# MEDICAL MICROBIOLOGY AND IMMUNOLOGY (M M & I)

#### M M & I 301 – PATHOGENIC BACTERIOLOGY

2 credits.

Medically important bacteria, emphasizing the process of pathogenesis and host/parasite interactions, as well as intervention strategies, immunity and genetics as they apply to the pathogens.

**Requisites:** (BIOCORE 381 and 382), (ZOOLOGY/BIOLOGY 101 and 102), or ZOOLOGY/BIOLOGY/BOTANY 152

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S **Repeatable for Credit:** No

Last Taught: Fall 2022

**Learning Outcomes:** 1. Identify and label parts of a bacterial cell and parts of bacterial genes and other genetic elements, and explain the function of those\\nfeatures to bacterial processes. Audience: Undergraduate

2. Apply bacteriological and immunological concepts to draw conclusions about detection, treatment, and prevention of bacterial infection. Audience: Undergraduate

3. Apply bacteriological and immunological concepts to draw conclusions about bacterial survival, proliferation, and transmission and human\ \nhost responses including those leading to host damage. Audience: Undergraduate

4. Demonstrate knowledge about the significance of historical discoveries in bacteriology and molecular biology. Audience: Undergraduate

5. Demonstrate knowledge about specific bacterial pathogens and the diseases they cause including virulence mechanisms, distinctive \nbacterial and disease characteristics, and methods of disease prevention. Audience: Undergraduate

#### M M & I 341 – IMMUNOLOGY

3 credits.

An introduction to the immune response to infectious disease. Examines the role of the host in host-parasite relationships using select microbial agents or antigens to illustrate the nonspecific and specific mechanisms of host defenses. Includes study of the nonspecific inflammatory response, the nature of microbial antigens, current concepts of antibody and cellmediated immune reactions to infectious agents and the principles underlying the development of vaccines.

**Requisites:** ZOOLOGY/BIOLOGY 101 or ZOOLOGY/BIOLOGY/ BOTANY 151 or BIOCORE 381

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2022

**Learning Outcomes:** 1. Identify the common types of immune cells and describe their main functions Audience: Undergraduate

2. Summarize how innate and adaptive immune cells recognize antigens and other ligands Audience: Undergraduate

3. Differentiate between cell-mediated and humoral immune responses Audience: Undergraduate

4. Understand immunological pathways used to respond to specific challenges (e.g. viruses, bacteria, fungi, parasites) Audience: Undergraduate

#### M M & I/ENTOM/PATH-BIO/ZOOLOGY 350 – PARASITOLOGY 3 credits.

The biology of water-borne, food-borne, soil-borne and vector-borne parasites of animals including humans. Parasites are explored in the context of transmission, associated disease, diagnosis and treatment options, and environmental, cultural and socioeconomic drivers of disease epidemiology.

**Requisites:** ZOOLOGY/BIOLOGY 101 and 102, or ZOOLOGY/BIOLOGY/ BOTANY 152 or ZOOLOGY 153, or BIOCORE 381

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci reg

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S **Repeatable for Credit:** No **Last Taught:** Spring 2024

M M & I/PATH-BIO 528 - IMMUNOLOGY

3 credits.

Development and functions of immune response in animals; a comprehensive study of experimental humoral and cellular immunity. **Requisites:** (CHEM 104 or CHEM 109) and (ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 151 or BIOCORE 383), or graduate/ professional standing **Course Designation:** Level - Intermediate L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No **Last Taught:** Fall 2023

#### M M & I 554 – EMERGING INFECTIOUS DISEASES AND BIOTERRORISM

2 credits.

Identification of analysis and solution of emerging infectious disease problems and the problems of bioterrorism.

**Requisites:** ZOOLOGY/BIOLOGY/BOTANY 152, ZOOLOGY/ BIOLOGY 101, (BIOCORE 383 and M M & I 301), MICROBIO 101, MICROBIO 303, or graduate/professional standing.

### Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No

### Last Taught: Fall 2022

**Learning Outcomes:** 1. Explain the problems due to infectious diseases in the pre-antibiotic era and how this has changed today Audience: Both Grad Undergrad

2. Describe the factors of infectious disease emergence and provide a disease example for each Audience: Both Grad Undergrad

3. Address a new Emerging Infectious Disease outbreak by identifying the problem, the reason this problem arose, and what can be done about it Audience: Graduate

#### M M & I/BIOCHEM 575 – BIOLOGY OF VIRUSES 2 credits.

Broad coverage of animal virology taught at molecular level. Topics include virus structure, viral replication/lifecycle, aspects of pathogenesis and prevention.

**Requisites:** (BIOCORE 381 and 382), ZOOLOGY/BIOLOGY/ BOTANY 151, M M & I 301, or graduate/professional standing **Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

#### **Repeatable for Credit:** No

#### Last Taught: Spring 2024

**Learning Outcomes:** 1. Identify and recognize fundamental members of the predominant families of RNA and DNA viruses that affect animals (humans included) by causing viral diseases, including AIDS, cancer, flu, and COVID-19 Audience: Both Grad Undergrad

2. Describe and demonstrate the basic concepts of virus particle structure and the biochemical mechanisms for entry and multiplication of diverse RNA and DNA viruses Audience: Both Grad Undergrad

3. Recognize and apply the basic principles of virus transmission and viral pathogenicity, combined with the factors that contribute to virus emergence and evolution, to situations involving virus outbreaks that affect global health Audience: Both Grad Undergrad

4. Identify and evaluate individual steps in a virus' replication cycle that can be effectively targeted by anti-viral drugs for pharmaceutical intervention of virus diseases Audience: Both Grad Undergrad

5. Design effective strategies for a) prevention of infection through development of viral vaccines and b) treatment of diverse human diseases by gene therapy through the design and administration of genetically engineered virus vectors Audience: Both Grad Undergrad

6. Use knowledge gained in lecture to critically assess primary literature and data presented in the weekly Molecular Virology Seminar Series Audience: Graduate

# M M & I/ONCOLOGY/PL PATH 640 – GENERAL VIROLOGY-MULTIPLICATION OF VIRUSES

3 credits.

The structure, multiplication, genetics, pathology and control of animal and plant viruses.

**Requisites:** (GENETICS 466 or 467) and (BIOCHEM 501 or 508) or graduate/professional standing

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No

Last Taught: Fall 2023

#### M M & I/BOTANY/GENETICS/PL PATH 655 – BIOLOGY AND GENETICS OF FUNGI

3 credits.

Fungal genetics, genomics, and physiology using plant pathogenic fungi and the genetic models Aspergillus nidulans and Neurospora crassa as model systems to explore the current knowledge of fungal genetics and plant/fungal interactions.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No

Last Taught: Fall 2022

#### M M & I 677 – ADVANCED TOPICS IN MEDICAL MICROBIOLOGY 1-3 credits.

Specialized topics of current interest in medical microbiology. **Requisites:** Graduate/professional standing

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** Yes, unlimited number of completions **Last Taught:** Fall 2023

**Learning Outcomes:** 1. Identify and describe key theories, concepts, and methods in medical microbiology and immunology Audience: Both Grad Undergrad

2. Apply, analyze, or evaluate advanced theories, concepts, or methods in medical microbiology and immunology Audience: Graduate

## M M & I 691 – FIRST SEMESTER SENIOR THESIS

3 credits.

First semester independent study with the goal to do the preliminary research to write a senior thesis in Medical Microbiology Immunology. **Requisites:** Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S **Repeatable for Credit:** No

Last Taught: Fall 2020

**Learning Outcomes:** 1. Identify a novel research question from the primary literature Audience: Undergraduate

2. Develop a testable hypothesis around the novel research question Audience: Undergraduate

3. Design experiments to test the hypothesis Audience: Undergraduate

# M M & I 692 - SECOND SEMESTER SENIOR THESIS

3 credits.

Second semester independent study with the goal to complete a senior thesis in Medical Microbiology Immunology. **Requisites:** Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2021

**Learning Outcomes:** 1. Execute and analyze data from designed experiments Audience: Undergraduate

2. Develop the next testable hypothesis from the primary data from the experiments Audience: Undergraduate

3. Write an honors thesis describing the gap in knowledge, the hypothesis addressing the gap in knowledge and the results of the experiments designed to test the hypothesis Audience: Undergraduate

#### M M & I 696 – CRITICAL THINKING IN MEDICAL MICROBIOLOGY AND IMMUNIOLOGY

3 credits.

Present assigned research papers from journals for critical evaluation. Write critiques of each paper evaluating the paper's introduction, methods, results, and discussion sections.

Requisites: M M & I 301 and 341

**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No

## Last Taught: Fall 2022

**Learning Outcomes:** 1. Articulate next-generation, DNA and RNA sequencing approaches and critically review their use in immune system studies Audience: Both Grad Undergrad

2. Describe proteomic techniques and their immune applications Audience: Both Grad Undergrad

3. Interpret the use of metabolomics in immunometabolism research Audience: Both Grad Undergrad

4. Explain technological advances that allow us to analyze complex immune systems at the single-cell level Audience: Both Grad Undergrad

5. Design omics experiments for immunology research Audience: Graduate

#### M M & I 699 - DIRECTED STUDY

1-3 credits.

Independent research in medical microbiology and immunology for undergraduates under the supervision of MMI faculty. Carry out literature reviews and laboratory bench work on an independent project; participate in laboratory meetings; and produce some written presentation of the work, usually in the form of a poster presentation at a local or national meeting.

#### **Requisites:** Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** Yes, unlimited number of completions **Last Taught:** Spring 2024

**Learning Outcomes:** 1. Apply concepts learned in coursework to real life situations Audience: Both Grad Undergrad

2. Read and effectively search scientific literature Audience: Both Grad Undergrad

3. Develop critical, analytical, and independent thinking skills Audience: Both Grad Undergrad

4. Develop independent scientific research development skills Audience: Graduate

#### M M & I 704 – INFECTIOUS DISEASES OF HUMAN BEINGS 3 credits.

Pathogenesis, clinical descriptions, and prevention. **Requisites:** Consent of instructor

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

#### Last Taught: Fall 2023

**Learning Outcomes:** 1. Describe the epidemiology, pathogenesis, and clinical presentation of the key infectious disease syndromes presented and relate these diseases with their causative agents Audience: Graduate

2. Explain how key infectious diseases are diagnosed and treated Audience: Graduate

3. Explain how key infectious diseases impact patient health and public health, and describe how they can be prevented Audience: Graduate

4. Discuss the basic pharmacologic concepts of antimicrobial drug therapy and be able to apply these concepts in clinical infectious disease settings Audience: Graduate

5. Explain the role of the clinical microbiology laboratory in the identification and treatment of infectious diseases Audience: Graduate

# M M & I/PATH-BIO 720 – ADVANCED IMMUNOLOGY: CRITICAL THINKING

3 credits.

Advanced focus on current questions in immunological research. Explores immunology topics including genetic, cellular, and molecular features of immune system fundamental to regulation of immune responses. **Requisites:** PATH-BIO/M M & I 528 and graduate/professional standing **Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No

Last Taught: Fall 2016

M M & I 740 – MECHANISMS OF MICROBIAL PATHOGENESIS 3 credits.

Host-pathogen relationships in microbial diseases. **Requisites:** Consent of instructor **Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** No **Last Taught:** Fall 2023 Learning Outcomercial Demonstrate understanding of the funder

**Learning Outcomes:** 1. Demonstrate understanding of the fundamentals of conserved strategies for bacterial pathogenesis across human, animal and plan pathogens Audience: Graduate

2. Be able to critically read and review primary research literature in bacterial pathogenesis Audience: Graduate

3. Develop grant writing skills Audience: Graduate

4. Demonstrate understanding of how NIH grant review and study sections work and be able to critically review peer grants Audience: Graduate

#### M M & I/PATH-BIO 750 – HOST-PARASITE RELATIONSHIPS IN VERTEBRATE VIRAL DISEASE 3 credits

3 credits

Detailed study of the pathogenesis of vertebrate viral disease, stressing viral invasion, dissemination, mechanisms of disease production and resistance, and transmission.

**Requisites:** (PL PATH/M M & I/ONCOLOGY 640 or PATH-BIO 513), PATH-BIO/M M & I 528, and graduate/professional standing **Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

**Learning Outcomes:** 1. Demonstrate understanding of mechanisms involved in pathogenesis of viral infections Audience: Graduate

2. Obtain experience in critically reading scientific research Audience: Graduate

3. Enhance scientific presentation skills Audience: Graduate

4. Design and prepare funding applications for research projects in viral pathogenesis Audience: Graduate

#### M M & I 760 – QUANTITATIVE SYSTEMS BIOLOGY AND DISEASE 3 credits.

An overview of methods used in quantitative systems biology, with a focus on biochemical systems relevant to the study of host-pathogen interactions, disease and microbial communities.

Requisites: Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

#### **Repeatable for Credit:** No

**Learning Outcomes:** 1. Recognize biochemical systems and pathways relevant to the study of host-pathogen interactions, disease, and microbes and microbial communities. Audience: Graduate

2. Develop mathematical models of biochemical systems by integrating basic mathematical and engineering concepts with principals from biochemistry, cellular and molecular biology, and immunology. Audience: Graduate

3. Translate molecular pathways relevant to immunity and disease into computational models and simulations. Audience: Graduate

4. Gain a working knowledge of resources and databases available for systems biology modeling and simulation. Audience: Graduate

5. Use programming tools (e.g., MATLAB, Python) to implement and test a systems biology model. Audience: Graduate

#### M M & I 901 – SEMINAR

1 credit.

Seminar series led by MMI faculty members. **Requisites:** Graduate/professional standing **Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement **Repeatable for Credit:** Yes, unlimited number of completions **Last Taught:** Spring 2024 **Learning Outcomes:** 1. Gain overall breadth of knowledge in microbiology Audience: Graduate

2. Provide a platform for student interaction with invited faculty from UW-Madison and other institutions Audience: Graduate

3. Develop skills for communicating complex ideas in a clear and understandable manner Audience: Graduate

# M M & I 902 – THE ROLE OF THE HUMAN MICROBIOME IN HEALTH AND DISEASE

2 credits.

The human microbiome can profoundly influence the balance between health and disease. Advances in next-generation sequencing technology and bioinformatics enabled the detailed study of the trillions of microorganisms living in us and on us and their associations with both healthy and disease conditions. Current state of the art approaches to study the microbiome through examples of human diseases with a known microbiome component. Critically assess the microbiome literature and design clinical studies aiming to include the microbiome as a variable. Bioinformatics tools required to study complex microbial communities by reproducing published datasets from human patients and learn ecological concepts to interpret results in a clinically meaningful way.

**Requisites:** MED SC-M 810, 811, 812, and 813

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

#### **Repeatable for Credit:** No

Last Taught: Spring 2024

**Learning Outcomes:** 1. Demonstrate a clear understanding of the current literature regarding the human microbiome and its role in health. Audience: Graduate

2. Compare and contrast current state-of-the art methodologies to study the human microbiome and further demonstrate the ability to apply this knowledge to critically assess clinical study outcomes involving microbiome data. Audience: Graduate

3. Describe and explain how basic bioinformatic pipelines are used to analyze and interpret microbiome data. Audience: Graduate

4. Apply learned ecological concepts to the analysis of a real human microbiome dataset generated by researchers at the UW-Madison. Audience: Graduate

5. Design a human microbiome study, clearly defining possible endpoints and inherent limitations. Audience: Graduate

# M M & I 911 – MICROBIOLOGY DIAGNOSTICS IN PUBLIC HEALTH 2 credits.

Learn firsthand how a public health lab handles testing. Learn about the different areas of testing in the lab from the experts and how we work with the CDC and clinical labs for surveillance, diagnostics, and outbreak response. Useful training for diagnostic testing and those that will order these tests in their practice.

Requisites: MED SC-M 810, 811, 812, and 813

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

**Learning Outcomes:** 1. Describe the different testing areas of the Communicable Disease Division at the Wisconsin State Laboratory of Hygiene (WSLH). Audience: Graduate

2. Describe the basics of common diagnostic test methods like PCR, sequencing, culture, and serology. Interpret test results and understand the limitations of those tests. Audience: Graduate

3. Describe how the WSLH works with epidemiologists to identify outbreaks of disease. Audience: Graduate

4. Describe how the WSLH works between clinical labs and the CDC for public health. Audience: Graduate

### M M & I/BIOCHEM/BMOLCHEM 914 – SEMINAR-MOLECULAR BIOSCIENCES (ADVANCED)

1 credit.

During the fall semester, molecular biosciences trainees who have not achieved dissertator status will present seminars based primarily on literature related to their projects. During the spring semester, molecular biosciences trainees with dissertator status will present seminars based upon their own research.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions **Last Taught:** Fall 2020

**Learning Outcomes:** 1. Identify and summarize key aspects of scientific rigor and reproducibility, including determination of sample size, statistical significance, measures of outliers, and experimental replicates Audience: Graduate

2. Describe the features of high quality presentations and best practices in scientific data/information interpretation Audience: Graduate

3. Apply and demonstrate best practices in the effective presentation of complex data/information to diverse scientific audiences Audience: Graduate

# M M & I 990 - RESEARCH AND THESIS

1-12 credits.

Carry out an independent research project that represents novel science in the chosen area under the guidance of an MMI faculty member. Evidence of success is measured by publication of results as first-authored papers in peer-reviewed papers.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions **Last Taught:** Spring 2024

**Learning Outcomes:** 1. Exhibit a broad understanding of general medical microbiology and/or immunology principles Audience: Graduate

2. Conduct independent research using a variety of approaches Audience: Graduate

3. Think critically to address research challenges Audience: Graduate

4. Exhibit and foster professional and ethical conduct in research Audience: Graduate

5. Collaborate with other investigators within or outside the thesis lab Audience: Graduate