DEPARTMENT OF BIOLOGY
COLLEGE OF ARTS AND SCIENCES
University of the Philippines Manila

BIOLOGY 160
FUNDAMENTALS OF ECOLOGY

COURSE DESCRIPTION: An examination of the interactions between biotic and abiotic factors, and between species in biotic communities covering theory, laboratory, and field studies. Ecological analyses at the level of the population, community, and ecosystem.

COURSE CREDIT: 5 units (3 units lec, 2 units lab)
9 hours/week (3 hours lecture, 6 hours laboratory)

COURSE PREREQUISITES: Bio 180, Bio 116 or Bio 128

COURSE GOALS: To enable the students to understand the principal concepts and theories that guide ecological inquiry, the methods that are used to answer ecological questions, and the applications of ecological principles in the understanding of current and emerging environmental problems in our generation. Particular emphasis will be given to population, community, and ecosystem. The practical component of the course will include laboratory exercises, as well as field studies.

COURSE OUTCOMES: By the end of the course, the students should be able to:

1. Explain the various ecological concepts and principles at the level of individual, population, community, and ecosystems.
2. Apply the knowledge and principles gained from the course in having informed decisions and in devising mitigation strategies for solving natural, biological, and environmental issue and concerns.
3. Demonstrate the use of appropriate sampling techniques to study animal and plant ecology in the field.
4. Design and carry out a research proposal (formulate good research questions, implement field sampling methods, analyze data using appropriate statistical techniques.
5. Communicate research findings and personal development orally and in writing.

COURSE OUTLINE:

UNIT I **INTRODUCTION, EVOLUTION & ADAPTATION, ORGANISM AND THE ABIOTIC ENVIRONMENT**	**LEARNING OBJECTIVES** On completion of this unit, the students should be able to: - explain the definition of ecology, including the diversity of information needed to understand ecology - describe the history of ecology as a scientific discipline - examine how an ecologist does research - discuss the levels of biological organization covered in ecology - argue that adaptations exist that allow organisms to cope with conditions that fall outside the range of tolerance - explain the roles of the different abiotic limits in influencing the survival, abundance,
1. Introduction: Significance, Definitions, History, Methods of ecological study, effects of scale, statistics in ecology	
2. Organisms and the abiotic environment: Adaptation and range of tolerance; nutrients, and soil conditions	
3. Organisms and the abiotic environment: Temperature and moisture	
4. Organisms and the abiotic environment: Climate, light, and periodicities	

	and distribution of organisms including nutrients, soil factors, temperature, moisture, climate, light, and periodicities.
EXAMINATION 1	
UNIT II **ECOSYSTEM ECOLOGY: SYSTEM CONCEPT, DEFINITIONS, ENERGY FLOW, MATERIAL CYCLING, TERRESTRIAL, AQUATIC ECOSYSTEMS**	**LEARNING OBJECTIVES** At the end of this unit, the students should be able to: - tell why an ecosystem is a system - describe what comprise the structure and function of an ecosystem - discuss the importance of energy and how it flows through the different components of the ecosystem - illustrate how the important nutrients cycle through the biosphere - examine how human activities have violated the principles governing the flow of energy and cycling of nutrients that have led to pollution and environmental degradation - explain the underlying ecological reasons for some of the environmental issues of our times such as acid rain, eutrophication, loss of biodiversity, ozone depletion, and global warming. - explore the various types and ecological significance of the terrestrial and aquatic ecosystems comprising the Earth's biosphere.
5. Ecosystem Concept and Definitions	
6. Energy Flow in the Ecosystem: Laws of thermodynamics; concept of production, food chains, food webs, trophic levels, ecological efficiencies, and energy budgets	
7. Nutrient (Biogeochemical Cycles) and Pollution: water cycle; nutrient, heavy metal, and hydrocarbon cycling; ozone depletion, global climate change, acid precipitation, eutrophication, biological magnification	
8. Terrestrial Ecosystems: Plant formations, life zones, biomes concept; tundra, taiga, deciduous forest, chaparral, desert, grassland, savanna, tropical rainforest	
9. Aquatic Ecosystems: Freshwater ecosystem; lentic and lotic; zonations; wetlands, estuaries; Marine ecosystems; zonations; seagrass, mangrove, coral reef, sandy and rocky shore ecosystems; structure and functions	
EXAMINATION 2	
UNIT III **POPULATION ECOLOGY: PROPERTIES, POPULATION GROWTH AND REGULATION, COMPETITION THEORIES AND MODELS, THE NICHE CONCEPT**	**LEARNING OBJECTIVES** At the end of this unit, the students should be able to: - define a population and know how to measure key properties of a population (eg, density, dispersion, natality, mortality) and population growth - construct life table and age pyramid - distinguish between exponential, geometric, and logistic population growth pattern - discuss the importance of energy allocation to reproduction - explain the relationship among size, age, and fecundity - contrast semelparity and iteroparity; r-selection and K-selection - enumerate the various types of factors regulating population size - discuss the various forms of population interactions in nature - develop competence in analyzing the various models on population and growth and competition (eg. Lotka-Volterra models) - explain how potentially competing species may coexist
10. Population Properties: Definitions, population structure; metapopulation concept; density, dispersion, natality, mortality, survivorship curve, life tables, age structure, sex ratio, dependency ratio, immigration and emigration.	
11. Population Growth & Life History Patterns: biotic potential, exponential growth, geometric growth, logistic growth patterns; environmental resistance; carrying capacity; life history patterns; semelparity and iteroparity; r and K strategists.	
12. Population Regulation: density-dependent and density-independent factors; extrinsic and intrinsic influences; mathematical model of regulation	
13. Population Interactions: neutralism, amensalism, commensalism, competition, predation, parasitism, protocooperation, mutualism; Intra and interspecific competition; Verhulst Pearl and Lotka-Volterra equations	
14. Competition Theories and the Niche Concept; fundamental and realized niches	

	- relate the concept of niche to interspecific competition
EXAMINATION 3	
UNIT IV **POPULATION ECOLOGY (cont'd), PREDATION THEORY AND MODELS, COEVOLUTION, POPULATION GENETICS, COMMUNITY ECOLOGY, SUCCESSION AND ISLAND BIOGEOGRAPHY**	**LEARNING OBJECTIVES** On completion of this unit, the students should be able to: - define predation and distinguish among its forms - sketch the Lotka-Volterra as well as Rosenzweig-McArthur models of predation and discuss their relative strengths and weaknesses - explain functional and numerical responses (Holling's disc equation) - describe plant-herbivore and herbivore-carnivore systems - discuss and give examples of social parasitism and mutualism - explain the differences between adaptation, natural selection, and evolution - describe the sources of genetic variation - summarize how species vary across their geographic range - compare allopatric and sympatric species - define isolating mechanisms - explain how species dominance influences community structure - define the concept of species diversity - explain how vertical structure and horizontal patterns of vegetation influence the terrestrial community - discuss how the physical environment influences the structure of aquatic communities - differentiate the three models of species abundance - define succession and describe the stages - contrast primary and secondary succession as well as autogenic and allogenic succession - evaluate the concept of a climax community - define the edge effect - discuss the island biogeography theory and relate its significance in conservation biology
15. Population Ecology: Predation, Parasitism, and Predator-preys systems; Lotka Volterra models, Rosenszweig-McArthur models, and Nicholson-Bailey model, Holling's disc equation	
16. Coevolution: Predator-prey system, predator tactics, prey defenses; mutualism systems, and social parasitism	
17. Population Genetics: The Hardy-Weinberg Law, Natural Selection, and Speciation	
18. Community Ecology: Structure, Abundance, and Diversity Measurements; vertical and horizontal structure; geometric, log normal, and broken stick models; Shannon-Weiner, Simpsons indices; community similarity indices.	
19. Community Ecology: Stability and Ecological Succession; autogenic and allogenic succession; primary and secondary succession; pioneer and climax communities	
20. Community Ecology: Island Biogeography; conservation biology	
21. Special Topics in Ecology (optional) eg. ecological restoration; landscape ecology; conservation ecology; invasive species; integrated pest management	

GENERAL ACTIVITIES:

- Lectures, Quizzes, Problem exercises, Assignments
- Group discussion, case study, written reports
- Laboratory Exercises (see below)

COURSE REQUIREMENTS

Lecture

- Examinations ---------- 70.0%
- Individual/paired Quizzes ---------- 15.0%
- Assignment (indiv/Group)---------- 7.5%
- Topic Report/Journal Report/Case study- 7.5%

100.0%

GRADING SYSTEM

1. The prefinal grade computation is based on 60% lecture grade and 40% laboratory grade. If the student is exempted from taking the final examination, the prefinal grade becomes the final grade.
2. To be exempted from taking the final exam, the student must have an average of 70% (2.5) or better in the lecture and laboratory.
3. For students who are not exempted from the final exam, the prefinal grade will be 80% while the final examination is 20%.
4. If a student missed an exam due to justifiable reason, he/she is required to take the final exam. His/her score in that exam will substitute for the missed exam. Only one missed exam is allowed.

GRADING SYSTEM:

93-100	=	1.00	70-74	=	2.50
90-92	=	1.25	65-69	=	2.75
87-89	=	1.50	60-64	=	3.00
84-86	=	1.75	54-59	=	4.00
80-83	=	2.00	Below 54	=	5.00
75-70	=	2.25			

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UNIVERSITY OF THE PHILIPPINES MANILA
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BIOLOGY 160 LABORATORY
Schedule of Laboratory Activities

No. of Meetngs	Activity
	Orientation
	Exercise 1 – Climatic factors
	Exercise 2 – Edaphic factors
	Exercise 6A – Terrestrial productivity setup
	Exercise 4 – Effect of pH, temperature, salinity on organisms
	Exercise 3 – Water analysis
	Exercise 6B – Aquatic productivity
	Exercise 5 – Food chain
	Exercise 7 – Herbivory
	Exercise 6A - Processing
	Reporting Ex 1 to 7
	1st Long Exam
	Exercise 8 – Population estimation
	Exercise 9 – Population growth
	Exercise 10 – Population mortality
	Exercise 11 – Population distribution
	Reporting Ex 8 to 11
	Bioweek (no meeting)
	2nd Long Exam
	Exercise 12 – Plant competition
	Pre-lab for field work
	Exercise 14 – Predator-Prey interactions
	Exercise 15 – Functional response of predators
	Preparation for field work and special problem
	Field work for Exercises 13, 16 and 17
	Processing of data; Creation of reports
	Reporting of Ex 12 to 17 and Special Problem
	3rd Long Exam

Grading system: 40% OF BIO 160 GRADE

Exams	60%
Oral reports	10%
Written Reports	15%
Field/Lab Performance	10%
Special Problem	5%
TOTAL	100%

FACULTY-IN-CHARGE:

Arnold V. Hallare, Dr. *rer nat* (Lecture)

Neil Edsel Ramirez, MSc (Laboratory)