

## WTCS Repository

# 10-806-184 Plant Biology

## Course Outcome Summary

### Course Information

**Description** This lecture/laboratory course provides students with an indepth study of the plant kingdom. The content includes, but is not limited to, plant cell anatomy and physiology, plant genetics, plant classification, plant anatomy and physiology, plant responses, plant life cycles, and ecology. A survey of viruses, prokaryotes, protista, and fungi as they pertain to plants is presented.

**Total Credits** 3.00

### Pre/Corequisites

**Prerequisite** Each Wisconsin Technical College determines the General Education course prerequisites used by their academic institution. If prerequisites for a course are determined to be appropriate, the final Course Outcome Summary must identify the prerequisites approved for use by the individual Technical College.

### Course Competencies

#### 1. Investigate the characteristics of living things

##### Assessment Strategies

1.1. through class discussions, quizzes and examinations

##### Criteria

*Your performance will be successful when:*

- 1.1. you list the characteristics of living things
- 1.2. you distinguish between growth, development and reproduction
- 1.3. you define homeostatis and give examples
- 1.4. you distinguish the levels of organization of living things

#### 2. Apply the scientific method to the biological sciences

##### Assessment Strategies

2.1. through class discussions, quizzes and examinations, and a written and oral report

##### Criteria

*Your performance will be successful when:*

- 2.1. you list the steps used in the scientific process
- 2.2. you develop an example utilizing the scientific method
- 2.3. you utilize inductive and deductive logic in the scientific method
- 2.4. you differentiate between the following terms: hypothesis, observation, theory, and law

### **3. Demonstrate a working knowledge of microscopes**

#### **Assessment Strategies**

3.1. through class discussions, quizzes and examinations, and a laboratory exercise and report

#### **Criteria**

*Your performance will be successful when:*

- 3.1. you name the parts of the compound microscope and the stereoscopic microscope
- 3.2. you describe the function of each of the parts of the microscope
- 3.3. you determine the total magnification of any given combination of ocular and objective lenses
- 3.4. you measure the field of view at 40x, 100x, and 470x magnification
- 3.5. you demonstrate the correct use of the compound microscope and the stereoscopic microscope

### **4. Apply basic biochemistry concepts as they relate to macromolecules**

#### **Assessment Strategies**

4.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

#### **Criteria**

*Your performance will be successful when:*

- 4.1. you define matter, energy and force
- 4.2. you identify bond types: covalent, ionic, and hydrogen (proton bonds) and name their basic structural subunits
- 4.3. you define the characteristics of water and name the basic structural subunits
- 4.4. you discuss acid-base balance and name the basic structural subunits
- 4.5. you discuss the nature of buffers and name the basic structural subunits
- 4.6. you describe the nature of synthetic and hydrolytic reactions and name the basic structural subunits
- 4.7. you name the four main types of organic molecules found in plants and their basic structural subunits
- 4.8. you describe the principal functions of each macromolecule
- 4.9. you distinguish between hydrolysis and dehydration synthesis and give an example of each
- 4.10. you distinguish between structural polysaccharides and energy storage polysaccharides and give an example of each
- 4.11. you define what an enzyme is and why enzymes are important to cells
- 4.12. you name the parts of an enzyme and describe the function of each part
- 4.13. you differentiate between ATP and ADP, and explain why ATP is important
- 4.14. you distinguish between primary and secondary metabolites
- 4.15. you name the main types of secondary metabolites and provide examples of each type

### **5. Investigate the plant cell and the cell cycle**

#### **Assessment Strategies**

5.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

#### **Criteria**

*Your performance will be successful when:*

- 5.1. you compare selected features of prokaryotic and eukaryotic cells -- size, cell wall, nuclear envelope, DNA, organelles, and cytoskeleton
- 5.2. you name the various types of plastids and what role(s) each plays
- 5.3. you describe the cytoskeleton and its functions
- 5.4. you describe how primary cell walls differ from secondary cell walls
- 5.5. you describe the cell cycle and its regulation
- 5.6. you describe the key events that occur in the G<sub>1</sub>, S, G<sub>2</sub>, and M phases of the cell cycle
- 5.7. you explain what mitosis is
- 5.8. you identify each of the four phases of mitosis, using a microscope
- 5.9. you describe what events occur in each of the four phases
- 5.10. you describe cytokinesis

## 6. Investigate the movement of substances into and out of cells

### Assessment Strategies

- 6.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### Criteria

*Your performance will be successful when:*

- 6.1. you explain the concept of water potential
- 6.2. you distinguish between osmosis and diffusion
- 6.3. you describe the fluid mosaic model of the cell membrane
- 6.4. you describe the role played by its two major components
- 6.5. you explain the role of transport proteins in the movement of materials across the cell membrane
- 6.6. you describe the similarities and differences between facilitated diffusion and active transport
- 6.7. you describe vesicle-mediated transport
- 6.8. you describe the roles of signal transduction and plasmodesmata in cell-to-cell communication

## 7. Investigate the flow of energy in living systems

### Assessment Strategies

- 7.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### Criteria

*Your performance will be successful when:*

- 7.1. you describe how the first and second laws of thermodynamics apply to living systems
- 7.2. you explain why oxidation-reduction (redox) reactions are important to living systems
- 7.3. you describe some of the factors that influence enzyme activity
- 7.4. you describe how feedback inhibition regulates cellular activity
- 7.5. you describe coupled reactions
- 7.6. you explain how ATP functions as an intermediate between exergonic and endergonic reactions

## 8. Investigate cellular respiration

### Assessment Strategies

- 8.1. through class discussion, quizzes and examinations, a laboratory exercise and report, and by developing a concept map

### Criteria

*Your performance will be successful when:*

- 8.1. you outline the main events of respiration -- glycolysis, the transition reaction, the citric acid cycle, oxidative phosphorylation (electron transport and chemiosmosis), and fermentation
- 8.2. you differentiate between aerobic and anaerobic respiration
- 8.3. you explain how glycolysis and fermentation are related
- 8.4. you explain the central role of the citric acid cycle in the metabolism of the cell

## 9. Investigate photosynthesis

### Assessment Strategies

- 9.1. through class discussion, quizzes and examinations, a laboratory exercise and report, and by developing a concept map

### Criteria

*Your performance will be successful when:*

- 9.1. you explain the role of light in photosynthesis
- 9.2. you name the principal pigments involved in photosynthesis
- 9.3. you explain why leaves are green
- 9.4. you separate the photosynthetic pigments using paper chromatography and thin layer chromatography
- 9.5. you name the reactants and products of the light dependent reactions
- 9.6. you name the reactants and products of the light independent reactions
- 9.7. you describe the main events associated with each of the two photosystems in the light reactions
- 9.8. you differentiate between antenna pigments and reaction center pigments
- 9.9. you describe the differences and similarities between C<sub>3</sub>, C<sub>4</sub>, and CAM pathways for carbon fixation

- 9.10. you describe the absorption spectrum
- 9.11. you describe the action spectrum
- 9.12. you prepare an action spectrum for the pigments in spinach leaves, using a spectrophotometer

## **10. Investigate sexual reproduction and heredity**

### **Assessment Strategies**

- 10.1. through class discussion, quizzes and examinations, a laboratory exercise and report, and by performing genetic crosses using living plants (e.g., Wisconsin Fast Plants)

### **Criteria**

*Your performance will be successful when:*

- 10.1. you relate the haploid and diploid chromosome number, meiosis, and fertilization
- 10.2. you explain the importance of crossing over
- 10.3. you list the main events of meiosis I
- 10.4. you explain how meiosis I differs from meiosis II
- 10.5. you compare the advantages and disadvantages of sexual and asexual reproduction
- 10.6. you summarize the major findings of Gregor Mendel and explain the unique aspects of his experimental method
- 10.7. you explain why a trait is visible in the parent but not in the offspring
- 10.8. you explain how a test cross is performed and its importance
- 10.9. you explain the concept of linked genes
- 10.10. you explain how the concept of linked genes is at odds with independent assortment
- 10.11. you list and give examples of different types of mutations
- 10.12. you explain how mutations affect the evolution of a population of organisms

## **11. Investigate the chemistry of heredity and gene expression**

### **Assessment Strategies**

- 11.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### **Criteria**

*Your performance will be successful when:*

- 11.1. you explain how DNA replication occurs
- 11.2. you explain what the genetic code is
- 11.3. you describe the main steps in transcription of RNA from DNA
- 11.4. you explain where translation occurs
- 11.5. you list the major steps of translation
- 11.6. you explain how gene expression is regulated in eukaryotes
- 11.7. you extract DNA from living cells

## **12. Investigate recombinant DNA technology, plant biotechnology, and genomics**

### **Assessment Strategies**

- 12.1. through class discussion and quizzes and examinations

### **Criteria**

*Your performance will be successful when:*

- 12.1. you explain how recombinant DNA technology is used to create novel genotypes
- 12.2. you discuss the importance of *Arabidopsis thaliana* as a model organism
- 12.3. you describe some of the techniques used in plant biotechnology to manipulate the genetic potential of plants
- 12.4. you explain what genomics is
- 12.5. you explain how one determines the function of a newly discovered gene

## **13. Examine the concepts of evolution**

### **Assessment Strategies**

- 13.1. through class discussion and quizzes and examinations

## Criteria

*Your performance will be successful when:*

- 13.1. you explain the difference between static and dynamic views of species
- 13.2. you describe five lines of evidence supporting the evolutionary process
- 13.3. you describe the Darwinian view of change over time
- 13.4. you distinguish the Darwinian view from inheritance of acquired characteristics
- 13.5. you distinguish natural from artificial selection
- 13.6. you identify each of Darwin's postulates
- 13.7. you provide evidence in support of each postulate
- 13.8. you relate evolution to Mendelian genetics
- 13.9. you recognize that evolution acts on phenotypes, not genotypes
- 13.10. you recognizes that populations, not individuals, evolve
- 13.11. you state the Hardy-Weinberg law
- 13.12. you demonstrate mathematically that gene frequency doesn't change in a non-evolving population
- 13.13. you identify five agents that can change gene frequency in a gene pool
- 13.14. you explain how each agent can alter frequency
- 13.15. you describe allopatric and sympatric speciation
- 13.16. you explain genetic isolation
- 13.17. you define co-evolution
- 13.18. you give examples of co-evolution

## 14. Investigate systematics

### Assessment Strategies

- 14.1. through class discussion, quizzes and examinations, and by preparing a cladogram

### Criteria

*Your performance will be successful when:*

- 14.1. you explain what binomial system of nomenclature is
- 14.2. you explain why the term "hierarchical" is used to describe taxonomic groups
- 14.3. you name the principal categories between the levels of species and kingdom
- 14.4. you explain what a cladistic analysis is
- 14.5. you draw a cladogram for mosses, ferns, pines, and oaks
- 14.6. you provide evidence for the existence of the three major domains of living organisms
- 14.7. you compare the major characteristics of each of the four kingdoms of eukaryotes

## 15. Investigate viruses and prokaryotic organisms

### Assessment Strategies

- 15.1. through class discussion, quizzes and examinations, and by preparing a cladogram

### Criteria

*Your performance will be successful when:*

- 15.1. you describe the basic structure of a prokaryotic cell
- 15.2. you explain how prokaryotes reproduce
- 15.3. you describe ways for genetic recombination to occur in prokaryotes
- 15.4. you explain the importance of cyanobacteria
- 15.5. you compare the metabolism of cyanobacteria and the purple and green bacteria
- 15.6. you explain how mycoplasmas differ from all other bacteria
- 15.7. you describe the physiology of the three groups of archaea
- 15.8. you describe the basic structure of a virus
- 15.9. you describe how viruses reproduce

## 16. Investigate the protists

### Assessment Strategies

- 16.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

## Criteria

*Your performance will be successful when:*

- 16.1. you explain how dinoflagellates, euglenoids, and cryptomonads are similar
- 16.2. you explain how oomycetes differ from other heterokonts
- 16.3. you list important plant disease causes by oomycetes
- 16.4. you list the basic characteristics of brown algae
- 16.5. you list the basic characteristics of red algae
- 16.6. you describe the characteristics of green algae that have led botanists to conclude that green algae are the protist group from which bryophytes and vascular plants evolved

## 17. Investigate fungi

### Assessment Strategies

- 17.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

## Criteria

*Your performance will be successful when:*

- 17.1. you name the characteristics of fungi that differentiate them from all other organisms
- 17.2. you describe the type of organism it is thought that fungi evolved from
- 17.3. you list the distinguishing characteristics of the Chytridomycota, Zygomycota, Ascomycota, and Basidiomycota
- 17.4. you explain the relationship of yeast to filamentous fungi
- 17.5. you explain how conidial fungi are related to other fungi
- 17.6. you describe some of the symbiotic relationships between fungi and other organisms
- 17.7. you describe the ecological importance of fungi

## 18. Investigate bryophytes

### Assessment Strategies

- 18.1. through class discussion, quizzes and examinations, and by preparing a correctly labeled drawing of the life cycle of *Polypodium* sp.

## Criteria

*Your performance will be successful when:*

- 18.1. you explain the concept of alternation of generations
- 18.2. you describe the general characteristics of a bryophyte
- 18.3. you compare the three phyla of bryophytes
- 18.4. you describe the life cycle of a bryophyte
- 18.5. you identify the parts of sporophyte
- 18.6. you identify the parts of the gametophyte
- 18.7. you compare the structure and form of the liverworts, hornworts, and mosses

## 19. Investigate seedless vascular plants

### Assessment Strategies

- 19.1. through class discussion, quizzes and examinations, a laboratory exercise and report, and by preparing correctly labeled drawings of the life cycles of a zygomycete, an ascomycete, and a basidiomycete

## Criteria

*Your performance will be successful when:*

- 19.1. you list "pivotal step" in the evolution of vascular plants that account for their success on land
- 19.2. you explain the difference between microphylls and megaphylls
- 19.3. you explain the evolutionary origin of each -- microphylls and megaphylls
- 19.4. you compare homosporous with heterosporous
- 19.5. you describe the life cycle of a fern (*Polypodium*)
- 19.6. you compare the structure and form of the whisk ferns, club mosses, quillworts, horsetails, scouring rushes, and ferns

## **20. Investigate the evolution and life cycle of gymnosperms**

### **Assessment Strategies**

- 20.1. through class discussion, quizzes and examinations, and by preparing a correctly labeled drawing of the conifer life cycle

### **Criteria**

*Your performance will be successful when:*

- 20.1. you discuss the importance of the seed in the evolution of plants  
20.2. you discuss what group of plants it is hypothesized that seed plants evolved from  
20.3. you draw and label the life cycle of conifers  
20.4. you name the four phyla of gymnosperms with living representatives

## **21. Investigate reproduction in angiosperms**

### **Assessment Strategies**

- 21.1. through class discussion, quizzes and examinations, a laboratory exercise and report, and by preparing a correctly labeled drawing of the angiosperm life cycle

### **Criteria**

*Your performance will be successful when:*

- 21.1. you identify the principal parts of a flower  
21.2. you describe some of the variations that exist in flower structure  
21.3. you compare the processes by which angiosperms form microgametophytes and megagametophytes  
21.4. you describe the structure of the mature microgametophyte in angiosperms  
21.5. you describe the structure of the mature megagametophyte in angiosperms  
21.6. you describe double fertilization  
21.7. you name the products of double fertilization

## **22. Investigate the evolution of angiosperms**

### **Assessment Strategies**

- 22.1. through class discussion, quizzes and examinations

### **Criteria**

*Your performance will be successful when:*

- 22.1. you state the current hypothesis on the origin of angiosperms  
22.2. you list the four principal evolutionary trends among flowers  
22.3. you compare different methods of pollination  
22.4. you describe some of the adaptations of fruits to their dispersal agents  
22.5. you describe how secondary metabolites have influenced angiosperm evolution

## **23. Investigate early development of the plant body**

### **Assessment Strategies**

- 23.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### **Criteria**

*Your performance will be successful when:*

- 23.1. you explain why polarity is important to plant embryogenesis  
23.2. you name the primary meristems of plants  
23.3. you list the tissues each of these meristems forms  
23.4. you compare the embryogenesis of monocots and dicots  
23.5. you explain how mutations have helped scientists to understand embryo development  
23.6. you identify the main parts of the monocot embryo and the dicot embryo  
23.7. you plant seeds of monocots and dicots to compare their development

## **24. Investigate cells and tissues of the plant body**

### **Assessment Strategies**

- 24.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

## Criteria

*Your performance will be successful when:*

- 24.1. you describe the composition of a meristem
- 24.2. you describe the overlapping processes of plant development
- 24.3. you identify the three tissue systems of the plant body
- 24.4. you identify the tissues that comprise each of these tissue systems
- 24.5. you identify parenchyma, collenchyma, and sclerenchyma cells
- 24.6. you compare parenchyma, collenchyma, and sclerenchyma cells
- 24.7. you identify the principal conducting cell in xylem
- 24.8. you identify the principal conduction cell in phloem
- 24.9. you list the characteristics of each cell type
- 24.10. you list the roles played by the epidermis

## 25. Investigate root structure and development

### Assessment Strategies

- 25.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### Criteria

*Your performance will be successful when:*

- 25.1. you compare the two principal types of root systems
- 25.2. you describe the functions of the root cap
- 25.3. you identify the tissues present in the root at the end of primary growth
- 25.4. you describe the effect secondary growth has on the primary body of the root
- 25.5. you identify the origin of lateral roots
- 25.6. you name modifications to the "typical" root in various plants

## 26. Investigate the primary structure and development of the shoot

### Assessment Strategies

- 26.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### Criteria

*Your performance will be successful when:*

- 26.1. you identify the structures of the shoot apical meristem
- 26.2. you describe the relationship between apical meristem and the shoot
- 26.3. you describe the three primary types of organization found in the primary structure of the stems of seed plants
- 26.4. you define leaf traces
- 26.5. you name the four basic types of leaf arrangement
- 26.6. you describe the structural differences between the leaves of monocots and dicots
- 26.7. you describe the structure of a "typical" leaf
- 26.8. you describe modifications to the "typical" stem found in various plants
- 26.9. you describe modifications to the "typical" leaf found in various plants

## 27. Investigate secondary growth in stems

### Assessment Strategies

- 27.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### Criteria

*Your performance will be successful when:*

- 27.1. you contrast annuals, biennials, and perennials
- 27.2. you describe the functions of the cells that compose the vascular cambium
- 27.3. you describe how secondary growth affects the primary body of the stem
- 27.4. you name the tissues that are produced by the cork cambium
- 27.5. you describe the function of the periderm
- 27.6. you explain what bark is
- 27.7. you explain how the composition of bark changes during the life of a woody plant
- 27.8. you define wood

- 27.9. you contrast conifer wood and angiosperm wood
- 27.10. you discuss the various uses of plants

## **28. Investigate plant hormones**

### **Assessment Strategies**

- 28.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### **Criteria**

*Your performance will be successful when:*

- 28.1. you compare the five major groups of plant hormones as to their chemical nature, site of biosynthesis, transport, and effects
- 28.2. you observe how plant hormones are used in tissue culture
- 28.3. you investigate how plant hormones exert their effects at the molecular level

## **29. Investigate external factors that influence plant growth**

### **Assessment Strategies**

- 29.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### **Criteria**

*Your performance will be successful when:*

- 29.1. you define tropism and provide examples of tropisms
- 29.2. you define and give examples of nastic movements
- 29.3. you explain how plants respond to light and gravity
- 29.4. you explain why it is important for plants to be able to "tell time"
- 29.5. you investigate the characteristics of biological clocks in plants
- 29.6. you explain how day length affects flowering
- 29.7. you characterize phytochrome
- 29.8. you explain how phytochrome is involved in flowering, seed germination, and stem growth
- 29.9. you characterize dormancy
- 29.10. you list environmental cues that may be necessary to break dormancy in seeds and buds

## **30. Investigate plant nutrition and soils**

### **Assessment Strategies**

- 30.1. through class discussion, quizzes and examinations, and a laboratory exercise and report

### **Criteria**

*Your performance will be successful when:*

- 30.1. you name the elements that are essential to plant growth
- 30.2. you list the function and deficiency symptoms of some of the essential elements
- 30.3. you name the sources of inorganic nutrients utilized by plants
- 30.4. you identify the components of nutrient cycles
- 30.5. you explain how humans have disrupted nutrient cycles

## **31. Investigate the movement of water and solutes in plants**

### **Assessment Strategies**

- 31.1. through class discussion, quizzes and examinations

### **Criteria**

*Your performance will be successful when:*

- 31.1. you explain the process of transpiration
- 31.2. you explain the structure and function of guard cells
- 31.3. you explain how the cohesion-tension theory accounts for the movement of water to the top of tall trees
- 31.4. you explain how the osmotically generated pressure-flow mechanism accounts for the movement of sugars from source to sink

## **32. Investigate ecology**

### **Assessment Strategies**

32.1. through class discussion, quizzes and examinations, and an oral and written report

### **Criteria**

*Your performance will be successful when:*

- 32.1. you differentiate between a population, a community, and an ecosystem
- 32.2. you describe how energy flows through a food chain
- 32.3. you identify various symbiotic relationships
- 32.4. you list factors that influence the distribution of biomes
- 32.5. you describe the characteristic plants of the major biomes
- 32.6. you describe succession
- 32.7. you describe biogeochemical cycles