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PLPT 496/892: Disease Dynamics & Evolution—A Peer Review of Teaching Project Benchmark Portfolio

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Benchmark Course Portfolio
Peer Review of Teaching
Spring 2016

PLPT 496/892:

Disease Dynamics & Evolution

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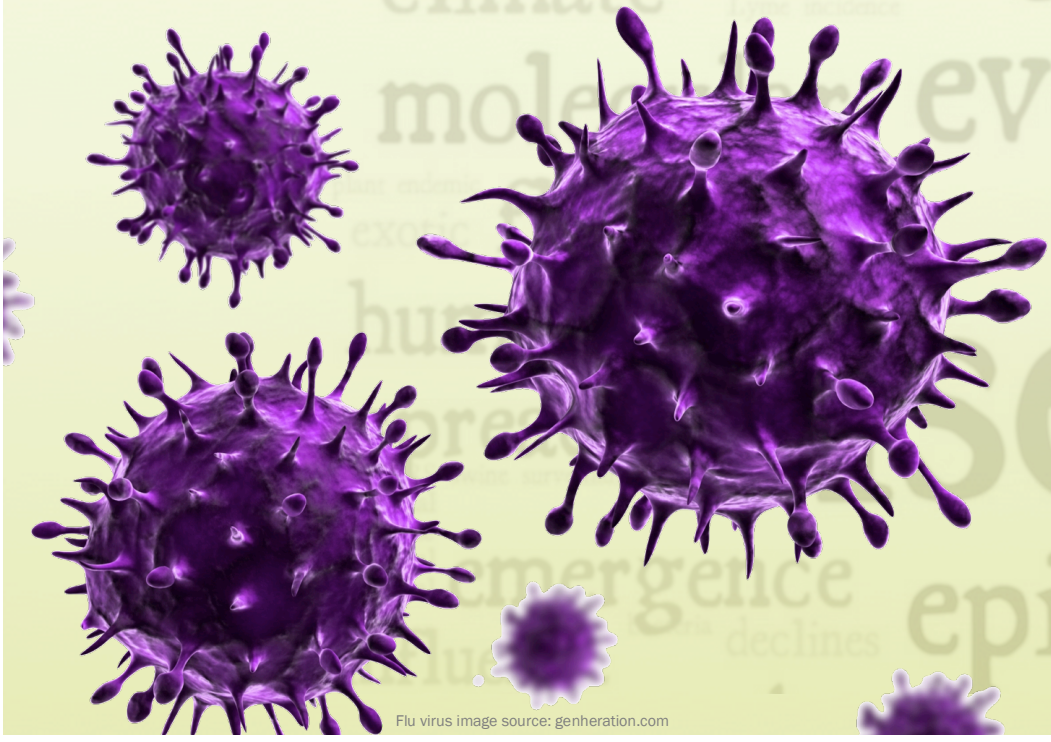

Flu virus image source: genheration.com

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Benchmark Course Portfolio

Course: Disease Dynamics and Evolution
PLPT 896/492, 3 credit hours
Spring 2016: 2 graduate students and 4 microbiology undergraduates

This course was designed to cover core concepts of disease ecology and pathogen emergence/evolution. These concepts are organism-agnostic and important for understanding infectious diseases of humans, animals, and plants. This course is appropriate for a wide variety of biology students, with interests in ecology, environmental biology, animal, plant, and human biology to microbiology, pre-vet and pre-med. A pre-requisite for undergraduates was BIOS 312 or permission of instructor.

Course Content and Goals

Why a course on disease dynamics and evolution? –

Infectious diseases of humans, animals, and plants have shaped human history, and will continue to do so in light of climate change and globalization. This course will cover core concepts of disease ecology and pathogen evolution. Concepts will be applied to understand how new diseases emerge and why epidemics occur.

The goal of this course was to use interesting and intriguing case studies of infectious diseases to develop critical thinking as scientists. There were five major components of the course shown in Figure 1 (right).

Base Knowledge
Principles of disease epidemiology
Molecular genetic markers
Concepts from population genetics
Next-generation sequencing
Phylogenetics for epidemiology

Disease Ecology
Disease cycles and pathogens of importance
Disease triangle
Vectors and reservoirs
Plants as hosts for human pathogens
SIR modeling (ROC curves)

Disease Emergence
Climate change and emerging diseases
Land use change and emerging disease
Emerging infectious diseases of plants

Pathogen Evolution
Evolution of virulence in fungi and bacteria
Evolution of antibiotic and fungicide resistance

Critical Thinking and Application
Searching primary literature
Reading scientific papers
Presenting scientific papers
Peer-review of scientific papers

Figure 1. Lecture topics and activities grouped according to one of the five core concepts in the course that lead from introductory base knowledge to topic-specific concepts of disease ecology, emergence, and pathogen evolution, and higher-level science skills in critical thinking and application.

Goals and Methods for Accomplishing Student Learning

Lectures and Case Studies – The course format was lecture-based and inquiry driven, using primary literature as case studies. Case studies were non-specific to organism type, where effort was made to cover predominant classes of pathogens (fungi, bacteria, viruses, and protozoans).

The host of importance within each paper was also considered when selecting case studies, such that animals, humans, and plants were included at least twice. Additional papers were concept-driven case studies, selected to introduce difficult core concepts from the course. Although these papers were based upon research on bacterial human pathogens, the concepts were transferrable to other non-human and/or non-bacterial pathosystems. Case studies were selected for their relevance lecture topics or activities in Figure 1. The following are titles of papers read as case studies in class (see Appendix B for full citation):

Fungi
Mucormycosis outbreak after Joplin, MO tornado (H)
Asian soybean rust outbreak in the Southeastern US (P)
Amphibian Chytrid disease worldwide outbreak (A)
Dutch elm disease pandemics (P)

Bacteria
E.coli O157:H7 outbreak on hamburger meat (H)
Salmonella enterica insect transmission (P & H)

Viruses
Bluetongue outbreak of ruminants in Europe (A)
HIV-1 pandemic – origin and transmission (H)
SARS outbreaks in China and Canada (H)

Protozoan
Chagas disease outbreak in Mexico (H)

Concept-driven Case Studies
Dysbiosis as a mechanism of pathogen evolution (H)
Mechanisms of drug resistance in bacteria (H)
Evolution/populations of select bacterial pathogens (H)

Figure 2. Disease outbreaks and concept-driven case studies discussed, with letters in parentheses to indicate the host of importance in the paper (A = Animal; H = Human; P = Plant).

1. Whole genome sequence typing to investigate the apophysomyces outbreak following a tornado in Joplin, Missouri, 2011.
2. Quantitative aspects of the spread of Asian soybean rust in the southeastern United States, 2005 to 2006.
3. *Escherichia coli* O157:H7–associated hemolytic-uremic syndrome after ingestion of contaminated hamburgers.
4. Evolution, population structure, and phylogeography of genetically monomorphic bacterial pathogens.
5. Climate change and the recent emergence of bluetongue in Europe.
6. Chagas disease in Mexico: an analysis of geographical distribution during the past 76 years – A Review.
7. Multilocus sequence typing suggests the chytrid pathogen of amphibians is a recently emerged clone.

8. Rapid evolution of introduced plant pathogens via interspecific hybridization.
9. Transmission and retention of *Salmonella enterica* by phytophagous hemipteran insects.
10. The origin and diversity of the HIV-1 pandemic.
11. 'Blooming' in the gut: How dysbiosis might contribute to pathogen evolution.
12. Combating bacteria and drug resistance by inhibiting mechanisms of persistence and adaptation.
13. Network theory and SARS: predicting outbreak diversity.

Discussion Questions –
Prior to discussing research papers in class, a "Questions to Check Your Understanding" sheet was provided to the students (Appendix C). Students were given approximately 15 minutes to answer questions. Discussion usually started with asking students to volunteer their answer to one of these questions. Particularly challenging questions typically went unanswered and allowed for us to discuss the purpose of the question and help students to work towards an answer together. In several instances, these discussions led to impromptu discussions of methods, concepts, and big picture ideas in scientific research.

Quizzes –
Three quizzes were given via blackboard and consisted of one question per lecture, case study, or student-led discussion (see Appendix D for an example quiz). Each answer required no more than a well-constructed paragraph, where answers either came directly from lecture notes or were discussed as an answer for the "Questions to Check Your Understanding" in-class exercise. These were open-note quizzes.

Reflection Journals –
Students were required to write about their thoughts on the week's major ideas, activities, discussions, and remaining questions or controversies that came up in class (see Appendix E). These journals provided students the opportunity to review and reinforce what they learned each week. They also had the added benefit of providing feedback about effectiveness of classroom activities and readings for teaching about infectious diseases. Topics identified in journals as causing confusion or questions asked were discussed further in subsequent classes.

Peer-Review of Scientific Paper – The final term projects required students to perform an in-depth critical review of a scientific paper dealing with an infectious disease (see Appendix F). These were submitted via blackboard, with due date / time as the end time of the scheduled final exam.

Attendance – Each student was allowed two unexcused absences, where any unexcused absences thereafter resulted in a 1-point deduction from the final grade.

Disease in the News – Students were asked to find information about a disease of interest in the news and report it at the beginning of each class. There was no grade value associated with this activity.

Paper Presentations – Each student led two group discussions on a journal article of their choice that focused on an infectious disease outbreak. This gave each student the opportunity to engage the primary literature on a topic that they found personally interesting and/or important to their future field of work. These student-led discussions will require the presenting student to research introductory information on this disease of their choice and discuss/interpret figures presented in the research paper. Below are titles of papers selected by the students for each presentation (see **Appendix B** for full citation). Each presentation had a grading rubric given to students prior to selecting a paper to present (see **Appendix G** and **Appendix H**). The learning outcomes were slightly different for each presentation (Figure 3), where the second presentation was designed to focus on critical evaluation of the paper and incorporated student peer-review using an evaluation sheet given to students prior to selecting the paper (see **Appendix I**).

Presentation 1:

1. Prevalence and molecular epidemiology of meticillin-resistant *Staphylococcus aureus* in nursing home residents in northern Germany
2. Precise Dissection of an *Escherichia coli* O157:H7 Outbreak by Single Nucleotide Polymorphism Analysis
3. Molecular Evolution of Zika Virus during Its Emergence in the 20th Century
4. Sexuality Generates Diversity in the Aflatoxin Gene Cluster: Evidence on a Global Scale
5. Collaborative Survey on the Colonization of Different Types of Cheese-Processing Facilities with *Listeria monocytogenes*
6. *Sclerotinia sclerotiorum* Populations Infecting Canola from China and the United States Are Genetically and Phenotypically Distinct

Presentation 2:

7. The Spread of Dengue in an Endemic Urban Milieu–The Case of Delhi, India
8. Comparative Genomic Analysis of Malaria Mosquito Vector-Associated Novel Pathogen *Elizabethkingia anopheles*
9. Phylogenetic Diversity of *Vibrio cholerae* Associated with Endemic Cholera in Mexico from 1991 to 2008
10. International Spread of an Epidemic Population of *Salmonella enterica* Serotype Kentucky ST198
11. Resistant to Ciprofloxacin LA-MRSA CC398 differ from classical community acquired-MRSA and hospital acquired-MRSA lineages: Functional analysis of infection and colonization processes
12. Genetic Variation of *Sclerotinia sclerotiorum* from Multiple Crops in the North Central United States

Learning Outcomes

Presentation 1
Presenting a scientific paper requires the student to read, synthesize, apply, and use critical thinking. This presentation will hone your skills in scientific inquiry, which will be a valuable (necessary) skill in your future career as a scientist.

Presentation 2
Critical reasoning skills are a hallmark of scientific thinking. The goal of your second presentation is to hone your ability to critically evaluate a scientific paper, building upon skills learned in your first presentation that was geared towards synthesis.

Figure 3. Learning outcomes from instructions on each of the student-led paper presentations (see full presentation rubrics in Appendices F and G)

About the Students Enrolled in Spring 2016

There were a total of six students that enrolled in this course in the Spring of 2016, which was the first semester that this course was offered as an Independent Study course. Four of the students were undergraduates and two were graduate students. All four undergraduates were majoring in microbiology and were either juniors or seniors. Both graduate students were specializing in plant pathology, where one was a second-year master's student and the other a first-year Ph.D. student.

	Class	Major	Career goal
"Student A"	Undergraduate	Microbiology	Bioinformatics/cancer
"Student B"	Undergraduate	Microbiology	Physical therapist
"Student C"	Undergraduate	Microbiology	Dental school
"Student D"	Undergraduate	Microbiology	Public health
"Student E"	Graduate	Plant Pathology	Environmental toxicology
"Student F"	Graduate	Plant Pathology	Undecided

Figure 4. Class, major, and career goal of students that enrolled in Spring 2016.

Most students were prepared for this course given their background coursework. Most had experience searching primary scientific literature and had good knowledge of bacterial pathosystems. There were, however, common deficiencies identified among students (Fig. 5). For example, few had experience in reading scientific papers and none had been introduced to methods for reading papers. A few students had experience presenting a scientific paper, though none had been given instruction on how to organize and summarize material in such a presentation.

Common Student Deficiencies

- Diseases of animals and plants
- Phylogenetics for epidemiology
- Next generation sequencing
- Statistics and p-values
- Fungal biology / pathogens
- Viral biology / pathogens
- Concepts in ecology
- Concepts in evolution
- Reading scientific papers
- Interpreting figures and tables
- Presenting scientific papers
- Critiquing scientific papers

Figure 5. Most common student deficiencies identified

Some areas of biological science were insufficient among most students, including basic understanding of evolution and phylogenetics for epidemiology, basic concepts in ecology, clear understanding of next generation sequencing, fungal and viral biology, statistics and p-values, and knowledge of diseases of animals and plants.

Some deficiencies were identified using the comments from students given in their weekly *Reflection Journals*. For example, one student indicated a lack of understanding of next generation sequencing technologies and another student indicated a lack of understanding of phylogenetics. To address these needs, lectures were developed that were not originally included in the course syllabus: "Introduction to Next Generation Sequencing" and "Introduction to Phylogenetics for Epidemiology".

Importance of Course in Departmental Curricula

This was a split-level course developed primarily for graduate students in plant pathology and undergraduate students in microbiology. Students were expected to use information learned previously in biology courses, which enhanced basic competencies in areas of interest to them (ie. human, plant, or animal-associated pathogens). Regardless of individual-student interests, techniques discussed were interdisciplinary and applicable for characterizing disease outbreaks and epidemics affecting animals, humans, and plant pathogens alike. Students were required to integrate and synthesize concepts learned in class for two in-class presentations.

Reading and discussing a total of 25 scientific peer-reviewed journal articles (see Appendix B) allowed students to develop critical thinking and analysis skills in an open and encouraging environment. Discussions allowed students to develop their abilities for speaking about scientific papers using scientific terminology. In-class discussion questions and student-led presentations teach students to develop effective analysis and critique, within a scientific framework. Skills taught and applied in this course, including reading, interpreting, and critiquing scientific papers. These are essential "real-world" problem-solving skills for scientists. Also discussed were societal, economic, ethical, and professional aspects of each research paper in order to further expose students to the "real-world" component of why and how research is conducted.

The abovementioned characteristics of this course make it appropriate for classification within the microbiology major as a capstone course, as defined by the CASNR "Guidelines and Application for Capstone Learning Experience". These characteristics also make this course complementary to existing courses within the graduate specialization in plant pathology.

Figure 6. Answers students provided when asked to describe a skill or knowledge gained from the class.

Student Comments

"I learned what to ask when evaluating scientific papers. I value this skill because I believe I want to go to grad school, …I probably will not get very far in grad school, or in the sciences in general, if I do not know how to evaluate scientific papers."

"I previously hadn't had a lot of experience reading scientific papers so getting practice with reading scientific papers was very valuable. I also definitely felt that my second presentation was much stronger than the first signaling an improvement in this skill."

"I learned how to critically think, and analyze a research paper before accepting what the authors suggest. I really value this skill because science is complex, a number of things need to be considered before reaching a conclusion. Also, this skill will help me further in my research."

"I think one of the major skills that I gained from this class was how to efficiently break down and read through a scientific journal. …[these] are important for individuals no matter what field that they decide to go into (ex. health, grad school, etc.) and know that I will use this information that I have learned later on down the road."

"THE most important thing I learned from this class is assessing a paper critically. Not only do I assess the methodology critically, but I pay very close attention to the arguments that the authors use to make their overall point. In essence, I have become a more balanced skeptic, instead of simply believing everything written. I believe that this enhances my comprehension of an article as when I read, I am reading more aggressively compared to my previous passive approach."

Planned Modifications for Course in Future

A major challenge in this course was microbiology student knowledge deficiencies in fungal pathogens, which are the primary infectious disease agent of plants. Most students had sufficient knowledge of bacterial pathogens of humans, which are the primary infectious disease agent of humans. Students lacked even fundamental knowledge about fungi, including basic information on their physical makeup (hyphae and spores) to how/where they survive and mechanisms of spread. Students were similarly unprepared for understanding viruses, though most had knowledge of at least two important viral diseases of humans, HIV and influenza.

Bias in student knowledge to human diseases and bacterial pathogens seemed to affect the interests of the students. This was seen most obviously in the topics of papers selected by students in the class (Fig. 7). In the first presentation, half of the student presentations were human bacterial diseases, one a human viral disease, and two were primarily fungal plant pathogens. Despite requirements to change host or pathogen for the second presentation, four out of six were human bacterial diseases, one was a human viral disease, and the sixth a fungal plant pathogen.

	First presentation topic	Second presentation topic
A	Methicillin-resistant staph outbreaks in Germany	Livestock-associated cipro-resistant staph
B	E. coli food-borne outbreak in Missouri/Kansas	International spread of Cholera
C	Zika virus emergence in Africa	Spread of Dengue within Dehli, India
D	Listeria survival within cheese facilities	Comparative genomics of *Elizabethkingia* spp.
E	Drivers of aflatoxin production by *Aspergillus* spp.	Cholera outbreaks in Mexico 1991 to 2008
F	White mold in China vs. U.S.	White mold on various crops in the U.S.

Figure 7. Topics of student-selected papers for presentations (Letters A-F refer to information on each student in Figure 4.

Changes to this course that will be made to address this are to include a lecture within the first two weeks of class that is an introduction to the basic biology and ecology of fungi and viruses. Additionally, in selecting papers to present for the class, students will not be allowed to select another paper that is on the same host (human, plant, animal) or same type of pathogen (bacterium, fungus, virus). Another activity that will be developed will ask students to compare and contrast these types of pathosystems, with the goal to better achieve student openness to non-human and non-bacterial topics.

Another issue discovered in class was difficulty in getting students to participate in the in-class discussion. One change designed to address this will be assignment of the "Questions to Check Your Understanding" at the same time that the paper is assigned to the students. Although these sheets will not be graded, students will be expected to answer these questions in discussion at the beginning of class. Another change to address student participation in class will be to have students give their first presentation earlier in the course. Discussion participation greatly increased after students had a chance to address the class in these presentations.

Appendix A – Course syllabus

"DISEASE DYNAMICS AND EVOLUTION"

PLPT 496/892 (3CR)
Spring 2016, N176 BEAD
1:00 – 2:15 p.m. Tuesdays and Thursdays
Prerequisite: BIOS 312 or permission of instructor

Instructor: Sydney Everhart, Ph.D., everhart@unl.edu
Office: 406 Plant Science Hall (East Campus)
Student hours: No set time. Contact anytime to set up a mutually convenient time.

Textbook: None; all of the course readings will come from primary research papers and review articles, as well as articles from the popular press. Readings will be available as PDFs on the class Blackboard site. Students will be required to read numerous research papers throughout the semester. These papers will be used to illustrate important concepts and to underscore how science is performed and communicated.

Why a course on disease dynamics and evolution? Infectious diseases of humans, animals, and plants have shaped human history, and will continue to do so in light of climate change and globalization. This course will cover core concepts of disease ecology and pathogen evolution. Concepts will be applied to understand how new diseases emerge and why epidemics occur.

Course format and target audience: Course format will be lecture based and inquiry driven, using primary literature and case studies. This course is appropriate for a wide variety of biology students, with interests in ecology, environmental biology, animal, plant, and human biology to microbiology, pre-vet and pre-med.

Grading:		Points	Percent
Reflection journals[1]:	(10pts each)	130	10%
Paper discussions[2]:	(195pts ea.)	390	30%
Quizzes (3 take-home)[3]:		312	24%
Final exam[4]:		338	26%
Attendance[5]:		130	10%
Total:		1300	100%

[1]Journals: You will be required to write about your thoughts on the week's major ideas, activities, discussions, and remaining questions or controversies that came up in class. These journals are mainly for you to review and reinforce what you learned each week. They also have the added benefit of providing feedback about effectiveness of classroom activities and readings for teaching about infectious diseases. Concepts identified in journals as causing confusion will be discussed further in subsequent classes.

[2]Paper discussion: Each student will lead two primary literature journal article discussions on two different infectious diseases. These student-led discussions will require the presenting student to research introductory information on this disease of their choice and discuss/interpret figures presented in the research paper.

[3]Take-home quizzes: These will be available in blackboard and will consist of one question per lecture, case-study, or student-led discussion. Each answer should be no more than a well-constructed paragraph *in your own words* (no cut and paste).

[4]Final exam: Final term projects are to perform an in-depth critical review of a scientific paper dealing with an infectious disease. These will submitted via blackboard, with due date / time as the end time of the scheduled final exam.

[5]Attendance: Each student is allowed two absences; one point will be taken away from your final grade for each unexcused absence thereafter. If a class is missed, it is the student's responsibility to obtain the notes/information from another student. Extensions on quizzes and assignments will be made in cases of documented illness or conflict only. Five unexcused absences will trigger instructor-initiated withdrawal.

Student learning outcomes:

- Asks good questions and knows how to search for credible information about science
- Can read and understand graphs and charts related to scientific information
- Identify and analyze the ecological and evolutionary processes that influence the dynamics of infectious diseases of humans, animals, and plants
- Compare and contrast disease dynamics of human, animals, and plant diseases
- Identify and analyze the ecological and evolutionary processes that influence disease dynamics at difference temporal and spatial scales
- Apply sound reasoning skills to identify the logical causes and regulators of disease
- Apply ecological and evolutionary concepts to predict how new diseases might emerge

Course schedule (will be modified as needed during the semester):

Date		
Jan 11	M	Course introduction and important diseases
Jan 13	W	General principles of disease epidemiology; disease cycles and pathogens
Jan 18	M	**No class (holiday)**
Jan 20	W	Disease triangle; reading scientific papers; searching primary literature
Jan 25	M	Molecular genetic markers
Jan 27	W	Case study: *E. coli* O 157H7 Jack-in-the-Box outbreak
Feb 1	M	Concepts from population genetics
Feb 3	W	Vectors and reservoirs
Feb 8	M	Emerging disease: climate change
Feb 10	W	Emerging disease: land use
Feb 15	M	Introduction to Next Generation Sequencing
Feb 17	W	Student-led paper discussion #1 [redacted]
Feb 22	M	Student-led paper discussion #2 [redacted]
Feb 24	W	Student-led paper discussion #3 [redacted]
Feb 29	M	Student-led paper discussion #4 [redacted]
Mar 2	W	Student-led paper discussion #5 [redacted]

Mar 7	M	Student-led paper discussion #6 [redacted]	
Mar 9	W	Emerging infectious diseases of plants	
Mar 14	M	Plants as hosts for human pathogens	
Mar 16	W	Introduction to phylogenetics for epidemiology	
Mar 21 Mar 23		SPRING BREAK	
Mar 28	M	Evolution of virulence in fungi and bacteria	
Mar 30	W	Evolution of antibiotic / fungicide resistance	
Apr 4	M	ROC Curves / SIR modeling	
Apr 6	W	Student-led paper discussion #1 [redacted]	
Apr 11	M	Student-led paper discussion #2 [redacted]	
Apr 13	W	Student-led paper discussion #3 [redacted]	
Apr 18	M	Student-led paper discussion #4 [redacted]	
Apr 20	W	Student-led paper discussion #5 [redacted]	
Apr 25	M	Student-led paper discussion #6 [redacted]	
Apr 27	W	Reviewing research papers and the review process	(course evaluations)
May 2—6		Take-home exam due (submission on Blackboard) **Note:** due date will correspond to the end time for the scheduled final exam for the course	

Students with Disabilities: Students with disabilities are encouraged to contact me (the instructor or teaching assistant) for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide individualized accommodations to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 232 Canfield Administration, 472-3787 voice or TTY.

Academic Honesty: Academic honesty is essential to the existence and integrity of an academic institution. The responsibility for maintaining that integrity is shared by all members of the academic community. To further serve this end, the University supports a Student Code of Conduct, which addresses the issue of academic dishonesty.

Statement on Diversity: The University of Nebraska-Lincoln is committed to a pluralistic campus community through Affirmative Action and Equal Opportunity. We assure reasonable accommodation under the Americans with Disabilities Act. Students with disabilities are encouraged to contact me for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, student must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

Appendix B – References for journal articles (* = *student-selected paper*)

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Appendix C – Example in-class self quiz on reading

Name

PLPT 496/892 Disease Dynamics and Evolution
March 29, 2016

Questions to Check Your Understanding

1. The predicted R_0 in China was between 2.2 and 3.6 – how many cases should have been reported in the first 120 days of disease transmission? How many were actually reported during the first three months?

2. What was the role of the Amoy Gardens complex in Hong Kong in the incorrect estimation of R_0?

3. Define both superspreaders and supershedders – how do these affect the estimation of the reproductive number R_0?

4. Contact network modeling was applied to the SARS outbreaks in Vancouver and Toronto, what was the major difference in these two outbreaks?

5. How might contact networks improve prediction of outbreaks over the use of R_0?

Appendix D – Example quiz with answers

PLPT 496/892 Disease Dynamics and Evolution
April 20, 2016
Due Friday, April 29th at 11:59 PM

Description/Instructions: There is one question for each of the nine classes up to the final student presentation, which includes lectures 14-16 and six student paper presentations (note: student presentations are in Paper Presentation #2 folder on Blackboard). This quiz is open note. Each answer should be no more than a well-constructed paragraph *in your own words* (no cut and paste). The due date is Sunday, May 1st at 11:59PM.

1. What are the three mechanisms of horizontal gene transfer (HGT) in bacteria and why is HGT significant with respect to bacterial evolution?

   Answer: This was a question on the "check your reading" sheet and the answer comes from the first page of our reading on 'Blooming in the gut", where the three mechanisms listed are: "transformation, phage-mediated transduction and conjugation-mediated plasmid exchange (Fig. 1a)" and this is significant for bacterial evolution because (also on page one), "HGT in particular enables bacterial evolution in quantum leaps, rather than by stepwise adaptation through mutations;".

2. What are the five crop management techniques recommended to reduce the risk of fungicide resistance?

   Answer: The answer comes from slide 43 in lecture 15: 1. rotate fungicides that have different modes of action, 2. adopt cropping practices that reduce disease pressure and reduce the number of fungal individuals exposed to selection, 3. avoid unnecessary fungicide applications, 4. make timely applications of fungicides, and 5. apply the full labeled rate.

3. What was the role of the Amoy Gardens complex in Hong Kong in the incorrect estimation of R_0 of the SARS outbreak?

   Answer: This question was on the "check your reading" sheet and the answer comes from page 2 on the paper with the title "Network theory and SARS": "Contact rates may be considerably lower outside hospitals and crowded apartment buildings and thus so may be the general value of R0 for SARS (Yu et al., 2004). Such disparity may account for the discrepancy between the estimates and the slower progress of the outbreak in China. In fact, further studies suggest that the unusually large cluster of infected cases in Amoy Gardens complex in Hong Kong was due to exposure to the virus-laden aerosol plume originating from one of the buildings in that area and not from direct person-to-person contact (Yu et al., 2004)."

4. [redacted]'s paper/presentation: What does MCG stand for and, for most isolates, how did MCG relate to the haplotype determined using microsatellite genotyping?

   Answer: MCG = mycelial compatability group; for the majority of isolates there was a one-to-one correspondence of MCG and haplotype (see abstract of paper).

5. [redacted]'s paper/presentation: What were the three steps in the evolution of the ciprofloxacin-resistant *Salmonella enterica* from 1960 to 2004?

Answer: See slide 21 of [redacted]'s presentation where it shows the figure that he used to explain the three steps: 1. chromosomal integration of the genomic island SGI1-K, 2. *gyrA* mutation Ser83Phe, 3. second *gyrA* mutation (codon 87) and *parC* mutation Ser80Ile.

6. [redacted]'s paper/presentation: What did the microarray analysis of the LA-MRSA show with respect to clustering of isolates in relation to their spa type or origins (ie. human, pigs, community, or hospital)?

   Answer: See slide 12 of [redacted]'s presentation showing Figure 1, where she explained that there was no association found between the microarray data and either spa type or origin of the strains.

7. [redacted]'s paper/presentation: What are the three possible modes of cholera introduction to Mexico?

   Answer: See slide 8 of [redacted]'s paper that lists the three possible modes: ballast water in tanks of ships, environmental reasons such as El Nino, and with immigrants.

8. [redacted]'s paper/presentation: What are the pan-, core-, and accessory-genomes?

   Answer: See slide 16 of [redacted]'s presentation, where she succinctly explained in class that the pan-genome is the entire gene set of all strains of a species, which can be broken down into the core- and accessory-genomes. The core-genome is genes present among all strains of a species and the accessory-genome is genes not present among all strains of a species (can be present in 1+ strains, but not all).

9. [redacted]'s paper/presentation: What were the two major limitations of this study?

   Answer: See page 14 of [redacted]'s paper where it states: "One of the major limitations of our study is the dependence on the Delhi surveillance system to detect dengue cases. Although better than the rest of India, clinical case reporting will be subject to bias and to some extent affected by individual socio-economic status. Moreover and potentially a more significant problem is the fact that the majority of infections are sub-clinical and thus the clinical cases represent only a small fraction of the circulating viral infections. Prospective studies aimed at detecting the incidence of sub-clinical infections, their relative occurrence with respect to clinical infections and factors affecting this relative occurrence could help lead to methods to extrapolate from clinical cases to total DENV infections."

Appendix E – Reflection journal guidelines

"DISEASE DYNAMICS AND EVOLUTION"
PLPT 496/892 (3CR)

Weekly Journals:

There are two main purposes of these journals: 1) to ensure that you understand the main points covered that week, and 2) to help you establish and work through some of your learning ideas without worrying about a grade. You can write as much or as little as you choose each week in your journal. However, we would like you to at least address the following questions in your journals: 1) What question(s) do you most wish had been answered this week?, 2) What was the most important new understanding for you this week?, and 3) What was the least clear about what material and experiences in class this week? You may do this either explicitly or implicitly. You are certainly encouraged to offer any other thoughts or ideas that you have each week. You should submit journal entries to us through the journals link on the class website **no later than 9:00 pm on Saturday of each week**. We will grade journals only on a complete/not complete basis. We will read journals to get a sense of what and how students in the class are thinking and understanding and comment appropriately in class the following Monday.

The purpose of these journals is to both ensure you understand the main points covered that week and to help you establish some of the learning ideas without worrying about a grade. There is no limit to how much you need to write, however, you need to address the following questions in your journals:

1. What questions do you wish had been answered this week?
2. What was the most important new understanding for you this week?
3. What was the least clear about the material and experiences in class this week?

Each journal is due no later than 9:00 pm on Saturday of each week. These journals will only be graded on a complete / incomplete basis. I will read journals to get a sense of how students are thinking and understanding, so that I so that I can comment accordingly in class.

Due dates for journals (mark your calendar):	
Journal 1	Jan 16
Journal 2	Jan 23
Journal 3	Jan 30
Journal 4	Feb 6
Journal 5	Feb 13
Journal 6	Feb 20
Journal 7	Feb 27
Journal 8	Mar 5
Journal 9	Mar 12
Journal 10	Mar 19
Journal 12	Apr 2
Journal 13	Apr 9
Journal 14	Apr 16

Appendix F – Final exam instructions

Disease Dynamics and Evolution
PLPT 492/896, Spring 2016
Final Exam
Submission is online by 5:30PM, Monday, May 2nd (scheduled end of final exam)
Submission is performed by uploading your review documents to Blackboard.

Select one of the two papers for your review:

> **Paper 1:** The, H.C., M.A. Rabaa, D.P. Thanh, N.D. Lappe, M. Cormican, M. Valcanis, B.P. Howden, S. Wangchuk, L. Bodhidatta, C.J. Mason, T.N.T. Nguyen, D.V. Thuy, C.N. Thompsen, N.P.H. Lan, P.V. Vinh, T.H. Thanh, P. Turner, P. Sar, G. Thwaites, N.R. Thompson, K.E. Holt, and S. Baker. 201X. South Asia as a reservoir for the global spread of ciprofloxacin resistant *Shigella sonnei*. Submitted to *BioRxiv*.
>
> **Paper 2:** [redacted]201X. Mating-type gene structure in *Didymella tanaceti* and their spatial distribution in pyrethrum fields. Submitted to [redacted]. *Paper must remain anonymous.

Your review should consist of three parts:

A. **Review** – Your 2-3 page written review (details below)
B. **References** – List of references used to support your opinion
C. **Changes** – Your itemized list of changes to the paper

A. **Review (288 pts):** Write a 2-3 page review (page limit excludes citations) that is formatted with single line space, 12pt font, Times New Roman, 1" margins. Your review should contain the following sections:
   1. Introduction/summary of paper (including gap/hypothesis of research)
   2. Merits of the paper
   3. Critique
   4. Discussion and your decision on the manuscript:
      a. Publish without changes
      b. Publish with minor modification
      c. Publish with major modification
      d. Reject with option for re-submission after major changes
      e. Reject without the possibility of re-submission
B. **References (25 pts):** Provide references (3-5) supporting your opinions. These must be peer-reviewed sources with full citation provided.
C. **Changes (25 pts):** Make a list of spelling or grammatical changes that need to be made to the text prior to publication. You can do this by making a list of changes, giving the line number and suggested change OR you can make suggested changes directly on the PDF (hand-written notes should be scanned/uploaded).

PLPT 496/892 Disease Dynamics and Evolution
February 3, 2016

Paper Presentation Guidelines

Learning outcome. Presenting a scientific paper requires you to read, synthesize, apply, and use critical thinking. This is an opportunity to engage the primary literature on a topic that is important and interesting to you. This presentation will hone your skills in scientific inquiry, which will be a valuable (necessary) skill in your future career as a scientist.

Tips for selecting a paper. Selecting a paper can be daunting. Once you've found a few papers that are candidates, consider how interesting the paper might be to the audience. For example, was the paper important because they used a new method? Did the results contradict previous knowledge about the pathogen? Did the study make a major public health, environmental, or economic impact? Do not shy away from challenging papers.

Note: Papers need to be approved by me before proceeding with your presentation. The deadline for emailing me with your selected paper is Monday, February 8th at 5:00pm. My email is everhart@unl.edu

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Components of your presentation (195 points):

5 pts

1. Background on the paper: Why did you select this paper?

50 pts

2. Background on the disease and pathogen that is relevant to the paper (this information will primarily come from sources other than the paper)
   Some examples:
   a. Recent important outbreaks of the disease? and/or is there a historical Scale of importance – is the problem local, regional, or global?
   b. Impact of the disease (mortality, economic and/or environmental impact), who is impacted by disease and why?
   c. Disease cycle: how is it spread? are there vectors? are there reservoirs of the pathogen in the environment or on other non-important hosts?
   d. Biology of the pathogen: is it asexual, sexual, long-lived, toxin producing, etc.

20 pts

3. Identify the gap in research (information from introduction to paper):
   a. What was important prior research leading to the current study?
   b. What was their hypothesis?
   c. Is there some justification for the research approach they selected?

20 pts

4. Outline of the methods used in the paper
   a. What were the steps they used?
   b. Where or how did they obtain data?
   c. Why was this particular method used?

30 pts

5. Results and discussion
   a. Provide a slide for **each figure and table** that are large enough to be seen
   b. Explain the results and interpret each table and figure
      Some questions that might help you explain tables/figures:
      i. What is the data being shown?
      ii. What is the purpose for showing this data?
      iii. How is each table/figure interpreted by the authors?
      iv. Do you agree with their interpretation or not?

20 pts

6. Summarize results of the paper
    a. What were the major findings or key points from this paper?
    b. Does this paper fill the gap that they identified?
    c. Were there any limitations to the approach used?
    d. Why do the authors think this work is important to the field?

25 pts

7. What is your opinion? Provide your critical scientific critique of the paper and justify your opinions
    a. Do you agree with the conclusions that the authors drew from the work?
    b. Do you see ways this paper might be improved?
    c. In general, what is your opinion of this work?
    d. Are any questions left unanswered by this paper?
    e. What might be the next research study to follow-up on this paper?

Not presenting today?

Undergrads: 5 x 5pts = 25 pts

Grads: 10 x 2.5pts = 25 pts

8. When you are not presenting the paper, you will be expected to read the paper and prepare one question that will help to develop conversation, for example:
    a. Were conclusions of the authors reasonable? Do you agree?
    b. Was the method appropriate for the question they asked?
    c. Was there something you thought could have been presented or analyzed better in the paper?
    d. Was the data sufficiently analyzed and presented in the paper?

PLPT 496/892 Disease Dynamics and Evolution
March 27, 2016

Paper Presentation 2
Guidelines & Rubric

Learning outcome. Critical reasoning skills are a hallmark of scientific thinking. The goal of your second presentation is to hone your ability to critically evaluate a scientific paper, building upon skills learned in your first presentation that was geared towards synthesis.

Criteria for selecting this paper. The paper you select should differ from the first paper you presented in at least one way: host species, pathogen species, OR molecular method used for typing the pathogen. In this presentation, you will be asked to compare and contrast this paper with the paper you selected for presentation #1.

Note: Papers need to be approved. The deadline for emailing me with your selected paper is Friday, April 1st at 5:00pm. My email is everhart@unl.edu

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Components of your presentation (195 points):

20 pts	1. Background on the disease and pathogen that is relevant to the paper (this information will primarily come from sources other than the paper **that must be cited – see #9**)
20 pts	2. Disease cycle: how is it spread? are there vectors? are there reservoirs of the pathogen in the environment or on other non-important hosts? a. Illustrate the disease cycle using a figure and explain each step of the disease cycle
5 pts	3. Identify the gap in research: Why did they do this study and what was their hypothesis?
20 pts	4. Outline of the methods used in the paper a. What methods did they use? b. Where or how did they obtain samples? c. What statistical analysis did they perform?
25 pts	5. Results and discussion a. Provide a slide for **each figure and table** that are large enough to be seen b. Explain the results and interpret each table and figure: i. What is the data being shown? ii. What is the purpose for showing this data? iii. How is each table/figure interpreted by the authors? iv. Do you agree with their interpretation or not?
10 pts	6. Summarize results of the paper a. What were the findings from this paper?
35 pts	7. Provide your critical scientific critique of the paper and justify your opinions a. Do you agree with the conclusions that the authors drew from the work? b. Are any questions left unanswered by this paper? c. Were there any limitations to the approach used? d. Does this paper fill the gap that they identified? e. What are changes you would recommend to the authors to improve the paper?

f. What might be the next research study to follow-up on this paper?

5 pts

8. Compare and contrast this paper with the previous paper you presented

5 pts

9. List citations at the end of your presentation, including all sources used for information

50 pts

10. Peer-evaluation score: Your peers will determine 50 points of your grade using the grading rubric on the following page. If not all 5 students are present, the absent student's evaluation score will be replaced using the average of all others.

Appendix I – Presentation 2 peer-review form

Your name: _____

PLPT 496/892 Spring 2016
Presentation Evaluation

Presentation by: _____

Paper title: _____

Disease introduction (3 pts) Circle score: 1 2 3

Was importance/impact of the disease described?

Were relevant examples used to illustrate the importance/impact?

Was the disease cycle described and explained in detail?

Paper Presentation (5 pts) Circle score: 1 2 3 4 5

Was detail used to describe the experimental design, including relevant background on the method, sampling, and approach used in the paper?

Were results clearly explained and interpreted?

Was critique of the paper well developed and justified?

Responses to questions (2 pts) Circle score: 1 2

Did the speaker understand and respond to your question in a knowledgeable manner?

Please provide one constructive suggestion for improvement:

Total score: _____