

APBI 235: Biotechnology in Agricultural Food Production
(3 credits)
Term 2, 2011/12

Faculty and Affiliations

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Course Description

An introduction to genetics, genomics, and biotechnology concepts with applications to agricultural food production and food safety. Applications of these concepts in the growing field of agriculture biotechnology will be discussed with specific examples in the fields of plant science, animal science, aquaculture, and food and environmental microbiology.

Learning Objectives

Students who enroll in this course will learn:

1. fundamental concepts in molecular biology (nucleic acid (DNA) and protein biochemistry, gene regulation) and genetics
2. genomics and approaches to genomic studies (basic concepts in systems biology research, gene sequencing, sequence bioinformatics, gene expression analyses, and molecular mapping)
3. biotechnology concepts including genetic modification (GM) and non-GM applications to agricultural food production
4. regulatory and ethical issues in biotechnology with a focus on Canadian policies

Learning Outcomes

Students will achieve a good working knowledge of the basics in molecular biology, genetics, and agricultural biotechnology. They will be able to implement knowledge gained to understand and critically evaluate the various uses of biotechnology in the production and enhancement of animal, plant, fish, and fermented food products. Students will further be enabled to better appraise ethical and regulatory issues associated with the use of agricultural biotechnology domestically and abroad.

Reading List

1. Required textbook: **Introduction to Biotechnology**, 2nd Edition. 2009. WJ Thieman, MA Palladino. Pearson/Benjamin Cummings (Publisher), ISBN 978-0-321-49145-9
2. Various web links and media articles to follow in support of biotech learning objectives - *n.b.* materials will be selected to provide *balanced* viewpoints towards biotechnology in agricultural food production.

Syllabus

Lecture 1: Course introduction and overview (Ch. 1) [SL, VM]

W 01-04

Fundamental Cellular Biology and Genetics

Lecture 2: Cell structure, chromosome structure, DNA replication (Ch. 2, pp. 26-38) [VM]

F 01-06

Lecture 3: Genetic mapping of traits [VM]

M 01-09

Lecture 4: RNA and protein synthesis; mutation causes and consequences (Ch. 2, pp.39-56)

W 01-11 [VM]

Lecture 5: Proteins as products (Ch. 4) [VM]

F 01-13

Enter the Genome Era

Lecture 6: Genomics and systems biology concepts - think big [SL]

M 01-16

Lecture 7: Genome sequencing and bioinformatics (Ch. 3, pp. 68-71; 78-80) [SL]

W 01-18

Lecture 8: Functional genomics – Expression profiling and gene discovery [SL]

F 01-20

Lecture 9: Molecular markers and genetic mapping [SL]

M 01-23

Agricultural Biotechnology – Genetic Engineering

Lecture 10: Molecular biology toolbox – Recombinant DNA technology (practical features of vectors; restriction enzymes, PCR, cloning PCR products) [VM]

W 01-25

Lecture 11: Molecular biology toolbox – Control of gene expression *in vivo* (promoters, promoter activity, altering gene expression levels) [SL]

F 01-27

Lecture 12: Class exercises in gene cloning [SL, VM]

M 01-30

- Lecture 13: Genetic engineering in animals and plants (expression constructs, gene delivery systems) [SL]
W 02-01
- Lecture 14: Assaying genetic engineering outcomes (transgene copy number, expression levels, phenotype; ‘substantial equivalence’ concept) [SL]
F 02-03
- Lecture 15: Review and discuss lectures 1-14 [SL, VM]
M 02-06
- Lecture 16: **MIDTERM EXAM** **Wednesday February 08**
- Lecture 17: Guest lecture on applications of natural plant products to pest control
F 02-10 (*Dr. Murray Isman, Dean, Faculty of LFS*)
- Lecture 18: Guest lecture on biomarker technologies for agricultural food production and food safety monitoring (*Dr. Kevin Allen, Faculty of LFS*)
M 02-13
- Lecture 19: Student led discussion on non-GM biotechnology applications to food production
W 02-15
- Lecture 20: Genetic engineering – Applications to fermentation product improvement [VM]
F 02-17 (Ch. 5, pp. 127-135; 141-144)

--WINTER BREAK--

- Lecture 21: Student led discussion on microbial biotech
M 02-27
- Lecture 22: Genetic engineering – Applications to agricultural crop improvement (Ch. 6, pp. 156-170) [SL]
W 02-29
- Lecture 23: Student led discussion on crop biotech
F 03-02
- Lecture 24: Genetic engineering – Applications to livestock improvement (Ch. 7, pp. 172-188) [SL]
M 03-05
- Lecture 25: Guest lecture on biotech in livestock productivity (*Dr. Ronaldo Cerri, Faculty of LFS*)
W 03-07
- Lecture 26: Student led discussion on biotech in livestock production
F 03-09

- Lecture 27: Genetic engineering – Applications to aquaculture improvement (Ch. 10, pp. 232-244; (omit section on GFP) 245-259) **[VM]**
M 03-12
- Lecture 28: Guest lecture on aquaculture (*Dr. Robert Devlin, Centre for Aquatic Biotechnology Regulatory Research (CABRR), Fisheries and Oceans Canada, West Vancouver, BC*)
W 03-14
- Lecture 29: Student led discussion on aquaculture
F 03-16
- Lecture 30: Genetic engineering – Applications to bioremediation (Ch. 9, pp. 209-230) **M**
03-19 **[VM]**
- Lecture 31: Guest lecture on biotechnology in bioremediation (*Dr. William Mohn, UBC Department of Microbiology and Immunology*)
W 03-21
- Lecture 32: Student led discussion on bioremediation
F 03-23
- Lecture 33: --no class--
M 03-26
- Lecture 34: Biotechnology policy 1 – Regulating biotechnology innovations (Plants with Novel Traits, food labeling, health and environmental concerns) **[SL]**
W 03-28
- Lecture 35: Values and ethics in agricultural biotechnology (Ch. 13; pp. 325-342; *Dr. Robin Downey, Genome British Columbia, Vancouver, BC*)
F 03-30
- Lecture 36: Biotechnology policy 2 – Intellectual property issues associated with biotechnology innovations (*Dr. Emily Marden, UBC Sauder School of Business*)
M 04-02
- Lecture 37: Student led discussion on IP and safety in ag biotech
W 04-04

-- Classes end --

FINAL --date/time/location to be announced--

Evaluation

Exams. Students will be assessed on their knowledge of the material covered in the lectures through one Midterm exam and one Final written exam. The exam format will be multiple choice and short answer. The mark breakdown is 40% of the final score for each exam.

Assignment. Students will each write one short essay on any aspect of agricultural biotechnology related to topics covered in lectures 17 through 36. Content should include: 1) a historical perspective of the selected topic; 2) presentation of current uses of biotechnology and associated technologies; 3) current and anticipated ethical, economic, environmental, and/or legal issues; and 4) a section on the student's perspectives on the topic (your chance to make and defend your stance!). The essay is to be approximately 1,000 words in length in Times New Roman 12 point font with double line spacing. The essay is due on the final day of class, April 04, by 2 pm and will constitute 10% of the final score for the course.

Discussion group. Students will work in small teams of 3 to 4. The team will summarize lecture and text information, as well as present additional information obtained from publications, websites, or other media that team members deem to be pertinent. Team members will present a 10 minute summary in class using Powerpoint slides and then lead a class discussion using prepared questions. Each team member will be evaluated on his/her presentation quality, poise, clarity, and ability to engage fellow students in discussion. The evaluation score will constitute 10% of the final score for the course.