**SYLLABUS**

**BIOL 312 MOLECULAR BIOLOGY OF THE CELL, SPRING 2017**

**Class meetings:** MWF 9:05-10:00, JSC 311

**Laboratory:** Th 9:05-12:05, JSC 412

**Instructor:**

Eric Cooper, Ph.D.

Office: Johnstone 341

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**Office hours:** MWF 3:00-4:30; Th 3:00-4:30; occasional evening “drop-in” sessions in Laura’s Lounge. Also, please feel free to make appointments by email or just drop in!

**Textbook**: Alberts, B. et al. Essential Cell Biology (4th edition) Garland Science, ISBN 978-0-8153-4454-4. We will also be supplementing the book with various other sources – lectures available online, animations, recent reviews of various topics, etc.

**Laboratory notebook**: If you already have a bound lab notebook from a previous course, feel free to start a new section for this one. Otherwise, a standard binder is fine.

**Email**: I will likely pepper you with emails throughout the semester via your Hartwick email, so please check this account frequently and read my notes!

**Previous knowledge:** For this course, students are expected to understand the “Central Dogma” of molecular biology, as covered in Biol 202. You should be *generally* familiar with the structures of the major macromolecules in cells (proteins, nucleic acids, lipids and sugars), the definition of a gene, how genes are regulated, and how genes code for RNA and, in turn, protein. We will begin the semester by reviewing these topics in the context of examples and then delve more deeply into them.

**Purpose of this course:** This course delves more deeply into many aspects of cellular biology, including transcription and translation, the cell cycle and the functions of different organelles and proteins within cells. We will also cover topics including selective movement of molecules into and out of cells, how proteins are targeted to the correct locations in cells, how protein concentrations are regulated, how proteins assemble into macromolecular machines to execute their functions, and how cells transmit extracellular signals into intracellular responses. For many topics, we will also consider how genetic, biochemical and molecular experimental approaches were used to explore important questions in the field, and how diseases may result if particular cellular functions are perturbed. BIOL 312 is appropriate for students interested in majoring in biology, chemistry, or biochemistry, and who are preparing for possible careers in teaching, research, health-related fields, science policy, etc. Whatever your reasons for being here, welcome!

**Attendance and classroom policies**: Attendance at each lecture and laboratory session is expected. In the event of illness or emergency, you are responsible for making arrangements to make up any missed work. Also, note that the laboratories often build on each other, so if you miss one, you will likely be behind! While in class, please be respectful of your classmates (and me) by keeping cell phones silent, and refraining from texting, checking email, updating Facebook pages, etc.

**Learning support**: Hartwick College is committed to upholding and maintaining all aspects of the Federal Americans with Disabilities Act of 1990 (ADA) and Section 504 of the Rehabilitation Act of 1973.  If a student with a disability wishes to request accommodations, they must contact Chad Christensen, Coordinator of Learning Support Services. He is located on the 5th floor of Yager Library in the Center for Student Success.  Any information regarding a student’s disability will remain confidential.  Requests for accommodations should be made as early as possible.

**Academic Honesty:** All students are expected to complete their OWN work. Everyone should have read The Hartwick College Academic Honesty Policy, available on-line at http://www.hartwick.edu/x12195.xml. The definitions and responses to academic dishonesty outlined in this policy will be strictly adhered to in this course.

**Assessments:**

**Quizzes:** There will be brief (~15 min of class) almost weekly quizzes related to each topic. Quizzes will be directly based on reading from the textbook, class material, “study guide” questions for each week, and other assignments that will accompany some of the topics we cover.

**Exams:** There will be four total exams – three in-class exams during the semester and a “non-comprehensive” final. Exam questions will be a combination of short-answer and “short-response” that integrates text readings and lecture material.

**Classroom & homework assignments:** Some topics we cover will be accompanied by in-class assignments for submission that day, or homework assignments that will be submitted to D2L.

**Participation:** Based on some blend of involvement in class discussion, arriving prepared for class, seeking help when necessary, etc.

**Laboratory assignments:**

1. *Pre-labs:*Some labs will be accompanied by pre-lab assignments. These are typically D2L quizzes based on the write-up for that day and any online animations or other resources that will prepare you for lab. These must be completed prior to the beginning of lab to receive credit.
2. *Daily assignments:* Most labs will be accompanied by assignments to either be submitted by the end of that day, or at a later time to be determined. These will assess your understanding of the experimental procedures performed that day.

1. *“Lab meeting” data presentations*: Several times throughout the semester, you will need to perform some lab work outside the 3-hour block of time on Thursday. If this is the case, you will then present your data with a brief Powerpoint during the next Thursday lab period. I should emphasize that it does not matter whether or not your experiment “worked” exactly how you hoped! However, it *does* matter that you put in a good faith effort to complete the experiments, understood what you were doing, and can clearly present your data to the group.
2. *Lab reports:* You will be writing one or two “formal” lab reports this semester. They should be in the form of a scientific paper and include the following: Introduction, Methods, Results and Discussion. Detailed instructions will be provided. But, be aware that these will summarize several weeks of work – the labs build on each other, so please be sure that you understand what is happening each week!
3. *Poster at student showcase:* Each lab group will be presenting a poster at the Student Showcase on May 8th. This will be the equivalent of the lab “final.”

**• Learning outcomes:** By the end of this course, you should be able to...

1. explain the two basic experimental approaches used in biology – biochemical fractionation and genetic (i.e. mutant identification) approaches
2. understand the difference between dehydration synthesis and hydrolysis reactions and how these contribute to assembling and disassembling the four major macromolecules
3. explain the cell theory and the theory of evolution by natural selection
4. describe the functional anatomy of prokaryotic and eukaryotic cells
5. describe and differentiate prokaryotic and eukaryotic genomes and the molecular structure of chromosomes
6. describe cell cycle checkpoints and the action of oncogenes and tumor suppressors
7. explain Mendel’s principles of segregation and independent assortment and describe some exceptions to, and extensions of, Mendelian inheritance (e.g. linkage, incomplete dominance, epistasis, etc.)
8. explain the chromosome theory of inheritance and differentiate between chromosomes, genes, alleles, genotype, phenotype, sex chromosomes, and autosomes
9. describe the structure of DNA and how it is replicated during S-phase
10. describe the structure of RNA, and differentiate between several types of RNA found in living cells
11. explain the central dogma of molecular biology, interpret the genetic code, and describe transcription, translation, and several examples of controls over gene expression
12. understand the complexity of eukaryotic transcription and how promoters and enhancers act to control this process
13. describe the following events in eukaryotic mRNA processing: capping, splicing, and polyadenylation; and describe the significance of alternative splicing
14. relate course content to broader social, medical, & environmental concerns
15. use and apply those facts, concepts, and principles appropriately, even in situations that you have not previously encountered.

16. learn the theory and practice of common molecular biology techniques, including gene cloning, gel electrophoresis

17. effectively organize and present data at frequent lab meetings

**TENTATIVE TENTATIVE TENTATIVE lecture schedule SP 2015:**

*\*Chapters 1-3 should be familiar to you! We will be frequently referring back to these chapters when we think of things like where energy comes from to drive non-spontaneous reactions, details of different kinds of bonds, microscopy, etc.. If it has been a while since Biol 202/203 and Intro chemistry, then you should start reading these chapters right away!*

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| **Day** | **Date** | **Topic** | **Reading** |
| MON | FEB 9 | Welcome!; Guiding principles for cellular processes | Ch. 1-3\* |
| WED | FEB 11 | Review of proteins & Central dogma | pp. 223-50; 121-41 |
| FRI | FEB 13 | Chaperones; How proteins are controlled: allostery, feedback & GTPases | pp. 150-57 |
| MON | FEB 16 | The ubiquitin-proteasome system and regulated protein degradation | pp. 250-52 |
| WED | FEB 18 | Biology of prions | pp. 126-27; D2L |
| FRI | FEB 20 | **Exam #1** |  |
| MON | FEB 23 | How to clone a gene | pp. 325-41 |
| WED | FEB 25 | Eukaryotic transcription I: discovery of transcription factors | D2L; pp. 230-32; 261-70 |
| FRI | FEB 27 | Eukaryotic transcription II: effects of chromatin | D2L; pp. 271-73; 180-91 |
| MON | MAR 2 | RNA processing; SMA vignette | pp. 232-38 |
| WED | MAR 4 | How do UTRs control localization and translation of mRNAs? | pp. 281-82; D2L |
| FRI | MAR 6 | MicroRNAs and siRNAs | pp. 282-84 |
| MON  WED  FRI | MAR 9  MAR 11  MAR 13 | Long noncoding RNA and X-inactivation  Same genes, different cells  **Exam #2** | p. 190-91, 284; D2L  pp. 273-80 |  |
| MON | MAR 16 | Transposons | pp. 307-09 |
| WED | MAR 18 | Retroviruses and HIV | pp. 309-11 |
| FRI | MAR 20 | The Virochip: using molecular biology to diagnose viral diseases | D2L |
| **SPRING BREAK** | | | |
| MON | MAR 30 | The phospholipid bilayer and membrane proteins | pp. 359-74 |
| WED | APR 1 | Channels & passive and active transporters | pp. 383-96 |
| FRI | APR 3 | Aquaporins; G-protein coupled receptors | D2L; pp. 535-539 |
| MON | APR 6 | Action of cholera toxin; Ion channels and taste receptors | pp. 396-403; 539-546 |
| WED  FRI | APR 8 APR 10 | Nuclear import; Protein sorting to mitochondria  The signal hypothesis, protein transport into ER; glycosylation | pp. 487-98  pp. 498-502 ; pp. 507-09 |
| MON | APR 13 | Vesicular transport, the SNARE hypothesis and secretion | pp. 503-15 |
| WED | APR 15 | Cholesterol biology and Familial hypercholesterolemia | pp. 515-21 |
| FRI | APR 17 | Cholesterol sensing mechanisms in cells | D2L |
| MON | APR 20 | **Exam #3** |  |
| WED | APR 22 | Actin cytoskeleton and motor proteins | pp. 583-92 and D2L |
| FRI | APR 24 | Intermediate filaments and progeria | pp. 567-71 |
| MON | APR 27 | Microtubules, dynamic instability and more motor proteins | pp. 571-83 |
| WED | APR 29 | Tumor viruses and the discovery of oncogenes | D2L |
| FRI | MAY 1 | Cell cycle I; Growth factor receptor signaling and entry into cell cycle | pp. 603-15 |
| MON | MAY 4 | Cell cycle II: Progression into S-phase; spindle assembly checkpoint | pp. 616-29 |
| WED | MAY 6 | Apoptosis | pp. 634-39 |
| FRI | MAY 8 | STUDENT SHOWCASE |  |
| MON | MAY 11 | Stem cells and cloning | pp. 702-12 |
| WED | MAY 13 | Cancer biology I | pp. 712-24 |
| FRI | MAY 15 | Cancer biology II | pp. 712-24 |

**Laboratory schedule:**

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| **Date** | **Topic** | **Assignment due?** | **Work in class before next lab** |
| FEB 12 | Plasmid preps, restriction digests and gel electrophoresis | Daily assignment |  |
| FEB 19 | Intro to PCR | Daily assignment |  |
| FEB 26 | Oligo design and T-PCR | Daily assignment | Set up F-PCR reactions |
| MAR 5 | Agarose gel electrophoresis | Presentation |  |
| MAR 12 | Ligations and transformations | Presentation | Remove plate from incubator; grow colonies |
| MAR 19 | Plasmid minipreps and restriction digests |  | Run samples on agarose gel |
| MAR 26 | **SPRING BREAK!** |  |  |
| APR 2 | Prepare sequencing samples; Ub purification | Presentation; Lab report I |  |
| APR 9 | Analyze sequencing data; digests and gel |  | Finish gel? |
| APR 16 | Yeast transformations |  | Grow yeast colonies |
| APR 23 | Yeast genomic DNA prep |  | PCR and gel |
| APR 30 | Ub polymerization; SDS-PAGE | Presentation |  |
| MAY 7 | Preparing posters for showcase |  |  |
| MAY 14 | TBA | Lab report II |  |

**Grade determination:**

\* Note that the number of quizzes and homework assignments is approximate!

**LECTURE PART: Percentage-wise breakdown of final grades:**

Exams and quizzes 80% of final grade

3x100pt exams

1x120pt final

~ 7x15pt quizzes (drop lowest)

Homework, problem sets 10% of the final grade (~6 for the semester)

In-class assignments 10% of the final grade

**LAB PART: Percentage-wise breakdown of final grades for the lab:**

Daily assignments 10%

Chapter 10 quizzes 10%

Lab Report I 20%

Lab report II 20%

Data presentations 20%

Showcase poster 20%

**Final grades** = 75% lecture/25% lab **(**Total number of points/Total possible points)

A range = 90-100, B range = 80-89, C range = 70-79, D range = 60-69, F < 60