FACULTY of SCIENCE and ENGINEERING
Department of Biology

Course: SC/BIOL 2010 4.0 – **Plant Biology**
Course Webpage: http://www.yorku.ca/plants/
Term: Winter Term 2012/2013

Prerequisite / Co-requisite: SC/BIOL 1010 6.0; or SC/BIOL 1000 3.0 and SC/BIOL 1001 3.0; or Permission of the Course Director.

Course Instructor: Roger R. Lew
(416) 736-2100 ext 66114
Farquharson 229 (lab)
planters@yorku.ca

Course consultation hours: I am usually in my lab, so please feel free to drop by.

Time and Location

Lectures	MWF 9:30	Accolade West 005
Laboratory	MTWR 2:30–5:30	
	R 6:30–9:30	Lumbers 118

Expanded Course Description

Plant Biology - Current advances in plant biology research, highlighting plant structure, physiology, development and diversity. Three lecture hours, three laboratory hours. One term. Four credits.

Overview. This course is an introduction to the field of botany. Non-biology majors with some background in biology may enroll with permission of the Course Director. The lectures will present information about prokaryotes, algae, fungi and plants (structure, function, and diversity; lifecycles; ecology; relevance to human society). The laboratories are integrated with lecture, and illustrate the biological diversity of algae, fungi, and nonvascular and vascular plants, and highlight key aspects of plant biology.

Organization of the Course. The course involves formal lectures by the lecturer and weekly laboratories. The textbook and lectures are central to the course. Lectures serve to enrich, clarify, and illustrate crucial issues from the textbook used to reveal the diversity of photosynthetic organisms and —a major part of the course— the life of a higher plant.The majority of the material presented in laboratory exercises focuses on developing the observational skills of the students: observation and recording of gross form and structure (including the life cycle of a fern), and microscopic form and structure. Opportunities to identify material using keys –from algae, conifers to pollen– test and hone the student's observational skills. The lecture and laboratory components are integrated (and usually synchronized). The final grade of the student is compiled from the combination of lecture and laboratory.

Course Learning Objectives. Please note that a detailed syllabus of lecture material and past tests on the course website (www.yorku.ca/plants) provide a highly detailed and practical presentation of the Learning Objectives

Brief statement of the purpose:

DIVERSITAS

Students will learn the major characteristics of biological groupings commonly compiled together in a plants course: Prokaryotic heterotrophs and autotrophs, Eukaryotic Protist groups emphasizing the autotrophs, the heterotrophic Fungi, and Land Plants. The Learning Objective is fulfilled by integration of lecture and lab components. In Lecture, the students learn the characteristics, economic importance, and evolutionary significance of the various groups. In Lab, students are given the opportunity to observe life cycles of these organisms, from both prepared and living material. The Observational Skills that the students acquire in Lab (including microscopic observation and documentation with drawings) are crucial for their ability to integrate their understanding of biotic diversity in the context of Lecture presentation.

Achievement of the *Diversitas* Learning Objectives is documented by term tests that challenge the student to apply and integrate their knowledge of biotic diversity, and by lab quizzes and write-ups that document their ability to observe and identify major biotic groups.

FORMA VITAE

Students will explore that form and development of an angiosperm, from seed to seed in the context of environmental and physiological cues that control each life stage transition. The Learning Objective is fulfilled by integration of lecture and lab components. In Lecture, the students learn about environmental cues that regulate each life stage transition of a flowering plant and how the plant achieves that transition. In Lab, students are given the opportunity to dissect a plant and explore its internal structures that support survival at each life

stage. The Learning Objectives include a transition to independent learning in which analytical thinking is emphasized.

Achievement of the *Forma Vitae* Learning Objectives is documented by term test and final exam that challenge the student to apply and integrate their knowledge of the life cycle of a flowering plant with analytical thinking, and by write-ups that document their ability to observe and explore the plant structures that support survival of the plant.

Brief list of specific learning objectives of the course

The specific objectives of the course are that students will be able to:

- critically examine the diversity of major organismal groups —their characteristics and life cycles
- understand the key evolutionary transitions from photosynthetic microorganisms (cyanobacteria) to protist eukaryotes (unicellular algae) to multicellular complexity (algae, fungi and land plants), and appreciate the remarkable depth and breadth of 4000 million years of evolution.
- develop and hone the observational skills required to identify major organismal groupings
- develop the flexibility required to apply and integrate fundamental principles and mechanisms in the evolution of diverse organisms —both form and function.
- Become familiar with the scientific language used to describe organismal diversity and the ecophysiological basis of the life cycle of a flowering plant.
- develop their ability to independently analyze organismal diversity and the life of a higher plant.

Course Text / Readings

Evert RF and SE Eichorn 2012 Raven Biology of Plants. Eighth Edition.

Raven Biology of the Plants provides an obligatory coverage of photosynthesis, organismal diversity and its evolution and the life cycle of flowering plants.

Lew and others 2012. Laboratory Manual for SC/BIOL 2010 4.0 (Plant Biology).

The laboratory manual provides explanations of each of the lab exercises, diagrammatic representations of diverse life cycles and identification keys for major groups.

Evaluation

- Two term tests (highest scoring 20%, lowest scoring 10%) and the final exam (30%)
- Laboratory exercises, write-ups and quizzes (40%). A detailed breakdown of the lab marks are available in the lab manual.

In the event of an absence from a term test, please provide a letter stating that you were absent, and acknowledging that the weight of the missed term test (15%) will be added to the weight of the final exam.

It is not always possible to accommodate missed lab assignments or quizzes, in which case, the weight of the missed lab assignment/quiz will be added to the weight of the final exam.

"Final course grades may be adjusted to conform to Program or Faculty grades distribution profiles."

Grading: The grading scheme for the course conforms to the 9-point grading system used in undergraduate programs at York (e.g., A+ = 9, A = 8, B+ - 7, C+ = 5, etc.). Assignments and tests* will bear either a letter grade designation or a corresponding number grade (e.g. A+ = 90 to 100, A = 80 to 90, B+ = 75 to 79, etc.). For a full description of York grading system see the York University Undergraduate Calendar - http://calendars.registrar.yorku.ca/2010-2011/academic/index.htm. Students may take a limited number of courses for degree credit on an ungraded (pass/fail) basis. For full information on this option see Alternative Grading Option in the *(Faculty of Science and Engineering)* section of the Undergraduate Calendar: (http://ugbio.apps01.yorku.ca/)
Assignment Submission: Proper academic performance depends on students doing their work not only well, but on time. Accordingly, **lab** assignments for this course must be received on the due date specified for the assignment. Assignments are to be handed in to the TA for your laboratory section per their instructions.
Lateness Penalty: Assignments received later than the due date will be penalized (Late penalties will be determined by the laboratory coordinator).
Missed Tests: Students with a documented reason for missing a course test, such as illness, compassionate grounds, etc., which is confirmed by supporting documentation (e.g., doctor's letter) will have the weight of the missed term test transferred to the final exam.

IMPORTANT COURSE INFORMATION FOR STUDENTS
All students are expected to familiarize themselves with the following information, available on the Senate Committee on Academic Standards, Curriculum & Pedagogy webpage (see Reports, Initiatives, Documents) - http://www.yorku.ca/secretariat/senate/committees/ascp/index-ascp.html

- Senate Policy on Academic Honesty and the Academic Integrity Website
- Ethics Review Process for research involving human participants
- Course requirement accommodation for students with disabilities, including physical, medical, systemic, learning and psychiatric disabilities
- Student Conduct Standards
- Religious Observance Accommodation

Science/Biology 2010.04 Plant Biology

3 credits lecture (3 hrs/week; 12 weeks); 1 credit laboratory (3 hours/week; 12 weeks)
Current advances in plant biology research, highlighting plant structure, physiology, development and diversity. Three lecture hours, three laboratory hours. One term. Four credits. Prerequisite: SC/BIOL 1010 6.0 or SC/BIOL1000 3.0 and SC/BIOL1001 3.0.

Textbook

Evert RF and SE Eichorn 2012 Raven Biology of Plants. Eighth Edition. WH Freeman. (Table of Contents[1]).

Lecture Topics

Photosynthesis, Light and Life (Chapter 7) (*ca 3 hours*)

light properties and physics of light absorption, pigments (porphyrin structure and function), light reactions (electron transfer, ATP and NADPH production), and dark reactions (carbon fixation, carboxylase reactions)

The mechanisms of photosynthesis are presented with especial emphasis on the remarkable geological changes that occurred due to 1–2 billion years of oxygenic photosynthesis, creating the currently high oxygen levels in the atmosphere (and very low carbon dioxide levels). The juxtaposition of photosynthetic 'terra-forming' and carbohydrate production that support heterotrophic organisms are key elements in the evolution of biological diversity.

Systematics: The Science of Biological Diversity (Chapter 12) (*ca 0.5 hour*)

classification, phylogeny and major organismal groups

A brief overview of the 'evolution' of classification schemes is presented, including the initial ones proposed by Linnaeus and others 300-400 years ago, culminating in the evolution-based classification schemes now used.

Procaryotes and Viruses (Chapter 13) (*ca 1 hours*)

procaryotic classification and major procaryotic groups

Morphological and functional classifications of bacteria are presented, with special reference to diagnostics and the central role of wall structure in the ubiquitous Gram-staining.

Protista (Chapter 15) (*ca 4 hours*)

Autotroph unicellular: Euglenoids, Cryptomonads, Haptophytes, Dinoflagellates. Major characteristics, life cycles and biology

Heterokonts (Stramenopiles): Diatoms, Chrysophytes, Phaeophytes (multicellular) and the heterotroph Oomycota.

Multicellular: Rhodophytes, Green Algae (Chlorophyceae, Ulvophyceae and Charophycea) and the heterotroph Slime Molds. Major characteristics, life cycles and biology

The unicellular and multicellular phyla of the protists represent an evolutionary bridge to the animal, fungal and plant kingdoms, especially the complexities of cellular architecture (anticipating cellular differentiation in multicellular organisms) and patterns of multicellular development. The phylogenetic sequence is very obscure. We will explore them thematically, beginning with the unicellular groups, the multicellular groups and the heterotrophic groups.

Fungi (Chapter 14) (*ca 2 hours*)

major fungal groups, life cycles and fungal biology

The heterotrophic decomposers of the fungal kingdom are presented with emphasis on life cycle, characteristics and ecology. Emphasis will be placed on the major groups (Chytridiomycota, Zygomycota, Ascomycota and Basidiomycota) and the symbionts (Glomeromycota, other mycorrhiza and lichens)

Bryophytes (Chapter 16) (*ca 2 hours*)

major characteristics, life cycles and biology

The major characteristics of Bryophytes are presented in the context of adaptations to the rigors of life on land, where water is scarce and protection of offspring –until they can survive on their own– is crucial

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Seedless Vascular Plants (Chapter 17) (*ca 2 hours*)

major characteristics, life cycles and biology

Adaptive vasculature, including architectural complexities of stelar anatomy to support photosynthetic leaves are emphasized, as well as life cycles.

Gymnosperms (Chapter 18) (*ca 1.5 hours*)

major characteristics, life cycles and biology

The three major extant phyla (Cycadophyta, Ginkgophyta and Coniferophyta) are emphasized.

Angiosperms (Chapters 19 and 20) (*ca 3 hours*)

evolutionary biology of flowering plants

The reproductive peculiarities of flowering plants are presented, and the remarkable world of coevolution as a major effecter of the explosion of speciation

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Plant Development and Physiology (Chapters 22, 23, 24 and 25) (*ca 16 hours)*

a detailed examination of the life cycle of a flowering plant

The life of a plant –from dormant seed through germination and mature plant form– is presented in the context of the environmental and hormonal cues that trigger each developmental stage. At this point, the lectures will have evolved to being more central to the course, supplanting the textbook.

Lecture examinations (60% of final grade): two term tests and a final exam

The lecture and laboratory components are integrated (and usually synchronized). The final grade of the student is compiled from the combination of lecture and laboratory.

Laboratory Exercises

The majority of the material presented in laboratory exercises focuses on developing the observational skills of the students: observation and recording of gross form and structure (including the life cycle of a fern), and microscopic form and structure. Opportunities to identify material using keys –from algae, conifers to pollen– test and hone the student's observational skills.

Photosynthesis

Oxygen evolution (effect of different wavelengths of light and CO_2 availability).

Algae and Fern Life Cycles

Identification of algae using keys, observation of fern life cycle (4 week exercise).

Fungi

Diverse life cycles and unique forms and patterns of fungi are examined and documented; the major role of fermentation is examined experimentally; a complete fungal life cycle is observed (4 week exercise).

Bryophytes
Seedless Vascular Plants
Gymnosperms

Diverse life cycles and unique forms and patterns of lower land plants are examined and documented; keys are used to identify gymnosperm species.

Pollen Identification I
Pollen Identification II

The angiosperm life cycle relies upon fertilization of the flower by pollen; both identification of pollen (in the context of its use in documenting pre-historic vegetation and climate) and observation of the dynamics of the pollination process are examined.

Angiosperm Anatomy Project I
Angiosperm Anatomy Project II

A flowering plant is dissected to examine structure and anatomy using various staining techniques and microscopic observation; the culmination of the student's developing adeptness in observation.

Fruit and Vegetable Anatomy Project

An extra credit opportunity for students to explore the nutritional value and anatomy of a fruit or vegetable they select.

Laboratory marks (40% of final grade): quizzes (keying) and lab write-ups.

Learning Objectives

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Roger R. Lew, Professor of Biology, York University, Toronto, Ontario, Canada
Course Director, SC/BIOL 2010.040, 4 April 2012

[i] Table of Contents (Evert RF and SE Eichorn 2012 Raven Biology of Plants. Eighth Edition. (chapters covered are in bold font).