

Biology 3322/5332, Section 001. 3 credit hours.

Plant Genetics, Fall 2016 Semester.

10:00 to 10:50 AM, MWF, Biology Life Sciences, Room 342

Prerequisites: Biology 2296 (Genetics) or equivalent.



Plant Genetics examines the current molecular and genetic analyses of the genetics of higher plants, with an emphasis on *Arabidopsis* and maize. Topics include plant reproduction, self-incompatibility, polyploidy in plants, chloroplast genetics, plant viruses, DNA and histone methylation and epigenetics, insertional elements, transposon tagging, RNA silencing in plants, plant genomics, embryonic pattern formation in plants, genetic engineering of monocot and dicot plants, chemical signaling in plants, leaf morphogenesis, flower development, and stem cell populations in plants.

Instructor: Gregory Smutzer, Ph.D. Phone: 215 204-1236

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Office Hours: 11 AM – 1 PM MWF, or by arrangement. Please e-mail me if you wish to meet at times outside of office hours.

Textbook: No textbook is required.

1. Thirteen scientific articles are posted on Blackboard in pdf format. The five readings in bold are **required** reading.
2. A chapter in **Developmental Biology, 8th edition**, By Scott F. Gilbert, Chapter 20 on Plant Development is required reading. 6th edition of Gilbert's textbook is accessible via NCBI website (<http://www.ncbi.nlm.nih.gov/sites/entrez?db=Books>), and chapter is also posted on course Blackboard site.
3. **"Patterns in Plant Development"** (2nd edition, 1989) by Steeves and Sussex is on reserve in SEAL for background information. The Steeves and Sussex book is an excellent reference on plant development.
4. **Problem Sets:** At least one problem set will be posted on the Blackboard site each week. Please make sure that you complete each problem set before each lecture exam. Schaum's Outlines of Genetics (McGraw Hill) is an excellent reference for the problem sets. Either the 3rd, 4th or 5th edition would be useful for this course. **Parts of the fourth edition are online.**



Grading: Two exams and a final exam will be given during the fall semester. Several homework assignments will be required, and will represent 3% of your final grade. Announced quizzes will equal 3% of your final grade. In addition, a three to five-page term paper is required on some aspect of higher plant genetics and development. Each exam is worth 30% of your final grade. Exams will be multiple-choice, short answer, discussion

questions, and problems. The final exam will not be cumulative. The written term paper will be due on Friday December 12th.

Exam 1	30% - Exam will start at 9:55 AM
Exam 2	30% - Exam will start at 9:55 AM
Final Exam	30% - Please note that exam starts at 8 AM.
Homework, in-class Assts.	2%
Quizzes	3%
Term Paper	5%-7% (Four pg. maximum including 300 word summary, references, 1.5 line spacing. Required. Failure to turn in a term paper [both written and electronic] will result in a failing grade for the course.)

Makeup exams: If an hourly exam is missed due to medical or legal reasons, documentation is required. If a medical or legal excuse is not presented, then a missed exam will result in a grade of zero percent. If an exam is missed for a medical or legal reason, then a makeup exam will be administered within one week of the scheduled exam.

Final Exam: Classes end on Monday, December 12th. Our last lecture is Monday, Dec. 12th. Tuesday, Dec. 13th and Wednesday Dec. 14th are study days. Final exam week starts on Thursday December 11. The final exam for lecture will be held in Room 342 BLS on Friday, Dec. 12 starting at 8:00 AM. Please do not ask to take the exam earlier than the scheduled date.

10:00 – 10:50 AM M W F	Friday 12/16	8:00 - 10:15 AM
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Withdrawals. Monday, September 12th, is the last day to withdraw from a course (without a W grade). Tuesday, October 25th is the last day to withdraw from an undergraduate course (with a W grade).

Cell Phones. Please turn off all cell phones and pagers before the start of each class.

Temple e-mail account. You can obtain an e-mail account online. Go to: <http://www.temple.edu/cs/>, and press "activate account." You can instantly obtain a Temple e-mail account.

Accommodation.

Any student who has a need for accommodation based on the impact of a disability should contact Disability Resources and Services at 100 Ritter Annex (003-00), 1301 Cecil B. Moore Ave., Philadelphia, PA 19122. The phone number is 215-204-1280. Please fill out the form for accommodation. Accommodations will be made for students with documented disabilities.

Attendance. Attendance is expected at lecture, and attendance will be taken during each class.

Academic Integrity

All relevant Temple University policies regarding Academic Integrity must be followed. These policies include no cheating, no plagiarism and reporting any knowledge thereof. Handbook, or the appropriate web-page (<http://oll.temple.edu/ih/writing/plagiarism2.htm>) for further information.

Student learning outcomes. Plant genetics examines the current molecular and genetic analyses of the genetics of higher plants, with an emphasis on *Arabidopsis* and maize. Topics include DNA methylation and epigenetics, insertional elements, transposon tagging, embryonic pattern formation in plants, chemical signaling in plants, leaf morphogenesis, flower development, chloroplast genetics and chloroplast transport, RNA silencing in plants, stem cell populations in plants, self-incompatibility, phytochromes, genetic engineering of monocot and dicot plants, flowering, and plant development.

Assessment: Basic knowledge of these facts, processes, and concepts will be quantitatively assessed through the use of lecture exams, homework assignments, quizzes, and a four-page term paper with abstract and scientific references.

Lecture topic

Suggested and Required Readings on Blackboard

Module One: Plant Reproduction and Development

Principles of Plant Development

Double Fertilization in Flowering Plants

Plant life Cycles, developmental genes

Plant Embryogenesis

Plant Hormones in Development – Auxins

Self-Incompatibility in Plants

Sex Chromosomes in Plants – Papaya, White Campion

(A). Gilbert *Devel. Biol.*, Ch. 20, pp. 627-630 (8th ed.)

(B). Walbot & Evans, *Nature Rev. Genet.* 2003, pp. 369- 371 only. Posted on Blackboard.

(A). Gilbert, *Develop. Biol.* Chapter 20, pp. 637-639.

(A). Gilbert, *Develop. Biol.* Chap. 20, pp. 627-630.

(A). Gilbert, *Devel. Biol.* Chap. 20, pp. 631-632.

(C). Vyskot and Hobza, *Trends in Genetics* 2004

(B). Walbot & Evans, *Nature Rev. Genet.*, pp. 372-373

Module Two: Plant Chromosomes and Polyploidy

Polyploidy in plants, Autopolyploidy, Allopolyploidy

Amphidiploids – *Raphanobrassica*

Triticale, wheat polyploids

Genome plasticity and polyploidy

Nucleolar Dominance

Monoploid Plants, Plant Hybrids

(D). Hulse & Spurgeon, *Scientific American*, 1974

(E). Dubcovsky and Dvorak, *Science*, 2007

Breakage-Bridge-Fusion Cycle in Plants
 Recombination in Corn
 Telomeric DNA and cell reproduction
 End Replication Problem
 Telomerase and DNA replication

(F). McKnight & Shippen, *Plant Cell*, 2004. p. 794-798

(G). Blackburn, *Scientific American*, February 1996

Exam I. Monday, October 10, 2016. Exam is maximum of 7 pages. ~15 MC, short answer, and problems. Make sure you complete the problem sets, do required readings, and study the PP slides.

Module Three: Chloroplast Genome and Plant Viruses

Chloroplast Genome
 Chloroplast Genetics
 Transit peptides in chloroplasts
 Chloroplast Evolution Plant and Algal Viruses
 TMV, CaMV, Giant Algal viruses – phycodnaviruses
 Virophages

(H). Leister, *Trends in Genetics*, 2003

Module Four: Epigenetics in Higher Plant Systems

Intro to Epigenetics
 DNA and Histone Methylation in Plants
 RNA-directed DNA methylation
 RNA-dependent RNA polymerases
 Habituation in plants
 Biotic stress and DNA methylation

Module V. Gene Silencing in Plants [a rapidly developing field]

Posttranscriptional Gene Silencing in Plants
 siRNA Pathway and Gene Regulation
 Virusoids and induction of DNA methylation
 Virus-induced gene silencing
Superman and *Kryptonite* Genes
 Chromomethyltransferases, DRM, ROS-1 genes
 Genomic Imprinting – *Medea*, *Polycomb Group* Genes
 Parental Conflict in Flowering Plants
 Demeter and DNA repair
 Histone code

(I). Henderson & Jacobsen, *Nature*, 2007.

(J). Ohad, N., *Nature*, 2007.

Module VI. Transposons and Related Genetic Elements

Controlling Elements in Maize (Transposons)
Dotted locus
Ac-Ds, *SpM*, *MdDR* transposable elements
Mu Killer, Transposon Tagging
 Pack Mules

(K). Rhoades.pdf file from Genetics Textbook (impt!)

(L). Federoff, N., *Scientific American*, 1984.

Exam II. Monday, November 7, 2016.

Module VII: Modern Plant Genetics

Genetic Systems – Corn, Snapdragon, *Arabidopsis*
 Plant Genomics
 Forward and Reverse Genetics
 Techniques in Plant Genetics, ISH, GUS reporter
 Gene Guns, *Ti* plasmids

(A). Gilbert, Chap. 4 pp. 90-92.

Module VIII. Plant Biotechnology

Plant Biotechnology – Monocots and Dicots

Ti plasmids and Gene Transfer

Vir genes, opine synthesis

Insect Resistance in Plants, Herbicide Resistant Plants

Golden Rice, GM Foods

Production of Biomass

Module IX: Plant Development

Flower Initiation, Oscillator Genes, *Constans*

Florigen, Cell Signaling in Plants

(M). Blasquez, *Science*, 2005.

Flower Morphogenesis, Flower Organ Identity

MADS Box genes and Flowering in Higher Plants

Cell Division in Plants

(A). Gilbert, Chap. 20, pp. 634-639

Pollination and Fertilization in Higher Plants

Seed Development

Stem Cell Niches, Establishment of Meristem

(A). Gilbert, Chap. 20, pp. 638-639.

Shoot Development – Plant Meristems and SAM

Stem cell niches - CLAVATA and WUS genes

Datura chimeras and plant stem cells

Leaf Development – Initiation and Growth

Root Development, RAM

Final Exam (Not Cumulative)

Friday, December 16, 2016 at 8 AM.

All 13 references are on Blackboard under Course Information folder entitled “References for Plant Genetics.” Gilbert’s Developmental Biology textbook, 6th edition is online at www.ncbi.nlm.nih.gov under Books. PDF of chapter also posted on Blackboard. Griffith’s Genetics textbook is also online at the NCBI website (www.ncbi.nlm.nih.gov) under “Books.”

Also, use **The Arabidopsis Information Resource**, www.arabidopsis.org website for *Arabidopsis* genes.

REMEMBER: DO ALL ONLINE PROBLEM SETS FOR EACH EXAM!!

Potential topics for the short term paper are posted on Blackboard.