Biology of Plants
Biology 315, Spring 2006
Union College

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Office Hours: W 2-3 pm, F 10-11 or by appointment

Course Synopsis: Plants are one of the major life forms on earth and are easily distinguished by their biochemistry, photoautotrophic nutrition, anatomy, modular growth form, and/or by their life history characterized by an alternation of generations. As such, the higher plants or embryophytes are a cohesive evolutionary group. However, the embryophyte clade is also diverse and contains over 350,000 species. These serve as the primary producers in most terrestrial, wetland, and in many aquatic environments. Within these habitats, plants have adapted to a wide range of physical and biological conditions and are functionally as well as taxonomically diverse. For example, plants have become adapted for pollen and seed dispersal by wind, water, insects, birds, or mammals. However, pollen and seed transfer are often carried out by completely different vectors (e.g., pollination by honeybees and dispersal by bears, raccoons or birds in the case of raspberries). The content of BIO 315 will focus on these two aspects of plant biology: unity and diversity. The course will consider the consequences of variation in plants using a conceptual framework that applies to all plants. This unifying foundation will serve as a starting point to evaluate the potential adaptive significance of variants in form, physiology, and life history characteristics that exist among diverse plant groups. The study of plant biology goes beyond the basics of content and also includes understanding the methods used by plant biologists. Throughout the lecture and laboratory portion of the course, students will explore the scientific process by evaluating models and experimental designs, by interpreting results, and by developing and testing hypotheses.

Structure of Course: In addition to lecture, class meetings will be devoted to discussions and other exercises where models, experiments, and results are critically evaluated. It is essential that you do the required reading—**you are responsible for learning from the text and other readings, even if the material is not reviewed in class**. In addition to reinforcing the lecture content, the laboratories will provide practice with the design, implementation, analysis, and writing of experiments. These are designed to last three hours, plan on it.

Course Requirements: All work must be completed and handed in to receive a grade for the course. You may make up a test only in the case of a documented emergency. Note that the final exam will be given only on the scheduled date. Make your summer plans accordingly. Attendance in class and lab is expected. Missing more than three lectures may affect your grade. Labs are not to be missed and will be made up with an acceptable, documented excuse brought to my attention in a timely manner.

Grading: The breakdown of the grades is as follows:

Tests (2 hourly, 1 lab practical; 10% lowest, 15% others)…..…….. 40%
Final Exam…….…... 20%
Other Assignments……..….5%
Lab
- Plant Structure Workbook……....10%
- Biomechanics Lab……..5%
- Invasive Species Lab……10%
- Photosynthesis Lab……...10%

Letter grades will be assigned based on a 10 point scale with +/-.

Required Texts: 1. Nabors, M.W. 2004. Introduction to Botany. Benjamin Cummings; 2. Van de Graaff, K.M., S.R. Rushforth and J.L. Crawley 2004. A Photographic Atlas for the Botany Laboratory, 4th ed. Morton Publishing Compay.

BIO 315 Biology of Plants
Topic Outline 2006

Week	Date	Unit	Topic	Lab	Reading/Assign.
1	3/27	Introduction	Introduction	No lab	N:1
	3/29		*Growth form		N:3
	3/31		**Discussion**: Constraints on plant structure		Niklas 1996, Hejnowicz and Barthlett 2005 **Discussion Worksheet Due**
2	4/3	Life Cycles	Diversity and Classification	Biomechanics of Vine and Tree Stems	N:16
	4/5		Life cycles		N:6 (p. 122-130)
	4/7		* Bryophytes and seedless vascular plants		N: 20, 21 **Biomechanics Lab Due 5 pm**
3	4/10	Plant Structure	Primary growth and structure: roots and leaves	Invasive Species I. Experimental Set-up (Field Trip)	N:4
	4/12		* Complete lab set-up		
	4/14		* Primary growth		
4	4/17		Primary and secondary growth: stems	*Secondary Growth	N:5
	4/19		Reproductive characters in seed plants		N:6 (130-143)
	4/21	Test I			
5	4/24		*Gymnosperms	Spring Ephemerals (Field Trip)	N:22
	4/26		*Angiosperms		N:23
	4/28		*Angiosperms, cont'd		
6	5/1		Pollination	Lab Practical Exam	**Plant Struct. Workbook Due**
	5/3		**Discussion**: Pollination, phylogeny and evolution		Johnson et al. 1998; **Discussion Worksheet Due**
	5/5		Steinmetz Symposium		

7	5/8	Plant Growth and Response	Photosynthesis Introduction	Invasive Species II. Harvest and Modeling	N:8 (review 7)
	5/10		Control of photosynthesis		
	5/12		*Plant growth analysis		Barbour et al. 1999, McConnaughay and Coleman 1999
8	5/15		C3 and C4 photosynthesis	CO_2 Enrichment in C3 and C4 Species	
	5/17		*Modeling photosynthesis		**Invasive Species Lab Due 5 pm**
	5/19		**Discussion**: CO_2 and PS		Adam et al. 2000
9	5/22		Transport	Bog Field Trip	N:10
	5/24	Test II			
	5/26		Plant response I-hormones and tropisms		N:11
10	5/29		Plant response II-phytochromes	Fruit	**Photosynthesis Lab Due 5 pm**
	5/31		Biotechnology and Agriculture		N:14
	6/2		Future of Plant Biology		
11		FINAL		date/time TBA	

*indicates lab exercise during lecture time, please meet in the laboratory and bring the Van De Graaf 2004 book.
N refers to the Nabors 2004 text.

References:

Adam, N.R., C.E. Owensby and J.M. Ham 2000. The effect of CO_2 enrichment on leaf photosynthetic rates and instantaneous water use efficiency of Adropogon garardii in the tallgrass prarie. Photosynthesis Research 65: 121-129.

Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gilliam, and M.W. Schwartz 1999. Terrestrial Plant Ecology, 3rd ed.. Addison Wesley Longman, Inc., NY, 649 pp.

Hejnowicz, Z. and W. Barthlott 2005. Structural and mechanical peculiarities of the petioles of giant leaves of *Amophophallus* (Araceae). American Journal of Botany 92: 391-403.

Johnson, S.D., H.P. Linder, and K.E. Steiner 1998. Phylogeny and radiation of pollination systems in Disa (Orchidaceae). American Journal of Botany 85: 402-411.

McConnaughay, K.D.M. and J.S. Coleman 1999. Biomass allocation in plants: ontogeny or optimality? A test along three resource gradients. Ecology 80: 2581-93.

Nabors, M.W. 2004. Introduction to Botany. Benjamin Cummings, NY.

Niklas, K. 1996. How to build a better tree. Natural History105 (2): 48-57.

Van De Graaff, K.M., S.R. Rushforth and J.L. Crawley 2004. A Photographic Atlas for the Botany Laboratory. Morton Publishing Company, Englewood, CO.

BIO 315 Biology of Plants
Revised Topic Outline 2006

Week	Date	Unit	Topic	Lab	Reading/Assign.
5	4/24		Secondary Growth	Secondary Growth	N:5
	4/26		Gymnosperms		N: 6 (130-33); 22
	4/28		Angiosperms,		
6	5/1		*Gymnosperms	Spring Ephemerals Field Trip	
	5/3		*Angiosperms		N:23
	5/5		Steinmetz Symposium		
7	5/8	Plant Growth and Response	Pollination	Fruit and Angiosperms	
	5/10		Lab Practical Exam		
	5/12		Photosynthesis		N: 8 (review 7);
8	5/15		C3 and C4 Photosynthesis	CO2 Enrichment in C3 and C4 Species	Plant Structure Workbook Due, in lab.
	5/17		*Modeling photosynthesis		
	5/19		Discussion: CO2 and PS		Adam et al. 2000
9	5/22		Transport	Invasive Species Harvest	N:10
	5/24	Test II			
	5/26		Plant response I- hormones and tropisms		N:11 Photosynthesis Lab, Due 4 pm
10	5/29		Plant response II- phytochromes	Bog Field Trip	
	5/31		Invasive Species Presentations		
	6/2		Biotechnology and Agriculture		N:14
11		FINAL		date/time TBA	

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References:

Adam, N.R., C.E. Owensby and J.M. Ham 2000. The effect of CO_2 enrichment on leaf photosynthetic rates and instantaneous water use efficiency of Adropogon garardii in the tallgrass prarie. Photosynthesis Research 65: 121-129.

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Johnson, S.D., H.P. Linder, and K.E. Steiner 1998. Phylogeny and radiation of pollination systems in Disa (Orchidaceae). American Journal of Botany 85: 402-411.

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Plant Biology, Spring 2003 Revised Topic Outline

Week	Date	Unit	Topic	Lab	Reading/Assign.
5	4/29	Plant Structure and Function	Transport	Spring Ephemerals Field Trip	review U: 8 & 9 sections dealing with transport
	5/1		Diversity and Classification		U: 15
	5/2		*Gymnosperms		U: 18 (439-454)
6	5/6		*Angiosperms	Invasive Species III. N-availability Analysis	U: 18 (455-464)
	5/8		**Discussion**: Pollination, phylogeny and evolution		U: 12 (287-292), 13 (312-316); Johnson et al. 1998; Discussion Worksheet Due
	5/9		Steinmetz Symposium		
7	5/13	Plant Growth and Response	Photosynthesis Introduction	CO_2 Enrichment in C3 and C4 Species (group A)	U: 10
	1/15		Control of photosynthesis and C3-C4 pathways	CO_2 Enrichment in C3 and C4 Species (group B)	U: 9 (209-213)
	5/16		*Modeling photosynthesis	CO_2 Enrichment in C3 and C4 Species (group C)	
8	5/20		**Discussion**: CO_2 and PS	Invasive Species IV. Harvest and Modeling	McConnaughay and Coleman 1999; Adam et al. 2000
	5/22		Growth, allocation and interaction		Photosynthesis Lab Due 5 pm
	5/23		*Plant growth analysis		U: 19 (469-479); Barbour et al. 1999, Ch. 6
9	5/27		Field Trip	Bog Field Trip	
	5/29	Test II w/practical			
	5/30		Plant response I-hormones and tropisms		U: 6
10	6/3		Plant response II-phytochromes	Fruit	U: 6 continued
	6/5		Biotechnology and Agriculture		Invasive Species Lab Due 5 pm; U: 5 (119-121); Appendix A
	6/6		Future of Plant Biology		Plant Structure Workbook Due
11		FINAL		date/time TBA	

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U refers to the Uno et al. 2001 text.

References:

Adam, N.R., C.E. Owensby and J.M. Ham 2000. The effect of CO_2 enrichment on leaf photosynthetic rates and instantaneous water use efficiency of Adropogon garardii in the tallgrass prarie. Photosynthesis Research 65: 121-129.

Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gilliam, and M.W. Schwartz 1999. Terrestrial Plant Ecology, 3rd ed.. Addison Wesley Longman, Inc., NY, 649 pp.

Gartner, B.L, 1991. Structural stability and architecture of vines versus shrubs of poison oak, Toxicodendron diversilobum. Ecology 72 2005-2015.

Johnson, S.D., H.P. Linder, and K.E. Steiner 1998. Phylogeny and radiation of pollination systems in Disa (Orchidaceae). American Journal of Botany 85: 402-411.

McConnaughay, K.D.M. and J.S. Coleman 1999. Biomass allocation in plants: ontogeny or optimality? A test along three resource gradients. Ecology 80: 2581-93.

Niklas, K. 1996. How to build a better tree. Natural History105 (2): 48-57.

Niklas, K., F. Molina-Freaner and C. Tinoco-Ojanguren 1999. Biomechanics of the columnar cactus Pachycereus pringlei. American Journal of Botany 86: 767-775.

Uno, G., R. Storey and R. Moore 2001. Principles of Botany. McGraw Hill.