DALHOUSIE UNIVERSITY

Syllabus:

Life Rewritten: Applications and Implications of Gene Editing and Synthetic Biology

BIOL 3037.03

8:35- 9:55 AM Monday, Wednesday

Winter 2020

Location: LSC C206

Instructors: *Dr. Erin Bertrand* erin.bertrand@dal.c*a* *office: 902- 494-1853 LSC BIOL 5076B*

Dr. Patrice Côté patrice.cote@dal.ca *office: 902 494-1318 LSC BIOL 7124*

TA*: Landon Getz* landon.getz@dal.ca

Office Hours: by appointment

Lectures: *2 x 80 min lecture time blocks per week*

Enrollment: 60

Course Description (Calendar)

This course introduces students to gene editing and synthetic biology tools (eg. CRISPR) as well as both current and future applications of those tools for conservation, medicine, and food production. This course empowers students to develop informed opinions about the ethics of using such tools in science and society.

Extended Course Description

Humans have been employing techniques to modify the genomic content of organisms for centuries. However, recent advancements in our understanding of CRISPR/Cas9 and related tools have enabled us to conduct targeted and efficient gene editing on an unprecedented scale. This is, literally, changing life as we know it. This course introduces students to gene editing and synthetic biology tools as well as both current and future applications of those tools for medicine, conservation and food production. This course empowers students to develop informed opinions about the ethics of using such tools in science and society.

Course Prerequisites

A mark of B- or better in both BIOL 2020 (Cell Biology) and BIOL 2030 (Genetics and Molecular Biology)

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Course Objectives:

Students will come away from this class being able to discuss:

- How current techniques for gene editing and synthetic biology work
- How natural biological phenomena are leveraged by scientists to conduct gene editing
- Examples of current and future applications of gene editing and synthetic biology tools in:
    - Medicine
    - Ecology and conservation
    - Food production
- Ethical and policy considerations surrounding the use of gene editing

Students will have gained practical experience in:

- Scientific writing
- Working constructively in small groups
- Producing podcasts to convey scientific information

Course Materials

Assigned readings, videos, and tutorials for each class will be available one weeks ahead of time on the course Brightspace page.

Resources will be designated as 'primary' if they are explicitly examinable, and 'background' or 'extensions' if they are useful for context and/or broader understanding, but not directly examinable.

There is no required textbook, but students may find "A Crack in Creation" by Dr. Jennifer Doudna, "Altered Inheritance: CRISPR and the Ethics of Human Genome Editing" by Dalhousie's Dr. Françoise Baylis, and 'Biotechnology' textbook, 2nd edition, by David Clark and Nanette Pazdernik. All of these will all be available on reserve in the Killam Library

Course Format:

This course is taught in two lecture time blocks per week. For a subset of the lecture blocks, students will be expected to have become familiar with course content through reading, watching videos and tutorials, and completing worksheets ***prior*** to coming to class. Rather than encountering content in class via lecture, students will instead use classroom time to work in small groups to synthesize content, guided by input from the instructors. We will use TopHat frequently. The course Join code is 793381

Groupwork: Students will answer a short questionnaire in class on day 1; answers from this questionnaire will be used to put students in teams. These teams will be designed to provide everyone with the necessary experiences and skillsets to work together effectively on a series of projects.

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Course Assessment

Component	Weight (% of final grade)	Description/ Due Date
Worksheets	30%	7 worksheets in total, indicated on schedule, evenly weighted, one lowest mark dropped
Peer evaluation and participation (PEP)	15%	Your participation in 6 class periods will be evaluated by your peers, indicated on schedule below. On class days when there is no peer evaluation, participation marks will be assigned where full marks are given for participation in each TopHat activity. The PEP score for each class will be evenly weighted.
Midterm	15%	2nd day of week 7
Podcast	20%	Topics assigned week 7, due last week of class
Final Exam	20%	Final Exam Period

Worksheets: There will be seven worksheets assigned throughout the semester. There will be three types of worksheets- A, B and C. Students will complete part one of the worksheet assignments before they come to class based on assigned readings, videos, and tutorials.

Worksheet style A: Students will complete a short answer style worksheet before they come to class and turn this in on Brightspace before the start of class. Students will then work in small groups to discuss and synthesize their answers and fill out a new version of the worksheet in class. At the end of class, all worksheets will be turned in for marking. Each student will receive a mark for each worksheet, 50% of the points awarded from their independent work before class and 50% from the revised group worksheet.

Worksheet style B: students will complete multiple choice questions before class and work together as a group to arrive at answers to a new short answer question worksheet in class. Each student will receive a mark for their multiple-choice answers (50%) and for the group's short answer questions (50%).

Worksheet style C: This style of worksheet is called "Ask an Expert". On these days, students will review provided materials and prepare three questions for an expert who will visit the class, either in person or virtually. These questions will be submitted on Brightspace before class. In class, students will work in small groups to select two questions to submit for asking the expert the following class period. Professors will select the final set of questions, and students who have questions selected earn bonus points. Student will be marked for the quality of their independent questions (50%) and their group questions (50%).

No points will be awarded for the group portion of the worksheets if the student is not in attendance.

Show and Tell: Students will work in assigned groups to select a clip from a song, TV show, movie, piece of literature etc. that has something to do with genome editing or synthetic biology. Each group gets 5 minutes **exactly** to present their clip/ description and 2-3 questions that they had about the scientific basis of the content of their 'show and tell' piece.

By Jan 13, each group will submit a PowerPoint slide that has a) weblink to clip and b) 2-3 questions. Students will be marked by their peers based on preparedness and ability to work well within the team.

Primary Literature Discussion: There will be 5 class days where students will come prepared to discuss a paper from the primary literature. Each student will be assigned to become an "expert" in one specific part of the paper. In class, students will get together with all the other students who are experts in the same part and discuss for 30 minutes. Then, students will re-group to pre-assigned groups where each member is an expert in a different aspect. The group is tasked with making sure each member understands the paper well by the end of the class period. Students will be marked by their peers based on preparedness, ability to work well within the team, and their ability to adequately explain their section of the paper.

Midterm: This test will occur in class and will serve to examine student's understanding of material covered in weeks 1-6 including worksheet and primary literature discussion materials. This exam will consist of multiple choice and short answer questions.

Podcasts: In groups of four, students will make 10-minute podcast episodes that defend one side of a debate topic. The target audience for the podcast is fellow undergraduate students with a basic knowledge of biology. There will be ten debate topics to choose from, each with two stances ("for" or "against"). Groups will have the chance to submit their top three choices for debate topic and stance and will be assigned a topic with those choices in mind. Students will be provided with access to high quality, open access sound editing tools as well as sound recording equipment to create their podcasts. We will listen to all podcasts during class time during the last two classes of the semester. Each student will record their opinion before and after hearing podcasts arguing each side. This is in the style of an oxford debate. The goal is to change as many minds as possible. Along with a 10-minute audio file, each group will submit an outline as well as a "*production document*" including a transcript and explaining the role each student played in the preparation of the podcast and providing detailed reference list for the content used to create your podcast. Detailed instructions and a list of resources for podcast production will be available on Brightspace when topics are assigned.

Event	Date	% of podcast grade
Topics released	Feb 12	
Rankings Due	Feb 20	
Topics and sides assigned	Feb 26 (day of midterm)	
Outline Due	Mar 11	20
Podcast and production document due	Mar 28	80

Final Exam: The final exam is designed to examine student's understanding of material discussed throughout the semester, concentrating on weeks 7-13, as well as student's ability to apply their new knowledge to advocate for specific ethical stances or policy solutions related to gene editing. The final exam will be scheduled during exam week.

Rubrics for non-multiple choice or short answer aspects of the course:

"Ask and Expert" question-marking Rubric

Criteria	**Indicators**
Clarity (33%)	The phrasing of the question is clear and concise
Relevance (34%)	Demonstrates that the student has read and understood background materials provided for this class by being previously unanswered and relevant to the topics the expert works on
Insight and synthesis (33 %)	Demonstrates a deep understanding of the subject matter by bringing together disparate information from previous classes to ask a question that is synthetic and shows particular insight
Bonus (10%)	Students and groups whose questions are selected receive 10 bonus points out of 100

Peer Evaluation Rubric (completed by all peers in your group, mean grade is assigned)

In class, each person will fill out a survey about each student they work with that day, ranking their participation 0-2:

0- disagree with four or five statements below
1- disagree with one, two or three statements below
2- agree with all statements below

- The team member was present for all discussions
- The team member was well prepared and did their best to understand the material
- The team member made a good effort to participate
- The team member was willing to consider and respect other's ideas and opinions
- Overall the quality of the team member's contribution was very good- excellent

To receive full participation marks, students will need to complete their peer evaluations in the last five minutes of class each day.

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Podcast Outline Marking Rubric:

Criteria	Indicators
Teamwork (25%)	The outline conveys that the team has found a way to work effectively, using the strengths of each person to build the project together.
Background (25 %)	The outline describes plans to include sufficient, clear background so that the target audience can understand the scientific content at the heart of the debate.
Clarity and synthesis (35%)	The outline describes plans to convey three scientifically supported arguments in an accessible, clear, cohesive manner and synthesizes available information to provide a convincing overarching argument
Support (15%)	The content is sufficiently supported by primary literature and avoids plagiarism. The supporting literature is properly cited.

Podcast Episode Marking Rubric:

Criteria	Indicators
Format (10%)	Follows all time and formatting guidelines for the audio file and production document
Teamwork (15%)	The production document and podcast episode convey that the team found a way to work effectively, using the strengths of each team member to build the project together.
Background (25 %)	The episode provides sufficient, clear background so that the target audience can understand the scientific content at the heart of the debate.
Clarity and synthesis (35%)	The episode conveys scientifically supported arguments in an accessible, clear, cohesive manner and synthesizes available information to provide a convincing argument
Support (15%)	The content in the episode is sufficiently supported by primary literature and avoids plagiarism. The supporting literature is properly cited in the production document
Bonus (5%)	The team that changes the most minds (for or against) earns 5 bonus points out of 100

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Course Policies

Complete attendance of all lectures is highly recommended, and class participation is key and will be reflected in worksheet and literature discussion marks directly.

Late assignments: 10% reduction in grade for every day an assignment is late. Extenuating circumstances will be considered; contact the instructors as soon as possible, within one week of the assignment due date, for consideration.

Brightspace will be used for regular updates and announcements; students are responsible for regularly monitoring this space.

Course Content and Schedule (subject to minor changes with one week's notice):

Date (2020)		Day 1 topic	Day 1 Format	Day 2 topic (if different from day 1)	Day 2 Format
Jan 6, Jan 8	Week 1	Intro/orientation/group picking	Lecture	Genetics refresher / Traditional GM/ History	Lecture
Jan 13, Jan 15	Week 2	Synthetic Biology and Crispr introduction	Lecture	Genome editing in popular culture discussion	Show and tell
Jan 20, Jan 22	Week 3	Ethics Foundations	Lecture		Lecture
Jan 27, Jan 29	Week 4	Gene therapy	WS-C		Ask an expert
Feb 3, Feb 5	Week 5	Xenotransplantation (chimeras)	WS-B	Stem Cells, Regeneration	Primary Lit
Feb 10, Feb 12	Week 6	Biological Warfare (history, policy)	WS-A	DIY/bioterrorism	Primary Lit
Reading break					
Feb 24, Feb 26	Week 7	Review		**Midterm Exam**	
Mar 2, Mar 4	Week 8	Gene editing in crops and aquaculture	WS-C		Ask an Expert
Mar 9, Mar 11	Week 9	Synthetic Biology/Minimal cell/microbial machine	WS-B		Primary Lit
Mar 16, Mar 18	Week 10	Gene Drives/ transgenics in Ecology/public health/conservation	WS-A		Primary Lit
Mar 22, Mar 25	Week 11	De-extinction	WS-B		Primary Lit
Mar 30, April 1	Week 12	**Podcasts**		**Podcasts**	
Final Exam Week		**Final Exam**			

Class periods with peer evaluation

WS type A- Short answer outside class and in class
WS type B- Multiple choice outside class, short answer in class
WS type C- Ask an expert preparation
Ask an expert- expert visits class and students ask them specific questions
Primary literature- read a paper and teach a specific part to your group
Show and Tell – group brings a popular culture piece to class and raises 2-3 questions about scientific content

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

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

Evaluation Definitions and Schema: In addition to the rubric provided above, which articulates the criteria evaluated in the main assignment, students should be aware of the definitions and evaluation schema that will be used for assigning grades to written assignments and presentations:

Grade	Point	%	Definition	Notes
A+	4.3	90-100	Exceptional	Exceptional work- exceeds expectations; high order, original thinking, research, critical evaluation skills; extraordinary analysis and synthesis skills; excellent grasp of subject matter and command of relevant literature
A	4.0	85-89	Excellent	High order, original thinking, research and critical evaluations skills; excellent analysis and synthesis skills; excellent grasp of subject matter and command of relevant literature
A-	3.7	80-84	Very Good	Evidence of strong original thinking, research and critical evaluations skills; very good analysis and synthesis skills; very good grasp of subject matter and command of relevant literature
B+	3.3	77-79		
B	3.0	73-76	Good	Evidence of some original thinking, research and critical evaluations skills; sufficient analysis and synthesis skills; good grasp of subject matter and command of relevant literature
B-	2.7	70-72		
C+	2.3	65-69	Satisfactory	Evidence of some understanding of the subject matter; ability to develop solutions to simple problems; benefitting from his/her university experience
C	2.0	60-64		
C-	1.7	55-59		
D	1.0	50-54	Marginal Pass	Evidence of minimally acceptable familiarity with subject matter, critical and analytical skills
F	0	0-69	Failure	Insufficient evidence of original thinking, research and critical evaluations skills; poor grasp of subject matter and command of relevant literature or failure to complete assignments on time or according to course specification
INC			Incomplete	Extensions available only in exceptional circumstances
ILL			Illness, compassionate reasons	Documentation must be submitted to instructor within one week of due date
W			Withdrew after deadline	Registrar assigns this

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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

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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

The full text of the code can be found here:
http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

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SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties	**Killam Library Ground floor** Rm G28 ***Bissett Centre for Academic Success***	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	**Killam Library Ground floor** Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	**Killam Library 3rd floor** Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours **All information can be found on our website: www.dal.ca/sfs**
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	**Killam Library Ground floor** Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week **See our website: writingcentre.dal.ca**