

SOCR 430, Applications of Plant Biotechnology

Fall 2012

Time/Place: Mon., Wed., Fri. 2-2:50 pm. W212 Plant Science Bldg.

Instructors: Dr. Pat Byrne, 970-491-6985, C131 Plant Science, Patrick.Byrne@colostate.edu
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Text: None required. Reading materials will be placed on RamCT. If you want to buy a good book on many topics we will cover, consider Dale et al., 2012, in the References list, ~\$47 on Amazon (be sure to get the 3rd edition, 2012).

Objectives: Students who take this course will

1. Become aware of the range of uses of plant biotechnology, including gene mapping, marker-assisted selection, technical and societal issues concerning transgenic crops, functional genomics, and genetic diversity studies.
2. Understand the advantages and disadvantages of different molecular marker systems used for DNA analysis.
3. Learn how genes controlling qualitative and quantitative traits are identified and characterized.
4. Understand how and why foreign genes are inserted into crop plants.
5. Be able to discuss benefits and risks associated with transgenic crops, and the regulation of those crops in the U.S.
6. Gain experience in written and oral communication concerning plant biotechnology.
7. Know how to obtain information about plant biotechnology issues through print and Internet resources.

Required activities: Students in this course are expected to

- Attend and participate in class.
- Read the assigned materials.
- Complete occasional short written and oral homework assignments.
- Complete two in-class exams and a final take-home exam.
- Write a term paper (~10 pages, double spaced) on some aspect of plant biotechnology.
- Participate in groups of 2 or 3 students to give a class presentation.

Encouraged activities. The following will help you learn more:

- Ask questions during lectures.
- Ask questions outside of lectures. Talk to the instructors after class or make an appointment.
- Attend seminars on campus in the area of plant biotechnology.
- Read beyond the assigned readings.
- Spend time exploring on-line resources related to biotechnology and genomics.

Grading:	Two in-class exams	15% each
	Final take-home exam	20%
	Homework assignments	15%
	Group presentation	10%
	Term paper	15%
	Participation in class and online	10%

Schedule of topics

Date	Topic	Reading
Aug. 20	Introductions and expectations; Plant genomes	Gene to Genomes, Ch. 1; Leitch & Leitch, 2008
Aug. 22	DNA extraction	Gene to Genomes, Ch. 2
Aug. 24	Marker principles and techniques; RFLPs	Genotyping Tools in Plant Breeding
Aug. 27	PCR, RAPDs, AFLPs	Gene to Genomes, Ch. 4; Genotyping Tools in Plant Breeding
Aug. 29	SSRs, DARts, SNPs	“ “
Aug. 31	Using markers for genetic diversity studies	
Sep. 3	Labor Day	
Sept. 5	Marker comparisons	
Sept. 7	Using markers for genetic mapping	
Sept. 10	Field trip: Dr. Byrne's marker lab	
Sept. 12	Quantitative trait locus (QTL) analysis 1	Online lesson, Plant and Soil Sciences eLibrary
Sept. 14	QTL analysis 2	Online lesson, Plant and Soil Sciences eLibrary
Sept. 17	QTL analysis 3	
Sept. 19	Bulk segregant analysis; Marker-assisted selection	
Sept. 21	Tissue culture	
Sept. 24	First exam	
Sept. 26	Methods for developing transgenic plants: promoters, selectable markers	
Sept. 28	Methods for developing transgenic plants: gene transfer	
Oct. 1	Insect resistant transgenic crops	
Oct. 3	Topics for term papers due Herbicide tolerant transgenic crops	
Oct. 5	Field trip: Dr. Dan Bush's lab, Biology Department	
Oct. 8	Transgenic crops for stress tolerance	
Oct. 10	Transgenic crops for health and nutrition	
Oct. 12	Phytoremediation	
Oct. 15	Health risks of transgenic crops	
Oct. 17	Environmental risks of transgenic crops	
Oct. 19	Outline for term paper due Explain group presentation scenarios; Regulation of transgenic crops	

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Oct. 22	Gene silencing, RNAi, VIGS	
Oct. 24	No class	
Oct. 26	Second exam	
Oct. 29	Gene silencing (continued); Reports from ASA meeting; Group presentation scenarios; The era of omics	
Oct. 31	Transcriptomics	
Nov. 2	Proteomics	
Nov. 5	Functional genomics (Rice seed size analysis)	
Nov. 7	Field trip: Dr. Jan Leach's lab, Functional genomics for disease resistance	
Nov. 9	Metabolomics	
Nov. 12	DNA sequencing; Genotype by sequencing	
Nov. 14	Field trip: CSU Proteomics and Metabolomics Facility	
Nov. 16	Bioinformatics	
Nov.19-23	Thanksgiving week	
Nov. 26	Bioinformatics (Shepardson 218 computer lab)	
Nov. 28	Term papers due; Take-home final exam distributed Group presentation	
Nov. 30	Group presentation	
Dec. 3	Group presentation	
Dec. 5	Group presentation	
Dec. 7	Final points, wrap-up, evaluation	
Dec. 10-14	Final exam week	
Dec. 12	Take-home final exam due	

Optional field trip: Cargill Specialty Canola Oils, Fort Collins, 2 hours

A few references on Plant Biotechnology

Chrispeels, M.J., and D.E. Sadava. 2003. **Plants, Genes, and Crop Biotechnology**. Jones and Bartlett, Sudbury, MA.

Christou, P., and H. Klee (editors). 2004. **Handbook of plant biotechnology**. John Wiley & Sons, Hoboken, N.J. In the Morgan Library Reference section.

Dale, J.W., M. von Schantz, and N. Plant. 2012. **From genes to genomes: Concepts and applications of DNA technology**. 3rd ed. John Wiley & Sons Ltd., New York.

Ferry, N., and A.M.R. Gatehouse. 2009. **Environmental impacts of genetically modified plants**. CABI, Wallingford, UK

Jain, S.M., and D.S. Brar. 2010. **Molecular techniques in crop improvement**, 2nd ed. SpringerLink E-Book.

Henry, R.J. (ed). 2006. **Plant conservation genetics**. Food Products Press, New York.

- Kesan, J.P. (ed). 2007. **Agricultural biotechnology and intellectual property: seeds of change**. CABI, Wallingford, UK; Cambridge, MA.
- Kole, C., C.H. Michler, A.G. Abbott, and T.C. Hall (ed.). 2010. **Transgenic Crop Plants**. Vol. 1. Principles and Development; Vol. 2. Utilization and Biosafety. Springer. SpringerLink E-Book.
- Lorz, H., and G. Wenzel. 2005. **Molecular marker systems in plant breeding and crop improvement**. Springer-Verlag, Berlin; New York.
- Morot-Gaudry, J.-F. et al. (ed). 2007. **Functional plant genomics**. Science Pub., Enfield, NH. Murphy, D. 2007. **Plant breeding and biotechnology: societal context and the future of agriculture** Cambridge University Press, Cambridge, UK.
- Newbury, H.J., 2003. **Plant molecular breeding**. Blackwell & CRC Press, Oxford; Boca Raton, FL.
- Paarlberg, R. 2008. **Starved for science: how biotechnology is being kept out of Africa**. Harvard Univ. Press, Cambridge, MA.
- Primrose, S.B., and R.M. Twyman. 2009. **Principles of gene manipulation and genomics**, 7th ed. John Wiley & Sons, Ltd, Chichester, UK.
- Ronald, P.C., and Adamchak, R.W. 2008. **Tomorrow's table: Organic farming, genetics, and the future of food**. Oxford Univ. Press, Oxford, UK.
- Shetty, K., et al. (ed). 2007. **Functional foods and biotechnology**. CRC/Taylor & Francis, Boca Raton, FL.
- Sharma, H.C. 2009. **Biotechnological approaches for pest management and ecological sustainability**. CRC Press, Boca Raton, FL.
- Slater, A., N.W. Scott, and M.R. Fowler. 2008. **Plant biotechnology: The genetic manipulation of plants**. 2nd ed. Oxford University Press, Oxford, UK.
- Weising, K., et al. 2005. **DNA fingerprinting in plants: principles, methods, and applications**, 2nd ed. CRC Press, Boca Raton, FL.

Some agricultural biotechnology web sites

Educational Portal: <http://education-portal.com/academy/course/introduction-to-biology.html>. Freely accessible lessons on a variety of biology topics.

Information Systems for Biotechnology: <http://www.nbiap.vt.edu/> Click on "News", then on "Subscribe to the ISB News Report". Select "Please sign me up to receive the ISB News Report electronically". Fill in the contact info, then click "Submit".

Crop Biotech Update, <http://www.isaaa.org/kc/cropbiotechupdate/>. To subscribe to the weekly update email, click on "Subscribe" on the menu on the left side of the screen.

Transgenic Crops: An Introduction and Resource Guide. CSU Soil & Crop Sciences Department. Overview of GM crops, animations, and extensive list of links.
<http://cls.casa.colostate.edu/TransgenicCrops/>.

Union of Concerned Scientists: http://www.ucsusa.org/food_and_agriculture/ .
Critical of transgenic crops, but more responsible than many such web sites.

The Center for Food Safety: <http://www.centerforfoodsafety.org/> Advocacy group that is strongly opposed to genetically engineered crops.

Plant and Soil Sciences eLibrary: <http://plantandsoil.unl.edu/croptechnology2005/pages/index.jsp>
This site from the University of Nebraska at Lincoln provides information on many aspects of agricultural biotechnology, organized in lesson format.

SciDev.Net: <http://www.scidev.net> News, views, and information about science, technology, and the developing world. Has a section on Agri-Biotech under Agriculture and Environment.

Academic Integrity: From the CSU General Catalog

“The foundation of a university is truth and knowledge, each of which relies in a fundamental manner upon academic integrity and is diminished significantly by academic dishonesty. Academic integrity is conceptualized as doing and taking credit for one’s own work. A pervasive attitude promoting academic integrity enhances the sense of community and adds value to the educational process. All within the University are responsible for and affected by the cooperative commitment to academic integrity.”

This course will adhere to the Academic Integrity Policy of the Colorado State University General Catalog, <http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf> (scroll down to p. 7) and the Student Conduct Code, Article III, <http://www.conflictresolution.colostate.edu/conduct-code>.

The principles and practices of academic honesty will apply to all components of this course: written assignments, online and in-class discussions, and presentations. Plagiarism is of particular relevance in a writing-intensive course like this one. Excerpts from a recent journal editorial addressing the issue are quoted below (Day et al., 2012. Biosystems Engineering 111:1).

“Plagiarism, the practice of taking someone else’s work or ideas and passing them off as one’s own, and its ancillary self-plagiarism, in which individuals republish work that they have already published, represent significant challenges to scientific journals. Authors have a right to be acknowledged as the source of their own work, and new authors must present their work in their own words.”

“... journals expect papers to be written in the author’s own words. It is their interpretation of the science that is important, and using their own words demonstrates understanding, so significant strings of words should not appear from other published works. Of course some repetition will arise by chance and some because standard phrases or descriptions of equipment or methods need to be reused. However this is not a justification for extracting text from the introduction, review, results or discussion of other papers. If it is important to use the actual words of another author, they should be put in quotation marks and be clearly referenced.”

Some links to information on academic integrity and plagiarism are as follows:

Practicing Academic Integrity: <http://learning.colostate.edu/integrity/index.cfm>

Ways to Avoid Plagiarism: http://learning.colostate.edu/integrity/ways_to_avoid.cfm

Writing Guide: Understanding Plagiarism:

<http://writing.colostate.edu/guides/researchsources/understandingplagiarism/index.cfm>