BIO 591
Advanced Genetics
Spring Semester 2008

Professor: David A. Gangitano, PhD
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Class hours: Monday 14-15.50hs
Classroom: CSF 104
Lab Hours: Wednesday 13-16.50hs
Classroom: CFS 219
Office Hours: Wednesday 13-16hs
Prerequisite: Introductory Genetics and Organic Chemistry

Required textbooks

1) Human Molecular Genetics. 3rd Edition. Tom Strachan, Andrew Read. Garland Science. (2003). Taylor and Francis Group.
2) Population Genetics: A Concise Guide. 2nd Edition. John H. Gillespie. The Johns Hopkins University Press (2004)

Suggested textbooks

1) Molecular Cell Biology. 5th Edition. Lodish et al. W. H. Freeman & Co. (2004)
2) Genetic Data Analysis. Bruce Weir. Sinauer Associates (1996)

Course description

The course will cover the following topics: Molecular Medicine, Advanced Forensic DNA and Population Genetics. The objective of the first module is to understand the organization and function of the genes to comprehend the origin of genetic diseases and molecular diagnostic. The second module includes different approaches to the analysis of degraded biological evidence. The third module is concerned with understanding the mechanisms involved in the movement of genetic material through space-time and the concepts related to evolution.

This course will cover DNA structure and function, chromosomes, pedigrees and the basic techniques of PCR, cloning and hybridization. A detail will be given of our new understanding of the structure, organization, expression and evolution of the human genome, and the progress of the many parallel genome projects.

Variation, mutation and disease relate this knowledge to Mendelian diseases, complex multifactorial diseases. Mapping and identification of disease genes, molecular pathology and molecular diagnosis will be treated in depth. Functional genomics, the role of animal models and new approaches to genetic treatment of disease will be covered as well.

This course will cover the analysis of the main molecular targets in Basic Molecular Biology Research in the post-genome era. Using the latest technology available, the most important techniques used in Basic Research will be assessed. Special DNA extraction methods for very degraded samples (hairs, bone & teeth), will be discussed as well as techniques for DNA quantification, strategies for the design of PCR and Real time PCR (genotyping and DNA sequencing), interpretation of results, biostatistics and quality assurance procedures.

Population genetics software will be employed to generate data and compare to another DNA databases (fragments and sequence) to establish phylogenetic relationships.
An advanced knowledge of the scientific literature and the ability to integrate molecular biology into practical applications and research is required. During the course students will develop independent learning skills and improve their ability to present complex scientific information orally.

Objectives

1. Familiarize with advanced techniques for DNA extraction from very degraded human tissue, plants and bacteria
2. Master the criteria used to decide which molecular technique should be used for gene expression, genotyping, and RNA expression.
3. Interpret results obtained from DNA sequencing as well as genotyping-based techniques from human, plants and bacteria.
4. Understand the principles of population genetics. Familiarize with the use of population genetics software and interpretation of results.
5. Be capable of design research strategies.
6. Understand the theory and application of new molecular technologies.

Examinations and Assignments

There will be one written final examination, in accordance with university policy. The final examination is *comprehensive* and may be based upon any information from anytime during the course. The written final examination will be composed of multiple choice questions, true-false questions, fill in the blank questions, and/or short answer questions. The final examination and tests may be

composed of any combination of the aforementioned question types or may be composed of only two or three of the question types. Students will be required to apply their acquired knowledge to design and perform an experiment using techniques that are widely accepted by the scientific community.

Assignments will consist of lab reports, quizzes, a written paper and oral presentations.

Lab reports will summarize data and address pertinent questions. Successful completion of lab reports will require the student to apply advanced knowledge acquired in class to molecular lab techniques. Assignments are due at the beginning of class on the due date. The instructor reserves the right to refuse late work, but will make reasonable accommodations for students who experience unfortunate circumstances.

Students will write a research paper on an *assigned Advanced Molecular Biology (AMB) topic*. This research paper must be fully referenced and cite published studies in the peer reviewed scientific literature. An oral presentation on another topic will be made during class. This second presentation will be on a AMB *topic selected by the student and approved by the instructor*. The student may elect to present a technical report or reports pertaining to AMB. This presentation can be made from the peer reviewed scientific literature.

The total combined weight of the lab reports will be 15% of the final grade. The written paper will comprise 30% as will the oral presentation (combined). Quizzes will represent 10% of the final grade. The remaining 40% will be based on the performance in the final examination.

	Number	Scope	Timeframe	Weight of Grade
Lab Reports	Variable	Non-comprehensive	Throughout term	15%
Quizzes	Variable	Defined	Variable	10%
Written Paper	1	Defined	Variable	15%
Oral Presentations	1	Defined	Variable	20%
Final Examination	1	Comprehensive	End of term	40%

Material for the final exam and tests may come from class material, supplemental reading material or class discussion that was not covered in the reading material.

In other words, attendance and active participation in class is extremely important in order to complete the course successfully and receive a good grade.

If a student is absent from the laboratory he/she may not be given an opportunity to make up the laboratory exercise, even if prior notice has been given the instructor. No make-ups will be given for the final exam unless arrangements have been made prior to the exam date. It is the student's responsibility to monitor the accuracy of the grades.

Deadlines for assignments, lab reports and other important announcements such as test times and locations will be announced either in class or by email. As a result, students *must* read their SHSU email in order to remain current.

Grading Policy
Final grades will be based upon the following scale: 90 plus average an "A"; 80 to 89 a "B"; 70 to 79 a "C"; 60 to 69 a "D"; and below 60 an "F". Students should not count on a curve of the final grade. The instructor reserves the right to modify the grading scheme to accommodate for a missed test or final examination in extenuating circumstances.

The instructor reserves the right to assign a final exam grade of 0% should she deem the absence was not properly handled or was unjustified. Appeals will be handled in accord with University Policy Statement 900823, Academic Grievance Procedures for Students.

Attendance policy
Attendance will be recorded in keeping with University policy. Students are expected to attend class. Class attendance requirements will be followed in accordance with Academic Policy Statement 800401. In accordance with university policy, students will not be penalized for absences of up to three hours as long as examinations and other assigned work have not been missed. If a student is absent it is their responsibility to obtain the class material and remain current with information distributed during class. Occasionally changes in schedule may be announced in class. *These changes apply to all students, even those who were absent from class.* One letter grade may, at the discretion of the instructor, be deducted from students' final grade if they miss more than four classes. There will be no distinctions between "excused" and "unexcused" absences. Students are expected to be on time to class. After the beginning of the class, late students may be counted as absent.

Academic dishonesty
http://www.shsu.edu/administrative/faculty/sectionb.html#dishonesty

Disabled student policy
http://www.shsu.edu/~vaf_www/aps/811006.html

Services for disabled students
http://www.shsu.edu/~counsel/sswd.html

Student absences on religious holy day policy
http://www.shsu.edu/catalog/scholasticrequirements.html#holyday

Syllabus topics (15 weeks)

Week 1 (16th January)
DNA structure and gene expression

Week 2 (21st January)
Chromosome structure and function

Week 3 (28th January)
Genes in pedigrees and populations.
Lab 1: Bone, hairs, nails and skin. DNA organic extraction.

Week 4 (4th February)
Genome projects and model organisms
Lab 2: DNA silica based extraction

Week 5 (11th February)
Organization of the human genome
Lab 3: Bone, hair, nail and skin: pre-treatment. Freezer-mill.

Week 6 (25th February)
Identifying human diseases
Lab 4: Real-time quantification and genotyping (MiniSTRs)

Week 7 (3rd March)
Molecular Pathology
Lab 5: Mitochondrial DNA analysis I (Parentage testing)

Week 8 (17th March)
Population genetics: Hardy-Weinberg equilibrium
Lab 6: Mitochondrial DNA analysis II (Parentage testing)

Week 9 (24th March)
Population genetics: Genetic drift
Lab 7: Mitochondrial DNA analysis III (Parentage testing)

Week 10 (31st March)
Population genetics: Imbreeding
Lab 8: Biodefense I (SARS)

Week 11 (7th April)
Population genetics: Selection and mutation
Lab 9: Biodefense II (SARS)

Week 12 (14th April)
Genetic Data Analysis I
Lab 10: Plant or turtle STR I (Sunflower)

Week 13 (21st April)
Genetic data Analysis II
Lab 11: Plant or turtle STR II (Sunflower)

Week 14 (28th April)
Y-chromosome: Population studies and anthropology (paper)
Lab 12: Genetic Data Analysis lab (population studies)

Week 15 (5th May)
Mitochondrial DNA: Population studies and anthropology (paper)
Lab 13: Genetic Data Analysis lab II (population studies)