Biology 230 Bevington
Field Botany Fall Term, 2008

COURSE SYLLABUS

TEXTS:

Judd, Walter S., Christopher S. Campbell, Elizabeth A. Kellog, Peter F. Stevens, and Michael J. Donoghue. 2008. PLANT SYSTEMATICS. Third Edition. Sinauer Associates, Inc. ISBN: 978-0-87893-407-2

Harlow, William M. 1957. TREES OF THE EASTERN AND CENTRAL UNITED STATES AND CANADA. Dover Publications, Inc.

COURSE OBJECTIVES:

A primary goal of the course is to acquaint you with the local flora and with major plant communities of the easterrn deciduous forest. You will collect plants on field trips and identify them in the laboratory. Special emphasis will be placed on a study of important plant families. Methods for collecting and preparing herbarium specimens will be covered, and each student will prepare a plant collection to be submitted to the instructor at the end of the semester.

The origins of variation in plant populations and the significance of variation in natural selection will be discussed. The central tenets of modern evolutionary theory will be examined with particular attention given to speciation in plants. Principles of plant population biology will be discussed.

A third objective is to introduce you to the study of plant ecology. The nature of plant communities and the forces which shape them will be examined. You will study methods of community analysis, and field trips will be scheduled to study local forest communities.

Finally there will be an introduction to conservation biology. We will discuss the importance of preserving for future generations natural communities and the plants which they contain. Because of mounting pressures for development and exploitation of natural resources, relatively few undisturbed natural areas remain in the eastern Unitd States. The natural areas which persist are priceless fragments of our biological heritage. We will examine the scientific, aesthetic, and spiritual values of biological diversity and the prospects for preserving it.

ATTENDANCE:

You should attend regularly scheduled classes, laboratories, field trips, and exams. Mising an exam means that the exam will be given a grade of zero and averaged with other test grades for the semester. If there is a valid excuse for missing an exam, that exam will not count against the final average and the remaining test scores will be averaged.

ACADEMIC HONESTY:

The instructor adheres to the policy statement on academic honesty outlined in the curent version of the Student Handbook.

PLANT COLLECTION:

Students will study 30 representative plant families and will be responsible for the important characteristics of these families. The instructor will provide booklets summarizing the characteristics of these families. The booklets will also include representative genera and species. The families are illustrated and thoroughly discussed in the text (pp. 230-515); digital photographs of representative species are on the CD which accompanies the text. To facilitate our field sampling exercises in plant community analysis, on-sight recognition of major tree species will be required.

Each student will prepare a collection of 60 plants to be submitted to the instructor at the completion of the course. **At least 40** of these specimens must be herbaceous, and the collection should contain at least one representative of each of the 30 families. The reason for this is to assure that students gain familiarity with a variety of different plants rather than focusing on just a few familiar ones. All specimens should be identified to genus and species. Floras and plant identification manuals will be available in the laboratory. Plant collections are due **Thursday 4 December**.

Plant presses and directions for specimen preparation will be provided during the first lab meeting. You will need the following items for lab and field work:

Notebook and pencil
Trowel or other digger
Plastic bags for specimens
Hand lens (10x)[1]
Small pocket metric ruler (plastic)
Newspapers

[1] The hand lens is not essential, but it is often helpful particularly if you work on your plant collection out of lab when dissecting microscopes are not available. It is also useful on field trips when you are collecting specimens and want to examine floral structures.

PAPER ON ECOLOGICAL SAMPLING DATA:

An ecological analysis of sampling data from field trips will be required in the form of a term paper. Papers must be written in college level English; papers not meeting this criterion will be returned without a grade to be rewritten. Format for the paper and data presentation will be discussed in class. The paper is due on **Monday 8 December**.

FIELD NOTEBOOK:

Each student will maintain a field notebook which will be submitted to the instructor at the end of the course. This should contain notes taken on field trips to various plant communities. You should also record in your notebook all of the accessions in your plant collection, the collection location for each accession, and the habitat type. You should record enough information so that someone could find the site where you made each collection. Suggested formats for your notebook will be given in the laboratory.

GRADING:

The final grade will be based on practical examinations in the laboratory and in the field, two (2) hour examinations covering lecture material, a term paper analyzing ecological sampling data, the plant collection, and a comprehensive final. Practical exams will be primarily devoted to recognition of plant families and identifying unknown plants using keys. The plant collection will be an important part of the final grade.

Two hour exams are tentatively scheduled for: **Tuesday 14 October**
Tuesday 25 November

The list below is a distribution of the point values for graded items during the semester. This is a guideline. There may be some variation from the values because the exact number of field quizzes and graded laboratory projects will not be known until later in the semester. Hence, the percentages are approximations, but they are fairly close.

	Point Value	Approximate Percentage
Written laboratory exercises (2 or 3), and recognition quizzes in the field (3 or 4)	450	22.5%
1st Hour exam	200	10 %
2nd Hour exam	200	10 %
Family recognition exam	200	10 %
Term paper (sampling data analysis)	250	12.5%
Plant collection	300	15 %
Final exam	400	20 %
	2000	100 %

LECTURE TOPICS

Plant Systematics and Evolution

Systematics: the study of biological diversity and its evolutionary history
Phylogeny, monophyletic groups, clades
Principles of botanical nomenclature
- The origin of plant names and why they are changed
- Rules for naming new species

Methods for preparing and identifying plant specimens
Herbarium methodology
Review of vegetative and reproductive characteristics
Other sources of taxonomic evidence (chromosome numbers, palynology, secondary metabolites, and molecular data)
Types and sources of variation in plant populations
Microevolution and the breeding population
Mutation, dispersal and gene flow, recombination
Variability and natural selection
- Examples of selection
- Modes of selection

Compatibility and breeding systems
The species situation in higher plants
- Races and species
- Isolation mechanisms
- Ecological relationships between species

Processes by which speciation occurs
- Allopatric and sympatric speciation
- Quantum speciation
- Punctuated equilibrium

Hybridization and introgression
Polyploidy
Extinction

Plant Population Biology

The seed bank, dormancy, and germination syndromes
Seedling mortality and recruitment
Competition and coexistence

Plant Ecology

The plant community
Three major ecological factors: light, temperature and water
Plant succession: primary
Succession: secondary
Plant geography
Theories of species diversity: Why are there more species in some communities than there are in others?
Three ecosystems: tundra, desert and rain forest

LABORATORY SCHEDULE

The laboratory activities scheduled below are tentative and could be rearranged depending on weather or other factors during the semester. If there is agreement in the class, we may schedule a field trip to Ricketts Glen Park over part of a weekend. There will be time scheduled for you to identify plant specimens for your collection; however, you will need to spend time out of class on this project. Floras and identification manuals will be available in the laboratory, and you can work on your collection in the laboratory or you can sign out one or two identification manuals to work over the weekend or over fall recess or Thanksgiving break. Identification manuals will be secured in a locked cabinet, so you should make arrangements to sign out what you need with the instructor for times other than a scheduled laboratory meeting.

As you collect specimens and identify them for your collection select one species which you have identified and secure **ten** (10) specimens of it. Press these and retain them for a later exercise in the laboratory (see 24 November). You can submit **<u>one</u>** of these specimens with your collection, but you will need all ten of them for writing a species description which we will do on 24 November.

25 Aug. Issue plant presses, discuss specimen preparation, pick up floras and identification manuals in Reeves Library, short local field trip to locate collecting sites

1 Sept. No classes (Labor Day)

8 Sept. Specimen Identification. Plan to bring to lab at least 3 specimens of each of 10 different flowering plants. When you collect these, put them in a plastic trash bag, add a handfull or two of water, and seal the bag with a Twist-Tie. Keep in a cool place, and we will store the bags in a walk-in cooler. Try to collect plants which are growing wild and avoid domestic plants.[2]

15 Sept. Field trip: Jacobsburg Park (possible field quiz)

22 Sept. Identification of specimens

29 Sept. Field trip: Tannersville Bog

4 Oct. – 7 Oct. Fall Recess

13 Oct. Field trip: Long Pond Barrens

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[2] It is not good form to parasitize the neighbor's vegetable garden for plant specimens. Similarly, digging up the front yard plantings of *Impatiens* and *Geranium* is unlikely to endear you to the little old lady who lives down the block.

20 Oct. Field trip: location to be announced

27 Oct. Quiz or lab exam (recognition, specimen identification). Work on plant collections

3 Nov. Field trip: sampling and data collecting at Jacobsburg

10 Nov. Laboratory work: analysis and discussion of sampling data from field trips, work on collections

17 Nov. Laboratory work: construction of dichotomous keys, work on collections

24 Nov. Writing species description for local taxa, work on collections

26 Nov. – 30 Nov. Thanksgiving Vacation

1 Dec. Field trip: Longwood Gardens

8 Dec. Plant biogeography

TARGET DATES FOR LECTURE TOPICS

Tues. 26 Aug.	The discipline of plant systematics, course overview. **Chapters 1 & 2**
Thur. 28 Aug.	Taxonomic nomenclature (**Appendix 1**), start review of reproductive & vegetative characteristics (parts of **Chapter 4**),
Tues. 2 Sept.	Complete reproductive and vegetative characteristics Start family characteristics (specific selections from **Chapter 9**)
Thur. 4 Sept.	Family characteristics
Tues. 9 Sept.	Family characteristics
Thurs. 11 Sept.	Sources of taxonomic evidence (chromosome numbers, palynology, secondary metabolites, and molecular data). Highlights of **Chapters 4 & 5**
Tue. 16 Sept.	Use and construction of keys (**Appendix 2, pp 557-560**). Variation in plant populations (**Chapter 6**).
Thur. 18 Sept.	Evolution. Selection, breeding systems (**Chapter 6, pp. 119-125**)
Tues. 23 Sept.	The species concepts in plants (**Chapter 6, pp. 143-149**). Races, isolation mechanisms, ecological relationships between species.
Thurs. 25 Sept.	Allopatric speciation, sympatric speciation, catastrophic (quantum) speciation, punctuated equilibrium (**Chapter 6, pp. 126-132**).
Tues. 30 Sept.	Complete speciation. Hybridization (**Chapter 6, pp. 132-139**)
Thurs. 2 Oct.	Introgression. Begin polyploidy.
Fri. 3 Oct.	Polyploidy and polyploid speciation (**Chapter 6, pp. 140-142**) Mid Term
Sat. 3 Oct. Tues. 7 Oct.	Fall Recess
Thurs. 9 Oct.	Plant population biology

Tues.	14 Oct.	**First hour exam** (14 lectures)
Thurs.	16 Oct.	Plant population biology
Tues.	21 Oct.	The plant community
Thurs.	23 Oct.	Ecological factors: light, temperature
Tues.	28 Oct.	Ecological factors: water
Thurs.	30 Oct.	Plant succession: hydroseres and xeroseres
Tues.	4 Nov.	Bog ecology
Thurs.	6 Nov.	Secondary succession
Tues.	11 Nov.	Principles and generalizations about succession
Thurs.	13 Nov.	Theories of species diversity: Why do some ecosystems have more species than others?
Tues.	18 Nov.	Plant geography and how ecosystems have changed over evolutionary time
Thurs.	20 Nov.	Tundra and deserts
Tues.	25 Nov.	**Second hour exam** (11 lectures)
Wed.	26 Nov. - Sun. 30 Nov.	Thanksgiving Vacation
Tues.	2 Dec.	Rain forests
Thurs.	4 Dec.	**Plant collections due**
Tues.	9 Dec.	Complete rain forests
Thurs.	11 Dec.	Last class

REFERENCE TEXTS

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Crawford, D.J. 1990. **Plant Molecular Systematics**. John Wiley and Sons.

Grant, Verne. 1981. **Plant Speciation**. Columbia University Press. Second Edition

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Rain Forests:

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Flenley, J. 1979. **The Equatorial Rain Forest: A Geological History**. Butterworth

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DIGITAL IMAGES IN THE PHOTO GALLERY OF VASCULAR PLANTS

The plant families we will study are listed on the following pages along with their principal characteristics. Digital images of many of the representative genera for these families are available on the CD that accompanies your text (Judd, W.S. et al. 2008. **Plant Systematics**, Third Edition. Sinauer Associates). The genera and species on the following pages for which images are included on the CD are listed here on pages i-vii. In addition, for most of these families there are additional images of other genera and species which are not included here.

Because of new evidence and reinterpretations of several taxa, some families have been combined or species have been renamed and moved to a new genus. In two instances a family has been eliminated and its genera moved to other families. These changes are noted below with brief rationales for the authors' changes and with references to pages in the text for a discussion of the changes. Families in **boldface type** are ones which have been eliminated by the authors of your text. Not all systematists necessarily concur with these changes.

Monocot Families

Poaceae: (Graminae)	*Setaria*
	Avena
	Triticum
Araceae:	*Arisaema*
	Pentandra
	Philodendron
	Symplocarpus
Orchidaceae:	*Cattleya*
	Cypripedium
	Habenaria
	Spiranthes
Liliaceae:	*Erythronium*
	Lilium
Commelinaceae:	*Commelina*
	Tradescantia

DIGITAL IMAGES IN PHOTO GALLERY OF VASCULAR PLANTS

Dicot Families Without Petals

Salicaceae:	*Populus* *Salix*
Juglandaceae:	*Carya ovata, C. illinoensis* *Juglans nigra*
Betulaceae:	*Alnus* *Betula* *Carpinus* *Corylus* *Ostrya*
Fagaceae:	*Castanea* *Fagus* *Quercus*
Urticacaceae	*Laportea* *Pilea* *Urtica*
Polygonaceae:	*Polygonum* *Rumex*
Chenopodiaceae:	*Chenopodium* *Atriplex*
Amaranthaceae:	*Amaranthus*

Note: Authors of the text place members of the Chenopodiaceae into Amaranthaceae. See their discussion on p. 327.

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Dicot Families With Separate Petals

Caryophllaceae:	*Cerastium*
	Lychnis
	Saponaria
	Silene
	Stellaria
Ranunculaceae:	*Actaea*
	Aquilegia
	Caltha
	Delphinium
	Ranunculus
	Thalictrum

Note: Most species of Ranunculaceae bloom in spring or early summer.

Magnoliaceae:	*Magnolia*
	Liriodendron
Brassicaceae:	*Arabidopsis*
(Cruciferae)	*Capsella*
	Raphanus
Rosaceae:	*Fragaria*
	Potentilla
	Rosa
	Rubus
Fabaceae:	*Arachis*
(Leguminosae)	*Desmondium*
	Glycine
	Medicago
	Melilotus
	Phaseolus
	Robinia
	Trifolium
	Wisteria

Note: Three subgroups are generally recognized within the Fabaceae: Caesalpinioidae, Mimosoideae, and Papilionoideae (=Faboideae).

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Fabaceae (continued):

Most authors consider these subgroups as subfamilies of Fabaceae, but they have also been treated as separate families (text pp. 372-376). Table 9.2 (p. 376) summarizes diagnostic features for the three groups. Flowers are highly variable with regard to color, shape, size and pollinators. A number of species show coevolutionary relationships with ants. Nitrogen fixation occurs in many species of legumes.

Aceraceae: *Acer negundo*
Acer platanoides
Acer saccharum
Acer saccharinum

Note: Aceraceae (the Maple Family) traditionally has been separated from other families. However, the text includes the maples in the family Sapindaceae as an "aceroid clade" along with another family called the Hippocastanaceae (horse chestnuts). See text, pp 438-440.

Malvaceae: *Abutilon*
Gossypium
Hibiscus

Note: The authors of your text include in Malvaceae (the mallow or cotton family) three families previously considered to be be distinct (see text, p. 425 for the rationale). These include the Tiliaceae (*Tilia*, basswood or linden), Sterculiaceae (e.g. *Theobroma*, chocolate), and an important tropical family called Bombacaceae (e.g. *Chlorisia*, *Ceiba*, kapok).

Onagraceae: *Chamerion angustifolium*
Epilobium (no digital image on the CD)
Oenothera

Note: *Epilobium angustifolium* (fireweed) contains both diploids and autotetraploids. In the past some authors have referred to these as "chromosomal races." Autopolyploids have generally not been recognized as separate species from their diploid ancestors. However, in *E. angustifolium* the geographic ranges of the two

DIGITAL IMAGES IN PHOTO GALLERY OF VASCULAR PLANTS

Onagraceae (continued):

ploidy levels are largely separate with diploid populations at higher latitudes than tetraploids. The two populations also flower at different times, and they are essentially completely reproductively isolated from each other. For this reason it has been argued that the fireweeds are sufficiently different from other species of *Epilobium* to warrant placing them in a separate genus, *Chamerion* (see text, pp. 142-143 and Figure 6.29). Hence, *Epilobium angustifolium* becomes *Chamerion angustifolium*.

Cornaceae:	*Cornus canadensis*
	Cornus florida
	Nyssa sylvatica
Apiaceae:	*Conium maculatum*
(Umbelliferae)	*Daucus carota*
	Heracleum
	Pastinaca

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Dicot Families With Fused Petals

Convolvulaceae:	*Convolvulus*
	Cuscuta
	Ipomoea
Lamiaceae: (Labiatae)	*Mentha*
	Monarda
	Nepeta
	Salvia
Scrophulariaceae:	*Verbascum*
	Castilleja
	Pedicularis

Note: The authors of your text have moved several genera from the Scrophulariaceae (Figwort Family) to two other families. They put *Castilleja* (Indian paint brush) and *Pedicularis* (lousewort) in the Orobanchaceae (Broomrape Family). See the text, pp. 484-486 for descriptions of these two families and the authors' logic.

Chelone
Digitalis
Penstemon

Note: The authors also consider three genera which have traditionally included in Scrophulariaceae (*Chelone*, *Digitalis*, *Penstemon*) to be closer in evolutionary affinity to the Plantaginaceae (Plantain Family), and they include them in Plantaginaceae for this reason. They also put some other genera from Scrophulariaceae into Plataginaceae (e.g. *Linaria*, "Butter-and-Eggs"). See text pp. 481-483 for the rationale. They consider that *Paulownia* (Princess Tree) belongs to Bignoniaceae (Trumpet Creeper Family), a family we will not study.

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Caprifoliaceae:	*Lonicera* *Linnaea* *Sambucus* *Viburnum*

Note: *Sambucus* (Elderberry) and *Viburnum* traditionally were included in Caprifoliaceae (Honeysuckle Family); however, authors of your text place both genera in a different family, Adoxaceae, which they refer to as the Elderberry Family. See pp. 504-505 for their discussion. Other systematists have not made this distinction.

Cucurbitaceae:	*Cucurbita* *Echinocystis* *Sicyos*
Asteraceae:	*Ambrosia* *Bidens* *Cichorium* (Chicory) *Eupatorium* *Helianthus* *Solidago* *Taraxacum*

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CHARACTERISTICS OF THIRTY REPRESENTATIVE FAMILIES OF FLOWERING PLANTS FOUND DURING THE AUTUMN IN EASTERN PENNSYLVANIA

Biology 230: FIELD BOTANY

BIOLOGY DEPARTMENT
MORAVIAN COLLEGE