CENTRAL TEXAS COLLEGE
SYLLABUS FOR BIOL 1411
GENERAL BOTANY

Semester Hours Credit: 4

INSTRUCTOR:

I. INTRODUCTION
   A. Botany is the study of plants. Topics included in this course relate to the fundamental biological concepts relevant to plant physiology, life cycle, growth and development, structure and function, and cellular and molecular metabolism. The role of plants in the environment, evolution, and phylogeny of major plant groups, algae, and fungi. (This course is intended for science majors) In this introductory course, we will emphasize major biological principals as they relate to plants and plant-like organisms.

   B. This course is designed for the student who desires knowledge of the plant kingdom or the student that wants to go on into Botany-related (or Biology) fields such as agriculture, plant breeding, plant identification, horticulture, floriculture, forestry, medical school, dental school etc.

   C. Recommended prerequisite: MATH 1314 – Successful completion of College Algebra or concurrent enrollment in higher-level mathematics is recommended.

II. LEARNING OUTCOMES
   Upon successful completion of this course, General Botany, the student will:

   A. Compare and contrast the structures, reproduction, and characteristics of plants, algae, and fungi.

   B. Describe the characteristics of life and the basic properties of substances needed for life.

   C. Identify the principles of inheritance and solve classical genetic problems.

   D. Describe phylogenetic relationships and classification schemes.

   E. Identify the major phyla of life with an emphasis on plants, including the basis for classification, structural and physiological adaptations, evolutionary history, and ecological significance.

   F. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.

   G. Identify the substrates, products, and important chemical pathways in photosynthesis and respiration.
H. Describe the unity and diversity of plants and the evidence for evolution through natural selection.

I. Compare different sexual and asexual life cycles noting their adaptive advantages.

J. Describe the reasoning processes applied to scientific investigations and thinking.

K. Apply scientific reasoning to investigate questions and utilize scientific tools such as microscopes and laboratory equipment to collect and analyze data.

L. Use critical thinking and scientific problem-solving to make informed decisions in the laboratory.

M. Communicate effectively the results of scientific investigations.

N. Compare and contrast the structures, reproduction, and characteristics of plants, algae, and fungi.

O. Describe the characteristics of life and the basic properties of substances needed for life.

P. Identify the principles of inheritance and solve classical genetic problems.

Q. Describe phylogenetic relationships and classification schemes.

R. Identify the major phyla of life with an emphasis on plants, including the basis for classification, structural and physiological adaptations, evolutionary history, and ecological significance.

S. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.

T. Identify the substrates, products, and important chemical pathways in photosynthesis and respiration.

U. Describe the unity and diversity of plants and the evidence for evolution through natural selection.

V. Compare different sexual and asexual life cycles noting their adaptive advantages.

W. Describe the reasoning processes applied to scientific investigations and thinking.

III. INSTRUCTIONAL MATERIALS

A. The instructional materials identified for this course are viewable through www.ctcd.edu/books

IV. COURSE REQUIREMENTS

Students are expected to put in substantial effort to understand the concepts presented in general botany. This effort will include reading the text in advance.
of lecture, attendance in all classes, attentiveness and participation in class, maintenance of excellent class notes and regular study. Details are provided below:

A. You will be given a lecture schedule which details the reading requirements. Reading should always be done before the corresponding lecture to ensure that you have the appropriate background to understand the lecture material. Quizzes may be used to prompt reading prior to lecture.

B. You must take excellent notes during class. This means much more than simply copying anything the instructor writes on the board. You must include enough in your notes that you could repeat the lecture for someone else in your own words. If you are not sure whether your note-taking skills are sufficient for the course, make an appointment with your instructor after the first lecture to get an evaluation of your note taking and suggestions for improvement. Occasionally you will be given a note outline for lecture. DO NOT count only on the outline for your information. Take your own notes during class and then rewrite your study notes using the outline, class notes and associated information from your text.

C. Regular and punctual attendance is essential for success in this course. Tardiness is here defined as being more than 5 minutes late for any class meeting. A student will be considered absent if he or she misses more than ½ hour of class. Students who are consistently tardy and/or absent will be counseled and further penalties will result if the behavior continues. See the policy on excessive absence in the section below and in your student handbook.

D. If you must be absent from any class meeting, it is your responsibility to find out what happened in class while you were gone. Exchange contact information with one or more other students in class so that you can ask them what happened and secure any assignments which were given during your absence. Absence on a previous class day is no excuse for not having completed homework for the current class. The policy governing missed exams and quizzes is detailed below in the appropriate section.

E. This course, like most other science courses, builds on itself and on past courses. Concepts presented at the beginning of the course will recur, be expanded on and provide the foundation for later material. If you do poorly on an exam, it is important that you go back over the material to be sure that you understand it. If you do not, it will likely come back to haunt you later in the course.
F. Office hours are posted on your instructor’s office door. You are welcome to come by if you have any questions about anything in lecture or lab, or if you wish to ask about something that interests you. If you do not understand something, office hours are the time and place to be sure of getting help. If the office hours conflict with your schedule, your instructor will make an appointment to meet with you at a mutually convenient time.

G. Extra credit possibilities will be built into the plant collection project. This project is the main opportunity for extra credit in the course. No extra credit opportunities will arise after the 12th week of classes. See your instructor during office hours for possible activities and projects.

V. EXAMINATIONS AND SEMESTER GRADE COMPUTATION

<table>
<thead>
<tr>
<th>Assignment name</th>
<th>Points possible</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 midterm exams (100 points each)</td>
<td>400 points</td>
<td></td>
</tr>
<tr>
<td>(exams include a lab practical portion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Papers</td>
<td>100 points</td>
<td></td>
</tr>
<tr>
<td>Quizzes/Drawings/Homework</td>
<td>100 points</td>
<td></td>
</tr>
<tr>
<td>Plant collection</td>
<td>200 points</td>
<td></td>
</tr>
<tr>
<td>Final exam (part new material and part comprehensive)</td>
<td>100 points</td>
<td></td>
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<tr>
<td></td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>900 points possible</td>
<td></td>
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</tbody>
</table>

After one midterm exam is dropped, the total points possible will be 800.

To keep track of your current average in the course, make a chart for yourself showing points possible and points earned. Divide the total points you have earned by the total possible as of that date and find your percentage.

B. Make-up lecture examinations and lab practicals will not be given! One midterm exam grade will be dropped. If you have a legitimate conflict with a regularly scheduled lecture exam time, you must contact the instructor at least 24 hours in advance to arrange to take the exam early. If an emergency prevents you from making the exam, the first missed exam will be dropped. The second (or more) missed exams will be averaged in as a zero. Emergencies include any event that causes you to miss the exam: car problems, car wrecks, sick children, being sick yourself, oversleeping………etc.

C. Quizzes may not be made up. There will be one drop quiz grade. You are responsible for attending all labs. If you miss one lab, I will try to make
lab materials available to you if this is possible so that you may complete
the work on your own to earn the points for that lab. Additional missed
labs will result in zeros.

D. Papers and other assignments are due when class begins. Materials turned
in after class begins up to 24 hours late will receive a 20% deduction.
Papers later than 24 hours but less than one week late will receive a 50%
deduction. No homework, papers or projects will be accepted more than
one week late.

E. If you find that you are having a difficult time in this course, please
discuss the problem with your instructor. DO NOT simply stop coming to
class. YOU MUST fill out an official drop form and send it through the
records office to avoid having the instructor drop you with a grade of “F”
(FN). For more details, see the absentee policy in your college handbook.

F. Determination of Semester Grade (after lowest exam was dropped):

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Points</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%-100%</td>
<td>720-800 points</td>
<td>A</td>
</tr>
<tr>
<td>80%-89%</td>
<td>640-719 points</td>
<td>B</td>
</tr>
<tr>
<td>70%-79%</td>
<td>560-639 points</td>
<td>C</td>
</tr>
<tr>
<td>60%-69%</td>
<td>480-559 points</td>
<td>D</td>
</tr>
<tr>
<td>0%-59%</td>
<td>0 -479 points</td>
<td>F</td>
</tr>
</tbody>
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V. NOTES AND ADDITIONAL INSTRUCTIONS

A. Course Withdrawal
It is the student’s responsibility to officially withdraw from the class if
circumstances prevent attendance. Any student who desires to, or must,
officially withdraw from a course after the first scheduled class meeting
must file an Application for Withdrawal or an Application for Refund.
The withdrawal form must be signed by the student. Application for
withdrawal will be accepted at any time prior to Friday of the 12th week of
classes during the 16 week fall and spring semesters. The deadline for
sessions of other lengths is as follows:

- 10 week session: Friday of the 7th week
- 8 week session: Friday of the 6th week
- 5 week session: Friday of the 3rd week.

The equivalent date (75% of the semester) will be used for sessions of
other lengths. The specific last day to withdraw is published each
semester in the Schedule Bulletin.
A student who officially withdraws will be awarded the grade of “W”, provided the student’s attendance and academic performance are satisfactory at the time of official withdrawal. A student may not withdraw from a class for which the instructor has previously issued the student a grade of “F” or “FN”.

B. Administrative Withdrawal/Absence Policy

An administrative withdrawal may be initiated when the student fails to meet CTC attendance requirements. The instructor will assign the appropriate grade (usually FN—failure due to non-attendance) on the Administrative Withdrawal form for submission to the registrar. The CTC catalog states that a student may be administratively withdrawn from any class when absences exceed a total of eight (8) class meetings for a Spring or Fall semester class and in the opinion of the instructor the student cannot satisfactorily complete the course. This course (General Botany) meets 4 times each week: two lectures and two labs. Thus, if you miss two entire weeks of class, you will have missed eight classes and are subject to being dropped with a grade of FN. Students who register late have missed classes and begin the course with recorded absences. Regardless of the nature of the absence, the student is responsible for completing all course work covered during any absence. The final decision on administrative withdrawal rests solely with the instructor.

C. Incomplete grade

The college catalog states, “An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course…” Prior approval from the instructor is required before the grade of “IP” is recorded. A student who merely fails to show for the final exam will receive a zero for the final and an “F” for the course.

D. Americans with Disabilities Act (ADA): The Disability Support Services Program provides services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the main campus. This service is available to all students, regardless of location. Explore the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

E. Cellular phones, beepers and other electronic devices will be turned off while the student is in the classroom, lab or any other learning situation.
F. Instructor Discretion: The instructor reserves the right of final decision in course requirements and grades.

G. Audio tape recorders may be used in class as long as they do not distract the instructor or other students.

H. Cell phones and other electronic devices must be turned off and placed out of sight during exams. Presence of a visible cell phone or other electronic device during an exam constitutes cheating and will be treated accordingly.

I. Civility: Students are expected to conduct themselves with civility at all times in the college environment. Minimal civility includes:
1. Arrive at class on time; turn off your cell phone and put it out of sight.
2. Stay in class for the entire period
3. If it is unavoidable that you must leave early one day, inform the instructor of the situation prior to the start of class and position yourself in class near the door so that you do not disrupt others when you leave.
4. Talking, sleeping, reading or working on other material during class time is inappropriate. If you do so you will be asked to leave.
5. Use socially acceptable language in class.
6. Treat other class members with respect and consideration.
7. Please do not bring any family members, friends, or non-enrolled students to any class meeting or function. Children are never allowed in the lab, even during a makeup time.
8. Cellular phones and beepers will be turned off during lecture and lab.

J. Cheating in any form will not be tolerated. Students observed cheating will earn a zero on that work. The student will be dropped from the course for scholastic dishonesty. A formal charge against the student may be made to the College Disciplinary Board which could result in expulsion from the college. CHEATING IS TAKEN VERY SERIOUSLY. It will result in a permanent blight on your academic record.

VI. COURSE OUTLINE
A. Unit One: Introduction to plant biology, scientific method, basic chemistry, energetic: photosynthesis and cell respiration.
1. Learning Outcomes: Upon successful completion of this unit, the student will:
   a. Identify the importance and usefulness of plants to humans and in natural systems. Use specific examples.
   b. Explain why fungi, algae and bacteria are studied in botany courses.
   c. Correctly write scientific names.
d. Design a simple experiment and identify the independent, dependent and standardized variables.
e. Discuss the scientific process and the ways that science “self-corrects”. Include a discussion of peer review.
f. Distinguish between inductive and deductive reasoning.
g. Diagram and explain the significance of the summary photosynthesis and cellular respiration reactions.
h. Give examples of the importance of plants to ecological processes.
i. Identify major regions of plant domestication and give examples of plants domesticated in the Americas.
j. Give examples of the major genetic changes that occurred in the domestication of corn (Maize).
k. Identify the chemicals basic to life and those especially important in plants.
l. Use models and diagrams to represent the four classes of macromolecules and explain their importance in plant cells.
m. Describe the major categories of secondary compounds in plants. Give examples of functions of some common secondary compounds.
n. Recognize plant cells and structures unique to them. Know the functions of the major organelles.
o. Describe how vacuoles are important to plant cell growth and storage.
p. Describe the structure and functions of plant cell walls in detail.
q. Describe the important transport process that move materials into and out of plant cells including: osmosis, diffusion, facilitated diffusion, active transport.
r. Explain the fundamental reactions that are used to store and transfer energy within living organisms.
s. Explain the purpose and major processes involved in photosynthesis.
t. Discuss the structure of the chloroplast in relation to the photosynthesis reactions.
u. Outline the two sub-reactions for photosynthesis.
v. Discuss the role of chlorophyll in the photosynthesis reaction and explain why leaves look green in relation to the electromagnetic spectrum.
w. Compare and contrast the photosynthetic pathways in C3, C4 and CAM plants.
x. Describe the structure and function of leaf stomata and the processes involved in stomatal control.
y. Compare and contrast the available energy produced through aerobic and fermentation processes.
z. Discuss the major events of glycolysis, the Kreb’s cycle and the electron transport chain.

aa. Compare chemiosmosis in photosynthesis and cellular respiration.

bb. Explain the 4 major sub-reactions of cellular respiration.

c. Explain the processes that occur in the electron transport chain, and how these differ from the processes occurring in the Kreb’s cycle (Citric acid cycle).

dd. Discuss the structure of the mitochondrion in relation to the cellular respiration reactions

2. Learning Activities

a. Classroom lecture

b. Read chapters before class relevant class sessions

c. Laboratory study (see below)

d. Quizzes and homework as needed.

3. Laboratory Assignments

a. Organic molecules

b. Macromolecules

c. The microscope

d. The plant cell

e. Experimental design

f. Begin plant collection

C. Unit Two: DNA replication, transcription, translation; Mitosis; Plant body; Stems; Roots; Movement of water, nutrients and sugars in plants

1. Learning Outcomes: Upon successful completion of this unit, the student will:

a. Describe the structure of DNA, and relate DNA structure to chromosome structure.

b. Describe the process of DNA replication.

c. Describe the process of DNA transcription and translation during protein production.

d. Explain how gene expression is regulated.

e. Distinguish between somatic and germ-line mutations.

f. Compare the growth of plants to the growth of animals; explain the meristem concept. Discuss the locations of meristems in angiosperms.

g. Compare the purpose, location and outcome (chromosome number) of meiosis and mitosis.
h. Diagram the cell cycle. Note where chromosome replication occurs.
i. Describe the stages of mitosis and explain how the process results in the outcome of equal chromosome number in mother and daughter cells. Use models to manipulate chromosomes through the steps of mitosis. Recognize the stages of mitosis in a prepared onion root tip slide.
j. Explain some uses of genetic engineering and discuss the pros and cons of introducing genetically engineered organisms to the environment.
k. Describe some examples of genetic engineering in plants.
l. List some potential benefits and drawbacks of genetic engineering.
m. Describe the steps of dicot seed germination and the parts of a seedling in lab.
n. Compare and contrast the seed structure and early development of monocots and dicots.
o. Discuss the controls of seed germination and dormancy.
p. Evaluate the effects of a specific germination factor on seed germination in lab.
q. Discuss the functions of vascular tissue in the plant body. Compare the structure and function of xylem and phloem cells.
r. Discuss the structure of dermal tissue and specialization of dermal cells.
s. Sketch leaf cross sections of monocots and dicots and a dermal peel showing stomata.
t. Describe the basic requirements of photosynthetic organisms and explain how these requirements are met in angiosperms.
u. Identify certain plants within your collection as belonging to the legume (Fabaceae) and sunflower (Asteraceae) plant families.
v. Compare and contrast the pattern of the 3 major tissue systems in the monocot and dicot shoot.
w. Sketch the tissue arrangements of monocot and dicot stems from the microscope. Label the tissue regions in the sketch.
x. Discuss the functions of ground tissue in roots, stems, and leaves.
y. Discuss the function of stems. Describe the two basic patterns of shoot tissues in angiosperms.
z. Discuss how leaves and stems have been modified for various functions in addition to photosynthesis.
aa. Describe the process of transpiration and explain how it both helps and hinders plant growth and survival.
bb. Describe the movement of a single molecule of water from the soil space until it exits through a stoma. What factors influence the opening and closing of stomata?

cc. Explain the cohesion-tension theory of water movement in plants.

dd. Explain the pressure-flow hypothesis of sugar movement in phloem. Explain how sugar is moved in and out of the phloem.

ee. Label the shoot apical meristem in a drawing and explain how the meristem develops.

ff. List groups of plants that exhibit secondary growth.

gg. Describe the two lateral meristems and explain how they develop from the primary dicot stem.

hh. Explain which tissue layers are lost during secondary growth of the vascular cambium and why this occurs. Describe which tissue types are added during secondary growth. Explain where they are added.

ii. Name the layers of the periderm and describe their functions.

jj. Explain which layers of the stem are part of the bark. Distinguish between inner and outer bark.

kk. Explain the function of lenticels and how they are helpful in plant identification.

ll. Describe the major properties of wood including the type of tissue from which it forms, why it has rings, what information can be inferred from the study of rings and the differences between heartwood and sapwood.

mm. Discuss the function of roots. Describe the two basic patterns of root growth in angiosperms.

nn. Explain how water and minerals are transported into the root’s xylem.

oo. Describe the structure of the root tip in detail and explain how cells at any given point change and the entire root grows.

pp. Describe the arrangement of the 3 tissue types in a cross section of a young monocot and dicot roots.

qq. Describe the structure, significance and location of the endodermis. Describe the origin of lateral roots.

rr. Name the essential plant macronutrients as described in class. List the sources of each nutrient. List some symptoms of nutrient deficiency in plants.

ss. Discuss the structure of soil and explain how soils act as a reservoir for nutrients, oxygen and water.

tt. Explain the main components of the nitrogen cycle and some important adaptations of plants to low nitrogen conditions.
uu. Describe several special adaptations of roots.
vv. Sketch cross sections of monocot and dicot roots from prepared microscope slides. Label the various tissues visible in the preparations.

2. Learning Activities
   a. Classroom lecture
   b. Read chapters before class relevant class sessions
   c. Laboratory study (see below)
   d. Quizzes and homework as needed.

3. Laboratory Activities
   a. DNA replication, transcription, translation
   b. Mitosis
   c. Root structure
   d. Stem structure
   e. Specialization of plant parts
   f. Continue plant collection

D. Unit three: Leaves—photosynthesis and transpiration; Plant behavior, hormones and taxis; Meiosis and alternation of generation; Biological evolution

1. Learning Outcomes: Upon successful completion of this unit, the student will:

   a. Compare the tissue patterns in cross sections of various monocot and dicot leaves.
   b. Compare and contrast leaves of aquatic, mesic and desert plants. Relate these differences to habitat requirements.
   c. Give a variety of examples of leaf specialization and explain their ecological significance.
   d. Identify leaf specializations in lab.
   e. Relate leaf structure to photosynthesis in C-3, C-4 and CAM plants.
   f. Sketch the tissue arrangements of CAM and C4 plants from the microscope and relate the structure to the physiology of these plant types.
   g. Explain the processes of leaf abscission and the development and cause of fall leaf color.
   h. List the 5 categories of plant hormones. Explain whether these hormones regulate or stimulate.
   i. List a few of the effects of each group of hormones as described in class.
   j. Explain how light and gravity affect the growth of plants. Relate these effects to plant hormones.
k. Define circadian rhythm and give examples of circadian rhythms in plants.
l. Define and give examples of thigmotropism. How is it controlled?
m. Explain the effects of photoperiodism in flowering plants
n. Explain the significance of phytochromes
o. Define growth movements and give examples and control mechanisms for these movements.
p. Describe the life cycle of a typical angiosperm.
q. Discuss the evolutionary origin of angiosperms and the significance of pollinators in the evolution of angiosperms.
r. Discuss the process of pollination, growth of the pollen tube and double fertilization in angiosperms.
s. Define a fruit and give examples of fleshy and dry fruits, dehiscent and indehiscent fruits as discussed in class.
t. Identify flower components on a variety of flower from different families in lab.
u. Identify fruit types in lab.
v. Explain the processes that ‘substitute’ for mitosis and meiosis in photosynthetic organisms that are not in the Kingdom Plantae.
w. Describe the three fundamental patterns of life cycles
x. Describe the stages of meiosis and explain how this process results in cells with half of the normal chromosome number.
y. Explain why meiosis is necessary in many photosynthetic organisms.
z. Recognize the stages of meiosis in diagrams. Create a diagram with specific set of chromosomes and indicated genes showing the effect of meiosis (including crossing over and segregation) on gene distribution in gametes.
aa. Explain the process of natural selection and give specific examples.
bb. Describe the major stages and timing of plant evolution.
cc. Describe the evidence Darwin and Wallace used to develop their ideas about evolution by natural selection.
 dd. Explain how biogeography provides evidence of evolution.
ee. Explain how molecular evidence is used today to understand the evolutionary history of plants.
ff. Discuss the various sources of genetic variability
gg. Describe the various concepts of the term “species”
hh. Discuss several ways that speciation may occur.
ii. Describe the system of binomial nomenclature.
jj. Discuss the basis for our modern system of classification.
2. Learning Activities
   a. Classroom lecture
   b. Read chapters before class relevant class sessions
   c. Laboratory study (see below)
   d. Quizzes and homework as needed.

3. Laboratory Assignments
   a. Leaf structure
   b. Leaf and Twig anatomy
   c. C3 and C4 leaf anatomy
   d. Meiosis
   e. classification labs on protista, fungi, bryophytes and seedless vascular plants
   f. Graphing
   g. Scientific paper
   h. Continue plant collection

E. Unit Four: Taxonomy; Cyanobacteria and protists; Fungi and lichens; Non-vascular plants; Seedless vascular plants.

1. Learning Outcomes: Upon successful completion of this unit, the student will:
   a. Know the characteristics of the Domains and Kingdoms of life.
   b. Compare and contrast prokaryotic and eukaryotic cell structure.
   c. Discuss how life has altered the atmosphere.
   d. Give examples of disease organisms and their corresponding human diseases.
   e. Explain how prokaryotic reproduction is different from reproduction in eukaryots. How do prokaryots maintain genetic diversity?
   f. Discuss the importance of the cyanobacteria to humans.
   g. Describe the characteristics of the major groups of photosynthetic protists and their evolutionary relationships to each other and to the Kingdoms Plantae and Fungi.
   h. Identify common protista microscopically in lab.
   i. Explain the life cycle of the common rockweed.
   j. Give examples of the many uses of algae by humans.
   k. Discuss the hypothesis for the origin of chloroplast and mitochondria in eukaryotic cells.
   l. Identify the structures and ploidy within representative algal life cycles.
   m. Discuss how the fungal body and fungal nutrition differ from the other organisms studied in this course.
n. Explain why many fungal groups produce both sexual and asexual spores.

o. Describe the 5 traditional groups of fungi. And give examples of each.

p. Distinguish between the life cycles of ascomycota, basidiomycota, zygomycota and the fungi imperfecti.

q. Distinguish between monokaryotic, dikaryotic and diploid hyphae. Identify these stages in fungal life cycles.

r. Describe the nutritional strategies of fungi including decomposition, parasitism, and mycorrhizal relationships.

s. Describe the structure and ecological role of lichens.

t. Name the three groups of non-vascular plants. Identify examples of these groups in lab.

u. Describe, diagram and name the specific structures involved in the life cycle of mosses and liverworts.

v. Describe the adaptations that allowed plants to make the move to land.

w. Describe the life cycle of a typical seedless vascular plant.

x. Give examples of the major groups of seedless vascular plants.

y. Identify the life cycles and specialized structures of lycophodium, selaginella, Equisetum, and ferns.

z. Explain the main differences between vascular and non-vascular plants.

aa. Identify mosses, liverworts, ferns, horsetails, and other non-vascular and spore producing vascular plants in the lab setting from specimens and/or photos.

2. Learning Activities
   a. Classroom lecture
   b. Read chapters before class relevant class sessions
   c. Laboratory study (see below)
   d. Quizzes and homework as needed.

3. Laboratory Assignments
   a. Survey of Cyanobacteria and Protista
   b. Survey of Fungi
   c. Survey of Bryophyta
   d. Survey of seedless vascular plants
   e. Plant collection completed
B. Unit 5: Gymnosperms; Angiosperm reproduction and diversity; Coevolution in flowering plants; Principles of ecology; Arid ecosystems; Mesic ecosystems; Aquatic ecosystems; Human impacts and sustainability.

1. Learning Outcomes: Upon successful completion of this unit, the student will:
   a. Name and give the characteristics of the four phyla of living gymnosperms.
   b. Describe/diagram or label the life cycle of a conifer.
   c. Give examples of economically important gymnosperms.
   d. Give examples of economically important angiosperm families and species.
   e. Discuss several reproductive advantages of seeds over spores.
   f. How are gnetophytes similar to angiosperms? Does this mean that gnetophytes are angiosperm ancestors? Explain.
   g. Compare the life cycles of angiosperms and gymnosperms.
   h. Identify common flower structures in a variety of flower types including: petals, sepals, stamens, pistils, number of carpels, superior and inferior ovary, staminate and carpellate flowers, regular and irregular flowers.
   i. Identify various inflorescence types including: panicle, spike, catkin, raceme, umbel, compound umbel and head.
   j. Identify the structures of the early and late embryo and relate these structures to the ovary and ovule.
   k. Identify fruits as simple or complex. Catagorize simple fruits as fleshy or dry and dry fruits as dehiscent or indehiscent.
   l. Compare the patterns of seed development in beans, peas and corn.
   m. Give examples and discuss the importance of coevolution between pollinators and flowering plants.
   n. Identify examples of flower types (structure and color) in lab that are pollinated by various categories of pollinators.
   o. Recognize angiosperm reproductive strategies: protandry, protogyny, dioecy, monoecy etc.
   p. Explain how flower position and structure control pollinator access. Give examples.
   q. Give examples of flower traits that are typical for various types of pollinators. Relate to coevolution of plants and pollinators.
   r. Give examples of how animals have co-evolved as seed dispersers.
   s. Discuss the locations and vegetation patterns of the major biomes. Explain the factors that influence the distribution of these biomes.
Discuss the major factors affecting distribution of world biomes.
Discuss the factors affecting biome distribution on a continental scale.
Diagram the water cycle, the carbon cycle and the nitrogen cycle.
Define the term niche. Give examples of various plant niches and the abiotic factors which define them.
Give examples of plant adaptations to arid biomes.
Where are major arid biomes located in the world? Where are the major arid biomes in North America?
What specific adaptations do succulent plants have to arid environments?
List four major reasons grasslands are important to humans.
What roles do fire and grazing play in grass biology?
How is grass reproduction suitable for prairie life?
Name and describe the locations of moist terrestrial ecosystems in North America.
Give examples of plant adaptations in each moist terrestrial ecosystem.
Besides temperature, how does the climate of a tropical rain forest differ from that of temperate deciduous forest?
How are water and mineral cycling different in tropical rain forest than in temperate forests?
What are the major causes of acid rain and how does acid rain affect forest ecosystems?
Describe and give examples of plants that live in major freshwater ecosystems.
Discuss the services provided by freshwater and marine ecosystems.
What are major lines of evidence that the earth is currently warming?
What are the major human inputs into global warming?
Draw an accurate human population growth curve. Discuss your prediction for human population growth in the future. Relate the growth pattern you predict to the growth curves for typical populations of plants and animals. What might be some limiting factors for human population growth?
In addition to global warming and acid rain, what are some other major ecological consequences of human population growth?
Discuss the various mechanisms by which global warming is likely to affect arid, moist and aquatic ecosystems.
Discuss the causes of desertification.
Discuss the consequences of loss of biological diversity.
2. Learning Activities
   a. Classroom lecture
   b. Read chapters before class relevant class sessions
   c. Laboratory study (see below)
   d. Quizzes and homework as needed.

3. Laboratory Activities
   a. Survey of gymnosperms
   b. Plant-pollinator interactions
   c. Plant adaptations to specialized environments.