

BIO 4492: Infectious disease: history, pathology, and prevention FALL 2019 R309

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COURSE DESCRIPTION

Leveraging the primary research literature, this course examines the history and pathology of infectious disease, the development of antibiotics and vaccines, the rise of antibiotic resistance, and the emergence and reemergence of diseases. In addition to gaining insights into the underlying causes and treatment of infectious disease, students will hone their ability to identify important biological questions, develop testable hypotheses, design experiments tailored to particular questions, and evaluate results. Through a series of written and oral assignments, students develop the skills to communicate about science effectively to both the research community and the general public. Prerequisites: One semester of Biology 500: Independent Research. Preference will be given to students who have completed Biology 349: Foundations of Microbiology. Area A. 3.0 units.

Background:

In 1900, Americans were more likely to die from a single infectious disease, Tuberculosis, than from cancer. A small cut, if infected, could quickly become life threatening. Viruses were an unknown entity. The discovery of compounds with potent antimicrobial activity, the development of vaccines against diseases from polio to measles, mumps, and rubella, and technological advances that provided even the remotest of locations access to clean water, reversed this trend, eliminating infectious disease as a major cause of death in the developed world. One hundred years later, however, the tides have turned. Antibiotics are increasingly ineffective, vaccination rates are at an all time low in many counties, and global warming is facilitating the comeback of vector borne diseases that were once eradicated from the continental US. If trends continue, infectious disease will again replace cancer as the leading cause of mortality in the developed world.

Objectives:

1. Gain insight into the molecular basis of infectious disease and approaches for treatment and prevention
2. Develop skills necessary for critical analysis of the primary literature
3. Hone the ability to communicate science effectively to both professional and lay audiences

REQUIRED READING MATERIAL

Writing in Biology: A Brief Guide by Leslie Ann Roldan and Mary Lou Pardue (Available on-line through Amazon and other sellers).

The Perfect Predator by Stephanie Strathdee and Thomas Patterson (Available on-line through Amazon and other sellers).

For those of you who have **not** had college level microbiology, we highly recommend obtaining a copy of **Microbiology: An Evolving Science** by Slonczewski and Foster.

Additional Reading

The best way to become a better writer is to read, read, and read some more. There is a great deal of fantastic science writing available online, not to mention a lifetime supply of fantastic books. To get you started I would suggest following the American Society for Microbiology blog "Small Things Considered" <http://schaechter.asmblog.org/schaechter/>.

EXPECTATIONS

Students are expected to work independently unless otherwise noted.

Read and Participate (300 pts):

- Students are expected to come to class having read assigned primary research articles and related material. PDFs of course materials will be available on the course website one week before class (bb.wustl.edu).
- Class discussion will focus on analysis of the question(s) addressed in the week's reading material and the approaches used to answer the question. Alternative approaches will be proposed and evaluated.
- For articles from the primary literature, students should be able to: 1) identify the question(s) being addressed; 2) describe the approaches used to address the question; 3) summarize the data in figures and tables (e.g., hypothesis, method, authors' interpretation, your interpretation); 4) assess the significance and/or validity of the authors' conclusions; and where appropriate, 5) propose follow-on experiments.
- Class participation will count towards 30% of the final grade.
- For assistance with reading a modern research paper please see sidebar pages 122-123 of Writing in Biology

Write (500 points total):

- To foster the ability to write clearly and concisely, students will complete 10 written assignments over the course of the semester.
 - Three 250 word summaries of assigned primary research articles (25 pts each)
 - One critical review of a primary research article from the bioRxiv (50 pts)
 - One single page Specific Aims on experimental questions related to your BIO500 research or equivalent. (50 pts for 1st draft & 50 points for the revision)
 - One 250 word "lay" summary of an assigned primary research article (25 pts)
 - One 3000 word essay pitched at a popular audience, focusing on either: 1) an emerging pathogen, its epidemiology, treatment, and prevention; 2) efforts to develop a vaccine against a life threatening disease such as Ebola, HIV, Malaria, or 3) approaches to combat the rise of antibiotic resistant organisms (300 pts--1st draft & revision scores averaged)
- All writing assignments are to be submitted as word documents by 5pm on their due date by email to Dr. Levin (plevin@wustl.edu).
- Writing assignments will be evaluated and returned with constructive feedback.
- If your score on a particular assignment is less than 75% of possible points you will be permitted one rewrite. Rewrites will only be allowed for one assignment over the course of

the semester so choose carefully (The Capstone essay and presentation are not included). Scores for original and rewrites will be averaged to calculate your final grade.

- For the 3000-word capstone essay, students are expected to incorporate the instructor and AI comments and suggestions for improvement at each stage of the process.
- Performance on written assignments will count towards 50% of the final grade.

Present (200 pts):

- In consultation with Dr. Levin and Mr. Blake, students are expected to develop a 30-minute PowerPoint presentation related to the topic of their final essay. The last three weeks of class will be devoted to student led presentations focusing on the topic of their final essays.
- In addition to deadlines noted on the syllabus, students are expected to schedule a practice talk with Dr. Levin and Mr. Blake at least one week prior to their final presentation.
- Oral Presentation will count towards 20% of the final grade or 200 points total (10% content; 10% presentation design and implementation)

COURSE WEB SITE

All materials are available on Canvas under BIO 4492.

PLAGIARISM AND CHEATING:

Unless explicitly told otherwise, you are expected to work independently. Plagiarizing from either the primary literature or from another student will result in a failing grade for the assignment, and potentially the course.

OTHER IMPORTANT NOTES:

- This is an upper level biology course that moves quickly that covers a significant amount of ground in a short period of time. It is critical to stay on top of the material. **Extra credit is NOT an option.**
- If you feel like you are falling behind or simply have questions about the material, please, please talk to either the instructor or the AI. We are here to help you!
- As a seminar, course participation is an essential part of this class and counts towards 30% of your grade. Missing more than one class, or repeatedly being tardy, will have a substantial negative impact on your final grade (Not to mention burning hundreds of dollars in hard earned cash. See: <http://cmcforum.com/life/02142013-Cmçnumbers-what-happens-when-you-skip-class>).

	Topic	Reading
8/27	Introduction to reading and writing about science	<p>Orwell, Politics and the English Language, 1968</p> <p>van Nunen, et al An association between tick bite reactions and red meat allergy in humans, 2009</p> <p>Hamsten et al, Identification of galactose-α-1,3-galactose in the gastrointestinal tract of the tick Ixodes ricinus; possible relationship with red meat allergy, 2013</p> <p>Steinke, The alpha-gal story: Lessons learned from connecting the dots, 2015</p> <p>http://www.radiolab.org/story/alpha-gal/</p>
8/29	Pathogenesis	<p>Riley et al., Aerial dissemination of pulmonary tuberculosis: a two-year study of contagion in a Tuberculosis Ward 1959</p> <p>Collier, Effect of diphtheria toxin on protein synthesis: inactivation of one of the transfer factors, 1967</p> <p>Read pages 120-130 of <u>Writing in Biology</u></p> <p>Writing assignment 1 due 250 word "highlight" summary of the alpha-gal story</p>
9/3	The amazing human immune system	<p>Kaufmann, Immunology's foundation: the 100-year anniversary of the Nobel Prize to Paul Ehrlich and Elie Metchnikoff, 2008</p> <p>METCHNIKOFF CHAPTERS I- IV, VI, and VIII (And any others you would like to read—the whole set of lectures is just lovely)</p>
9/5	Microbes as the source of disease	<p>Belluck, A Common Virus May Play Role in Alzheimer's Disease</p> <p>Marshall et al, Attempt to fulfill Koch's postulates for pyloric Campylobacter, 1995.</p> <p>Kumar, et al., Amyloid-peptide protects against microbial infection in mouse and worm models of Alzheimer's disease, 2015</p> <p>Writing assignment 2 due 250 word "highlight" summary of Kumar</p>
9/10	The golden and not so golden age of antibiotics	<p>Fleming, On the antibacterial action of cultures of a Penicillium, 1929</p> <p>Abraham & Chain, An enzyme from bacteria able to destroy penicillin, 1940</p> <p>Katayama, Ito, and Hiramatsu, A New Class of Genetic Element, Staphylococcus Cassette Chromosome <i>mec</i>, Encodes Methicillin Resistance in Staphylococcus aureus, 2000</p> <p>Cousins, Wherever you are, time is running out for treating gonorrhoea, 2018</p>

9/12	<p>Fighting fire with fire: Overcoming MDR with antimicrobials</p>	<p>Maidan, Triclosan is an aminoglycoside adjuvant for the eradication of <i>Pseudomonas aeruginosa</i> biofilms, 2018</p> <p>Jiao et al, Comparable Efficacy and Better Safety of Double -Lactam Combination Therapy versus -Lactam plus Aminoglycoside in Gram-Negative Bacteria in Randomized, Controlled Trials, 2019</p> <p>Lancelotti, Antibacterial Activity of Ticagrelor in Conventional Antiplatelet Dosages Against Antibiotic-Resistant Gram-Positive Bacteria, 2019</p> <p>Writing assignment 3 due 250 word “highlight” summary of Maiden or Jiao</p> <p>Assignment 4 Peer Review Materials:</p> <ul style="list-style-type: none"> • Drubin, Any jackass can trash a manuscript but it takes good scholarship to create one, 2011 • Example peer review of one of Dr. Levin’s manuscripts • bioRxiv paper uploaded onto CANVAS to review
9/17	<p>What is old is new again: Phage Therapy for MDR pathogens</p>	<p>Strathdee and Patterson, The Perfect Predator: A Scientist's Race to Save Her Husband from a Deadly Superbug: A Memoir, 2019</p> <p>Segal et al, Stronger together? Perspectives on phage-antibiotic synergy in clinical applications of phage therapy, 2019</p> <p>Dedrick et al, Engineered bacteriophages for treatment of a patient with a disseminated drug-resistant Mycobacterium abscessus, 2019</p>
9/19	<p>Nosocomial infections and the power of best practices</p>	<p>Gawande, The Checklist, 2007</p> <p>Lister, On the Antiseptic Principle in the Practice of Surgery 1867</p> <p>Pronovost et al, An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU, 2006</p> <p>Specific Aims Assignment Materials: Examples of Specific Aims for Writing Assignment 5</p> <p>Writing assignment 4 due: Peer Review of BioRxiv paper</p>
9/24	<p>The Magical Mystical Microbiome</p>	<p>Bonham et al, Extensive horizontal gene transfer in cheese-associated bacteria, 2017</p> <p>Zimmer, Antibiotics have turned our bodies from gardens into battlefields, 2014</p> <p>Schwendner et al, Preparing for the crewed Mars journey: microbiota dynamics in the confined Mars500 habitat during simulated Mars flight and landing, 2017</p>

9/26	<i>Clostridium difficile</i> and the miracle of the 'poop pill'	<p>Yong, Sham Poo Washes Out, 2016</p> <p>van Nood et al, Duodenal Infusion of Donor Feces for Recurrent <i>Clostridium difficile</i>, 2013</p> <p>Bojanova and Bordenstein: Fecal Transplants, what is being transferred? 2016</p> <p>Writing Assignment 5, Specific Aims Version 1 Due</p>
10/1	Walter Reed and the Identification of viruses as a source of infectious disease	<p>Reed, Carroll, and Aristides, The etiology of yellow fever: an additional note, 1901</p> <p>Duchiade, Brazilian Forests Fall Silent as Yellow Fever Decimates Threatened Monkeys, 2018</p> <p>O'Brien and Goedert, HIV causes AIDS: Koch's postulates fulfilled, 1996</p> <p>Discussion of Assignment 6: Lay Summary Knight, Clear as Mud, 2003</p>
10/3	MEASLES	<p>Conniff, A Forgotten Pioneer of Vaccines, 2013</p> <p>Hilleman, Current overview of the pathogenesis and prophylaxis of measles with focus on practical implications, 2001</p> <p>Stokes et al, Use of living attenuated measles-virus vaccine in early infancy, 1960</p> <p>Bynak et al, 1968</p>
10/8	Vaccines and autism: scientific integrity and the importance of scientific literacy	<p>https://next.wellcomecollection.org/articles/outside-the-child</p> <p>Wakefield et al., Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children, 1998</p> <p>Hviid et al, Measles, Mumps, Rubella Vaccination and Autism, 2019</p> <p>Schaffer, Fear, Misinformation, and Measles spread in Brooklyn, 2019</p> <p>Writing Assignment 5, Specific Aims Version 2 Due</p>
10/10	IN CLASS MOVIE	<p>Resistance, 2015</p> <p>Writing Assignment 6: Lay Summary of Bahra et al. DUE</p>
10/15	FALL BREAK	NO CLASS
10/17	Positive Strand RNA viruses: Norovirus	<p>The Norovirus: A Study in Puked Perfection, 2013</p> <p>Wobus, Murine Norovirus, 2006</p> <p>Orchard et al, Discovery of a proteinaceous cellular receptor for a Norovirus, 2016</p>

		Capstone writing assignment and oral presentation “Pitch” paragraph due
10/22	Negative strand RNA viruses: Ebola	<p>Baumgaertner, As Ebola rages, the world just watches, 2019</p> <p>Rosenke et al, Plasmodium Parasitemia Associated Increased Survival in Ebola Virus–Infected Patients, 2016</p> <p>Corti et al., Protective monotherapy against lethal Ebola virus infection by a potently neutralizing antibody, 2016</p>
10/24	Retroviruses and cancer: Avian Sarcoma Virus	<p>Review: Vogt, Retroviral oncogenes: a historical primer, 2012</p> <p>Rous, A sarcoma of the fowl transmissible by an agent separable from the tumor cells, 1911</p> <p>Baltimore, Viral RNA-dependent DNA polymerase: RNA-dependent DNA polymerase in virions of RNA tumor viruses, 1970</p> <p>Opperman et al, Uninfected vertebrate cells contain a protein that is closely related to the product of the avian sarcoma virus transforming gene (src), 1979</p> <p>Revised Pitch paragraph & list of 10 primary sources due</p>
10/29	Parasitic Vector Borne Disease: Malaria and the search for a vaccine	<p>Pasteur Approach to a Malaria Vaccine May Take the Lead, 2013</p> <p>Seder et al, Protection Against Malaria by Intravenous Immunization with a Nonreplicating Sporozoite Vaccine, 2013</p> <p>Sissoko et al, Safety and efficacy of PfSPZ Vaccine, 2017</p> <p>Robinson, Plasmodium-associated changes in human odor attract mosquitoes, 2018</p>
10/31	Halloween! Viral Vector Borne Disease: Zika I Zika Biology	<p>Petersen et al, Zika Virus, 2016</p> <p>Boorman and Porterfield, A simple technique for infection of mosquitoes with viruses transmission of Zika virus, 1956</p> <p>Simpson, Zika Virus Infection in Man, 1964</p> <p>Duffy et al, Zika Virus Outbreak on Yap Island, 2009</p> <p>Slide list for oral presentation due</p>
11/5	Vector Borne Disease: Zika II: Zika’s impact on the host	<p>de Oliveira, Increase in Reported Prevalence of Microcephaly in Infants Born to Women Living in Areas with Confirmed Zika Virus Transmission During the First Trimester of Pregnancy — Brazil, 2015</p> <p>Yockey et al., Vaginal Exposure to Zika Virus during Pregnancy</p>

		<p>Leads to Fetal Brain Infection, 2016</p> <p>Beck, Zika Makes Microcephaly 20 Times More Likely, 2017</p> <p>Vital Signs: Zika-Associated Birth Defects and Neurodevelopmental Abnormalities Possibly Associated with Congenital Zika Virus Infection — U.S. Territories and Freely Associated States, 2018</p>
11/7	<p>Vector Borne Disease: Zika III</p> <p>Combatting vector borne disease—mosquito eradication strategies/vaccine development</p>	<p>Spector, The Mosquito Solution, 2012</p> <p>Dawes, Research and development of Zika virus vaccines, 2016 Oxitec Promotional Material</p> <p>Carvalho, Suppression of a Field Population of <i>Aedes aegypti</i> in Brazil by Sustained Release of Transgenic Male Mosquitoes, 2015</p> <p>Oral Presentation draft PowerPoint presentation due</p>
11/12	<p>What was last year's Nobel prize anyways? And how does it relate to infectious disease?</p> <p>Phage Display</p>	<p>2018 Nobel Prize in Medicine</p> <p>Smith, Filamentous fusion phage: novel expression vectors that display cloned antigens on the virion surface, 1985</p> <p>Parmley and Smith, Antibody selectable filamentous fd phage vectors: affinity purification of target genes, 1988</p> <p>Burton et al, A large array of human monoclonal antibodies to type 1 human immunodeficiency virus from combinatorial libraries of asymptomatic seropositive individuals, 1991</p>
11/14	<p>Pre-Thanksgiving Plant Pathogens 101</p>	<p>TBD</p> <p>Capstone writing assignment figures and annotated bibliography due</p> <p>Figures should be your own (not copied and pasted!)</p>
11/19	<p>VIDEO</p>	<p>TBD</p>
11/21	<p>STUDENT PRESENTATIONS</p>	<p>Capstone writing assignment high quality draft due</p> <p>3000 word essay</p>
11/26	<p>STUDENT PRESENTATIONS</p>	
11/28	<p>Thanksgiving</p>	<p>NO CLASS</p>
12/3	<p>STUDENT PRESENTATIONS</p>	
12/5	<p>STUDENT PRESENTATIONS</p>	<p>Capstone writing assignment final version due</p>