Montgomery County Community College
BIO 152
Principles of Biology II
4-3-3

COURSE DESCRIPTION:
Emphasis is placed on the diversity of life from an evolutionary and ecological perspective. Domains, super groups and kingdoms are discussed from the standpoint of structure, function, metabolism, reproduction, development and evolutionary adaptation. Taxa are compared and contrasted with one another and as they relate to development and ecosystem biology. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITES:
Previous Course Requirements
- BIO 151 Principles of Biology I with a minimum grade of "C"

Concurrent Course Requirements
None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Discuss the fundamental features of evolution and the mechanisms by which populations of organisms change.	Lectures Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
2. Apply the principles of taxonomy and phylogeny and demonstrate these principles to the major groups of organisms studied.	Lectures Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
3. Apply the characteristics of life to viruses and sub viral agents.	Lectures Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
4. Discuss possible mechanisms associated with the origin of life and the development of complex groups of organisms.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
5. Apply the characteristic features of Bacteria and Archaea and how they relate to the eukaryotes.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
6. Explain the phylogeny of the Eukarya as described by the modern supergroup classification.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
7. Relate the characteristic features of traditional protists and how they relate to one another, their prokaryotic origin and relationship to other taxa.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
8. Relate the characteristic features of plants, as it relates to their taxonomy, structure and function, reproduction and evolutionary development.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
9. Relate the characteristic features of fungi to their taxonomy, structure and function, reproduction and evolutionary development.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
10. Relate the characteristic features of animals to their taxonomy, structure and function, reproduction and evolutionary development.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
11. Explore the basic principles of ecology and the interdependence of organisms and the environment.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
<u>Laboratory</u> 12. Use the binocular and dissecting microscopes to identify features of cells and organisms.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
13. Set up various laboratory apparatuses.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
14. Set up various laboratory apparatuses; perform dissections and ecological modeling, as described in the list of laboratories.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework
15. Apply knowledge of scientific method to laboratory experiments.	Lectures and Class Discussions Analysis of Current Articles, Reviews and Primary Literature Hands-On Laboratory Activities, including Dissections	Exams Quizzes Writing Assignments Homework

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS[1]

I. Evolution
   - A. Darwin and natural selection
   - B. Evidence supporting evolution
   - C. Gradualism vs. punctuated equilibrium

II. Population Genetics
   - A. Hardy-Weinberg equilibrium
     1. Gene frequencies - equilibrium and change
     2. Gene frequencies - how determined

III. Speciation
   - A. Allopatric and sympatric - importance and examples
   - B. Mechanisms with definition and examples

[1] Presented at or above the depth of the current textbook; there may be *slight* variation with different instructors.

1. Prezygotic and postzygotic
2. Reproductive isolation
3. Microevolution vs. macroevolution
4. Evidence for speciation/evolution

IV. Origin of Life
- A. Oparin, Haldane, Miller
- B. Chemical evolution, prebionts, protocells, first life
- C. Significance of RNA / ribozymes

V. Taxonomy/Systematics
- A. History: Early, Linnaeus
- B. Hierarchy of taxa
- C. Importance of phylogeny and synapomorphy
  1. Monophyletic vs. Polyphyletic
  2. Systems: phenetics, cladistics, classical
- D. Schemes: early, Whittaker's 5 Kingdoms, domain and supergroup system

VI. Viruses and subviral agents
- A. Characteristics, living vs. non-living
- B. Classification
  1. RNA viruses: single stranded (ss) +, ss–, double stranded (ds)
  2. Retroviruses
  3. DNA viruses: ds & ss
- C. Infection and reproductive cycles of the above
- D. Origin of viruses
- E. Viroids
- F. Prions

VII. Prokaryotes
- A. Domain Bacteria
  1. Characteristics & phylogeny, Gram & modern classification
  2. Examples – Cyanobacteria and other main groups
  3. Importance
- B. Domain Achaea
  1. Characteristics & examples – main groups –metabolic classification

VIII. Eukaryotes: Domain Eukarya
- A. Modern Supergroup designation
- B. Endosymbiotic Origin
- C. Adaptive advantages of diploid / eukaryotic cells
- D. Common characteristics
- E. Diversity of protists (grouped based on the traditional scheme)
  1. Algae
     a. characteristics & phylogeny of main types
     b. sexual/asexual reproduction; alternation of generations
     c. evolutionary development
  2. Protozoans
     a. taxonomy (representative Phyla)
     b. nutrition & morphology
     c. sexual/asexual reproduction (types, examples, importance)

d. evolutionary development (free-living, parasitic)

3. Fungus-like protists
    a. taxonomy (Phyla Oomycota, Myxomycota, Acrasiomycota)
    b. characteristics

F. Evolutionary relationships of Protista according to supergroups

IX. Kingdom Fungi
- A. Vegetative structure (unicells, hyphae, mycelium)
- B. Asexual and sexual reproduction
- C. Sexual reproduction characteristics (dikaryotic cells, meiosis)
- D. Taxonomy: Chytridomycetes, Zygomycetes, Ascomyetes, Basidiomycetes
    1. Life cycles
    2. Economic & environmental importance
- E. Lichens
    1. Symbiotic relationships, nutrition & ecological roles
    2. Types
- F. Evolutionary origins of fungi

X. General features of Kingdom Plantae
- A. Characteristics & origin of land plants
- B. Adaptations necessary for establishment of land plants
- C. Alternation of generations - with variation among taxa
- D. Taxonomy and generic characteristics
    1. Nonvascular plants
    2. Vascular plants without seeds
    3. Vascular plants with unenclosed seeds
    4. Vascular plants with enclosed seeds

XI. Bryophytes
- A. Characteristics and morphology
- B. Reproduction / life cycle

XII. Seedless Vascular Plants
- A. Evolutionary Significance of Vascular Tissues
- B. Evolutionary Significance of Predominant Sporophyte
- C. Evolutionary Significance of Microphylls vs. Megaphylls
- D. Evolutionary Significance of Homospory vs. Heterospory
- E. Taxonomy
    1. Examples: Lycophytes, Psilophytes, Sphenophytes
    2. Life cycles of each, significance of *Selaginella*
    3. Importance to formation of fossil fuels

XIII. Gymnosperms
- A. Characteristics & the evolutionary significance and advantages of seeds
- B. Representative phyla

XIV. Angiosperms
- A. Characteristics
- B. Monocots vs. Eudicots
- C. Vegetative structure
    1. Seeds, germination and plant establishment
    2. General plant tissues

3. Roles in asexual reproduction
4. Roots: types, structure & functions, primary/secondary growth and development
5. Stems: types, structure & functions, primary/secondary growth and development, herbaceous vs. woody stems
6. Leaves: types, structure & functions, modifications/adaptation

D. Sexual Reproduction
1. Flower - types
a. essential organs and accessory organs
b. coevolution of plants and their pollinators
2. Megasporogenesis and microsporogenesis
3. Life cycle with seed/fruit development
6. Evolutionary adaptation and significance of fruits

E. Reasons for Evolutionary Success

XV. General Features of Kingdom Animalia
A. Characteristics
B. Origins
C. Symmetry (radial, bilateral)
D. Body Cavity (Acoelomates, Pseudocoelomates, Coelomates)
E. Embryonic tissues and significance (endoderm, mesoderm, ectoderm)
F. Embryonic Development (Protostomes, Deuterostomes)
G. Taxonomy, phyla and rationale plus traditional vs. modern classification

XVI. Sponges / Porifera
A. Characteristics, development, reproduction
B. Significance and evolutionary origin

XVII. Cnidaria
A. Characteristics & development & reproduction
B. Taxonomy: representative class examples

XVIII. Lophotrochozoa
A. General characteristics
B. Flatworms / Platyhelminthes
1. Characteristics & evolutionary advancements
2. Free-living vs. parasitic
3. Taxonomy: representative class examples
4. Structure, function, reproduction

C. Rotifers / Rotifera: characteristics & ecological role
D. Mollusks / Mollusca
1. Characteristics and taxonomy: representative class examples
2. Structure, function & reproduction

F. Segmented Worms / Annelids
1. Characteristics and taxonomy: representative class examples
2. Structure, function & reproduction
3. Evolutionary/adaptive advantages

G. Less Common Lophotrocozoans: e.g. Nemertea, Bryozoans, Brachiopods, basic characteristics of each

XIX. Ecydsozoa
- A. General Characteristics
- B. Nematodes – characteristics and ecological roles
- C. Arthropods
  1. Characteristics & taxonomy (representative class examples)
  2. Structure, function & reproduction
  3. Evolutionary/adaptive advantages

XX. Deuterostomes
- A. Phylum Echinodermata
  1. Characteristics & taxonomy: representative class examples
  2. Structure, function & reproduction
  3. Evolutionary/adaptive advantages
- B. Phylum Chordata
  1. Characteristics and examples of
  2. Subphylum Urochordata: characteristics & examples
  3. Subphylum Cephalochordata: characteristics & examples
  4. Subphylum Vertebrata
     a. characteristics & evolutionary/adaptive advantages
     b. representative class examples with characteristics
        1) Fishes, types & links to tetrapods
        2) Amphibians
        3) Reptiles & Aves; amniotic eggs
        4) Mammals
  5. Introduction to Primate Evolution

XXI. Evolutionary comparisons of major taxa
- A. Body shape and size
- B. Circulatory systems
- C. Gas exchange
- D. Digestive systems

XXII. Animal development
- A. Spermatogenesis, cells and maturation sequence, sperm
- B. Oogenesis, cells and maturation sequence, eggs
- C. Fertilization, blocks to polyspermy
- D. Cleavage in Protostomes vs. Deuterostomes
- E. Formation of the blastula
- F. Gastrulation and primary germ layers
- G. Morphogenesis & organogenesis
- H. Developmental genetics: maternal and zygotic genes

XXIII. Ecology
- A. Physiological and organismal ecology
  1. Terrestrial and aquatic biomes
  2. Limits to species distributions
     a. Abiotic factors: temperature, water, light, salinity, pH
     b. Biotic factors: predation, parasitism, competition

B. Population ecology
    1. Population density and dispersion patterns
    2. Demography: life tables, survivorship curves, age structure
    3. Population growth
        a. Exponential and logistic growth models
        b. Density dependence and density independence
    4. Life history traits
C. Community ecology
    1. Ecological niche concept and competitive exclusion
    2. Species richness and diversity
    3. Ecological succession
D. Ecosystems ecology
    1. Trophic levels
    2. Energy flow: food chains and food webs
    3. Biogeochemical cycling of water and nutrients

LABORATORIES[2]

I. Population genetics; mathematical modeling
II. pV92 PCR polymorphism and Hardy Weinberg equilibrium
III. Determination of Bacteriophage Titer
IV. Obtaining a Pure Bacterial Culture: Gram Staining
V. Observation and Identification of Protists Using Dichotomous Keys
VI. Fungal Reproduction and Carbon Preference in *Physarum*
VII. Taxonomy and Observation of Plants
VIII. Culture and Development of Fern Gametophyes
IX. Flowering Plant Reproduction
X. Flowering Plant Structure and Growth
XI. Observations / Dissection of Sponges, Flat-, Round- and Segmented Worms
XII. *Drosophila* Life Cycle & Staining of Polytene Chromosomes
XIII. Dissection of Fish, Frog and Mammal
XIV. Development of Medaka Fish

LEARNING MATERIALS:

Textbook:
Reece, et al. (2011). *Campbell Biology* (9th ed.). Benjamin Cummings Publishing.

Lab Manual:
Individual Laboratory Outlines will be distributed electronically or in class

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

[2] Exact laboratories may vary with instructor

COURSE APPROVAL:

Prepared by:	R. Wayne Habermehl Professor of Biological Sciences	Date:	6/1/1998
Revised by:	Christopher J. Harendza, Ph.D. Associate Professor and Coordinator of Biology	Date:	10/22/2004
Revised by:	Christopher J. Harendza, Ph.D. Interim Dean STEM & Professor of Biology	Date:	7/15/2012
VPAA/Provost or designee Compliance Verification:			
	Victoria L. Bastecki-Perez, Ed.D.	Date:	7/16/2012
Revised by:	Debbie Dalrymple .	Date:	06/27/2016
VPAA/Provost or designee Compliance Verification:			
	Victoria L. Bastecki-Perez, Ed.D.	Date:	06/27/2016

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.