MICROBIOLOGY, IMMUNOLOGY AND PATHOLOGY
COLORADO STATE UNIVERSITY

Graduate Curriculum: MS-A and PhD Programs

MS-A & PhD Credit Requirements

MS-A	PhD
30 credits total	72 credits total
24 credits at CSU	24 credits at CSU (30 credits can be applied from MS or DVM degree)
16 credits must be 500+	21 credits must be 500+ (beyond MS/DVM if applicable)
12 credits must be regular courses*	16 credits must be regular courses*
Of the total regular courses, 9 credits must be regular courses* with MIP prefix	Of the total regular courses, 13 credits must be regular courses* with MIP prefix
2 credits must be MIP700	4 credits must be MIP700

*Regular course work is defined as courses other than topics (MIP700 or MIP796), or any course above X82 including: seminars (MIP792), independent or group studies (MIP795 or MIP796), research credits (MIP698/MIP798), thesis/dissertation credits (MIP699/MIP799), and supervised college teaching (MIP784).

Required Courses

Course Number and Title	*Offered*	*Credits*
MIP700 -Topics in Microbiology, Immunology and Pathology	Fall and Spring	1

Discussion of research literature in core areas, a new topic every semester.
Must be taken once every year.

MIP792A - Graduate Student Seminar	Fall and Spring	1

Students present their research in this weekly seminar.
Must be taken every semester and present every other year.

MIP554 - Research Policies and Regulations	Fall	1

Research policies and regulations will be reviewed in the context of ethics theories and practical solutions will be discussed for realistic case studies on issues in the research environment. This course has a focus on Responsible Conduct of Research (RCR) and meets federal standards for providing trainees with formal ethics training. Face-to-face RCR training is required for trainees as part of their formal or informal training experience. CSU requires that all trainees (postdoctoral fellows, graduate students) funded by the NIH, NSF, USDA NIFA take an approved face-to-face training course.

General Electives

MIP470 -Graduate Fellowship Proposal Preparation	Fall	1

Guidance for the process of preparing a proposal for submission to the National Science Foundation -GRFP.

MIP540 -Biosafety in Research Laboratories Spring 2

Practical applications of biosafety principles, including lab practices and regulatory aspects of research involving infectious microorganisms and rDNA.

MIP544 -Reproducible Biomedical Research Methods Fall 3

Provides training in best practices for early-stage graduate students using a variety of cell and molecular biology approaches as examples.
Credit allowed for only one of the following: CM 544, CM 581A3, MIP 544, or MIP 611.

MIP580A8 -Professional & Career Development: Grad School Fall 1

A modular course that teaches the basics about rotations, committee selection, program requirements, and other skills for success geared towards first- and second-year students.

MIP580A9 -Professional & Career Development: Presentations... Fall 1

A modular course teaches the three Ps: presentations, publishing logistics, and preliminary exams.

MIP580B5 -Professional & Career Development: Career Skills Fall 1

A modular course that develops skills for employment opportunities by exploring different career fields while gaining an in-depth perspective of the business of scientific research.

MIP643 -Grant Writing for Microbiology/Pathology Spring 1

The ability to effectively communicate scientific ideas, project goals and experimental approaches is vital for graduate students (and all scientists). To assist in developing these skills, students will receive a series of formal lectures/discussions on how to prepare an effective grant proposal. Students will create a full NIH-R21 format research proposal based on their own research project.

MIP666 -Writing Scientific Manuscripts Fall 3

Language is the key to publication, to funded grants, and to long and productive careers in science. As a practicing scientist, ninety, perhaps ninety-nine, percent of those who will come to know you, will come to know you only through your written words –your manuscripts, your grant applications, your reviews, and your abstracts. If the words you write cannot carry the force of your science, you might as well not bother. Science without the words is not truly science at all.

MIP710 –Research Teams Mentoring Spring 1

This course teaches graduate students pursuing research-based master's or PhD degrees and postdoctoral fellows pursuing original research skills and techniques to effectively mentor in a research laboratory setting.

Virology Electives

MIP533 -Epidemiology of Infectious Disease Spring 3

The epidemiologic bases of infectious and zoonotic diseases have a major impact on community health. The course will focus principally on zoonotic, emerging, and vector-borne diseases that are recognized on a national or global level. Instructors will be drawn from CSU as well as from CDC and USDA laboratories in the Fort Collins area to provide students with cutting edge theoretical as well as "real world" practical insight into the epidemiology of these diseases.

MIP537A -Advanced Virology I - Fundamentals/New Insights Spring even years 1

The study of virology at the molecular and cellular level has been fundamental to our knowledge of structural biology, mechanisms of nucleic acid and protein biosynthesis, regulation of gene expression, and the host-pathogen molecular arms race. These will be topics of the lectures. Emphasis in the course will be on vertebrate animal viruses (insect viruses will be covered in later modules).

MIP537B -Advanced Virology II- Mechanisms of Viral Disease Spring even years 1

This course will focus on the mechanisms by which viruses cause disease. Students should have an understanding of virus structure/replication, entry, spread, and viral evolution from Module I (or similar coursework) to lay the groundwork for subsequent presentations on particular mechanisms of disease and systemic effects of viral infection. Particular emphasis will be placed on current knowledge and unifying concepts regarding virus interactions with the host at the molecular, cellular, and whole animal levels.

MIP537C -Advanced Virology III -Discovery Tools & Control Spring even years 1

This course will focus on the mechanisms by which viruses cause disease. Students should have an understanding of virus structure/replication, entry, spread, viral evolution and immunopathogenesis from Advanced Virology I and II (or similar coursework) to lay the groundwork for subsequent presentations on particular mechanisms of disease and systemic effects of viral infection. This course will focus on arthropod-borne viruses including alphaviruses, flavivirues and bunyaviruses and mechanisms of disease in the vertebrate host. It will address mosquito biology, innate immunity in the mosquito vector and emerging technologies for discovery and control

Bacteriology Electives

MIP550 -Microbial and Molecular Genetics Laboratory Spring 4

This course is an introduction to various *in vivo* genetic and *in vitro* molecular techniques used in prokaryotic gene analysis and studying gene regulation. Genetic and molecular techniques will be performed in class by the students using instructor-derived protocols.

MIP573A -Bacterial Pathogenesis: Introduction and Mechanisms Spring odd years 1

The first module in a series of three modules designed to conceptualize and integrate the complex cellular and molecular processes that occur when bacteria infect a host and cause disease. Classic and contemporary examples will be used to provide introductory concepts for a broad range of pathogens to define diverse mechanisms of pathogenesis in molecular and genetic terms.

MIP573B -Bacterial Pathogenesis: Mechanisms & Lifestyle Spring odd years 1

The second module in a series of three modules designed to conceptualize and integrate the complex cellular and molecular processes that occur when bacteria infect the host and cause disease. This module will further explore bacterial strategies of survival in the host in the context of diverse pathogens

MIP573C -Bacterial Pathogenesis: Evading Host Defenses Spring odd years 1

The third module in a series of three modules designed to conceptualize and integrate the complex cellular and molecular processes that occur when bacteria infect the host and cause disease. This module will further explore bacterial strategies of survival in the host in the context of obtaining nutrition from the host and avoiding the innate immune response.

MIP681A5 -Introduction to Advanced Microbial Physiology Fall even years 1

This course provides a condensed series of topics to establish a foundation in the biochemistry and physiology of microbes, and the background required to pursue the more in-depth and literature-based materials of subsequent modules. Topics include the structure/function of the prokaryotic cell, bioenergetics, central and intermediary metabolism, membrane function, macromolecule biogenesis, and regulation of physiology/metabolism.

MIP681A6 -Advanced Microbial Physiology Experimentation Fall even years 1

This course addresses state-of-the-art experimentation techniques and emerging concepts in the study of bacterial physiology and metabolism.

MIP681A7 -Microbial Physiology –Translational Discover Fall even years 1

This course will explore how the metabolism and physiology of bacteria can be exploited for drug discovery, diagnostic development and tools important for biotechnology. Subject material addresses both historical and state-of-the-art concepts in translational discovery.

Vector Biology Electives

MIP535 -Mosquito Collection and Identification Methods Fall odd years 1

The purpose of this course is to provide students with a comprehensive foundational training in the morphological identification of one group of medically-important arthropods: mosquitoes. Using a teaching collection as reference material, students will learn the basic morphology of insects and how to use a dichotomous key for identification. Students will participate in field trips during the first few weeks of the semester to collect adult and larval mosquitoes, which they will then properly mount, label, and identify to turn for a grade at the conclusion of the 8 weeks. Molecular techniques to identify cryptic species will also be introduced.

MIP567 -Introduction to Biology of Disease Vectors Spring even years 1

This course will introduce students to the basic knowledge in vector biology, epidemiology, physiology, genetics, genomics, vector/pathogen/host interactions, and old and new strategies in vector control and control of vector-borne diseases.

MIP568 -Biology of Arbovirus Vectors/Genetics Spring even years 1

This course will provide advanced knowledge of vector biology associated with arbovirus transmission, epidemiology, vector/arbovirus/host interactions, and diseases. It will also integrate concepts of vector genetic manipulation techniques and genetic control strategies into this knowledge base

MIP569 -Biology of Parasite/Bacteria Vectors Spring even years 1

This course provides advanced knowledge in vector biology, epidemiology, physiology, genetics vector/pathogen/host interactions pertaining specifically to vectors of eukaryotic and bacterial pathogens.

Molecular and Genomic Approaches Electives

MIP543 -RNA Biology Fall odd years 3

From microbes to mammals, understanding the fundamentals of molecular biology is required for a student's mastery of their biology. Training in the area of RNA biology, therefore, is fundamental for the well-rounded student in the life sciences. This course will provide graduate students and advanced undergraduates with an in-depth, cutting edge exposure to the subject of RNA biology/post-transcriptional control.

MIP545 -Microbial Metagenomics/Genomics Data Analysis Fall 2

Microbiomes, microbes and their genetic material present in a host/environment, are linked to risk to disease in humans, animals and plants. Metagenomics, including 16S rRNA community survey methods and shotgun metagenomics, use high throughput sequencing technology to provide insight towards composition and potential function of microbiomes. This course provides hands on experience in using bioinformatics and statistical tools necessary to process and analyze the resulting large datasets.

MIP565 -Next Generation Sequencing Platform/Libraries Fall 1

This course is designed to give comprehensive training in the design and execution of next generation sequencing experiments. Some wet-lab experience and basic understanding of nucleic acids is required, but students from non-life science disciplines are welcome

MIP570 -Functional Genomics Fall 3

Genome sequences continue to be completed on a regular basis, and numerous bioinformatics, genomic and proteomic tools rapidly reveal a wealth of information contained in these genomes. This course combines lectures and laboratory exercises to cover state-of-the-art functional genomic tools at the advanced undergraduate and beginning graduate levels. Topics include web-based bioinformatics tools; gene and homology searches; whole genome comparisons; principles of DNA microarrays; principles of proteomics; applications and visualization of next generation sequencing*; in vivo* technologies for assessing gene expression.

Immunology Electives

MIP525 -Flow Cytometry for Immunology Fall 1

This course provides students with the basic tools to understand and interpret flow cytometry principles. Additionally it covers background of flow cytometry, experimental design and applications, and briefly explains cell sorting.

MIP651 -Immunobiology Fall 3

This course will examine what is known and/or thought about how humoral and cellular components of the host's immune system interact in multiple ways with "non-self" environmental contacts to cause a variety of immune responses and diseases.

MIP730 -Principles of Flow Cytometry and Cell Sorting Spring 1

This course explores the background of flow cytometry, fluorescent molecules, experimental design, Flow Cytometry data Analysis, applications, and principles of cell sorting.

MIP542 -Pillars of Immunology Fall odd years 1

This course will explore the fundamental discoveries in immunology through review of pillar publications that shape our current understanding of modern immunology.

MIP680A4 -Fundamentals of Infectious Disease Immunity Spring odd years 1

This course will introduce students who are researching or interested in immune responses to infectious agents to the basic knowledge in host/pathogen interactions, activation and escalation of the immune response during infections, innate and adaptive immune mechanisms, and vaccine development and production.

MIP680A5 –Immunity to Viruses Spring odd years 1

This course will introduce graduate students and advanced undergraduate students who are researching or interested in immune responses to viruses, how viruses evade the host response and cause disease, and how the immune response can contribute to pathology.

MIP680A6 -Immunity to Bacteria and Parasites Spring odd years 1

This course will introduce students who are researching or interested in immune responses to bacteria and parasites, and how these pathogens evade the immune response.

Prion Biology Electives

MIP520 -Fundamentals of Prion Biology Fall 1

This course provides a broad overview of prion biology. Students will understand the current state of prion research, future research directions, and the relationship of prion disease with other disease systems. The course will encourage critical reading and synthesis of the literature, with an emphasis on writing skills.

MIP620 -Advanced Prion Biology Spring 1

This course builds upon and advances concepts introduced in MIP 520 Fundamentals of Prion Biology. Students will understand the current state of prion research, future research directions, and the relationship of prion disease with other disease systems. The course will develop comprehension and analytic skills through critical reading of primary research articles and synthesis of the interpretations, impact and future directions of current research, with an emphasis on writing skills

Pathology Electives

MIP675 -Advanced Bioanalytic Pathology Spring odd years 2

Students will learn basic concepts needed to interpret clinical laboratory data from domestic small animals. This course is typically taken by students in the DVM program.

MIP766 -Cytopathology Spring 1

This one credit course will focus on improving a student's basic cytology skills. Cases submitted to Clinical Pathology by the Veterinary Teaching Hospital will be reviewed on a weekly basis. Students who have completed the Clinical Pathology section of Junior Practicum (VM786), veterinary interns, and veterinary residents will be eligible to take the course.

MIP767 -Advanced General Pathology Fall 1

Detailed study of general pathology and associated disease, directed towards first and second year graduate and post-professional students. This course serves, in part, as preparation for ACVP board exams.

MIP768 -Advanced Clinical Pathology Spring 1

Detailed study of clinical pathology (cytology, hematology, and biochemistry) for post-professional students in CVMBS residency and/or graduate degree granting programs. This course serves, in part, as preparation for ACVP board exams.

MIP778 -Pathobiology of Laboratory Animals Fall odd years 3

Laboratory Animal pathology is a subspecialty of veterinary pathology focusing on diagnosis and characterization of naturally-occurring and induced diseases in animal models for human disease. MIP778 is the primary post-graduate didactic exposure to pathobiology of laboratory animals offered at CSU. This course will provide an overview of unique biology, spontaneous and induced diseases, and animal model use in the most common laboratory animal species. Clinical, diagnostic, and pathologic features of diseases will be emphasized.

MIP779 -Laboratory Animal Pathology Rotation Spring even years 1

Using case material compiled from submissions to the Laboratory Animal Resources necropsy service, the VTH Diagnostic services, the Armed Forces Institute of Pathology, and other resources, students will analyze selected slides demonstrating histologic pathology in laboratory animals and provide a diagnosis and a brief summary of the pathogenesis.

Courses offered by other CSU Departments

BC563 -Molecular Genetics Fall 4

Mechanisms of replication, transcription, processing, translation, and packaging of genetic material, emphasizing original literature and methods.

BC565 -Molecular Regulation of Cell Function Spring 4

Molecular regulation of cell organization, membrane formation, organelle biogenesis, cell communication, shape and motility, growth, aging, and death.

BC663 -Gene Expression Spring 2

Eukaryotic transcription mechanisms with emphasis on methods of study and regulatory mechanisms.

BIOM525 -Cell and Tissue Engineering | Spring even years | 3

Cell and tissue engineering concepts and techniques with emphasis on cellular response, cell adhesion kinetics, and tissue engineering design.

BMS500 -Mammalian Physiology I | Fall | 4

Cell physiology of nerve, skeletal, cardiac and smooth muscle with an emphasis on how cellular functions integrate into systems behavior.

BMS501 -Mammalian Physiology II | Spring | 4

Respiratory, renal, digestive, endocrine, metabolic, and reproductive function.

ERHS510 -Cancer Biology | Spring | 3

Cancer biology, from epidemiology and classification, through the molecular basis of the phenotypes to detection and treatment.

ERHS611 -Cancer Genetics | Fall | 2

Role of genetic background in determining individual susceptibility to cancer.

GRAD544 -Ethical Conduct in Research | Fall and Spring | 1

Principles and practice of ethical conduct of research.

GRAD550 -STEM Communication | Fall and Spring | 1

Review and practice of key communication principles for Science, Technology, Engineering, and Mathematics (STEM) professionals.

NSCI575/GRAD575 -Ethical Issues with Big Data | Fall | 1

Examines big data research through an applied interdisciplinary approach to ethical issues surrounding collection, use, reporting, and preservation of big data. Incorporates a wide range of transferable skills training, so students are well equipped to engage and lead data-centric research within or outside academia.

DSCI510 -Linux as a Computational Platform | Fall | 1

Use of the Linux operating system for computational work using command-line tools; basic Linux commands, running and managing jobs, installing software.

DSCI511 -Genomics Data Analysis in Python | Fall | 2

Analyzing complex data sets using Python.

DSCI512 -RNA-Seq Data Analysis | Fall | 1

Hands-on experience with tools for analysis of next generation sequencing data.

STAR511 -Design and Data Analysis for Researchers I | Fall | 4

Statistical methods for experimenters/researchers emphasizing design and analysis of experiments using R software.

STAR512 -Design and Data Analysis for Researchers II | Spring | 4

Statistical methods for experimenters and researchers emphasizing design and analysis of experiments.

STAT544 -Biostatistical Methods for Quantitative Data | Spring | 3

Regression and analysis of variance methods applied to both observational studies and designed experiments in the biological sciences.

VS562 -Applied Data Analysis | Spring | 3

Data management, application and interpretation of statistical analysis, and reporting of results for students in health science fields.

More curriculum details and MIP course syllabi are available by request from cvmbs-mip_microbio@mail.colostate.edu