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| Course title: | **BIOL 226 - From Genes to Genomics** | | |
| Course code: | CRN 22176 | Term: | Winter 2024 |
| Course credits: | 3.0 | Delivery: | Lecture & Lab |
| Class session: | 01 | Start Date: | Wed Jan 3, 2024 |
| Lecture room: | Thorvaldson 271 | Lab room: | Thorvaldson G77 |
| Lecture time: | **MWF 10:30 to 11:20 am**  **Attendance highly recommended** | Lab times: | **TR 8:30 - 11:20 am**  **MTWRF 1:30 - 4:20 pm**  **MWR 5:30 - 8:20 pm** |
| Website/notes: | via Canvas | Prerequisites | Biology 120.3 |
| Outside of class: | Midterm: Tues, Feb 7, 5:45-6:45 pm in Arts 143/241 | BIOL 121 is strongly recommended. Students with credit for BIOL 211 will not receive credit for BIOL 226. | |

**Instructor: Nicole Webster**

Office: 320.3 CSRB

\*CSRB 320 is locked, please call or email ahead

Office#(306) 966-4445

Email: [nicole.webster@usask.ca](mailto:nicole.webster@usask.ca)

Office Hours: Wednesdays, 11:30-12:30 in CSRB320

or by appointment

Dr. Webster is a faculty member in the Department of Biology. She has a PhD from the University of Alberta and an MSc from The University of Leiden (The Netherlands). Her main area of study is the evolution and development of how snails grow their shells.

**Lab Coordinator: Andres Posso-Terranova**

Office: room G77 THORV Building

Office#(306) 966-4431

Email: [andres.posso@usask.ca](mailto:andres.posso@usask.ca)

Office Hours: By appointment only

Dr. Posso-Terranova is the laboratory coordinator for genetics courses in the Department of Biology. He holds a MSc in plant breeding (Colombia) and a PhD in evolutionary genetics (Canada).

Respect

Masks

Lectures and laboratories for BIOL226 Fall 2022 are fully face to face, conditional on the fluid public health situation. **While there is no mask mandate in place on campus for the time being, mask use is for the safety and comfort of all. Please be respectful.** For updates on Health and Safety requirements, visit: [*https://covid19.usask.ca/about/safety.php#Expectations*](https://covid19.usask.ca/about/safety.php#Expectations).

Distractions

Please be sure that any devices are muted prior to coming to class and avoid distracting your fellow classmates. As attendance is not required, I expect you to leave if you need to be distracting.

Email Etiquette

While I am happy to answer questions and discuss topics, please respect my time. I will do my best to answer your email within 1 business day. Do not expect replies on evenings and weekends.

Calendar Description

Content ranges from Mendelian genetics to molecular biology to population genetics. Examples from eukaryotic species, including humans, are emphasized. Topics include classical transmission genetics, cytogenetics, transcriptional regulation, gene function, mutation, DNA repair, recombinant DNA technology and structural/ functional/comparative genomics.

Course Overview

BIOL226 is an introduction to the basic genetics concepts that are essential to most modern biological sciences. We intend to prepare students for senior molecular biology and genetics courses for which this course is a prerequisite. The course combines classical genetics with molecular and genomics analysis. The first half of the course focuses on Mendelian genetics as it relates to the *Chromosomal Theory of Inheritance*. We explore practical applications of classical genetics principles such as linkage and recombination in building genetic maps. In the second half, we turn to understand the fundamental molecular processes (transcription and translation) that coordinate the flow of genetic information. We explore the origin of mutations and how genomes are functionally organized. We then investigate how the genome is transcriptionally regulated to yield phenotypic variation both genetically and epigenetically. The course ends by addressing population genetics.

Learning Outcomes

By the completion of this course, students will be expected to:

1. Understand the basics of genetic analysis at the genetic and genomic levels.
2. Understand the functional organization of prokaryotic and eukaryotic genomes.
3. Understand gene expression and genetic regulation mechanisms.
4. Solve basic genetic problems.

Resources

Textbook: ‘Introduction to Genetic Analysis’ – 12th edition. Griffiths et. al. 2020.

Available as an ebook, bound text book, or loose leaf copy. This **is recommended** to maximize your learning opportunities and enhance your understanding. Older versions of the textbook may suffice and are available at the Natural Sciences Library.

Achieve® is an online platform for assignments. Students will receive an access code for Achieve® with a purchase of the ebook/Achieve® bundle (<https://store.macmillanlearning.com/ca/digital/intro/achieve>). This is the most **cost effective** option.

Achieve website for Biol 226: <https://achieve.macmillanlearning.com/courses/3wmetg>

**Course ID**: 3wmetg

Lab Manual: Each student is required to purchase an access code from the U of S campus bookstore for downloading the lab book

Purchase link: <https://shop.usask.ca/CourseSearch/?course%5b%5d=UOFS,202301,BIOL,BIOL226,01&>

Canvas: Lecture notes (.pdf), lecture recording, and other online resources will be posted and accessible through the Canvas course page. Students can also engage in course discussions and ask questions about the course material.

Poll Everywhere: A web-based student response system. You can access it with any internet-capable device. All responses are anonymous. I will use this tool to gauge your understanding of concepts, encourage student engagement, and foster discussion during lecture. No grades are assigned, but students are strongly encouraged to participate to enhance their learning and the classroom experience.

Download at: <https://www.polleverywhere.com/mobile> OR

Browser link: <https://pollev.com/biol226>

Lecture Schedule

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Lecture # | Topic | Assignments | Lab |
| Jan 03 - Wed | 1 | Course introduction |  | None |
| Jan 05 - Fri | 2 | Topic 1: The fundamental Principles of Inheritance |  |
| Jan 08 - Mon | 3 | Topic 1: The fundamental Principles of Inheritance |  | None |
| Jan 10 - Wed | 4 | Topic 1: The fundamental Principles of Inheritance |  |
| Jan 12 - Fri | 5 | Topic 2: Chromosomal Basis of Mendelism |  |
| Jan 15 - Mon | 6 | Topic 2: Chromosomal Basis of Mendelism |  | Remote |
| Jan 17 - Wed | 7 | Topic 2: Chromosomal Basis of Mendelism |  |
| Jan 19 - Fri | 8 | Topic 3: Extensions of Mendelian Laws |  |
| Jan 22 - Mon | 9 | Topic 3: Extensions of Mendelian Laws |  | #1 |
| Jan 24 - Wed | 10 | Topic 3: Extensions of Mendelian Laws |  |
| Jan 26 - Fri | 11 | Topic 4: Linkage and Gene Mapping |  |
| Jan 29 - Mon | 12 | Topic 4: Linkage and Gene Mapping |  | #2 |
| Jan 31 - Wed | 13 | Topic 4: Linkage and Gene Mapping |  |
| Feb 02 - Fri | 14 | Topic 4: Linkage and Gene Mapping |  |
| Feb 05 - Mon | 15 | Lecture catch up and/or review |  | #3 |
| Feb 06 – Tues |  | **MIDTERM EXAM topics 1-4 (5:45-6:45, Arts 143/241))** | |
| Feb 07 - Wed | 16 | Topic 5: From Gene to Phenotype | Achieve 1-4 10:30 |
| Feb 09 - Fri | 17 | Topic 5: From Gene to Phenotype |  |
| Feb 12 - Mon | 18 | Topic 5: From Gene to Phenotype |  | #4 |
| Feb 14 - Wed | 19 | Topic 5: From Gene to Phenotype |  |
| Feb 16 - Fri | 20 | Topic 6: DNA Damage, Repair, and Mutation |  |
| Feb 19 – 23 | Winter Break - no classes or labs | | | |
| Feb 26 - Mon | 21 | Topic 6: DNA Damage, Repair, and Mutation |  | #5 + Quiz #1 |
| Feb 28 - Wed | 22 | Topic 6: DNA Damage, Repair, and Mutation |  |
| Mar 01 - Fri | 23 | Topic 6: DNA Damage, Repair, and Mutation |  |
| Mar 04 - Mon | 24 | Topic 7: Studying Genes and Genomes |  | #6 |
| Mar 06 - Wed | 25 | Topic 7: Studying Genes and Genomes |  |
| Mar 08 - Fri | 26 | Topic 7: Studying Genes and Genomes |  |
| Mar 11 - Mon | 27 | Topic 8: Regulation of Gene Expression in Bacteria |  | #7 |
| Mar 13 - Wed | 28 | Topic 8: Regulation of Gene Expression in Bacteria |  |
| Mar 15 - Fri | 29 | Topic 8: Regulation of Gene Expression in Bacteria |  |
| Mar 18 - Mon | 30 | Topic 9: Regulation of Gene Expression in Eukaryotes |  | #8 |
| Mar 20 - Wed | 31 | Topic 9: Regulation of Gene Expression in Eukaryotes |  |
| Mar 22 - Fri | 32 | Topic 9: Regulation of Gene Expression in Eukaryotes |  |
| Mar 25 - Mon | 33 | Topic 10: Population Genetics |  | #9 |
| Mar 27 - Wed |  | Good Friday -University closed |  |
| Mar 29 - Fri | 34 | Topic 10: Population Genetics |  |
| Apr 01 - Mon | 35 | Topic 10: Population Genetics |  | Lab evaluation and Quiz #2 |
| Apr 03 - Wed | 36 | Topic 10: Population Genetics |  |
| Apr 05 - Fri | 37 | Lecture catch up and/or review |  |
| Apr 6 - 26 |  | FINAL EXAM – Topics 1-10 |  |  |

Laboratory Schedule

Each student is required to purchase an access code from the U of S campus bookstore for downloading the lab book- <https://shop.usask.ca/CourseSearch/?course%5b%5d=UOFS,202301,BIOL,BIOL226,01&>

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| --- | --- | --- | --- | --- | --- |
| **Date** | **Week** | **Lab** | **Lab Exercise** | **Key points** | **Assignments / Lab Quizzes** |
| **January 15-19** | 1 | Remote Activity | **Remote activity:** Check essential information and general introduction in Canvas (Module 1) | -Presentation of lab details and support, how to access the genetics simulator, assignment requirements - The Lab coordinator will set up the breeding experiment (P1 X P2). | - |
| **January 22-26** | 2 | lab #1 | Laboratory #1. Introduction to genetics and monohybrid crosses  **(In-person activity)** | -The different stages of a model organism (*Drosophila* melanogaster) -Phenotypic traits and male vs. female flies’ differentiation. -*Drosophila* genetics notation -Breeding experiment: Remove P1 and P2 flies, score parentals | - Return assignment #1 at the end of the laboratory session (physical copy or through Canvas) |
| **January 29 - February 2** | 3 | lab #2 | Laboratory #2. *Drosophila* breeding experiment: F1 generation and dihybrid crosses.  **(In-person activity)** | - Obtain and analyze F1 and F2 data that illustrate segregation and assortment. - Propose a genetics model of inheritance for several traits  -Breeding experiment: score and analyze F1 flies -Set up F1 x F1 cross to obtain F2 generation | - Return assignment #2 at the end of the laboratory session (physical copy or through Canvas) |
| **February 5-9** | 4 | lab #3 | Laboratory #3. *Drosophila* breeding experiment: (Sex-linked traits).  **(In-person activity)** | -Obtained simulated F1 data that illustrate sex-linkage.  - Propose a genetic model of inheritance for several traits - Analyze hypothetical crosses that illustrate a gene-interaction -Breeding experiment: Remove F1 parental flies and predict F2 outcome. | - Return assignment #3 at the end of the laboratory session (physical copy or through Canvas) |
| **February 12-16** | 5 | lab #4 | Laboratory #4. Gene linkage and chromosome mapping.  **(In-person activity)** | - Obtain F1 data that illustrates trihybrid and test-crosses. - Describe the difference between independent assortment and gene linkage - Map two genes on a chromosome - Analyze real-case data from a trihybrid cross to map three genes  -Breeding experiment: score and analyze F2 flies | - Return assignment #4 at the end of the laboratory session (physical copy or through Canvas) |
| **February 19-23** | 6 |  | Midterm break. No lab sessions this week. | | |
| **February 26 - March 1** | 7 | lab #5 | Laboratory #5. *Drosophila* eye color: A combination of protein pigments  **(In-person activity)** | -Describe the *Drosophila's* protein-pigment differences. - Identify genes (enzymes) that are involved in the biosynthesis of protein pigments.  - Recognize the epistatic interactions between pigmentation genes. | - **Lab quiz #1.** Room G77, during lab session time. Access through Canvas. Topics: Labs 1-4  - Return assignment #5 at the end of the laboratory session (physical copy or through Canvas) |
| **March 4-8** | 8 | lab #6 | Laboratory #6. The Chi-square (X2) test: A statistical test for experiments.  **(In-person activity)** | - Propose a scientific hypothesis for a genetic cross.  - Calculate a X2 statistic value.  - Use a calculated X2 value to determine whether there is a statistically significant difference between hypotheses | - Return assignment #6 at the end of the laboratory session (physical copy or through Canvas)- |
| **March 11-15** | 9 | lab #7 | Laboratory #7. *Drosophila* class data review: hypotheses testing and gene mapping.  **(In-person activity)** | -Determine the genetics model of inheritance of four genes - Propose a scientific hypothesis (dihybrid cross) and statistically test its validity. - Map three genes on a chromosome | - Return assignment #7 at the end of the laboratory session (physical copy or through Canvas)- |
| **March 18-22** | 10 | lab #8 | Laboratory #8. DNA genotyping of *Drosophila* mutants: The white-1 locus (w).  **(In-person activity)** | - Establish the link between genotype and the white-eyes phenotype in *Drosophila*. - Identify two common molecular genetics methods. - Perform a PCR test to identify *Drosophila* mutants.  - Perform a simulated PCR test to differentiate DNA sequences. | - Return assignment #8 at the end of the laboratory session (physical copy or through Canvas)- |
| **March 25 - 29** | 11 | lab #9 | Laboratory #9. Population genetics: Gene pool and allele frequencies.  **(In-person activity)** | - Describe the gene pool concept. -Estimate genotype and allele frequencies based on phenotypic data. | - Return assignment #9 at the end of the laboratory session (physical copy or through Canvas)- |
| **April 1-5** | 12 |  | Lab evaluation and lab quiz #2.  **(In-person activity)** | - Lab evaluation and Lab quiz #2 | **Lab quiz #2.** Room G77, during lab session time. Access through Canvas. Topics: Labs 5-9 |

Assessment Details

Grading Scheme

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| --- | --- | --- | --- |
|  | **Details** | **Date** | **Value** |
| **Midterm Exam** | Multiple choice, Topics 1-4, In lecture | Tuesday, February 7, 5:45 (1h)  Arts 143/241 | **20%** |
| **Problem sets** | Achieve problem sets 1-4 | Wed, Feb 8, 10:30 am | **2.5%** |
|  | Achieve problem sets 5-10 | Monday April 8, 10:30 am | **2.5%** |
| **Lab** | 9 assignments (10%), 2 quizzes (30%) | See lab manual for specifics | **40%** |
| **Final Exam** | Multiple Choice, Topics 1-10, Scheduled separately | TBD: April 6 - 26 | **35%** |
|  |  | **Total** | **100%** |

Criteria to pass

Regardless of the marks you receive in this course, you must complete all lab quizzes (n=2).

Details

There are four components in the marking scheme of the course: Midterm and Final exam questions will be based only on the material presented and discussed in lecture.

1) **Midterm Exam:** **20%** of final course grade. Date: February 7 from 5:45pm-6:45pm in Arts 143 and Arts 241 Length: 1hour. Format: 40 multiple choice questions. Calculators allowed. The midterm exam covers all Classical Genetics lectures up to the exam date. No phones, laptops, tablets or other material allowed.

2) **Final Exam Value: 35%** of final grade. Date: Consult the Final Exam Schedule. Length: 3 hours. Format: 100 multiple choice questions. Calculators allowed. The final exam covers all of the material delivered in the lectures. No phones, laptops, tablets or other material allowed.

3) **Achieve® problem sets 5%** of final grade. Questions for each topic will be posted and completed by the student online. Problem sets will be accessible for at least 5 weeks to be completed and submitted online. **No extensions will be given**. To avoid last minute issues with internet access, please make sure you submit your assignments in advance. Questions will have unlimited attempts.

4) **Lab Component**: **40%** of final grade. A total of nine (9) lab assignments (worth 10% in total) must be returned as physical copies (i.e., printed) or submitted online through Canvas, according to the lab schedule (deadlines). Two lab quizzes (15% each) are based on the information provided in the briefings, video material, practical component, and laboratory manual. They will be performed **in-person** during the scheduled lab sessions and accessible through Canvas. Hence, **a laptop computer or larger tablet will be required for taking the quizzes**. Please contact the lab coordinator if you do not have access to one. The format includes multiple choice questions, fill in the blank, matching concepts, true/false, etc.

The lab component of BIOL226 is a requirement to pass BIOL226. Students are expected to attend labs and take both lab quizzes to pass the course. Students that have not completed the lab component (take both quizzes) will be assigned an INF (incomplete fail) mark for the course.

**Land Acknowledgement**

We acknowledge that the Saskatoon campus of the University of Saskatchewan is on Treaty Six Territory and the Homeland of the Métis. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. We recognize that in the course of your studies you will spend time learning in other traditional territories and Métis homelands. We wish you safe, productive and respectful encounters in these places.

**Required Syllabus Content**

Copyright

Course material created by your professors and instructors is their intellectual property and cannot be shared without written permission. This includes exams, PowerPoint/PDF lecture slides and other course notes. If materials are designated as open education resources (with a creative commons license) you can share and/or use them in alignment with the CC license. Other copyright-protected materials created by textbook publishers and authors may be provided to you based on license terms and educational exceptions in the Canadian Copyright Act.

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Academic Integrity

The University of Saskatchewan is committed to the highest standards of academic integrity. <https://academic-integrity.usask.ca/> Students are urged to read the Regulations on Academic Misconduct (<https://governance.usask.ca/student-conduct-appeals/academic-misconduct.php>) and to avoid any behaviours that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence.

For help developing the skills for meeting academic integrity expectations, see: <https://academic-integrity.usask.ca/students.php>

Students are encouraged to ask their instructors for clarification on academic integrity requirements. All students are encouraged to be aware of the rules for courses set out in the Academic Courses Policy on Class Delivery, Examinations, and Assessment of Student Learning (<https://policies.usask.ca/policies/academic-affairs/academic-courses.php>).

Access and Equity Services (AES) for Students

Access and Equity Services (AES) is available to provide support to students who require accommodations due to disability, family status, and religious observances.

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates.

Students who require accommodations for pregnancy or substantial parental/family duties should contact AES to discuss their situations and potentially register

Students who require accommodations due to religious practices that prohibit the writing of exams on religious holidays should contact AES to self-declare and determine which accommodations are appropriate. In general, students who are unable to write an exam due to a religious conflict do not register with AES but instead submit an exam conflict form through their PAWS account to arrange accommodations.

Any student registered with AES, as well as those who require accommodations on religious grounds, may request alternative arrangements for mid-term and final examinations by submitting a request to AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES. For more information or advice, visit https://students.usask.ca/health/centres/access-equity-services.php, or contact AES at 306-966-7273 (Voice/TTY 1-306-966-7276) or email aes@usask.ca.

Student Supports

Academic Help – University Library

Visit the University Library and Learning Hub to find supports for undergraduate and graduate students with first-year experience, study skills, learning strategies, research, writing, math and statistics. Students can attend workshops, access online resources and research guides, book 1-1 appointments or hire a subject tutor through the USask Tutoring Network

Connect with library staff through the AskUs chat service or visit various library locations on campus.

Enrolled in an online course? Explore the Online Learning Readiness Tutorial.

Teaching, Learning and Student Experience

Teaching, Learning and Student Experience (TLSE) provides developmental and support services and programs to students and the university community. For more information, see the students’ website http://students.usask.ca.

College Supports

Students in Arts & Science are encouraged to contact the Undergraduate Student Office and/or the Trish Monture Centre for Success with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources. Contact information is available at: (http://artsandscience.usask.ca/undergraduate/advising/)

Financial Support

Any student who faces unexpected challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central https://students.usask.ca/student-central.php.

Gordon Oakes Red Bear Student Centre

The Gordon Oakes Red Bear Student Centre) is dedicated to supporting Indigenous student academic and personal success. The Centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The Centre is an intercultural gathering space that brings Indigenous and non-Indigenous students together to learn from, with and about one another in a respectful, inclusive, and safe environment. Visit https://students.usask.ca/indigenous/index.php or students are encouraged to visit the ASC’s website https://students.usask.ca/indigenous/gorbsc.php

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success and facilitates international education experiences at USask and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange, and English as a Second Language students in their transition to the University of Saskatchewan and to life in Canada. ISSAC offers advising and support on matters that affect international students and their families and on matters related to studying abroad as University of Saskatchewan students. Visit https://students.usask.ca/international/issac.php for more information.