UNIVERSITY OF SASKATCHEWAN

Department of Biology

COURSE SYLLABUS

Course title:	BIOL 226 - From Genes to Genomics		
Course code:	CRN 82713	Term:	Fall 2022
Course credits:	3.0	Delivery:	Lecture & Lab
Class session:	01	Start Date:	Sept 01 2022
Lecture room:	EDUC1003	Lab room:	Thorvaldson G77
Lecture time:	**MWF 8:30 to 9:20 am**	Lab time:	**MTWRF 1:30 to 4.20pm**
Website/notes:	via Canvas	Prerequisites	Biology 120.3 or 110.6

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.
Prerequisites: Biology 120.3 or 110.6

Learning Context

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 recommended. Please be respectful of each other's choices.** For updates on Health and Safety requirements, visit: *https://covid19.usask.ca/about/safety.php#Expectations*.

Course Overview

BIOL226 is an introduction to the basic genetics concepts that permeate several fields in the biological sciences and is intended to prepare students for senior molecular biology and genetics courses. 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*. Practical applications of classical genetics principles such as linkage and recombination in building genetic maps are explored. In the second half, we turn to understand the fundamental molecular processes (transcription and translation) that coordinate the flow of genetic information through biological polymers, the origin of mutations and how genomes are functionally organized. We then move to investigate how the genome is transcriptionally regulated to yield variation at the level of the phenotype both genetically and epigenetically. The course ends by addressing questions in evolutionary and population genetics.

Note: The University of Saskatchewan Learning Charter is intended to define aspirations about the learning experience that the University aims to provide, and the roles to be played in realizing these aspirations by students, instructors and the institution. A copy of the Learning Charter can be found at:
http://www.usask.ca/university_secretary/LearningCharter.pdf

Learning Outcomes

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

1. Understand the basics of genetic analysis at the gene and genome levels.
2. Understand the functional organization of prokaryotic and eukaryotic genomes.
3. Understand gene expression and regulation mechanisms.
4. Be able to solve basic genetic problems.

Instructor information:

Instructor: Carlos Carvalho

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Lab Coordinator: Andres Posso-Terranova

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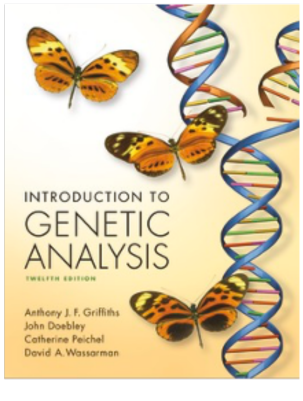
Dr. Carvalho is a regular faculty member in the Department of Biology. He holds an MSc in molecular biology (Japan) and a PhD in molecular genetics (Canada). Dr. Posso-Terranova is a laboratory coordinator for genetics courses in the Department of Biology. He holds a MSc in plant breeding (Colombia) and a PhD in evolutionary genetics (Canada).

Office Hours: Please note that all instructors have other commitments that may take them away from their office. Specific appointments can be set by email only.

Lecture Topics



		Griffiths chapters
TOPIC 1	The Fundamental Principles of Inheritance	1/2/3
TOPIC 2	Chromosomal Basis of Mendelism	2/3/17
TOPIC 3	Extensions of Mendelian Laws	5
TOPIC 4	Linkage and Gene Mapping	4
TOPIC 5	From Gene to Phenotype	8/9
TOPIC 6	DNA Damage, Repair and Mutation	15
TOPIC 7	Studying Genes and Genomes	6/10/14
TOPIC 8	Regulation of Gene Expression in Bacteria	11
TOPIC 9	Regulation of Gene Expression in Eukaryotes	12
TOPIC 10	Population Genetics	18

Lecture Schedule

Date	Lecture #	Topic	Achieve Assign.
Sept 02 – FRI	1	Course Introduction & Context	
Sept 05 – MON	-	Labour Day	
Sept 07 – WED	2	TOPIC 1 – The Fundamental Principles of Inheritance	ASSIGN. 1,2,3,4,5 open at 8am
Sept 09 – FRI	3	TOPIC 1 – The Fundamental Principles of Inheritance	
Sept 12 – MON	4	TOPIC 1 – The Fundamental Principles of Inheritance	
Sept 14 – WED	5	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 16 – FRI	6	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 19 – MON	7	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 21 – WED	8	TOPIC 3 – Extensions of Mendelian Laws	
Sept 23 – FRI	9	TOPIC 3 – Extensions of Mendelian Laws	
Sept 26 – MON	10	TOPIC 3 – Extensions of Mendelian Laws	
Sept 28 – WED	11	TOPIC 4 – Linkage and Gene Mapping	
Sept 30 – FRI	-	National Day for Truth and Reconciliation	
Oct 03 – MON	12	TOPIC 4 – Linkage and Gene Mapping	
Oct 05 – WED	13	TOPIC 4 – Linkage and Gene Mapping	
Oct 07 – FRI	14	TOPIC 4 – Linkage and Gene Mapping	
Oct 10 – MON	-	Thanksgiving	
Oct 12 – WED	-	MIDTERM EXAM	ASSIGN. 1,2,3,4,5 due at 8am
Oct 14 – FRI	15	TOPIC 5 – From Gene to Phenotype	ASSIGN. 6,7,8,9,10,11,12 open at 8am
Oct 17 – MON	16	TOPIC 5 – From Gene to Phenotype	
Oct 19 - WED	17	TOPIC 5 – From Gene To Phenotype	
Oct 21 – FRI	18	TOPIC 5 – From Gene To Phenotype	
Oct 24 – MON	19	TOPIC 6 – DNA Damage, Repair and Mutation	
Oct 26 – WED	20	TOPIC 6 – DNA Damage, Repair and Mutation	
Oct 28 – FRI	21	TOPIC 6 – DNA Damage, Repair and Mutation	
Oct 31 – MON	22	TOPIC 6 – DNA Damage, Repair and Mutation	
Nov 02 –WED	23	TOPIC 7 – Studying Genes and Genomes	
Nov 04 – FRI	24	TOPIC 7 – Studying Genes and Genomes	
Nov 07 – MON	-	Fall Break	
Nov 09 – WED	-	Fall Break	
Nov 11 – FRI	-	Fall Break	
Nov 14 – MON	25	TOPIC 7 – Studying Genes and Genomes	
Nov 16 – WED	26	TOPIC 8 – Regulation of Gene Expression in Bacteria	
Nov 18 –FRI	27	TOPIC 8 – Regulation of Gene Expression in Bacteria	
Nov 21 – MON	28	TOPIC 8 – Regulation of Gene Expression in Bacteria	
Nov 23 – WED	29	TOPIC 9 – Regulation of Gene Expression in Eukaryotes	
Nov 25 – FRI	30	TOPIC 9 – Regulation of Gene Expression in Eukaryotes	
Nov 28 – MON	31	TOPIC 9 – Regulation of Gene Expression in Eukaryotes	
NOV 30 – WED	32	TOPIC 10 – Population Genetics	
DEC 02 – FRI	33	TOPIC 10 – Population Genetics	
DEC 05 - MON	34	TOPIC 10 – Population Genetics	
DEC 07 - WED	35	TOPIC 10 – Population Genetics	
DEC 13 - MON			ASSIGN. 6,7,8,9,10,11,12 due at 8am
TBD	-	FINAL EXAM	

Laboratory Schedule

Each student is required to purchase an access code from the U of S campus bookstore for downloading the lab book- https://artsandscince.usask.ca/ebook.

Date	Week	Lab	Lab Exercise	Key points	Assignments / Lab Quizzes
September 6-9	1	-	**<u>Remote activity:</u>** Check essential information and general introduction in Canvas (Module 1)	Presentation of lab details and support, how to access the genetics simulator, assignment requirements -Breeding experiment: Set up main cross (P_1 X P_2) by Lab Coordinator	-
September 12-16	2	1	Laboratory # 1. Introduction to genetics and monohybrid crosses **(In-person)**	-The different stages of a model organism (*Drosophila* melanogaster) -Phenotypic traits and male vs. female flies' differentiation. -*Drosophila* genetics notation -Breeding experiment: Remove P_1 and P_2 flies, score parentals	- Return assignment # 1 at the end of the laboratory session (physical copy or through Canvas)
September 19-23	3	2	Laboratory # 2. *Drosophila* breeding experiment: F_1 generation and dihybrid crosses. **(In-person)**	- Obtain and analyze F_1 and F_2 data that illustrate segregation and assortment. - Propose a genetics model of inheritance for several traits -Breeding experiment: score and analyze F1 flies -Set up F_1 x F_1 cross to obtain F_2 generation	- Return assignment # 2 at the end of the laboratory session (physical copy or through Canvas)
September 26 - 30	4	3	Laboratory # 3. *Drosophila* breeding experiment: (Sex-linked traits). **(In-person)**	-Obtained simulated F_1 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 F_1 parental flies and predict F_2 outcome.	- Return assignment # 3 at the end of the laboratory session (physical copy or through Canvas)
October 3-7	5	4	Laboratory # 4. Gene linkage and chromosome mapping. **(In-person)**	- Obtain F_1 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 F_2 flies	- Return assignment # 4 at the end of the laboratory session (physical copy or through Canvas)
October 10-14	6		**Thanksgiving week. No sessions this week**		

October 17-21	7	5	Laboratory # 5. *Drosophila* eye color: A combination of protein pigments. **(In-person)**	-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)
October 24 - 28	8	6	Laboratory # 6. The Chi-square (X^2) test: A statistical test for experiments. **(In-person)**	- Propose a scientific hypothesis for a genetic cross. - Calculate a X^2 statistic value. - Use a calculated X^2 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)-
October 31 – November 4	9	7	Laboratory # 7. *Drosophila* class data review: hypotheses testing and gene mapping. **(In-person)**	-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)-
November 7-11	10		**Reading week: review your lab manual and material posted online**		
November 14-18	11	8	Laboratory # 8. DNA genotyping of *Drosophila* mutants: The white-1 locus (w). **(In-person)**	- 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)-
November 21-25	12	9	Laboratory # 9. Population genetics: Gene pool and allele frequencies **(In-person)**	- 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)-
November 28- December 2	13		Lab evaluation and **lab quiz # 2.** **(In-person)**	-	**Lab quiz # 2.** Room G77, during lab session time. Access through Canvas. Topics: Labs 5-9

Resources

Textbook: 'Introduction to Genetic Analysis' – 12th edition. Griffiths et. al. 2020. The ebook license with Achieve® is available through the bookstore. Achieve is an online platform with several learning resource features (https://store.macmillanlearning.com/ca/digital/intro/achieve).

Lecture notes (pptx) and other online resources will be posted and accessible through the Canvas course page. Through Canvas® students can also engage in course discussions about the course material.

Lectures will make use of Poll Everywhere®, a web-based student response system that is accessed through an app downloaded to a cell phone or via a webpage. Responses through Poll Everywhere are anonymous. This tool will be used to gauge the understanding of concepts taught during lecture and quickly address gaps, encourage student engagement, and foster discussion. No marks are assigned to answering Poll Everywhere questions, but students are strongly encouraged to participate to enhance the classroom experience.

Online assignments will be administered through Achieve®. Students are requested to purchase a license for Achieve® (course ID:). Students who have purchased the ebook/Achieve® bundle would have been provided an access code for Achieve®. Assignments will be accessible for two 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.

Most lectures will be based on chapters of the Griffiths text listed above. In some cases, sections of chapters will be complemented with information from the Snustad text. Chapter links to the lectures will be announced in class. Copies of the textbook can be found in the Natural Sciences Library. The textbook should help students to prepare in advance for lecture and as a resource in studying for exams, it should not be used as a substitute for the lecture notes and attendance.

Grading Scheme

Evaluation of Student Performance

There are four components in the marking scheme of the course: Midterm exam, Final exam, laboratory assignments (n=9) and lab quizzes (n=2). While there are no minimal marks required in these individual components in order to successfully pass the course, students are required to attend, turn in laboratory assignments and take the lab quizzes (n=2).

Midterm and Final exam questions will be based on the material (posted notes) presented and discussed in lecture. Use the textbook and online material as reference for context when studying for these exams.

1) Midterm Exam Value: **25%** of final course grade. Date: October 12 from 8:30am to 9:20am at EDUC1003. Format: 40 multiple choice questions. Calculators allowed. No phones, laptops, tablets or other material allowed. The midterm exam covers the first four topics of the course.

2) Final Exam Value: **40%** of final grade. Date: Consult the Final Exam Schedule. Length: 3 hours Format: 60 multiple choice questions. The final exam covers the whole material delivered in the course. No phones, laptops, tablets or other material allowed.

3) Achieve® assignments: **5%** of final grade. Assignments for each topic will be posted and completed by the student online.

4) Lab Component: **30%** of final grade. A total of nine (9) lab assignments (worth 10%) must be returned as

physical copies (i.e., printed) or submitted online through Canvas, according to the lab schedule (deadlines). Two lab quizzes (20%) 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. 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 a INF (incomplete fail) mark for the course.

Copyright

Course materials are provided to you based on your registration in a class, and anything created by your professors and instructors is their intellectual property, unless materials are designated as open education resources. This includes exams, PowerPoint/PDF slides and other course notes. Additionally, 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 (see http://laws-lois.justice.gc.ca/eng/acts/C-42/index.html). Before you copy or distribute others' copyright-protected materials, please ensure that your use of the materials is covered under the University's Fair Dealing Copyright Guidelines available at https://library.usask.ca/copyright/general-information/fair-dealing-guidelines.php. For example, posting others' copyright-protected materials on the open web is not covered under the University's Fair Dealing Copyright Guidelines, and doing so requires permission from the copyright holder.

For more information about copyright, please visit https://library.usask.ca/copyright/index.phpwhere there is information for students available at https://library.usask.ca/copyright/students/rights.php, or contact the University's Copyright Coordinator at mailto:copyright.coordinator@usask.ca or 306-966-8817.

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php#IXXIIAPPEALS)

For more information on what academic integrity means for students see the Academic Integrity section of the University Library Website at: https://library.usask.ca/academic-integrity#AboutAcademicIntegrity

You are encouraged to complete the Academic Integrity Tutorial to understand the fundamental values of academic integrity and how to be a responsible scholar and member of the USask community - https://library.usask.ca/academic-integrity.php#AcademicIntegrityTutorial. As part of the lab you are required to complete the first tutorial module.

Access and Equity Services (AES) for Students

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. In order to access AES programs and supports, students must follow AES policy and procedures. For more information or advice, visit https://students.usask.ca/health/centres/access-equity-services.php, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

Treaty Acknowledgement

As we engage in Remote Teaching and Learning, we would like to 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 would also like to recognize that some may be attending this course from other traditional Indigenous lands. We ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.