University of Saskatchewan

Department of Biology

From genes to genomics
Fall 2023

Course tile	From Genes to Genomics
Course code:	CRN 82713
Course credits:	3.0
Class session:	01
Term:	Fall 2023
Lecture room:	Phys 107
Lecture time:	MWF 8:30 to 9:20 am
Website/notes:	via Canvas
Delivery:	Lecture & Lab
Start Date:	Sept 06 (Wed) 2023
Lab room:	Thorvaldson G77
Lab time:	MTWRF 1:30 to 4.20pm
Prerequisites	Biology 120.3 or 110.6
Achieve course ID	cps26g

Course Syllabus – Fall 2023

Land Acknowledgment

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.

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.

Learning Context and Attendance Expectations

Lectures and laboratories for BIOL226 will be delivered 100% **in person** for the Fall 2023. **There will be no video recording of lectures available to students. There will also be no make up lectures or labs.** While attendance is not mandatory, students are expected to be present in all lectures and labs. Up to 5% of extra marks will be distributed based on participation *during lectures* using Poll Everywhere (see below).

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: https://teaching.usask.ca/documents/vptl/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:

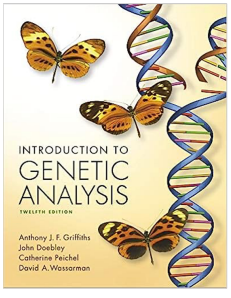
Instructor: Carlos Carvalho
Contact info:
Office: room 225 CSRB
Ph# 966-4436
Email: carlos.carvalho@usask.ca

Lab Coordinator: Andres Posso-Terranova
Contact info:
Office: room G77 THORV Building
Ph# 966-4431
Email: andres.posso@usask.ca

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



Classical Genetics	Topic 1 – The Fundamental Principles of Heredity	Chpt 1,2,3
	Topic 2 – Chromosomal Basis of Mendelism	Chpt 2,3,17
	Topic 3 – Extensions of Mendelian Laws	Chpt 5
	Topic 4 – Linkage and Genetic Mapping	Chpt 4
Molecular Genetics	Topic 5 – Molecular Transfer of Genetic Information	Chpt 8,9
	Topic 6 – Mutation and Repair	Chpt 15
	Topic 7 – Recombinant DNA & Genomic Analysis	Chpt 6,10,14
	Topic 8 – Regulation of Gene Expression I (prokaryotes)	Chpt 11
	Topic 9 – Regulation of Gene Expression II (eukaryotes)	Chpt 12
	Topic 10 – Population Genetics	Chpt 18

Lecture Schedule (putative)

Fall 2023 - Lectures M W F @ PHYS107 – 8:30 to 9:20

Date	Lecture #	Topics	Achieve® Assignments
Sept 06 – Wed	1	Course Introduction & Context	
Sept 08 – Fri	2	TOPIC 1 – The Fundamental Principles of Inheritance	ASSIGN. 1,2,3,4,5 open at 8am
Sept 11 – Mon	3	TOPIC 1 – The Fundamental Principles of Inheritance	
Sept 13 – Wed	4	TOPIC 1 – The Fundamental Principles of Inheritance	
Sept 15 – Fri	5	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 18 – Mon	6	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 20 – Wed	7	TOPIC 2 – Chromosomal Basis of Mendelism	
Sept 22 – Fri	8	TOPIC 3 – Extensions of Mendelian Laws	
Sept 25 – Mon	9	TOPIC 3 – Extensions of Mendelian Laws	
Sept 27 – Wed	10	TOPIC 3 – Extensions of Mendelian Laws	
Sept 29 – Fri	No lecture	National Day for Truth and Reconciliation	
Oct 02 – Mon	11	TOPIC 4 – Linkage and Gene Mapping	
Oct 04 – Wed	12	TOPIC 4 – Linkage and Gene Mapping	
Oct 06 – Fri	13	TOPIC 4 – Linkage and Gene Mapping	
Oct 09 – Mon	No lecture	Thanksgiving	
Oct 11 – Wed		MIDTERM EXAM	ASSIGN. 1,2,3,4,5 due at 8am
Oct 13 – Fri	14	TOPIC 5 – Molecular Transfer of Genetic Information	ASSIGN. 6,7,8,9,10,11,12 open at 8am
Oct 16 – Mon	15	TOPIC 5 – Molecular Transfer of Genetic Information	
Oct 18 – Wed	16	TOPIC 5 – Molecular Transfer of Genetic Information	
Oct 20 – Fri	17	TOPIC 5 – Molecular Transfer of Genetic Information	
Oct 23 – Mon	18	TOPIC 6 – Mutation & Repair	
Oct 25 – Wed	19	TOPIC 6 – Mutation & Repair	
Oct 27 – Fri	20	TOPIC 6 – Mutation & Repair	
Oct 30 – Mon	21	TOPIC 6 – Mutation & Repair	
Nov 01 – Wed	22	TOPIC 7 – Recombinant DNA and Genomic Analysis	
Nov 03 – Fri	23	TOPIC 7 – Recombinant DNA and Genomic Analysis	
Nov 06 – Mon	No lecture	Fall Break	
Nov 08 – Wed	No lecture	Fall Break	
Nov 10 – Fri	No lecture	Fall Break	
Nov 13 – Mon	24	TOPIC 7 – Recombinant DNA and Genomic Analysis	
Nov 15 – Wed	25	TOPIC 7 – Recombinant DNA and Genomic Analysis	
Nov 17 – Fri	26	TOPIC 8 – Regulation of Gene Expression I	
Nov 20 – Mon	27	TOPIC 8 – Regulation of Gene Expression I	
Nov 22 – Wed	28	TOPIC 8 – Regulation of Gene Expression I	
Nov 24 – Fri	29	TOPIC 9 – Regulation of Gene Expression II	
Nov 27 – Mon	30	TOPIC 9 – Regulation of Gene Expression II	
Nov 29 – Wed	31	TOPIC 9 – Regulation of Gene Expression II	
Dec 01 – Fri	32	TOPIC 10 – Population Genetics	
Dec 04 – Mon	33	TOPIC 10 – Population Genetics	
Dec 06 – Wed	34	TOPIC 10 – Population Genetics	
Dec 08 - Fri	35	TOPIC 10 – Population Genetics	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://shop.usask.ca/CourseSearch/?course[]=UOFS,202309,BIOL,BIOL226,01&

Date	Week	Lab	Lab Exercise	Key points	Assignments / Lab Quizzes
September 5-8	1	-	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 -Breeding experiment: Set up main cross (P_1 X P_2) by Lab Coordinator	-
September 11-15	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 18-22	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 25 - 29	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 2-6	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 9-13	6		Thanksgiving week. No sessions this week		
October 16-20	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 23 – 27	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 30 – November 3	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 6-10	10		Reading week: review your lab manual and material posted online		
November 13-17	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 20-24	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 27- December 1	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: (https://shop.usask.ca/CourseSearch/?course[]=UOFS,202309,BIOL,BIOL226,01&). Achieve is an online platform with several learning resource features. 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.

- Lecture notes (pptx files) and other online resources will be posted and accessible through the Canvas course page. Using Canvas students can also engage in course discussions about the course material and contact the instructors.

- Poll Everywhere®, a web-based student response system that is accessed through an app downloaded to a cell phone or via a webpage. This tool will be used to gauge the understanding of concepts taught during lecture and quickly address gaps, encourage student engagement, and foster discussion.

- Achieve® on line assignments. Students are requested to purchase a license for Achieve® (**course ID: 55bwy3**). Students who have purchased the ebook/Achieve® bundle would have been provided an access code for Achieve®. Assignments will be accessible in the window of time indicated in the schedule table above. Assigments must be submitted exclusively online by the deadlines indicated in the table. Students have an unlimited number of attempts on answering questions. Once submitted, assignments cannot be retrieved and modified by the student **Please note that no deadline extensions will be given**. To avoid last minute issues with internet access, please plan to submit your assignments at least a day in advance.

Grading Scheme

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 labs, turn in laboratory assignments and take the lab quizzes. 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 11 from 8:30am to 9:20am at Phys107. Format: 40 multiple choice questions. Calculators allowed. No phones, laptops, tablets or other material allowed. The midterm exam covers all lectures up to the exam date (Classical Genetics).

2) Final Exam Value: **40%** of final grade. Date: Consult the Final Exam Schedule. Length: 3 hours Format: 100 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 (https://iam.macmillanlearning.com/login?retURL=https://achieve.macmillanlearning.com/courses).

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.

Note: 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.

5) Poll Everywhere Participation: **+5% (Extra Marks)**

Poll Everywhere will be used during lectures to assess students' understanding of the material. While participation in polls is not required and answers will not be marked, students who chose to participate can collect up to **5%** of extra marks in the course, according to the total percentage of polls answered. Students will have participation automatically registered by answering the poll during lecture, independently of whether their answer was correct or not. Students interested in participating are asked to have a laptop/tablet or a smart phone and pre register in the Poll Everywhere course account (https://www.polleverywhere.com/home). The BIOL226 Active Response URL is: PollEv.com/carloscarvalho. **Participation marks will be taken exclusively through Poll Everywhere in class. There will be no alternative assignment for extra marks provided**.

Copyright

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://governance.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://governance.usask.ca/student-conduct-appeals/non-academic-misconduct.php) For more information on what academic integrity means for students see the Guides for Academic Conduct at: https://governance.usask.ca/governance/guidelines-for-academic-conduct.php#PrincipleIIHonestyandIntegrity

Examinations through Access and Equity Services for Students (AES)

Students who have disabilities (learning, medical, physical, or mental health) are encouraged to register with Access and Equity Services (AES). Students who suspect they may have disabilities should contact AES for advice and referrals. In order to access AES programs and supports, students must follow AES policy and procedures. You must contact AES in advance to request special exam accommodations. Changes in exam dates are not going to be considered as part of these accommodations. If you miss an exam for a valid reason, you can apply for a make up (midterm) or deferred (final) exams. For more information, check https://students.usask.ca/health/centres/access-equity-services.php or contact AES at 966-7273 or aes@usask.ca.

Student Support

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.