BIOL 202H – Molecular Biology & Genetics

Fall 2020
T, Th 11:30 am – 1:30 pm
215 Coker Hall

Instructor: Dr. Steve Matson
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502 Fordham Hall
Office Hours: Monday 2-4:00 pm
Wednesday 3-5:00 pm

I use 'sign up' on Sakai to schedule office hours to be held using Zoom. 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 occasional announcements on this site. It is your responsibility to check it regularly. The course Sakai site name is BIOL202H.001.FA20.

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 and analyze the results of the experiment
- 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 leads 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
- Describe the basic 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 will 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 in 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 two class meetings each week. We will be appropriately physically distanced in the classroom and everyone is required to wear a face covering (mask) at all times.

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 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*, 10th 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 textbook and the access card may be greater than purchasing a new book.

Required Reading

Particular book chapters and supplemental readings are required (see course dates/topics/assignments for details) and you will be expected to 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 Guided Reading Questions (available on Sakai) or taking a short quiz.
- In-class assignments may include Poll Everywhere (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 9 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 9 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 matson98983

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 Poll Everywhere please go to https://poll.unc.edu/. As an incentive to engage during class, 5% of your grade will come from Poll Everywhere participation. In addition, some of the questions posed in class will reflect questions used previously on exams and therefore are good examples of what will be expected of you on exams.

Writing Assignment

There will be one major writing/media assignment in this class. This will be a creative writing/media assignment to 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 November 17, 2020.

This 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.

This assignment 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 groups of 4-5 students 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 Sakai site as a reference for other members of the class. In-class presentations will begin on **October 27** and will occupy approximately one-half of the class period for two class sessions.

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. 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%)
MasteringGenetics assignments (10%)
Participation/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.

Diversity and Inclusion

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

The University of North Carolina Office of Diversity and Inclusion provides resources, events and information about current initiatives at UNC to support equality for all members of the Carolina community. I hope that you will communicate with me if you experience anything in this course that does not support an inclusive environment. You can also report any incidents you may witness or experience on campus on in your remote class to the Equal Opportunity and Compliance Office at https://eoc.unc.edu/report-an-incident/ as well as finding information at the Office of Diversity and Inclusion on their website https://diversity.unc.edu/.

Community Standards in Our Course and Mask Use

This fall semester, while we are in the midst of a global pandemic, all enrolled students are required to wear a mask covering your mouth and nose at all times in our classroom. This requirement is to protect our educational community — your classmates and me — as we learn together. If you choose not to wear a mask, or wear it improperly, I will ask you to leave immediately, and I will submit a report to the Office of Student Conduct. At that point you will be disenrolled from this course for the protection of our educational community. An exemption to the mask wearing community standard will not typically be considered to be a reasonable accommodation. Individuals with a disability or health condition that prevents them from safely wearing a face mask must seek alternative accommodations through the Accessibility Resources and Service. For additional information, see Carolina Together.

Zoom Recordings

The University may record meetings of this class for educational purposes. These recordings will be shared only with students enrolled in the course for purposes of academic instruction only. Your instructor will communicate to you how you may access any available recordings.

Unauthorized student recording of classes on personal devices or on any other format is prohibited.

Students requesting the use of assistive technology as an accommodation should contact Accessibility Resources & Service. Other students must obtain express permission from the department to record the class, and the University will only grant such permission in extraordinary circumstances in which the student otherwise lacks access to a recording made by the University or instructor. Students shall not copy, reproduce, or distribute any recordings of their classes, and students shall delete any recordings at the conclusion of the course.

Any violation of these prohibitions or restriction on the making, use, copying, or distribution of recording of classes shall constitute an honor code violation.

Dates, topics and assignments

Date	Topic	Reading	Pre-class assignment	Homework
Week 1				
8/11	Overview of genetics; process of science	Ch. 1; Reading on Sakai	Intro to MG; GRQ#1	MG1
8/13	Chromosomes, mitosis, meiosis and the cell cycle	Ch. 2; skip 2.5	GRQ#2	MG2; Study Module
Week 2				
8/18	Genetic crosses; Mendel's pea experiments	Ch. 3; pp. 31-42; reading on Sakai	GRQ#3	MG3
8/20	Pedigrees and probability	Ch. 3; pp. 42-49; Reading on Sakai	GRQ#4; MG Quiz	MG4
Week 3				
8/25	Class cancelled due to COVID-19			
8/27	Modifying Mendel's ratios	Ch. 4; pp. 53-76	GRQ#5	MG5

Week 4				
9/1	Linkage and mapping	Ch. 7; pp. 121-139	Study module; GRQ#6	MG6
9/3	Sex determination and sex chromosomes	Ch. 5; pp. 83-96; Reading on Sakai	GRQ#7	MG7
9/4-9/7	**Midterm exam I**	To be administered on Sakai		
Week 5				
9/8	Chromosome mutations	Ch. 6; pp.99-116 Reading on Sakai	GRQ#8	MG8
9/10	Bacterial genetics	Ch. 8; pp.144-159 Reading on Sakai	GRQ#9	MG9
Week 6				
9/15	DNA/RNA structure	Ch. 9; pp. 161-178 Reading on Sakai	GRQ#10	MG10
9/17	Chromosome structure	Ch. 11; pp. 202-216	GRQ#11	MG11
Week 7				
9/22	DNA replication	Ch. 10; pp.182-200 Reading on Sakai	GRQ#12	MG12
9/24	Genetic code	Ch. 12; pp. 218-228	GRQ#13	MG13
Week 8				
9/29	Transcription and RNA splicing	Ch. 12; pp. 228-238	GRQ#14	MG14
10/1	Translation/ protein structure	Ch. 13; pp. 241-258 Reading on Sakai	GRQ#15	MG15
Week 9				
10/6	Molecular techniques Blast search	Ch. 9, pp. 177-179; Ch. 17 pp. 333-335	N/A	N/A
10/8	**Midterm exam II**	N/A	N/A	N/A
Week 10				
10/13	Gene Mutation	Ch. 14; pp. 261-270 Reading on Sakai	GRQ#17	MG17
10/15	DNA repair and transposons	Ch. 14; pp. 271-281	GRQ#18	MG18
Week 11				
10/20	Regulating gene expression prokaryotes	Ch. 15; pp. 285-299	GRQ#19	MG19
10/22	Regulating gene expression eukaryotes	Ch. 16; pp. 302-319	GRQ#20	MG20
Week 12				
10/27	Genomics; group presentations (4)	Ch. 18; pp. 347-358 Reading on Sakai	GRQ#21	MG21
10/29	Recombinant DNA; group presentations (2)	Ch. 17; pp. 323-338, 341-343	GRQ#22	MG22

Week 13				
11/3	Cancer Genetics	Ch. 19; pp 376-389	GRQ#23	MG23
11/5	**Midterm exam III**		N/A	N/A
Week 14				
11/10	Genetic testing GMOs	ST2, pp.450-461 ST6, pp. 500-509 Reading on Sakai	GRQ#24	MG24
11/12	Epigenetics	ST1, pp. 439-449 Reading on Sakai	GRQ#25	MG25
Week 15				
11/17	Gene therapy Personalized medicine	ST3; pp. 468-480 ST7; pp. 510-520 Reading on Sakai	GRQ#26	MG26
11/24	**Final Exam; 12 PM**			