



# UNIVERSITY OF CALGARY

## DEPARTMENT OF BIOLOGICAL SCIENCES COURSE OUTLINE

### 1. **Course:** **CMMB 511 – MOLECULAR BIOLOGY AND GENETICS**

Lecture Section(s)	L01	TR	11:00-12:15	SS 541	Fall 2015
<b>Instructor(s):</b>	Dr. L. Gedamu	BI 350	220-5556	lgedamu@ucalgary.ca	
Biological Sciences Department	BI 186	403-220-3140	biosci@ucalgary.ca		

2. **Prerequisites:** CMMB 411  
See section 3.5.C in the Faculty of Science section of the online Calendar  
[www.ucalgary.ca/pubs/calendar/current/sc-3-5.html](http://www.ucalgary.ca/pubs/calendar/current/sc-3-5.html)

3. **Grading:** The University policy on grading and related matters is described sections [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

<b>Midterm Exam</b>	<b>(November 19, 2015)</b>	<b>40 %</b>	<b>In-Class</b>
<b>Assignment I</b>	<b>(October 22, 2015)</b>	<b>30 %</b>	
<b>Assignment II</b>	<b>(December 8, 2015)</b>	<b>30 %</b>	

There will not be a final exam scheduled by the Registrar's office

Each piece of work (assignments and midterm test) submitted by the student will be assigned a percentage score. The student's average percentage score for the various components listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade, bearing in mind that an F grade will result if any outstanding assignments exist.

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize himself/herself with these regulations. See also [Section E.6](#) of the University Calendar
5. **Scheduled out-of-class activities:** Dates and times of approved class activities held outside of class hours. N/A
6. **Course Materials:** *Molecular Cell Biology*, H. Lodish, D. Baltimore, A. Berk, S.L. Zipursky, P. Matsudaira & J. Darnell. W.H. Freeman & Company, New York, 6th Edition.
7. **Examination Policy:** Students should also read the Calendar, [Section G](#), on Examinations.
8. **Writing across the curriculum statement:** See also [Section E.2](#) of the University Calendar.
9. **Human studies statement:** indicating whether students in the course may be expected to participate as subjects or researchers. See also [Section E.5](#) of the University Calendar.

### ETHICS IN THE BIOLOGICAL SCIENCES

Studies in the Biological Sciences involve the use of living and dead organisms. Students taking laboratory- and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

## 10. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) **Academic Misconduct:** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties
- (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- (c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at [http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities\\_0.pdf](http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf).
- Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of Biological Sciences, Dr. H. Addy by email [addy@ucalgary.ca](mailto:addy@ucalgary.ca) or phone 403 220-3140.
- (d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPPA). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also
- (f) <http://www.ucalgary.ca/secretariat/privacy>.
- (g) **Student Union Information:** VP Academic Phone: 403 220-3911 Email: [suvpaca@ucalgary.ca](mailto:suvpaca@ucalgary.ca)  
SU Faculty Rep. Phone: 403 220-3913 Email: [science1@su.ucalgary.ca](mailto:science1@su.ucalgary.ca), [science2@su.ucalgary.ca](mailto:science2@su.ucalgary.ca) and [science3@su.ucalgary.ca](mailto:science3@su.ucalgary.ca);  
Student Ombuds Office: 403 220-6420 Email: [ombuds@ucalgary.ca](mailto:ombuds@ucalgary.ca); <http://ucalgary.ca/provost/students/ombuds>
- (h) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.
- (i) At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses ([www.ucalgary.ca/usri](http://www.ucalgary.ca/usri)). Your responses make a difference - please participate in USRI Surveys.

Department Approval \_\_\_\_\_ ORIGINAL SIGNED \_\_\_\_\_ Date \_\_\_\_\_

Department Approval  
For NO FINAL EXAM: \_\_\_\_\_ ORIGINAL SIGNED \_\_\_\_\_ Date: \_\_\_\_\_  
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UNIVERSITY OF CALGARY  
DEPARTMENT OF BIOLOGICAL SCIENCES  
COURSE OUTLINE  
CMMB 511

MOLECULAR BIOLOGY AND GENETICS

TERM: Fall 2015 SECTION NO: 01

PREREQUISITE(S): CMMB 411

A student may not register in a course unless they have a grade of at least C- in each prerequisite course.

COURSE COORDINATOR: Dr. L. Gedamu

LECTURER: Dr. L. Gedamu BI 350 220-5556 lgedamu@ucalgary.ca

LECTURES: TR 11:00 a.m. SS 541

TEXT: Recommended: Molecular Cell Biology, H. Lodish, D. Baltimore, A. Berk, S.L. Zipursky, P. Matsudaira & J. Darnell. W.H. Freeman & Company, New York, 6th Edition.

RESERVE READING ROOM: See attached list.

SPECIFIC READING: Reference to some articles will be provided as the term progresses and will be discussed during the course.

MARK DISTRIBUTION: A. Composition of Final Grade

Midterm Exam (November 19/2015)	40%	IN CLASS
Assignment I (October 22/2015)	30%	
Assignment II (December 8/2015)	30%	

B. Final Exam

There will not be a final exam scheduled by the Registrar.

The concepts of molecular biology as they apply to genetics. Application of current methodology to the understanding of the genetics of prokaryotes and lower and higher eukaryotes. Genomic organization and function of subcellular organelles such as mitochondria will also be considered. The mechanism(s) of regulation of gene expression will be discussed in relation to viral, nuclear as well as organelle genomes.

## COURSE OUTLINE

### I. INTRODUCTION

General principles of gene expression in eukaryotes.

- Eukaryotic gene transcription
- Transcriptional units
- RNA processing
- Levels of gene regulation
  - Transcriptional/Post-transcriptional event
  - mRNA stability/Post-translational signals

### II. TOOLS OF MOLECULAR CELL BIOLOGY: MOLECULAR TECHNOLOGY

- Biological assay of mRNA
- Examining Nucleic Acid Sequences
  - i. Molecular hybridization and detection
  - ii. Rate of Nucleic Acid Hybridization as a measure of genomic complexity
  - iii. Southern and Northern Blot Analysis
  - iv. S1 Nuclease/RNase protection Analysis
  - v. Primer Extension
  - vi. Polymerase Chain Reaction (PCR) Amplification
  - vii. Restriction endonucleases/Restriction Mapping
  - viii. DNA Sequencing
  - ix. Recombinant DNA: Selection and Production of Specific DNA
    - Cloning Vectors
    - cDNA (complementary DNA) Clones
    - Genomic Clones
- Nucleic Acid: Protein Interaction Analysis and Protein Purification
  - i. Footprinting
  - ii. Bandshift
  - iii. U.V. Cross-linking
  - iv. Specific DNA-Affinity Chromatography
- Functional Analysis of Cloned Genes
  - i. Transgenics
  - ii. Transfection
  - iii. In vitro transcription

### III. EUKARYOTIC CHROMOSOMES AND GENES: GENERAL STRUCTURE

- Morphology of Chromosomes
- Packaging of DNA/Nucleosomes and Chromatin Structure

### IV. EUKARYOTIC CHROMOSOMES AND GENES: MOLECULAR ANATOMY

- Genomic Complexity/Classifying Eukaryotic DNA
- Organization of Structural Genes/External and Internal Relationships
  - i. Families of Protein-Coding Genes
  - ii. Tandemly Repeated Genes Encoding rRNA, tRNA and Histones
  - iii. Repetitious DNA
  - iv. Rearrangements in Chromosomal DNA

### V. RNA SYNTHESIS AND PROCESSING IN EUKARYOTES

- The structure and biosynthesis of Eukaryotic mRNAs
- The Biochemical Signals in mRNA Biogenesis
- The Biochemistry of RNA Splicing
- mRNA Turnover/Stability in the Cytoplasm

## VI. EUKARYOTIC GENE CONTROL

- Signals for Gene Control in Eukaryotes
  - i. Hormones (Proteins, Steroids)
  - ii. Circulating or Secreted Protein Factors (Growth Factors, Cytokines etc.)
  - iii. Environmental (Nutrition, Toxic Substances, Infection, Inflammation, Heat shock)
  
- Levels of Regulation
  - i. Transcriptional
    - Tissue - or Cell-Specific Gene Control
    - Differential and Developmental
  - ii. RNA Processing
    - Differential Processing of Transcripts (Poly A Choice, Splicing Variation)
  - iii. Cytoplasmic Control
    - Changes in mRNA Stability
    - Translation Efficiency of Specific mRNAs
    - Overall Rate of Translation Under Various Conditions
  
- Mechanisms of Transcriptional Control
  - i. Cis-acting DNA Sequence Motifs
    - Promoters/Enhancers/Silencers
    - Response Elements
  - ii. Trans-acting Regulatory Protein Factors (Positive- and Negative-Acting)
    - Recognize Specific DNA Target Sequences
    - Bind to Other Transcription Factor
  - iii. Changes in Chromatin Structure
  - iv. Changes in DNA Methylation Status

## VII. GENE REGULATION AND FUNCTIONAL STUDIES IN TRYPANOSOMATIDS

### VIII. RNA interference (RNAi), Knock out and Functional analysis of genes.

#### Grading Scale

<u>Cut-Off</u>	<u>Letter Grade</u>
95	A+
90	A
85	A-
80	B+
75	B
70	B-
65	C+
60	C
55	C-
50	D+
45	D
40	D-
Below 40	F