

ON THE ORIGINS OF DISEASE: VPAT 4000

Course Coordinator:

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Course Objectives:

- 1) Understand the evolutionary origins of disease susceptibility in man and animals ie: why we get sick and why there are both similarities and differences between human and animal diseases
- 2) Develop a basic understanding of the pathological basis of disease
- 3) Use this knowledge to assess information and ask relevant questions about disease

Meeting Times: The class is scheduled to meet Tuesday/ Thursday 3:30-4:45pm Veterinary Building Room 149; however, alternate meeting times may be scheduled between the students and the instructor.

Course Description: A comparative and evolutionary perspective on the origins and pathogenesis of disease. Topics include: Darwinian medicine, pathology, adaptations and susceptibility to disease, natural selection and infectious disease, evolution of host defenses, parasites and allergies, evolutionary models of cancer, diet and toxins, degeneration and aging, paleopathology, diseases of civilization, selective breeding and disease susceptibility, and environmental impacts on disease incidences. Diseases of both man and animals will be studied. Assigned reading from different journal articles and texts will supplement lectures and discussions.

Course Readings and Lecture PowerPoints

One-two reading assignments will be given each week. Most will be articles and pdf's of the articles will be posted on the e-Learning course site. Other source material will be recommended when the topics are covered for those especially interested.

PowerPoints will be available the day of or right after the lectures on the e-Learning course site. Some lectures will have handouts and they will also be posted.

Assignments and Quizzes:

One to two questions will be given at the end of each lecture. Students will be asked to research these questions for the next discussion period. Occasional unannounced short quizzes will be given based upon these questions.

Recommended Texts:

This is a new course, and material is coming from a variety of sources, so there is no required textbook; however

Evolution in Health and Disease 2nd Edition, By Stephen Sterns and Jacob Koella, and *Why We Get Sick* by Randolph Nesse and George Williams are recommended. Both are available from Amazon.com.

Course examinations

Two examinations will be given in this course; one mid-term and one final. Sixty percent of the course grade will be determined by these two examinations (30% each). Participation in discussions will be worth 20 % and the remaining 20% will be based on assignments and quizzes. The examinations will be mostly short answer and essay.

Grading

A = 93-100
A- = 90-92
B+ = 88-89
B = 83-87
B- = 80-82
C+ = 78-79
C = 73-77
C- = 70-72
D = 60-69
F = 59 or below

Absence policy

Attendance is **required** for this class. If you anticipate an absence, please be courteous enough to let the instructor know about it. We also do not want you to take an exam if you are sick since you will just infect us all. Please let either Dr. Uhl or the departmental office staff know about your absence as soon as possible and we can arrange for a make-up examination to be given. The format of the make-up examination is up to the instructors giving the examination. We reserve the right to deny a make-up examination (with a grade of 0%) to anyone we believe to be abusing this privilege.

Topical Outline:

- I) Introduction to Evolutionary Medicine
 - A) Historical perspective
 - B) Definitions: the why we get sick questions
 - C) Natural selection in disease
 - D) Importance of a comparative perspective
- II) Tools for Studying Disease
 - A) Pathology: basic mechanisms of disease
 - B) Microbiology/virology: identification of agents
 - C) Genome sequences: susceptibility genes
 - D) Fossil genes: determinations of selective pressure
 - E) Epigenomics: inherited environmental affects on gene expression
 - F) Paleopathology: evidence of disease in the past
 - G) Historical records: descriptions and impact of disease in the past

III) Cost of Adaptations: Disease Susceptibility

- A) Oxygen and free radicals: the early compromises
- B) Evo Devo: consequences of past choices
- C) Jaws, teeth: rise of predation
- D) Emergence from water: maintaining hydration
- E) Movement: osteoarthritis
- F) Diet: plants, meat, parasites and toxins
- G) Endothermia: energy and overheating
- H) Sex: conflicts and compromises
- I) Aging: accumulated effects of compromises
- J) Brains: the cost of increasing memory and intelligence

IV) Infectious diseases

- A) An arms race without end: Natural Selection and Pathogens
- B) Effects of transmission on virulence
- C) Bacteria: Masters of Resistance
- D) Parasites: Cost/Benefit of a Close Relationship
- E) Viruses: Rosetta Stones of the Immune System
- F) Why do new pathogens emerge and old ones disappear?

V) Host defenses: The Inflammatory System

- A) Early Origins: Development of the Mediators
- B) Tissue Responses: Acute Inflammation
- C) Tissue Response: Chronic Inflammation & Repair
- D) Legacies and Limitations

VI) Host Defenses: The Immune System

- A) Non-specific: Innate Responses
- B) Specific: Adaptive Responses
- C) MHC: Self, Non-Self and Infectious Tumors
- D) Isolated Populations: Problems of Living in Paradise
- E) Downside of Cleanliness: Allergies and the Hygiene Hypothesis
- F) Viral Obsessions and Senescence

VII) Cancer: Problems in Proliferation

- A) Evolutionary Models of Cancer
- B) Problems in Evolutionary Engineering
- C) Overrun by Free Radicals
- D) Cost of Reproductive Success

VIII) Toxic diseases: A tale of plants and drugs

- A) Diet and the Evolution of Enzyme Systems
- B) Fossil Genes and Drug Metabolism
- C) Impact on Animal Models

IX) The pitfalls of looking backwards: How to ask the right questions

- A) Studying disease in an evolutionary context
- B) Generating testable hypotheses

X) Paleopathology

- A) Disease in Ancient Remains: What Survives
- B) Diseases in Extinct Species: Expectations and Evidence
- C) Role of Disease in Extinctions
- D) Prehistoric Animal Diseases
- E) Prehistoric Human Diseases
- F) Genetic Legacies

XI) Disease in Historical Times

- A) Human Diseases in History: the Why Questions
- B) Animal Diseases in History: the Why Questions
- C) Plants and Disease
- D) Genetic and Cultural Legacies

XII) Domestic Animals: Survival of the Sickest?

- A) Intensity of Selection
- B) Costs of Selective Breeding: Disease Susceptibility
- C) Benefits of Selective Breeding: Models of Human Diseases

XIII) Disease Ecology

- A) Environmental Factors and Disease
- B) Lessons from the Past
- C) Predictions for the Future?