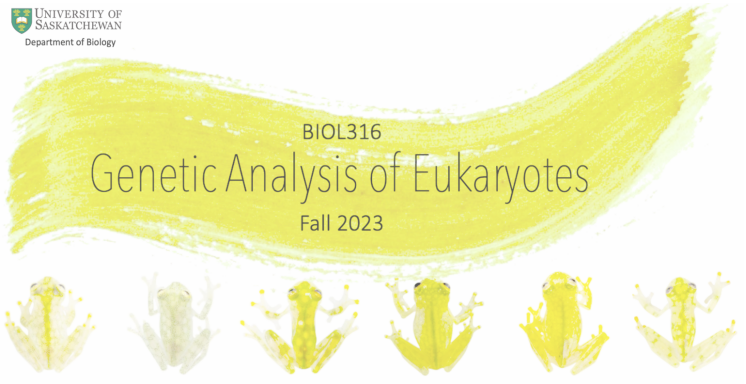


Course title:	BIOL 316 – Genetic Analysis of Eukaryotes		
Course code:	CRN 81864	Term:	T1 Fall 2023
Course credits:	3.0	Delivery:	In person
Class session:	01	Start Date:	Thu Sept 7, 2023
Lecture room:	PAC232	Lab room:	Rm G11 Thorvaldson Bldg
Lecture time:	T/Th 10:00am - 11:20am	Lab time:	Wed 1:30 to 4.20pm
Website/notes:	via Canvas	Prerequisites	BIOL226

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.

Learning Context

Lectures and laboratories for BIOL316 are **in person** for the Fall 2023.

Course Description

Examines research strategies used in genetic analysis to dissect the complexity of multicellular life. This course is built around model organism-based research, emphasizing the scientific discovery process in genetics through the application of long standing research strategies as well as novel molecular approaches. Students will be exposed in the laboratory to practical examples of eukaryotic model organisms (yeast, *Nicotiana, Drosophila, C. elegans*) and their utility in revealing conserved gene function across eukarya. Lecture topics include forward and reverse genetic strategies, transgenesis, systems biology approaches, gene networks, RNAi, gene editing and molecular forensics. Students are expected to present an individual seminar on a chosen model organism used in genetics research in the end of the course.

General learning Outcomes

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

1. Appreciate the diversity and regulatory complexity of eukaryote genomes.
2. Understand the basic strategies and molecular tools used in research at the gene and genome level.
3. Understand the role of model organisms in genetics research.
4. Be able to read, understand, summarize and present scientific articles.
5. Be able to identify a scientific problem and devise experimental approaches to address it.

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/about/policies/learning-charter.php.

Course Overview

Lecture Component and Descriptive Learning Objectives

The course consists of lectures delivered in person. The pptx files corresponding to the lecture notes, as any other material in the course, will also be available in the Canvas course page (https://canvas.usask.ca/courses/64535)

Modules:

Module 1 – The Basis of Genetic Analysis
Module 2 – Model Organisms and their Genomes
Module 3 – Mutant Analysis and Gene Function
Module 4 – System Biology and Gene Networks
Module 5 – Molecular Forensics

Module	Lectures	Learning Objectives	Readings	Evaluation
The Basis of Genetic Analysis	1,2,3,4	• Understand the rational thinking behind genetic analysis and its analytical tools	**Meneely Chp 1** Watson Ch 5 & 7	Midterm / Final Exams
Model Organisms and their Genomes		• Understand the most used model organisms in genetics research and their genomes • Understand the organization, complexity and layers of regulation of the eukaryotic genome and transcriptome.	**Meneely Chp 2**	Midterm / Final Exams
Mutant Analysis and Gene Function	5,6,7,8, 9	• Understand the concept of mutation, spontaneous and induced mutation rates and mutagenesis as a tool in genetic research. • Understand the main approaches in genetic analysis (forward and reverse genetics) in the context of model organisms. • Understand the types and applications of modified genetic screen strategies and sensitized genetic backgrounds (suppression, enhancement, synthetic lethality, temperature sensitive screens). • Understand the concept of lethal mutations and genetic balancers. • Be able to conceptualize a genetic screen strategy to isolate mutants in genes involved in a certain biological process. • Be able to anticipate the use of genetic balancers and correct genetic markers in the context of screens. • Understand the basic strategy in mapping genes in the context of human genetic disorders: positional cloning, RFLP markers, chromosome walking, LOD analysis, exon trapping and the use of model organisms as proxy biological systems for functional analysis of candidate disease genes. • Understand the concept and application of DNA libraries (genomic and cDNA). • Understand the process of screening for a clone in a library. • Be able to conceptualize building a library to address a specific biological question.	**Meneely Chp 4-9** Watson Ch 6 & 12	Midterm / Final Exams
Systems Biology and Gene Networks	10,11,12,13,14	• Understand Whole Genome Sequencing (WGS) strategies and genome assembly (shotgun approach). • Understand different DNA sequencing technologies, from Sanger sequencing to New Generation Sequencing (NGS) strategies. • Understand the basic applications of bioinformatics tools for sequence analysis. • Understand the concept of Systems Biology. • Understand the experimental design and applications of different microarray approaches and RNAseq for transcriptome analysis. • Understand the proteomics approaches, technologies and applications. • Appreciate the distinct roles, benefits and pitfalls that transcriptomics and proteomics have in genetic analysis. • Understand the importance of non-coding elements in the genome and the rationale of the *Encode Project*. • Appreciate the historical context in the discovery of post-translational mechanisms of gene silencing: Co-suppression in Arabidopsis, RNA interference in *C. elegans*. • Understand the RNAi pathway, distinct inducers and the role of nucleases (Dicer and Argonauts) and RNA-protein complexes (RISC) in signaling, amplification and RNA degradation / translation inhibition. • Understand the different inputs of interference: dsRNAs (siRNA) and miRNA genes. • Understand the application of RNAi strategies in genetics research.	**Meneely Chp 10-12** Watson Ch 9-14	Final Exam
Molecular Forensics	21,22,23, 24	• Understand the concept of molecular fingerprinting (MF) and its application in law enforcement. • Understand protein polymorphisms used in molecular fingerprinting (blood types, etc) • Be able to differentiate the molecular markers used in MF (VNTRs, STRs, SNPs) and point to the advantages and limitations of using them in determining molecular profiles. • Be able to calculate the uniqueness of a DNA profile (likelihood of two profiles arising by chance in a population). • Understand the technology used in CODIS: banding patterns, multiplex PCR, STR panel tests. • Understand how allele frequencies in different human populations impact molecular profiling. • Understand the pitfalls of MF analysis: DNA degradation, PCR and fluorescence scanning artifacts (polymerase slippage, signal bleeding, etc) and DNA contamination issues. • Understand the challenges and technical improvements to deal with samples with low copy number / degraded templates such as in miniplex reactions. • Understand the concept of DNA databases and ethical issues associated with it. • Understand the concept of uniparental inheritance of mitoDNA and Y chromosome DNA and their role in molecular profiling. • Understand the implications of MF technology and the hunt for ancient DNA (paleoforensics).	Watson Ch 16	Final Exam

Laboratory Component

Laboratories are an integral part of BIOL316 and students are expected to be present to all assigned laboratory practicals. There will be no make up laboratories.

Laboratory experiments:

LABORATORY 1 – Mutagenesis and Complementation in *Saccharomyces cerevisae*
LABORATORY 2 – *Nicotiana sp* transgenesis
LABORATORY 3 – Gene expression regulation in *Drosophila melanogaster*
LABORATORY 4 – Chemotaxis in *Caenorhabditis elegans*
LABORATORY 5 – RNA interference in *Caenorhabditis elegans*

Course Schedule

Fall 2023 – Lecture & Lab Schedule

Date	Lecture / Lab	Lecture (Tue/Thr 10:00 - 11:20)	Laboratories (Wed 1:30 - 4:20)
Sept 07 – Thu	1	Course Introduction & Context	
Sept 12 – Tue	2	Module 1 - The Basis of Genetic Analysis	
Sept 13 - Wed	Lab (yeast)		Laboratory 1 – week 1 Seminar Topic Distribution
Sept 14 – Thu	3	Module 1 - The Basis of Genetic Analysis	
Sept 19 – Tue	4	Module 2 – Model Organisms and their Genomes	
Sept 20 – Wed	Lab (yeast /*Nicotiana sp*)		Laboratory 1 – week 2 Laboratory 2 – week 1
Sept 21 – Thu	5	Module 2 – Model Organisms and their Genomes	
Sept 26 – Tue	6	Module 3 - Mutant Analysis and Gene Function	
Sept 27 – Wed	Lab (yeast /*Nicotiana sp*)		Laboratory 1 – week 3 Laboratory 2 – week 2
Sept 28 – Thu	7	Module 3 - Mutant Analysis and Gene Function	
Oct 03 – Tue	8	Module 3 - Mutant Analysis and Gene Function	
Oct 04 – Wed	Lab (yeast)		Laboratory 1 – week 4 QUIZ 1 (lab 2)
Oct 05 – Thu	9	Module 3 - Mutant Analysis and Gene Function	
Oct 10 – Tue	10	Module 3 - Mutant Analysis and Gene Function	
Oct 11 – Wed	Lab (yeast)		Laboratory 1 – week 5
Oct 12 – Thu		MIDTERM EXAM	
Oct 17 – Tue	11	Module 4 – Systems Biology and Gene Networks	
Oct 18 – Wed	Lab (yeast)		Laboratory 1 – week 6 - Analysis
Oct 19 – Thu	12	Module 4 – Systems Biology and Gene Networks	
Oct 24 – Tue	13	Module 4 – Systems Biology and Gene Networks	
Oct 25 – Wed	Lab (*Drosophila*)		QUIZ 2 (lab 1) Laboratory 3 – week 1
Oct 26 – Thu	14	Module 4 – Systems Biology and Gene Networks	
Oct 31 – Tue	15	Module 4 – Systems Biology and Gene Networks	
Nov 01 – Wed	Lab (*Drosophila*)		Laboratory 3 – week 2 - Analysis
Nov 02 – Thu	16	Module 5 – Molecular Forensics	
Nov 07 – Tue	No lecture	Fall Break	
Nov 08 – Wed	No lecture	Fall Break	
Nov 14 – Tue	17	Module 5 – Molecular Forensics	
Nov 15 – Wed	Lab (*Drosophila* / *C. elegans*)		QUIZ 3 (lab 3) Laboratory 4 – Analysis Laboratory 5 – week 1
Nov 16 – Thu	18	Module 5 – Molecular Forensics	
Nov 21 – Tue	19	Module 5 – Molecular Forensics	
Nov 22 – Wed	Lab (*C. elegans*)		QUIZ 4 (lab 4) Laboratory 5 – week 2
Nov 23 – Thu	20	Model Organism Seminars	
Nov 28 – Tue	21	Model Organism Seminars	
Nov 29 – Wed	Lab (*C. elegans*)		Laboratory 5 – week 3 Model Organism Seminars
Nov 30 – Thu	22	Model Organism Seminars	
Dec 05 – Tue	23	Model Organism Seminars	
Dec 06 - Wed	Lab (*C. elegans*)		QUIZ 5 (lab 5) Model Organism Seminars
Dec 07 - Thu	24	Model Organism Seminars	
TBD	-	FINAL EXAM	

Instructors:

Course Instructor: Dr. Carlos Carvalho
Contact info:
Office: room 220.5 CSRB
Ph# 966-4436
Email: carlos.carvalho@usask.ca
Profile: Dr. Carvalho is a regular faculty member in the Department of Biology. He holds a PhD in genetics and teaches and conducts research in this field of study.
Office Hours: Available by email or meetings by appointment.

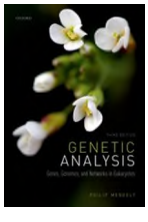
Lab Coordinator: Dr. Andres Posso-Terranova
Contact info:
Office: room G77 THORV Building
Ph# 966-4431
Email: andres.posso@usask.ca
Profile: Dr. Posso is an evolutionary biologist and laboratory coordinator of genetics courses in the Department of Biology.
Office Hours: Available by email or meetings by appointment.

Teaching Assistant: Mr. Amir Sabeti
Contact info: CSRB 2nd Floor
Email: amir.sabeti@usask.ca
Profile: Amir is a PhD student in Dr. Carlos Carvalho's lab. He is working on deciphering the role of a novel isoform of the hypoxia inducible factor protein (HIF-1) in *C. elegans.*
Office Hours: Available by email or meetings by appointment.

Teaching Assistant: Ms. Delanie McEvoy
Contact info: CSRB 2nd Floor
Email: dhm012@mail.usask.ca
Profile: Del is a MSc. student in Dr. Chris Ambrose's lab. Her work involves plant epidermal cell division and expansion concerning microtubule dynamics in *Arabidopsis thaliana*.
Office Hours: Available by email or meetings by appointment.

Recommended texbooks

The course is being re-organized around the recently adopted Meneely "Genetic Analysis" textbook. A substantial part of the course content will still use material from the Watson (out of print). If you are planning to purchase a textbook to follow the course, please buy the up-to-date Meneely text.



1.Genetic Analysis – Genes, Genomes and Networks in Eukaryotes – 3rd edition. Meneely. 2020.
2.Recombination DNA: Genes and Genomes, A Short Course – 3rd edition. Watson, Caudy, Myers and Witkowski. 2007 (*out of print*).

The course structure and modules follow mostly the Meneely text. Some of the lecture material will use the Watson textbook, in particular Module 5. When relevant, the instructor will identify the scientific literature used in the notes for further consultation. Copies for consultation of these texts are available in the Natural Sciences Library, though these may not yet be accessible this term due to pandemic restrictions.

On line resources

Lecture notes, laboratory material, and lecture recordings will be accessible through Canvas.

Grading Scheme

Please note that there will be no assignments for extra marks.

Midterm Exam

Value: **25%** of final course grade.
Date: Thursday, October 6th from 10:30 to 11:30
Format: 1:30 hour exam. Essay questions.

Final Exam
Value: **40%** of final grade.
Date: TBA
Format: 3 hour exam. Mix of multiple choice and essay questions.

Lab Quizzes
Value: **15%** of final grade.
4 quizzes based on the class discussion at the end of each laboratory exercise (see schedule for dates).
Format: 35 min quiz. Mix of multiple choice and short answer questions.

Individual Seminars
Value: **20%** of final grade.
Due Date: See Course Schedule.
Format: A 15 min. individual power point presentation. The seminar should introduce an orthodox or emergent model organism chosen in advance by the student and exemplify its research contributions in genetics through the selection and presentation of a relevant scientific article. The article can be in any genetics/developmental/mol biology related field, as long as it explores experimental approaches in modern genetic analysis. Details on the seminar content, structure and evaluation will be provided during the first lab session (Sept 07) together with the assignment of topics.

Attendance Expectations

There are no mandatory components to this course. A final mark of 50% or above is required for passing. No make-up lab quizzes will be offered. Students who miss exams with a **reasonable justification** can apply to take make up (midterm) or deferred (final) exams.

Midterm and Final Examination Scheduling

Midterm and final examinations must be written individually and in person at the scheduled dates and rooms. Students who miss the final exam **because of no fault of their own or for medical or other valid reasons** must contact the College and apply for a deferred final exam. Applications for deferred final exams must be entered by the student at the Undergraduate Office's webpage (https://artsandscience.usask.ca/undergraduate/advising/deferred-exams.php) not later than three days after the exam date and require the payment of a processing fee. The deferred exam format may change at the sole discretion of the instructor. Students who miss the midterm exam should contact Dr. Carvalho directly for instructions. **Exams cannot be offered at an earlier day/time than posted**. Students are encouraged to review all University examination policies and procedures:
http://www.usask.ca/calendar/exams&grades/examregs/

University of Saskatchewan Grading System

Students in BIOL 316 are reminded that the University has established a grading system to be used in all of its courses. Information on literal descriptors for grading at the University of Saskatchewan can be found in Paws under the 'My Final Grades' tab.

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, you can apply for a make up or deferred exam. 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.