Overview

Welcome to Molecular Biology, by far the most exciting of field not only in biology but in any other science. We are witnessing an explosion of knowledge that is revolutionizing our understanding of how cells function. Furthermore, all this knowledge is helping us to comprehend diseases at the molecular level and to better design therapeutically reagents to treat a multitude of conditions. We will spend a semester together learning about different aspects of Molecular Biology, mostly related to how genes and proteins interact with each other and how inheritable mutations that disrupt the normal function of proteins can lead to human disease. There will also be an emphasis on the protein structure and the different techniques that scientists use to make discoveries in molecular biology. On the pedagogical side, we will heavily use peer-to-peer teaching and computer modeling tools to investigate in depth many of the topics covered in this class.

Class materials

- MOLECULAR CELL BIOLOGY 7th Edition by Lodish et al, Freeman

Learning objectives

Students who successfully complete this course will be able to:

- Describe the general principles of gene and genome organization, genome replication, and gene expression in both prokaryotic and eukaryotic organisms.
- Understand the processes of Transcription and Translation and how both are regulated.
- Discuss the basic elements of protein folding, sorting and post-translation modification.
- Explain various levels of gene regulation and protein function including signal transduction and cell cycle control.
- Interpret the outcome of experiments that involve the use of recombinant DNA technology, and other common molecular biology techniques.
- Understand the molecular basis of genetic disorders and the role that mutations play in triggering disease onset.
- Read basic molecular biology primary literature and design experiments to test molecular biology hypothesis.
Blackboard

You must access the Blackboard site before you come to class. There I will post all assignments, announcements, as well as handouts and papers. You are responsible for printing out and bringing handouts and papers to class as appropriate. I will constantly make changes to the syllabus, so make sure you have the latest version. I will also use BB to send messages either to the whole class or to specific students, please feel free to use the same communication channel if you wish to.

Attendance and participation

- You are expected to attend and to be punctual every lecture. In class we do much more than just following the textbook. If you know that you are going to miss a class, let me know in advance. If something comes up and you end up missing a class come talk to me to get remedial work. If there was a graded activity the day you miss you won’t be able to make it up. After 5 unexcused absences you’ll get an ‘F’ for the course.

- If you have a cell phone and/or pager, please be sure to turn it to silent mode before the lecture begins. Personal MP3 players, iPods, portable DVD players, portable gaming devices, or any other type of portable entertainment devices MUST be turned OFF before the lecture begins.

- You may use a laptop to take notes, however this privilege will be revoked if you are found using your laptop for any other purpose during the lecture. Powerpoint/Keynote slides or any other material I use to teach will only be available after the class is over. Take notes, it’s important

- iClikers should be taken as you get into class and they should be returned promptly after each class. They are not toys, treat them carefully and do not misuse them. I will revoke its use if it becomes disruptive to the class. If you break one, you’ll have to replace it.

- Participation is important. Raise your hand if you have a question or want to comment on something, just do it orderly. A dialogue is much better than a monologue.

How to do well in this class

- Allocate enough time for the class. Read, search, read, ask, google and read. At your level it is not acceptable to expect all knowledge to come from your professors. As you move in your career you’ll be expose more and more with classes where the instructor is a facilitator of learning rather than a reciter of topics. Be resourceful and learn where to find credible and trustable information.

- Follow a plan. I have designed the course with the following study plan for each class in mind

  1. Read assigned textbook pages before coming to class
  2. Attend class, take notes and be proactive.
  3. Review class materials and add your notes to the class slides.
  4. Read all materials and look for extra information
  5. Make effort to understand concepts rather than memorizing them
  6. Send me questions or make use of my office hours if you need further clarifications

- Work in groups, form study groups. Different people master different skills; forming a study team with people with different skills than yours may help you a lot in this class. But remember: you are still responsible to do your own work.
Students with disabilities

If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. All discussions will remain confidential. Additionally, you will need to register with the Counseling and Disability Services Office in Crooker Center. This office can be reached at (713) 525-2169 or 6953.

Academic Integrity

Each student must do their own work on exams, quizzes, and writing assignments. Please read the UST Policy on Academic Dishonesty in the Undergraduate Catalog, as you are responsible for this information. “The penalty for an incident of academic dishonesty is, at the discretion of the faculty member, either a mark of zero for the work in question or the grade of ‘F’ for the course”. Upon a second charge of academic dishonesty […] the student shall be dismissed from the University without the possibility of readmission. The transcript will note “Dismissed for Academic Dishonesty, Not Eligible to Return”, along with the date (Undergraduate Catalog, UST).

Exams

- Exams will be a combination of multiple choice, short answer, true or false, fill-in-the-blank, and essay questions. Also, you may be requested to draw a simple diagram or complete problems similar to the ones assigned as homework.

- There will be 2 exams worth 100 points plus a comprehensive and cumulative final exam worth 300 points. The dates on the exams will not change; mark them in your calendar NOW.

- **THERE ARE NO MAKE-UP EXAMS.** If you miss an exam you will receive a zero. If you have an emergency that forces you to miss an exam you must contact me as soon as possible.

Grades

Grades will be assigned according to the percentage of the total number of possible points. Incompletes (I) are given only in extreme circumstances and will require a written contract between the student and myself. To be eligible for an incomplete, you must have a C or better at the end of the semester. UST policy does not permit substitution of the incomplete grade (I) for substandard performance.

- Exams: 200 (100 each)
- Final Exam: 300
- Snapshot: 50
- Quizzes: 100 (50 each)
- Class Problems + Exercises: 50
- **TOTAL**: 700

**UST POLICY ON SEMESTER GRADES** (UST Faculty Handbook 2004)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tr>
<td>A</td>
<td>(92-100%)</td>
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<td>A-</td>
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<td>D</td>
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<td>F</td>
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6.2.15d “Course grades are communicated to students by the Registrar’s Office. Faculty members may not post course grades, even with a coded listing, or by any other means, whether orally or in writing, communicate them to the students”.

6.2.17a “Final examination books are not to be returned to students…final examination books must be kept on file for at least one year after the examination”
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
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<tr>
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<td>Class 0 - Introduction</td>
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<td>Martin Luther King</td>
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<td>(W) Jan 21</td>
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<td>3.1-3.2</td>
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<td>Post-Translation modifications I</td>
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<td>Techniques: Purifying and detecting proteins</td>
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<td>Molecular Genetics – Transcription-Translation</td>
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<td>Molecular Genetics – DNA replication</td>
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<td>Molecular Genetics-DNA repair</td>
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<td>Techniques: Cell Culture and siRNA</td>
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<td>FINAL EXAM 12:00 – 2:30pm</td>
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SNAPSHOTS

This is a new initiative to cover lots of material while promoting peer-to-peer teaching. Education theory indicates that peer-to-peer is one of the most effective ways of learning with one of the greatest rates of concept understanding and retention. We will use this system through the use of SNAPSHOTS, modeled after the same CELL journal series. Each of you will have to cover a disease whose molecular mechanism has been elucidated. For your assigned disease, you will have to create a SNAPSHOT, which will summarize tons of information about that topic. Here are some of the points you can include when creating each SNAPSHOT. The purpose of these points is to guide you through this process; by no means you need to include every single point nor can you not add others. You will have to read, get tons of information and decide what goes in and out of the SNAPSHOT you are preparing. You need to include the most important concepts, not all. For some SNAPSHOTS that would mean to talk a lot about the domains involved while for others would mean to talk a lot about the regulation of the gene, complex or pathway. Make sure you do a great job: your SNAPSHOT is worth as much as quiz. Moreover, the whole final exam will incorporate concepts treated in class with the information present in all the class SNAPSHOTS.

- **SNAPSHOTS- A guide**
  - What are the symptoms or the disease?
  - What genes are involved? To what pathways do those genes belong?
  - What is the structure of the gene? Where is located in the genome? How many introns and exons does it have?
  - Does the gene have recognizable domains or motifs?
  - Is it conserved? Can you find it in other organisms? How low in evolution can you go and still detect this gene?
  - Does it express everywhere?
  - Does it undergo alternative splicing? Is alternative splicing dependent on tissue expression?
  - Where is the protein localized? How does it get there?
  - Does it undergo post-translational modification? Which ones? How many? Where?
  - What is the function of the protein? What is their catalytic reaction?
  - How post-translational modification affects that function?
  - Has the structure been resolved?
  - Does it bind other proteins? How? What region is involved in that binding?
  - Is this gene regulated? How? By who?
  - Have mutations been identified? Which ones? What is their effect?
  - Do we have knockout models in other organisms?
  - Have mutations of this gene been found in patients? Which ones? Do we know what disease-leading effect cause those mutations
  - What are the effects of these mutations in the expression of the gene?
  - What are the effects of these mutations in structure, function or localization of the protein?
  - How is the structure of the proteins related to the function of the overall complex/family?

After you prepare your SNAPSHOT, you will have to present it to the rest of your peers in class. This is how the whole process is going to work:

- On the day and time assigned to you, you will have 5 minutes to introduced to the class the topic assigned to you.

- To help the class follow your presentation, you will create a SNAPSHOT modeled after the CELL snapshots and you will bring a copy for every single student in the class, including your professor.

- Your presentation will be followed by a 5 minutes Q&A session.
Here is some advice to do well when creating SNAPSHOTS and presenting them to your peers:

- The point of this exercise is for you to learn where to find information, read it and identify what is relevant.
- Be very visual and succinct without skipping important information. Clarity is a must.
- Design the best concept to create your SNAPSHOTS. Creativity matters for your grade.
- Also, be right! Double check everything to avoid introducing mistakes.
- Avoid adding irrelevant information or concepts that you do not understand or cannot explain. Remember: you will be liable for that information in the final exam.
- Read from different sources: common information from several sources it a great indication of its importance.
- Make it interesting!
- You will have 5 minutes to present your Snapshot in class via powerpoint presentation.
- Before that, you will pass to the class a copy of your SNAPSHOT.
- When others present your information, make sure you ask questions and understand it very well as you will be liable for all information there. You do not need to memorize each disease and pathway but the exam will contain questions that will require your full understanding of everybody’s SNAPSHOT.

As mentioned above, try to look for several sources of information but make sure they are credible and trustable sources. Molecular Biology is evolving by the minute, information from 1995, for example, is considered very old. Make sure you rely on recent papers and reviews rather than outdated old books. Here are some suggestions:

- Pubmed: **The most important source.** Focus in getting reviews, not primary data. Certain journals are specifically devoted to publish only reviews. Some of my favorites:
  - Nature Reviews Molecular Cell Biology
  - Nature Reviews Genetics
  - Nature Reviews Cancer
  - Trends in Cell Biology
  - Trends in Genetics
  - Trends in Molecular Medicine

- Books: Yes, your textbook is a very good source of information, but for most of you, you will need to go deeper if you want to have a good grade. I have others that you can consult in my office hours.

- Bioinformatic websites: No, Wikipedia is not one of them. Here is some of the websites that can help you a great deal:
  - GeneCards: [http://www.genecards.org/](http://www.genecards.org/)

Be very careful about websites. Just because is there it doesn’t mean is true. If you are not sure a certain website is trustable then ask me or do not use it. If you put outdated information it will hurt your grade. It is much safer to go with recent reviews.

**EVALUATION of the SNAPSHOT PROJECT**

SNAPSHOT: 25pts

PRESENTATION: 20pts

PARTICIPATION: 5pts
EXTRA CREDIT: Molecular Biology Research talk. (10 points)

You may also choose to attend a molecular biology related, scientific lecture at Rice University, Baylor College of Medicine, MD Anderson, or the University of Texas Health Science Center. Your visit will be assessed by a 1000 word written report detailing the lecture topic, the results of the study, and the significance of the results. This experience will be worth up to 10 points on your total grade and it is due no longer than a week after the talk. My preference is that you go to one of the talks in the Bluffer Series at M.D. Anderson.

OPTIONAL SERVICE LEARNING (25 extra points)

■ GENETICS AMBASSADORS

This extra credit project will require that you volunteer at an under-served academic institution of your choice. This experience will count for up to 25 extra points of your total grade. You will have to contact K-12 science professor and offer to bring to their students an activity designed by you. It can be designed for any K-12 level, for either a lecture or a lab session and it has to deal with topics related to genetics and molecular biology. I’ll allow groups of max. three to perform this service learning.

Here are some websites with some examples of activities to stimulate your creativity:

• The Tech, Museum of Innovation [http://genetics.thetech.org/online-exhibits/genes-common]
• Harvard Outreach Program [http://outreach.mcb.harvard.edu/materials.htm]
• NIH-DNA day [http://www.genome.gov/20519692] and [http://www.genome.gov/10005911]

Use these websites as a model to create your own activity. Make it interesting and make sure it has the proper difficulty for the proposed level: not too hard, not too easy.

Here is the order of events that you should follow:

1. Sit down with your group, browse those websites and start deciding what kind of activity you want to produce and what is the targeted grade.
2. Contact professors from an under-served institution and propose your ideas.
3. Set up a meeting with the professor and get a fair idea about what to expect and how to better design your activity
4. Get my approval (office hours, please)
5. Design your activity
6. Present materials to the professor and to me for final approval.
7. Deliver your activity.
8. Collect the evaluation forms (Yes, the professor will also evaluate your work)
9. Make a three page summary Newsletter about your experience (make sure to take pictures to add in the newsletter and get the opinion from students)

Here is how your work will be evaluated:

• 15 points: rubric evaluation from the professor at the underserved institution
• 5 points: newsletter evaluation
• 5 points: my personal evaluation of your work and enthusiasm

You have learned a lot of genetics and molecular biology at UST, it is time to pass some of that to less privileged kids and stimulate their interest to pursue STEM related careers.
The following advices have been taken from “DNA day-Speaking about genetics” from the NIH. I STRONGLY suggest you visit their page and read all their points; they will help you make this activity a success http://www.genome.gov/12011706

Share the Excitement of Scientific Discovery
Communicate the process of critical thinking and scientific analysis by involving students in open-ended scientific discovery. Emphasize hands-on experimentation to convey that the process of inquiry-based science is more important than memorizing content or achieving a "correct," pre-planned result. Convey that in real science the answer may not be simple, stable, or known.

Don't Lecture - Engage!
Guide students in thinking, exploring, investigating, drawing conclusions, and having fun. Model inquiry, rather than lecturing facts. Spark student interest with topics relevant to them, reinforce learning by highlighting their successes and encouraging deeper thinking.

Bring Your Presentation to Life
Students succeed in learning content by becoming involved in the process. Present a short demonstration within the allotted time. Encourage students to record their observations and engage in discussion concerning the broader philosophical basis of science (e.g., How certain is the data? How do scientists apply their findings in a broader context? Do the results have social implications?)

Prepare and Know Your Audience
Be aware of the students' abilities and scientific course backgrounds, space restrictions, equipment availability, etc.

Understand Your Role in Science Education
By partnering with teachers, you help the public understand and appreciate your work and you give a stamp of importance to science education. You provide unique insights to the trials and tribulations of science that is relevant to peoples' lives, not revealed in textbooks. Ensure that your handouts are targeted at the appropriate readability level.

Foster Equity in the Classroom
Be respectful of differences in learning styles and don't focus on a select few to the exclusion of others. Consider that gender and cultural backgrounds may make some students hesitant to speak out. Don't make students compete for your time and attention. Use anxiety-reducing strategies to encourage cooperative learning.