GRANDE PRAIRIE REGIONAL COLLEGE

DEPARTMENT OF SCIENCE & TECHNOLOGY

COURSE OUTLINE

BIOLOGY 1080 Organisms In Their Environment

Instructors:

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Transferability:

University of Alberta - Biology 108
University of Calgary - Jr. Biology
University of Lethbridge - Biology 1020

Course Description:

Biology 1080 is an introduction to how the diverse organisms on this planet have been affected by their environment and how the current environment is the product of the activities of organisms. This course also examines how evolution has operated over long time periods to produce major groups of organisms and how evolutionary origins are reflected in their classification. The principles that underlie our understanding of the major lineages will be discussed using examples from monera, fungi, protists, animals, and plants. A description of the involvement of organisms in major ecosystem processes leads to an evaluation of the stability of those systems and of human impact on the processes.

Requirements:

- Since presence at lectures and laboratories, participation in classroom discussion and projects, and the completion of assignments are important components of this course, students will serve their interests best by regular attendance. Those who choose not to attend must assume whatever risks are involved. In this connection, the attention of the students is directed to the *Academic Guidelines of Grande Prairie Regional College.*
- Mid-term exam(s)
- Final lecture exam scheduled by the Registrar's Office during term exam week
- Final lab exam
- Occasional lecture and/or lab quizzes and reports

Evaluation:

Midterm Exam(s):	30%
Lab Reports/Quizzes	15%
Final Lab Exam:	15%
Final Lecture Exam:	40%

Resources:

Campbell, N.A., 1999, BIOLOGY, 5th ed., Benjamin/ Cummings Publishing Co. **[required textbook]**
[Note: the 3rd or 4th editions are also acceptable]

Taylor, M.R., 1999, Student Study Guide for Campbell's BIOLOGY, 5th ed., Benjamin/Cummings Publ. **[optional]**

Biology 1080 Laboratory Manual: 1999-2000, Biology Instructional Group, GPRC, and the Dept. of Biological Sciences, University of Alberta **[required]**

World Wide Web Biology 108 Home Page Address:
http://gause.biology.ualberta.ca/bio108.hp/bio108hp.html

Note: *The textbook & study guide recommended for this course are also used in BI 1070.*

BIOLOGY 1080
ORGANISMS AND THEIR ENVIRONMENT

DETAILED OUTLINE:

I. Introduction [Chapter 1]

- A. Underlying Themes
  1. Organizational levels
  2. The Cell Theory
  3. Two types of cells
  4. Correlation between structure and function
  5. DNA – universality of the genetic code
- B. Science As A Way Of Knowing
  1. Hypothetico-deductive thinking
  2. Induction and deduction
  3. Falsifiability of scientific hypotheses
  4. Formation of predictions

II. Theory of Evolution

- A. Darwin's Definition – Descent with Modification
- B. Implications of the Theory of Evolution
- C. Scientific Credentials of the Theory of Evolution
  1. Falsifiability
  2. Predictions

III. Theory of Natural Selection

- A. Darwin's Definition – Differential Reproductive Success
- B. Scientific Credentials of the Theory of Natural Selection
  1. Falsifiability
  2. Predictions
- C. Cumulative Versus Single-Step Selection

IV. A Darwinian View of Life [Chapter 22]

- A. Lamarck's Contributions
- B. Darwin's Contributions
  1. Recognition of the fact of evolution
  2. Proposal of a mechanism for evolution
- C. Major Influences On Darwin
  1. Voyage of the Beagle
     - 1.1. Fossils – change through time
     - 1.2. Fossils – extinctions
     - 1.3. Galapagos Islands – importance of the environment
  2. Essay on human population growth by Tomas Malthus
  3. Artificial Selection – indication of natural variability
- D. Theory of Natural Selection – deducible by a formal argument
  1. Premises creating a struggle for existence
  2. Premises creating a change through time
  3. Macroevolution as a result of microevolution

E. Darwin's Unanswered Questions
    1. How traits are passed from parent to offspring
    2. Source of the variability
F. Neo Darwinian Theory and the Modern Synthesis
    1. Unearthing of Mendel's papers
    2. Discovery of the structure of the DNA molecule
G. General Concepts
    1. Agent of selection
    2. Unit of selection/of evolution
    3. Population/gene pool/evolution
    4. Fitness
    5. Variability – sources
H. Evidence for Evolution
    1. Artificial selection
    2. Fossil record
        2.1. Bias in the fossil record
        2.2. Order in the fossil record
        2.3. Evidence of change through time
        2.4. Evidence of extinctions
        2.5 Transitional forms
        2.6. Why are there gaps?
        2.7. Use of the fossil record in making predictions
    3. Biogeography
    4. Comparative anatomy
        4.1. Homologous structure
        4.2. Vestigial structures
    5. Comparative embryology
    6. Molecular biology
        6.1. Evolutionary history reflected in genes & proteins
        6.2. Variety of techniques
        6.3. Substantiation of Darwin's idea
I. Examples of Natural Selection in Action
    1. Industrial melanism
    2. Drug resistance in bacteria [chapter 18]
    3. Darwin's finches

V. The Evolution of Populations [Chapter 23]

A. The Hardy Weinberg Theorem
    1. Predictions
    2. Assumptions behind a non-evolving population
B. Factors in Evolution [Agents of Microevolution]
    1. Genetic Drift
        1.1. Bottleneck effect
        1.2. Founder effect
    2. Gene Flow
        2.1. Relationship to natural selection
        2.2. Role in preventing speciation

3. Mutations
4. Nonrandom Mating
    4.1. Inbreeding versus outbreeding
    4.2. Positive versus negative assortive mating
5. Natural Selection
    5.1. Differential success in reproduction
    5.2. As an adaptive agent of microevolution

C. Types of Natural Selection
    1. Directional
    2. Stabilizing
    3. Disruptive
D. Generation of Variability
    1. Mutations
    2. Sexual reproductive & genetic recombination
E. Preservation of Variability
    1 Diploidy
    2. Polymorphism
        2.1. Heterogeneous environment
        2.2 Disruptive selection
        2.3. Frequency-dependent selection
        2.4. Heterozygote advantage/hybrid vigor
    3. Factors increasing/decreasing genetic variation
F. Can Evolution Produce Perfect Organisms?

VI. The Origin of Species [Chapter 24]

A. The Biological Species Concept
B. Reproductive Barriers
    1. Prezygotic
        1.1. Habitat isolation
        1.2. Temporal isolation
        1.3. Mechanical isolation
        1.4. Behavioural isolation
        1.5. Gametic isolation
    2. Postzygotic
        2.1. Hybrid inviability
        2.2. Hybrid sterility
        2.3. Hybrid breakdown
C. Types of Speciation
    1. Anagenesis [phyletic evolution]
    2. Cladogenesis [branching evolution]
D. Allopatric Speciation
    1. Formation of a geographic barrier to reproduction
    2. Genetic divergence
        2.1. Different mutations
        2.2. Different selective pressures
        2.3. Different influences of genetic drift
    3. Formation of biological barriers to reproduction

4. Founding populations/rapid speciation/gaps in the fossil record
5. Adaptive radiation

E. Sympatric Speciation
   1. Plants
      1.1. Via formation of fertile polyploids
      1.2. Common/Hybrid vigor
   2. Animals
      2.1 Via disruptive selection or positive assortive mating
      2.2. Rare

F. Theory of Punctuated Equilibrium

VII. Classification and Systematics [Chapter 25]

A. Terms
   1. Systematics
   2. Taxonomy
   3. Phylogeny
   4. Homology/analogy
   5 Monophyletic/polyphyletic/paraphyletic

B. Linnaeus' Contribution
   1. Binomial nomenclature
   2. Hierarchical taxa – kingdom, plylum, class, order, family, genus, species

C. Molecular Biology as a Tool for Systematics
   1. Advantages
   2. Protein comparisons
      2.1. Enables comparisons among very different organisms
      2.2. Example – cytochrome *c*
   3. DNA comparisons
      3.1. DNA-DNA hybridization
      3.2. Restriction mapping
      3.3. Direct DNA sequencing
   4. Analysis of fossilized DNA
   5. Molecular clocks

D. Three Schools of Thought in Systematics
   1. Are based on relative importance of branching points or degree of divergence
   2. Phenetics – degree of divergence
   3. Cladistics – branching points
   4. Classical Systematics – balance of the two

E. The Red Wolf - Is It A Species?

VIII. Origin of Life [Chapter 26]

A. Requirements For the Origin of Life

B. Steps
1. Spontaneous formation of monomers
2. Formation of polymers
3. Formation of protobionts
4. Formation of true cells [formation of information molecules and a complex metabolism]

C. Movement From Heterotrophy to Autotrophy

D. Significance of the Appearance of Autotrophs

E. Movement From Anerobes to Aerobes

F. Movement From Prokaryotes to Eukaryotes [Endosymbiotic Theory]

G. Movement From Unicellularity to Multicellularity

IX. Prokaryotes and Metabolic Diversity [Chapter 27]

A. General
B. Main Evolutionary Branches
   1. Eubacteria
   2. Archaebacteria
C. Main Characteristics
   1. Mostly unicellular
   2. Small size
   3. Small amount of genetic material
   4. Circular DNA, plasmids
   5. No membrane-bound organelles
   6. Cell wall
   7. Capsules
   8. Endospores
D. Reproduction
   1. Asexual – binary fission
   2. Variability
   3. Generation time
E. Metabolic Diversity
   1. Major modes of nutrition
   2. Terms
      2.1. Chemoautotroph/chemoheterotroph
      2.2. Photoautotroph/photoheterotroph
      2.3. Obligate aerobe/anaerobe

2.4. Facultative anaerobe
2.5. Decomposer [saprobe]
2.6. Symbiosis/mutualism/commensalism/ parasitism
2.7. Methanogens/ extreme halophiles/extreme thermophiles

F. Ecological Importance of Bacteria
1. Cyanobacteria
2. Typical bacteria

X. Origins of Eukaryotes [Chapter 28]

A. Limitations of Prokaryotes due to Small Size

B. Evolution of the Endomembrane System

C. The Endosymbiotic Theory
1. Advantages to host & to endosymbiont
2. Evidence for the endosymbiont theory

D. Evolution of Diploidy

XI. Kingdom Protista [Chapter 28]

A. General Characteristics

B. Major Groups
1. Protozoa – heterotrophic protists
a. classification – based on how they feed & move
b. typical phyla
- Rhizopoda [amoeba]
- Zoomastigophora [zooflagellates]
- Ciliophora [ciliates]
2. Slime molds – fungus-like decomposers
3. Algae – relatively simple photoautotrophs
a. basis for classification
b. typical phyla
- Dinoflagellata
- Phaeophyta [brown algae]
- Rhodophyta [red algae]
- Chlorophyta [green algae]
c. evolutionary adaptations of seaweed

C. Alternation of Generation [in the life cycle of some algae]

D. Ecological Importance of the Protists

E. Origin of Multicellularity

XII. Kingdom Plantae [Chapters 29 & 30]

A. General Characteristics

B. Significance of Immobility in Plants

C. Evolutionary History of Plants
   1. Link between Chlorophyta and plants
   2. Selective factors in early plants
   3. Advantages of living on land
   4. Disadvantages of living on land
   5. Characteristics of the ancestral plant
   6. Later developments

D. General Classification
   1. Nonvascular plants
      1.1. Division Bryophyta
      1.2. Division Hepatophyta
   2. Seedless vascular plants [no pollen]
      2.1. Division Pterophyta
   3. Vascular plants with seeds & pollen
      3.1. Division Coniferophyta [unprotected seeds]
      3.2. Division Anthophyta [protected seeds]
         3.2.1. Class Monocotyledon
         3.2.2. Class Dicotyledon

E. Alternation of Generations
   1. General Trends
   2. Advantage of extending sporophyte phase

F. Comparison of the Major Divisions

G. Seed Plants – Why So Successful?
   1. Enclosed seeds
   2. Fruits
   3. Modifications for Dispersal
   4. Double fertilization and the endosperm

H. Comparison between Gymnosperms and Angiosperms

I. Plant Diversity

J. What Determines Plant Distribution?

K. Plants in Ecosystems

L. Evolutionary Trends in the Plant Kingdom

XIII. Kingdom Fungi [Chapter 31]

A. General Characteristics

B. Some Terms
   1. Syngamy
   2. Plasmogamy
   3. Dikaryon
   4. Karyogamy

C. Basis for Classification

D. Typical Divisions
   1. Zygomycota
   2. Ascomycota
   3. Basidiomycota
   4. Deuteromycota

E. Ecological Importance

F. Fungi & Disease

XIV. Kingdom Animalia [Chapters 32 & 33]

A. The Animal Body
B. Characteristics Used to Classify Animals
    1. Basic body plan [asymmetry/ radial symmetry/ bilateral symmetry]
    2. Digestion [intracellular/ intracellular & extracellular/ extracellular only]
    3. Number of primary germ layers [diploblastic with enoderm and ectoderm/ triploblastic with enoderm, mesoderm, ectoderm]
    4. Body cavities [acoelomate/ pseudocoelomate/ coelomate]
    5. Pattern of embryonic development [protostome/ deuterostome]
    6. Segmentation [nonsegmented/ simple segmentation/ specialization of segments]
C. Life in the Sea
D. Major Branches of Animal Phyla
    Subkingdom Parazoa
        Porifera
    Subkingdom Eumetazoa
        1. Branch Radiata – Cnidaria
        2. Branch Bilateria
            2.1. Acoelomate – Platyhelminthes
            2.2. Pseudocoelomate – Nematoda
            2.3. Coelomate
                2.3.1. Protostomes
                    a. nonsegmented – Mollusca
                    b. simple segments – Annelida
                    c. specialized segments - Arthropoda
                2.3.2. Deuterostomes
                    a. nonsegmented – Echinodermata
                    b. segmented – Chordata
E. Comparison Between Sessile and Active Lifestyles
F. Adaptations Required For Life on Land
G. The Cambrian Explosion
H. Evolutionary Trends in the Major Animal Phyla
I. Phylum Chordata
    1. Vertebrate Phylogeny
    2. Trends In Vertebrate Development
    3. Survey of the Major Vertebrate Classes
J. Summary of the Major Evolutionary Trends In Animals