Department: BIOL

Course No: 110

Credits: 4

Title: Introduction to Botany

Contact: Kentwood D. Wells

Content Area: Grp 3 Science and Technology

Catalog Copy: BIOL 110. Introduction to Botany. Fall. 4 credits. Structure, physiology and reproduction of seed plants as a basis for an understanding of the broader principles of biology as well as the relation of plants to human life. Includes a survey of the important groups throughout the plant kingdom. Laboratory: required. Lecture: required. Students may not receive more than 12 credits for courses in BIOL at the 100 level

Course Information: a. BIOL 110 is a comprehensive introductory botany course designed for Biology majors with a particular interest in plant biology, or for majors in related fields who need a general introduction to concepts and principles of plant biology. The course provides a thorough introduction to modern plant biology, emphasizing the structure, function and diversity of green plants. The course goals are to provide: 1) basic background in anatomy, physiology, genetics, and evolution of plants necessary for advanced study in the biological sciences and related fields; 2) a varied and in-depth laboratory experience in content areas closely tied to lectures; and 3) develop skill in critical thinking and hypothesis testing important to any field of science.

b. The course requires that students average passing grades on 2 or 3 in-class, 1-hour exams and one final exam. Depending on the instructor, these exams may comprise multiple choice questions. Exams that are only part multiple choice also include short essays requiring some synthesis of lecture material and interpretive questions based on data presented as numbers, graphs and diagrams. The textbook is treated as supplementary to the lecture material, with each week of lecture covering parts of 1 to 2 chapters. The laboratory component comprises between 33 and 50% of the final grade, depending on the instructor, and is evaluated on the basis of quizzes, written problem sets and exercises and rigorously evaluated lab reports, in addition to a final practical exam.

c. Course content includes: Angiosperm morphology (flower structure, fruit types, leaf morphology), anatomy (primary and secondary growth, leaf structure), cell structure (cell and tissue types), and physiology (photosynthesis, respiration, plant hormones); Mendelian and population genetics; review of green plant phylogeny and diversity including green algae, mosses and related plants, ferns and related plants, gymnosperms and angiosperms, as well as lichens and fungi, which are traditionally covered in botany courses.

Meets Goals of Gen Ed: Goal 1 (Become articulate): In the laboratory portion of the course, students are required to write one or two reports based on data collected during experiments conducted in the laboratory. Each of these reports comprises four sections (Introduction, Materials/methods, Results and Discussion), emulating an actual published scientific paper. This exercise helps students become more literate by forcing them to individually articulate the results of their experiments.

Goal 2 (Acquire intellectual breadth and versatility): This course expands the intellectual breadth of students by increasing their knowledge and appreciation of the natural world, introducing them to abstract concepts, and forcing them to think rationally by carrying out hypothetico-deductive experiments in the laboratory. Many students are accustomed to considerable memorization in their high school courses, and are challenged in this course by our emphasis on the physiological processes that explain why plants work, the evolutionary processes that explain how they adapted to terrestrial life, and the ecological processes that allow them to avoid competition and sequester water and nutrients without the benefit of motility.

Goal 7 (Acquire a working understanding of the processes by which they can continue to acquire and use knowledge): Students in this course are introduced to the hypothetico-deductive method used by scientists, as well as inductive approaches used for historical questions (phylogeny). The understanding of how science works will be useful to students as they critically examine scientific and pseudoscientific claims throughout their life.

CA3 Criteria: 1. Explore an area of science or technology by introducing students to a broad, coherent body of knowledge and contemporary scientific or technical methods. Plant biology is broad, encompassing organisms so diverse that they occupy one of four traditional kingdoms of eukaryotes in the traditional Linnaean taxonomic hierarchy. BIOL 110 presents a coherent body of knowledge, incorporating up-to-date information about the anatomy, physiology, ecology, phylogeny and evolutionary biology of plants.

2. Promote an understanding of the nature of modern scientific inquiry, the process of investigation, and the interplay of data, hypotheses, and principles in the development and application of scientific knowledge. BIOL 110 teaches not only the traditional scientific method, involving hypothesis formation and experimental testing, but also inductive approaches used to answer historical questions in biology not open to direct experimentation. Students, for example, learn modern methods for inferring phylogenies from nucleotide sequence data in addition to conducting classic laboratory experiments designed to test hypotheses about the nature of the light and dark reactions of photosynthesis.

3. Introduce students to unresolved questions in some area of science or technology and discuss how progress might be made in answering these questions. Students are made aware of areas of active research in the plant sciences, and of outstanding and important unanswered questions.

4. Promote interest, competence, and commitment to continued learning about contemporary science and technology and their impact upon the world and human society. Green plants are the fuel that drives ecosystems, being the agents that capture solar energy and make it available to humans and other heterotrophic organisms. The central importance of plants to life on earth is

emphasized, and the relevance of plants to increasing atmospheric carbon dioxide concentrations, global warming, and human population growth makes this course not only educational but relevant to the lives of the students that take it.

CA3 Lab Criteria: The laboratory component of the course requires three contact hours per week on the part of students and their laboratory instructors. The laboratories are all hands-on, involving either series of experiments involving chemical or physical apparatus, greenhouse observations, microscopic examination of plant cells and tissues, dissection of living plants, scoring of the results of experimental hybridizations, or examination of living representatives of major plant groups. The labs that include the phrase "Introduces students to the structure, diversity and evolution of..." all involve examination of living material of representatives of a major group of plants.

Below is a representative laboratory schedule. Minor deviations from the laboratories occur depending on the faculty member in charge of the course in any given semester; however, deviations are minor and generally involve trials of innovative new laboratory experiments in an attempt to keep the laboratory part of the course contemporary and interesting.

Week 1: Walking tour of the greenhouse and campus to get an overview and appreciation of the diversity and adaptation of green plants.

Week 2: Angiosperm reproduction, with demonstrations of the diversity of fruit and infloresence types. Hands-on dissection of flowers to learn floral morphology and the major flower types, and understand the connection between flowers and fruits.

Week 3: Angiosperm classification, introduction to the use of dissecting and compound light microscopes, and practice examining plant cells under the microscope.

Week 4: Plant anatomy. Examination of prepared slides and sectioning fresh material for the purpose of understanding primary and secondary growth, root and shoot anatomy, and the structure of wood, bark, and monocot vs. dicot stems. Also, shoot and root evolutionary modifications are examined by students.

Week 5: Transpiration experiment. Hands-on experiment to determine what factors affect the rate at which plants lose water through transpiration, measure transpiration and estimate leaf conductance. Students may write a laboratory report on the transpiration experiments depending on the faculty member in charge of the course.

Week 6: Gymnosperms and Fossils. Introduces students to the structure, diversity and evolution of the non-flowering seed plants known as gymnosperms. Introduces students to the types of fossils that exist, and students are allowed to perform an acetate peel of an actual coal ball fossil.

Week 7: Early land plants. Introduces students to the structure, diversity and evolution of seedless vascular plants such as pteridophytes (ferns), lycophytes (club mosses), and sphenophytes (horsetails or scouring rushes).

Week 8: Bryophytes and algae. Introduction to the structure, diversity and evolution of bryophytes (mosses, liverworts, and hornworts), green algae, and other groups of algae not currently considered plants but that have traditionally been included in botany courses (e.g. cyanobacteria, diatoms, chrysophytes, and red and brown algae).

Week 9: Fungi and lichens. Introduction to the structure, diversity and evolution of fungi (basidiomycetes, ascomycetes, zygomycetes), as well as symbioses involving fungi and either cyanobacteria or green alge (lichens).

Week 10: Photosynthesis. Students conduct experiments to measure absorption of light of various wavelengths by chlorophyll extracted from leaves, investigate which wavelengths are most important for photosynthesis, and measure starch output from plants kept in the dark vs. exposed to light. Students may write a lab report on this lab depending on the faculty member in charge of the course.

Week 11: Respiration. Experiments are conducted to measure aerobic respiration in aquatic plants and anaerobic respiration in fungi (yeast).

Week 12: Genetics. Results of Mendelian monohybrid and dihybrid crosses are scored and analyzed statistically to illustrate the principles of segregation and independent assortment.

Generally, two weeks of lab are lost because of Labor Day and Thanksgiving, and the last week of lab is devoted to a lab practical exam, thus accounting for all 15 weeks of the semester.

Role of Grad Students: Graduate TAs teach all sections of the laboratory. Two TAs are present in each laboratory section, and there are generally three laboratory sections. The TAs are supervised by the laboratory coordinator as well as the faculty member in charge of the lecture component of the course. TAs are required to attend weekly meetings to familiarize themselves with the material to be taught the following week. New TA's are required to attend teaching workshops offered to all incoming teaching assistants in the university.