ENT 5275 Insect-transmitted diseases of humans

Classes Tu/Th: 10:15 to 11:30; Rm 480 Hodson Hall, St. Paul Campus

This is a 3-credit course

This course will replace Medical Entomology, Ent 5275. It is designed for a mixed class of advanced undergrads (2275) and grad (5275) students.

Grading Option: A-F or S/N

Instructor: Ann Fallon

Offered: Spring semester; annually

I. Course Description (*)

What's so attractive about human blood? How have human interactions with insects evolved? Insects and ticks transmit viral, bacterial, protozoan and filarial diseases to humans, particularly in tropical countries. Zika, most recently, and also dengue and other mosquito-borne viruses pose an increasing challenge in the southern US as climate change increases the range of important vector species. Lyme disease and other tick-borne diseases are increasing in the US, and pose challenges in diagnosis and treatment. This course covers contemporary topics in "Medical Entomology" that will provide an overview of arthropod-borne disease and its impacts on global health. Students will study the historical, contemporary and epidemiologic stories demonstrating exposure and control strategies via lecture, student discussions, laboratory demonstrations, and critical review of current best practices in medical entomology.

II. Course Prerequisites

Biol 1009 or equivalent

III. Course Goals and Objectives

At the end of this course, students will be able to:

- Describe the basic biology of mosquitoes, ticks, and other arthropod vectors and the mechanisms they use to transmit disease
- Discuss the epidemiology of important vector-borne diseases both locally and worldwide
- Appreciate the changing dynamics of vector-borne disease, including the importance of both historic and emerging infections in the context of human behavior and climate change

- Communicate strategies for the control and reduction of arthropod-borne disease

IV. Methods of Instruction and Work Expectations

This course will include lectures, laboratory demonstrations and case studies, with weekly discussion of a relevant publication. Students enrolled for graduate-level credit will be expected to prepare two 2000-word term papers on two topics of their choice. Papers should be formatted as mini- reviews with an Introduction; subheadings as appropriate; Discussion; References (minimum of 10 references). Examples will be provided.

IV. Methods of Instruction and Work Expectations

This course combines lectures and laboratory demonstrations (60%), case studies (20%), and group discussions (20%).

Students will be expected to review assigned course readings prior to class, participate in class discussion, and complete two midterm and one comprehensive final examination.

Student (undergraduate) grades will be assigned as follows:

1. Class participation (25% of grade). Students will obtain credit for asking questions, and participating in discussions and hands-on activities.
2. Examinations (65 % of grade; midterms and final exam will have equal weight).
3. Unannounced quizzes (10% of grade)
4. For 5000-level (graduate) credit: Class participation, 20%; Examinations, 45%, Quizzes, 10%. The two minireviews will count for 25% of the grade.

V. Topics

Week 1

1. Human health and insects: scope of the course; why vectors are important; global change and resurgence of arthropod-borne disease

2. What is an arthropod? Basic biology and lifecycles; Interactions between vectors and pathogens; Microscopy of specimens from the teaching collection

Week 2

3. Morphological and physiological adaptations; blood feeding and pathogen transmission; demonstration of live mosquitoes and colony maintenance

4. Pathogens transmitted by insects: an overview (viruses, bacteria, protozoa, filarial worms)

Week 3

5. Mechanical vs. biological transmission; Problems caused by insects themselves, unrelated to an infectious agent (chiggers, scabies, eyelash mites, bedbugs, allergic reactions to bites and venoms)

6. Mosquitoes-borne disease and reproductive cycles; blood-feeding and host specificity; specificity of vector-pathogen interactions; worldwide movement of mosquitoes and insecticide resistance genes

Week 4

7. The malaria life cycle: mosquito/pathogen interactions; patterns of human migration and evolutionary resistance to malaria

8. Malaria in the United States; how did we eliminate it? Airport malaria as a contemporary problem

Week 5

9. Global distribution of malaria; types of malaria pathogens; climate change and movement of vectors; social issues in tropical medicine

10. Malaria prevention and treatment; Quinine and WWII; Malaria as a cure for syphilis; Nobel prize for artemisinin; discovery of new drugs; problems of resistance

Week 6

11. Exam 1

12. Mosquitoes and viruses: what are the characteristics of mosquito-borne viruses? How many are there? How do they replicate; how dangerous are they?

Week 7

13. Yellow fever and Aedes aegypti: Epidemics in the US; Construction of the Panama Canal; Contemporary outbreaks in Africa, South America

14. Development of the Yellow fever vaccine; vaccine shortages

Week 8

15. Dengue Hemorrhagic Fever: Global travel after WWII and spread of dengue serotypes

16. Why do immune responses make a secondary dengue infection potentially fatal; cytokine storms and hemorrhagic manifestations; implications for vaccines

Week 9

17. Withdrawal of the dengue vaccine: What went wrong?

18. Mosquito-borne viruses in Minnesota: LaCrosse encephalitis, St. Louis encephalitis and West Nile virus; concept of dead-end hosts

Week 10

19. Zika virus and its vectors; microcephaly in South America, but not in Africa; how do insect-borne viruses evolve and spread; how do you pinpoint the insect vector of an emerging disease?

20. Use of insecticides for prevention of mosquito-borne diseases; agricultural use of insecticides and contamination of breeding sites; evolution of resistance

Week 11

21. Exam 2

22. Lyme disease and ticks; how does a tick differ from an insect; tick biology and reproduction

Week 12

23. Mites: Chiggers, scabies and other itches; personal protection; delusory parasitosis

24. Venoms: scorpions, bees, tick-borne paralysis. Immunological basis for hypersensitivity; anaphylactic shock; use of the epipen after a bee sting

Week 13

24. Fleas and Plague: historical perspective; still a problem in the American west; what makes a flea a good vector?

25. Rocky Mountain Spotted fever: Rickettsia, an obligate intracellular bacterium

Week 14

26. Wolbachia: a bacterial infection of insects used to control mosquitoes; cytoplasmic incompatibility; transgenic mosquitoes pros and cons

27. Tropical diseases: Hemiptera and Chagas' disease in South America; Bedbugs; Sleeping sickness in Africa, vectored by tsetse fly, unique aspects of tsetse biology

Week 15

28. Filarial infections: Black flies and River Blindness; Mosquitoes and Elephantiasis; Problems with finding therapeutic treatments for multicellular pathogens

29. Overview; human progress against insect disease vectors; career opportunities

Final exam: Will be based on the U of M schedule; in class