IB 472/CPSC 462: Plant Molecular Biology
Course Syllabus
Fall 2018

INSTRUCTOR

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COURSE INFORMATION

Place and time: 2083 Natural History Building, 3:00 - 3:50 pm, Monday and Wednesday, Aug. 27 – Oct. 17, 2018
Credit: 1 hour
Pre-requisites: IB150 Organismal and Evolutionary Biology
Requirements that course meets: Optional course for IB undergraduate and graduate students to learn genomics.

Course website: https://compass2g.illinois.edu/

Optional textbooks: If you would like a text as a general reference, consider either **Molecular Biology of the Cell**, 5th ed., B. Alberts, et al. (2008) or for a simpler and more general text that covers more about the mechanics of recombinant DNA technology, try **Recombinant DNA: Genes and Genomes - A Short Course** (Paperback), 3rd ed., J. Watson et al. (2006). Both of these are available (new and used at "reasonable" prices) at Amazon.com.

PDF files of recommended reading materials will be posted on the course website.

General information: Although "omics" approaches are revolutionizing basic and applied plant biological research, understanding the mechanisms by which gene expression is regulated and how gene products function often requires a one-gene-at-a-time (OGAAT) approach. This course provides an overview of selected topics that fall under the OGAAT as well as genome wide approaches. It will cover basic measurements of gene expression, mechanisms regulating transcription, and the construction of transgenic plants for addressing specific biological questions. This course will revolve around understanding experimental techniques and how they can be applied to understanding mechanisms that regulate gene expression. Specific learning outcomes include:

1. Understand fundamental features of eukaryotic genes.

2. Have full knowledge of plant DNA structure and organization.
3. Assess the main properties and functions of cis- and trans-acting factors.
4. Evaluate various forms of siRNA and miRNA.
5. Evaluate different approaches to quantify gene expression.
6. Explain the mechanisms of agrobacterium-mediated transformation.
7. Understand and appreciate targeted genome editing to improve crops.
8. Apply molecular biology techniques in research.

SUGGESTED LEARNING STRATEGIES FOR LECTURE

1. Read posted materials for the lecture.
2. Print lecture ppt file prior to each lecture.
3. Participate fully in all active learning exercises.
4. Learn definitions of all unfamiliar terms that appear in slides, and in the assigned reading.
5. Don't procrastinate on homework. Homework questions emphasize the most important concepts and skills that you will need to master in order to do well on exams.
6. Review figures in reading materials and on PPT slides to practice generating and interpreting figures. Pay particular attention to understanding how to interpret figures and tables.
7. Master all computational skills and data interpretation skills that are critical components of the scientific process; be able to apply these skills when confronting a new genetics problem.

GRADING AND ASSIGNMENTS

Homework Assignments: Two sets of homework problems consisting of short questions or calculations will be distributed on Sep. 17 and Oct. 8. You will have a week to prepare written answers to the questions (word-processed). Homework problems should be an individual effort since they account for 60% of the final grade. Homework assignments will be posted on the class web site.

Short Paper: A short review essay evaluating a research article on plant molecular biology should be submitted by October 8 for peer reviews. The essay should be prepared following the "News and Views" article style in Nature that summarizes and discusses the significance and places the work in a broader context.

Class Participation: Students are encouraged to participate in discussions in class, before or after class, or any time by e mail.

Grading policy and breakdown of final grade

40% Two sets of homework problems
40% Written essay (journal article evaluation); 'News & Views' style
15% Evaluation of three essays

5% Attendance

Guideline for writing the essay:

- Importance of the topic to the field
- The degree of advancement or breakthrough that adds value to the existing knowledge
- Substance and scope of the of research covered in the essay
- Clear and compelling conclusions
- Overall organization and clarity of writing

Grading criteria for the written essay:

Summary of findings in the article – accuracy, completeness (10 points)
Discussion – significance, context (20 points)
Technical merit – spelling and grammar (3 points)
Overall organization, clarity (5 points)
Citation of key references (2 points)

COURSE POLICIES

General:
This course will follow all policies in the Student Code: http://studentcode.illinois.edu/.

Academic Integrity:
This course will follow Article 3 of the Student Code http://studentcode.illinois.edu/article3_part1_3-101.html. This rule defines infractions of academic integrity, which include but are not limited to cheating, fabrication, and plagiarism. You are responsible for being knowledgeable what these infractions are for not following these guidelines. Plagiarism while writing the scientific manuscripts will be carefully monitored. If you do not feel you fully understand what constitutes plagiarism, see your TA or Ray Ming.

Attendance:
Your attendance at class is required and 1 point will be deducted for each missing lecture. The total deduction can exceed 5% of the final grade with no upper limit. The information covered in class will make up the majority of content on the homework assignments. Class starts promptly at 3:00 pm. "Things" happen, but please make every effort to be on time.

Late work:
Homework is due one week after the assignments are posted. A deduction of 10% of points is in effect for every week the assignment is late. If you are ill, please get a note

from your physician or the McKinley clinic and any missed deadlines will be changed by mutual agreement.

Writing assignment:
The final essay is due on Oct. 5. There is no grace period for this writing assignment. Plagiarism will result in a grade of 0 for the written essay.

Accommodation of disability:
If you require special accommodations, please contact Ray Ming. All accommodations will follow the procedures as stated in Article 1-110 of the Student Code (http://studentcode.illinois.edu/article1_part1_1-110.html)

Class schedule

Date	Day	Topic
Aug. 27	Monday	**Course Introduction, Plant DNA structure and organization I**
		A, B, Z, C, D, E forms of DNA
		DNA packaging
		Histon modification
		Chromatin remodeling
Aug. 29	Wednesday	**Fundamental features of eukaryotic genes**
		Intron-exon boundary
		Alternative splicing
		Exon reshuffling
Sep. 3	Monday	**Labor day**
Sep. 5	Wednesday	**Gene conversion**
		Non crossover gene conversion
		Crossover gene conversion
Sep. 10	Monday	**Cis-acting elements**
		Loss of function and gain of function experiments
		Enhancers and silencers
Sep. 12	Wednesday	**Trans-acting factors**
		Basal transcription factors
		Inducible transcription, site specific transcription factors
		Plant trans-acting factors
Sep. 17	Monday	**Yeast two-hybrid system**
		Yeast/bacterial/plant two hybrid system
		One hybrid analyses
Sep. 19	Wednesday	**microRNA**
		miRNA biosynthesis and function
		Diversity and conservation of plant miRNAs
		Evolutionary origin of miRNAs

Sep. 24	Monday	**siRNA and RNAi** Trans-acting siRNAs Diversification of small RNA pathways Biological functions of RNAi Homework 1 due at 11:59 pm
Sep. 26	Wednesday	**Measuring/quantifying gene expression I** Blot hybridization Nuclease protection essay Differential display
Oct. 1	Monday	**Measuring/quantifying gene expression II** Serial analysis of gene expression (SAGE) Cap analysis of gene expression (CAGE) Massively parallel signature sequencing (MPSS)
Oct. 3	Wednesday	**Measuring/quantifying gene expression III** RNA-seq Direct RNA sequencing
Oct. 8	Monday	**Reporter genes and selectable markers** β-Glucuronidase (GUS) Luciferase Green florescent protein (GFP Short essay due at 11:59 pm
Oct. 10	Wednesday	**Agrobacterium-mediated transformation (I)** The biology of Agrobacterium sp. Genetic engineering by Agrobacterium-mediated transformation
Oct. 15	Monday	**Agrobacterium-mediated transformation (II)** Floral dip Effect of various sugars on transformation Scientific and social concerns involving transgenic plants Homework 2 due at 11:59 pm
Oct. 17	Wednesday	**CRISPR/Cas9 and targeted genome editing** The biology of CAS9 CRISPR/Cas9 as a new tool in molecular biology