

11:216:110

Evolution, Disease, and Medicine Syllabus

Instructor: TBA

Offered: Each Fall Semester

Credits: 3

Prerequisites: None

Overview: This course introduces the theory of evolution and its real-world applications to the practice of medicine. Concepts of survival and reproduction defining evolutionary fitness, co-evolution, competition, natural selection, bottleneck effects, adaptation and exaptation will be introduced and applied in the context of discussion of human and animal disease and the medical treatment thereof. The course will cover infectious and non-infectious diseases. We will also extend these concepts past individual-level medicine to population-level public health and consider real-world cases such as antibiotic resistance, vaccination leading to strain replacement, and disease control decisions such as targeting specific populations for vaccination.

Rationale: This course will provide a concise introduction to the theory of Evolution, meant to be accessible to any student. Students who wish to enter any of a wide variety of fields (such as evolutionary biology, public health, medicine, nursing, or health related research, including pharmaceutical research) will gain a practical understanding of applied evolutionary theory.

SAS Core Curriculum Learning Goals

II: Areas of Inquiry

Natural Sciences

- e. Understand and apply basic principles and concepts in the physical or biological sciences.
- f. Explain and be able to assess the relationship among assumptions, method, evidence, arguments, and theory in scientific analysis.

Core Learning Goals:

1. Students will be able to define and discuss concepts of evolutionary fitness as survival and reproduction, heritability with variation as the mechanism for adaptation, natural and sexual selection as a mechanism of speciation, and non-selection-based mechanisms of evolution.
2. Students will be able to analyze disease and disease-related healthcare concepts from human medicine as evolutionary pressures.

3. Students will be able to evaluate medical treatment strategies within the context of evolved responses and altered selective pressures.
4. Students will be able to apply logic and formal argument to determine and explain whether or not particular conclusions are adequately supported by presented facts.

Weekly Topics

Week 1	Initial Survey	
	A	Introduction to evolutionary fitness
	B	Discussion of definitions and causes of disease
Week 2	Quiz #1	
	A	Mechanisms of evolution (genes, DNA, basics)
	B	Natural selection
Week 3	A	Exaptation
	B	Selective transparency
Week 4	Quiz #2	
	A	Evolutionary fitness with competition
	B	Co-evolution
Week 5	A	Signs and symptoms of infectious disease
	B	Co-evolutionary arms race of infectious disease
Week 6	Quiz #3	
	A	Continued discussion of signs and symptoms and treatment
	B	Disease in competition: multiplayer arms race (part 2)
Week 7	A	Review of Evolution and Adaptation
	B	Review of Host/ Pathogen Co-evolutionary Influences
Week 8	Midterm Exam	
Week 9	A	Injury
	B	Toxins
Week 10	Quiz #4	
	A	Allergy and immunity
	B	Cancer

Week 11	A	Mental illness
	B	Mental illness continued
Week 12	Quiz #5	
	A	Genetic Disorders
	B	Sex and Reproduction (part 1)
Week 13	A	Sex and Reproduction (part 2)
	B	Sex and Reproduction (part 2) continued
Week 14	Quiz #6	
	A	Recap, future directions, and wrap-up discussion
	B	Recap, future directions, and wrap-up discussion continued.

Assessment and Assessment Plan:

All assessment will use the CRC's Core rubrics.

5 short quizzes

For each quiz, there will be one question assessing performance of Course Learning Goal 1 that asks the student to define and discuss a basic scientific concept from among the list above.

For example: For Course Learning Goal 1 and CRC Core Rubric for NSe

“Using only the biological definition for the word **‘Adapt’** – Can an individual adapt? Why or why not?”

For each quiz, there will be at least one question assessing performance of one of Course Learning Goals 2-4 (such that at least 2 Quizzes cover each of these Learning Goals over the duration of the semester).

For example: For Course Learning Goals 2 and 4 and CRC Core Rubric for NSf (Learning goal 2 is assessed by the answer to the first sentence, Learning goal 4 is assessed by the 3-part answer to the second sentence).

“Using an evolutionary perspective of foraging success and resource limitation, discuss the evolutionary fitness of “hollandaise syndrome” (i.e. when an instance of vomiting causes avoidance of the triggering food in the future). Provide a logical argument for whether or not having this trait is adaptive when the gastrointestinal distress was caused by (a) an infectious pathogen, (b) an allergy, and (c) a toxin (i.e. a poisonous chemical).”

Midterm exam

The format of the midterm exam will be the same as though it were a very long quiz. Questions addressing all 4 Learning Goals will be included and assessed according to the CRC Core Rubric for both NSe and NSf (as appropriate to each question).

Final exam

The format of the final exam will be the same as the midterm. Questions addressing all 4 Learning Goals will be included and assessed according to the CRC Core Rubric for both NSe and NSf (as appropriate to each question).