College of San Mateo
Official Course Outline

1. **COURSE ID:** BIOL 220 **TITLE:** General Botany **C-ID:** BIOL 210+220 = BIOL 130S; BIOL 210+220+230 = BIOL 135S
   Units: 5.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; 96.0-108.0 Lab hours; 96.0-108.0 Homework hours; 240.0-270.0 Total Student Learning hours
   Method of Grading: Letter Grade Only
   Prerequisite: Successful completion of Intermediate Algebra or equivalent, or placement by other measures as applicable.
   Recommended Preparation:
   BIOL 110, or BIOL 195 or equivalent biology course with lab and CHEM 192, or CHEM 210 or CHEM 410 or equivalent chemistry course with a lab.

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC
   AA/AS Degree Requirements:
   CSM - GENERAL EDUCATION REQUIREMENTS: E5a. Natural Science
   CSU GE:
   CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B2 - Life Science
   CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B3 - Laboratory Activity
   IGETC:
   IGETC Area 5: PHYSICAL AND BIOLOGICAL SCIENCES: B: Biological Science
   IGETC Area 5: PHYSICAL AND BIOLOGICAL SCIENCES: C: Science Laboratory

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Principles of biology as illustrated by plants with emphasis on structure, physiology, evolution, comparative diversity, and reproduction in plants, fungal, and protistan phyla. One or more field trips may be required. Extra supplies may be required.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Demonstrate an understanding of the characteristics, structural organization, developmental processes, and function of plants.
   2. Identify and describe plant structures and relate them to their functions, including transpiration, photosynthetic pathways, and energy and nutrient acquisition.
   3. Demonstrate an understanding of life cycles within and among major plant, fungal, and photosynthetic protist taxa.
   4. Provide evidence for evolution, construct and interpret phylogenetic relationships of major groups of plants, fungal, and photosynthetic protist taxa.
   5. Demonstrate an understanding of how organisms are organized into and interact within and among populations and communities.
   6. Describe the processes that occur within ecosystems including energy flow, and the role of nutrient cycling in maintaining ecosystem integrity.
   7. Perform, document, and analyze scientific experiments, and apply critical thinking and scientific reasoning skills.
   8. Demonstrate proficiency in the use of the compound microscope in the examination of cells, tissues, and organs, in plants, fungal, and photosynthetic protist taxa.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Demonstrate an understanding of the characteristics, structural organization, developmental processes, and function of plants.
   2. Identify and describe plant structures and relate them to their functions, including transpiration, photosynthetic pathways, and energy and nutrient acquisition.
   3. Demonstrate an understanding of life cycles within and among major plant, fungal, and photosynthetic

protist taxa.
4. Provide evidence for evolution, construct and interpret phylogenetic relationships of major groups of plants, fungal, and photosynthetic protist taxa.
5. Demonstrate an understanding of how organisms are organized into and interact within and among populations and communities.
6. Describe the processes that occur within ecosystems including energy flow, and the role of nutrient cycling in maintaining ecosystem integrity.
7. Perform, document, and analyze scientific experiments, and apply critical thinking and scientific reasoning skills.
8. Demonstrate proficiency in the use of the compound microscope in the examination of cells, tissues, and organs, in plants, fungal, and photosynthetic protist taxa.

6. **COURSE CONTENT:**

Lecture Content:

What is plant biology? (SLOs 1, 6)
The relationship of humans to their environment
Human and animal dependence on plants
Scientific experimentation and plant science inquiry

The nature of plant life (SLO 1)
Attributes of living organisms
Chemical and physical basis of life
Chemical components of cells

Plant cells and tissues (SLOs 1, 2, 8)
Plant cellular structure and cell components
Plastids and vacuoles
Cell membranes and the cell wall
Cellular reproduction and cell cycle
Meristems
Simple and complex tissues

Leaves, Stems, and Roots (SLOs 1, 2, 5 8)
Leaf arrangement and types
Internal structure of leaves
Stomata, mesophyll, and veins
Specialized leaves
Autumnal changes in leaves; abscission
Human and ecological relevance of leaves
Stems structure and development
External stem morphology
Tissue patterns in stems; steles
Herbaceous and woody dicotyledonous stems
Monocotyledonous stems
Specialized stems
Wood structure, uses and properties
Root structure and development
Specialized roots
Mycorrhizae; root nodules
Human relevance of roots

Flowers, Fruits and Seeds (SLOs 1, 2, 3, 5, 6)
Differences between dicots and monocots
Structure and types of flowers and fruits
Fruit and seed dispersal
Seed structure, germination, and longevity

Water in plants (SLOs 1, 2, 5, 6)
Molecular movement, diffusion, osmosis, imbibition, plasmolysis, active transport
The Cohesion-Tension Theory; regulation of transpiration; transport of organic molecules

The Pressure-Flow Hypothesis; mineral requirements for growth; macronutrients and micronutrients
Transpiration and the water cycle

Plant metabolism (SLOs 1, 2, 5, 6)
Enzymes and energy transfer; oxidation-reduction reactions
Photosynthesis: major steps, C3, C4, and CAM processes
Other significant processes that occur in chloroplasts
Respiration: major steps; factors affecting the rate of respiration
Additional metabolic pathways; assimilation and digestion
Photosynthesis and the carbon cycle

Plant breeding, growth, and propagation (SLOs 1, 2, 5, 6, 7)
Nutrients, vitamins, plants growth regulators
Interactions of plant growth regulators; photoperiod; phytochromes; dormancy.
Crop plant evolution
Plant breeding: using compatible and incompatible germplasm
Seed and asexual propagation

Evolution and Genetics in plants (SLOs 1, 2, 4, 6)
The study of evolutionary biology
Charles Darwin; evidence for evolution
Microevolution and macroevolution
Rates of evolution; allele frequencies
The role of hybridizations in evolution; apomixis; polyploidy
Plant names and classification
Development of the binomial system of nomenclature; Linnaeus
The International Code of Botanical Nomenclature
Development of the kingdom concept; classification of major groups
The species concept; the future of plant classification
Dichotomous keys

Kingdom Protista (SLOs 1, 3, 4, 5)
Features and classification of photosynthetic protist
Distinctions between protista and plants
Alternation of generations
Human and ecological relevance of algae

Kingdom Fungi (SLOs 1, 3, 4, 5, 6)
Distinctions between the protista, plants, and fungi
Features and classification of fungal phyla
Human and ecological relevance of fungi
Lichens
Human and ecological relevance of lichens

Bryophytes (SLOs 1, 2, 3, 4, 5, 6)
Structure, form, life cycles, classification, and ecological importance of representative bryophytes

The Seedless Vascular Plants (SLOs 1, 2, 3, 4, 5, 6)
Structure, form, life cycles, reproduction, and classification of representative seedless vascular plants, including fossils
Human and ecological relevance of seedless vascular plants

Seed Producing Plants (SLOs 1, 2, 3, 4, 5, 6)
Structure, form, life cycles, development of gametophytes, fertilization, seed development, and classification of representative phyla of gymnosperms
Human relevance of conifers and other gymnosperms
Structure, form, life cycle, development of gametophytes, fertilization, and development of seeds of representative flowering plants
Pollination ecology
Herbaria and methods of plant preservation

Trends of specialization and classification of flowering plants

Flowering plants and civilization (SLOs 1, 2, 5, 6)
Origin of selected families of cultivated plants

Ecology and Biomes (SLOs 1, 2, 5, 6)
Plants and the environment; life histories; natural cycles
Ecological succession; global climate changes; erosion; biodiversity
Impact of humans on plant communities
Restoration biology
Major biomes of North America: tundra; taiga; temperate deciduous forests; grasslands; deserts; mountain and coastal forests; intertidal zone (tide pools), and tropical rain forests.
Possible Field trips: Redwood forest ecosystem; Tide pools organisms survey; Edgewood Park chaparral, grassland, oak forest study

Lab Content:

Lab Content
The Biology 220 labs are designed to complement the material presented in lectures. Students complete and submit worksheets for each lab.

Lab 1: Introduction to the study of plants and plant structure (SLOs 1, 7)
Observation of characteristics of a diversity of terrestrial plants and their distinguishing features. Overview of lab procedures.

Lab 2: Plant cells and tissues (SLOs 1, 2, 8)
Observation of fresh samples and prepared microscope slides of plant tissues, and introduction or review of the proper use of the compound microscope.

Labs 3, 4, and 5: Leaves, Stems, and Roots (SLOs 1, 2, 5, 8)
Macroscopic and microscopic observation of leaves, stems, and roots. Study of the distinguishing features of the vegetative organs of Liliopsida, Magnoliopsida, and Gymnosperms. Study of specialized forms of leaves, stems, and roots.

Lab 6: Flowers, Fruits and Seeds (SLOs 1, 2, 3, 5)
Diversity of fleshy and dry fruits and dehiscent and indehiscent fruits. Study of the variation in flower morphology, fruit morphology, and seed structure and dispersal.

Lab 7: Water relations in plants (SLOs 1, 2, 5, 6, 7)
Study of osmosis, simple diffusion, plasmolysis, imbibition, and transpiration.

Lab 8: Photosynthesis (SLOs 1, 2, 5, 6, 7)
Separation of pigments by chromatography; study of the absorption spectrum of photosynthetic pigments; data collection using spectrophotometers; study of C3, C4, and CAM plants.

Lab 9: Plant Propagation (SLOs 1, 2, 5, 6, 7)
Propagation using seeds, leaf, and stem cuttings. Students maintain a notebook with sketches and measurements on the growth and development of germinated seeds and the growth of propagated plants and write and submit a paper following scientific protocol.

Lab 10: Kingdom Protista (SLOs 1, 3, 4, 5, 7)
Study of the features and classification of photosynthetic Protista; alternation of generations; fresh samples and microscope slides of representative photosynthetic protista. Discussion of human and ecological relevance of photosynthetic protista.

Lab 11: Bryophytes and Seedless Vascular Plants (SLOs 1, 2, 3, 4, 5)
Study of the distinguishing features, life cycles, and classification of bryophytes and seedless vascular plants using fresh samples and microscope slides of representative bryophytes and seedless vascular plants.

Lab 12: Seed-Producing Plants (SLOs 1, 2, 3, 4, 5)
Study of the distinguishing features, life cycles, and classification of seed-producing plants using

fresh samples and microscope slides or representative seed-producing plants.

Lab 13 and 14: Field Studies

Field trips to selected locations, including Redwood forest, tide pools, a Botanical Garden, or a local ecological preserve. (SLOs 1, 2, 4, 6)

Study of organisms, populations, and community interactions; ecological roles of organisms; ecological surveys or sampling and distribution of organisms.

TBA Hours Content:

This class has no TBAs.

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**

Typical methods of instruction may include:

A. Lecture
B. Lab
C. Activity
D. Critique
E. Directed Study
F. Discussion
G. Experiments
H. Field Experience
I. Field Trips
J. Guest Speakers
K. Observation and Demonstration
L. Other (Specify): • Lecture accompanied by computerized demonstrations and presentation materials, digital images, animations, simulations, audio and video content, and other supplementary learning materials • Laboratory work with fresh and preserved plant material, prepared slides, and experiments • Discussions • Field Trips to local parks, botanical gardens, tide pools, and other natural settings suitable for the observation and study of plants • Field Trip written reports; homework reports • Laboratory reports • Papers, oral, and poster presentations • Studies of model organisms for understanding genetic inheritance in plants

8. **REPRESENTATIVE ASSIGNMENTS**

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

Writing Assignments:
Written laboratory assignments clearly record each exercise: theoretical questions, experimental design, procedures, observations, summary, and interpretation of results. Assignments evaluate how well results compare to expectations, relate experiments and results to principles studied in lecture. Reports on field data collections and observations. Independent research into selected topics resulting in written paper, poster, and/or oral presentations demonstrating critical thinking and reasoning skills.

Reading Assignments:

Reading Assignments:
Reading college level textbook to understand lecture and laboratory concepts fully, illustrate points made in lecture, define terms, and provide examples. Reading appropriate relevant scientific papers.

Other Outside Assignments:

Students complete a paper using scientific protocol, using reliable scientific sources of information, and proper reference citations.

9. **REPRESENTATIVE METHODS OF EVALUATION**

Representative methods of evaluation may include:

A. Class Participation
B. Class Performance
C. Class Work
D. Exams/Tests
E. Field Trips
F. Group Projects
G. Homework
H. Lab Activities
I. Oral Presentation

J. Papers
K. Portfolios
L. Projects
M. Quizzes
N. Research Projects
O. Simulation
P. Written examination
Q. • lecture exams consisting of multiple-choice questions, fill-in questions, matching, short answer and essay questions. • lab practical examinations. • poster and oral presentation illustrating a plant family and its evolutionary features or a relevant current botanical topic. • individual field trip reports; lab reports; homework assignments; and other relevant botanical report.

10. **REPRESENTATIVE TEXT(S):**
Possible textbooks include:
A. Bidlack, J. and S. Jansky. *Stern's Introductory Plant Biology*, 15th ed. New York, NY: McGraw -Hill, 2020
B. Mauseth, J. D.. *Botany: An Introduction to Plant Biology*, 7th ed. Sadbury, MA: Jones & Bartlett Learning, 2021
C. Mary Ann Clark, Matthew Douglas, Jung Choi. *Biology 2e*, ed. Houston, TX: OpenStax, 2024

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Course Originator: Paul Hankamp