MOLECULAR BIOLOGY

Course Description: This course explores the basic techniques and scientific context of molecular biology, with an emphasis on cloning and recombinant DNA technology. A focus will be on experimental approaches and the laboratory activities. The lecture portion of the course will support the laboratory activities and cover basic molecular genetics such as nucleic acid structure and function, gene structure and expression. Advanced concepts of regulation, genomics/bioinformatics, chromatin structure, recombination, and transposition will be considered. Laboratory will focus on the practice of techniques central to cloning, recombinant DNA manipulation and molecular identification applications in a variety of biological disciplines. Advanced laboratory topics include PCR, DNA sequencing and analysis of polymorphisms.

LEARNING OBJECTIVES

Upon successful completion of this course, the student will understand:

1. Basic nucleic acid structure and function
2. Molecular mechanisms of gene expression and regulation
3. Molecular mechanisms of recombination
4. The molecular mechanisms underlying recombinant DNA technology
5. The context and application of genomics/bioinformatics

Upon successful completion of this course, the student will have practiced techniques central to recombinant DNA technology and cloning, including:

1. DNA isolation, quantitation and assessment of structure, purity and quality
2. Genomic cloning and transformation
3. PCR and DNA sequencing
4. Safe molecular biology laboratory practices
5. Informatics approaches to molecular biology

Major Course Requirements

Tentative Evaluation:

Your final grade will be based on the percentage you earn out of the total possible points. Individual extra credit is not possible, but extra points may be built into exams or other assignments. Statistical manipulations, if used (at the Instructor’s discretion), will be performed only once, at the end of the semester. A 10-point grading scale will be used:

A = 90 - 100 %
B = 80 - 89.9 %
C = 70 - 79.9 %
D = 60 - 69.9 %
F = 0 - 59.9 %
Components of Course Grade (Tentative)

Lecture: 75%
- 4 Quizzes @ 25 pts = 100
- Midterm Exam @ 150 pts = 150
- Final Exam (comprehensive) = 150
- [Additional Assignments @ Instructor’s Discretion] = 50

Laboratory: 25%
- Lab Data, Quizzes, Reports, Assignments, Notebook = 150

TOTAL = 600

POINTS WILL BE DEDUCTED FOR LACK OF LAB ATTENDANCE !!!

The time schedule may require adjustment. Should this be the case, the assignments and weighting may change slightly. Additional assignments may or may not be provided at the Instructor’s discretion. Such assignments might include homeworks, group projects, reading assignments, quizzes, etc. Regardless of any such changes, the lecture and laboratory weighting of your grade shall remain at 75% and 25%, respectively. For example, if you make 90% of total points available for the lecture and 80% of total points available for the laboratory portion, then your grade would be calculated as:

\[(0.9 \times 75) + (0.8 \times 25) = (67.5) + (20) = 87.5/100 \text{ possible} = B\]

An assignment will likely be due during the last week of class.

Every attempt will be made to follow the time and evaluation schedules shown here. It is the student’s duty to attend each class session and be aware of all assignments, deadlines, changes, etc.

NOTE: All Exams are the property of the Instructor as they must be saved for course records. Students may use the exams for study purposes during specified lab periods, but they must be saved and returned to the Instructor at the specified time in order for the final grade to be submitted. DO NOT LEAVE THE ROOM WITH OR COPY THE EXAMS IN ANY MANNER (photocopying, photographing, scanning, typing, etc)!

Exams will be a mixture of multiple choice, matching, fill-in the blank, short answer, labeling, calculations and essay questions. Some will require analysis and interpretation of data or experimental design to assess critical thinking skills. Some questions will be derived from laboratory activities. The Final Exam (Thursday, May 9 from 8:00 - 10:30 AM) will contain new material from the end of the semester.

Quizzes may be given at any time in class. There will be no makeups. Homeworks and other assignments may be given in class. The other assignments may include data interpretation, experimental design, calculations, opinion papers, research article summaries, etc. They will generally be due at the start of lecture class the following week. You are encouraged to get together and work on them as a group. However, unless specified otherwise, the assignments must be turned in individually and be written in your own words, NOT COPIED. An assignment grade of ZERO will be given if the work is not in your own words.

Attendance at class is required, and will be monitored. Each student will be given a 3-absence grace allowance before losing attendance points.
Required Readings


BlackBoard: Course-associated site for posting notes, readings, labs, data, etc.

Course Listserv: All students must subscribe to the class listserv, using your official University-mandated email account (firstinitiallastname@islander.tamucc.edu). You may ask questions of interest to the instructor or other students on the class listserv, eg. clarification of an assignment, as well as receive important class announcements. You are encouraged to subscribe to the Opportunities Listserv as well.

To subscribe, send an e-mail to “molbio-list-request@listserv.tamucc.edu”. Make sure that your e-mail address appears in the “From:” heading, and that the word “subscribe” is typed in the subject line. You will receive a subscription acknowledgement confirming that you have done everything correctly. To post messages to the listserv, send to “molbio-list@listserv.tamucc.edu”. Because of security concerns, you should post messages from the official TAMUCC computer account (Islander) that is used to subscribe to the listserv. At the end of class, please send an e-mail to “molbio-list-request@listserv.tamucc.edu” with “unsubscribe” in the subject heading. Please use this service to ask questions about class materials, dates, assignments, etc.

You should also subscribe to the Opportunities Listserv using the same procedure:“opportunities-list-request@listserv.tamucc.edu” This service provides notification of scholarships, research and volunteer opportunities and science-related job opportunities.

Recommended or Supplemental Reading: Supplemental readings will be posted on the Blackboard course site.

Text-Associated Website: The textbook has a free companion website with study-aids, animations & videos, essays, and links to additional materials: http://wwwclasswire.com/garlandscience

List of Supplies
You will need a laboratory notebook, “sharpie”, calculator, laboratory coat, and safety glasses.

Students should come prepared each day with textbook, lab notebook, calculator, and personal lab equipment.

Supplies REQUIRED for lab include:
- Lab coat
- Safety glasses or goggles
- Lab Notebook: Binder to organize handouts and data printouts
- Calculator
- Sharpie for labeling
- Closed-toe shoes
- A USB drive is recommended for capturing data files to be used in lab reports.
Course Policies

ALL E-MAIL COMMUNICATIONS WITH THE INSTRUCTOR OR LATER MUS MUST BE MADE THROUGH YOUR OFFICIAL UNIVERSITY E-MAIL (@ISLANDER), BY UNIVERSITY RULE.

Attendance/tardiness, Late work and Make-up Exams   You are expected to attend all classes and labs in a timely manner. Important new material, as well as schedule changes and quizzes may occur at any time. It is expected that you will take notes, ask/answer questions, and participate in group activities.

LATE WORK will not be accepted, except as below, or unless otherwise specified.
Attendance is the student’s responsibility. You are responsible for the material covered in every lecture, even if it is not in the book, regardless of your attendance. Nothing missed during an unexcused absence can be made up. An excused absence allows us to make alternative arrangements to complete an assignment. Only unavoidable absences are excused. Routine events (holiday travel, non-emergency medical visits, parent-teacher conferences, household or auto repairs) should be scheduled to avoid conflicts with class. An acceptable excuse must be:
• from an appropriate source (doctor, dentist, funeral director) stating the nature of the event
• In writing, on official letterhead, and signed (it will not be returned)
• presented prior to, or within 1 week of, the absence
• It must state the dates for which the excuse applies

There are No make-up examinations: For some scheduled events, you may arrange to take a lecture exam before, but not after, its scheduled time. Quizzes cannot be made-up.

Expectations:
You are responsible for your own education. Take notes in class as some new information may be presented. Lecture notes from the instructor, when made available, do not represent everything you need to know. Read the book and handouts for further detail not covered in class, and to be prepared for laboratory. If you don’t understand, then please ask, or see the instructor after class. Don’t allow yourself to fall behind. Be diligent and thorough on written assignments and examination answers. If you are not sure of an answer, at least try. For many people, putting anything down on paper clarifies their thinking and helps with recall. Also:
• Be aware of university-imposed deadlines (ie drop dates)
• Be aware of test times and dates, including changes which may be announced in class
• Check your exams for clerical errors. The test score is not the end of the learning process. Review tests to determine why you missed an answer. Correcting your mistakes is an effective way to learn material (reflective learning).
• Work on all assigned homework problems in a timely manner. Seek tutorial help from classmates or the course/laboratory Instructors.
• Keep track of your progress in class.

The following procedures will be enforced:
• All major exams are the property of the instructor and may not be removed from class, copied, reproduced or photographed in any way
• You must be prepared to present a photo ID at all examinations
• If you leave an examination room—for any reason—you must hand in your test and you will not be allowed to resume the examination. Attend to personal matters (e.g., rest room visits) before the examination.
• It is important to do the specified readings BEFORE coming to class for coverage of that topic. Lecture will consist of an overview, answering questions and problem-solving. The PPT notes may not be reviewed in detail except in regard to specific questions. Quizzes will be used to make sure you stay on-track. You must take responsibility for your education.
Cell Phone/Electronic Device Usage Policy on Disruptive Behavior:

As adult university students, you are expected to act with courtesy and common sense. Disruptive, disrespectful, or abusive language/behavior towards anyone in class (student, staff, faculty) will not be tolerated and could result in permanent removal from class. This includes tardiness to class, talking in class, insubordination, and electronic disturbances (cell phones, ipods, etc). Turn it off. Hazardous materials are used in the laboratory so “play” or reckless behavior will not be allowed. Children are not allowed in class or lab.

Academic Integrity/Plagiarism.

University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in appropriate action at the discretion of the instructor, including failure of the course. Everything should be in your own words.

Dropping a Class

I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with me before you decide to drop to be sure it is the best thing to do. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. November 5 is the last day to drop a class with an automatic grade of “W” this term.

Preferred methods of scholarly citations (Format from J. Experimental Marine Biology and Ecology)


Grade Appeals*

As stated in University Rule 13.02.99.C2, Student Grade Appeals, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Rule 13.02.99.C2, Student Grade Appeals, and University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules Web site at http://www.tamucc.edu/provost/university_rules/index.html. For assistance and/or guidance in the grade appeal process, students may contact the Office of Student Affairs.

Disabilities Accommodations*

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call or visit Disability Services at (361) 825-5816 in Driftwood 101.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.
OUTLINE AND SEQUENCE OF LECTURE TOPICS  (Tentative)
1. The Central Dogma; Nucleic acids & genetic information
2. The importance of weak chemical interactions, intra- and inter-molecular interactions
3. Macromolecular structures of nucleic acids and proteins
4. Techniques of molecular biology I: Quantification, electrophoretic analysis, digestion, mapping, cloning, detection by hybridization, PCR
5. Basic Genome Structure:
   Prokaryotic structure
   Prokaryotic gene organization & structure
   Eukaryotic chromatin
   Eukaryotic gene organization & structure
6. Genome Polymorphisms: Repetitive sequences, SNPs, microsats, detection
7. Techniques of molecular biology II: finding genes experimentally and in silico, bioinformatics
8. Chromatin structure affects gene expression
9. Transcriptional regulation; Studying transcriptomes; Engineering expression
10. RNA synthesis & processing in prok and euk
11. Regulatory RNA
12. Mutation and DNA repair mechanisms
13. Mobile genetic elements (transposons, viruses) and recombination (homologous, site-specific & transposition)
Tentative Laboratory Activities:
Time and materials permitting, the following laboratory activities are tentatively planned:
1. Safety and Molecular Biology Lab Orientation: Critical Operating Procedures
2. Micropipetting and Calibration, Centrifugation, Laboratory Calculations
3. Working with DNA, Dilution, Concentration by EtOH Precipitation
4. Nucleic Acid Quantification by Spectrophotometry
5. Gel Electrophoresis to Analyze DNA, Estimating Size & Structure
   Linear vs circular & supercoiled
   Nucleosomes
6. Plasmid DNA Isolation
7. Restriction Digestion and Interpretation/Analysis
8. Genomic DNA Isolation & Analysis (Human DNA)
9. PCR Amplification and Analysis (microsatellite)
10. Purification of Genomic DNA from Seagrass Epiphyte Communities
11. PCR Amplification of Community DNA and Analysis
12. Cloning PCR Products and Transformation into *E. coli*
13. Propagating Transformants
14. Screening Transformants (PCR and/or Restriction)
15. Amplification and PCR Cleanup for Sequencing (rDNA & microsats)
16. Fragment analysis of microsats
17. DNA Sequencing of Bacterial rRNA Genes
18. Analysis of DNA Sequencing Reactions
19. Bioinformatics to analyze microsats
20. Bioinformatics to identify Bacterial Species from rRNA Gene Sequences
Tentative Syllabus
(course schedule)

Wk1: Jan 24  Introduction; Slide Set #1: Central Dogma; Genomes, Transcriptomes & Proteomes (Ch 1)

Wk 2: Jan 29, 31  Genomes, Transcriptomes & Proteomes (Ch 1); Chemical Interactions: Weak, Intra- & Inter-Molecular (ECB 5; Watson 3 & 6)
Lab: Introduction, Lab Safety & Paperwork, Micropipetting, EtOH PPT, Spectrophotometric Quantification of DNA, Lab Calculations Homework

Wk 3: Feb 5, 7  Quiz 1; Slide Set #2: Studying and manipulating DNA (Ch 2.1 & 2.2)
Lab: Lab Calculations, pipetting, centrifugation & resuspension, RE Digests

Wk 4: Feb 12, 14  RE Mapping and Hybridizations (Ch 3.3); DNA structure, manipulation and analysis (See Also Ch 7 & 8; Watson 6 & 21)
Lab: Gel Electrophoresis analysis & interpretation

Wk 5: Feb 19, 21  Quiz 2; Cloning & Engineering DNA (Ch 2; Watson 21); PCR (Ch 2.1 & 2.3)
Lab: Human DNA seq polymorphisms I: Genomic DNA & PCR; [Lab Practical]

Wk 6: Feb 26, 28  Slide Set #3: Comparison of Prok vs Euk Genomes & Gene Structure; Euk nuclear genomes and chromosomes (Ch 7, 8; Watson 7)
Lab: Human DNA seq polymorphisms II: Electrophoresis, interpretation & re-PCR; [Lab Practical]

Wk 7: Mar 11-15  Spring Break

Wk 8: Mar 19, 21  Euk Genome Polymorphisms (Ch 7.2.4; Ch 3.1-3.3; Extra Material); Lab: Human DNA seq polymorphisms III: Data Analysis; Intro to Cloning Project; Environmental DNA and PCR
MIDTERM EXAM

Wk 9: Mar 26, 28  Slide Set #4: Euk Gene Str & Locating Genes-Experiment & Bioinformatics (Ch 5)
Lab: Gel analysis, interpretation; Review of Cloning Methods

Wk 10: Apr 2, 4  Markers of genes, gene expression and RNA processing (Ch 5; Extra Material)
Lab: Cloning Rxs & Transformation
2 Consecutive extra-lab returns to process transformants: pick clones, streak & repick to masterplates

Wk 11: Apr 9, 11  Quiz 3: DNA/Genome Sequencing (Ch 4.1);
Lab: Plasmid preps and PCR/RE Digest screening rxs

Wk 12: Apr 16, 18  Genome Str Effects on Gene Expression  (Ch 10; Watson 7 & ECB 5)
Lab: Gel analysis & PCR for DNA seq

Wk 13: Apr 23, 25  Transcriptional Regulation (Ch 11; 12); Studying Transcriptomes and Proteomes (Ch 6.1; Extra Material); Regulatory RNA (Ch 12)
Lab: PCR cleanup & DNA seq Rxs
Wk 14: Apr 30, May 2  
**Quiz 4;** Mutation & DNA Repair (Ch 16); Mobile genetic elements (Ch 9)
**Lab:** DNA seq Rx cleanup & load capillary sequencer

Wk 15: May 7  
Recombination: Homologous, site-specific, Transposition (Ch 17)
**Lab:** Bioinformatics analysis of environmental DNA sequences

Wk 16:  
**Thursday May 9**  
FINAL EXAM (8-10:30 AM)