BIO-1510: PRINCIPLES OF BIOLOGY II

Cuyahoga Community College

Viewing: BIO-1510 : Principles of Biology II

Board of Trustees:
10/26/2023

Academic Term:
Fall 2024

Subject Code
BIO - Biology

Course Number:
1510

Title:
Principles of Biology II

Catalog Description:
Designed for science majors. The diversity of life, animals, plants, and ecology are explored in both lecture and laboratory settings. Topics include the origin and evolution of life, systematics, classification, structural and functional variations in animals and plants, populations, communities, and ecosystems.

Credit Hour(s):
4

Lecture Hour(s):
3

Lab Hour(s):
3

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
BIO-1500 Principles of Biology I, or BIO-150H Honors Principles of Biology I; or departmental approval: equivalent knowledge or skills.

Outcomes

Course Outcome(s):
Diversity: Analyze the diversity of life on Earth resulting from evolution.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

a. Describe the scientific explanations for the origin of life and the key events in evolution of life on Earth, including evolution of photosynthesis, eukaryotic cells, multicellularity, and land adaptations.
b. Explain how systematics, classification, and phylogenetics are used to categorize and describe the unity and diversity of life.
c. Explain and demonstrate how phylogenetic trees are formulated and evaluated, and distinguish between scientific and non-scientific methods of classification in biology.
d. Explain how modern depictions of taxonomic relationships among organisms can be verified but are also subject to change based on scientific discovery and advancement.
e. Explain the evolutionary relationships among Archaea, Bacteria, and Eukarya using current models.
f. Describe prokaryotic diversity.
g. Describe the diversity and phylogeny of unicellular eukaryotes and the multiple independent origins of multicellular eukaryotes.
h. Describe the diversity of multicellular eukaryotes including algae, fungi, plants, and animals.

i. Demonstrate safe and proper use of lab equipment when observing specimens and performing experiments and procedures, and respond appropriately to instructor feedback as it is given.
j. Use lab equipment to collect and analyze data pertaining to the growth and/or behavior of living organisms.

Course Outcome(s):

Animals: Compare the structural and functional organization of animal bodies and the mechanisms used to maintain homeostasis.

Objective(s):

a. Describe how the structure of the vertebrate brain has evolved, and explain the functional significance of those changes.
b. Describe the major events in the generation and conduction of a nerve impulse and synaptic transmission.
c. Describe neural and hormonal control of digestion, respiration, circulation, osmoregulation, and reproduction.
d. Explain the interdependence of the muscular and skeletal systems for movement, support, and locomotion.
e. Explain the physiology of muscle contraction.
f. Describe and compare the different types of animal digestive systems.
g. Describe digestion, absorption and elimination in the vertebrate digestive tract and the evolutionary adaptations to accommodate different diets.
h. Describe the respiratory adaptations for gas exchange in aquatic and terrestrial environments.
i. Explain the role of blood in transport, regulation, and defense.
j. Describe evolutionary changes in the heart and circulation in vertebrates and explain the functional significance of those changes.
k. Differentiate between an osmoconformer and osmoregulator, and describe the various osmoregulatory structures of invertebrates and vertebrates.
l. Describe the vertebrate urinary system and explain the role of the kidney nephron in the process of filtration, reabsorption, and secretion.
m. Distinguish between sexual and asexual methods of reproduction in animals.
n. Compare external and internal fertilization, and explain different strategies for embryonic and fetal development.
o. Describe and explain various types of animal behavior.
p. Describe the organization of the animal body, including body plans, tissues, symmetry, body cavities, developmental patterns, and segmentation.
q. Explain and provide examples of negative feedback and positive feedback.
r. Differentiate between ectotherms and endotherms and their temperature regulation mechanisms.

Course Outcome(s):

Plants: Compare the structural and functional organization of plants and the mechanisms used to maintain homeostasis.

Objective(s):

a. Recognize the major evolutionary lineages in plants.
b. Describe the successive adaptations to terrestrial environments that characterize land plant evolution.
c. Explain co-evolution with respect to plant-animal interactions and angiosperm diversity.
d. Differentiate between the characteristics of monocots and eudicots.
e. Identify and explain the functions of the major plant cells and tissues.
f. Describe primary and secondary growth in plants.
g. Compare the tissue organization of roots and stems in monocots and eudicots.
h. Compare the tissue organization of leaves in monocots, eudicots, and conifers.
i. Explain the responses of plants to light, gravity, mechanical stimuli, water, and temperature.
j. Describe the roles of the major plant hormones.
k. Provide examples of plant chemical and physical defenses.
l. Identify the nutrients required by plants and describe the adaptations for acquiring these nutrients.
m. Explain the transpiration-cohesion theory of water movement in plants.
n. Explain mass-flow transport of carbohydrates in plants.
o. Explain the haplodiplontic life cycle of plants and compare variations in the life cycles of major plant lineages.
p. Explain the unique reproductive structures in the major plant lineages.

Course Outcome(s):

Ecology: Analyze the relationships and interactions between living things and their environment.

Objective(s):

a. Analyze a population growth curve, and explain the factors that affect population growth.
b. Evaluate data from statistical models to assess population growth and its influencing factors.
c. Analyze population demographics by interpreting survivorship curves and dispersion patterns.
d. Describe the interactions between populations within a community.
e. Provide and explain examples of invasive, dominant, foundation, and keystone species in specific habitats.
f. Explain how chemicals cycle through the various compartments of an ecosystem and use numerical concepts to relate chemical cycling to primary and ecosystem productivity.
g. Explain how energy flows through the trophic levels in an ecosystem.
h. Compare and contrast the biotic and abiotic characteristics of the major terrestrial and aquatic ecosystem.
i. Describe examples of anthropogenic influences on ecosystems, including the effects of human interference on biodiversity and the historical and contemporary impacts of conservation efforts in biology.

Methods of Evaluation:

a. Quizzes
b. Examinations
c. Laboratory practicals
d. Written reports
e. Research papers
f. Projects (individual or group)
g. Presentations (individual or group)
h. Article discussions/reviews/summaries
i. Discussion boards
j. Homework assignments
k. Case studies

Course Content Outline:

a. Concepts:
   i. Phylogenetic systematics
   ii. Classification and taxonomy using the Linnaean hierarchy
   iii. Origin of life hypotheses
   iv. Key events in the evolutionary history of life on Earth
   v. Evolutionary tree of life
   vi. Lateral gene transfer
   vii. Major domains of life (Bacteria, Archaea, and Eukarya)
   viii. Extremophiles
   ix. Modes of nutrition
   x. Endosymbiosis
   xi. Diversity of eukaryotes, including unicellular and multicellular forms
   xii. Major phyla of Animalia, Fungi, and Viridiplantae
   xiii. Plant adaptations to land
   xiv. Life cycles of plants and fungi
   xv. Ecological roles of fungi
   xvi. Key innovations in animal evolution (symmetry, tissues, body cavity, developmental patterns, and segmentation)
   xvii. Organization of the animal body
   xviii. Animal tissues (epithelium, connective, muscle, and nervous)
   xix. Homeostasis and feedback regulation (positive and negative)
   xx. Temperature regulation (endothermic and ectothermic)
   xxi. Evolution of animal nervous systems
   xxii. Nerve impulse transmission (resting potential and action potential)
   xxiii. Saltatory and continuous conduction
   xxiv. Synapses and neurotransmitters
   xxv. Reflex arc
   xxvi. Organization of the vertebrate nervous system (central, peripheral, autonomic, somatic, sympathetic, and parasympathetic)

xxvii. Evolution of the vertebrate brain
xxviii. Sensory-motor integration
xxix. Link between nervous and endocrine systems
xxx. Endocrine glands and major animal hormones
xxxi. Skeletal systems (endoskeleton, exoskeleton, and hydroskeleton)
xxxii. Bone structure
xxxiii. Skeleton and muscle interaction
xxxiv. Sliding filament theory of muscle contraction
xxxv. Role of calcium ions in muscle contraction
xxxvi. Modes of animal locomotion (terrestrial, aerial, and aquatic)
xxxvii. Comparative animal digestive systems
xxxviii. Structures and functions of vertebrate digestive organs
xxxix. Mechanical and chemical digestion
xl. Absorption of nutrients
xli. Roles of accessory organs in digestion
xlii. Factors affecting the rate of diffusion across a membrane
xliii. Comparative animal respiratory structures
xliv. Mechanisms for breathing in amphibians, reptiles, birds, and mammals
xlv. Countercurrent exchange
xlvi. Transport of respiratory gases and regulation of breathing
xlvii. Open and closed circulatory systems
xlviii. Organization of vertebrate cardiovascular system
xlix. Composition of blood
l. Evolution of the chambered heart
li. Structure and function of vessels (arteries, veins, and capillaries)
lii. Connection between cardiovascular and lymphatic system
liii. Comparative animal excretory systems
liv. Osmolarity and osmotic balance
lv. Osmoregulatory organs (flame cells, nephridia, Malpighian tubules, and kidneys)
lvi. Nephron structure and function
lvii. Nitrogenous wastes (ammonia, urea, and uric acid)
lviii. Hormonal control of osmoregulation
lix. Sexual and asexual reproduction in animals
lx. Sex determination in animals
lxi. Structure and function of reproductive organs
lxii. Strategies for embryonic and fetal development (oviparity, ovoviviparity, and viviparity)
lxiii. Plant adaptations to land
lxiv. Haplodiplontic life cycle of plants
lxv. Heterosporous life cycle of seed plants
lxvi. Bryophytes
lxvii. Ferns and fern allies
lxviii. Gymnosperms
lxix. Angiosperms (monocots and eudicots)
lxx. Sexual and asexual reproduction in seedless and seed plants
lxxi. Vascular tissue (xylem and phloem)
lxxii. Ground tissue (parenchyma, collenchyma, and sclerenchyma)
lxxiii. Dermal tissue (epidermal, trichomes, root hairs, and guard cells)
lxxiv. Meristem tissue (apical and lateral)
lxxv. Primary and secondary growth in plants
lxxvi. Leaf, stem, and root structure (internal and external) and function
lxxvii. Modified leaves, stems, and roots
lxxviii. Flower, fruit, and seed structure, function, and diversity
lxxix. Transpiration
lxxx. Guard cell regulation of stomata
lxxxi. Casparian strip
lxxxii. Absorption and movement of water, minerals, and nutrients in plants
lxxxiii. Plant dormancy and life span (evergreen, deciduous, annual, and perennial)

lxxxiv. Pollination (self-pollination and cross-pollination)
lxxxv. Double fertilization of angiosperms
lxxxvi. Fruit and seed dispersal
lxxxvii. Adaptive advantage of seeds
lxxxviii. Germination in plants
lxxxix. Major plant hormones
xc. Tropisms in plants (photo-, thigmo-, and gravitropism)
xci. Reversible sensory reactions in plants (circadian clocks, solar tracking, and leaf action)
xcii. Plant nutrients and special nutritional strategies (nitrogen fixation, mycorrhizae, carnivorous plants, and parasitic plants)
xciii. Plant physical and chemical defenses
xciv. Levels of ecological organization (populations, communities, ecosystems, and the biosphere)
xcv. Population growth models
xcvi. Factors affecting population growth rates
xcvii. Population distribution
xcviii. Carrying capacity
xcix. Survivorship curves
c. r-selected and k-selected life history models
ci. History of and predictions for human population growth
cii. Ecological footprints
ciii. Ecological niche
civ. Competition
cv. Competitive exclusion principle
cvi. Predator/prey relationships
cvii. Batesian and Mullerian mimicry
cviii. Symbiotic relationships, including commensalism, mutualism, and parasitism
cix. Coevolution
cx. Community disturbances
cxi. Keystone species
cxii. Primary and secondary succession
cxiii. Biogeochemical cycles: water, carbon, nitrogen, and phosphorus
cxiv. Energy flow through trophic levels
cxv. Productivity (primary and secondary) and biomass
cxvi. Species richness and relative abundance
cxvii. Climate (latitude, atmospheric circulation, altitude, ocean currents, etc.)
cxviii. Terrestrial biomes and aquatic ecosystems
cxix. Pollution
cxx. Eutrophication
cxxi. Biological magnification
cxxii. Invasive species
cxxiii. Current environmental issues

b. Skills:
i. Prepare a wet mount for examination under a compound light microscope.
ii. Construct or use dichotomous keys.
iii. Construct or interpret phylogenies or cladograms.
iv. Evaluate evolutionary hypotheses.
v. Sample the environment for microorganisms.
vi. Distinguish among representative bacteria and protists using a microscope.
vii. Distinguish among plant phyla and identify representatives of each group.
viii. Distinguish among fungal phyla and identify representatives of each group.
ix. Distinguish among animal phyla and identify representatives of each group.
x. Distinguish among chordate clades and identify representatives of each group.
xi. Identify basic types of animal tissues and key cells.
xii. Identify the type of skeleton in various animal specimens.
xiii. Dissect and identify the major components of the following animal systems: digestive, respiratory, circulatory, urinary, nervous, and reproductive.
xiv. Assign representative plant specimens as nonvascular, seedless vascular, gymnosperm, or angiosperm.
xv. Identify the internal and external anatomy of leaves, stems, and roots, using live, preserved, and microscopic specimens.

xvi. Differentiate between monocots and eudicots, based on their anatomy.
xvii. Dissection of flowers, seeds, and fruits.
xviii. Determine the mechanism of seed dispersal based on the fruit of an angiosperm.
xix. Identify the parts of a flower and describe their roles in reproduction.
xx. Trace the path of water through vascular plants, starting in the soil and exiting the stomata.
xxi. Construct a population growth curve.
xxii. Analyze population pyramids.
xxiii. Estimate population size using mark-recapture and/or quadrat sampling.

c. Issues:
i. Origin of life hypotheses
ii. The nature of viruses
iii. Natural vs. unnatural taxonomic groups
iv. Inherent anthropocentric bias in classification systems
v. Fluctuating nature of classification
vi. Complexity is not necessarily better than simplicity
vii. Modern challenges to taxonomy
viii. Separation of cytogamy and karyogamy
ix. Ancestral vs. derived characteristics
x. Not all animals are mammals
xi. Majority of animals are invertebrates
xii. Common misconceptions about plants
xiii. Plants respond to internal and external stimuli
xiv. Oxygen requirement of plants
xv. Photosynthesis is not unique to plants
xvi. Plant mass is derived from carbon dioxide
xvii. Human population growth and sustainability
xviii. Human impacts on biodiversity
xix. Interconnectedness of terrestrial and aquatic ecosystems
xx. Global warming

Resources

Dolphin, W., Vleck, D., Colbert, J.T., & Westgate, L.M. *Biological Investigations: Form, Function, Diversity & Process*. 12th ed. New York: McGraw Hill, 2019.

Raven, P.H. Johnson, G.B., Mason, K.A., Losos, J.B. & Singer, S.R. *Biology*. 12th ed. New York: McGraw Hill, 2020.

Adams, B.J. and Crawley, J.L. *Van De Graaff's Photographic Atlas for the Biology Laboratory*. 8th ed. Englewood, CO: Morton Publishing, 2018.

Vodopich, D.S. and Moore, R. *Biology Laboratory Manual*. 12th ed. New York: McGraw Hill, 2019.

Brooker, R.J., Widmaier, E.P., Graham, L.E., & Stiling, P.D. *Biology*. 5th ed. New York: McGraw Hill, 2019.

Carroll, S.B. *Into the Jungle: Great Adventures in the Search for Evolution.* New York: Pearson, 2008.

Futyuma, D. and Kirkpatrick, M. *Evolution.* 4th ed. New York: Oxford University Press, 2017.

Shubin, N. *Your Inner Fish: A Journey into the 3.5 Billion Year History of the Human Body.* New York: Knopf Doubleday Publishing Group, 2009.

Urry, L., Cain, M., Wasserman, S., Minorsky, P., Orr, R., Campbell, N. . *Biology in Focus*. 3. Hoboken: Pearson, 2020.

Jenkins C., Caprette C., Koch J., Ochs K., Vaidya, E. *Principles of Biology II*. 1. Cincinnati: Van-Griner, 2022.

Resources Other

a. NOVA - http://www.pbs.org/wgbh/nova/
b. McGraw-Hill Virtual Laboratory - http://www.mhhe.com/biosci/genbio/virtual_labs/
c. Action Bioscience: Bringing Biology to Informed Decision Making - http://www.actionbioscience.org/
d. Encyclopedia of Life – http://eol.org (http://eol.org/)
e. Tree of Life Web Resource - www.tolweb.com (http://www.tolweb.com/)
f. Howard Hughes Medical Institute Biointeractive - http://www.hhmi.org/biointeractive/
g. Digital morphology at the University of Texas - http://digimorph.org/
h. International Union for the Conservation of Nature, Biodiversity - http://www.iucn.org/what/tpas/biodiversity/
i. Smithsonian National Museum of Natural History, Biodiversity - http://www.mnh.si.edu/explore/diversity.htm
j. The University of California Berkeley, Museum of Paleontology online exhibits - http://www.ucmp.berkeley.edu/exhibits/index.php (http://www.ucmp.berkeley.edu/exhibits/)
k. Tom Volk's Fungi: Dept. of Biology, Univ. of Wisconsin-LaCrosse - http://botit.botany.wisc.edu/toms_fungi/
l. Plants in Motion - http://plantsinmotion.bio.indiana.edu/plantmotion/starthere.html
m. American Society of Plant Biologists, Education - http://my.aspb.org/?page=Education
n. ChloroFilms: Plant Videos on YouTube: http://www.chlorofilms.org/index.php?module=Pages&func=display&pageid=16 (http://www.chlorofilms.org/?module=Pages&func=display&pageid=16)
o. Global Invasive Species Database - http://www.issg.org/database/welcome/
p. Environmental Literacy Council - http://www.enviroliteracy.org/
q. U.S. Census Bureau: International Database - http://www.census.gov/idb/ranks.html
r. CIA World Factbook - https://www.cia.gov/library/publications/the-world-factbook/

Instructional Services

OAN Number:

Ohio Transfer 36 TMNS and Transfer Assurance Guide OSC004 and OSC024 (2 of 2 courses, both must be taken)

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