

Botany 3303 - Plant Genetics -Fall 2009

Prerequisites: Botany LS1105 or Botany SI2104 or Micro LS/SI2054, Chem PS/SI1050 or SI1120 or 2310, Math QL1050 or QL1080

Lecture/Lab: TuTh, 9:00-10:50

Instructor: Dr. S. Harley; Office: SL409M, 626-7434; e-mail: sharley@weber.edu

Office hours: MWF 10:30-11:20, TuTh 11:00-11:50, or by appointment

Course Web Site: <http://faculty.weber.edu/sharley/3303/3303.htm>

Catalog description: The principles of classical (Mendelian) and molecular genetics as applied to plants.

Plant Genetics is scheduled to meet four hours a week for lectures, videos, and various activities related to principles of heredity and molecular genetics as applied to plants. The course begins with consideration of the rules of inheritance and the mathematical descriptions of these rules. From there, the course moves to the molecular mechanisms of gene expression. Then, the methods of recombinant DNA technology are covered, both the mechanical aspects of these techniques and the consequences. Finally, the emerging -omics fields, such as genomics and proteomics, are introduced.

Course goals:

- ◇ To acquire a firm grounding in the rules of Mendelian heredity.
- ◇ To be able to apply statistics to the study of Mendelian heredity.
- ◇ To appreciate the roles of non-Mendelian heredity.
- ◇ To appreciate the interplay between plant reproductive strategies and heredity.
- ◇ To appreciate the critical roles of DNA in constructing life as we know it.
- ◇ To be able to explain the cellular processes, including regulatory aspects, of DNA replication and gene expression.
- ◇ To understand the principles and explain the techniques associated with production of transgenic plants.
- ◇ To be able to articulate and think critically about issues (agricultural, ecological, social, ethical, etc.) associated with transgenic plants.
- ◇ To appreciate the role of plant genetics, as represented by plant breeding and transgenic plants, in the development of agriculture, both historically and currently.
- ◇ To understand the importance of model systems in studying various aspects of organisms, including genetics, development, physiology, and reproduction.
- ◇ To appreciate that the science disciplines are not static; new fields of study open as various technologies provide new ways to acquire or analyze information about organisms.
- ◇ To use the information and experiences in this course to further develop and enhance your Botany Student Portfolio.

Required texts and materials:

CD with notes, figures, problem sets, and class activities. (The CD will be handed out the first day of class.)

Watson JD. *The Double Helix*. Norton Critical Edition, ed. by Gunther S. Stent.

A calculator capable of determining standard deviation (two variable statistics).

Supporting materials:

If you still have your general botany textbook, please make use of it. If you have a genetics book from a course you took in another department, the same applies. Plant Genetics is an upper division course; by now you should know how to use the index and expanded table of contents of a textbook to locate reading material that matches lecture material.

Recommended web sites

Visit the Botany 3303 Home Page (<http://faculty.weber.edu/sharley/3303/3303.htm>) to access links to recommended web sites.

Students with disabilities

Any student requiring accommodations or services due to a disability must contact Services for Students with Disabilities (SSD) in room 181 of the Student Services Center. SSD can arrange to provide course materials in alternative formats, if necessary.

Lecture Outline (subject to change)

Each topic has a lecture note (PDF) or PowerPoint file on your CD. Most topics also have a PDF file of problems. There are links to Adobe's free Acrobat Reader (for PDF files) and Microsoft's free PowerPoint Viewer at the course home page.

1. Introduction
Why a genetics class that focuses on plants?
2. Genetics Pre-Mendel, Gregor Mendel, and Genetics Post-Mendel
3. Nuclear Division Processes (Mitosis and Meiosis) and the Cell Cycle
4. Angiosperm Life Cycle
Gametophytes and Sporophytes, Gametes and Spores
5. Monohybrid Cross
6. Dihybrid Cross (including epistasis)
7. Statistics: Probability and Goodness of Fit
Chi-Square Analysis

End of material to be covered on the first exam.

8. Polygenic Inheritance and More Statistics
Mean, Standard Deviation
9. Linkage, Crossing Over, and Chromosome Mapping
Three Point Crosses

10. Genetic Aspects of Reproduction in Plants
 - Sexual Reproduction
 - Asexual Reproduction
11. Cytoplasmic inheritance (Extranuclear Inheritance)

End of material to be covered on the second exam.

12. The big debate: What is the chemical nature of the gene?
 - Protein vs. DNA: Griffin
 - Avery, MacLoud, and McCarty
 - Hershey and Chase
13. The winner: DNA
 - The structure of DNA: Chargaff, Watson and Crick, Wilkins, Franklin
14. How cells work with DNA
15. The stability (or lack thereof) of the genome
 - Mutations
 - Transposable elements: Barbara McClintock
16. Recombinant DNA
 - Gene Libraries - genomic, cDNA; Analysis
17. Agriculture and Plant Genetics
 - Conscious and Unconscious Selection of Traits
 - Traditional Plant Breeding
 - The Green Revolution: Then and Now
 - Transgenic Plants
18. Model Systems, Genome Sequencing Projects, and the rise of -omics
 - Arabidopsis thaliana*
 - rice
 - black cottonwood
 - Bioinformatics: Genomics, Proteomics, Metabolomics, ...
19. Applications of Molecular Biology Techniques
 - RFLP Analysis
 - DNA Bar Codes

End of material to be covered on the final exam.

Class Activities

PDF files for all activities are on your CD.

Lab Activities:

Cell Cycle
Leaf Phenotype Analysis
X² Analysis
Tissue Culture
DNA Isolation
Electrophoresis
Enzyme Induction

Paper Simulations:

Gene Expression
Microarray Analysis
Genetic Engineering

Videos:

Class web site has links to support materials for all three videos.

Nova: The Secret of Photo 51 - The Rosalind Franklin side of the story of the discovery of the structure of DNA.

Nova-Frontline Special: Harvest of Fear - Detailed consideration of issues surrounding GMOs. PDF of review questions on your CD.

Nova: Seeds of Tomorrow - 20 years old and still relevant. PDF of review questions on your CD.

Reading Assignments with Writing to Learn Components:

TBA

Quizzes

There will be 6-8 quizzes. The quiz questions will be drawn from the problems on your CD.

Written Assignments

All written assignments that you do outside of class are to be typed (word processed), double spaced, with one inch margins and 12 point font (Times New Roman). Any graphs are to be prepared on a computer.

Book Review of *The Double Helix* by James D. Watson

At a minimum read *The Double Helix* as well as the preface material, the original research papers, the "Three Other Perspectives," Stent's review of the book reviews, and at least three of the book reviews in the Norton Critical Edition of *The Double Helix*. A reader's guide written by Kenneth Miller at Brown University is available on your CD as **Reader's Guide to The Double Helix.htm**. The author of one of the book reviews denied permission to include his review in the Norton Critical Edition, although three responses to that review are included. The review was published in *Science*, so I have included it on your CD as **double_helix-chargaff_review.pdf**.

To provide you with additional information about the events surrounding and following the elucidation of the structure of DNA, you will be also have a PDF file of two chapters from Francis Crick's book, *What Mad Pursuit*. Also, your CD has PDF files of one of Rosalind Franklin's obituaries and a short remembrance by her sister written fifty years after Franklin's death. Finally, we will watch a video in class, "Photo 51." The course home page has a link to PBS's web site on "Photo 51."

Information about writing book reviews will be presented in class. Links to online resources on how to write a review are on the course home page.

Essay

In your Botany Student Portfolio, you are to include an essay in which you address the core concepts in Plant Biology given below. In that essay, you need to support your information with specific examples, graphs, lists, etc. For this class you are to write an essay that focuses specifically on the genetic aspects of the core concepts. Be sure to cite any references that you use. Italics indicate areas directly addressed in Plant Genetics; parentheses indicate areas that are indirectly addressed.

- a) Plants are like other organisms in regard to: basic metabolism, *sexual reproduction*, *clonal reproduction*, (hormonally regulated development), (ability to respond to the environment), (diversity), and *evolution*.
- b) Plants are unique organisms in: *their varied life histories - especially a sporic one with alternation of generations*; their role are primary producers in food webs, serving as the interface organisms between the organic and inorganic worlds via mineral assimilation and photosynthesis; and the oxygenation of the atmosphere.
- c) *Plants serve as an important source of products: food, fiber, flavorings, feed, fuel, pharmaceuticals, etc.*

Grade Calculation

Exams	45%
Activities and Quizzes	35%
Book Review	10%
Essay	10%

Percentages to achieve specific grades are as follows:

A = 93-100	B = 83-86.9	C = 73-76.9	D = 63-66.9
A- = 90-92.9	B- = 80-82.9	C- = 70-72.9	D- = 60-62.9
B+ = 87-89.9	C+ = 77-79.9	D+ = 67-69.9	E ≤ 59.9

BTNY 3303. Plant Genetics. Activity Schedule (subject to change).

Week	Tuesday	Thursday
1	Aug 25	Aug 27
2	Sept 1	Sept 3 Lab: Cell Cycle
3	Sept 8	Sept 10
4	Sept 15 Lab: Fast Plants, Day 1	Sept 16 Lab: Fast Plants, Day 2
5	Sept 22 Lab: Chi Squared Analysis	Sept 24 Exam 1
6	Sept 29	Oct 1 Lab: Tissue Culture
7	Oct 6	Oct 8
8	Oct 13	Oct 15 Video: Seeds of Tomorrow
9	Oct 20 Video: The Secret of Photo 51	Oct 22 Lab: Isolation of Onion DNA
10	Oct 27	Oct 29. Book review of <i>The Double Helix</i> Due. Lab: Electrophoresis
11	Nov 3 Exam 2	Nov 5. Draft of essay due. Simulation: Gene Expression
12	Nov 10. Lab: Set up Enzyme Induction	Nov 12. Lab: Collect data for Enzyme Induction
13	Nov 17	Nov 19 Simulation: Microarray Analysis Lab: Terminate Tissue Culture
14	Nov 24. Video: Harvest of Fear	Nov 26. Thanksgiving - no class
15	Dec. 1. Essay due. Simulation: Genetic Engineering	Dec. 3
Finals	Dec 8 (Tuesday), 9:30-11:20. Exam 3.	