

Department of Biology Course Outline

SC/BIOL 4410 3.00 Advanced Drosophila Genetics Fall 2019

Course Description

A study of recent advances in Drosophila genetics. The course addresses techniques such as chromosomal analysis, lethal tagging, genetic dissection, mosaic analysis, genetic screens, transposon tagging, enhancer trapping, methods for manipulating genes in transgenic flies and genetic ablation. Three lecture hours. One term. Three credits.

Prerequisites

SC/BIOL 2020 3.00, SC/BIOL 2021 3.00, SC/BIOL 2040 3.00, SC/BIOL2070 3.00.

Course Instructors and Contact Information

Instructor: Dr. Kyle Belozarov

Contact: Chemistry Building (CB216)

vbelozer@yorku.ca (**communication by e-mail is HIGHLY preferred**)

Office hours: It's a small upper-year course, so e-mail me for an appointment, and I will meet with you in my office. Online office hours will be provided using Adobe Connect.

Schedule

Lectures: Fridays 2:30 pm – 5:30 pm; CB129

All lectures will be recorded and the recordings will be available on Moodle.

Evaluation

Midterm (October 25, 120 min)	25%
In-class mini-quizzes* (10 total)	20%
After-class comments sheets	5%
Research project (due by December 3)	20%
Final exam (cumulative, 180 min, date TBD)	30%

* In-class mini-quizzes will be 10 min long, and will be given in the beginning of every lecture, with the exception of the first lecture, and the day of the midterm. The mini-quizzes will contain mostly multiple-choice and short-answer questions that will test your knowledge of material discussed in the previous week's lecture.

Missed evaluation policy: The weight of all missed mini-quizzes and after-class comment sheets will be moved to your final exam. This will be done automatically for everyone, regardless of the reason why an evaluation was missed. Therefore, there is no need to e-mail me letting me know that you plan to or have missed an evaluation.

If you miss the midterm (for any reason), its weight will also be automatically moved to the final exam. No need to submit any documentation. There will be no make-up midterms.

Important Dates

Classes start:	September 4
Fall Reading Week	October 12 - 18
Drop Deadline:	November 8 (Last day to drop the course without receiving a grade)
Course withdrawal:	November 9 - December 3 (Course still appears on transcript, but no grade will be shown)
End of classes:	December 3
Final Exam:	TBA, during the December exam period (Dec 5 – 20)

For additional important dates such as holidays, refer to the ["Important Dates"](#) section of the Registrar's Website.

Resources

Textbooks: None. Original articles and reviews will be extensively used in this course. Pdf's of these articles will be posted on Moodle, and will also be available through York University library.

Learning Outcomes

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

1. Comfortably and rapidly read original scientific articles in the general area of *Drosophila* molecular genetics, summarize the central findings of a study, and critically analyze the experimental designs and methods chosen by the authors.
2. Clearly explain the advantages of using *Drosophila* as a model organism in biomedical research. Explain the steps and the methodology involved in establishing *Drosophila* models of specific human genetic diseases.
3. Design a forward genetic screen to isolate novel recessive alleles of a given gene and a similar screen to isolate recessive mutations with a specific phenotype. Define and explain complementation group analysis. Be able to provide a complete experimental protocol, including the rationale for the use of markers and balancers, for these screens.
4. Explain P-element transgenics in *Drosophila*: (1) how are transgenes introduced into the germline? (2) what is the genetic scheme used to mobilize existing P-element transgenes? (3) what is enhancer trapping and how is it used in biomedical research?
5. Fully explain the UAS-Gal4 binary system, and articulate the advantages of this system compared to single-transgene approaches.
6. Explain the molecular mechanism of RNA interference, and its utility in genetic analysis. Be able to compare and contrast a reverse genetic screen and a forward genetic screen.
7. Explain somatic mosaics: (1) what are they and how are they different from germline mutations? (2) what are the advantages of somatic mosaics? (3) what transgenes are required to generate a somatic mosaic? Be able to design molecular genetic experiments utilizing four techniques: Flp-Out, TARGET, MARCM, and twin-spot generator.
8. Explain meiotic recombination in *Drosophila*, and predict F1 progeny ratios from chromosomal linkage maps. Define the differences between linkage maps, physical maps, and molecular maps. Explain how gene conversion results in non-Mendelian allele frequencies, and how it relates to meiotic recombination.

Course Content

Major topics covered in the course:

1. Genes, mutations, alleles, chromosomes, balancers
2. Classical mutagenesis (EMS, X-rays)
3. Complementation analysis
4. Hybrid dysgenesis
5. P-elements
6. Transgenic flies
7. P-element mediated mutagenesis (gene disruption, imprecise excision)
8. P-element hopping
9. Enhancer trapping
10. UAS/Gal4 binary system
11. RNAi
12. Gal80, Gal80TS, TARGET
13. Flippase
14. FLPout
15. Conventional FRT mosaics
16. MARCM and twin-spot generator
17. Inverse PCR for transgene localization
18. Deletion mapping
19. Positional cloning
20. Cytogenetic, linkage, and molecular maps
21. Meiotic recombination
22. Gene conversion
23. Heterochromatin
24. Various Drosophila models of specific human genetic diseases

Experiential Education and E-Learning

E-Learning components:

- Moodle Website
- Extensive use of online databases and data visualization software, e.g. Pubmed, Flybase, BLAST, Cytoscape, DROID, DPim.
- Online office hours provided using Adobe Connect

Course Policies

1. **Missed evaluation policy:** The weight of all missed mini-quizzes and after-class comment sheets will be moved to your final exam. This will be done automatically for everyone, regardless of the reason why an evaluation was missed. Therefore, there is no need to e-mail me letting me know that you plan to or have missed an evaluation.

If you miss the midterm (for any reason), its weight will also be automatically moved to the final exam. No need to submit any documentation. There will be no make-up midterms.

2. The weight of research project cannot be transferred to the final, and if you do not submit the project by the deadline, you will receive zero points for this evaluation. Sorry, no exceptions!

3. If you request that I re-mark an evaluation, please keep in mind that re-marking can result in your score being raised, confirmed, or lowered. Second round of re-marking will not be offered.

4. Standard accommodation policies as set by the university will be followed in the course.

5. All students in the course must be familiar with York University's policies on academic integrity.

Please consult the following website for more detail:

<http://www.yorku.ca/academicintegrity/students/index.htm>

Academic Honesty and Integrity

York students are required to maintain the highest standards of academic honesty and they are subject to the Senate Policy on Academic Honesty (<http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/>). The Policy affirms the responsibility of faculty members to foster acceptable standards of academic conduct and of the student to abide by such standards.

There is also an academic integrity website with comprehensive information about academic honesty and how to find resources at York to help improve students' research and writing skills, and cope with University life. Students are expected to review the materials on the Academic Integrity website at - <http://www.yorku.ca/academicintegrity/>

Access/Disability

York University is committed to principles of respect, inclusion and equality of all persons with disabilities across campus. The University provides services for students with disabilities (including physical, medical, learning and psychiatric disabilities) needing accommodation related to teaching and evaluation methods/materials. These services are made available to students in all Faculties and programs at York University.

Students in need of these services are asked to register with disability services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs. Please note that registering with disabilities services and discussing your needs with your professors is necessary to avoid any impediment to receiving the necessary academic accommodations to meet your needs.

Additional information is available at the following websites:

Counselling & Disability Services - <http://cds.info.yorku.ca/>

Counselling & Disability Services at Glendon - <http://www.glendon.yorku.ca/counselling/personal.html>

York Accessibility Hub - <http://accessibilityhub.info.yorku.ca/>

Ethics Review Process

York students are subject to the York University *Policy for the Ethics Review Process for Research Involving Human Participants*. In particular, students proposing to undertake research involving human participants (e.g., interviewing the director of a company or government agency, having students complete a questionnaire, etc.) are required to submit an *Application for Ethical Approval of Research Involving Human Participants* at least one month before you plan to begin the research. If you are in doubt as to whether this requirement applies to you, contact your Course Director immediately.

Religious Observance Accommodation

York University is committed to respecting the religious beliefs and practices of all members of the community, and making accommodations for observances of special significance to adherents. Should any of the dates specified in this syllabus for an in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course director immediately. Please note that to arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete an Examination Accommodation Form, which can be obtained from Student Client Services, Student Services Centre or online at

http://www.registrar.yorku.ca/pdf/exam_accommodation.pdf (PDF)

Student Conduct in Academic Situations

Students and instructors are expected to maintain a professional relationship characterized by courtesy and mutual respect. Moreover, it is the responsibility of the instructor to maintain an appropriate academic atmosphere in the classroom and other academic settings, and the responsibility of the student to cooperate in that endeavour. Further, the instructor is the best person to decide, in the first instance, whether such an atmosphere is present in the class. The policy and procedures governing disruptive and/or harassing behaviour by students in academic situations is available at - <http://secretariat-policies.info.yorku.ca/policies/disruptive-and-or-harassing-behaviour-in-academic-situations-senate-policy/>