

SEMESTER AT SEA COURSE SYLLABUS

Voyage: Fall 2014

Discipline: Biology

BIOL 3559: Global Infectious Diseases

Division: Upper

Faculty Name: John L. Dahl, Ph.D.

Pre-requisites:

One semester of college-level introductory level biology.

COURSE DESCRIPTION

Prior to the discovery of antibiotics in the first half of the 20th century, infectious diseases regularly killed huge numbers of human beings, and epidemics have routinely altered historical events in communities and whole societies. In the past several decades, improvements in public health and availability of effective drugs have greatly reduced human morbidity and mortality. However, the threats of drug-resistance and new emerging infectious diseases pose increasing challenges to global health. In this course we will examine microbiology, epidemiology, health management, and social impacts of several major infectious diseases including influenza, HIV/AIDS, cholera, tuberculosis, malaria, and human helminthic infections. Necessary biological background will be provided where appropriate, e.g. the anatomy/physiology of the human respiratory, digestive, circulatory, integumentary, and immune systems. We will also look at antibiotic discovery and the molecular actions of antibiotics and explanations for why antibiotic resistance occurs. Presentations of diseases in class will closely parallel current and historical health concerns of each country visited.

COURSE OBJECTIVES

1. Gain an appreciation for the roles that epidemics have had on altering history and civilization.
2. Understand the roles and limitations of antibiotics in treating bacterial infections.
3. Learn how anatomical systems of the body are affected by infectious agents.
4. Learn classical and modern microbial approaches to understanding infectious diseases.
5. Understand ecological relationships of microbes with the environment and with humans.
6. Understand how the immune system functions to fight infections.
7. Examine the roles of microbes in dynamic human social interactions such as politics, quarantining, mass vaccination efforts, war, and attempts to improve public health.

REQUIRED TEXTBOOKS

AUTHOR: Irwin Sherman

TITLE: Twelve Diseases That Changed Our World

PUBLISHER: ASM Press

ISBN #: 1555814662

DATE/EDITION: 2007/First edition (\$28 new at Amazon)

AUTHOR: Tracy Kidder

TITLE: Mountains Beyond Mountains
PUBLISHER: Random House Trade Paperbacks
ISBN #: 0812980557
DATE/EDITION: 2009/ First edition (\$11 new, \$0.01 used at Amazon)

TOPICAL OUTLINE OF COURSE

Depart Southampton- August 23:

A1- August 25: Introduction to the course and to its field program. A brief history of theories of disease leading up to the germ theory of disease

- Emerging Infectious Diseases
- techniques of pure culture and molecular biology
- introduction to World Health Organization and Centers for Disease Control

Reading Assignment:

None

Assignment Due Today:

Watch the films *Evolution: The Arms Race* (first 30 min) and *Pandemic* (113 min)

A2-August 27: Infectious typhus during Napoleon's invasion of Russia; Biological weapons development during the Cold War; Review of basic biochemistry, molecular biology.

- biological Weapons Convention Treaty between the U.S. and U.S.S.R.
- Sverdlovsk biological weapons accident (anthrax)
- effects of syphilis on Ivan the Terrible

Reading Assignment:

Chpt 4 from Disease and History("General Napoleon and General Typhus") (pdf)

Assignment Due Today:

Be prepared to discuss Case no. 1 (anthrax) (pdf)

Watch the film *The Anthrax Files* (60 min) before arriving in St. Petersburg

St. Petersburg: August 29- September 2

A3- September 3: Robert Koch, Louis Pasteur, and the Golden Age of Microbiology

- contributions of Louis Pasteur and Robert Koch to bacteriology
- race to discover agent of plague by prodigies of Pasteur and Koch
- Koch's postulates and difficulties in satisfying them

Reading Assignment:

Chpt 5 from *12 Diseases* ("Bubonic Plague")

The Black Death Decoded (pdf)

Assignment Due Today:

Watch the movie *The Seventh Seal* (96 min)

A4- September 5: Plague

- brief history of the Black Death and of plague outbreak in Hamburg 1712-1713
- insects as vectors for disease
- introduction to the lymphatic system and to bacterial virulence factors
- establishing *Yersinia pestis* as the actual cause of the Black Death

Reading Assignment:

Plague as an Emerging Disease (pdf)

The Decameron, Introduction and First Day, Third Story (pdf)

Assignment Due Today:

Watch the movie *Unit 731: Nightmare in Manchuria* (96 min)

Hamburg: September 7-11

A5- September 12: Chlamydia and Gonorrhea

- introduction to male and female reproductive systems
- Bacterial pili, bacterial adhesion, and antigenic variation
- obligate intracellular parasites
- vaccine failures and the hidden epidemic of Chlamydia
- testing, treatment, and prevention of STIs
- incidence and prevalence of infectious diseases, red-light districts

Reading Assignment:

Assignment Due Today:

Use CDC data to identify prevalence and incidence of STIs in student's city, county, state, and nation

Be prepared to discuss Case no. 5 (Chlamydia) (pdf)

Antwerp: September 14-16

Le Havre: September 17-19

A6-September 20: Antibiotics and Antibiotic Resistance

- discovery and development of antibiotics
- mechanisms of antibiotic action
- mechanisms by which bacteria acquire antibiotic resistance
- alternatives to using antibiotics (intro to the human microbiome)

Reading Assignment:

Smithsonian magazine article on human microbiome (pdf)

Assignment Due Today:

Be prepared to discuss Case no. 6 (*Clostridium difficile*) (pdf)

Watch the movie *Modern Marvels: Antibiotics* (50 min) before next period

A7- September 22: The Irish Potato Blight and fungal infections

- basic fungal biology
- fungi as animal and plant pathogens
- brief overview of human fungal infections

- the practice of quarantine

Reading Assignment:

Chpt 2 from *12 Diseases* (“The Irish Potato Blight”)

Assignment Due Today:

Quiz #1

Be prepared to discuss Case no. 41 (*Candida*) (pdf)

Watch the movie *When Ireland Starved* (98 min) before arriving in Dublin

Dublin: September 24-27

A8- September 28: Diarrhea

- comparisons between *Escherichia coli* and *Salmonella typhimurium*
- viral causes of diarrhea

Reading Assignment:

NY Times article: “*The Burger That Shattered Her Life*”

Assignment Due Today:

Be prepared to discuss Case no. 9 (*E. coli*) (pdf)

Watch the movie *Food Inc.* (91 min) before next class period

A9- September 30: Cholera and Typhoid Fever

- introduction to the gastrointestinal tract
- Typhoid Mary, John Snow, Robert Koch, and Max von Pettenkofer
- bacterial toxins: A-B type bacterial toxins and type III secretion systems
- cholera prevention by vaccine, prophylaxis, and sari cloth

Reading Assignment:

Chpt 3 from *12 Diseases* (“Cholera”)

WHO Background document: The diagnosis, treatment, and prevention of typhoid fever (pdf)

Assignment Due Today:

Watch the movies *The Painted Veil* (125 min) and *Sheltering Sky* (138 min) before arriving in Morocco

Be prepared to discuss Case no. 23 (*Vibrio cholerae*) (pdf)

Lisbon: October 1-2

In transit: October 3

Cadiz: October 4-5

A10- October 7: Eradication of infectious disease: Small Pox and Guinea Worm

- history and philosophy of vaccination
- Work of the Carter Center to combat infectious diseases

Reading Assignment:

Chpt 4 from *12 Diseases* (“Smallpox: the Speckled Monster”)

Chpt 10 from *Water and Sanitation-Related Diseases and the Environment* (the

effort to eradicate Guinea worm) (pdf)

Assignment Due Today:

Be prepared to discuss Case no. 37 (small pox) (pdf)

Watch the movie *Rx for Survival: Disease Warriors* (55 min) before next class period

Casablanca: October 8-11

A11-October 13: Polio

- introduction to neuro-muscular system
- Salk and Sabine Vaccines
- challenges to eradication of polio

Reading Assignment:

Three *Nature* articles: Polio's moving target. (2013) 496: p.290; Polio's last stand (2001) 409: p.280; Polio's last stand (2012) 485: p.563 and one Science article: The Art of Eradicating Polio (2013) 342: p.29

Assignment Due Today:

Watch the movie *The Origin of AIDS* (92 min)

Quiz #2

A12- October 15: Malaria

- introduction to the circulatory system
- life cycle of plasmodium in humans and mosquitos
- malaria prevention
- link to the sickle-cell trait

Reading Assignment:

Chpt 8 from *12 Diseases* ("Malaria")

Finish reading *Mountains Beyond Mountains (MBM) Part I*

Science article Pasteur Approach to a Malaria Vaccine (2013) 341: p. 1352 (pdf)

Assignment Due Today:

Watch the video "Winged Scourge"

Be prepared to discuss Case no. 48 (Malaria) (pdf)

Watch the movie *Rx for Survival: Deadly Messengers* (55 min) before next class

Dakar: October 16-19

A13- October 21: HIV/AIDS

- origin and life cycle of HIV
- transmission of HIV
- interaction of HIV with immune system and progression to AIDS

Reading Assignment:

Chpt 11 from *12 Diseases* ("AIDS: the 21st Century Plague")

Assignment Due Today:

Watch the movie *Silverlake Life a View From Here* (99 min) before next class
Be prepared to discuss Case no. 29 (HIV) (pdf)

A14- October 23: Tuberculosis

- introduction to the respiratory system
- prevention, treatment, and diagnosis of TB
- rise of drug resistant TB
- funding rates for TB and HIV. The Gates Foundation

Reading Assignment:

Chpt 7 from *12 Diseases* (“Tuberculosis: the People’s Plague”)

Science article on HIV and TB in South Africa (pdf)

Finish reading *MBM* Part II

Assignment Due Today:

Watch the movie *Rx for Survival: Rise of the Superbugs* (55 min) before next class

Be prepared to discuss Case no. 14 (*Mycobacterium tuberculosis*) (pdf)

Takoradi: October 25-26

Tema: October 27-28

A15- October 29: Schistosomiasis

- understand the link between humans, snails, and the multiple stages of the parasite

Reading Assignment:

Finish reading *MBM* Part III

Assignment Due Today:

Be prepared to discuss Case no. 49 (Schistosomiasis) (pdf)

Watch the movie *The Constant Gardener* (130 min) before next class

A16- October 31: Influenza

- antigenic shift and antigenic drift
- global monitoring

Reading Assignment:

Chpt 10 from *12 Diseases* (“The Great Influenza”)

Assignment Due Today:

Watch the movie *American Experience: Influenza* (52 min) before next class

Be prepared to discuss Case no. 10 (Influenza) (pdf)

Quiz #3

Study Day: November 2

A17-November 3: Hepatitis

- hepatitis A, B, and C
- viral oncogenes

Reading Assignment:

Finish reading *MBM* Part IV

Assignment Due Today:

Be prepared to discuss Case no. 27 (hepatitis viruses) (pdf)

Watch the movie *Contagion* (106 min) before next class period

A18- November 5: Syphilis

- the “arrow of disease” (evidence that syphilis is a new world disease)
- primary, secondary, and tertiary syphilis
- U.S. human studies of syphilis (Tuskegee Study and Guatemala)

Reading Assignment:

Chpt 6 from *12 Diseases* (“Syphilis: the Great Pox”)

Discover magazine article “Arrow of Disease” by Jared Diamond (pdf)

Assignment Due Today:

Watch the movie *Miss Ever’s Boys* (118 min) before arriving in Rio

Be prepared to discuss Case no. 22 (*Treponema pallidum*) (pdf)

Rio de Janeiro: November 7-9

In-transit: November 10-11

Salvador: November 12-14

A19- November 15: Chagas Disease

- discovery of Chagas
- transmission, epidemiology, and prevention

Reading Assignment:

Chpt 1 from *20th Century Microbe Hunters* (“Chagas Disease – A Kiss of Death”)
(pdf)

Finish reading *MBM* Part V

Assignment Due Today:

Quiz #4

A20- November 17: Herpes

- different types of herpes viruses
- clinical signs and symptoms
- prevention of infection

Reading Assignment:

Assignment Due Today:

Be prepared to discuss Case no. 28 (Herpes) (pdf)

Study Day: November 19

A21-November 20: : Neglected Tropical Diseases (NTDs)

- reasons to focus on NTGs
- onchocerciasis (River Blindness) in Amazon natives
- lymphatic Filariasis in the Americas

Reading Assignment:

Lymphatic Filariasis: eliminatin in the Americas (CDC) (pdf)

Assignment Due Today:

Bridgetown: November 22-24

A22-November 25: Dengue Fever

- symptoms of dengue fever
- life-cycle of virus in humans and mosquito
- dengue hemorrhagic fever and dengue shock syndrome

Reading Assignment:

Assignment Due Today:

Begin reading *MBM* Part IV

Be prepared to discuss Case no. 64 (Dengue) (pdf)

Watch the movie *Hot Zones* (57 min) before next class period

Assignment Due Today:

Quiz #5

A23- November 27: Yellow Fever

- introduction to the hepatic system
- research and conquest of yellow fever in Cuba

Reading Assignment:

Chpt 9 from *12 Diseases* (“Yellow Fever: the Saffron Scourge”)

Master’s thesis on yellow fever epidemic of Memphis (pdf)

Assignment Due Today:

Watch the movie *Sicko* (124 min) before next class

Havana: November 29- December 2:

Study Day- December 3

A24-December 4 (A Day Finals):

FIELD WORK

Field lab attendance is mandatory for all students enrolled in this course. Please do not book individual travel plans or a Semester at Sea sponsored trip on the day of our field lab.

***FIELD LAB** (At least 20 percent of the contact hours for each course, to be led by the instructor.)*

Idea #1: The Field Lab will visit the Department of Infectious Diseases at Ibn Roch Centre University Hospital in **Casablanca, Morocco** (about a 4 mile distance from where the boat will be docked). Prior to the visit we will read the journal article “Epidemiological profile of invasive bacterial diseases in children in Casablanca, Morocco. This paper describes a WHO sentinel study to inform vaccine introduction decisions in Morocco. We will meet the paper’s primary author, Dr. El Mdaghri, who will describe the nature of this prospective study in Morocco. Later, we will visit a local Moroccan orphanage caring for children newborn to 15 years of age. The purpose of this visit will be to interact with these children and to learn of health care issues they face. Within 5 days of the visit, a 1000-word report on the topic “What infectious diseases is Morocco dealing with how are these issues being dealt with” will be due. Participation in the Field Lab and the quality of this report will constitute 20% of the student’s course grade.

Idea #2: Visit to with medical doctors and health care workers in **Dakar, Senegal** who are receiving or petitioning funds from the Global Funds to coordinate efforts to battle HIV, Tuberculosis, and Malaria in Dakar and in Senegal. This field lab could include visits to clinics treating Senegalese suffering from these infections. In addition, it may be possible during this field lab to visit with representatives of the One-Million Community Health Worker Campaign that is striving to have one million health care workers available in communities in Sub-Saharan Africa by 2015. Experiencing the combination of these two agencies (Global Fund and the One-Million Community Health Worker Campaign) would offer students a unique perspective on international health initiatives in Africa.

Idea #3: Visit to a TB/HIV research lab in **Rio de Janeiro, Brazil**. I am currently in contact with someone from the Centers for AIDS Research (CFAR) and someone at John Hopkins hospital (two people with research colleagues in Rio de Janeiro) to see what options may exist for a field lab experience in either of these countries). The goals of a trip to a clinic/research clinic in Rio would be have students meet and hear from people engaging in battling HIV/TB both in the research labs and in treatment clinics. Brazil is generally considered one of the world’s great success stories in the fight against HIV/AIDS, and this Field Lab would help students witness first-hand the kinds of strategies employed in this ongoing public health battle. Within 5 days of the visit, a 1000-word report on the topic “How Brazil has worked to address the issues of infectious diseases” will be due. Participation in the Field Lab and the quality of this report will constitute 20% of the student’s course grade.

FIELD ASSIGNMENTS

- Students will keep a journal of their experiences in port countries with a particular attention paid to issues of infectious diseases in the communities of these countries.
- Towards the conclusion of the course (following the final lecture on Nov. 27th), students will submit a paper of approximately 1000 words describing how they believe the problems of infectious diseases (it can be one specific infectious disease) can be best addressed. Students will be asked to address these problems both from Western perspectives and from the perspectives of the country(ies) where the infectious disease is most relevant.

METHODS OF EVALUATION / GRADING RUBRIC

Teaching Methods:

Lectures and discussions will be the primary formats for delivering content in class and will be interspersed with application-related experiences and small group work. Student work will include small group projects and attendance and participation is expected for each lecture period.

Readiness concept: The responsibility to learn is fundamentally that of the student. In order to succeed in a new subject, students must be actively engaged in the process of learning. Preparation for each class is essential and requires that each student read the assigned readings, have deeply processed issues, and be able to express a point of view.

Course requirements and Evaluation:

Final course grade will be based upon the following percentages:

5 quizzes [50% - 10% each]

Completed journal [10%]

Student paper based upon field lab [20%]

Student paper on how to solve the problem of an infectious disease [10%]

Final Exam [10%]

Grade will be determined based upon the following final percentages of possible points:

A+ 100 - 97.6%

A 97.5 - 92.6%

A- 92.5 - 90.0%

B+ 89.9 - 87.6%

B 87.5 - 82.6%

B- 82.5 - 80.0%

C+ 79.5 - 77.6%

C 72.6 - 77.5%

C- 72.5 - 70.0%

D+ 69.9 - 67.6%

D 67.5 - 62.6%

D- 62.5 - 60.0%

F 59.9% and below.

RESERVE LIBRARY LIST

AUTHOR: Eugene Nester et al.

TITLE: Microbiology; A Human Perspective
PUBLISHER: McGraw-Hill Scientific
ISBN #: 0073375314
DATE/EDITION: 2011/7th

AUTHOR: Paul de Kruif
TITLE: Microbe Hunters
PUBLISHER: Mariner Books
ISBN #: 0156027771
DATE/EDITION: 2002/3rd

ADDITIONAL RESOURCES

Students will have access to the following DVD movies via onboard CCTV. Watching these movies will be a required part of course activities:

The Anthrax Files
The Seventh Seal
Unit 731: Nightmare in Manchuria
Modern Marvels: Antibiotics
When Ireland Starved
Rx for Survival: Rise of the Superbugs
Rx for Survival: Disease Warriors
Rx for Survival: Deadly Messengers
Contagion
The Constant Gardener
Miss Ever's Boys
The Painted Veil
Sheltering Sky
Food Inc.
The Origin of AIDS
Silver Lake Life
Hot Zones
American Experience: Influenza

HONOR CODE

Semester at Sea students enroll in an academic program administered by the University of Virginia, and thus bind themselves to the University's honor code. The code prohibits all acts of lying, cheating, and stealing. Please consult the Voyager's Handbook for further explanation of what constitutes an honor offense.

Each written assignment for this course must be pledged by the student as follows: "On my honor as a student, I pledge that I have neither given nor received aid on this assignment." The pledge must be signed, or, in the case of an electronic file, signed "[signed]."

That Changed Our World. Irwin W. Sherman. ASM Press, Washington, DC, USA, 2007. ISBN-10: 978-1555814662. ISBN-13: 978-1555814663. Pages: 219; Price: US \$29.95. Twelve Diseases That Changed Our World offers engaging observations on a dozen diseases to serve 2 goals. The opening chapters meet the title's promise by tracing the impact of hereditary blood disorders porphyria and hemophilia on the succession of European monarchs in the 16th through 19th centuries. Irwin W. Sherman. Covers the history of twelve important diseases and addresses public health responses and societal upheavals. Chronicles the ways disease outbreaks shaped traditions and institutions of Western civilization. Explains the effects, causes, and outcomes from past epidemics. Describes a dozen diseases to show how disease control either was achieved or failed. Makes clear the interrelationship between diseases and history. Presents material in a compelling, clear, and jargon-free prose for a wide audience. Provides a picture of the best practices for dealing with disease outbreaks In a sweeping, thoughtful account, Twelve Diseases That Changed Our World considers the history of twelve important diseases: their impact, their consequences, their costs, and the lessons learned. Examining hemophilia, blight, tuberculosis, cholera, smallpox, bubonic plague, influenza, malaria, yellow fever, syphilis, porphyria, and AIDS, this book not only covers the diseases' histories but also addresses public health responses and societal upheavals. Historical perspectives on these diseases will be indispensable for a better understanding of how we and our forebears survived the onslaughts.