

## Department of Biology Course Outline

### SC/BIOL 4410 3.00 Advanced Drosophila Genetics Fall 2015

#### 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. Vladimir (Kyle) Belozerov

**Contact:** Farquharson Bldg. Room 020B  
(416)736-2100 ext. 66643  
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'll meet with you in my office.

#### Schedule

**Lectures:** Fridays 11:30 pm – 2:30 pm; Ross South 174

#### Evaluation

*Midterm* (October 23, 90 min) **25%**

*In-class mini-quizzes* (10 total, in the beginning of every class, 10-15 min each) **20%**

*Research project* **20%** (due by December 4, 2015 at 5:30 pm)

*Participation in class discussions* **5%**

*Final* (cumulative) **30%**

#### Important Dates

First class – September 11, 2015

Last class – December 4, 2015

Drop deadline – November 9, 2015

Midterm – October 23, 2015

Project due – December 4, 2015 by 5:30 pm

Final - TBA

NOTE: for additional important dates such as holidays, refer to the "Important Dates" section of the Registrar's Website at <http://www.yorku.ca/yorkweb/cs.htm>

## 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.
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, including names and functions of key enzymes and protein complexes in the *Drosophila* RNAi pathway. 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 phenomenology of 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 the molecular mechanism of gene conversion, including key enzymes and Holliday junction intermediates. How does gene conversion result in non-Mendelian allele frequencies?
9. Explain every step in a homologous recombination experiment in *Drosophila*, including the structure of targeting and auxiliary transgenes, and their specific functions. Compare and contrast homologous recombination with classical mutagenesis and reverse genetic gene targeting.

## 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. Recombinases
14. Flippase
15. FLPout
16. Conventional FRT mosaics
17. MARCM
18. Twin-spot generator
19. Inverse PCR, and regular PCR for transgene localization
20. Deletion mapping
21. PCR to find classical mutations
22. Cytogenetic, linkage, and molecular maps
23. Meiotic recombination
24. Gene conversion
25. Genetic engineering by homologous recombination

### **Experiential Education and E-Learning**

#### **E-Learning components:**

- Moodle Website
- group work on practice problems (online forum)
- Extensive use of online databases and data visualization software, e.g. Pubmed, Flybase, BLAST, Cytoscape, DROID, DPim.

### **Other Information**

N/A

### **Course Policies**

1. If you are sick on the day of midterm, bring your attending physician's statement to me within 5 business days of the missed midterm. I will then schedule a makeup midterm for you.
2. If you know you will have to miss a class (for any reason, no documentation is necessary), e-mail me, and I will transfer the weight of the missed quiz and participation mark to your final. I will only do this if you e-mail me before the class you plan on missing.
3. 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!
4. 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.
5. Standard accommodation policies as set by the university will be followed in the course.
6. 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>

## University Policies

### **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](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/>