BIOL 202H – Molecular Biology & Genetics

Fall 2019
M,W,F 10:10 – 11:00
1378 Genome Sciences Building

Instructor: Dr. Steve Matson
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502 Fordham Hall
Office Hours: 1:00 – 2:30 Mon and Wed

I use sign up -- please go to Sakai and sign up for office hours so that I know you are coming. I am also available by appointment. Please contact me if you cannot see me during the times listed above.

Prerequisites: BIOL 101 and CHEM 101 with a grade of C or better

Sakai Site

You must have an onyen to log on -- if you do not have an onyen go to (https://improv.itsapps.unc.edu/#UserCreateOnyenPlace:createOnyen). The Sakai site will have the detailed syllabus for the course, postings from lectures such as PowerPoint slides and any supplemental material. I will also post announcements on this site. It is your responsibility to check it regularly. The course Sakai site name is BIOL202H.001.FA19.

Main Goals of the course

1. To provide you with the core principles of genetics and molecular biology
2. To gain higher level thinking skills
3. To excite you about basic science and its applications

Course Learning Outcomes

Upon completion of Biology 202H, a student should be able to:

Skills –

- Build hypotheses to answer a specific scientific question, design an experiment using an appropriate technique/assay to answer the question, predict the results of the experiment and analyze the results
- Give examples of how advances in genetics and molecular biology, from the discovery of DNA's structure to the sequencing of individual genomes, have changed the world (e.g. recombinant insulin, personalized medicine, transgenic crops)
- Prepare and deliver a short presentation based on reading and research

Concepts --

- Explain the term "allele" for a single gene at a population, organismal, cellular and molecular level; explain how dominance and recessiveness are expressed at these levels
- Explain where genetic variation comes from in a population (e.g. meiosis, mutation and epigenetic changes)
- Predict genotypic and phenotypic ratios of offspring in defined genetic crosses and work these problems in reverse (i.e. when given data about offspring determine the genotypes and phenotypes of parents)
- Deduce modes of inheritance (e.g. autosomal dominance, X-linked recessive) from genetic pedigrees and explain how incomplete penetrance and variable expressivity complicate these analyses
- Distinguish single gene traits from polygenic traits and the influence of environment on traits
- Explain how DNA is replicated normally and abnormally and how these concepts are utilized in polymerase chain reaction (PCR)
- Understand the mechanism of recombination and its impact on genetic variability
- Compare and contrast the consequences of germline errors during meiosis (such as non-disjunction and translocations) and somatic errors during abnormal mitosis (such as non-disjunction and cancer)
- Explain the flow of genetic information based on the central dogma from DNA to proteins and how mutations are carried through this flow of information
- Describe the nature of the genetic code
- Describe the general organization of prokaryotic and eukaryotic genomes, including the identification and significance of the different parts of a gene (i.e. regulatory/nonregulatory, exons/introns, transcription start site, translation start site, UTRs)
- Explain how a gene can be regulated transcriptionally and post-transcriptionally and how this lead to limited expression under different conditions (e.g. different environments, during the course of development or under disease conditions)
- Predict the outcome of experimental manipulations in genes
- Described the basis steps in gene cloning
- Design a transgenic animal/bacteria where a protein of interest is specifically produced
- Explain the significance of research in genetic model organisms to understand fundamental biological phenomena

Course goals

1. To provide you with the core principles of genetics and molecular biology. The lectures and the book with provide the basic content. We will take an historical approach at times to discuss famous experiments and how they were done. We will examine the basic "rules" of genetics and molecular biology. After this class you will be

prepared to do research in a lab on campus and to build upon this content with BIOL 205 and upper level genetics courses and/or molecular biology courses.

2. To gain higher level thinking skills.

To the right there is a visual representation of "Revised Bloom's Taxonomy" which was developed as method of classifying educational goals for student performance evaluation. You should be well equipped to remember and understand facts with good study habits. We are looking for you to apply and analyze. How will we achieve this in this class? We will have in-class questions to practice this immediately and you will have homework problems to practice on your own or in groups. We will also explore classic experiments as a way of thinking through the logic of the experiment. What question were they trying to answer? What data was collected and how was it analyzed? This will allow us to see where the foundations of genetics and molecular biology come from. Practice is the most important way to gain these skills. By the way – UNC medical school thinks this course is an excellent pre-requisite for medical school because it teaches students to *think*.

3. This course should excite you about basic science and its application.
A foundation is genetic crosses with model organisms (basic science tool) allows you to understand human genetic diseases. A foundation in making recombinant DNA constructs (basic science tool) allows you to understand how plants are modified to be herbicide resistant or how recombinant proteins are turned into medicines. Genetics and molecular biology provide the tools that other disciplines use in biological research.

Expectations

The course will have three class meetings each week. Please note this is not a passive class – participation is key to developing an advanced understanding of genetics and molecular biology. You are expected to be actively engaged in this course through discussions, class activities and pre- as well as post-class assignments and readings. It is expected that you will spend several hours reading and working problems associated with each class period. If you stay on top of your reading and homework there will be no need to "cram" for an exam. Practice, practice, practice.

Textbook

Klug et. al. *Essential of Genetics*, 9th edition
Feel free to choose an ebook or a physical book

Required: **Access to Mastering Genetics** an online activity and homework tool (more detail below). This comes included with a new physical textbook or ebook but can be

purchased separately if you buy a used textbook. If you have a used textbook you can buy the Mastering Genetics access card at the bookstore. However, the cost of the used text book and the access card may be greater than purchasing a new book.

Required Reading

Particular book chapters and some supplemental readings are required (see course dates/topics/assignments for details) and you will be expected to have read them before class so that you can complete the Guided Reading and/or quiz assignment and be able to participate fully in the class discussion.

Class Attendance

Students are expected to attend and participate in class meetings. While the course follows the textbook, some of the material discussed in class may not be found in the text. You are responsible for all material and announcements made in class. You are not responsible for material that was not covered in class unless it was specifically assigned.

Assignments

You will have pre-class assignments, in-class assignments and post class assignments.

- The pre-class assignments will be based on assigned readings from the textbook and will involve answering a set of Guiding Reading Questions or taking a short quiz.
- In-class assignments may include Learning Catalytics (see below) and other activities.
- Post-class assignments will be Mastering Genetics homework assignments that will be graded.

Due dates for homework assignments will be 8 am on the following class day. Updates will be announced on Sakai. You are responsible for submitting the assignments on time. There will be no "second chances".

Homework via Mastering Genetics (10% of your final grade)

Homework will be due the morning before almost every class period at 8 am. Some Mastering Genetics homework assignments may take as little as 30 minutes while others will take over an hour with animations and short tutorials interspersed in the homework. It is your responsibility to complete the homework before the deadline. To be safe assume your clock is 5 min slower than the time stamp on Mastering Genetics. Late homework will receive zero credit. Please do not ask me to make an exception to this rule.

It is your responsibility to finish your homework early so that late night crises do not prevent your finishing on time. Do not count on the Mastering Genetics program to

provide an accurate account of how long the assignment will take. These estimates are just that – estimates. There will be numerous graded at-home assignments. We are trying to ensure that you succeed by giving you these regular opportunities to assess your understanding of the material. See Sakai (under Resources) for the course code and how to register for Mastering Genetics.

Please sign up and complete all assignments for the class matson48423

Learning Catalytics/Poll Everywhere (5% of your final grade)

In this class we will use a polling system to answer questions that are posed during class. You can submit your responses using a laptop or other mobile device with a WiFi connection. For instructions on how to access or register for Learning Catalytics please follow the guidelines found on Sakai (under Resources). As an incentive to engage during class, 5% of your grade will come from Learning Catalytics. Missing just a couple of classes can have an impact on your participation grade. You can access LC through Mastering Genetics or directly by visiting learningcatalytics.com. I will provide the 'session ID' for each class.

Learning Catalytics is a tool for students who are in the classroom. If you are found answering and you are not in the classroom you will receive a zero for your grade for the semester.

Writing Assignment

There will be one major writing assignment in this class. This will be a creative writing assignment that will be discussed in more detail during the first two weeks of class. You must complete and submit this assignment no later than 5 PM on **Wednesday, December 4, 2019**.

This paper cannot be a research paper. Any student submitting a research paper will be asked to redo the assignment. Failure to complete this assignment will result in a grade of Incomplete for the course.

These papers will be graded H (honors), P (pass) or F (fail). Students receiving an F will be allowed to re-write their paper to receive a passing grade. A grade of H on the writing assignment will raise your letter grade, as determined by test scores, your group presentation, class participation and homework, by one-half grade (i.e. C to C+ or B+ to A-, etc.). A grade of P on the assignment will have no impact on your earned letter grade. Any student receiving a grade of F who fails to make up the assignment will receive an F for the course. Papers turned in late can receive a grade no higher than P (this includes re-writes of F papers).

Group Presentation (10% of your final grade)

The class will be divided into 6 groups of 4 students each and each group will be responsible for preparing and making a 10-minute media (e.g. PowerPoint, video, etc) presentation to the class. Each group will be assigned a fully sequenced genome and will be responsible for discussing the sequencing, annotation and unique characteristics of that genome. There will be a 5 minute question period following each presentation during which the group will be responsible for answering questions asked by other members of the class. The finished presentations will be placed on the class web site as a reference for other members of the class. In-class presentations will take place during the week of **November 18** and will occupy all of our class time on those days.

The presentations will be graded as follows: accuracy of information (25%), clarity in both the oral and media presentation (25%), accuracy in answering questions (25%) and overall quality of the complete presentation (25%). It is possible for different members of the group to receive different scores where there is a clear difference in effort and participation.

What you should bring to class everyday

1. PowerPoint slide outlines (for taking notes)
2. Extra blank paper for drawings, notes, activities, etc.
3. Learning Catalytics/Poll Everywhere device (laptop, smart phone, tablet)

Grading

Your grade for this course will be determined as follows:

3 midterm exams (16.7% each = 50%)
1 cumulative final exam (25%)
Mastering Genetics assignments (10%)
Participation/Learning Catalytics/Poll Everywhere (5%)
Group project (10%)

Grades will not be assigned for individual exams, only points. You will be able to determine how you did from the posted distribution of scores after each test. Final grades will be assigned on the total number of points for the entire summer session: A 93 – 100%; A- 90-92%; B+ 87-89%; B 83-86%; B- 80-82%; C+77-79%; C 73-76%, C- 70-72%, D+ 66-69%; D 60-65%; F < 60%

Exam questions will be taken from class meetings and assigned readings. Exams must be taken on the dates indicated. There will be no make-up exams except in extraordinary circumstances (e.g. medical emergency or family emergency documented in writing). The final exam will be retained by the instructor but will be available for viewing by

appointment. Requests for regrades must be submitted in writing within 1 week after the exam is reviewed in class.

This is not a weed-out course. I believe all students can succeed in BIOL202H and, in fact, the average grade in this course is in the B/B- range. Remember, a C is average. If you are wondering if there are a predetermined number of students who will receive an A or a D the answer is NO. It is possible for everyone in the class to receive an A if everyone in the class performs at an A level. You have many opportunities to demonstrate your mastery of the material in this course.

Topics, dates and assignments

Date	**Topic**	**Reading**	**Pre-class assignment**	**Homework**
W; 8/21	Introduction to Genetics	Chap. 1; pp 1-11; reading on Sakai	GRQ#1	MG assignment
F; 8/23	Mitosis and meiosis	Chap. 2; pp 12-27, skip 2.5	GRQ#2	MG assignment
M; 8/26	Genetic crosses	Chap. 3; pp 31-42	GRQ#3A	MG assignment
W; 8/28	Pedigrees and probability	Chap. 3; pp 43-48	GRQ#3B MG Quiz	MG assignment
F; 8/30	Mendel's pea experiments	Mendel paper on Sakai;	GRQ Mendel	No homework
W; 9/4	Modifying Mendel's ratios	Chap 4; pp 53-64	GRQ#4A	MG assignment
F; 9/6	Modifying Mendel's ratios	Chap 4; pp 64-77	GRQ4B	MG assignment
9/9	No class			
9/11	Sex determination & sex chromosomes	Chap. 5; pp. 84-96	GRQ#5	MG assignment
9/13	Linkage & mapping	Chap.7; pp 120-133	GRQ#6A	MG assignment
9/16	Linkage & mapping	Chap. 7; 133-139	GRQ#6B	MG assignment
9/18	Database activity; review for exam	No reading	No assignment	Study for exam
9/20	**Midterm Exam**			
9/23	Chromosome mutations	Chap. 6; pp 99-107	GRQ#7A	MG assignment
9/25	Chromosome mutations	Chap. 6; pp 107 - 116	GRQ	MG assignment
9/27	Bacterial genetics	Chap. 8, pp. 143-151	GRQ	MG assignment
9/30	Bacterial genetics	Chap. 8; pp. 151-158	GRQ	MG assignment
10/2	DNA structure	Chap. 9 pp. 160-176	GRQ	MG assignment
10/4	Chromosome structure	Chap. 11; pp. 199-202, 205-212	GRQ	MG assignment

10/7	DNA Replication	Chap. 10; pp.180-191	GRQ	MG assignment
10/9	DNA Replication	Chap. 10; 191-196	GRQ	MG assignment
10/11	Genetic Code	Chap. 12; pp. 215-224	GRQ	MG assignment
10/14	Transcription	Chap. 12; pp. 225-230	GRQ	MG assignment
10/16	Transcription	Chap. 12; pp. 230-234	GRQ	MG assignment
10/21	**Midterm Exam**			
10/23	Translation	Chap. 13; pp.238-247	GRQ	MG assignment
10/25	Protein structure	Chap. 13; pp. 247-255	GRQ	MG assignment
10/28	Gene mutation	Chap. 14; pp. 257-266	GRQ	MG assignment
10/30	DNA repair	Chap. 14; pp. 266-272	GRQ	MG assignment
11/1	Transposons	Chap. 14; pp. 272-276	GRQ	MG assignment
11/4	Regulating gene expression	Chap. 15; pp. 280-290	GRQ	MG assignment
11/6	Regulating gene expression	Chap. 15; pp. 291-299	GRQ	MG assignment
11/8	Regulating gene expression	Chap. 15; pp. 299-301; 303	GRQ	MG assignment
11/11	Recombinant DNA	Chap 17; pp. 322-333	GRQ	MG assignment
11/13	Recombinant DNA	Chap. 17; pp. 333-338; reading on Sakai	GRQ	MG assignment
11/15	**Midterm exam**			
11/18	Group presentations	Chap. 18; pp. 345-354	GRQ	No assignment
11/20	Group presentations	Reading on Sakai	No assignment	No assignment
11/22	Biotechnology applications	Chap. 19; pp. 378-383, 386-389, 507-514	GRQ	MG assignment
11/25	Cancer Genetics	Chap. 16; pp. 307-318	GRQ	MG assignment
12/2	Roles of RNA	ST2; pp. 474-483	GRQ	MG assignment
12/4	Medical applications	ST4; pp. 497-506 ST6; pp.519-530	GRQ	MG assignment
12/13	**Final Exam 8 am**			