

# BIO-151H: HONORS PRINCIPLES OF BIOLOGY II

## Cuyahoga Community College

**Viewing: BIO-151H : Honors Principles of Biology II**

**Board of Trustees:**

December 2021

**Academic Term:**

Fall 2022

**Subject Code**

BIO - Biology

**Course Number:**

151H

**Title:**

Honors Principles of Biology II

**Catalog Description:**

Honors course 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, classifications, structural and functional variations in animals and plants, populations, communities, and ecosystems. Emphasis on evolution as the unifying theory in biology. Strong focus on inquiry-based learning.

**Credit Hour(s):**

4

**Lecture Hour(s):**

3

**Lab Hour(s):**

3

## Requisites

**Prerequisite and Corequisite**

BIO-150H Honors Principles of Biology I or BIO-1500 Principles of Biology I.

## Outcomes

**Course Outcome(s):**

1. Diversity: Analyze the diversity of life on Earth resulting from evolution.

**Objective(s):**

1. 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.
2. Explain how systematics and classification are used to categorize and describe the unity and diversity of life.
3. Explain and demonstrate how phylogenetic trees are formulated and evaluated, and distinguish between scientific and non-scientific methods of classification in biology.
4. Explain how modern depictions of taxonomic relationships among organisms can be verified but are also subject to change based on scientific discovery and advancement.
5. Compare the biological species concept to the phylogenetic species concept.
6. Explore the evolution of primate genomes, including humans and great apes.
7. Explain the evolutionary relationships among Archaea, Bacteria, and Eukarya.
8. Describe prokaryotic diversity.
9. Describe the diversity of unicellular eukaryotes and the multiple independent origins of multicellular eukaryotes.
10. Describe the diversity of multicellular eukaryotes.
11. Describe the possible role of hox genes in the Cambrian explosion.

12. 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.
13. Use lab equipment to collect and analyze data pertaining to the growth and/or behavior of living organisms.

**Course Outcome(s):**

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

**Objective(s):**

1. Describe the organization of the animal body, including evolution of body plans, tissues, symmetry, body cavities, developmental patterns, and segmentation.
2. Explain the adaptations required for the evolution of terrestrial vertebrates.
3. Explain and provide examples of negative feedback and positive feedback.
4. Differentiate between ectotherms and endotherms and their temperature regulation mechanisms.
5. Explain the adaptations required for the evolution of endothermy.
6. Differentiate and describe the divisions of the vertebrate nervous system.
7. Describe how the structure of the vertebrate brain has evolved, and explain the functional significance of those changes.
8. Describe the major events in the generation and conduction of a nerve impulse and synaptic transmission.
9. Describe neural and hormonal control of digestion, respiration, circulation, osmoregulation, and reproduction.
10. Understand the interdependence of the muscular and skeletal systems for movement, support, and locomotion.
11. Explain the physiology of muscle contraction.
12. Describe the different types of animal digestive systems.
13. Describe digestion, absorption and elimination in the vertebrate digestive tract and the evolutionary adaptations to accommodate different diets.
14. Describe the respiratory adaptations for gas exchange in aquatic and terrestrial environments.
15. Explain the role of blood in transport, regulation, and defense.
16. Describe evolutionary changes in the heart and circulation in vertebrates and explain the functional significance of those changes.
17. Differentiate between an osmoconformer and osmoregulator, and describe the various osmoregulatory structures of invertebrates and vertebrates.
18. Describe the vertebrate urinary system and explain the role of the kidney nephron in the process of filtration, reabsorption, and secretion.
19. Distinguish between sexual and asexual methods of reproduction in animals.
20. Compare external and internal fertilization, and explain different strategies for embryonic and fetal development.
21. Describe how sexual selection has led to the evolution of secondary sexual characteristics.
22. Explain the influence of evolution and ecology on parental investment, mate choice, and mating systems.
23. Explain the evolution of altruistic behaviors in animals, including the roles of reciprocity and kin selection.

**Course Outcome(s):**

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

**Objective(s):**

1. Explain the evolution of land plants from green algae.
2. Recognize the major evolutionary lineages in plants.
3. Describe the successive adaptations to terrestrial environments that characterize land plant evolution.
4. Explain co-evolution with respect to plant-animal interactions and angiosperm diversity.
5. Differentiate between the characteristics of monocots and eudicots.
6. Explain the significance of monocots for the human food supply.
7. Identify and explain the functions of the major plant cells and tissues.
8. Describe primary and secondary growth in plants.
9. Compare the tissue organization of roots and stems in monocots and eudicots.
10. Compare the tissue organization of leaves in monocots, eudicots, and conifers.
11. Explain the responses of plants to light, gravity, mechanical stimuli, water, and temperature.
12. Describe the roles of the major plant hormones.
13. Provide examples of plant chemical and physical defenses and explain the influence on herbivore evolution.
14. Explain the role of secondary compounds in plant defenses.
15. Identify the nutrients required by plants and describe the adaptations for acquiring these nutrients.
16. Explain the transpiration-cohesion theory of water movement in plants.
17. Explain mass-flow transport of carbohydrates in plants.

18. Explain the haplodiplontic life cycle of plants and compare variations in the life cycles of major plant lineages.
19. Explain the unique reproductive structures in the major plant lineages.

**Course Outcome(s):**

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

**Essential Learning Outcome Mapping:**

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

**Objective(s):**

1. Analyze a population growth curve, and explain the factors that affect population growth.
2. Evaluate data from statistical models to assess population growth and its influencing factors.
3. Analyze population demographics by interpreting survivorship curves and dispersion patterns.
4. Describe the interactions between populations within a community.
5. Measure the growth or interaction of species under specific environmental conditions using quantitative techniques in the laboratory.
6. Provide and explain examples of invasive, dominant, foundation, and keystone species in specific habitats.
7. Explain the evolution of symbiotic relationships among species.
8. Describe the effects of competition and predation on the evolution of a species.
9. Explain how chemicals cycle through the various compartments of an ecosystem and use numerical concepts to relate chemical cycling to primary and ecosystem productivity.
10. Explain how energy flows through the trophic levels in an ecosystem.
11. Describe the link between primary productivity, biodiversity, and ecosystem stability.
12. Compare and contrast the biotic and abiotic characteristics of the major terrestrial and aquatic ecosystems.
13. Explain the effects of human activities on terrestrial and aquatic ecosystems.
14. Explain the connection between human activities on land and the health of aquatic ecosystems.
15. 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:**

1. Required research paper and/or project
2. Quizzes
3. Exams
4. Laboratory practicals
5. Written reports
6. Presentations (individual or group)
7. Poster Presentations
8. Article discussions/reviews/summaries
9. Discussion boards
10. Homework assignments
11. Case studies

**Course Content Outline:**

1. Concepts:
  - a. Phylogenetic systematics
  - b. Classification and taxonomy using the Linnaean hierarchy
  - c. Origin of life hypotheses
  - d. Key events in the evolutionary history of life on Earth
  - e. Evolutionary tree of life
  - f. Lateral gene transfer
  - g. Hox genes
  - h. Major domains of life (Bacteria, Archaea, and Eukarya)
    - i. Extremophiles
    - j. Modes of nutrition
    - k. Endosymbiosis

- I. Diversity of eukaryotes, including unicellular and multicellular forms
- m. Major phyla of Animalia, Fungi, and Viridiplantae
- n. Plant adaptations to land
- o. Life cycles of plants and fungi
- p. Ecological roles of fungi
- q. Key innovations in animal evolution (symmetry, tissues, body cavity, developmental patterns, and segmentation)
- r. Organization of the animal body
- s. Animal tissues (epithelium, connective, muscle, nervous)
- t. Homeostasis and feedback regulation (positive and negative)
- u. Temperature regulation (endothermic and ectothermic)
- v. Evolution of animal nervous systems
- w. Nerve impulse transmission (resting potential and action potential)
- x. Saltatory and continuous conduction
- y. Synapses and neurotransmitters
- z. Reflex arc
- aa. Organization of the vertebrate nervous system (central, peripheral, autonomic, somatic, sympathetic, and parasympathetic)
- bb. Evolution of the vertebrate brain
- cc. Sensory-motor integration
- dd. Link between nervous and endocrine systems
- ee. Endocrine glands and major animal hormones
- ff. Skeletal systems (endoskeleton, exoskeleton, hydroskeleton)
- gg. Bone structure
- hh. Skeleton and muscle interaction
  - ii. Sliding filament theory of muscle contraction
  - jj. Role of calcium ions in muscle contraction
- kk. Modes of animal locomotion (terrestrial, aerial, aquatic)
- II. Comparative animal digestive systems
- mm. Structures and functions of vertebrate digestive organs
- nn. Mechanical and chemical digestion
- oo. Absorption of nutrients
- pp. Roles of accessory organs in digestion
- qq. Factors affecting the rate of diffusion across a membrane.
  - rr. Comparative animal respiratory structures
- ss. Mechanisms for breathing in amphibians, reptiles, birds, and mammals
- tt. Countercurrent exchange
- uu. Transport of respiratory gases and regulation of breathing
- vv. Open and closed circulatory systems
- ww. Organization of vertebrate cardiovascular system
- xx. Composition of blood
- yy. Evolution of the chambered heart
- zz. Structure and function of vessels (arteries, veins, and capillaries)
- aaa. Connection between cardiovascular and lymphatic system
- bbb. Comparative animal excretory systems
- ccc. Osmolarity and osmotic balance
- ddd. Osmoregulatory organs (flame cells, nephridia, Malpighian tubules, kidneys)
- eee. Nephron structure and function
  - fff. Nitrogenous wastes (ammonia, urea, uric acid)
- ggg. Hormonal control of osmoregulation
- hhh. Sexual and asexual reproduction in animals
  - iii. Sex determination in animals
  - jjj. Structure and function of reproductive organs
- kkk. Strategies for embryonic and fetal development (oviparity, ovoviviparity, viviparity)
- III. Intersexual and intrasexual selection
- mmm. Parental investment and mate choice
- nnn. Polygynous, polyandrous, and monogamous mating systems
- ooo. Altruism, kin selection, and reciprocity
- ppp. Plant adaptations to land

- qqq. Haplodiplontic life cycle of plants
- rrr. Heterosporous life cycle of seed plants
- sss. Bryophytes
- ttt. Ferns and fern allies
- uuu. Gymnosperms
- vvv. Angiosperms (monocots & eudicots)
- www. Sexual and asexual reproduction in seedless and seed plants
- xxx. Vascular tissue (xylem and phloem)
- yyy. Ground tissue (parenchyma, collenchyma, sclerenchyma)
- zzz. Dermal tissue (epidermal, trichomes, root hairs, guard cells)
- aaaa. Meristem tissue (apical and lateral)
- bbbb. Primary and secondary growth in plants
- cccc. Leaf, stem, and root structure (internal and external) and function
- dddd. Modified leaves, stems, and roots
- eeee. Flower, fruit, and seed structure, function, and diversity
- ffff. Transpiration
- gggg. Guard cell regulation of stomata
- hhhh. Casparian strip
- iiii. Absorption and movement of water, minerals, and nutrients in plants
- jjjj. Plant dormancy and life span (evergreen, deciduous, annual, perennial)
- kkkk. Pollination (self-pollination & cross-pollination)
- llll. Double fertilization of angiosperms
- mmmm. Fruit and seed dispersal
- nnnn. Adaptive advantage of seeds
- oooo. Germination in plants
- pppp. Major plant hormones
- qqqq. Tropisms in plants (photo-, thigmo-, and gravitropism)
- rrrr. Reversible sensory reactions in plants (circadian clocks, solar tracking, leaf action)
- ssss. Plant nutrients and special nutritional strategies (nitrogen fixation, mycorrhizae, carnivorous plants, parasitic plants)
- tttt. Plant physical and chemical defenses
- uuuu. Secondary compounds in plants
- vvvv. Levels of ecological organization (populations, communities, ecosystems, and the biosphere)
- www. Population growth models
- xxxx. Factors affecting population growth rates
- yyyy. Population distribution
- zzzz. Carrying capacity
- aaaaa. Survivorship curves
- bbbbb. r-selected and k-selected life history models
- ccccc. History of and predictions for human population growth
- ddddd. Ecological footprints
- eeeee. Ecological niche
- ffffff. Competition
- ggggg. Competitive exclusion principle
- hhhhh. Predator/prey relationships
- iiii. Batesian and Mullerian mimicry
- jjjjj. Symbiotic relationships, including commensalism, mutualism, and parasitism
- kkkkk. Coevolution
- lllll. Community disturbances and the Intermediate disturbance hypothesis
- mmmmm. Keystone species
- nnnnn. Primary and secondary succession
- ooooo. Biogeochemical cycles: water, carbon, nitrogen, phosphorus
- ppppp. Energy flow through trophic levels
- qqqqq. Trophic cascade
- rrrrr. Productivity (primary and secondary) and biomass
- sssss. Species richness and relative abundance
- ttttt. Climate (latitude, atmospheric circulation, altitude, ocean currents, etc.)
- uuuuu. Terrestrial biomes and aquatic ecosystems

- vvvvv. Anthropogenic pollution
- wwwww. Point vs. nonpoint source pollution
- xxxxx. Eutrophication
- yyyyy. Biological magnification
- zzzzz. Invasive species
- aaaaaa. Current environmental issues
- bbbbbb. Climate change
- ccccc. Watershed

2. Skills:

- a. Prepare a wet mount for examination under a compound light microscope.
- b. Construct or use dichotomous keys.
- c. Construct or interpret phylogenies or cladograms.
- d. Evaluate evolutionary hypotheses.
- e. Sample the environment for microorganisms.
- f. Distinguish among representative bacteria and protists using a microscope.
- g. Distinguish among plant phyla and identify representatives of each group.
- h. Distinguish among fungal phyla and identify representatives of each group.
- i. Distinguish among animal phyla and identify representatives of each group.
- j. Distinguish among chordate clades and identify representatives of each group.
- k. Identify basic types of animal tissues and key cells.
- l. Identify the type of skeleton in various animal specimens.
- m. Dissect and identify the major components of the following animal systems: digestive, respiratory, circulatory, urinary, nervous, and reproductive.
- n. Assign representative plant specimens as nonvascular, seedless vascular, gymnosperm, or angiosperm.
- o. Identify the internal and external anatomy of leaves, stems, and roots, using live, preserved, and microscopic specimens.
- p. Differentiate between monocots and eudicots, based on their anatomy.
- q. Dissection of flowers, seeds, and fruits.
- r. Determine the mechanism of seed dispersal based on the fruit of an angiosperm.
- s. Identify the parts of a flower and describe their roles in reproduction.
- t. Trace the path of water through vascular plants, starting in the soil and exiting the stomata.
- u. Construct a population growth curve.
- v. Analyze population pyramids.
- w. Estimate population size using mark-recapture and/or quadrat sampling.

3. Issues:

- a. Origin of life hypotheses
- b. The nature of viruses
- c. Defining species
- d. Natural vs. unnatural taxonomic groups
- e. Inherent anthropocentric bias in classification systems
- f. Fluctuating nature of classification
- g. Complexity is not necessarily better than simplicity
- h. Modern challenges to taxonomy
- i. Separation of cytogamy and karyogamy
- j. Ancestral vs. derived characteristics
- k. Not all animals are mammals
- l. Majority of animals are invertebrates
- m. Common misconceptions about plants
- n. Plants respond to internal and external stimuli
- o. Oxygen requirement of plants
- p. Photosynthesis is not unique to plants
- q. Plant mass is derived from carbon dioxide
- r. Human population growth and sustainability
- s. Human impacts on biodiversity
- t. Interconnectedness of terrestrial and aquatic ecosystems
- u. Global warming

## Resources

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

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Carroll, S.B. *Endless Forms Most Beautiful*. WW Norton Co., 2005.

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

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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., and Stiling, P.D. *Biology*. 5th ed. New York: McGraw-Hill, 2019.

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Futuyma, D. *Evolution*. 4th ed. Sinauer Associates, 2017.

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Pollan, M. *The Botany of Desire: A Plant's-Eye View of the World*. Thorndike Press, 2001.

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## Resources Other

1. NOVA - <http://www.pbs.org/wgbh/nova/>
2. McGraw-Hill Virtual Laboratory - [http://www.mhhe.com/biosci/genbio/virtual\\_labs/](http://www.mhhe.com/biosci/genbio/virtual_labs/)
3. Action Bioscience: Bringing Biology to Informed Decision Making - <http://www.actionbioscience.org/>
4. Encyclopedia of Life – <http://eol.org> (<http://eol.org/>)
5. Tree of Life Web Resource - [www.tolweb.com](http://www.tolweb.com) (<http://www.tolweb.com/>)
6. Howard Hughes Medical Institute Biointeractive - <http://www.hhmi.org/biointeractive/>
7. Digital morphology at the University of Texas - <http://digimorph.org/>
8. International Union for the Conservation of Nature, Biodiversity - <http://www.iucn.org/what/tpas/biodiversity/>
9. Smithsonian National Museum of Natural History, Biodiversity - <http://www.mnh.si.edu/explore/diversity.htm>
10. The University of California Berkeley, Museum of Paleontology online exhibits - <http://www.ucmp.berkeley.edu/exhibits/index.php> (<http://www.ucmp.berkeley.edu/exhibits/>)
11. Tom Volk's Fungi: Dept. of Biology, Univ. of Wisconsin-LaCrosse - [http://botit.botany.wisc.edu/toms\\_fungi/](http://botit.botany.wisc.edu/toms_fungi/)
12. Plants in Motion - <http://plantsinmotion.bio.indiana.edu/plantmotion/starthere.html>
13. American Society of Plant Biologists, Education - <http://my.aspb.org/?page=Education>
14. 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>)
15. Global Invasive Species Database - <http://www.issg.org/database/welcome/>
16. Environmental Literacy Council - <http://www.enviroliteracy.org/>
17. U.S. Census Bureau: International Database - <http://www.census.gov/idb/ranks.html>
18. CIA World Factbook - <https://www.cia.gov/library/publications/the-world-factbook/>

## Instructional Services

### OAN Number:

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