



COLLEGE OF BIOLOGICAL SCIENCE  
Department of Molecular and Cellular Biology

## **Pathogenic Bacteriology MICR\*4010**

Course offered by: Department of Molecular and Cellular Biology

Course coordinator and instructor: Dr. Youai Hao, x58332, SCIE 3516 haoy@uoguelph.ca

Guest Lecturer: Dr. Joseph Lam, x53823, SCIE 4244, jlam@uoguelph.ca

Guest Lecturer: Peggy Pritchard, x54626, LIB Rm 279, ppritcha@uoguelph.ca

Lectures: See schedule below.

Classes will be held in MCKN 227, on Tuesdays and Thursdays from 8:30 – 9:50 am.

### Calendar Description

Interactions between bacterial pathogens and host animals, including immune and inflammatory responses of the host's defense mechanisms. The structural and physiological characteristics of a number of important bacteria causing human and animal diseases are considered.

Prerequisites: (MBG\*2020, MCB\*2210) or MCB\*2050, (MICR\*2020, MICR\*2420), (MICR\*3230 recommended)

This course is aimed at senior students, who will be encouraged to integrate information from previous courses in the study of bacterial pathogenesis.

Required text book: Bacterial Pathogenesis – A Molecular Approach, 3<sup>rd</sup> Edition, by Brenda Wilson, Abigail A. Salyers, Dixie D. Whitt, and Malcolm E. Winkler. (2011) ASM Press, ISBN: 978-1-55581-418-2.

### Methods of Evaluation

One Midterm Exam will be held during the first hour of class on the specified dates (see schedule below), and is worth 20% of the final grade.

*Please ensure you are present for the midterm exams, as there will be no opportunity available to sit the exams at an alternative time.*

There are 2 assignments, one will be a written one (critique on papers related to a particular bacterial pathogen), and the other will be an in-class group presentation project. Each assignment is worth 20% of the final grade.

The due dates for these assignments are given in the schedule.

Please ensure that a printed copy of your work is handed in to the course instructor during class time, or to SCIE 3516 by 5 pm on the due date. Additionally, a pdf file of your first assignment should be sent to the course instructor by 5 pm on the same due date.

*Time extensions will not be allowed; 5% will be deducted from the assignment marks for every day of lateness for up to three days. After 3 days, it will not be accepted.*

In-class participation and understanding will be assessed twice during the semester using Immediate Feedback Assessment Technique (IFAT) cards, as well as the participation during in-class group presentations, either as “presenters” or as “interrogators”.

This assessment will be worth 5% of your final grade.

The date of the final exam will be April 19, 2016 Time: 11:30 am -1:30 pm, location TBA, and will be worth 35% of the final grade.

### Summary of grading scheme

	% of final grade
Midterm 1	20
IFAT cards	5
Assignment 1	20
Assignment 2	20
Final exam	35

**Approach:** The aim of this course is to examine the fundamental aspects of bacterial structure, physiology, genetics and how these factors interact with host systems during infections. Note that the focus is on Bacterial Pathogenesis as suggested by the title of the course and will not be taught like a medical microbiology course by cataloguing bacteria pathogens based on various systems of infections. Hence, the instructors will provide current knowledge on the concepts of virulence and virulence mechanisms of bacteria using specific examples and how these are important to the bacteria for causing an infection.

Through the 1<sup>st</sup> course assignment, each student will be required to obtain and synthesize information about one specific pathogen, and be expected to contribute knowledge about these pathogens to regular class discussions (Note: please avoid using Wikipedia as your sole source of information).

Through the 2<sup>nd</sup> course assignment, students will be asked to form groups of 4-5 in order to discuss the available knowledge concerning 3 specific topics outlined in the Table of Presentations below. Specifically, every 2 groups will focus on searching the literature for up-to-date and relevant information on the topic that their group has picked out from “a hat/box”, then one of the 2 groups will deal with background literature to address the importance and the knowledge gap, while the other group will be focusing on presenting a critique of specific sets of experiments (from several papers to make a cohesive story), with the aim of highlighting the importance of the pathogen, the virulence factor(s), the organization of the genes for certain virulence factor, or the effectiveness of a vaccine, etc. One week before the presentation of the topic that you group has picked, an Abstract (200 words maximum) and a list of the references used must be handed in to the course instructor, who will make these available on the D2L site for the rest of the students in the course. Presenters are expected to prepare a 30 min talk, leaving time for discussions. The non-presenting group on the same topic will become the “Interrogators” to initiate discussions after each seminar presentation. The rest of the students in this class are encouraged to join in on any of the discussions. Also, taking notes during the seminar presentations is highly recommended. In order to stimulate awareness of how bacterial pathogens shape the world around us, students will also be expected to keep abreast of current affairs/”breaking news” during the course period as they relate to bacterial pathogens.

Each group will give a mark on the presenting group (student marks), which will account for 50% of the final marks for assignment 2. The instructor’s mark will account for the next 50% of the mark for assignment 2.

### Learning objectives:

This is an advanced course. Emphasis will be placed on demonstrating the ability to “think, discuss, integrate, and synthesize”. Students are expected to take responsibility for their own learning, and

lectures should be seen as introductory to a given topic. More in-depth reading suggestions, from the textbook, as well as from pertinent and recent scientific papers, will be provided during class time, and for full understanding it is expected that students augment their class-time learning with home study.

Concerning Assignment 1: On the first day of class, each student will draw from a hat (or a box) the names of one pathogenic bacterial species, “a pet pathogen,” which will form the basis of their take-home assignments. During class students will be especially expected to contribute information about their pet pathogens to class discussions. The primary aims of the course are as follows: a) To develop an understanding of the molecular bases for bacterial pathogen-host interactions and some of the approaches and tools used to investigate them. b) To develop critical thoughts, i.e., the ability to take information from the literature, evaluate it, and to draw your own conclusions from it. c) To develop an awareness of the impact of bacterial pathogens on the world around us, and an appreciation for the importance of microbiology as a scientific discipline.

Recommended starting points for researching your "pet pathogen":

<http://guides.lib.uoguelph.ca/MICR4010>

Concerning Assignment 2:

**Learning Outcomes:**

By the end of this course, students will be expected to understand the fundamental components of host-bacterial pathogen interactions, and to apply these concepts to studies of *any* bacterial pathogen with a goal of understanding the likely outcome of infection. Students will also be expected to be proficient in the reading *and understanding* of the primary literature as it pertains to bacterial pathogenesis, with the added ability to critically evaluate experiments and to suggest pertinent future directions for research.

**Presentation:**

Each lecture will address a theme in bacterial-pathogen interactions. In general, human disease will be discussed, although some bacterial infections of agricultural and veterinary importance will also be explored as appropriate. A class schedule is given below. The schedule may be subject to slight change according to the needs of the class and availability of ‘just published’ hot topics in bacterial pathogenesis.

Date	Topic	Assignments/notes
Tuesday Jan. 12	First Day Of Class bits & pieces  An Introduction to the use of Web of Science/PubMed/Google Scholar, and other Literature Search databases (Avoid using Wikipedia)	Hand out: assignment 1 “Bacterial Pathogens!” Pick “a pathogen”
Thursday Jan. 14	Impact of bacterial pathogens, host defences, prevention.	Reviewing Chapters 1-2 Lecturer: Dr. Joseph Lam
Tuesday Jan. 19	Innate immunity	Lecturer: Dr. Joseph Lam Reviewing Chapter 3
Thursday Jan. 21	Interactive workshop on literature search and U of G library services available (note: this class will be held in the	Librarian, Ms Peggy Pritchard, will be the instructor.

	computer lab in the Summerlee Science Complex, room SSC1304)	
Tuesday Jan. 26	An opportunistic pathogen – <i>Pseudomonas aeruginosa</i> , one of the 6 scariest bacterial pathogens, virulence regulation, quorum sensing, biofilm life style, vaccine strategies.	Lecturer: Dr. Youai Hao Chapter 14, and specific additional references will be provided.
Thursday Jan. 28	Special lecture on recent research on the prevalence multi-drug resistance (MDR) in a particular serotype of <i>P. aeruginosa</i>	Lecturer: Dr. Youai Hao  Thrane et al. 2015, mBio 6(5):e01396-15. doi:10.1128/mBio.01396-15.
Tuesday Feb. 2	The Microbiome in Humans – techniques used; Metagenomic data; Are we what we eat?  The normal bacterial microbiota of humans -not all bugs are bad!! Defining virulence/pathogenicity -what makes some bacteria pathogenic?	Chapter 5 – the Normal Human Microbiota  Lecturer: Dr. Youai Hao  <b>In class Open Book Quiz #1 – (IFAT card)</b>
Thursday Feb. 4	Koch’s Postulate – variations of a theme!	Chapter 6 – Microbes and Disease, establishing a connection.  Lecturer: Dr. Youai Hao
Tuesday Feb. 9	Guest lecture on innate immunity and <i>Streptococcus pneumococcal</i> infections and why the aging population is more prone to contract pneumonia.	Guest lecture by Dr. Dawn Bowdish, Associate Professor, McMaster University (Chapter 11)
Thursday Feb. 11	Virulence: Measuring infectivity and virulence - establishing model systems	Chapter 8 <b>Hand out:</b> <b>assignment 2</b> <b>“Important global issues of bacterial pathogenesis”</b>
Feb 15/19	WINTER BREAK “Winter Convocation” –NO CLASSES	
Tuesday Feb. 23	<b>1<sup>st</sup> Midterm – in class</b>	No exceptions or conflicts accepted – i.e., no make up examination
Thursday Feb. 25	Virulence factors I: Invading and Evading mechanisms: Adhesins	Chapter 11  Lecturer: Dr. Youai Hao

	<ul style="list-style-type: none"> <li>-Mechanisms</li> <li>-Tissue tropism</li> <li>-Consequences</li> <li>-Prevention</li> </ul>	
Tuesday Mar. 1	<p>Virulence factors II:  Evading mechanisms -  Biofilms  Capsules / LPS  Avoidance of uptake by phagocytes  Avoidance of killing by phagocytes  Resistance to antibiotics</p>	<p>Chapter 11-12</p> <p>Lecturer: Dr. Youai Hao</p> <p><b>Due date for Assignment 1</b></p>
Thursday Mar. 3	<p>The role of biofilms and OMVs in virulence.</p>	<p>Guest lecturer: Dr. Amber Park</p> <p>References will be provided</p> <p>Remind Group 1 and 2 to send Abstract and reference papers</p>
Tuesday Mar. 8	<p>Virulence factors III:  Toxins  -The world of bacterial toxins</p>	<p>Lecture slides will be posted.</p> <p>Lecturer: Dr. Youai Hao</p>
Thursday Mar. 10	<p>Virulence factor IV:  Secretion Systems / Invasins</p>	<p>chapter 13</p> <p>Lecturer: Dr. Youai Hao</p> <p><b>Open book Quiz #2 - (IFAT card)</b></p>
Tuesday Mar. 15	<p>Presentation Topic – Pneumococcal vaccines  Group 1</p>	<p>Beginning of Assignment #2 Group presentation.</p>
Thursday Mar. 17	<p>Presentation Topic – Pneumococcal vaccines  Group 2</p>	<p>40<sup>th</sup> class day – last day to drop classes</p>
Tuesday Mar. 22	<p>Presentation Topic – Pathogenicity Islands (PAI)  Group 3</p>	
Thursday Mar. 24	<p>Presentation Topic – Pathogenicity Islands (PAI)  Group 4</p>	
Tuesday Mar. 29	<p>Presentation Topic – Antibiotic Resistance – a Global Problem  Group 5</p>	

Thursday Mar. 31	Presentation Topic – Antibiotic Resistance – a Global Problem Group 6	
Tuesday Apr. 5	Bacteria as biological weapons - Why all the hype? - In depth: 3 microbial pathogens that could be used as biological weapons	Lecturer: Dr. Youai Hao
Thursday Apr. 7	Class conclude – discussion on study questions	Lecturer: Dr. Youai Hao
Tuesday Apr. 19, 2016 (11:30 am-1:30 pm)	FINAL EXAM	Room TBA

\* Please note: adaptive immunity will not be covered in any detail since this has been covered elsewhere in a recommended prerequisite (MICR\*3230). Innate immunity will be reviewed since aspects of it are vital for the understanding of the role of impedins. Students who lack an immunology background are encouraged to speak to the course coordinator for advice on background reading.

#### Office hours:

There are no regularly scheduled office hours. Contact course coordinator to make an appointment if required.

#### Academic Integrity Statement:

Students are expected to have read, and understand, what constitutes academic misconduct: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconductoffen.shtml>.

Ignorance of such offences is not an acceptable defense. Students suspected of committing academic misconduct will be reported to the Associate Dean (Academic) of the College of Biological Sciences.

#### Accessibility:

The University of Guelph is committed to creating and maintaining a barrier-free University community and to eliminating discrimination against individuals with disabilities. To help provide the best possible service to students, the University has established an accessibility website at [www.uoguelph.ca/accessibility](http://www.uoguelph.ca/accessibility). This site brings together the services, groups and committees at the University devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. The University welcomes feedback on any accessibility issues at this website.

#### Please note: Policy on Electronic Recording of Classes by Students:

“Electronic recording of classes is expressly forbidden without prior consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.”