

**Faculty of Science Course Syllabus
Department of Biology
BIOL 2030.03
Genetics and Molecular Biology
WINTER 2019**

Instructor(s):

Andrew Schofield (Professor - Unit 1)	a.schofield@dal.ca	LSC 2122	494-2551
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Paul Bentzen (Professor- Unit 3)	paul.bentzen@dal.ca	LSC 6052	494-8089
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Lectures: MWF 12:35 – 1:25 pm McCain Auditorium 1 (Scotiabank)

Laboratories: 5 lab sessions, 2 hours per lab LSC 6009 and 6012

Tutorials: 10 tutorials, 50 minutes per tutorial Various; check location via [Dal Online](#)

Course Description

The power and prominence of modern genetics are emphasized through a blend of classical and molecular approaches. Topics include: Mendelian, population and quantitative genetics; chromosome structure and variation; structure and function of nucleic acids; DNA replication, transcription and translation; gene expression; gene mutations; and genetic engineering. Course-based research experience in lab.

Course Prerequisites

-Courses:

Grade of C or higher in BIOL 1010 or BIOL 1020.03 or BIOA 1002.03 or BIOL 1031.03 or DISP (SCIE 15XX) or equivalent. RECOMMENDED: CHEM 1011.03 and CHEM 1012.03
EXCLUSIONS: GENE 2000.03

-Knowledge/skills:

Before enrolling in this course, students should be able to:

- Compare and contrast the fundamental characteristics of eukaryotic, prokaryotic, diploid and haploid organisms
- Describe the stages of mitosis and meiosis and the cell cycle.
- Recall the basic concept of heredity, and that genetic information is encoded in DNA.
- Define genotype, phenotype, chromosome, gene, allele, recessive and dominant.
- Contrast the basic differences between DNA and RNA and describe how information flows from DNA to RNA to protein.



- Identify the minimal regulatory elements and how they function in the control of gene expression of inducible operons in prokaryotes.
- Define the principal classes of physical and chemical mutagens, the changes mutation introduces to the amino acid sequence of a polypeptide, and the resulting effect on phenotype.
- Describe the basic methodology of gene cloning and DNA technology/biotechnology, some applications, and their ethical and societal implications.
- Interpret the concepts of evolution as changes in allele frequencies and the Hardy-Weinberg principle. Calculate expected genotype and allele frequencies in simple cases.
- Describe the components of a scientific paper.
- Collect scientific literature using library resources, incorporate information from them into a scientific paper, and properly cite these sources.
- Explain the importance of academic integrity

Course Objectives/Learning Outcomes

On completion of this course, students shall be able to:

- Defend the importance of genetics to society and the study of biology, and explain this to non-specialists.
- Manipulate Mendelian principles of heredity for both autosomal and sex-linked inheritance.
- Apply rules of heredity to the eukaryotic cell cycle. Relate meiotic crossing over and genetic linkage.
- Show how complex genetic systems lead to modifications of the basic principles of Mendelian inheritance.
- Analyze human pedigrees.
- Summarize the basic principles of population and quantitative genetics, and apply these principles to real biological systems.
- Diagram the structure of DNA, DNA replication, how DNA is transcribed to RNA, and how RNA is translated into proteins.
- Diagram the structure of RNA and how post-transcriptional processing modifies it prior to translation.
- Interpret genetic and protein variability using detailed knowledge of the genetic code and the processes of transcription and translation.
- Compare and contrast the regulation of gene expression in prokaryotic and eukaryotic cells
- Relate chromosome structure, the types of rearrangements that occur, and the consequences of variations in chromosomal number.
- Describe in detail restriction endonucleases, their role in recombinant DNA technology and the study of genetic variation.
- Explain and illustrate the fundamental biochemistry required in the application of modern techniques of molecular biology: (i) gel electrophoresis and RFLP analysis; (ii) contemporary methods used for determination of DNA sequences, and the key similarities and differences among them; (iii) amplification of DNA via the polymerase chain reaction (PCR); (iv) evaluation of gene expression via quantitative PCR; (v) determination of epigenetic methylation of DNA sequences.
- Classify physical and chemical mutagens, identify chemical mutagens by the Ames test, and predict the effect of different types of mutation on phenotype.

- Describe different approaches to the genetic modification of multicellular organism, including CRISPR-Cas9.
- Explain approaches to the study of genetic variation at the molecular level, including single nucleotide polymorphisms and tandem repeat variation, and some of the key applications of these approaches.
- Manipulate the theories and topics covered in lecture and readings by solving problems in lecture, tutorials and labs.
- Develop a testable scientific hypothesis and design a research approach with appropriate controls.
- Apply techniques used in genetic and molecular biology laboratories.
- Generate, organize, interpret, and critique data collected from experiments in the laboratory and communicate results by an original and individually written scientific paper.
- Summarize, paraphrase, cite and reference scientific literature to avoid plagiarism.

Course Materials

REQUIRED:

1. **BIOL 2030 Study Guide/Lab Manual**, 2019 Winter term version
2. **SaplingLearning Access (for grades for your tutorial assignments) and a version of the text:**
 - **Option 1 (a good deal):** SaplingLearning access + Pierce, Benjamin A. Genetics, A Conceptual Approach (6th ed) 2017. (Ebook) for ~\$70.00

OR

 - **Option 2:** SaplingLearning access through the computer terminals in the Wallace McCain Learning Commons (Open hours: Mon-Fri: 8 am-10 pm, Sat and Sun: 10am-10pm) + Pierce, Benjamin A. Genetics, A Conceptual Approach (6th ed) 2017. (Ebook) **FREE.**

Other text options that you can use along with Option 1 or 2:

 - Pierce, Benjamin A. Genetics, A Conceptual Approach (6th ed). 2017. NY: W.H. Freeman (Looseleaf) + Solutions Manual + SaplingLearning access for ~\$117
 - Pierce, Benjamin A. Genetics, A Conceptual Approach (6th ed). 2017. NY: W.H. Freeman (Hardcover) + Solutions Manual + SaplingLearning access for \$~200 + tax
 - Reserve copies of 6th edition at Killam Library
 - Older versions (3rd, 4th or 5th editions) of Pierce may be used; page numbers of readings and assigned questions will be different: you will have to compare them to the copies on reserve in library and photocopy them yourself
3. **BIOL2030 Course website:** Connect through my.dal.ca (Brightspace) Check often, at least every Friday! What is going on next week? What is due? What should I be working on?
4. **Top Hat Access.** Participation mark for lectures- worth 1% per unit, possible 3% total over the term. Must answer 80% of the questions for full marks. \$20.00 per term

Recommended:

5. Knisely, Karin. 2017. *A Student Handbook for Writing in Biology*. 5th ed. VA: W.H. Freeman

Course Assessment

Component	Weight (% of final grade)*	Date
<i>Top Hat classroom response system</i>	3	Every lecture
<i>Sapling tutorial assignments</i>	9	Weekly(online)
<i>Midterm I</i>	22	Mon. Feb. 25, 19:00-21:00
<i>Midterm II</i>	22	Tues. Mar. 26, 19:15-21:15
<i>Final exam</i>	22	(Scheduled by Registrar)
<i>Laboratory Assignments</i>	22	Various

***Weight cannot be shifted from one midterm because exams are not cumulative.**

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100) A (85-89) A- (80-84)	Excellent	Considerable evidence of original thinking; demonstrated outstanding capacity to analyze and synthesize; outstanding grasp of subject matter; evidence of extensive knowledge base.
B+ (77-79) B (73-76) B- (70-72)	Good	Evidence of grasp of subject matter, some evidence of critical capacity and analytical ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.
C+ (65-69) C (60-64) C- (55-59)	Satisfactory	Evidence of some understanding of the subject matter; ability to develop solutions to simple problems; benefitting from his/her university experience.
D (50-54)	Marginal Pass	Evidence of minimally acceptable familiarity with subject matter, critical and analytical skills.
F (<50)	Inadequate	Insufficient evidence of understanding of the subject matter; weakness in critical and analytical skills; limited or irrelevant use of the literature.

Course Policies

TOP HAT: We will be using the Top Hat (www.tophat.com) classroom response system in lecture. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or through text message.

You can visit the Top Hat Overview (<https://success.tophat.com/s/article/Student-Top-Hat-Overview-and-Getting-Started-Guide>) that describes how you will register for a Top Hat account, as well as providing a brief overview to get you up and running on the system.

You can register for Top Hat by visiting our Brightspace site. Our course join code will be given to you in lecture.

Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email (support@tophat.com), the in app support button, or by calling 1-888-663-5491.

The 3% maximum grade (1% per Unit) will be based on **participation**. It does not matter if you get an answer right or wrong, just that you responded. To forgive for occasional missed classes or unexpected technical issues, we will count only 80% of your responses. (i.e. if you respond to 80% of the Top Hat questions during lectures for that particular Unit, you will get the full 1% for this grade).

LABORATORY FORMAT: The green page of the Study Guide/Lab Manual contains more details of the lab content and weekly schedule. Note that labs are held every second week so you should go to DAL ONLINE to check which lab section you have registered and check the schedule carefully. Online pre-lab quizzes must be completed before lab. Although data is collected together, **all written work is individual**. Online lab assignments are screened by Urkund for plagiarism. All assignments are due as described on the lab schedule (green page) in the study guide. Not enough money on my DalCard or printer problems are not acceptable excuses for lateness. Late labs will receive a 5% deduction if submitted after the start of lab on the same day, or 10% deduction for each day late. **Note: You must attend the lab for which you are registered.**

TUTORIAL FORMAT: Register for the Sapling tutorial assignments through the **Sapling** link in our Brightspace course **only**, entering your tutorial day (**Monday to Thursday**) when prompted. The yellow pages of the Study Guide/Lab Manual (or the schedule posted in the **Tutorials** folder) contain more details on the content and weekly schedule. Tutorials are held most weeks. Please go to DAL ONLINE to check your tutorial section time and location. Room locations **may be changed** by the registrar so check at <http://www.registrar.dal.ca/timetable/> **Note: You must attend the tutorial section for which you are registered.** Following each tutorial, you will have **5 days** to complete the online Sapling Learning tutorial assignment. There are 10 assignments total, with your lowest mark dropped.

MIDTERM/EXAM FORMAT: The two midterms and final exam have equal weight. There will be an exam at the end of each lecturer's section, so the weighting cannot be changed. These tests are designed to test you on the material presented in lectures, the text and tutorials. The test papers consist entirely of questions requiring multiple choice answers. More details on format and content will be given in lecture before each midterm.

Midterms are two hours in length and are held in the evening. The exam on the third lecturer's material will also be two hours in length and will be held during the final examination period scheduled by the registrar's office. The specific date and time for the BIOL 2030 final exam will be announced early in October or February and posted at <http://www.registrar.dal.ca/exam/>. We do not give early midterms or exams so check the schedule **before making travel arrangements**.

Alternate writing times for midterms/exam will **ONLY** be given to students who have another Dalhousie exam or class at the same time or who are ill. Students who have a timing conflict with a midterm or exam should contact the **Instructor** at least two weeks prior to the exam date to arrange another time. Students who are ill should see the "REGULATIONS REGARDING MISSED..." policy below.

EXAM VIEWING: You will not receive your exams back. Each professor will hold a midterm viewing session after the exam for you to look at your exam. Watch for news in Brightspace as to the date and location of the exam review sessions. Contact the exam professor if you have any questions about his/her exam.

REGULATIONS REGARDING MISSED MIDTERMS/EXAMINATIONS/ASSIGNMENTS:

Requests for an alternative midterm/exam time due to extenuating circumstances: A student requesting an alternative time for a midterm or final examination will be granted that request only in exceptional circumstances. Such circumstances include having another Dalhousie class or exam scheduled at the same time or other mitigating circumstances outside the control of the student. Elective arrangements (such as travel plans) are **not** considered acceptable grounds for granting an alternative examination time. Students should contact the **Instructor** at least two weeks prior to the exam date to arrange another time.

Missed exams, midterms, tutorials, labs and lab reports due to illness or other exceptional circumstances: Alternative arrangements will be considered provided that:

- A student who misses class work (assignment, lab, tutorial, midterm or exam) because of illness or other reasons:

1. **Notifies the Instructor** by e-mail prior to the academic requirement deadline or scheduled time to arrange a makeup or extension.
2. **Submits a Student Declaration of Absence Form through Brightspace** within three (3) days following the last day of absence. Can be used **once** per term for absences of **3 days or less** only. For more info https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html
3. For absences of **longer than 4 days**, students cannot submit a Student Declaration of Absence Form. Please contact the instructor and have adequate documentation to support your absence.

Note. A student who fails to comply with **any** of these rules may not be able to make up for lost work. The decision on when and if special arrangements can be made will be at the discretion of the Instructor.

There will be times during your term when you will have deadlines in several different courses at the same time. **PLAN AHEAD. WORK CONSISTENTLY. TEST YOUR RECALL.** Your time at University should, among other things, teach you to develop effective time management skills and study habits. On the other hand, unforeseen events such as personal/family crises or illness CAN OCCUR during the term. These occurrences are unavoidable and the teaching staff of 2030 will be most understanding and willing to make alternate arrangements. Please speak to one of the teaching staff.

Course Content
BIOL 2030.03 TENTATIVE Lecture Outline Unit 1 (WINTER 2019)

WK #	LEC #	TUT #	DATE	PROF	TOPIC	Pierce (6 th edition)
1	1		Jan. 7	Schofield1	Introduction to Genetics	Chapter 1 (5, 12-13) Chapter 2 (17-21)
1	2		Jan. 9	Schofield2	Cell Reproduction; Mitosis & Meiosis	Chapter 2 (20-25, 27-35)
1	3		Jan. 11	Schofield3	Basic Principles of Heredity	Chapter 3 (48-69) Study Guide: Appendix F&G
2	4	1	Jan. 14	Schofield4	Extensions and Modifications of Basic Principles; Complementation	Chapter 5 (109-125)
2	5		Jan. 16	Schofield5	Probability Strategies to deal with ratios in crosses	Chapter 3 (56-67) Study Guide: Appendix H
2	6		Jan. 18	Schofield6	Sex determination and Sex-linked Characteristics – Part 1	Chapter 4 (81-99)
3	7	2	Jan. 21	Schofield7	Sex determination and Sex-linked Characteristics – Part 2	Chapter 4 (81-99)
3	8		Jan. 23	Schofield8	Pedigree Analysis & Applications	Chapter 6 (146-157)
3	9		Jan. 25	Schofield9	Linkage and Mapping in Eukaryotes – Part 1	Chapter 7 (174-189)
4	10	3	Jan. 28	Schofield10	Linkage and Mapping in Eukaryotes – Part 2	Chapter 7 (197-198), Supp. Info: 198-203)
4	11		Jan. 30	Schofield11	Intro to Quantitative Genetics	Chapter 24 (716-721)
4			Feb. 1		HOLIDAY- Munro Day – University closed	
5	12	4	Feb. 4	Schofield12	Quantitative Genetics	Chapter 24 (727-736) [self review 721-727]
5	13		Feb. 6	Schofield13	Population Genetics	Chapter 25 (716-723)
			Feb. 25	Schofield	Midterm 1 (1900 - 2100) (A MONDAY night)	
						MCCAIN AUDITORIUM 2-ONDAATJE

BIOL 2030.03 TENTATIVE Lecture Outline Unit 2 (WINTER 2019)

WK #	LEC #	TUT #	DATE	PROF	TOPIC	Pierce (6 th edition)
5	14	4	Feb. 8	Venkatachalam1	The Molecular Basis of Heredity and DNA Structure	Chapter 10 (287-309)
6	15		Feb. 11	Venkatachalam2	DNA Replication	Chapter 12 (339-359) Review Chapter 2 (23-35)
6	16		Feb. 13	Venkatachalam3	Transcription	Chapter 13 (373-390) Chapter 17 (497-499)
6	17		Feb. 15	Venkatachalam4	RNA Interference and Gene Editing	Chapter 14 (418-421) Chapter 17 (491-495, 504-506) Chapter 19 (593-594)
FEB 18-22 WINTER STUDY WEEK – NO CLASSES, Feb. 18 University closed, open Feb. 19-22						
7	18	5	Feb. 25	Venkatachalam5	Post-transcriptional Processing and Editing - Part 1	Chapter 14 (399-418) Chapter 17 (502-504)
7			Feb. 25	Schofield	Midterm 1 (1900 - 2100) (A MONDAY night)	MCCAIN AUDITORIUM 2-ONDAATJE
7	19		Feb. 27	Venkatachalam6	Post-transcriptional Processing and Editing - Part 2	Chapter 14 (399-418) Chapter 17 (502-504)
7	20		Mar. 1	Venkatachalam7	The Genetic Code	Chapter 15 (429-440) Chapter 18 (518-521)
8	21	6	Mar. 4	Venkatachalam8	Translation	Chapter 15 (441-452)
8	22		Mar. 6	Venkatachalam9	Prokaryotic gene regulation – the <i>lac</i> operon, <i>lac</i> mutations and catabolite repression.	Ch. 16 (465-474) Ch. 13 (376-385)
8	23		Mar. 8	Venkatachalam10	Eukaryotic gene regulation: sites of regulation from DNA to protein.	Ch. 13 (386-390) Ch. 14 (409-411) Ch. 16 (463-465) Ch. 17 (491-509)
9	24	7	Mar. 11	Venkatachalam11	REVIEW	
			Mar. 26	Venkatachalam	Midterm 2 (1915 - 2115) (A TUESDAY night)	MCCAIN AUDITORIUM 2-ONDAATJE

BIOL 2030.03 TENTATIVE Lecture Outline Unit 3 (WINTER 2019)

WK #	LEC #	TUT #	DATE	PROF	TOPIC	Pierce (6 th edition)
9	24	7	Mar. 13	Bentzen1	Chromosomal Rearrangements	Chapter 8 (218-230)
9	25		Mar. 15	Bentzen2	Variations in Chromosomal Number	Chapter 8 (230-241)
9	26	8	Mar. 18	Bentzen3	Mutation & its effect on phenotype, mutagens, and the Ames test	Ch. 18 (515-534) Ch. 8 (218-221)
10	27		Mar. 20	Bentzen4	Gel-electrophoresis, restriction endonuclease mapping & Southern blotting	Ch. 19 (561-564, 567-568) Ch. 11 (312-313)
10	28		Mar. 22	Bentzen5	The polymerase chain reaction and qPCR	Ch.19 (559-561, 568-571, 582-586)
11	29	8	Mar. 25	Bentzen6	DNA sequencing technologies	Ch.19 (568-571, 582-586)
			Mar. 26	Venkatachalam	Midterm 2 (1915 - 2115) (A TUESDAY night) MCCAIN AUDITORIUM 2- ONDAATJE	
11	30		Mar. 27	Bentzen7	DNA sequencing continued: applications	Ch. 20 (608-613, 615-618)
11	31		Mar. 29	Bentzen8	Study of genetic variation: RFLPs to SNPs	Ch. 20(614-615, 619-622)
12	32	9	Apr. 1	Bentzen9	Recombinant DNA technology: Cloning genes and their transcripts, and genetic modification of organisms	Ch. 11 (321-322) Ch. 19 (571-578)
12	33		Apr. 3	Bentzen10	Genome editing via CRISPR: treatment of genetic diseases and controlling evolution	Ch. 14 (420-421) Ch. 19 (564-567; 596-597)
12	34		Apr. 5	Bentzen11	Epigenetics, methylation & bisulfite sequencing	Ch. 21 (642-657)
13	35	10	Apr. 8	Tutorial 10	12:35-13:25 in McCain Auditorium 1, Scotiabank.	
						FINAL EXAM SCHEDULED BY REGISTRAR DURING EXAM PERIOD

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>