Biology 130: Introduction to Ecology

"All have their worth and each contributes to the worth of others"
- J.R.R. Tolkien, The Silmarillion

Instructor: Jason Pienaar, PhD (Klamath 65, jpienaar@uoregon.edu, office hours: 9am – 11 am Wednesdays.)

Text: Specific SimuText (ST) online Ecology chapters and labs are required for class and cannot be shared. The cost is $61.00. More information on how to purchase the text, and technical help can be found at this website. Further information that you will need to acquire the text will be given out on the first day of class, so please wait till then before purchasing.

Course description: Organisms, the communities they make up and the abiotic components of the environments they live in form ecosystems, which through various processes and interactions regulate the flux of energy and matter through an environment. Ecology is the science that studies these interactions and processes - it is an interdisciplinary science comprising aspects of both biological and earth sciences.

In this introductory course, we will build up in scales of organization, starting with the evolutionary forces that shape characteristics of a given species, then moving onto the dynamics of populations of a given species, the interactions of populations of different species to form communities and the interaction of communities with their abiotic environments to regulate the flux of energy and matter as ecosystems. We will also cover a well-studied example of how ecology intimately affects our general health and wellbeing as humans – the ecology of some of the microbial communities that live on and in us.

Assessment

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*SimuText chapters: E4E = Evolution for Ecology, PG = Population Growth, CD = Community dynamics, TBA = to be announced, EE = Ecosystem ecology.
STUDY UNIT 1: **EVOLUTION AND ECOLOGY (4 LECTURES, 1 DISC.)**

**STUDY MATERIAL:** Simutext “Evolution for Ecology”, SimuText lab “Darwinian snails”, Class slides, Discussion material.

**KEY CONCEPTS**
- Rate of Evolution
- Natural selection
- Phenotypic & Genetic Variation
- Allele frequencies
- Scientific experiments

**LEARNING OUTCOMES**
- Understand why ecologists need to be aware of evolutionary processes.
- Understand how natural selection works.
- Be able to articulate concrete examples of rapid evolution in an ecological context.
- Be able to calculate allele frequency changes over time.
- Understand the difference between discrete and quantitative traits.
- Understand the concepts of local adaptations and trade-offs.
- Understand the concept of genetic drift.
- Be able to explain why integrated pest management requires knowledge of how natural selection works
- Be able to conduct a controlled scientific experiment in principle

**TERMINOLOGY**

**SELF STUDY**
- Complete Questions 1-58 in the “Evolution for Ecology” chapter

**STUDY UNIT 2: **POPULATION ECOLOGY (4 LECTURES, 2 DISC.)**
STUDY MATERIAL: SimuText “Population Growth”, SimuText lab “Isle Royal”, Class Slides, Discussion material.

KEY CONCEPTS

• Ecological modeling
• Geometric growth
• Exponential growth
• Logistic growth
• Metapopulation dynamics
• Stochasticity in population dynamics

LEARNING OUTCOMES

• Know how and when to use the geometric population growth model.
• Be able to provide real life examples of geometric population growth.
• Know how and when to use the exponential population growth model.
• Understand the concepts of a finite rate of increase, per capita growth rate and intrinsic growth rate.
• Be able to calculate the doubling time for a population.
• Be able to provide examples of exponential population growth.
• Know how and when to use the logistic population growth model.
• Understand the concept of carrying capacity.
• Understand the difference between density dependent and density independent factors affecting population growth and be able to provide examples.
• Be able to calculate population growth rates when immigration and emigration events are included.
• Understand the concept of variation in population growth and be able to discuss some of the causes.

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Allee effects, Birth rate, Carrying capacity, Chaos, Death rate, Delayed density dependence, Demography, Demographic stochasticity, Density dependence, Discrete logistic equation, Dispersion, Doubling time, e, Emigration, Empirical data, Environmental stochasticity, Exponential growth, Extinction, Geometric growth, Growth rate, Intraspecific competition, Immigration, Intrinsic growth rate, K, λ, Metapopulations, Natural logarithm, Patches, Population dynamics, Positive feedback, r, r_{max}, Sigmoidal, Source-Sink systems, Stochasticity, t_d,
SELF STUDY

Complete Questions 1-61 in the “Population growth” chapter

STUDY UNIT 3

**COMMUNITY ECOLOGY (4 LECTURES, 2 DISC.)**

STUDY MATERIAL SimuText “Community Dynamics”, SimuText lab “the Barnacle zone”, SimuText lab “Top down control”, Class Slides, Discussion material.

KEY CONCEPTS

- Ecological theory
- Disturbance and succession
- Food chains and indirect effects
- Top-down verse Bottom-up control
- Community stability

LEARNING OUTCOMES

- Understand how life history traits and trade-offs of individual species affect succession.
- Know and understand the assumptions and outcomes of the facilitation, inhibition and tolerance models of succession.
- Understand how trophic and behavioral cascades are the result of disturbances in food chains.
- Know the definition of and be able to provide examples of ecosystem engineers.
- Understand the difference between top-down and bottom-up control and how they relate to community structure and food chain length.
- Understand how resistance, return time and resilience interact to determine community structure after disturbances.
- Understand the diversity, food web theory, and dominant and keystone species hypotheses for community stability and be able to discuss them by means of examples.
- Be able to calculate community importance and total impact.

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Allogenic, Alternative stable states, Autogenic, Behavioral cascades, Catastrophic disturbance, Community, Community importance, Community structure, Connectance, Constancy, Disturbance, Dominant species,
Ecosystem engineers, Ecosystem size hypothesis, Exotics, Facilitation, Inhibition, Intermediate disturbance hypothesis, Invasive species, Keystone species, Life history traits, Niche, Non-equilibrium dynamics, Persistence, Population, Primary producers, Primary succession, Productivity hypothesis, Productive space hypothesis, Resistance, Resilience, Return time, Secondary succession, Self-thinning, Succession, Tolerance, Top down effects, Total impact, Trade-offs, Trophic cascades, Trophic levels

**Self Study**

Complete Questions 1-52 in the “Community dynamics” chapter.

**Study unit 4: Ecosystem Ecology (4 lectures, 2 disc)**

**Study Material**

SimuText chapter “Ecosystem Ecology”, SimuText lab “Nutrient pollution”, class slides, Discussion materials

**Key concepts**

- Energy flow
- Primary production
- Secondary production
- Ecosystem energetics
- Ecosystem services

**Learning outcomes**

- Understand that concepts of energy flow, sustainability and an ecological footprint.
- Understand how gross and net primary production can be estimated in terrestrial and aquatic ecosystems.
- Understand how lifecycle accounting can help us make decision regarding bio fuel economics.
- Know how to calculate the components of trophic efficiency: consumption, assimilation and production efficiency.
- Understand the factors that cause variation in consumption, assimilation and production efficiencies.
- Understand how and why energy flow differs in different ecosystems
- Understand what ecosystem services are and how they are being impacted by human activity.
**TERMINOLOGY**


**SELF STUDY**

Complete Questions 1-79 in the “Ecosystem Ecology" chapter.

**STUDENTS WITH DISABILITIES:**

The University of Oregon is working to create inclusive learning environments. Please notify us if there are aspects of the instruction or design of this course that results in barriers to your participation. You may also wish to contact the Accessible Education Center in 164 Oregon Hall at 346-1155 or uoaec@uoregon.edu. If you have a documented disability and anticipate needing accommodations in this course, please talk to your instructors during the first week of class. Please request that the Counselor for Students with Disabilities send a letter verifying your disability.