BIOLOGY 121 ECOLOGY, GENETICS AND EVOLUTION

SECTION 225 MWF 1200 Bi 2000

Course description: Ecological relationships in populations, mechanisms of inheritance, evidence for and mechanisms of evolution.

Prerequisites: **ONE OF**: Bi 12, BIOL 111, BIOL 112 or the equivalent.

Required for: Life Sciences majors or honours (e.g., Biology, Microbiology and Immunology), prerequisite for many BIOL and MICB courses, prerequisite for admission or part of program in other faculties e.g., medicine, dentistry, forestry, etc.

Teaching Team:

Instructor: **Dr. Carol Pollock**
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T.A.: **Katelyn Tovey**
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Peer tutor: **Doug Curley**
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Required text: Freeman, S., Harrington M., Sharp, J. 2011. **BIOLOGICAL SCIENCE** 1st or 2nd Canadian Custom edition; Freeman, S., 3rd edition, 2008, OK.
Copies of this text are available from the UBC Bookstore, Discount Books or for **short-term** loan from the Biology Office, BioSci Room 2521.

EVALUATION

Term work: VISTA assignments, clicker questions*, major assignment (or CSL) - 15% (5%, 5%, 5%)
Midterm 1: Wed. Feb. 1st – 15%
Midterm 2: Wed. Feb. 29th – 15%

Final (Date TBA April 11-25): 55%: Cumulative: material for first midterm ~28%, for second midterm ~28%, material covered between second midterm and final ~44%.

Policy on missed midterms:

With valid excuse (other midterms the same day is **NOT** a valid excuse). Email or see me **immediately** when the exam is missed. Grade for questions on final for that section counts for **28%+15%.**

Policy on missed final:

See the Dean's Office in your faculty to determine if you will be allowed to write a deferred final. If you miss both midterms, you may not be able to write a deferred final. Official date for deferred exams will be July/Aug. 2012.

Academic Honesty: Students can consult and discuss with others but unless otherwise indicated, all assignments and exams are individual effort. Those who do not adhere to UBC regulations face disciplinary action. See the Academic Calendar for regulations.

Community Service Learning - more information in class on Jan. 9.

In brief: Opportunity to work in Vancouver elementary school during mid-term break – week of Feb. 20.
Required to attend training session, run a program (with others) and then write it up and have an interview with Nikta Fay, liaison between CSL and BIOL 121.
Contribution to grade: 5%, excused from class assignment.

COMMUNITY GUIDELINES: (Will be posted separately on VISTA)

RESOURCES AND CONTACTS

Learning Centre Wesbrook room 200 – hours will be posted
Other students (bulletin board on VISTA)
First-year Biology web site: http://www.zoology.ubc.ca/bio1
Biology program web site: (for those planning to go on in Biology): http://www.biology.ubc.ca/
Biology Program Office: BioSci Room 2521, phone 604-822-4260

Comprehensive learning support http://leap.ubc.ca
AMS tutoring services: http://students.ubc.ca/success/firstyear.cfm
VISTA: lecture outlines, pre-lecture quizzes, supplementary materials, moderated bulletin board: http://www.vista.ubc.ca
Instructor, T.A. peer tutor

HOW TO USE YOUR TEXT

Chapter references provided
Index
Mastering Biology (Instructions posted on VISTA site)

STEPS TO SUCCESS IN BIOL 121

1. Before lecture:
   - go to VISTA BIOL 121 folder, read text references, make notes effectively
   - do pre-tests, print outline to use as basis for notes

2. During lecture:
   - attend, be respectful of others, participate in activities
   - ask questions
   - take notes
   - "clickers" will be used (there is a clicker-opt-out option)

3. After lecture:
   - review notes to make sure notes are clear and complete and concepts are understood
   - post questions on bulletin board
   - go to the Learning Centre for clarification and supplementary activities
   - email/visit instructor/T.A./peer tutor if concepts still unclear

DON'T WAIT UNTIL THE MIDTERM/FINAL FOR CLARIFICATION

SUPPORT AVAILABLE

1. Before the lecture, I will post lecture outline, text references and supplementary materials on VISTA.

2. During the lecture I will try to provide
   - important and interesting material in a variety of different ways, including active learning whenever possible
   - an inclusive and respectful atmosphere for all students
   - questions that will be used with clickers so you can gauge your progress
   - the opportunity and the basics; it is up to you to do the rest!

3. After lectures one of the teaching team will:
   - be available through email (M-F 9 a.m. to 6 p.m.) or in the Learning Centre (hours will be posted)
   - check the bulletin board in VISTA

REMEMBER: LEARNING IS HARD WORK

Aids for student success: surface learning *vs.* deeper learning

Active Learning: Wherever possible activities will be provided where students are required to participate by discussing material in groups, collecting data, etc. Clicker questions will be used to collect survey information, assess student preparation as well as understanding of concepts. Research has shown that use of clickers to provide immediate feedback is very beneficial in promoting deeper learning in students.

Concept Maps: A visual representation of ideas, information and processes. By preparing a concept map you develop your own ideas about relationships among ideas presented in class and from your readings. Research in education has shown that the process of creating a concept map is an effective means of summarizing and leads to deeper learning.

Groups: ~ 6 students per group, will be randomly assigned later in Jan. This group will work on an assignment together (more information coming Jan. 16). You can also use this group as a study group; the formation of study groups has been shown to be an important key to university success.

LEARNING OUTCOMES OF BIOL 121 (See final pages of this outline, will be posted separately on VISTA site):

Biology 121 Section 225: Tentative Schedule Winter 2012

Dates	Topics	Text References
Introduction Jan. 4, 6	Course overview. Thinking like a biologist What is a theory? Levels of organization in biology	 Chapter 1 pp. 1180-1181
Introduction to ecology **Patterns of Biodiversity,** **Community Ecology,** **Ecosystems** Jan. 9, 11, 13, 16, 18, 20, 23	Areas of study in ecology Abiotic component of ecosystems Biomes Biogeography (distribution of organisms) *Species interactions Community structure Problem solving. Assignment: ecological (carbon) footprint Ecosystems, Ecological Footprint Assignment: concept map	Chapter 50 Chapter 53 Chapter 54
Genetics Jan. 25, 27, 30	*Characteristics of DNA, cell cycle, cell division and cytokinesis Control of the cell cycle, transferring genetic information, mutation Asexual, sexual reproduction, Preparation for midterm	Chapter 14 pp.309-316, Chapter 11 Chapter 15, Chapter 16 pp. 360-363 Chapter 12
Wed. Feb. 1	**Midterm 1**	

Genetics cont. Feb. 3, 6, 8, 10 13, 15, 17	*Meiosis, consequences of meiosis *Mendelian genetics * Linkage * Extending Mendel's rules Problem solving. * Pedigree analysis, Inheritance in humans Analyzing and engineering genes Control of gene expression	Chapter 12 Chapter 13 Chapter 13: pp. 300-303, Chapter 19 Chapter 18, Chapter 21
Feb. 20-24	**Mid-term break**	
Evolution Feb. 27	Charles Darwin: theory of evolution Preparation for midterm	Chapter 24
Wed. Feb. 29	**Midterm 2**	
Evolution cont. Mar. 2, 5, 7, 9, 12, 14, 16, 19, 21, 23	* Evidence for evolution Natural selection * Alleles in populations - Hardy Weinberg equilibrium, genetic drift, gene flow, mutation, inbreeding * Types of natural selection, sexual selection * Speciation * Phylogeny and the fossil record Great changes: History of life on earth	Chapter 24 Chapter 25 Chapter 26 Chapter 27
Population Ecology Mar. , 26, 28, 30,	Population characteristics * Demography Population Dynamics Assignment: carbon footprint	Chapter 52
Biodiversity & conservation Apr. 2, 4	* Biodiversity and conservation. Finale: Course in perspective, review	Chapter 55
TBA	Final exam	

*** These lectures have a VISTA pretest that must be completed before class starts.**

Biology 121 Learning Outcomes Jan. 2012

ECOLOGY OUTCOMES

Students should be able to:

A) Patterns of Biodiversity

1) Describe the effect of global climate patterns and other physical and biological factors on the distribution of species.
2) Analyze patterns of biodiversity given experimental data.
3) Explain the relationship between genetic, population, and species diversity.

B) Community Ecology

4) Describe how resources and conditions set niche space for organisms.
5) Explain the relationship between niche overlap and realized/fundamental niches of organisms.
6) Predict the outcome of niche overlap.
7) Analyze how biotic and abiotic factors affect community structure, and the importance of these factors in specific communities.

8) Analyze changes in community structure that occur as a result of a disturbance (i.e., primary and secondary succession).

C) Population Ecology

9) Estimate the size of a population using different methods, including marked recapture.
10) Compare populations with respect to characteristics that affect demographics such as age, sex and health etc.
11) List the four processes that ultimately control population size and explain how they can be used to estimate changes in population size from one year to the next.
12) Illustrate population growth using mathematical models, especially the logistic model and "boom and bust" cycles.
13) Determine the life history strategy of different organisms, with respect to fecundity and survivorship, given experimental data.
14) Explain how and why population growth normally varies with population density.
15) Explain why population growth slows as population size approaches carrying capacity.

D) Ecosystem Ecology

16) Given information about an ecosystem (e.g. a food web):
    a. Identify the trophic level and energy source(s) of an organism.
    b. Estimate the relative biomass of groups of organisms.
    c. Predict the potential biotic interactions amongst organisms.
17) Predict the impact of change on ecosystems including the effect of human activities (using examples such as global carbon, nitrogen, and water cycles).

GENETICS OUTCOMES

Students should be able to describe how Mendel's principles of segregation and independent assortment are a consequence of chromosome movement in meiosis.

Core outcomes: Students should be able to:

1) Determine whether eukaryotic cells are haploid, diploid or polyploid.
2) Illustrate with simple diagrams how cells produce daughter cells during mitosis and how diploid cells produce haploid cells during meiosis, including tracing the location of alleles during the process.
3) Demonstrate (using simple diagrams or calculations) how sexual reproduction contributes to genetic variation and to degrees of relatedness amongst parents and offspring.
4) Illustrate with simple diagrams how crossing over results in different gene combinations.
5) Illustrate how dominant alleles provide sufficient gene function to confer a phenotype even when only one copy is present, and how this differs from codominance and incomplete dominance.
6) Calculate expected frequencies in monohybrid, dihybrid and multihybrid crosses.
7) Infer the mode of inheritance (e.g., number of genes, dominance, linkage, sex linkage), given data from experimental crosses.

8) Analyze data from a test cross to determine whether genes are linked, as well as the recombination frequency of linked genes.
9) Deduce from a pedigree whether a trait is autosomal or sex linked, dominant or recessive.

Additional (i.e. noncore outcomes)

a1) Integrate all of the above genetics learning outcomes as applicable into our current understanding of genetic diversity.
a2) Describe genetic sex determination in animals and the consequences of having genes on the X chromosome.
a3) Describe the events that occur during the cell cycle, how the cycle is regulated and how errors in regulation can lead to cancer.
a4) Assess the role of the environment in gene expression .
a5) Assess the positive and negative impact of personal genomics studies (e.g., allele identification "kits").

EVOLUTION OUTCOMES

Students should be able to describe evolution as a change in allele frequency.
Students should be able to explain how adaptation occurs by natural selection.
Students should be able to distinguish between shorter-term events: microevolution – and longer term events: macroevolution – the pattern of descent.

Core outcomes: Students should be able to:

1. Predict how natural selection acting on individuals will affect evolution in populations.
2. Explain and give examples of how homologies (structural, developmental and molecular) provide evidence for evolution.
3) Predict the relatedness of organisms through interpretation of phylogenetic trees, including alternate representations of the same tree.

The focus of the Hardy-Weinberg equilibrium should not be the equation *per se* but rather the link it provides between genetics, ecology and evolution.

4) Calculate the frequency of alleles contributed by a generation in a population, given information on the genotype frequencies of that population.
5) Analyze information on the genotype frequencies of a given population to determine whether or not that population is in Hardy-Weinberg equilibrium.
6) Predict how sources of variation in populations (including different types of selection, genetic drift, gene flow, mutation, and inbreeding), will contribute to changing allele frequencies in a population.
7) Describe how genetic variation on a molecular level can affect the evolution of a population.

8) Explain how evolution is neither directed nor “progressive”, drawing on examples from the history of the diversity of life on earth, such as the Cambrian explosion.
9) Distinguish among the ways gene flow is interrupted in different modes of speciation.

Additional (non-core) outcomes:

a1) Describe the contribution of historical figures (such as Darwin, Wallace, Lamarck, Lyell, Malthus, Cuvier, Hutton, Linnaeus, and Mendel) to the theory of evolution.
a2) Explain with examples why islands and lakes can be evolutionary “hot spots”.