BIOL 3083 — PRINCIPLES OF ECOLOGY

Instructor: TBA

Affiliation: CUNY Graduate Center, Ecology, Evolutionary Biology, and Behavior (EEB) PhD subprogram *and* Brooklyn College, Department of Biology

Office hours: TBA

Contact: TBA

Meeting times: TBA
Tuesdays and Thursdays from 2:15pm to 3:30pm.

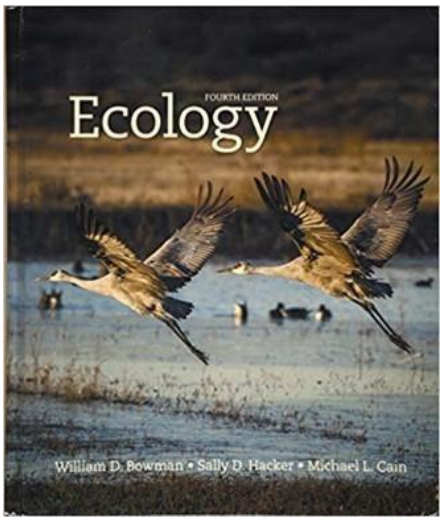
Late policy: Students may leave class if I have not arrived after 15 minutes since the meeting hours started.

Description: 3 hrs; 3 credits.
Introduction to the principles of ecology; biology of populations, communities, and ecosystems; basic issues of biodiversity.

Prerequisites: Biology 1001 and 1002; or permission of the instructor

Goals: Students will learn the relationships between organisms and their biotic and abiotic environments; the course includes physiological, population, and community ecology. By the end of the course, students will be able to: describe the key components of natural selection; explain how natural selection has contributed to evolution and diversity of life forms; demonstrate familiarity with evolutionary mechanisms; describe major biotic and abiotic factors that determine the distribution of plants and animals; demonstrate an understanding of population genetics and demography; define the major types of intraspecific and interspecific interactions; demonstrate an understanding of community structure and dynamics.

Textbook: *Ecology*, 4th Edition (2017) by Bowman, Hacker, and Cain ISBN 978-1-60535-618-1



Note: Students do not have to use the suggested textbook, but they do need to familiarize themselves with the topics covered in the course. A complete list of topics is listed at the end of the syllabus.

Other materials: Slides will be made available electronically by the instructor.

Evaluation: Final grades for this course will be determined by three exams and coursework:

- Warm-up exam (10%)
- Midterm exam (20%)
- Final exam (40%)
- Coursework (30%)

Assessment: Exams are graded on a curve and will only include topics covered in class.

Grading scale:

A	90% and above
A-	89, 88, 87
B+	86, 85, 84
B	83, 82, 81, 80
B-	79, 78, 77
C+	76, 75, 74
C	73, 72, 71, 70
C-	69, 68, 67
D	66 and below

Cheating policy: Cheating will result in a FAIL.

Non-discrimination policy: The instructor has a ZERO TOLERENCE policy and will not accept discrimination based on race, color, national or ethnic origin, age, religion, disability, veteran status, sex, sexual orientation, and gender identity and expression. All members of the class will be treated with RESPECT—this is non-negotiable and will be strictly enforced.

Academic integrity policy: The faculty and administration of Brooklyn College support an environment free from cheating and plagiarism. Each student is responsible for being aware of what constitutes cheating and plagiarism and for avoiding both. The complete text of the CUNY Academic Integrity Policy and the Brooklyn College procedure for policy implementation can be found at www.brooklyn.cuny.edu/bc/policies. If a faculty member suspects a violation of academic integrity and, upon investigation, confirms that violation, or if the student admits the violation, the faculty member MUST report the violation. *Students should be aware that faculty may use plagiarism detection software*.

Disability services policy: The Center for Student Disability Services (CSDS) will be working remotely for the fall semester. In order to receive disability-related academic accommodations students must first be registered with CSDS. Students who have a documented disability or suspect they may have a disability are invited to schedule an interview by calling (718) 951-5538 or emailing testingcsds@brooklyn.cuny.edu. If you have already registered with CSDS, email Josephine.Patterson@brooklyn.cuny.edu or testingcsds@brooklyn.cuny.edu to ensure the accommodation email is sent to your professor.

Student bereavement policy: see http://www.brooklyn.cuny.edu/web/about/initiatives/policies/bereavement.php

Religious non-attendance: State law regarding non-attendance because of religious beliefs is noted in the front matter of the Undergraduate Bulletin and Graduate Bulletin, see http://www.brooklyn.cuny.edu/web/about/administration/enrollment/registrar/bulletins.php

Exam dates: TBA

Course schedule:

	General topic	Date	Textbook / paper readings
Week 1:	Welcome		
	Intro to ecology		Chapter 1, Pages 2 to 21
Week 2:	Natural selection		
	Natural selection		Chapter 6, Pages 136 to 159
Week 3:	Life histories		Chapter 7, Pages 160 to 181
	WARM-UP EXAM		
Week 4:	Biogeography		Chapter 2, Pages 22 to 49 Chapter 4, Pages 84 to 108
	Discussion session 1		Whose conservation?
Week 5:	Biogeography		Chapter 18, Pages 399 to 423
	The Biosphere		Chapter 3, Pages 50 to 83
Week 6:	The Biosphere		
	Discussion session 2		Decolonizing ecology
Week 7:	Populations and life tables		Chapters 9 & 10, Pages 204 to 248
	Populations and life tables		
Week 8:	Populations and life tables		
	Discussion session 3		"Natural," maps and power
Week 9:	Revision session		
	MIDTERM EXAM		
Week 10:	Office hours		
	SPRING BREAK		
	Population dynamics		
Week 11:	Population dynamics		Chapter 11, Pages 249 to 271
	Interactions		
Week 12:	Discussion session 4		Science communication
	Interactions		Chapters 12–15, Pages 272 to 355
Week 13:	Communities		
	Communities		Chapters 16 & 17, Pages 356 to 398

Week 14:	Discussion session 5 Revision session	Social sciences and ecology
Week 15	**FINAL EXAM**	TBA

Topics in Principles of Ecology:

- Introduction − Definition of ecology − Difference between biotic and abiotic factors
  Organization of ecology (individuals to the biosphere)
  Ecological maxims
  The importance of scale in ecology
  Controlled experiments
  The scientific method
- Natural selection ○ The relationship between evolution and ecology ○ Heritability
  - Basic genetics (genes, alleles, genotypes, phenotypes) ○ Hardy-Weinberg equilibrium
  - Descent with modification and natural selection
  - How populations diverge
  - Mechanisms of evolution (mutation, natural selection, genetic drift, gene flow)
  - Adaptive evolution
  - Spatial variation of traits of individuals of a species (clines) ○ Temporal variation of traits of individuals of a species ○ Co-evolution of interacting species
  - Limits to perfect adaptation (gene flow, environmental change, lack of genetic variation, evolutionary history, ecological trade-offs)
  - Speciation (genetic divergence, genetic drift, hybridization) ○ Evolutionary trees ○ Extinction and speciation ○ Adaptive radiation
- Life histories ○ Life history strategies ○ Genetic control ○ Environmental control
  - Reproduction (asexual versus sexual, semelparous versus iteroparous, r-selected versus K-selected species)
  - Plant classifications (competition versus disturbance tolerance versus stress tolerance)
  - Dimensionless ratios

- Life-history trade-offs (survival versus reproduction, growth versus reproduction, current versus future reproduction, quality versus quantity of offspring)
- Complex life cycles ○ Evolution of life-histories

• Biogeography ○ Climate versus weather
Climate and species distributions
Climate averages versus climate extremes
Atmospheric circulation patterns
Hadley cell
Polar cell
- Ferrell cell
- Climate zones and effects on abiotic features and seasonality ○ Prevailing winds ○ Coriolis effect ○ Seasonal climate variation ○ Long-term climate variation (e.g., El Nino Southern Oscillation) ○ Chemical environment (salinity, acidity, oxygen concentrations) ○ Physiological ecology
- Impacts of environment on ecological success ○ Climate envelopes
- Geographic ranges (potential versus actual) ○ Stress and coping with the environment (tolerate versus avoid) ○ Temperature and survival (unicellular organisms, plants, animals) ○ Ectotherms versus endotherms ○ Evolution of endothermy ○ Solvents and solutes ○ Salt and water
- Water balance (microorganisms, plants, animals) ○ Definition of biogeography
- Common biogeographic patterns (local, regional, and global scales) ○ Measures of diversity (alpha, beta, gamma) ○ Local versus regional species richness
- Biogeographic regions (Nearctic, Neotropical, Palearctic, Ethiopian, Oriental, Australasian) ○ Continent formation

and evolutionary isolation ○ Species-area
relationships
- Island biogeography and species richness patterns

• The Biosphere ○ Defining terrestrial biomes
according to plant life
- Nine terrestrial biomes (tropical rainforest, tropical seasonal forest and savanna, desert, temperate grassland, temperate shrubland and

woodland, temperate deciduous forest, temperate evergreen forest, boreal forest, tundra)

- Mountains as analogous biomes ○ Freshwater biological zones

Lotic (flowing water) versus lentic (still water) systems

Marine biological zones

Nearshore zones

Shallow ocean zones

Open ocean

- Populations ○ Individuals, populations, ramets, and genets ○ Distribution and population abundance ○ Absolute versus relative abundance ○ Habitat suitability and abiotic and biotic factors ○ Historical factors and dispersal ○ Geographic range and patchy distributions
    - Spatial arrangement of individuals within a population (clumped, regular, random)
    - Ecological niche (fundamental versus realized)
    - Estimating population abundance (area-based counts, distance methods, mark-recapture)
    - Life tables (how survival and reproductive rates vary with the age of an organism)
    - Cohort life tables versus static life tables ○ Survivorship curves (Type I, Type II, Type III) ○ Age classes and age structure
    - Matrix representation of fecundity and survivorship ○ Stable age distributions
- Growth and regulation ○ Population growth rates ○ Condition for population decline
    - Geometric growth
    - Discrete reproductive periods versus continuous breeding ○ Exponential growth ○ Doubling times ○ Density-independent factors affecting population growth ○ Density-dependent factors affecting population growth ○ Allee effect
    - Logistic growth and carrying capacity
    - Beverton-Holt equation (discrete-time equivalent of logistic growth) ○ Human population growth and the human carrying capacity
- Population dynamics ○ Births, deaths, immigration, and emigration
    - Patterns of population growth in real systems (exponential growth, logistic growth, population fluctuations, population cycles) Population cycles, delayed density dependence, over-compensatory dynamics, and the Ricker equation
      Stochastic growth rates

    ○ ○

- Small populations and extinction (genetic factors, demographic factors, environmental factors)
- Metapopulations

- Interactions ○ Predation and trophic interactions (carnivory, herbivory, parasitism) ○ Parasitoids
  - Diet preferences, specialists, generalists, encounter rate, and handling time
  - Predator and prey adaptations to trophic interactions
  - Plant-herbivore interactions, overcoming plant defense mechanisms, and co-evolution
  - Predator-prey interactions and the Lotka-Volterra model ○ Population growth isoclines, population cycles, and neutral stability ○ Predation and communities (direct and indirect effects) ○ Symbionts, parasites, and pathogens ○ Global parasite diversity and parasite species : host species ratios ○ Ectoparasitism (outside host) versus endoparasitism (inside host) ○ Parasite-host co-evolution and genotype dynamics ○ Red Queen dynamics
  - Competition (intraspecific and interspecific) ○ Interspecific competition and ecological niche ○ Types of competition (exploitative, interference, allelopathy) ○ Limiting resources, competition, and population growth
  - Asymmetrical competition and amensalism
  - Overlapping requirements, resource partitioning, and the outcomes of competition (competitive exclusion, competitive coexistence)
  - Competition and evolution (natural selection and character displacement)
  - Intraspecific and interspecific competition and the Lotka-Volterra competition model
  - Isocline combinations, competitive exclusion, and the coexistence requirement
- Communities ○ Defining communities based on abiotic and biotic features of an environment
  - Whole communities and reasons for considering subsets (practicalities, guilds, functional groups) ○ Food webs and interaction webs ○ Community structure (species diversity, species composition) ○ Species richness, species evenness, and the Shannon index

- Species diversity versus biodiversity
- Rank abundance curves ○ Species accumulation curves
- Direct and indirect interactions and trophic cascades ○ Trophic facilitation
- Competitive networks and species coexistence
- Types of species (foundation species, keystone species, ecosystem engineers)
- Measuring interaction strength
- Communities and change (abiotic and biotic agents of change, stresses versus disturbances)
- Succession (primary and secondary succession, pioneer and climax stages)
- Three models for succession (facilitation model, tolerance model, inhibition model)
- Alternative stable states, stability, hysteresis, and regime shifts