

BIOLOGY 255/255L MOLECULAR GENETICS (FALL 2018)

Lafayette College

117 Kunkel Hall (Lecture)/301 Kunkel Hall (Laboratory)

Lecture: Mondays, Wednesdays, and Fridays, 8:00–8:50 am EST

Lab: Mondays or Tuesdays, 1:10-4:00 pm EST

INSTRUCTOR INFORMATION

Instructor:

Dr. Khadijah A. Mitchell

Office Location:

203 Kunkel Hall

Email:

mitcheka@lafayette.edu

(24 hour e-mail response time, preferred method of contact)

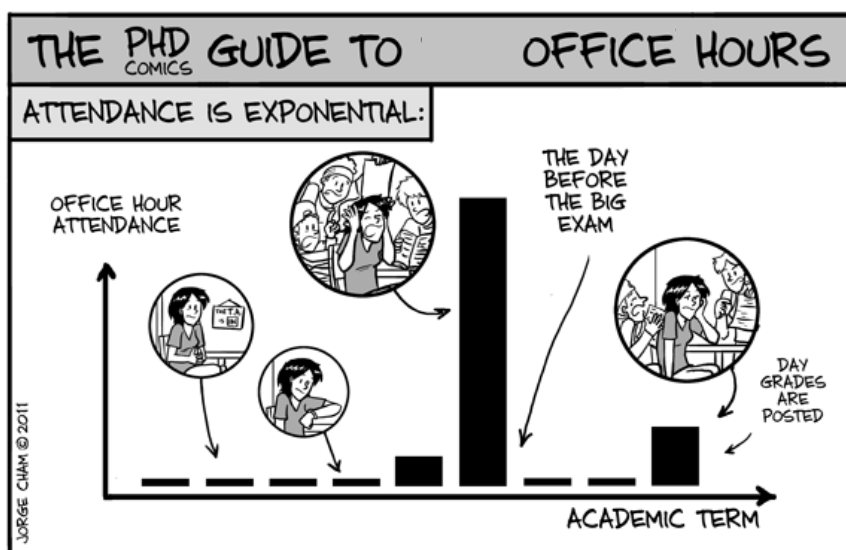
Phone:

610-330-5946

Office Hours:

Mondays (11 am-12 pm EST), Tuesdays (10 am-12 pm EST), or by appointment.

Office hours are a great resource. Don't let your office hour attendance be exponential!



Source: Modified from phdcomics.com

Lab Teaching Assistants:

Monday:

Ashley Kushner (kushnera@lafayette.edu)

Tuesday:

Chenyu Zhang (zhangc@lafayette.edu)

COURSE DESCRIPTION

This course is a comprehensive introduction to molecular genetics, at the DNA, gene, chromosome, genome, and epigenome levels. Students begin with studying Mendelian and non-Mendelian inheritance patterns, and how both influence human health and disease. This is followed by an emphasis on the molecular aspects and properties of genetic material in prokaryotes and eukaryotes (including DNA and RNA structure, DNA replication, transcription, translation, gene regulation, epigenetics, gene mutation, DNA repair, recombination, immunogenetics, and transposition). The learning concludes with analyzing genetic mechanisms in individuals and populations. This course places a heavy emphasis on active learning, formative assessment, and information literacy.

"Tell me and I forget. Teach me and I may remember. Involve me and I learn." – Benjamin Franklin

PREREQUISITES

General Biology (BIOL 101) and General Chemistry (CHEM 121 and CHEM 122, with labs)

COURSE AIMS

This combined lecture and lab course will:

- Explore molecular genetic concepts from scientific and societal perspectives, using real-world examples.
 - Empower students to disentangle genetic facts from myths and misconceptions through analytical and critical thinking skills in a molecular genetics context.
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LECTURE LEARNING OBJECTIVES

Upon successful completion of this course, students will be able to:

- Define “gene”, describe features of a typical prokaryotic and eukaryotic gene, and sketch a gene with all key upstream and downstream regulatory elements.
- Predict the outcomes of genetic crosses using Punnett squares, probability, and statistics.
- Define “chromosome”, describe normal eukaryotic chromosome structure and number, diagram chromosome transmission during cell division, linkage, and genetic recombination, and compare and contrast prokaryotic and eukaryotic chromosomes.
- Determine Mendelian and Non-Mendelian inheritance patterns in human populations through pedigree analysis, and elucidate mechanisms of disease.
- Understand how the diversity of life evolves over time by processes of genetic change, particularly the role of genetic and genomic variation in health and disease.
- Improve genetic and genomic health literacy through information literacy (the process of finding, retrieving, organizing, and evaluating information).

LAB LEARNING OBJECTIVES

Upon successful completion of this course, students will be able to:

- Outline the steps of the scientific method, analyze and interpret results, format results in figures and tables, and communicate experimental methods and results in written format for the following labs:
 - Genetic transfer in *E. coli* and human cells.
 - Reverse-Transcription PCR (RT-PCR) for a kidney cancer-related gene (Course-Based Undergraduate Research Experience).
 - Exploring genetic variation in a caffeine metabolism gene.
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REQUIRED TEXTBOOKS

Lecture

Genetics: Analysis and Principles, 6th Edition, Robert J. Brooker, 2017

The Gene: An Intimate History, Siddhartha Mukherjee, 2016

Lab

The lab course component will use various published protocols and scientific literature, as well as internet-based resources.

INSTRUCTOR EXPECTATIONS

Attendance: Please make every effort to attend all classes (both lecture and lab) and on time. Three unexcused absences from lecture and lab without a Dean’s Excuse or Coach’s letter will result in a full letter grade drop.

Sickness/illness: If you are not feeling well, please notify me and stay home to take care of yourself. You will be responsible for the lecture and/or lab material missed. Unfortunately, lab sessions cannot be made-up.

Assigned readings: All assigned readings should be read before coming to class (both lecture and lab).

Class Success Tip: Try to finish your readings before coming to class.

Solving chapter problems: This text was selected for its many types of questions. You should be able to answer the in-chapter comprehension and concept check questions, as well as the end-of-chapter conceptual and experimental questions. These types of questions are similar to quiz and exam questions.

Class Success Tip: Work as many problems as you can, both alone and in groups. If you want my assistance solving a particular problem, please let me know in advance so I can be prepared to discuss the solution with you.

Class participation: Active listening skills, discussion participation, and respect for our classroom is expected and encouraged at all times.

Information literacy mini-assignment and lab report submissions: These assignments should be submitted on the course Moodle site by the specified deadline.

Lecture and lab documents: All documents will be available on the course Moodle site for the following week every Friday by 5:00 pm EST. Everyone is expected to check the site weekly before coming to class.

Class Success Tip: You should check Moodle (at least) every Friday at 5:00 pm EST.

Cell phone policy: Cell phones must be turned to silent or vibrate during class time.

Laptop and tablet policy: Laptops and tablets are permitted during lecture, however, their use should be restricted to class-related materials. Laptops and tablets are permitted in the lab as directed by the course instructor.

STUDENT EXPECTATIONS

Expectations work both ways. What are your expectations of me as your instructor?

FEDERAL CREDIT HOUR POLICY:

The student work in this course is in full compliance with the federal definition of a four credit hour course. Please see the Registrar's Office web site (<https://registrar.lafayette.edu/wp-content/uploads/sites/193/2013/04/Federal-Credit-Hour-Policy-Web-Statement.doc>) for the full policy and practice statement.

ASSIGNMENTS AND GRADING

	Points	Percentage
Lecture (75% of the overall grade)		
4 Information Literacy Mini-Assignments (5 points each)	20	3
4 In-Class Quizzes (20 points each)	80	12
3 In-Class Exams (100 points each)	300	45
1 In-Class Final Exam (Cumulative, 100 points)	100	15
Laboratory (25% of the overall grade)		
1 Information Literacy Mini-Assignment (5 points)	5	1
10 In-Class Pre-Lab Quizzes (7 points each)	70	11
3 Lab Reports (25 points each)	75	11
3 In-Class Lab Notebook Checks (5 points each)	15	2
TOTAL	665 points	100%

Extra credit will not be provided and this course will not be curved. Late assignments are not accepted and partial credit will not be given for late assignments.

You will be graded according to the following Lafayette College five-letter plus/minus grading scale.

<http://catalog.lafayette.edu/current/Catalog/Academic-Programs/Attendance-and-Standing/Grades>

A	4.0	95-100%	A-	3.7	90-94.9%		
B+	3.3	86-89.9%	B	3.0	83-85.9%	B-	2.7 80-82.9%
C+	2.3	76-79.9%	C	2.0	73-75.9%	C-	1.7 70-72.9%
D+	1.3	66-69.9%	D	1.0	63-65.9%	D-	0.7 60-62.9%
F	0.0	0-59.9%					

ACADEMIC INTEGRITY

According to the Statement on the Rights and Responsibilities of Students, Section II. In the classroom: *“Students who cheat on examinations, plagiarize, or are otherwise dishonest, or who help others to do so, are subject to disciplinary action.”*

In addition, the Student Code of Conduct Academic Integrity section states:

“Moreover, certain violations of the community’s standards clearly rise to the level of academic dishonesty and can have serious consequences.”

Please consult the most recent Lafayette College Student Handbook with any questions regarding the Statement on the Rights and Responsibilities of Students and Student Code of Conduct: <https://conduct.lafayette.edu/wp-content/uploads/sites/93/2017/08/StudentHandbook-2017-18.pdf>

ADDITIONAL SUPPORT FOR YOUR LEARNING

Office Hours: This is the best way to help me help you. Your questions and ideas are always welcomed.

Disabilities: In compliance with Lafayette College policy and federal laws, I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with the Disability Services Office to verify their eligibility for appropriate accommodations.

Campus resources: The Academic Tutoring and Training Information Center (ATTIC) and the Disability Services Office are resources made available throughout the semester and are provided free of charge.

INCLEMENT WEATHER POLICY

I expect to hold lectures and labs despite inclement weather. However, there is sometimes a possibility of classes being canceled. I will alert all students of a canceled class through an announcement on the course Moodle site and via email. If class is ever canceled due to inclement weather, it will be made up at another time.

DIVERSITY, INCLUSION, AND EQUITY STATEMENT

Our classroom and lab is a community of scholars and a radically inclusive space for all students. One of my goals as your instructor is to make sure that the background and perspective of every student is appreciated and respected, regardless of their ability level, country of origin, ethnicity, gender, genetic information, learning style, nationality, political affiliation, race, religion, sexual orientation, or social class. I am committed to providing an atmosphere for learning that respects diversity and inclusion, as well as promotes equity by removing any educational barriers in our classroom and/or lab.

A large proportion of this course is discussion-based. While we are working together to build our classroom and lab community, I ask each one of you to:

- share your own unique experiences, values, and beliefs.
- be open to the views of others.
- honor the uniqueness of your colleagues.
- appreciate the opportunity that we have to learn from each other.
- value each other’s opinions and communicate in a respectful manner.
- keep class discussions that your colleagues may have of a personal nature confidential.

LECTURE FORMAT AND SCHEDULE (Subject to change)

Every semester week will include two “Interactive Lectures” and a “Game of Genes” group learning activity, which can include exam review, information literacy sessions, or problem-based learning activities. Student choice matters. If there is a topic not covered that you’d like to learn more about, let me know and I will incorporate it into our schedule. *Co-Instructor: Ben Jahre (Skillman Library)

		Monday	Wednesday	Friday
Week	Dates	Interactive Lecture Topic	Interactive Lecture Topic	Game of Genes
Unit 1: Patterns of Inheritance				
1	8/27-8/31	Background and Course Overview* Co-Instructor: Ben Jahre	Overview of Genetics (Brooker: Chapter 1)	Problem-Based Learning Activity
2	9/3-9/7	Mendelian Inheritance (Brooker: Chapter 2) (Mukherjee: Mendel, Pages 17-20; 47-55)	Info Lit Mini-Assignment #1 Due by 5:00 pm EST Chromosome Transmission During Cell Division and Sexual Reproduction (Brooker: Chapter 3) (Mukherjee: Morgan, Pages 92-98)	Info Lit Workshop I* Co-Instructor: Ben Jahre
3	9/10-9/14	Extensions of Mendelian Inheritance (Brooker: Chapter 4) (Mukherjee: McKusick, Pages 260-265)	Info Lit Mini-Assignment #2 Due by 5:00 pm EST Quiz 1 (Chapters 1-4) Non-Mendelian Inheritance (Brooker: Chapter 5) (Mukherjee: Muller, Pages 94, 114-118)	Problem-Based Learning Activity
4	9/17-9/21	Genetic Linkage and Mapping in Eukaryotes (Brooker: Chapter 6) (Mukherjee: Bateson, Pages 61-63)	Genetic Transfer and Mapping in Bacteria (Brooker: Chapter 7) (Mukherjee: Beadle and Tatum, Pages 161-163, Jacob, Pages 164-165)	Variation in Chromosome Structure and Number (Brooker: Chapter 8)
5	9/24-9/28	Exam 1 Review	Exam 1 (Chapters 1-8)	Problem-Based Learning Activity
Units 2 and 3: Molecular Structure of DNA, DNA Replication, and Properties of Genes				
6	10/1-10/5	Molecular Structure of DNA and RNA (Brooker: Chapter 9) (Mukherjee: Griffiths, Pages 112-115, Avery, MacLeod, McCarty, Pages 133, 136-137, Franklin, Pages 143-145, 149-152)	Chromosome Organization and Molecular Structure (Brooker: Chapter 10) (Mukherjee: Chromatin, Pages 134-135)	Problem-Based Learning Activity
7	10/8-10/12	NO CLASS - FALL BREAK	Quiz 2 (Chapters 9-10) DNA Replication (Brooker: Chapter 11)	Problem-Based Learning Activity
8	10/15-10/19	Gene Transcription and RNA Modification (Brooker: Chapter 12)	Translation of mRNA (Brooker: Chapter 13) (Mukherjee: Garrod, Pages 260-	Gene Regulation in Bacteria (Brooker: Chapter 14)

			261, Nirenberg, Ochoa, Khorana, Page 168)	
9	10/22-10/26	Exam 2 Review	Exam 2 (Chapters 9-14)	Problem-Based Learning Activity
10	10/29-11/2	Gene Regulation in Eukaryotes I: Transcriptional and Translation Regulation (Brooker: Chapter 15) (Mukherjee: Epigenetics, Pages 391-407)	Gene Regulation in Eukaryotes II: Epigenetics (Brooker: Chapter 16) (Mukherjee: Epigenetics, Pages 391-407)	Info Lit Mini-Assignment #3* Co-Instructor: Ben Jahre
11	11/5-11/9	Non-coding RNAs (Pre-recorded lecture) (Brooker: Chapter 17) (Mukherjee: CRISPR/Cas9, Pages 470-479) NO CLASS – RESEARCH CONFERENCE	Quiz 3 (Chapters 15-17) Genetics of Viruses (Brooker: Chapter 18)	Info Lit Mini-Assignment #4
12	11/12-11/16	Gene Mutation and DNA Repair (Brooker: Chapter 19)	Recombination, Immunogenetics, and Transposition (Brooker: Chapter 20)	Exam 3 Review
13	11/19-11/23	Exam 3 (Chapters 15-20)	NO CLASS-THANKSGIVING	NO CLASS-THANKSGIVING
Unit 4: Genetic Analysis of Individuals and Populations				
14	11/26-11/30	Medical Genetics and Cancer (Brooker: Chapter 25) (Mukherjee: Vogelstein, Page 297)	Developmental Genetics (Brooker: Chapter 26)	Problem-Based Learning Activity
15	12/3-12/7	Population Genetics (Brooker: Chapter 27) (Mukherjee: Darwin, Pages 28-46)	Quiz 4 (Chapters 25-27) Evolutionary Genetics (Brooker: Chapter 29) (Mukherjee: Darwin, Pages 28-46)	Final Exam Review
16/17	12/10-12/18	FINAL EXAM: TBA		

LAB FORMAT AND SCHEDULE (Subject to change)

Each lab session will begin with a pre-lab quiz and short lecture, followed by the lab activity. Please adhere to all wet lab safety guidelines. Working in an unsafe manner will result in dismissal from wet labs. Protective equipment (PPE) and appropriate clothing must be worn at all times during wet labs. No sandals or open-toed shoes are allowed. Contact lenses are prohibited. Open food and drinks should not be brought into wet labs. The lab information literacy mini-assignment and lab reports are to be submitted on the course Moodle site by the specified deadline.

Week	Dates	Laboratory Topic
Unit 1 Lab Report: Genetic Transfer in <i>E. coli</i> and Human Cells		
1	8/27-8/31	DRY LAB: Genetic Transfer in <i>E. coli</i> : Bacterial Transformation Overview
2	9/3-9/7	Pre-lab quiz 1 WET LAB: Genetic Transfer in <i>E. coli</i> : Bacterial Transformation I
3	9/10-9/14	Pre-lab quiz 2 WET LAB: Genetic Transfer in <i>E. coli</i> : Bacterial Transformation II
4	9/17-9/21	Pre-lab quiz 3 WET LAB: Genetic Transfer in Human Cells: Mammalian Transfection
5	9/24-9/28	DRY LAB: Unit 1 Lab Report Clinic Notebook Check 1
Units 2 and 3 Lab Report: Reverse-Transcription PCR (RT-PCR) for a kidney cancer-related gene (Course-Based Undergraduate Research Experience)		
6	10/1-10/5	Pre-lab quiz 4 DRY LAB: Kidney Cancer CURE Overview DRY LAB: Select a kidney cancer-related gene and design RT-PCR primers Unit 1 Lab Report Due Friday 10/5 by 5:00 pm EST
7	10/8-10/12	NO CLASS - FALL BREAK
8	10/15-10/19	Pre-lab quiz 5 WET LAB: RNA isolation and quantitation
9	10/22-10/26	Pre-lab quiz 6 WET LAB: cDNA synthesis
10	10/29-11/2	Pre-lab quiz 7 WET LAB: PCR and gel electrophoresis
11	11/5-11/9	NO CLASS - RESEARCH CONFERENCE
12	11/12-11/16	DRY LAB: Units 2 and 3 Lab Report Clinic Notebook Check 2 Units 2 and 3 Lab Report with information literacy mini-assignment Due Friday 11/16 by 5:00 pm EST
Unit 4 Lab Report: Exploring Genetic Variation in a Caffeine Metabolism Gene		
13	11/19-11/23	Pre-lab quiz 8 DRY LAB: Caffeine Metabolism Overview WET LAB: DNA isolation and quantitation
14	11/26-11/30	Pre-lab quiz 9 WET LAB: PCR
15	12/3-12/7	Pre-lab quiz 10 WET LAB: Restriction digest and gel electrophoresis
16/17	12/10-12/18	DRY LAB: Units 4 Lab Report Clinic Notebook Check 3 Unit 4 Lab Report Due Friday 12/14 by 5:00 pm EST