

Molecular Biology 3003: Microbial Genetics
Fall Semester 2018/2019

Instructor: Dr. Danielle Sexton

Office hours: Mondays, 10-11 am in TBD. I will also be available after most lectures, via email, and by appointment.

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Course objective: This course is designed to give students an appreciation for the genetics of bacteria, the techniques (molecular and biochemical) used in genetic studies, and an introduction to important, current papers in the literature.

Required Materials

Snyder *et al.*, Molecular Genetics of Bacteria, 3rd or 4th Ed. ASM Press, Washington, D.C. New copies of the 4th edition available new from ASM Press for \$129.95 USD or amazon.ca for \$149.95. New copies of the 3rd edition available from amazon.ca for \$105.95. The 4th edition is also available in the Reserve Room of the Health Sciences Library.

Course format: 3 lectures and 1 tutorial per week

Lectures are Monday and Wednesday 11:30 am -12:20 pm and Friday 1:30 – 2:20 pm in T34 Rm 103

Evaluation:

30% Midterm exam*

40% Final exam*

25% Tutorials

- 6% for presentation

- 6% for written analyses

- 5% for leading discussions

- 4% for participation

- 4% for completion of practice questions

5% In-class quizzes

* If you do better on the final exam than you did on the midterm exam, the percentage value for each will be adjusted to 20%/50%.

Students are required to complete *at least* 85% of the course work to receive credit for MOL BIOL 3003.

Midterm and Final Exams

Exams will deal with both theory and practice of the material covered in the lectures and general topics from tutorials. The final exam will be cumulative and the date will be arranged in December by the registrar's office.

Any queries about exam marks will involve a complete re-marking of the exam; exams written in pencil will not be eligible for re-marking. Any missed exams or tutorials will be granted accommodation only for medical or compassionate reasons, and must be approved by the Associate Dean's office. Please note that MSAF's may not be used for the midterm.

Tutorials

Tutorials will be held once a week (50 min). These are designed to acquaint students with current literature incorporating topics or techniques that complement those discussed in lecture. Students will be required to present, explain, and interpret data from a current paper (provided two weeks in advance), and both lead and participate in discussions of the papers and their relevance to lecture topics. Practice questions that reflect those you will see on midterm and final exams will also be provided and discussed. Presentations, written analyses, practice questions will be submitted to your TAs during tutorial time.

In class quizzes

In class quizzes will be submitted during lecture time. These are designed so that students can apply their learning to novel problems.

Weekly Topics and Readings

SECTION 1 – CHROMOSOME CONTENT AND ORGANIZATION

LECTURES 2, 3 – Sept. 5 and 7

Recommended reading:

Chapter 1 - The Bacterial Chromosome: DNA Structure, Replication and Segregation (3rd/4th Ed.)

Chapter 2 – Bacterial Gene Expression: Transcription, Translation and Protein Folding (3rd/4th Ed.)

Specifically, we will be covering:

Chapter 1:

Review of DNA structure: p. 13-17 (3rd/4th Ed.)

DNA replication: p. 18-22 and 29-34 (3rd Ed.)

p. 19-23 and 31-34 (4th Ed.)

Histone-like proteins: p. 30 (3rd Ed.)

p. 31 (4th Ed.)

Condensins: p. 38 (3rd Ed.)

p. 40 (4th Ed.)

Supercoiling: p. 38 and 48-51 (3rd Ed.) p. 41 and 47-50 (4th Ed.)

Chapter 2:

RNA introduction: p. 71-72 (3rd Ed.) p. 67-69 (4th Ed.)

Transcription: p. 74-85 (3rd Ed.) p. 70-81 (4th Ed.)

Translation: p. 89-90 (3rd Ed.) p. 86-92 and 95 (4th Ed.)

Genetic code: p. 93-98 (3rd Ed.) p. 97-105 (4th Ed.)

Relevant Practice Questions from Chapter 2:

Questions for thought: All except 4, 5, 7, 8 and 9 (3rd Ed.) or 4, 5 and 7 (4th Ed.)

Problems: All except 6, 7 and 8 (3rd Ed.) or 5, 6, and 8 (4th Ed.)

SECTION 2 – DNA REPLICATION (IN VIVO AND IN VITRO)

LECTURES 3-6 – Sept. 10-14

Quiz on PCR primer design

Specifically, we will be covering:

Continued – Chapter 1

Overview of DNA replication: p. 17-25; 29-34; 46-48 (3rd Ed.) p. 17-25; 31-33; 43-47 (4th Ed.)

Applications for DNA polymerases: p. 61-64 (3rd Ed.) p. 58-62 (4th Ed.)

PCR: p. 63-64 (3rd Ed.) p. 58-61 (4th Ed.)

Restriction endonucleases and cloning vectors: p. 55-56 (3rd Ed.) p. 53-54 (4th Ed.)

Site-directed mutagenesis: p. 62-63 (3rd Ed.) p. 60-61 (4th Ed.)

Relevant Practice Questions from Chapter 1:

Questions for thought: All except 4 (2nd part) and 7 (3rd and 4th Ed.)

Problems: 1, 2 and 6 (3rd Ed.) or 1, 2, 6 and 7 (4th Ed.)

SECTION 3 - MUTATIONS AND MUTATIONAL ANALYSIS

LECTURES 7-12 - Sept. 17- 28

* Quiz on screening and selecting for mutants of interest*

Recommended reading:

Chapter 1 - The Bacterial Chromosome: DNA Structure, Replication and Segregation (3rd and 4th Eds.)

Chapter 3 – Bacterial Genetic Analysis (3rd and 4th Eds.)

Specifically, we will be covering:

Chapter 1

DNA gyrase and antibiotics: p. 55 (3rd Ed.) p. 52-53 (4th Ed)

Chapter 3

Overview – types of mutations: p. 153-163 (3rd Ed.) p. 137-149 (4th Ed.)

In detail – useful mutations: p. 139-143 (3rd Ed.) p. 125-130 (4th Ed.)

Selecting/screening for mutants: p. 168-169 (3rd Ed.) p. 155-157 (4th Ed.)

Luria-Delbruck experiment; mutations rates: p. 144-152 (3rd Ed.) p. 130-134 (4th Ed.)

Genetic analysis: p. 167-170 (3rd Ed.) p. 153-157 (4th Ed.)

Cloning by complementation: p. 173-174 (3rd Ed.) p. 165-167 (4th Ed.) – better explanation than the 3rd Ed.

Reversion vs Suppression: p. 163-167 (3rd Ed.) p. 149-153 (4th Ed.)

Relevant Practice Questions from Chapter 3:

Questions for thought: All (3rd and 4th Eds.)

Problems: 1, 2, 3, 5, 6, 7, 8, 9, 10

SECTION 4 - PLASMIDS

LECTURES 13-16 – Oct. 1-5

Recommended reading:

Chapter 4 – Plasmids (3rd and 4th Eds.)

Specifically, we will be covering:

General plasmid characteristics: p. 197-207 (3rd Ed.) p. 183-192 (4th Ed.)

Plasmid replication control: p. 209-222 (3rd Ed.) p. 194-203 (4th Ed.)

Plasmid partitioning and incompatibility: p. 222-235 (3rd Ed.) p. 202-215 (4th Ed.)

Plasmid incompatibility; cloning vectors: p. 229-240 (3rd Ed.) p. 209-216 (4th Ed.)

Gene replacements: p. 186-190 (3rd Ed.) – note Figure 3.39 (p. 188) p. 159-161 (4th Ed.) – note Figure 3.23 (p. 160)

Relevant Practice Questions from Chapter 4:

Questions for thought: All except for 8 (3rd Ed.) or 7 (4th Ed.)

Problems: 1, 3, 4, 5 (3rd Ed.) All (4th Ed.)

SECTION 5 - CONJUGATION

LECTURES 16-17 – Oct. 15-17

Recommended reading:

Chapter 5 – Conjugation (3rd and 4th Eds.)

Specifically, we will be covering:

Overview of conjugation components: p. 243-250 (3rd Ed.) p. 219-226 (4th Ed.)

Regulation of conjugation: p. 250-266 (3rd Ed.) p. 227-242 (4th Ed.)

Relevant Practice Questions from Chapter 5:

Questions for thought: All (3rd and 4th Eds.)

Problems: 1, 3, 4, 5, 6, 7 (3rd and 4th Eds.)

SECTION 6 – TRANSFORMATION

LECTURES 18-19 – Oct. 19-22

Recommended reading:

Chapter 6 – Transformation (3rd and 4th Eds.)

Specifically, we will be covering:

p. 277-290 (3rd Ed.) p. 247-261 (4th Ed.)

Relevant Practice Questions from Chapter 6:

Questions for thought: All (3rd and 4th Eds.)

Problems: 1, 2, 3, 4 (3rd and 4th Eds.)

SECTION 7 – PHAGE AND TRANSDUCTION

LECTURES 22-25 – Oct. 24-31

Recommended reading:

Chapter 7 – Lytic Bacteriophages: Genetic Analysis and use in Transduction

Specifically, we will be covering:

Introduction to phage: p. 293-296 (3rd Ed.) p. 265-270 (4th Ed.)

Lytic development and controlling the timing of gene expression: p. 295-306 (3rd Ed.) p. 270-279 (4th Ed.)

Phage DNA replication and packaging: p. 306-318 (3rd Ed.) p. 279-289 (4th Ed.)

Resistance to phage: p. 309-314 (only 4th Ed.)

MOI: p. 320-321 (3rd Ed.) p. 298-299 (4th Ed.)

Generalized Transduction : p. 335-339 (3rd Ed.) p. 314-317 (4th Ed.)

Phage display: p. 299-301 (3rd Ed.) p. 292-298 (4th Ed.)

Relevant Practice Questions from Chapter 7:

Questions for thought: All (3rd or 4th Eds.)

Problems: 1, 2, 8 (3rd Ed.) 1, 2, 10 (4th Ed.)

SECTION 8 – LYSOGENY AND λ PHAGE

LECTURES 25-27 – Oct. 31-Nov. 5

QUIZ on regulation using lambda as a model

Recommended reading:

Chapter 8 – Lysogeny: the Paradigm and the Role of Lysogenic Conversion in Bacterial Pathogenesis (3rd and 4th Eds.)

Specifically, we will be covering:

Lysogeny and phage lambda: p. 343-359 (3rd Ed.) p. 323-340 (4th Ed.)

Phage and bacterial pathogenesis: p. 366-369 (3rd Ed.) p. 345-350 (4th Ed.)

Relevant Practice Questions from Chapter 8:

Questions for thought: 1, 2, 3 and 4 (3rd and 4th Eds.)

Problems: 1, 2, 3, 4, 6, 8 (3rd Ed.) 1, 2, 3, 4, 10 (4th Ed.)

SECTION 9 – TRANSPOSONS

LECTURES 27-31 – Nov. 5-14

Recommended reading:

Chapter 9 – Transposition, Site-Specific Recombination and Families of Recombinases

Specifically, we will be covering:

Introduction to transposons: p. 377-383 (3rd Ed.) p. 361-366 (4th Ed.)

Transposition: p. 389-400 (3rd Ed.) p. 372-382 (4th Ed.)

Transposon mutagenesis: p. 400-410 (3rd Ed.) p. 382-387 (4th Ed.)

Relevant Practice Questions from Chapter 9:

Questions for thought: 1, 2, 3 (3rd and 4th Eds.)

Problems: 3, 4 (1st part), 5, 6, 7, 8, 9 (3rd Ed.) 3, 4, 5, 6, 7 (4th Ed.)

SECTION 10 – RNA-BASED REGULATION

LECTURES 31-36- Nov. 14-26

QUIZ on RNA-based regulation

Recommended reading:

Chapter 12 - Regulation of Gene Expression (3rd and 4th Eds.)

Specifically, we will be covering:

trp operon : p. 517-518 (3rd Ed.) p. 484-486 (4th Ed.)

Types of transcriptional regulators: p. 521-524 (3rd Ed.) p. 488-491 (4th Ed.)

trp operon – antitermination: p. 530-536 (3rd Ed.) p. 497-503 (4th Ed.)

Riboswitches: p. 537-540 (3rd Ed.) p. 503-505 (4th Ed.)

Regulatory RNAs: p. 580-581 (3rd Ed.) p. 507-511 and 560-562 (4th Ed.)

Relevant Practice Questions from Chapter 12:

Questions for thought: All (not just relevant to this module, but relevant to overall course material)

Problems: 4, 5 (again, not just relevant to this module, but relevant to overall course material)

Late Work, Missed Work, and Extensions

Late submissions will be penalized with a 10% per day deduction on the grade of the assignment. Students will be able to make up missed work following the guidelines under the Request for Relief for Missed Academic Work policy. Missed work cannot be made up without a valid MSAF or permission from the Faculty Office, as appropriate. Extensions may be given for medical or compassion reasons, or during extreme circumstances.

Academic Dishonesty

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and

academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at www.mcmaster.ca/academicintegrity. The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University’s Academic Accommodation of Students with Disabilities policy.

Requests for Relief for Missed Academic Term Work McMaster Student Absence Form (MSAF)

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”

Academic Accommodation for Religious, Indigenous Or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar’s Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email

Online Access and Work

In this course, we will be using email, Avenue to Learn, and additional web pages. Students should be aware that, when they access the electronic components of this

course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.