Genomics, Proteomics & Bioinformatics

Course Description:  An introduction to integrative biological study using genome-wide approaches and bioinformatics. The “-omics” technologies (genomics, transcriptomics, proteomics, metabolomics, etc) will be reviewed. Applications to understanding biological function in various biological disciplines will be emphasized. Hands-on bioinformatics activities will be practiced. Prerequisites: Genetics (BIOL 2416) AND either Cell Biology (BIOL 3410) or Biochemistry I (CHEM 4401).

LEARNING OBJECTIVES

By the end of the course, students should be able to:
1. Conceptualize the function of organisms at the levels of the genome, the transcriptome, the proteome and the metabolome.
2. Describe basic methodology associated with genomics, comparative gene expression studies, proteomics and metabolomics
3. Describe the utility of genome database projects in model and commercial organisms.
4. Describe basic methodology associated with sequence processing, comparative gene expression analysis, and data mining.
5. Describe the contribution and importance of bioinformatics in the application of the “-omics” technologies.
6. Describe applications of genomics technologies in medicine, agriculture and environmental science.
7. Describe the concept of “Systems Biology” as distinct from traditional biological disciplines.
8. Recognize applications for the emerging field of “Synthetic Biology”.
9. Critically evaluate the quality and utility of genomic data.
10. Describe “Next Generation” DNA sequencing technologies

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 bonus 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)

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>MidTerm Exam (In-class + Take Home)</td>
<td>200</td>
</tr>
<tr>
<td>Final Exam</td>
<td>150</td>
</tr>
<tr>
<td>Quizzes</td>
<td>150</td>
</tr>
<tr>
<td>Homeworks or Other Assignments</td>
<td>150</td>
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<tr>
<td>Paper Review</td>
<td>50</td>
</tr>
<tr>
<td>Genomics Project</td>
<td>100</td>
</tr>
<tr>
<td>Attendance/Participation</td>
<td>50</td>
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<td></td>
<td></td>
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<tr>
<td>TENTATIVE TOTAL</td>
<td>800</td>
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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.

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.

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 (Wednesday, Dec. 14 from 1:45 - 4:15 PM) 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 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.

The Genomics Project will be the design, implementation, and presentation of a genomics application that incorporates a sequence of bioinformatics tools.

Attendance at class is required. Each student will be given a 2-absence grace allowance before losing attendance points.

Required Readings


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, e.g. 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 “Genomics-list-request@sci.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 “Genomics-list@sci.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 “Genomics-list-request@sci.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@sci.tamucc.edu”. This service provides notification of scholarships, research and volunteer opportunities and science-related job opportunities.

Other Required, Recommended or Supplemental Readings: It is HIGHLY recommended that you obtain a genetics book to use as a reference. Other readings will be distributed via Listserv or 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 must have access to a computer and internet.

Course Policies
ALL E-MAIL COMMUNICATIONS WITH THE INSTRUCTOR 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 new information, not in the textbook, may be presented. Lecture notes from the instructor, when made available, do not represent everything you need to know. Read the book, assigned readings and handouts for further detail not covered in class. 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 Instructor.
* 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 personal matters (e.g., rest room visits) before the examination.

**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, crackberrys, 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.
Tentative Topic List
(course schedule)

Introduction; The “Omics” Technologies
  Genomes
  Transcriptomes
  Proteomes
  Other “-Omes”
  Regulation is key
  Evolution
  Ethical, Legal & Social Implications (ELSI)
  Applications: Medicine, agriculture, biofuels, environment

Ch 1; Supplemental Readings
See also Ch 12
See also Ch 13.3 & 13.4
See also Ch 6.3

Cloning, Mapping & Sequencing

Human Genome Project

New DNA Sequencing Technologies

Review of Gene Structure

Analyzing Gene Sequence Data – Bioinformatics
  Locating genes/verification/functional characterization
  Scanning sequences & sign posts
  Annotation of gene sequences
  Comparing sequences/Comparative Genomics I
  Genomic Polymorphisms (Indels, microsats, SNPs)
  Signature genes & Metagenomics

Ch 5; Supplemental Readings
Supplemental Readings
Supplemental Readings
Supplemental Readings
Supplemental Readings

Studying Transcriptomes & Proteomes
  Microarrays, Q RT PCR, SAGE, Next Gen Seq
  Protein Profiling methods; Protein Interactions

Ch 6; Supplemental Readings

Genome Anatomy, Organization and Accessibility

Ch 7, 8, 10

Regulation of Gene Expression – Coordinating Genome Activities
  Chromatin structure
  Transcriptional regulation & RNA Processing
  Regulation of genome activity (Transient, Permanent, Semi-Permanent)

Ch 10, 11, 12, 14
Ch 10
Ch 11, 12
Ch 14

Genome Maintenance & Changes
  Mutation & Repair
  Recombination
  Evolution of Genomes (new genes, Non-coding seqs)

Ch 16, 17, 18
Ch 16
Ch 17
Ch 18

Molecular Phylogenetics

Ch 19