



MBG*4110 Epigenetics

Fall 2023

Section(s): C01

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 1.00 - August 24, 2023

1 Course Details

1.1 Calendar Description

Epigeneticists study how chromatin regulates the establishment and maintenance of hereditary tissue-specific gene expression programs. As such, this course will focus on the structure of chromatin and its links to DNA replication and gene expression. A variety of epigenetics phenomena (gene silencing, position effects, transposable genetic elements, whole chromosome inactivation and gene imprinting) will be covered in detail. Other themes will include how the maintenance of the epigenetic landscapes are mediated through non-coding RNAs and how metabolism, stress and the environment can affect the epigenetic control of gene expression. Modern advances in epigenetics will be explored through the analysis and critique of primary literature.

Pre-Requisites: MBG*3040

1.2 Course Description

This course is providing in-depth knowledge of chromatin structure, histone modifications and DNA methylation as they relate to gene silencing, position effects, gene imprinting and the suppression of mobile genetic elements.

The first half of the course has two major themes: 1) Fundamental aspects of DNA replication and the transmission of epigenetic marks to the newly synthesized DNA; 2) The re-establishment of chromatin structure and the maintenance of gene silencing and epigenetic landscape of the cells.

The second half of the course deals with more complex aspects of contemporary epigenetics: 1) RNA-mediated control of chromatin structure; 2) Suppression of transposon mobility; 3) Epigenetics of early development; 3) Metabolism and epigenetics; 4) Transgenerational inheritance. We will study how the structure and transmission of chromatin relate to development, disease, early neuronal development, immune evasion by parasites and others.

Prerequisites: MCB*2050, MCB*3040

1.3 Timetable

Course schedule Lectures: TTH 8:30-9:50 *Face-to-Face, MCKN 227*

Office hours: TTH 10:30-12:00 face-to-face SSC3245 or ZOOM

ZOOM meetings:

Krassimir Yankulov's Personal Meeting Room

<https://zoom.us/j/2440888785?pwd=djBHMmVYUUUvSzF6MVdOQnJLSDMxUT09>

Meeting ID: 244 088 8785

Passcode: 7KSNew

1.4 Final Exam

12/13/2023

2 Instructional Support

2.1 Instructional Support Team

Instructor: Dr. K Yankulov

Email: yankulov@uoguelph.ca

Telephone: +1-519-824-4120 x 56466

Office: SSC 3245

Office Hours: TTH 10:30-12:00, virtual via ZOOM:

<https://zoom.us/j/2440888785?pwd=djBHMmVYUUUvSzF6MVdOQnJLSDMxUT09>

Meeting ID: 244 088 8785

Passcode: 7KSNew

Face-to-face meetings will be held upon request in Yankulov office (SSC3245).

2.2 Means of Communication

- Please send an e-mail if you need academic consideration or for other urgent matters

- Please ask for clarifications on assignments in class
- If you need to discuss course material please join the meetings during the virtual office hours. If these hours are not feasible, please schedule another time slot via e-mail.

We will use e-mails for out of class messaging.

We will use the assigned class time for clarifications and questions.

Virtual office hours via ZOOM and can be attended by more than one person.

3 Learning Resources

There is no textbook for this course. Basic information can be found in the McMillan textbooks assigned for the MCB*1090, MBG*2040 and MCB*2050 courses. In some of the lectures I will refer to materials in the *Lodish et al.* textbook, Chapter 9 (Chromatin) or Chapter 19 (DNA replication).

Assigned papers and review articles from recent literature are essential components of this course. **These original papers will be Face-to-Face presented in class, with the expectations that all students engage in the discussions and in the analysis of these papers**

3.1 Course Content

The direct instructional methods of this course are lectures and student presentations. The assignments include an oral presentation on an original research publication plus a written report, a presentation handout and the design of questions on the same publication. These assignments will develop your communication and problem-solving skills. Peer evaluation and peer discussions are also included.

4 Learning Outcomes

Learning goals and rationale

The central theme of this course is the increasing importance of epigenetics; i.e. heritable information that is carried by chromatin structure and not by the sequence of DNA itself. We will focus on the processes that confer the maintenance and modifications of chromatin through multiple cell divisions. We will learn how global gene expression programs are epigenetically maintained in differentiated cells and tissues and how the epigenome “senses” the environment and passes information to progeny. Such epigenetic processes play key roles in development, cell adaptation and disease . We will emphasize recent experiments

that reveal an emerging paradigm for the transmission of epigenetic information and for the control of gene expression. The molecular mechanisms of complex genetic traits such as transposition, position-effect variegation, imprinting and RNA-mediated gene repression will be examined. Recent discoveries in epigenetic control of development, environmental responses and behavior will be investigated through presentations of original research papers.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Master their knowledge on structure and function of chromatin.
2. Master their knowledge on mechanisms of non-Mendelian inheritance.
3. Master their knowledge on mechanisms of DNA replication, chromatin duplication and inheritance of epigenetic state.
4. Master their knowledge on eukaryotic gene expression during cell differentiation and adaptation.
5. Master their knowledge on the role of RNA in epigenetic processes.
6. Master their knowledge on horizontal gene transfer and mobile DNA elements.
7. Master their knowledge on analysis of primary literature.
8. Master their knowledge on presentation skills.

5 Teaching and Learning Activities

5.1 Course Schedule

TENTATIVE COURSE SCHEDULE

THE SCHEDULE WILL BE UPDATED DURING THE FIRST WEEK OF CLASSES DEPENDING ON COURSE ENROLLMENT.

Sept. 07: Course Introduction and administration. A brief review of Mendelian genetics. Genetic information and genetic paradigms. Epigenetics and physiology, psychology, development, pathology.

Sept. 13, 16: Lecture Panel 1. Chromatin, Histones, Histone Code. *Histone modifications and their function. Histone Modifying enzymes. Non-Histone Proteins. DNA methylation. Nucleosome remodeling factors. Techniques in Epigenetics.*

Sept. 19, 21: Lecture Panel 2. DNA replication and the transmission of epigenetic marks.

Initiation of DNA replication, origins, initiation factors, cell cycle control of initiation. Chromatin and origins of DNA replication. Elongation of DNA replication, elongation factors, pausing of the forks. Replication-coupled chromatin re-assembly. Histone Chaperones. Transmission of DNA methylation.

Sept. 26, Sept. 28, Oct. 03: Lecture Panel 3. Gene silencing and the maintenance of chromatin structures.

SIR proteins and related Histone-Deacetylases. Histone-Methyl-Transferases. Changes in chromatin structure. Telomere Position Effect and Position-Effect Variegation. Epigenetic health disorders. Immune evasion by parasites.

Oct. 05: Review of lecture panels 1-3

Oct. 09 - No classes, Thanksgiving break

Oct. 12: Presentations 1, 2: DNA replication and chromatin

Oct. 17: Presentations 3, 4: Transmission of epigenetic marks

Oct. 19: Presentations 5, 6: Gene silencing

Oct. 24 – Midterm exam on Lecture Panels 1-3, presentations 1-6

Oct. 26, Oct. 31, Nov. 02: Lecture Panel 4. Non-coding RNA, chromatin and transposons. *Bi-directional transcription. Long non-coding RNAs. Mobile Genetic Elements. Mechanisms of transposon mobility. Suppression of transposon mobility by RNA, heterochromatin, PIWI, MIWI*

proteins.

Nov. 07, Nov. 9: Lecture Panel 5. Epigenetics and Development. Insulated chromatin domains. *X-chromosome inactivation. Gene imprinting. Topologically Associated Domains and Long Range Chromatin Interactions.*

Nov. 14, Nov. 16: Lecture Panel 6. Epigenetics and Metabolism. Trans-generational epigenetic inheritance. *Links between metabolism and epigenetic marks. Epigenetics and Neurobiology.*

Nov. 21: Presentations 7, 8: *RNA and chromatin, transposable genetic elements*

Nov. 23: Presentations 9 and 10, *Topologically Associated Domains*

Nov. 28: Presentations 11 and 12: *Transgenerational inheritance, Neurons and epigenetics*

Dec. 01: Last day of classes

5.2 Important Dates

Sept. 07	First class
Oct. 25	Midterm exam (Lecture panels 1-3, presentations 1-6)
Dec.01	Last day of classes
FINAL EXAM	TBA

6 Assessments

6.1 Marking Schemes & Distributions

Two exams will be conducted during the semester. Each exam will consist of questions from the presentations of original research papers and questions from the lecture material.

Midterm exam will have a weight of 34/100 marks

Final exam will have a weight of 33/100 marks.

Learning outcomes 1,2,3,4,5,6.

THE EXAMS WILL CONTAIN SHORT ANSWER AND MULTIPLE CHOICE QUESTIONS ON THE LECTURE MATERIAL THE WEIGHT OF THESE QUESTIONS WILL BE 25-27 MARKS.

6-8 MULTIPLE CHOICE QUESTIONS PRODUCED BY THE PRESENTERS OF THE RESEARCH PAPERS WILL ALSO BE INCLUDED IN EACH EXAM. EACH OF THESE QUESTIONS HAS A WEIGHT OF 1 MARK.

Analysis and presentation of an original research paper

Presentation Performance - individual mark 8%

Slide/handout quality - group mark 6%

Written Report-individual mark 10%

Proposed MC questions-individual mark 6%

Learning outcomes 7, 8..

6.2 Assessment Details

Analysis of an original research paper - Presentation (8%)

Learning Outcome: 7, 8

Presentation: Groups of three will present a seminar on an original research paper that illustrates important concepts and emerging ideas in the field of epigenetics. These presentations are 20 minutes long plus 5 minutes of question period. This assignment is worth 8/100 marks.

The material presented by student groups will appear in the quizzes. Attendance is expected and strongly encouraged.

The list of papers, the schedule for the presentations and instruction on the preparation of the presentations will be posted in *Courselink/Course Information* on **Sept. 07/2023**.

- NB: Papers from the list will be assigned to groups that are formed by the instructor. If you have **a very good reason to NOT to present** on a certain date or if you prefer **certain presentation partners and a specific paper** please advise by e-mail by noon on Sept. 10/2023.
- The presentation schedule will be finalized by 4 p.m. on Sept. 11/2023.

Analysis of an original research paper - Written Assignments (22%)

Learning Outcome: 7, 8

Written Assignments: You will use the templates posted on *COURSELINK* for both the report and the handout. Instructions for these assignments are given in the forms.

- **Handout:** The whole group will prepare a handout (two pages) for the class. This assignment is worth 6/100 marks.
- **“News-and-Views” report on the research paper:** Each student will submit a 1000-word report that outlines the central topic, key findings and significance of the research paper. This assignment is worth 10/100 marks.

Questions for the exams: Each student will submit **four multiple choice questions with five answers** on key messages from the presented paper. The answers to these MC questions should to be found in the Handout and slides. You can not exchange these questions with your group members and by no means with the class. Some of these

questions will be included in the midterm and final exams. This assignment is worth 6/100 marks.

Submission timeline and penalties: The PowerPoint presentation and the Handout will be submitted to the *DROPBOX in CourseLink* **by noon before the day of presentation**. The "News-and-Views" report and the proposed questions for the quizzes will be submitted **by 4 p.m. on the day of your presentations**. Timely submission is essential. A penalty of 1 MARK per hour is firmly in effect.

Peer discussions and class participation (3%)

For each presentation I will assign a group of 6 students, who will read the handout and the presented paper ahead of the presentation and engage in a discussion with the presenters. Each insightful question, comment and/or suggestions will be awarded 0.25, 0.5 or 1.0 bonus marks.

Additional "bonus" marks will be awarded for questions and comments during lectures.

Maximum class participation mark for the semester is 3 marks.

6.3 Submission timeline and penalties

The PowerPoint presentation and the Handout will be submitted to the *DROPBOX in CourseLink* **by noon before the day of presentation**. The "News-and-Views" report and the proposed questions for the quizzes will be submitted **by 4 p.m. on the day of your presentations**. Timely submission is essential. A penalty of 1 MARK per hour is firmly in effect.

6.4 Grading and academic considerations

- If you miss the midterm, you will get an opportunity to write an alternative midterm on the same lecture material and presentations. The alternative midterm will be held in my office not later than Dec. 01/2023
- You will receive incomplete (INC) if you do not write the midterm or the final exam.
- You will receive incomplete (INC) if you do not participate in a presentation.
- Only under exceptional circumstances you can reschedule your presentation for the final week of classes or receive an alternative assignment. You will need academic consideration to do so.

7 Department of Molecular and Cellular Biology

Statements

7.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

7.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.
<http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

7.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.
<http://www.selfregulationskills.ca/>

7.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities

and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar.

(<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

7.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

8.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse

students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

8.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

8.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

8.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
