AGR 5307: Molecular Genetics for Crop Improvement

Spring Semester 2016, 3 credits
Monday (3108 McCarty B) Period 4; Wednesday (3108 McCarty B) Period 3 and 4; Friday (3096 McCarty B) Period 4
Instructor: Fredy Altpeter
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Laboratory-3062 McCarty D, Phone 273 3401
Contact Hours (in office): Period 5 after class and by appointment

Course Objectives:

Introduce into concepts and applied aspects of plant molecular and cellular biology that allow students to understand and discuss strategies for crop improvement through biotechnology.

Learning Outcomes:

After completion of this course the student will be able to:

1. Contrast and compare the organization, structure and control of prokaryote versus eukaryote genes.
2. Understand the details of gene expression control in prokaryotes and eukaryotes.
3. Describe eukaryotic posttranscriptional processing, initiation of translation and posttranslational modifications, subcellular targeting, stability and degradation of RNA and proteins.
4. Understand the fundamental concepts and techniques for the use of recombinant DNA technology, plant tissue culture, genetic engineering, gene expression, molecular characterization of plants and marker assisted breeding.
5. Understand the mechanisms, applications, regulatory and commercial issues of current and emerging biotechnologies including targeted regulation of (trans)gene expression, targeted gene silencing/RNAi, viral vectors, targeted genome editing (Zinc finger, TALEN, CRISPR/Cas9), intragenic, cisgenic biotechnologies for crop improvement.
6. Accomplishing the above course objectives will enable the students to apply these newly acquired skills in the critical evaluation of professional literature or scientific presentations in molecular genetics and biotechnology. The students will be able to evaluate these skills during the course while discussing selected recent plant biotechnology articles describing original research and during a case study

65 % of the course will be **lectures**
15 % of the course will be **laboratory demonstrations**
15 % of the course will be analysis and discussion of molecular crop improvement **papers**
5 % of the course will be a **case study on ethical aspects** of transgenic crops

Lectures:

Introduction into gene expression in prokaryotes and plants (transcription, translation, protein sorting, regulation of gene expression).
Methodology from isolating a gene to its targeted expression in transgenic plants. (Isolation of nucleic acids, vector and gene library construction, PCR, sequencing, database analysis, plant tissue culture, gene transfer, characterization of transgenic plants, expression profiling).
Transgene silencing, viral vectors and application for crop improvement and functional genomics.
Crop Biotechnology, past current and future.
Barriers and Paths to market for transgenic crops (regulatory and commercial aspects).
New Biotechnologies (intragenic, cisgenic, genome editing with zinc finger nucleases, TALEN, CRISPR/Cas9)
"Superweeds ?" When and how to introduce containment factors into crops.
Molecular markers in plant breeding.

Laboratory Demonstrations of Methodology:

Isolation of nucleic acids, vector construction, plant tissue culture, gene transfer, characterization of transgenic plants, blotting techniques, qRT-PCR

Papers: (each student will present one paper)

Recent original research articles describing molecular improvement of crops through biotechnology. Development of molecular markers, marker assisted breeding.

Case study on ethical aspects of transgenic crops:

Students will read and discuss conceptual papers reflecting the view on ethical aspects of transgenic plants of a specific group and students will present this view (not their own) for further group discussion.

Prerequisites:

AGR 3303 or PCB 3063

OUTLINE (subject to change)

Lec	Date	Topic	READINGS
Homework 1 due Jan 18th; Take Home exam on Gene Expression due Feb 1st			
1+ 2	1/6 3rd + 4th per.	Course Overview & Genome organization, Prokaryotic Transcription	**iGenetics 15--35; 81-86; 326-329** Current Opinion in Genetics & Development 2004, 14: 620-626
3+ 4	1/8+ 1/11	Regulation of Prokaryotic Gene Expression and Eukaryotic Transcription.	**iGenetics 491-507; 87-90**
5+ 6	1/13+ 1/15	Regulation of Eukaryotic Gene Expression; Precise Regulation of Gene Expression	**iGenetics; 518-531;** Plant Physiology 1998, 118: 1111-1120 European J of Biochemistry 2004, 271:2335-2349
7+ 8	1/20+ 1/22	Processing of Transcripts in Eukaryotes Translation, Protein Modification, Sorting and Degradation	**iGenetics 90-97; 102-124** Trends in Biochemical Sciences, 2003, 28:182-187 Current Opinion in Plant Biology 2004, 7: 171-181
Take Home exam due Feb 1st			
9+ 10	1/25+ 1/27	Methods I: Isolation of nucleic acids, cDNA synthesis, Restriction digest, Electrophoresis, Gene cloning, Hybridiz.	**iGenetics 171-183; 248-255; 261-263** PNAS 1974, 71: 1743-1747 Academic Radiology 2004 11: Suppl 1: S42-53 Plant Science 2004, 167: 491-498
11+ 12	1/29+ 2/1	Methods II (Gene libraries, PCR, Sequencing, Data analysis)	**iGenetics 183-199; 255-261; 263-265;** http://www.ncbi.nlm.nih.gov/Education/BLASTinfo/tut1.html Biochemistry and Molecular Biology Education 2000, 28: 274-276
13+ 14	2/3 3rd + 4th per.	Wet lab (location will be announced) DNA isolation, PCR, Gel electrophoresis	**iGenetics 171-183; 248-255; 263-265**
15+ 16	2/5+ 2/8	Methods III Tissue culture, Gene transfer, Analysis of gene integration and expression	**iGenetics 282-287; Plant Biotechnology and Genetics** 113-132; 245-272; Microbiology &. Molecular Biology Reviews 2003, 67: 16-37; Trends in Plant Science. 7: 84-91
17+ 18	2/10 3rd + 4th per.	Wet lab 3047 McCarty D Tissue culture, Gene Transfer	**iGenetics 282-287** http://ceprap.ucdavis.edu/Transformation/transform1.htm
19+ 20	2/12+ 2/15	Methods IV Gene Silencing (RNAi) and its applic. for genomics & crop improvement	**iGenetics 537-540** BMPB page 352-355' MCB 380 – 387; 393 Trends in Biotechnology 2004, 22: 463-469
21+ 22	2/17	Wet lab (location will be announced) Blotting techniques, qRT-PCR	**iGenetics 261-263** Academic Radiology 2004 11: Suppl 1: S42-53.
23+ 24	2/19+ 2/22	Methods V New Biotechnologies Intragenic, Cisgenic, Genome Editing (Zinc finger nucleases, TALEN, CRISPR/Cas9)	http://ftp.jrc.es/EURdoc/JRC63971.pdf Trends in Biotechnology 2013, Vol. 31, No. 7 Voytas and Gao 2014 http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1001877
25+26	2/24+ 2/26	Methods VI Mapping, Molecular markers	**iGenetics 401-417; 230-233; 269-280**
Homework 2 due March 4th			
SPRING BREAK 2/29, 3/2 and 3/4			
27	3/7	Review of methods section, answering student's questions	
	03/9	**In Class Exam on Molecular Methods, 3108 McCarty B, 3rd and 4th period**	
28+29	3/11+ 3/14	Crop Biotechnology	**iGenetics 243-265**
30	03/16	3 Papers presented by students and discussion	Will be assigned
31	03/23	3 Papers presented by students and discussion	Will be assigned
32	03/30	3 Papers presented by students and discussion	Will be assigned
33	04/06	Barriers and path to market for biotech crops	Plant Biotechn. Journal,2010,8:101–111
34	04/13	Ethical case study on "Golden Rice"	Will be assigned
		Final exam, date and location to be announced	

Suggested Text:

iGenetics – A Molecular Approach / P.J. Russell
Edition: 3rd
Published: San Francisco: Pearson, Benjamin Cummings, 2009.
ISBN-10: 0-321-56976-8

Molecular Cell Biology (**MCB**) / H. Lodish et al.
Edition: 7th ed.
Published: New York: Freeman and Company, 2012.
ISBN-10: 142923413X

Plant Biotechnology and Genetics / C.N. Stewart JR.
Edition: 2nd ed.
Published: John Wiley & Sons, 2016.
ISBN: 978-1-118-82012-4

Grading:

Grading will be based on two homework assignments (5% each) take home exam (15 %), in class exam (15 %), presentation of one assigned paper (20 %), presentation of case study paper (15%) and a final exam (25 %).

% of available marks	Grade
92-100	A
90-91.9	A-
88-89.9	B+
82-87.9	B
80-81.9	B-
78-79.9	C+
72-77.9	C
70-71.9	C-
68-69.9	D+
62-67.9	D
60-61.9	D-

Exam objectives:

Exam 1 (take home due: February 1st, 2016): Gene expression and regulation in prokaryotes and eukaryotes (genome organization, transcription, processing of transcripts, translation, protein folding and sorting, regulation of gene expression, degradation of RNA and proteins).

Exam 2 (in class March 9th, 2016): Concepts and techniques for the use of recombinant DNA technology, gene isolation, vector construction, plant tissue culture, genetic engineering, gene expression analysis, molecular characterization of plants, marker assisted breeding, mechanisms and applications of gene silencing for crop improvement, new biotechnologies.

Final exam (date to be announced): The final exam will evaluate the students' ability to apply the acquired skills in the critical evaluation of professional literature. A scientific article in plant molecular genetics/biotechnology will be handed to students at least 1 week before the exam. During the exam questions will address molecular concepts, molecular techniques, results and conclusions associated with the article.

Expectations:

Students are expected to be prepared and participate in class discussions, ask questions and push for clarity. Students are also expected to arrive on time to class and to have cell phones turned off.

CLASS POLICIES

ATTENDANCE- Students are expected to attend all classes. Students are required to e-mail the course instructor if they need to be excused from any lecture or laboratory. Any student who makes an appointment for any review session is required to be present five (5) minutes before the beginning of the session.

MAKEUP EXAMS- Make-up exams will be accepted only by special permission of the course instructor. Permission to make up work will be granted on a case by case basis and not all requests will be approved.

Academic Honesty, Software Use, UF Counseling Services, Services for Students with Disabilities

In 1995 the UF student body enacted an honor code and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

In adopting this honor code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the university community. Students who enroll at the university commit to holding themselves and their peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action. The quality of a University of Florida education is dependent upon community acceptance and enforcement of the honor code.

The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

On all work submitted for credit by students at the university, the following pledge is either required or implied: **"On my honor, I have neither given nor received unauthorized aid in doing this assignment."**

The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge is

diminished by cheating, plagiarism and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff and administrators who practice dishonest or demeaning behavior.

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean, Student Honor Council, or Student Conduct and Conflict Resolution in the Dean of Students Office.

(Source: 2010-2011 Undergraduate Catalog)

It is assumed all work will be completed independently unless the assignment is defined as a group project, in writing by the instructor.

This policy will be vigorously upheld at all times in this course.

Software Use:

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575,* **www.counseling.ufl.edu/cwc/**

  Counseling Services

  Groups and Workshops

  Outreach and Consultation

  Self-Help Library

  Training Programs

  Community Provider Database

- *Career Resource Center,* First Floor JWRU, 392-1601, **www.crc.ufl.edu/**

Students with Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodations. Students with disabilities should follow this procedure as early as possible in the semester