

BIOLOGY 3011 - GENETICS

Pre-requisites: Biol 2001, Biol 2002 and Biol 3003

Meeting time and location: TBA, Room: TBA

Course description: Principles and problems of heredity, including gene transmission, mutation, recombination, and function.

What you need: Must purchase online smart textbook “Genetics: from genes to genomes” by Leland H Hartwell from McGraw Hill. You can purchase and access your eTextbook through Blackboard see instructions video.

Other course materials: Videos, scientific articles and other materials are accessed through Blackboard in the “course documents” tab within each module folder.

Instructor: TBA

Contact: Through the discussion board “student-instructor” forum for all course content and procedure issues. By email for personal issues only.

Office hours: TBA.

e-mail: TBA (I will try to answer within 24 hrs). Emails received on Friday evening or during the weekend will not be answered until Monday. I will ignore questions answered in the syllabus or emails asking questions that belong in the *Blackboard discussion forum: student-instructor forum (see below)*. If you think I should have responded your email but haven't, please check my email address spelling. **Please do not email/message me through Blackboard.**

Discussion forums on Blackboard: You are encouraged to use the student-student discussion forum to discuss with your classmates all course materials, homework, and assignments (**not quizzes or exams**). However, make sure to submit your work written in your own words to avoid plagiarism. *Transcribed videos, identical or nearly identical responses from my slides or from the internet is consider plagiarism.*

Course structure and expectations:

Attendance in-person for this course is **mandatory**.

Homework & preparation for class

- Students read/watch/listen the assigned materials for each class – readings include the eTextbook chapters, articles, slides, and/or notes, and the videos include lectures and other explanatory videos.
- *The assigned materials are to be read and watched **lightly, it is your first exposure to the course material** – you should try to understand general concepts - take notes of what you do not understand or need help with and bring to class for questions and discussions.*
- Students will meet with their group about once a week to do assignments, homework, and study.
- Students will complete assigned Connect and Connect lab simulations.
 - Be aware that sometimes connect assignments are due before topic is covered in class. These are based on the required readings and videos assigned!

Synchronous in-person lectures

- All exams and many quizzes will be done in-person unless specified.
- Students will take **pop** quizzes about the assigned material and at the end of a module or module section.
- Minimal or no traditional lectures will take place during class.
- Students will ask questions about assigned material, do activities using the knowledge they learned from the assigned material, do assignments in class such as solve genetic problems with their group.
- Students will participate in class discussions.

Minimum expected time commitment for this course: at least **16 hours** per week.

3:30 hours/week → Synchronous class attendance is mandatory and quizzes and tests can only be taken in class unless specified.

7+ hours/week → Class preparation at least 2hrs/class hour

2:30 hours/week → Homework

2+ hours/week → Study time

1+ hours/week → Group work

Assessments: *Except quizzes and exams, all course assignments with their deadlines will be posted on Blackboard. You will get prior notice for pop quizzes and exams. Final exam will be on the date and time assigned by BC during final exams period.*

- *Blackboard totals are not accurate, your grade is an accumulation of points not averages (see below) the grade center is for you to see your grade but blackboard is not able to*

generate a proper cumulative grade for the course.

- Online connect types of assignments and laboratory simulations. Students will be able to do the connect assignments as many times as they wish before the deadline. Students highest grade before deadline will be counted for every assignment.
- Pop quizzes about the assigned materials and/or at the end of each section.
- Exams: 3 in person exams.
- Participation includes attendance, arriving on time to class, peer group participation evaluations, being actively engaged with the material we are discussing, asking, and answering questions in class, and on the student's forum or the instructor forum on Blackboard.
- Other than connect assignments include both individual and group work. Some of your group work will be submitted individually and this work must be original (your own) not the same for all group members. You are expected to submit all assignments on time. Work that is not completed on time cannot get more than a B+ grade. See below a list of some of the types of assignments (other than connect) you will do in this course.
 - Concept maps: Concept maps once certain topics or to combine several topics. What is a concept map? [Concept Mapping – organize and connect ideas | Scarfe Digital Sandbox](#)
 - Mutations Assignments (individual and group submissions)
 - DNA damage and Repair assignment (individual and group submissions)
 - Problem sets about different topics.
 - Discussions on Blackboard discussion board.
 - Summaries in different formats (e.g. tables, pictorial representations, and graphics) and students peer-explain presentations.

Learning outcomes expected for this course:

Department of Biology Learning Outcomes

Cellular and molecular biology

- Demonstrate a working understanding of the Central Dogma and describe the general details of DNA replication, transcription, and translation
- Describe the eukaryotic cell cycle and multicellular reproduction and describe how differential sex chromosome gene expression regulates important aspects of animal development.

Genetics

- Students will demonstrate an understanding of basic Mendelian genetics and the physical basis of Mendelian principles
- Students will demonstrate an understanding of pedigree analysis.
- Students will distinguish between sex-chromosome linkage inheritance patterns and autosomal inheritance patterns.
- Students will demonstrate an understanding of the mechanisms by which different mutagenic agents cause mutations.
- Students will distinguish between genetic mapping and complementation mapping.
- Students will define DNA recombination and describe mechanisms of DNA recombination.

Practical competencies

- Students will Interpret genetic results in tabular and graphical form in order to identify and formulate a hypothesis and design genetic experiments or statistical analysis to test the hypothesis.

Genetics course general and specific learning goals:

1. Students will define basic concepts of genetic inheritance and classify types of mutations, their molecular, cellular and physiological consequences.

- 1.1. Students will describe in their own words common genetic terms and definitions, including; alleles, genes, dominance, heterozygosity, etc.
- 1.2. Students will define the laws of segregation and independent assortment and recognize their relevance to the meiotic divisions and how they relate to generating genetic diversity.
- 1.3. Students will define the principle of the Chi square to test genetic hypothesis.
- 1.4. Students will define diploidy, haploidy, polyploidy, euploidy and aneuploidy.
- 1.5. Students will identify and describe pictorially the processes of mitosis and meiosis.
- 1.6. Students will diagram the number of chromatids and chromosomes (C and N) throughout the cell cycle.
- 1.7. Students will define biochemical pathways and genetic pathways
- 1.8. Students will identify assumptions that are used to develop mapping functions
- 1.9. Students will compare the patterns of inheritance of linked and unlinked (independently assorting) genes.
- 1.10. Students will generate a table to connect types of mutations, mutagens that cause them and the repair mechanisms that may repair the specific kinds of damage.
- 1.11. Students will define crossover interference.
- 1.12. Students will recognize how the biology an organism must be understood to map genes on a chromosome.
- 1.13. Students will distinguish between genetic mapping and complementation testing
- 1.14. Students will define crossover interference and what its values mean
- 1.15. Students will classify mutagens by their kind and type of DNA damage they cause.
- 1.16. Students will define regulatory components of genes (e.g. Cis acting and trans acting factors)
- 1.17. Students will recall transcription, translation in relationship to the genetic code.
- 1.18. Students will describe levels of regulation of gene expression in procaryotes and eukaryotes.
- 1.19. Students will describe modes by which bacteria exchange genetic material
- 1.20. Students will define bacterial operons (anabolic and catabolic)
- 1.21. Students will identify tools for the study of gene regulation
- 1.22. Students will list kinds of non-mendelian inheritance
- 1.23. Students will describe patterns of organelle inheritance
- 1.24. Students will define maternal mRNA inheritance
- 1.25. Students will define all forms of non-mendelian inheritance

2. Students will explain how mutations and genetic analysis can be used to examine biological processes and diseases.

- 2.1. Students will define chromosome non-disjunction to explain how euploidy, aneuploidy or polyploidy may arise.
- 2.2. Students will connect phenotype with genotype, and explain how these relationships can give rise to altered Mendelian ratios.

- 2.3. Students will create tables of the rules for identifying patterns of inheritance in pedigrees based on their identification of inheritance patterns from actual pedigrees
 - 2.4. Students will create a video/presentation explaining the difference between genetic mapping and complementation.
 - 2.5. Students will explain how mutational analysis can reveal information concerning biochemical pathways
 - 2.6. Students will diagram the relationship between linkage and recombination.
 - 2.7. Students will explain the different inheritance patterns of autosomal linked genes and sex-chromosome linked genes.
 - 2.8. Students will describe the limits and uses of pedigree analysis and when pedigrees are consistent or inconsistent with different modes of inheritance (autosomal vs sex-chromosome linked, recessive vs dominant)
 - 2.9. Students will explain the importance of chromosome balance and X-chromosome inactivation.
 - 2.10. Students will describe how genes may be involved in a pathway.
 - 2.11. Students will deduce a biochemical pathway and to determine where in the pathway various mutations would alter the pathway.
 - 2.12. Students will classify mutations based on the genotype and phenotype they cause.
 - 2.13. Students will classify mutagenic agents and their mechanisms of action.
 - 2.14. Students will explain how mutations can reveal relationships between protein structure and function.
 - 2.15. Students will generate a concept map to connect mutagens with the type of mutations they produce, the DNA repair mechanisms these are associated with, mutations that affect protein structure and regulation of gene expression and the technologies that can be used to study gene function and regulation of gene expression.
 - 2.16. Students will distinguish organelle pattern of inheritance from nuclear gene inheritance patterns.
 - 2.17. Students will explain why, in certain cases, an offspring's phenotype is determined by the genotype of the parents and not by the genotype of the offspring.
 - 2.18. Students will differentiate deviation from Mendelian ratios and non-mendelian inheritance.
 - 2.19. Students will distinguish epigenetic from Mendelian inheritance.
 - 2.20. Students will create pedigrees for non-mendelian patterns of inheritance
 - 2.21. Students will create pedigrees for mutations in genes that are maternally inherited.
 - 2.22. Students will explain the mechanisms by which genes are silenced, both at the DNA modification level and histone level.
- 3. Students will apply basic concepts of genetic inheritance to solve genetic problems using critical and creative thought process.**
- 3.1. Students will utilize Punnett squares and the branching methods to compute genetic ratios.
 - 3.2. Students will apply probability laws to compute gamete genotypic ratios and organismal genotypic and phenotypic ratios.
 - 3.3. Students will apply Chi square to test specific hypotheses.
 - 3.4. Students will build pedigrees based on genetic data
 - 3.5. Students will use pedigree analysis to map physically genes on chromosomes
 - 3.6. Students will calculate recombination frequencies to make genetic maps.
 - 3.7. Students will distinguish two and three factor mapping
 - 3.8. Students will utilize crossover interference data to estimate expected crossover frequencies.

- 3.9. Students will distinguish between sex-chromosome linkage inheritance patterns from autosomal inheritance patterns by solving word problems having both types of patterns.
 - 3.10. Students will distinguish basic mendelian inheritance patterns from more complex variations involving multiple alleles, incomplete dominance and epistatic interactions and biochemical genetic pathways by the solution of word problems involving these types of interactions.
 - 3.11. Students will order biochemical intermediates into a biochemical pathway and determine the effect of mutations on the progression of the pathway.
 - 3.12. Students will utilize their knowledge of the mutations and the genetic code to identify the kind of mutations that gave rise to specific mutant proteins.
 - 3.13. Students will utilize their knowledge of being able to analyze a DNA sequence, find and translate a putative mRNA and predict what effect different mutagenic agents would have on protein function.
 - 3.14. Students will utilize their knowledge of the different kinds of mutations and the process of transcription and translation to predict the changes in proteins cause by specific mutation.
 - 3.15. Students will utilize their understanding of the concept of complementation analysis to solve complementation problems. (e.g., identify if a process is affected by more than one gene, or if an observed trait is cause by one or more genes, or to organize mutants into complementation groups)
 - 3.16. Students will utilize their knowledge of synthetic biology and mechanisms regulating gene expression in eukaryotes and prokaryotes to solve problems.
 - 3.17. Students will distinguish between cis and trans regulatory elements.
 - 3.18. Students will distinguish between upstream and downstream effects.
- 4. Students will interpret genetic data in tabular and graphic form to identify and formulate hypothesis.**
- 4.1. Students will formulate hypothesis based on interpreting gamete and/or progeny phenotypic and/or genotypic ratios.
 - 4.2. Students will utilize genetic analysis of to build biochemical pathways.
 - 4.3. Students will interpret pedigrees to hypothesize the mode of inheritance of a specific disease.
 - 4.4. Students will analyze phenotype and genotype, and how these relate to altered Mendelian ratios.
 - 4.5. Students will analyze data presented in tabular and graphical format, and make hypothesis concerning mode of inheritance.
 - 4.6. Students will analyze data presented in tabular and graphical format, and make hypothesis concerning mode of gene regulation.
 - 4.7. Students will differentiate between structural and regulatory genes based on their analysis of genetic and biochemical data.
 - 4.8. Students will distinguish genetic from epigenetic phenomena by analyzing data in tabular form.
- 5. Students will design molecular genetic experiments to test specific hypothesis.**
- 5.1. Students will propose genetic experiments to assess the type of mutation identified in screens.
 - 5.2. Students will design genetic experiments to test genetic background of organisms.
 - 5.3. Students will design genetic experiments to test how many genes may be involved in a process.

- 5.4. Students will design genetic experiments to test whether a gene is linked to the X chromosome.
- 5.5. Students will propose molecular genetic experiments to uncover mechanisms of regulation of gene expression.
- 5.6. Students will design genetic tests to identify whether a mutation affects a cis or a trans acting factor.
- 5.7. Students will propose molecular genetic experiments to assess at what level a specific gene is regulated.

Outcomes of assessment: 100% of the final grade will be based on the sum of the following assessments:

Proportion of total course grade out of 1000 points:

Connect assignments	150 points Connect assignments and virtual labs.
Group & individual assignments/activities	225 points Assigned Blackboard group substantive discussions & responses, summaries, problems, concept maps, solving problems, presentations, etc.
Pop quizzes	200 points.
Participation	50 points in class and on Blackboard forums 50 points Group participation (from peer evaluations), my observations, and attendance.
Exam1	100 points
Exam 2	100 points
Cumulative Final Exam	125 points (on the BC assigned time and date)

- *Blackboard totals are not accurate, your grade is an accumulation of points, not averages. The grade center is for you to see your grade, but blackboard is not able to generate a proper cumulative grade for the course.*

Students will demonstrate that they are meeting the stated learning objectives through their performance in tests/exams, homework, and assignments. **There are no negotiations for grades.** Exams will assess your ability to retain, recall, understand the material covered in lecture and in the assigned materials, and **importantly, your ability to integrate and extrapolate the material covered by solving problems.** Grades may be curved or scaled at the discretion of the instructor only. **There are no make-up exams or quizzes.**

Bonus assignments are included in each section and thus there will be no make ups. For example, the course quizzes add up to > 200 (even if student misses a quiz, they can still get 100% of the 200 points assigned for quizzes). If the students accumulate more than the allotted points for a section such as quizzes, the additional points will not be counted (i.e. no student can get more than 200 points for their quizzes).

Grading: All assignments will be due at the specified time. **There will be no extensions for the homework or assignments.** You will be allowed to submit late, but late submissions cannot get more than a B+ grade. To accommodate for emergencies, there are additional bonus Connect homework/virtual labs, and quizzes (better than dropping a low grade as all points contribute to your grade).

Letter grading scheme: The scheme is below. A one-point difference in your final is a 10 point (course is out of 1000 points) difference so do not request additional points unless I have made a mistake in grading or adding grades. No additional curbing of grades will be done.

A+	97-100
A	94-96
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	73-65
D/F	64-60
F	59 or less

Topical outline:

Module 0: Course readiness and preparation

This module includes course readiness material and other important material that is mandatory. Please do not skip.

Module 1: Mendelian inheritance “the basics”

I. Basic Mendelian Genetics

- A. Segregation of alleles
 - Punnett square
- B. Independent assortment
 - Method of branching
- C. Chi square test
 - What is it for and what it tells

II. The physical basis of Mendelian principles

- A. Chromosomes and ploidy
- B. Mitosis
- C. Meiosis

Module 2: Mendelian inheritance and Linkage analysis

III. Sex-chromosome linkage Read:

- A. The origins of the discovery of sex-chromosome linkage.
- B. The implications of sex-chromosome differences.
- C. Recognize, from the results of genetic crosses when sex-chromosome linkage is indicated and when it is not.
- D. The meiotic basis of nondisjunction.

IV. Pedigree analysis:

- A. When is pedigree analysis used?
- B. The limits and uses of pedigree analysis
- C. Using pedigree analysis to understand different modes of gene transmission

V. Linkage analysis:

- A. Distinguish the inheritance patterns of linked and unlinked genes
- B. Understand the relationship between linkage and recombination
- C. Use recombination frequencies to make genetic maps
- D. Understand and use three-point test crosses
- F. Understand the meaning of and be able to calculate crossover interference

Module 3: Confusing phenotypic ratios.

VI. Extensions of Mendelian genetics:

- A. Multiple alleles
- B. Complex dominance relationships
- C. Multiple alleles
- D. Gene interactions (Epistasis and an introduction to biochemical-genetic analysis of pathways, Novel phenotypes, redundancy, complementation)

Module 4: Mutations, damage and repair, and what mutations can tell us.

VII. Mutations:

- A. Mutations and their classification
 - 1. What are mutations and what do they tell us about gene function.
 - 2. Classification of mutations based on the type of lesion and their effect on phenotype
- B. Different categories and mechanisms of mutagenic agents
 - 1. Electromagnetic radiation- X-rays, Gamma rays, UV light
 - 2. Chemical mutagens
 - 3. DNA mutagens -IS elements and transposons
 - 4. Protein mutagens- DNA binding enzymes (CRISPR Cas 9)
 - 5. DNA repair mechanisms

Module 5: What mutations and mutational analysis can tell us

- VIII. What gene structure tell us about function:** Relationship between mutations and protein structure and function

1. Genetic code
2. Review of transcription and translation

IX. Gene function:

- A. Biochemical-genetics analysis of pathways
- B. Complementation analysis

Module 6: Regulation of gene expression

X. Control of gene expression in eukaryotes:

- A. Genetic dissection of regulatory components of a eukaryotic gene (Cis acting: 5' UTR, promoter, enhancers, 3'UTR, alternative splicing. Trans-acting: transcription factors/co-factors)
- B. RNA interference, RNA and protein degradation
- C. Genetic tools to study mechanism regulating eukaryotic gene expression

XI. Control of gene expression in bacteria:

- A. Genetic analysis of the lactose operon
- B. Genetic analysis of tryptophan metabolism

Module 4: Non-Mendelian Inheritance

XII. Non-mendelian genetics: Chapter 15 Organellar inheritance

- A. Organelle inheritance – mitochondrial and chloroplast inheritance
- B. Maternal mRNA contribution (snail shell coiling)

XIII. Epigenetic control of cell processes

- A. Differences between genetic and epigenetic
- B. Different outcomes of crosses according to Mendelian principles and epigenetic effects
 - i. X-chromosome inactivation
 - ii. Maternal-paternal silencing

Class rules and regulations: These policies and expectations are intended to create a productive learning atmosphere for all students. Please bring any concerns you may have to my attention immediately. To create and preserve the course atmosphere that optimizes teaching and learning, all students share the responsibility of creating a positive learning environment. Students are expected to conduct themselves in a manner that does not disrupt teaching or learning and are expected to follow these standards: Course communication and discussions should be civilized and respectful to everyone and relevant to the topic we are discussing. Discussion forums are meant to allow for a variety of viewpoints. This can only happen if we respect one another and our differences. I will begin lectures promptly at the designated time and students are expected to be on time to these sessions. In addition, class will end at the designated time. Please refrain from engaging in other tasks during the class as it is disruptive to me and to others around you.

Netiquette: If we have an emergency online lecture (e.g., due to college closure due to weather, etc) or in communication in the discussion board. Do not interrupt others. Put your hand up and wait to be called when you want to speak. Avoid direct messaging me. I will not answer questions that are not related to the lecture during lectures or review sessions. Do not use the chat to discuss with classmates' topics not related to the current lecture.

It is much more conducive to teaching if I can see your faces and that there is someone listening or participating on the other side of the screen. Although it is not mandatory during class, I will appreciate it if you keep your camera on and your microphone off unless you are called to speak. Like in person lectures I expect that you stay off your phone, email or other activities and are pay attention in class. You are expected to participate in class and in the group activities.

Unacceptable behaviors: Foul language, interrupting others, misusing the chat feature/discussion board, disrespecting classmates or the instructor. Repeated misconduct will be referred to Judicial Affairs.

Encouraged behaviors: Respectful dialogue and class material discussions, waiting your turn to speak, staying on topic.

Unconscious Bias: To prevent unconscious discrimination, the instructor asks that instead of your name you use your EMPLID number on tests and assignments. Assignments in blackboard are anonymous so that instructors don't see the name of the student when correcting, names will show to the instructor in each assignment after all students have been graded.

Class Preparation: It is expected the students prepare themselves before they come to class. This includes, for example, solving assigned problems and reading and understanding assigned material and previous lecture before coming to the class. Students are responsible of knowing about all topics discussed and presented in this course in addition to the textbook content assigned.

Note: Course materials and assignments will be posted on Blackboard and Connect regularly. Students are responsible for checking and doing the assignments/readings on a timely basis.

University's Policy on Academic Integrity: The faculty and administration of Brooklyn College support an environment free from cheating and plagiarism. Each student is responsible for being aware of what constitutes cheating and plagiarism and for avoiding both the complete text of the CUNY Academic Integrity Policy and the Brooklyn College procedure for implementing that policy can be found at this site: www.brooklyn.cuny.edu/bc/policies. If a faculty member suspects a violation of academic integrity and upon investigation, confirms that violation, or if the student admits the violation, the faculty member MUST report the violation. Students should be aware that faculty may use plagiarism detection software.

Student Disability Services: The Center for Student Disability Services (CSDS) is committed to ensuring students with disabilities enjoy an equal opportunity to participate at Brooklyn College. In order to receive disability-related academic accommodations, students must first

be registered with CSDS. Students who have a documented disability or suspect they may have a disability are invited to schedule an interview by calling (718) 951-5538 or emailing Josephine.Patterson@brooklyn.cuny.edu. If you have already registered with CSDS, email Josephine.Patterson@brooklyn.cuny.edu or testingcsds@brooklyn.cuny.edu to ensure accommodation emails are sent to your professor.

Attendance and bereavement:

[Student Bereavement Policy](#).

Non-attendance due to religious beliefs: The state law regarding non-attendance because of religious beliefs is noted in the front matter of the *Undergraduate Bulletin* and *Graduate Bulletin*. These may be found on the [Academic Calendars, Course Schedules, and Bulletins](#) page of the Registrar's website.
