UNIVERSITY OF SASKATCHEWAN

Department of Biology

COURSE SYLLABUS

Course title:	**BIOL 316 - Molecular Genetics of Eukaryotes**		
Course code:	CRN 81864	Term:	T1 Fall 2020
Course credits:	3.0	Delivery:	Remotely
Class session:	01	Start Date:	Wed Sept 4, 2020
Lecture room:	NO ROOM	Lab room:	NO ROOM
Lecture time:	MWF 09:30 to 10:20 am	Lab time:	Mon 1:30 to 4.20pm
Website/notes:	via Canvas	Prerequisites	Biology 226

Land Acknowledgment

As we engage in Remote Teaching and Learning, I 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. I would also like to recognize that some may be attending this course from other traditional Indigenous lands. I 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.

Remote Learning Context

The current global health crisis due to Covid-19 prevents this course from being offered face to face in the Fall 2020. This syllabus represents an alternative remote learning version of BIOL316 that combines synchronous and non-synchronous interaction modules in an attempt to achieve all usual learning outcomes of BIOL316.

Course Description

Examines advanced topics in the molecular genetics of eukaryotes. Examples of topics covered include epigenetics, RNA interference or post-transcriptional gene silencing, the role of model organisms in scientific research, organelle genetics, and RNA splicing. The lab will involve a combination of hands-on experimentation, computer-based analysis and student presentations. Prerequisite: BIOL 226

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 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: http://www.usask.ca/university_secretary/LearningCharter.pdf. Information on literal descriptors for grading at the University of Saskatchewan can be found at: http://students.usask.ca/academics/grading/grading-system.php.

Resources for students

Remote classes is likely a new challenge for many of students. The University put together information on tools and technologies to help students navigate the resources needed to be ready for this new delivery style and reduce stress. You can access these resources at:
https://students.usask.ca/study/remote-learning.php#Accessingcoursework

Course Overview - Lectures

The course consists of recorded lectures and remote sessions (Office hours on Friday mornings and Journal Club sessions on Monday afternoons) through WebEx, as indicated in the lecture schedule. Lectures will be pre-recorded and made available to students via Canvas. Lecture videos for the corresponding week will be posted in advanced to students on Mondays. The pptx files for the lectures, as any other material in the course, will also be available in Paws (Course Material).

Weekly WebEx sessions (office hours)

One hour sessions addressing questions arising from the lecture notes will be held every Friday from 9:30am to 10:30 through WebEx. There will be no WebEx session on Oct 16 (Thanksgiving week) or during the seminar weeks in the end of the course (see lecture schedule). To improve the use of time, students are asked to post in advance their questions in the Discussion Board. Individual folders (fora) for each Module will be initiated by the instructor every week so that threads should be posted in the correct Module forum. Students are encouraged to check the Discussion board during the week and respond to each other's posts/questions. The questions still needing addressing by the following Friday will be tackled by the instructor during the WebEx session. Students should try to attend the WebEx session live at the address below, especially if they feel they are not been able to follow the lectures. Sessions will be recorded and posted on Paws.
https://usask.webex.com/meet/carlos.carvalho

Discussion Board and Office Hours

The Discussion tab can be found in the side bar of the BIOL316 Course in Canvas. Discussion folder will be open for each lecture week, starting week 2 up to week 10. Students are encouraged to enter comments, questions concerning the lecture material covered that week. Questions will be addressed by the instructor at the Friday WebEx live session or by email when appropriate. Student can also answer each other questions or add comments. Discussion boards for past weeks will remain available for reading but close for comments up to the end of the course.

Office Hours: Students are welcome to email with concerns about the course (carlos.carvalho@usask.ca). If, however, you have a general question about the lecture material, please use the Discussion Board at Paws first. Your question may be shared by many, so opening it up using the Discussion Board may be helpful to others and to me as I prepare the WebEx sessions.

Course Overview – Journal Club

The current campus shutdown situation makes the delivery of in person laboratory sessions for this course inviable. As an alternative that will address different experimental and practical aspects of eukaryotic genetics, a weekly Journal Club (JC) will take place instead. Students will be assigned one peer-review article a week. There will be a total of 6 JCs. Pdfs of the papers for Journal Clubs will be posted on the Journal Club folder in the Course Material at Paws. Students are expected to read the papers and address the questions in the '**Paper Discussion Exercise**' (PDE). PDEs for each article will be made available through Canvas one week prior to the paper discussion. A discussion of each article, centered on the exercise, will take place via WebEx (https://usask.webex.com/meet/carlos.carvalho) on the assigned Monday 1:30 timeslot (see Schedule) when students will have the opportunity to ask questions. The Paper Discussion Exercise due dates are shown in the schedule below. The student should complete the questions and send the respective PDE weekly via Canvas. Late submission will not be accepted. Each PDE will be marked to a total of 10 marks. The JC accounts for 15% of the course marks. Students are encouraged to work together and share ideas about the papers and PDEs. The JCs and the respective paper references are shown below.

Journal Club topic: The Discovery of RNA interference, a scientific journey.

JC 1: Izant and Weintraub, 1984. Cell 36: 1007-1015
Inhibition of thymidine kinase gene expression by anti-sense RNA: A molecular approach to genetic analysis.
Paper Discussion Exercise 1 – due Sept 28 1:30pm

JC 2: Guo et al., 1995. Cell 81:611-620
par-1, a gene required for establishing polarity in *C. elegans* embryos, encodes a putative Ser/Thr kinase that is asymmetrically distributed.
Paper Discussion Exercise 2 – due Oct 5 1:30pm

JC 3: Fire et al., 1997. Nature 391:806-810.
Potent and specific genetic interference by double-stranded RNA in *Caenorhabditis elegans*.
Paper Discussion Exercise 3 – due Oct 19 1:30pm

JC 4: Tabara et al., 1999. Cell 99:123-132
The *rde-1* gene, RNA interference, and transposon silencing in *C. elegans*.
Paper Discussion Exercise 5 – due Nov 2 1:30pm

JC 5: Grishok et al., 2000. Science 287:2494-2497
Genetic requirements for inheritance of RNAi in *C. elegans*.
Paper Discussion Exercise 4 – due Oct 26 1:30pm

JC 6: Mello, 2007. Ang.Chemie, 6985-6994
The Nobel Lectures. Return to the RNAi world. Rethinking gene expression and evolution (Nobel Lecture)
Paper Discussion Exercise 6 – due Nov 16 1:30pm

Lecture Modules

Module	Lectures	Learning Objectives	Readings	Evaluation
Fundamentals of Eukaryotic Genes	1,2,3,4	• Understand the organization, complexity and layers of regulation of the eukaryotic genome and transcriptome. • Understand the distinct roles and mechanisms of mRNA splicing and RNA decay.	Watson Ch 5, 7	Midterm / Final Exams
Gene Level Analysis	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.	Watson Ch 6, 12	Midterm / Final Exams
Genome Level Analysis	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*.	Watson Ch 10,11, 12,13, 14	Final Exam
Epigenomics	15, 16	• Understand the importance of gene dosage and chromosome inactivation as a mechanism to achieve silencing. • Understand the role of RNAs in X chromosome silencing in humans. • Understand the physiological consequences of gene unbalance in the context of chromosome anomalies in humans. • Understand the concept of genetic mosaicism. • Appreciate the role of methylation in gene silencing (imprinting), the histone code and epigenetic reprograming. • Understand the ways to study epigenetic markers in the genome. • Understand the limitations in reproducing the epigenome with the existing animal cloning technology.	Watson Ch 8	Final Exam
RNA interference	17,18,19,20	• 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.	Watson Ch 9	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 patters, 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

Course Schedule

		Pre-recorded *Lectures*	Fridays 9:30 *WebEx sessions*	Mondays 1:30 *JC/seminar*	
w1	Sept 05 - Friday	Introduction	(NO WebEx session)		
w2	Sept 07 – Monday	Labour day (no class)		NO JC	
	Sept 09 - Wednesday	Lec02			
	Sept 11 - Friday	Lec03	(WebEx session 1)		
w3	Sept 14 - Monday	Lec04		Distribution of Individual Seminar topics	
	Sept 15 - Wednesday	Lec05			
	Sept 18 – Friday	Lec06	(WebEx session 2)		
w4	Sept 21 - Monday	Lec07		Journal Club 1	
	Sept 23 Wednesday	Lec08			
	Sept 25 – Friday	Lec09	(WebEx session 3)		
w5	Sept 28– Monday	Lec10		Journal Club 2	**PDE -1 due**
	Sept 30 – Wednesday	Lec11			
	Oct 02 – Friday	Lec12	(WebEx session 4)		
w6	Oct 05 – Monday	Lec13		Journal Club 3	**PDE -2 due**
	Oct 07 – Wednesday	Lec14			
	Oct 09 – Friday	Lec15	(WebEx session 5)		
w7	Oct 12 – Monday	Thanksgiving (no class)		NO JC	
	Oct 14 – Wednesday	MIDTERM EXAM			
	Oct 16 – Friday	Lec16	(NO WebEx session)		
w8	Oct 19 – Monday	Lec17		Journal Club 4	**PDE -3 due**
	Oct 21 – Wednesday	Lec18			
	Oct 23 – Friday	Lec19	(WebEx session 6)		
w9	Oct 26 – Monday	Lec20		Journal Club 5	**PDE -4 due**
	Oct 28 – Wednesday	Lec21			
	Oct 30 – Friday	Lec22	(WebEx session 7)		
w10	Nov 02 – Monday	Lec23		Journal Club 6	**PDE -5 due**
	Nov 04 – Wednesday	Lec24			
	Nov 06 – Friday	Lec25	(WebEx session 8)		
w11	Nov 09 – Monday	Fall break		NO JC	
	Nov 11 – Wednesday	Fall break			
	Nov 13 – Friday	Fall break	(NO WebEx session)		
w12	Nov 16 – Monday	Seminars		Seminar lab time	**PDE -6 due**
	Nov 18 – Wednesday	Seminars			
	Nov 20 – Friday	Seminars	(NO WebEx session)		
w13	Nov 23 – Monday	Seminars		Seminar lab time	
	Nov 25 – Wednesday	Seminars			
	Nov 27 – Friday	Seminars	(NO WebEx session)		
w14	Nov 30 – Monday	Seminars		Seminar lab time	
	Dec 02 – Wednesday	Seminars			
	Dec 04 – Friday	Seminars	(NO WebEx session)		
w15	Dec 07 – Monday	Seminars			
	TBA	FINAL EXAM			

Instructors:

Instructor: Carlos Carvalho
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Instructor Profiles & Other Information: 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 (http://artsandscience.usask.ca/profile/CCarvalho#/profile).

Suggested Resources

Suggested textbooks for Reference:

1- Recombination DNA: Genes and Genomes, A Short Course – 3rd Edition. Watson, Caudy, Myers and Witkowski. 2007.
2- Molecular Biology of the Cell – 6th edition. Alberts, Johnson, Lewis, Raff, Roberts,Walter. 2014.

Some of the lecture material will use the Watson textbook listed above, but will not be limited or entirely based on the text. The Alberts text will be useful for Module 1, Splicing mechanisms. When relevant, the instructor will identify the scientific literature used in the notes for further consultation. Printing of this textbook has recently been discontinued and this course will adopt a new text for future offerings. Two copies for consultation are on reserve in the Natural Sciences Library (Geology Library) for this course.

Electronic Resources
Lecture notes, laboratory material, and lecture videos files are accessible through the Modules and Panopto videos tabs on Canvas, respectively.

Grading Scheme

Take Home Exam format: A word file with exam questions will be sent out by email to students on the exam start time. Students will have 24 hours to type in the answers, save the exam file as their last name followed by the initial of first name (ex SmithJ.docx) and email it back to the instructor (carlos.carvalho@usask.ca) before the deadline. These are individual examinations. Students are asked not to consult with each about exam questions.

Midterm Exam
Value: 25% of final course grade.
Date: Wednesday, October 14th from 9:30 to October 15th at 9:30am.
Format: Take home exam, assay questions.

Final Exam
Value: 40% of final grade.
Date: TBA
Format: 24hrs, take home exam. The exam is comprehensive in that it will cover all lectures and seminar material. Material delivered since the midterm exam will be emphasized. JC material will not be covered in the final exam.

Journal Club exercises:
Value: 15% of final grade.
Due Date: A week after the respective Journal Club (see Course Schedule)
Format: Six Paper Discussion Exercises (PDEs) with question relative to the experimental approach in the paper as well as strategies for future work on the topic will be graded. PDEs will be available together with the paper pdfs in the JC folder at Paws.

Individual Seminars:
Value: 20% of final grade.
Due Date: See Course Schedule.
Format: A 15 minute power point presentation via WebEx. The seminar should introduce a canonical or

emergent model organism chosen by the student and exemplify the research contributions that were accomplished using the model. The pdf or pptx file of the presentation has to be submitted to the instructor 24 hours in advance to the presentation and will be posted in Paws. Student seminars will be part of the material tested on the final exam. Students are encouraged to attend these seminars and take notes of the discussion. Student seminars will be recorded. Further explanation of the seminar component and the distribution of seminar topics will happen via WebEx on Monday, Sept 14 at 1:30. Please attend this session. Students who are not present will have a seminar topic assigned to the student. The seminar will be evaluated in two components: 1) the oral presentation (10% of course marks) and b) the pptx file (10% of course marks). An evaluation sheet with the detailed feedback and seminar marks will be emailed to students on Dec 7, the last day of classes. There is no possibility to make up seminar presentations.

Attendance Expectations

There are no mandatory components to this course. A final mark of 50% or above is required for passing. Students are expected to be set up in their homes to follow remote lectures and attend live sessions, including having the proper computer hardware/software and access to sufficient internet bandwidth. Students are asked to organize their time appropriately to follow lectures as they are posted as well as participate in WebEx sessions. Particularly, students are asked to log in during student's seminar presentations. No make-up exercises will be offered. Students who miss JC or their seminar presentations with a **reasonable justification** will have the equivalent course marks transferred to the final exam.

Midterm and Final Examination Scheduling

Midterm and final examinations must be written individually on the dates scheduled and submitted to the instructor by email (carlos.carvalho@usask.ca) before the 24hr deadline stipulated. **No late exams will be accepted**. If a student is unable to write a midterm **through no fault of his or her own or for medical or other valid reasons**, documentation must be provided and an opportunity to write the missed exam may be given. Students who miss the final exam must contact the College and apply for a deferred final exam. Deferred exam dates are assigned by the Undergraduate Office and exam format may change at the sole discretion of the instructor. 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 at: http://students.usask.ca/current/academics/grades/grading-system.php

Integrity Defined (from the Office of the University Secretary)

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 (http://www.usask.ca/university_secretary/honesty/StudentAcademicMisconduct.pdf) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (http://www.usask.ca/university_secretary/honesty/StudentNonAcademicMisconduct2012.pdf)

For more information on what academic integrity means for students see the Student Conduct & Appeals section of the University Secretary Website at:
http://www.usask.ca/university_secretary/pdf/dishonesty_info_sheet.pdf

Examinations through Access and Equity Services for Students (AES)

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. In order to access AES programs and supports, students must follow AES policy and procedures. You must contact AES n 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 (midterm) or a deferral (final) exam. For more information, check http://students.usask.ca/current/disability/ or contact AES at 966-7273 or dss@usask.ca.