MOLECULAR BIOLOGY

Course Description: This course examines the molecular mechanisms of biological information storage, change, transfer and expression. Experimental approaches will be emphasized and supported by the laboratory activities. The lecture portion of the course covers basic molecular genetics such as nucleic acid structure and function, replication and expression. Advanced concepts of DNA topology and chromatin structure, mutation and repair, recombination and transposition, regulation of gene expression, Next Gen DNA sequencing, and genomics/bioinformatics will be considered. Laboratory will focus on the practice of techniques central to recombinant DNA manipulation and molecular identification applications in a variety of biological disciplines. Laboratory topics include PCR, Q-rtPCR, DNA sequencing, bioinformatics, molecular identifications and analysis of polymorphisms.

LEARNING OBJECTIVES

Upon successful completion of this course, the student will be able to describe:

1. Basic nucleic acid structure and function
2. Chromatin structure, genome organization and DNA topology
3. Molecular mechanisms of mutation, DNA repair, recombination and transposition
4. Molecular mechanisms of gene expression and regulation
5. The molecular mechanisms associated with recombinant DNA technology
6. The context and application of genomics, Next Gen DNA sequencing, and bioinformatics
7. Applications of molecular biology for identification and study of genetic variation

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

1. DNA/RNA isolation, quantitation and assessment of structure, purity and quality
2. PCR, Q-rtPCR and DNA sequencing
3. Experimental approaches used for molecular identifications and analysis of genetic variation
4. Informatics approaches to molecular biology
5. Safe molecular biology laboratory practices

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%
- 6 Quizzes @ 15 pts = 90
- 3 Exams @ 100 pts = 300
- Additional Assignments @ Instructor’s Discretion = 60

Laboratory: 25%
- Participation, Lab Data, Quizzes, Reports, Assignments, Presentation = 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, check BlackBoard, check listserv messages and be aware of all assignments, deadlines, and changes therein.

**NOTE:** All Exams are the property of the Instructor as they must be saved for course records. Students may use the exams for study/reflection 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 are all strictly forbidden)!

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 8 from 8:00 - 10:30 AM)** will contain new material from the end of the semester.

The first 2 weeks of class are a quick review of basic biology and chemistry (Chapts 1-5) which you are already expected to be familiar with. Accordingly, it will only be reviewed briefly in class, but **you are nonetheless required to understand this material thoroughly**! Therefore, the first 5 chapters of the book must be read and learned mostly on your own. BlackBoard will be setup with 6 online quizzes (totaling approx. 90 pts) which you will be required to take at a specified time to assess this learning. To assist your learning, the instructor will answer specific questions at the beginning of lectures 2 and 4. BlackBoard will have some supplementary PPT notes. PLUS, there is no lab on Wks 2 & 3 to provide you with extra time to do this work, and the TAs will be available to help tutor you on this material if needed. Please pay careful attention to the specified time to take the quizzes. **You MUST get your BlackBoard access figured out ASAP so you will not fall behind or miss the quizzes !**
Attendance at class is expected and required. Other quizzes or assignments may be given at any time in class. There will be no makeups. Homeworks or 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.

Exam/Quiz/Assignment grades are not dropped. The whole class is important and it all counts!
Lab attendance and participation are absolutely required and will be monitored!

Required Readings

Companion Website: www.whfreeman.com/cox (many student resources and study-aids)

BlackBoard: (http://bb9.tamucc.edu) Course-associated site for messaging, quizzes, posting PPT notes, supplementary materials and readings, video-recordings, links to resources, labs, data, announcements, etc. You MUST use this and get your access figured out ASAP! Call the IT Help desk for assistance:
(361) 825-2692 (local); (866) 353-2491 (toll free); email: computer.helpline@tamucc.edu; internet: Submit a Ticket
TUTORIALS: Island Online: https://iol.tamucc.edu/; IT website: http://it.tamucc.edu/
If you haven't already prepared your computer for Blackboard, access Blackboard Technical Requirements and follow the directions.

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. If you do not receive this acknowledgement message, LOOK in your junk folder and permit these messages for your inbox. 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.
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:
   a. Lab coat
   b. Safety glasses or goggles
   c. Lab Notebook: Binder to organize handouts and data printouts
   d. Calculator
   e. Sharpie for labeling
   f. Closed-toe shoes
   g. 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 LAB TA 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 OR MAKEUP 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 or notes, 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 [If something happens (eg a car accident) you are expected to use all means to contact the instructor ASAP if an excuse is expected – use email, phone and pony express !]
   • It must state the dates for which the excuse applies

There are No make-up examinations: For some University 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 only 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, copying exam answers, 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, but it may impact your financial aid! Be aware of 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**

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 on 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 on the process, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, consult Texas A&M University-Corpus Christi University Procedure 13.02.99.C2.01 Student Grade Appeal Procedures (http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage (http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school or the College of Science and Engineering Dean’s Office.

**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. Intro; Overview: living systems, biological information flow, RNA World, evolution, scientific method
2. The “Expanded” Central Dogma; chemical structure of DNA and other information molecules, post-synthetic modifications
3. The importance of chemical bonds and weak chemical interactions, chemical basis of intra- and inter-molecular interactions, molecular structures
4. Macromolecular structure of proteins, folding and function
5. Protein-nucleic acid interaction examples of function
6. DNA and RNA structures, variations and analyses; absorbance and hybridization
7. MIXED IN THRUOUT: Studying Genes: DNA isolation, digestion, electrophoretic analysis, mapping, cloning and vectors, transformation/mobilization, libraries, detection by hybridization, PCR, DNA sequencing, genotyping, mutagenesis & expression of recombinant proteins, protein localization, protein-protein interactions, DNA microarrays
8. Intro to –omics: Genomes, transcriptomes and proteomes (The BIG picture)
9. Chromosomes and DNA topology; Supercoiling & packaging
10. Chromatin structure and nucleosomes; Regulation of structure
11. DNA Replication mechanisms
12. DNA mutation and repair mechanisms overview
13. Recombinational repair and homologous recombination
14. Site-Specific recombination and Transposition
15. Transcription mechanisms
16. RNA Processing mechanisms
17. Gene expression regulation overview
18. Transcriptional regulation
19. Post-transcriptional regulation
Laboratory TAs:  
Section .101 (T 2:00-5:00):  Whitney Roberson  
wroberson@islander.tamucc.edu  
Office Location & Hrs:  EN 301  (Hrs TBD)

Section .102 (T 5:30-8:30):  Whitney Roberson  
wroberson@islander.tamucc.edu  
Office Location & Hrs:  EN 301  (Hrs TBD)

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, RE Digestion  
4. Nucleic Acid Quantification by Spectrophotometry; Fluorometry  
5. Gel Electrophoresis to Analyze DNA, Estimating Size & Structure  
   Linear vs Circular & Supercoiled  
   Nucleosome Organization  
6. Plasmid and Genomic DNA Isolations  
7. PCR Amplification and Cleanup for Sequencing (rDNA & Microsats)  
8. DNA Sequencing and Fragment Analysis  
9. Analysis of Genetic Variation (Human Microsats)  
10. Bioinformatics to Analyze Barcodes for Molecular ID  
11. Bioinformatics for Molecular Identification of Bacteria from rRNA Gene Sequences  
12. RNA Isolation and Q-rtPCR for Gene Expression Analysis  

CLASS and LAB SCHEDULE:  See Syllabus Below and Also Excel Spreadsheet  
Version of Course and Lab Schedule (Both available on BlackBoard)
Tentative Syllabus
(course schedule)

Wk 1: Jan  (Ch 1-2) Course Intro; Studying molecules; Information in DNA [Self-Study Review Expected]

Wk 2: Jan  (Ch 3) Questions; Chemistry of information molecules [Self-Study Review Expected]
No Formal Lab: TAs available to tutor Ch 1-3
Students take Online Quizzes 1-3 on BlackBoard – No Later Than 8:00 AM Thurs
Morning Jan
(Ch 4-5) Protein structure & function [Self-Study Review Expected]

Wk 3: Feb  (Ch 6) Questions; DNA Structure [Self-Study Review Expected]
No Formal Lab: TAs available to tutor Ch 4-5
Students take Online Quizzes 4-5 on BlackBoard – No Later Than 8:00 AM Thurs
Morning Feb
(Also parts of Ch 7) Techniques for studying genes

Wk 4: Feb  (Ch 8; Also parts of Ch 7) Genomes, transcriptomes & proteomes; Techniques for studying genes
Students take Online Quiz 6 on BlackBoard – No Later Than 8:00 AM Thurs
Morning Feb 13
Lab 1: Intro; Lab Procedures, Safety; Calculations; Pipetting

Wk 5: Feb  (Ch 9, 10) DNA Topology; Nucleosomes, Chromatin structure
Lab 2: Calculations; Pipetting; EtOH PPT, DNA Quantification, RE Digestion

Wk 6: Feb  (Ch 10,11, 12) Nucleosomes, Chromatin structure; DNA replication; DNA mutation & repair
Lab 3: Calculations; Gel Analysis from Lab 2; Nucleosome Analysis Lab

Wk 7: Mar  (Ch 12) DNA mutation & repair
Lab 4: Hu DNA Polymorphism I (Genomic DNA & PCR)

Mar 10-14  Spring Break

Wk 8: Mar  (Part II of Ch 7) Techniques for studying genes: cDNA, PCR, DNA Sequencing
Lab 5: Hu DNA Polymorphism Data Analysis; Lab Data Analysis

Wk 9: Mar  (Ch 8) Genomes, transcriptomes & proteomes; Techniques for studying genes
Lab 6: DNA Barcoding Expt I (Genomic DNA & PCR)

Wk 10: Apr  (Ch 12) DNA mutation & repair
Lab 7: DNA Barcoding Part II (Gels); rRNA Clone Seq I (plasmid prep & PCR)

Wk 11: Apr  (Ch 13) Recombinational repair, Homologous recombination
Lab 8: rRNA Clone Seq II (Gels, DNA Seq Rxs)

Apr  EXAM II [Ch 7(part II), 8, 12]

Wk 12: Apr  (Ch 14) Site-specific recombination & transposition
Lab 9: rRNA Clone Seq III (DNA Seq Rx Cleanup & Sequencing)
Wk 13: Apr  
(Ch 19; 21) Gene expression overview; Transcriptional regulation (Euk)  
Lab 10: DNA Barcoding Bioinformatic Data Analysis; rRNA Clone Seq IV  
Bioinformatic Analysis

Wk 14: Apr, May  
(Ch 21; 22) Transcriptional regulation (Euk); Post-transcriptional regulation (Euk)  
Lab 11: Q-rtpCR I (RNA Isolation, F-Quant, PCR)

Wk 15: May  
(Ch 22, Also part of Ch 16) Post-transcriptional regulation (Euk) and RNA Processing  
Lab 12: Q-rtpCR Data Analysis & Results Discussion; Lab Wrap-up

Thursday May       FINAL EXAM (8-10:30 AM)