

Section 2191, MTWR 5th Period, 2318 Fifield Hall

Date		Instructor	Topic
Mon	Aug 24	All	Course introduction
Tues	Aug 25	Hannah	The gene in molecular terms
Wed	Aug 26	Hannah	The gene pre-Mendel to Mendel
Thurs	Aug 27	Hannah	The gene as a unit of function
Mon	Aug 31	Hannah	The gene as a unit of mutation
Tues	Sept 1	Hannah	The *rII* cistron of phage T4
Wed	Sept 2	Hannah	The gene and the operon
Thurs	Sept 3	Hannah	Allelic interactions - cistrons and operons ; Genic interactions - epistasis
Mon	***Sept 7***		***Labor Day Holiday – No Class***
Tues	Sept 8	Hannah	Transposable elements I - molecular and genetic properties
Wed	Sept 9	Hannah	Transposable elements II - tools of forward and reverse genetics
Thurs	Sept 10	Hannah	Forward and reverse genetics - further approaches
Mon	***Sept 14***	***Chase / Hannah***	***Discussion paper on genes, mutations and transposons***
Tues	Sept 15	Gabriel	Segregation, assortment, chromosome mechanics, nondisjunction
Tues	***Sept 15***	***6:15-8:10 PM***	***Exam 1 – Genes, Mutations & Transposons***
Wed	Sept 16	Gabriel	Genes & chromosomes
Thurs	Sept 17	Gabriel	Linkage, gene order, linearity, crossing-over, recombination
Mon	Sept 21	Gabriel	Tetrad analysis & sister-strand exchange
Tues	Sept 22	Gabriel	Mechanisms of crossing over - gene conversion & Holiday structures
Wed	Sept 23	Gabriel	Mechanisms of crossing over - Messelson-Radding gene conversion
Thurs	Sept 24	Gabriel	Mechanisms of crossing over – double-strand-break repair model
Mon	Sept 28	Gabriel	Mechanisms of crossing over – synthesis dependent strand annealing and early cross-over decision consensus models
Tues	Sept 29	Gabriel	Mechanisms of crossing over - Parasexuality and mitotic recombination
Wed	Sept 30	Gabriel	Site-specific recombination systems
Thurs	***Oct 1***	***Chase***	***Discussion paper on recombination***
Mon	Oct 5	Moore	Chromosome structure and organization
Mon	***Oct 5***	***6:15-8:10 PM***	***Exam 2 – Recombination***
Tues	Oct 6	Moore	Chromosome function
Wed	Oct 7	Moore	Chromosome variation
Thurs	Oct 8	Moore	Genome organization

Date		Instructor	Topic
Mon	Oct 12	Moore	Molecular markers
Tues	Oct 13	Moore	Molecular markers
Wed	Oct 14	Moore	Linkage mapping I
Thurs	Oct 15	Moore	Linkage mapping II
Mon	Oct 19	Moore	Physical mapping
Tues	Oct 20	Moore	Positional cloning
Wed	***Oct 21***	***Chase /Moore***	***Discussion paper on chromosomes, genomes, markers & maps***
Thurs	Oct 22	Chase	Non-Mendelian inheritance - organelle inheritance I
Thurs	***Oct 22***	***6:15-8:10 PM***	***Exam 3 – Chromosomes, genomes, markers& maps***
Mon	Oct 26	Chase	Non-Mendelian inheritance - organelle inheritance II
Tues	Oct 27	Chase	Non-Mendelian inheritance - maternal effects, cytoplasmic microorganisms, meiotic drive
Wed	Oct 28	Chase	Non-Mendelian inheritance – epigenetics I
Thurs	***Oct 29***	***No Class***	***Florida Genetics Symposium***
Mon	Nov 2	Chase	Non-Mendelian inheritance – epigenetics II
Tues	Nov 3	McCarty	Developmental genetics - general concepts
Wed	Nov 4	McCarty	Developmental genetics – drosophila I
Thurs	Nov 5	McCarty	Developmental genetics – drosophila II
Mon	Nov 9	McCarty	Developmental genetics – plants I
Tues	Nov 10	McCarty	Developmental genetics – plants II
Wed	***Nov 11***	***NO CLASS***	***Veterans Day Holiday***
Thurs	***Nov 12***	***Chase***	***Discussion paper on Non-Mendelian and developmental genetics***
Mon	Nov 16	Kirst	Population genetics - Hardy-Weinberg equilibrium
Mon	***Nov 16***	***6:15-8:10 PM***	***Exam 4 – Non-Mendelian and developmental genetics***
Tues	Nov 17	Kirst	Population genetics – segregation, recombination & linkage disequilibrium
Wed	Nov 18	Kirst	Forces that change gene frequencies: mutation
Thurs	Nov 19	Kirst	Forces that change gene frequencies: migration
Mon	Nov 23	Kirst	Forces that change gene frequencies: random genetic drift
Tues	Nov 24	Kirst	Population genetic structure & effective population size
Wed	Nov 25	Kirst	Population genetic structure & effective population size
Thurs	***Nov 26***	***NO CLASS***	***Thanksgiving Holiday***

	Date	Instructor	Topic
Mon	Nov 30	Kirst	Natural and artificial selection
Tues	Dec 1	Kirst	Short and long-term responses to selection
Wed	Dec 2	Kirst	Heritability, genetic correlation and gain from selection
Thurs	Dec 3	Kirst	Molecular dissection of quantitative variation – linkage analysis
Mon	Dec 7	Kirst	Molecular dissection of quantitative variation – association studies
Mon	*Dec 7*	*Chase*	*Take-home Instructor evaluations given*
Tues	***Dec 8***	***Kirst /Chase***	***Discussion paper on population and quantitative genetics***
Wed	Dec 9	Kirst	Review / question-answer session
Wed	*Dec 9*		*Take-home Instructor evaluations due*
Wed	***Dec 9***	***6:15-8:10 PM***	***Exam 5– Population & quantitative genetics***