|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NEW YORK CITY COLLEGE OF TECHNOLOGY  **The City University Of New York** | | | | School of Arts and Sciences  **Department of Biological Sciences** | |
| **Course Information** | | | | | |
| **Course title:** | Genetics (Lecture and Laboratory) | | | | |
| **Course code:** | BIO2450 and BIO2450L | | | | |
| **Credit Hours:** | 4 credit hours | | 3 hours lecture and 3 hours lab per week for 15 weeks | | |
| **Prerequisite:** | BIO1201 | | | | |
| **Text:** | **Lecture** | “Concepts of Genetics, Second Edition” by Brooker RJ.  ISBN: 978-0-07-352535-8 | | | |
| **Lab** | Various handouts will be used for all laboratories in this course | | | |
| **Materials** | Lab coat, disposable gloves, calculator | | | | |
| **Course Description:** | This course introduces students to fundamental concepts in classical and molecular genetics. Topics are chosen to provide a broad overview of fields including Mendelian Inheritance, viral and bacterial genetics, molecular structure of genes, transcription and translation, genetic analysis, cancer genetics, and population and quantitative genetics. Laboratories complement lectures by providing a hands-on, inquiry-based approach to research questions in genetics focusing on both molecular and classical approaches. | | | | |
| **Grading Procedure (see Grading Policies for details)** | | | | | |
| Lecture: 60% | | | | Lab: 40% | |
| The Lecture component will include 4 exams plus other assignments at the discretion of the instructor. The Lab component will include 4 quizzes, 5 short lab summaries, and a final full laboratory report. | | | | | |
| **Course Coordinators** | | | | | |
| **Dr. Christopher Blair** | | | |  | |
| (718) 260-5342 | CBlair@citytech.cuny.edu | | |  |  |
| **Instructors** | | | | | |
| **Lecture** | **Name: Dr. Christopher Blair** | | | | |
| **Email:** CBlair@citytech.cuny.edu | | | | **Phone:** 718) 260-5342 |
| **Laboratory** | **Name: Dr. Christopher Blair** | | | | |
| **Email:** CBlair@citytech.cuny.edu | | | | **Phone:** 718) 260-5342 |

**Grading Rubric (Combined)**

Students’ performance on this course will be evaluated as follows:

Lecture: 60% of final grade based on 4 exams.

Lab: 40% of final grade, based on quizzes, homework, and formal lab report.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assignments** | | | **Points** | **Note** | |
| **Laboratory Grading** | There are 4 quizzes, which will account for 50% of the final lab grade. | Quiz 1 | 5% | Letter grades will be determined using a standard percentage point evaluation as outlined below:  **A:** 93-100  **A-:** 90-92.9  **B+:** 87-89.9  **B:** 83-86.9  **B-:** 80-82.9  **C+:** 77-79.9  **C** 70-76.9  **D:** 60-69.9  **F:** Below 60 | |
| Quiz 2 | 5% |
| Quiz 3 | 5% |
| Quiz 4 | 5% |
| Homework assignments (5)  worth 25% of the final lab grade | | 10% |
| The final laboratory report is worth 25% of the final lab grade | | 10% |
|
|
|
|
|
|
|
| **Lecture grading** | Exam 1 | | 15% | **Percentage Category:** | |
| Exam 2 | | 15% | **Lecture Exams** | 60% |
| Exam 3 | | 15% | **Laboratory Quizzes** | 20% |
| Exam 4 | | 15% | **Lab Homework** | 10% |
| **Total** | | **100%** | **Final Lab Report** | 10% |

**Grading Policy (Lecture) - 60% final course grade**

|  |  |  |  |
| --- | --- | --- | --- |
| **Assignments** | | **Points** | **Grading** |
| **Lecture Component** | Exam 1 | 25% | Letter grades will be determined using a standard percentage point evaluation as outlined below:  **A:** 93-100  **A-:** 90-92.9  **B+:** 87-89.9  **B:** 83-86.9  **B-:** 80-82.9  **C+:** 77-79.9  **C** 70-76.9  **D:** 60-69.9  **F:** Below 60 |
| Exam 2 | 25% |
| Exam 3 | 25% |
| Exam 4 | 25% |
| **Total** | **100%** |

**Grading Policy (Laboratory) - 40% final course grade**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assignments** | | | **Points** | **Grading** |
| **Laboratory Component** | There are 4 quizzes, which will account for 50% of the final lab grade. | Quiz 1 | 12.5% | Letter grades will be determined using a standard percentage point evaluation as outlined below:  **A:** 93-100  **A-:** 90-92.9  **B+:** 87-89.9  **B:** 83-86.9  **B-:** 80-82.9  **C+:** 77-79.9  **C** 70-76.9  **D:** 60-69.9  **F:** Below 60 |
| Quiz 2 | 12.5% |
| Quiz 3 | 12.5% |
| Quiz 4 | 12.5% |
| Homework assignments (5) | | 25% |
| Final Laboratory Report | | 25% |
| **Total** | | **100%** |

|  |
| --- |
| **Grading Policy** |
| All grades are counted (i.e. none are dropped). Make-ups are allowed at the discretion of the individual instructor, but are usually reserved for emergency situations or in select cases where a student has communicated with his/her instructor well ahead of time. Doctor’s notes are generally required. Approximately 5 bonus questions will be provided on each lecture exam. In addition, over the course of the semester there will be two short pop lab quizzes that will serve as extra credit. |

|  |
| --- |
| **Extended Course Description** |
| BIO2450 is designed to provide students with a broad introduction to the field of genetics. Today, genetics is used at least to some extent in multiple sub-disciplines within the life sciences, thus requiring a strong foundational understanding of the field. Further, with the advent of next-generation DNA sequencing technologies it has never been easier to dive into genetic analysis. The course is divided into multiple units, and topics have been carefully selected to provide a comprehensive overview of some of the more common themes as well as newer topics that are progressing at a rapid pace including bioinformatics and genomics. The first portion of the course reviews and expands upon topics covered in BIO1101 (e.g. mitosis, meiosis, recombination, etc.) and introduces students to Mendelian Inheritance. The second portion of the course discusses the molecular biology of genes and the process of DNA replication. Part IV focuses on the processes of transcription and translation. The final two units focus more on applied concepts and include biotechnology, genetic analysis and genomics, medical genetics, population genetics and quantitative genetics. Laboratories complement lectures by providing a hands-on, inquiry-based approach to research questions in genetics through utilization of both wet-lab and computational methodologies. |

|  |
| --- |
| **Course Learning Outcomes** |
| * Become proficient in basic terminology used in the field of genetics. * Understand Mendelian patterns of inheritance and more complex inheritance patterns. * Demonstrate knowledge pertaining to viral and bacterial genetics. * Acquire knowledge regarding the molecular properties of genes and chromosomes. * Develop a more complete understanding of transcription, translation, and DNA replication. * Become familiar with the diverse roles of genetics in the medical field. * Develop a foundational understanding of evolutionary, population, and quantitative genetics. * Use laboratories to develop experimental and quantitative skills. * Continue to develop reading and analytical writing skills. |

|  |
| --- |
| **Academic Integrity at City Tech and CUNY** |
| Students and all others who work with information, ideas, texts, images, music, inventions, and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the College recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion. |

|  |
| --- |
| **Final Laboratory Report** |
| Students are responsible for one full laboratory report related to **EITHER** the genetically modified organisms (GMO) laboratory exercise, PTC exercise, or barcoding exercise. This should be formatted as a full scientific paper with the appropriate sub-headings (Abstract, Introduction, Materials and Methods, Results, Discussion). The report should be 5-7 pages (double-spaced) exclusive of references. At least five (5) references from the primary peer-reviewed literature should be used in the report. These generally include journal articles. Websites (including Wikipedia) and popular news articles are not acceptable. The library is an excellent resource for help performing a literature search. Be careful of plagiarism and cite appropriately. **Any idea that is not your own or is not common knowledge needs an appropriate citation.** Reports are due on the last day of class (Week 15) and will count as 10% of the final course grade. Grading follows the rubric below. |

|  |
| --- |
| **Homework (Laboratory)** |
| Throughout the semester there will be five (5) short homework assignments/summaries related to the laboratory experiments. Summaries should be approximately one page in length (single-spaced) that highlights the goals of the experiment, the methodology, results and conclusions. Tables and figures may be included. These assignments are not a full laboratory report, but short summaries of the respective exercise. Thus, you are **NOT** required to format the summary into specific subsections. All homework assignments are due in class one week following the relevant laboratory exercise. A grade of zero will be given for any homework assignment submitted late. Grading follows the rubric below. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Grading rubric for one page summaries | | | | | | |
| Score | **Criteria** | **Excellent (5 pts)** | **Very Good (4 pts)** | **Good (3 pts)** | **Fair (2 pts)** | **Poor (1 pt)** |
|  | **Background, scientific accuracy and relevance** | Provides an excellent, yet brief background of topic and clearly states the goals and objectives of the experiment. | Provides a succinct well-thought out rationale for experiment and provides accurate background information. | Provides an adequate explanation of background information and purpose, but may deviate at times. | Provides little background information and context. Does not demonstrate a clear understanding of purpose. | Background information is missing or is inaccurate. Demonstrates lack of understanding of experimental goals |
|  | **Methods and results** | Analyses and results are clear and present with little to no errors. Reader gains important insights. All tables and figures contain informative legends and are appropriately referenced in text. | Analyses and results are clear and present. Reader gains important insights, though some sections may be confusing. Tables and figures appropriate with informative legends. | Analyses and results present, but are unclear. Context is provided, but may be difficult to comprehend | Analyses and results basic. Tables and/or figures lacking context and appropriate legends. | Analyses and results missing. |
|  | **Conclusions** | Provides an excellent conclusion to the summary that reiterates the primary purpose, major findings, and potential explanations for unanticipated results. | Provides acceptable concluding remarks and demonstrates knowledge regarding purpose. May not include potential explanations for unexpected results. | Adequate concluding remarks included. Some statements may stray from primary purpose of experiment. | Few concluding remarks included that may deviate from the purpose of experiment. | No conclusions are provided. Reader is confused as to purpose. |
|  | **Quality of writing, language and presentation** | Excellent spelling and grammar used throughout summary. Reader gains important insight. Summary exhibits excellent clarity that conveys meaning. | Adequate spelling and grammar that conveys meaning. Reader gains important insights, though some statements may be confusing. | Spelling and grammar are generally adequate and text conveys meaning, although writing is relatively basic and confusing in some places. | Multiple instances of poor spelling, grammar, and sentence structure that impedes meaning. Reader gains some insight. | Multiple instances of poor spelling, grammar, and sentence structure that significantly impedes meaning. Reader gains little insight. |
|  | **Document length** | Summary is between 1-2 pages |  |  |  | Summary is over 2 pages in length or summary is less than half a page. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Grading rubric for final lab report | | | | | | |
| Score | **Criteria** | **Excellent (5 pts)** | **Very Good (4 pts)** | **Good (3 pts)** | **Fair (2 pts)** | **Poor (1 pt)** |
|  | **Appropriate sections** | All sections of report present | One section of report missing. | Two sections of report missing. | Three sections of report missing. | Four or more sections of report missing. |
|  | **Introduction, scientific accuracy and relevance** | Provides an excellent introduction of topic and clearly states the goals and objectives of the experiment. Provides adequate citations. | Provides a succinct well-thought out rationale for experiment and provides accurate background information. | Provides an adequate explanation of background information and purpose, but may deviate at times. Few statements contain citations. | Provides little background information and context. Does not demonstrate a clear understanding of purpose. Citations generally lacking. | Introduction section is inaccurate or missing. Demonstrates lack of understanding of experimental goals. Citations generally lacking. |
|  | **Methods and results** | Analyses and results are clear and present with little to no errors. Reader gains important insights. All tables and figures contain informative legends and are appropriately referenced in text. | Analyses and results are clear and present. Reader gains important insights, though some sections may be confusing. Tables and figures appropriate with informative legends. | Analyses and results present, but are unclear. Context is provided, but may be difficult to comprehend | Analyses and results basic. Tables and/or figures lacking context and appropriate legends. | Analyses and results missing. |
|  | **Discussion and conclusions** | Provides an excellent discussion of results in light of other recent peer-reviewed research. Does not simply restate results. Cites appropriately. | Discussion is present and reasonably well developed. Most statements contain appropriate citations, but organization could be improved. | Discussion is present, but basic. Some statements may stray from primary purpose of experiment. Citations are infrequently used. | Limited Discussion that may deviate from the purpose of experiment. Citations are extremely limited. | Discussion is missing or ambiguous. Reader is confused as to purpose. Citations are missing. |
|  | **Quality of writing, language and presentation** | Excellent spelling and grammar used throughout report. Reader gains important insight. Report exhibits excellent clarity that conveys meaning. | Adequate spelling and grammar that conveys meaning. Reader gains important insights, though some statements may be confusing. | Spelling and grammar are generally adequate and text conveys meaning, although writing is relatively basic and confusing in some places. | Multiple instances of poor spelling, grammar, and sentence structure that impedes meaning. Reader gains some insight. | Multiple instances of poor spelling, grammar, and sentence structure that significantly impedes meaning. Reader gains little insight. |
|  | **References** | >5 references from peer-reviewed literature. Reference section present with no formatting errors. | >5 references from peer-reviewed literature. Reference section present with few formatting errors. | <5 references from peer-reviewed literature. Reference section present with no formatting errors. | <5 references from peer-reviewed literature. Reference section present with few formatting errors. | <5 references from peer-reviewed literature. Reference section missing or contains numerous errors. |
|  | **Document length** | Lab report between 5-7 pages |  |  |  | Lab report <5 or >7 pages |

|  |
| --- |
| **Library Support for Undergraduate Research** |
| Student Services: <https://library.citytech.cuny.edu/services/student/index.php>   * The Student Services page on the Library’s website features links to:   + Ask Us (24/7 online chat reference service)   + borrowing/renewing information   + library technology information   + citations and writing guide   + interlibrary loan information   + how to reserve group study rooms   + It’s Your Library! student information handout (<https://library.citytech.cuny.edu/uploads/StudentServices_2.pdf>)   Ask a Librarian: <https://library.citytech.cuny.edu/help/ask/index.php>   * 24/7 web chat with a librarian * Students can also: call the Library during open hours, email us, or make a one-on-one research appointment (or stop by the Ask a Librarian desk when the Library is open)   Research Guides by Subject: <http://libguides.citytech.cuny.edu/>   * Guides to research using books, articles, database, internet, and other sources for selected disciplines and departments at City Tech * Contact your library faculty subject specialist to request a research guide for your discipline: <https://library.citytech.cuny.edu/research/subjectSpecialists.php>   Citations and Formatting Guides: <http://libguides.citytech.cuny.edu/citations>   * The Library’s research guide for citation styles, formatting, and writing research papers. * Includes suggested citation and research management tools: <http://libguides.citytech.cuny.edu/citations/writing>   Tutorials: <https://library.citytech.cuny.edu/help/tutorials/index.php>   * Video, slideshow, and text-based tutorials on the research process, evaluating information, using library and internet resources, and other research topics * The Library has an instructional design intern working with us this year to help revise these tutorials and create new tutorials, let us know if there are specific kinds of tutorials that would be useful for your students |

**Lecture Schedule**

Chapters are indicated for the 2nd Edition of “Concepts of Genetics” by R. Brooker McGraw Hill Publishers

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit 1 – Patterns of Inheritance** | **Week 1** | **Overview of Genetics**   * Gene expression * Genotype & phenotype * The study of genetics   **Reproduction and Chromosome Transmission**   * Chromosomal features * Mitosis & meiosis * Sexual reproduction | **Ch. 1**  Pg. 1 – 19  **Ch. 2**  Pg. 20 - 41 |
| **Week 2** | **Mendelian Inheritance**   * Gregor Mendel and his pea plants * Laws of Segregation and Independent Assortment * Inheritance patterns and probability | **Ch. 3**  Pg. 42 - 72 |
| **Week 3** | **Sex Determination and Sex Chromosomes**   * Genetics of sex determination * Dosage compensation & X-chromosome inactivation * Sex chromosome properties and transmission patterns   **Extensions of Mendelian Inheritance**   * Dominant vs. recessive alleles * Gene expression and the environment * Dominance and allele interactions * Sex-influenced inheritance * Pleiotropy, epistasis and gene interactions   **Extranuclear Inheritance**   * Chloroplast DNA * Mitochondrial DNA * Theory of endosymbiosis | **Ch. 4**  Pg. 73 – 89  **Ch. 5**  Pg. 90 – 112  **Ch. 6**  Pg. 113-120 |
| **Week 4** | **EXAM 1** (Background, mitosis, meiosis, Mendelian genetics, sex determination, extranuclear inheritance) | |
| **Genetics of Bacteria**   * Overview of bacterial reproduction * Conjugation, transduction, and transformation * Evolution of antibiotic resistance   **Genetics of Viruses**   * Structure of viruses * Viral reproduction | **Ch. 9**  Pg. 184 – 205  **Ch. 10**  Pg. 206 - 219 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit II - Molecular Structure and Genetic Replication** | **Week 5** | **Molecular Structure of DNA and RNA**   * DNA and genetics * Molecular structure of nucleotides * Discovery and structure of the DNA double helix * Molecular structure of RNA | **Ch. 11**  Pg. 220 - 241 |
| **Week 6** | **Molecular Structure and Organization of Chromosomes**   * Organization and structure of bacterial chromosomes * Eukaryotic genome sizes * Organization and structure of eukaryotic chromosomes in dividing and non-dividing cells | **Ch. 12**  Pg. 242 - 261 |
| **Week 7** | **DNA Replication**   * Overview of DNA replication * Bacterial DNA replication – replication forks * Bacterial DNA replication – synthesis * Bacterial DNA replication – accuracy * Eukaryotic DNA replication | **Ch. 13**  Pg. 262 - 285 |
| **Unit III – Molecular Properties of Genes** | **Week 8** | **EXAM 2** (Bacterial and viral genetics, molecular structure of DNA, RNA, chromosomes, DNA replication) | |
| **Gene Transcription and RNA Modification**   * Overview of transcription * Transcription in Bacteria * Transcription in Eukarya * RNA editing | **Ch. 14**  Pg. 286 - 312 |
| **Week 9** | **Translation of mRNA**   * Genes and proteins * The genetic code and protein synthesis * Structure and function of tRNAs * Structure and function of ribosomes * Stages of translation | **Ch. 15**  Pg. 313 - 342 |
| **Unit IV: Genetic Technologies** | **Week 10** | **Biotechnology**   * Microorganisms and biotechnology * Genetically modified animals * Stem cells and cloning * Genetically modified plants * Human disease and gene therapy | **Ch. 21**  Pg. 477 - 501 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit IV: Genetic Technologies** | **Week 11** | **EXAM 3** (Gene transcription, translation, and biotechnology) | |
| **Genomics I: Analysis of DNA**   * Overview of chromosome mapping * Cytogenetic mapping * Linkage mapping * Physical mapping * Genome sequencing * Metagenomics | **Ch. 22**  Pg. 502 - 527 |
| **Week 12** | **Genomics II: Functional Genomics, Proteomics, and Bioinformatics**   * Functional genomics * Proteomics * Bioinformatics | **Ch. 23**  Pg. 528 - 548 |
| **Unit V: Genetic Analysis of Individuals and Populations** | **Week 13** | **Medical Genetics and Cancer**   * Inheritance of genetic diseases * Genetic screening and detection of disease-causing alleles * Prions and disease * Genetics and cancer * Personalized medicine | **Ch. 24**  Pg. 549 - 582 |
| **Week 14** | **Population Genetics**   * Hardy-Weinberg equilibrium * Natural selection * Genetic drift * Migration * Nonrandom mating * Mutation as the ultimate source of genetic variation | **Ch. 25**  Pg. 583 - 612 |
| **Week 15** | **Quantitative Genetics**   * Overview of quantitative genetics * Statistical methods * Polygenic inheritance * Heritability * Artificial selection and selective breeding | **Ch. 26**  Pg. 613 - 638 |
| **EXAM 4 - FINAL** (Genomics I, Genomics II, Medical Genetics, Population Genetics, Quantitative Genetics) | |

**Laboratory Schedule**

**Handouts will be used for all laboratories in this course. These will be posted to OpenLab site (https://openlab.citytech.cuny.edu/geneticslab/) and must be printed out and brought to class.**

|  |  |  |
| --- | --- | --- |
| **Week 1** | **Introduction to Genetics**  Probability, Mendelian Genetics, chi-square and measurements, | **Date** |
| **Week 2** | **Cytogenetics and Karyotyping**  Chromosomal alterations and human disease | **Date** |
| **Week 3** | **Mitosis & Meiosis**  *Sordaria* recombination and genetic crosses  *Homework 1: Cytogenetics write-up due* | **Date** |
| **Week 4** | **Quiz 1 – Introduction, Cytogenetics, Mitosis, Meiosis** | |
| **Monohybrid and Dihybrid Crosses**  Fruit fly (*Drosphila*) genetics Lab 1  **Population Genetics**  Human blood type frequencies Lab 1  *Homework 2:* Sordaria *write-up due* | **Date** |
| **Week 5** | **Monohybrid and Dihybrid Crosses**  Fruit fly (*Drosphila*) genetics Lab 2  **Population Genetics**  Human blood type frequencies Lab 2 | **Date** |
| **Week 6** | **Monohybrid and Dihybrid Crosses**  Fruit fly (*Drosphila*) genetics Lab 3  **Simulating Population Genetic Processes**  Genetic drift, mutation, gene flow, natural selection | **Date** |
| **Week 7** | **Monohybrid and Dihybrid Crosses**  Fruit fly (*Drosphila*) genetics Lab 4  **Lab Review (Crosses and Population Genetics)** | **Date** |
| **Week 8** | **Quiz 2 – Inheritance and Population Genetics** | |
| **DNA profiling in forensic science**  Pipetting and DNA fingerprinting Lab 1 (restriction digests)  *Homework 3: Genetic crosses write-up due*  *Homework 4: Blood typing and population genetics write-up due* | **Date** |
| **Week 9** | **DNA profiling in forensic science**  DNA fingerprinting Lab 2 (gel electrophoresis and analysis) | **Date** |
| **Week 10** | **Quiz 3 – DNA Fingerprinting** | |
| **Molecular Genetics, PCR, and Genotyping**  PTC genetics and GMO Lab 1 (DNA extraction and PCR)  *Homework 5: DNA fingerprinting write-up due* | **Date** |
| **Week 11** | **Molecular Genetics, PCR, and Genotyping**  PTC genetics and GMO Lab 2 (restriction enzyme digestion and gel electrophoresis) | **Date** |
| **Week 12** | **Molecular Genetics, PCR, and Genotyping**  PTC genetics and GMO Lab 3 (lecture, data analysis, and review questions) | **Date** |
| **Week 13** | **DNA Barcoding and Evolutionary Genetics**  DNA extraction and PCR from fish samples | **Date** |
| **Week 14** | **DNA Barcoding and Evolutionary Genetics**  Gel electrophoresis, BLAST, multiple sequence alignment and phylogenetic inference | **Date** |
| **Week 15** | **Quiz 4 – Molecular and Evolutionary Genetics** | **Date** |
| **Full Laboratory Report Due (PTC, GMO OR Barcoding)** | |