CIEE Global Institute - Monteverde

Course name:	Biology of Tropical Diseases
Course number:	(GI) BIOL 2004 MOCR
Programs offering course:	Monteverde Open Campus Block: STEM and Society
Open Campus track:	STEM and Society
Language of instruction:	English
U.S. semester credits:	3
Contact hours:	45
Term:	Fall 2019

Course Description

This course immerses students in studying the basic biology and epidemiology of most common tropical human diseases, especially Neglected Tropical Diseases. It looks at the basic biology of disease vectors, biology of transmission and infection, and the epidemiology of the disease. The course also exposes students to the basic biology necessary to understand the evolution of virulence and evolution of resistance to antibiotics. The factors that maintain tropical diseases and contribute to their spread, including land transformation and climate change, will be considered throughout.

Learning Objectives

By completing this course students will be able to:

- Name the major human diseases that occur in the tropics
- Give the main vectors that transmit diseases in the tropics
- Describe the basic life cycle of the main vectors of tropical disease
- Contrast how major tropical diseases are transmitted and how transmission impacts threat of epidemics
- Investigate the basic epidemiology of major tropical diseases
- Understand how virulence and drug resistance occurs
- Summarize how human-induced changes in the environment, including changes in climate, have favored the spread and virulence of diseases in the tropics and outside of the tropics into temperate zones

Course Prerequisites

None

Methods of Instruction

Students will attend lectures and related activities. Lectures will emphasize theory and current empirical patterns. Lecture Activities will place important concepts into hands on learning opportunities. These will result in worksheets that will be graded.

Assessment and Grading

1. Weekly Quizzes	20 %
2. Lecture Activities	15 %
3. Final oral presentation	5 %
4. Research paper	10 %
5. Final Exam	30 %
6. Participation	20 %
Total	100 %

Course Requirements

Weekly Quizzes

Each week, students will take a quiz on the previous week's course material, including lectures, labs, activities and readings. Quizzes will have True/False, Multiple Choice, calculations, filling in blanks and short answer questions. Quizzes will cover only new material, but similar questions to those on the quizzes will be seen again on the comprehensive final exam.

Lecture Activities

After each lecture, students will have a series of tasks and demonstrations related to the lecture material. They will work in groups to complete the tasks, handing in answers to a series of questions before leaving the class.

Final Exam

At the end of the course students will take an exam covering all previous material. As with quizzes, the final exam will have a variety of question formats, including True/False, Multiple Choice, filling in blanks.

Research Paper

At the end of the course students in groups will present a research report on the possible impact of habitat disturbance and climate change on a specific tropical disease. The report should be at least 1500 words in length including references. The results will also be presented orally to the rest of the group.

Participation

Participation is valued as meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Meaningful contribution requires students to be prepared in advance of each class session and to have regular attendance. Students must clearly demonstrate they have engaged with the materials as directed, for example, through classroom discussions, online discussion boards, peer-to- peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Attendance Policy

Regular class attendance is required throughout the program, and all unexcused absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus and Short Term programs, unexcused absences that constitute more than 10% of the total course will result in a written warning.

Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class. Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

For CIEE classes, excessively tardy (over 15 minutes late) students must be marked absent. Attendance policies also apply to any required co-curricular class excursion or event, as well as to Internship, Service Learning, or required field placement. Students who miss class for personal travel, including unforeseen delays that arise as a result of personal travel, will be marked as absent and unexcused. No make-up or re-sit opportunity will be provided.

Attendance policies also apply to any required class excursion, with the exception that some class excursions cannot accommodate any tardiness, and students risk being marked as absent

if they fail to be present at the appointed time.
Unexcused absences will lead to the following penalties:

Percentage of Total Course Hours Missed	*Equivalent Number of Open Campus Semester classes*	*Minimum Penalty*
Up to 10%	1 content classes, or up to 2 language classes	Participation graded as per class requirements
10 – 20%	2 content classes, or 3-4 language classes	Participation graded as per class requirements; **written warning**
More than 20%	3 content classes, or 5 language classes	Automatic **course failure**, and possible expulsion

Weekly Schedule

NOTE: this schedule is subject to change at the discretion of the instructor to take advantage of current experiential learning opportunities.

Week 1 Introduction

Class 1.1 Introduction to the tropics and tropical diseases

Students will see what tropical regions are what tropical ecosystems allow the existence of tropical diseases. Tropical diseases will be defined and the list of Neglected Tropical Diseases provided by the World Health Organization and other organizations will be discussed.

Readings: Feasey et al. 2010, Hotez 2016.

Week 2 Virus caused diseases

Class 2.1 Biology of viruses

Students will explore the basic biology of viruses, including what viruses are and how they replicate in eukaryotic cells. The main types of disease-causing viruses will be covered. The particular case of rabies, a vertebrate-borne disease, will be used as an example of the biology of virus infection in this class. Arthropod-borne viruses will be emphasized as the main causes of most virus-caused tropical diseases.

Reading: pp 608-620 in Kuno and Chang 2005

Class 2.2 Mosquito-transmitted viral infections in the tropics

Students will explore the biology of mosquitoes, the main vectors of viruses that cause disease in the tropics. Habitats, natural history, life cycles, host preference, biting preference, and activity patterns will be discussed. The main tropical diseases of this kind will be discussed: dengue, chikungunya, yellow fever and zika. The epidemiology of the diseases will be explored.

Readings: pp 457-464 in Despommier et al. 2017

Class 2.3 Evolution of virulence

Why the virulence of diseases increases or discussed in particular regions of the world will be discussed using evolutionary principles. Students will be exposed to key concepts to understand how virulence changes over time: mutation, natural selection, fitness, adaptation, and evolution.

Readings: Cologna et al. 2005.

Week 3 Bacteria caused diseases

Class 3.1 Biology of bacteria

Students will explore the basic biology of bacteria, including what bacteria are and how they replicate and infect animal tissue. The main types of disease-causing bacteria will be covered. The particular case of leptospirosis will be used as an example of the biology of bacterial infection.

Readings: Mwachui et al. 2015.

Activity 3.2 Main bacteria-caused diseases in the tropics

In groups, students will research on and present the biology and epidemiology of the main bacteria-caused tropical diseases, using provided literature but adding online information. Diseases covered include Buruli ulcer, leprosy, trachoma, and

yaws.

Class 3.3 Evolution of drug resistance

Students will discuss how resistance to drugs originates and spreads using the evolutionary concepts learned last week.

Reading: Gillespie 2002

Week 4 Protozoa-caused diseases

Class 4.1 Biology of protozoa

Students will explore the basic biology of protozoa, including what protozoa are and how they reproduce in multiple hosts. The main types of disease-causing protozoa will be covered.

Readings: pp 1-5, 9-10 in Despommier et al. 2017

Class 4.2 Malaria

The basic biology and epidemiology of the different types of malaria will be discussed. The life cycle of the protozoa *Plasmodium* will be discussed in detail.

Readings: pp 97-128 in Despommier et al. 2017.

Activity 4.3 Trypanosomiasis and Leishmaniasis

In groups, students will research on and present the biology of vectors of protozoa that cause Trypanosomiasis (American and African) and Leishmaniasis. Habitats, natural history, life cycles, host preference, biting preference, and activity patterns will be discussed. Other groups will research and present on the biology and epidemiology of these diseases.

Week 5 **Helminth-caused diseases**

Activity 5.1 Biology of parasitic worms

In groups, students will research on and present the biology of parasitic worms using provided literature but adding online information. Taxa covered will include cestodes, trematodes, and nematodes. Habitats, natural history, life cycles, host preference, biting preference, and activity patterns will be discussed.

Class 5.2 Cestod-caused diseases

Students will explore the basic biology and epidemiology of the main cestod-caused tropical diseases: Taeniasis/cysticercosis, Echinococcosis. Minor diseases caused by cestods will be covered too, although with less emphasis.

Readings: pp 331-354, 373-382 in Despommier et al. 2017.

Class 5.3 Climate change, land transformation and their impact on ecosystems

Students will be exposed to the the data on land transformation and climate change in the Anthropocene. Future climatic predictions will be discussed. Human-caused ecosystem changes will be discussed. The effect of climate change and land transformation on tropical ecosystems will be analyzed using Monteverde as a case study. The effects of climate change and land transformation on vectors and diseases in the tropics will be emphasized. In groups, students will choose a main tropical disease and research on the expected outcome of land transformation and climate change on the distribution and biology of the vector, and the virulence and drug resistance of the disease in the next decades. Students will produce a written report and present the results orally on the last lecture day.

Readings: Pounds, et al. 2006, Campbell-Lendrum et al. 2015, We et al 2016.

Week 6 **Helminth-caused diseases continued**

Class 6.1 Trematode-caused diseases

Students will explore the basic biology and epidemiology of the main trematode-caused tropical diseases: schistosomiasis, clonorchiasis, opisthorchiasis, fascioliasis, and paragonimiasis.

Readings: pp 389-442 in Despommier et al. 2017.

Class 6.2 Nematode-caused diseases

Students will explore the basic biology and epidemiology of the main nematode-caused tropical diseases: ascariasis, hookworm disease, trichuriasis, filiariasis, and dracunculiasis.

Readings: pp 209-240 and 267-304 in Despommier et al. 2017.

Class 6.3 The future of tropical diseases.

The future of tropical diseases will be discussed following student presentations on the effect of climate change and land transformation on the main tropical diseases.

- Final Exam

Course Materials

Course Textbook

Despommier DD, et al. Parasitic Diseases. 6th ed (2017). Parasites Without Borders, Springer-

Verlag, New York.

Readings

Campbell-Lendrum, D., Manga, L., Bagayoko, M. and Sommerfeld, J., 2015. Climate change and vector-borne diseases: what are the implications for public health research and policy?. *Phil. Trans. R. Soc. B*, 370(1665), p.20130552.

Cologna, R., Armstrong, P.M. and Rico-Hesse, R., 2005. Selection for virulent dengue viruses occurs in humans and mosquitoes. *Journal of virology*, 79(2), pp.853-859.

Feasey, N., Wansbrough-Jones, M., Mabey, D.C. and Solomon, A.W., 2009. Neglected tropical diseases. *British medical bulletin*, *93*(1), pp.179-200.

Gillespie, S.H., 2002. Evolution of drug resistance in Mycobacterium tuberculosis: clinical and molecular perspective. *Antimicrobial agents and chemotherapy*, *46*(2), pp.267-274.

Hotez, P.J., 2016. Neglected tropical diseases in the anthropocene: the cases of Zika, Ebola, and other infections. *PLoS neglected tropical diseases*, *10*(4), p.e0004648.

Mwachui, M.A., Crump, L., Hartskeerl, R., Zinsstag, J. and Hattendorf, J., 2015. Environmental and behavioural determinants of leptospirosis transmission: a systematic review. *PLoS neglected tropical diseases*, *9*(9), p.e0003843.

Pounds, J.A., Bustamante, M.R., Coloma, L.A., Consuegra, J.A., Fogden, M.P., Foster, P.N., La Marca, E., Masters, K.L., Merino-Viteri, A., Puschendorf, R. and Ron, S.R., 2006. Widespread amphibian extinctions from epidemic disease driven by global warming. *Nature*, 439(7073), p.161.

Kuno, G. and Chang, G.J.J., 2005. Biological transmission of arboviruses: reexamination of and new insights into components, mechanisms, and unique traits as well as their evolutionary trends. *Clinical microbiology reviews*, *18*(4), pp.608-637.

Wu, X., Lu, Y., Zhou, S., Chen, L. and Xu, B., 2016. Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. *Environment international*, 86, pp.14-23.