

Molecular, Cellular and Integrative Physiology Master's Program Requirements

Course Requirements

Lecture Classes

- PSL 829: Cellular and Integrative Physiology II (Fall, hybrid format, 3 credits)
- PSL 828: Cellular and Integrative Physiology (Spring, in-person, 3 credits)
- PSL 813: Molecular Mechanism of Human Disease and Targeted Therapies (every other Fall, 3 credits)
- Elective Credits (4-11) approved by Physiology Graduate Director, in consultation with mentor
Note: these courses should be selected by the student to support their specific research/training interests. The thesis mentor and guidance committee may also suggest elective courses to develop knowledge and skills relevant to the dissertation research topic.

Seminar Classes:

- PSL 950: Topics in Physiology. Two PSL 950 courses to be taken at any time during the MS program.

PSL 950 courses are 1 credit each, topics vary by semester and are typically held in-person. Other 800-level seminar courses can be substituted for up to 2 cr of the requirement, per approval of MCIP Grad Program Director. The PSL 950 course courses must come from different topics (e.g. you cannot repeat the same topic course twice for credit).

Teaching Requirement

- None

Other Requirements

- Graduate School Responsible and Ethical Conduct of Research (RECR) Seminar Series and refresher every year

Encouraged Activities to Develop your Skill in Scientific Research and Communication

- Participation in Physiology Research Forum
- Participation in Department of Physiology Seminars
- Participation in the Annual Physiology Department Retreat

Master's Thesis Research Credits (PSL 899): 8-15 credits

- Years 1-2: Recommend registering for 3 credits every fall and spring semester or as many as needed to bring total up the semester credit minimum.
- Years 3+ (if needed): Must register each fall and spring semester for at least the MS credit minimum and can use PSL 899 credits during these semesters to fulfil it.

Total Credit Requirement = 30 credits minimum

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Envisioned Timeline for MCIP Master's (MS) Program

Year	Fall	Spring
1	PSL 829: Cellular and Integrative Phys II PSL 813: Molecular Mechanisms of Human Disease (if offered, fall of odd years) or Elective PSL 899: Thesis Research <i>(Recommend 3 credits or as many needed to bring total up to semester credit minimum)</i> Guidance Committee Selection	PSL 828: Cellular and Integrative Phys I PSL 899: Thesis Research <i>(Recommend 3 credits or as many needed to bring total up to semester credit minimum)</i> PSL 950: Topics in Physiology First Guidance Committee Meeting
2	PSL 813: Molecular Mechanisms of Human Disease (if offered, fall of odd years) or Elective PSL 950: Topics in Physiology PSL 899: Thesis Research <i>(Recommend 3 credits or as many needed to bring total up to semester credit minimum)</i>	PSL 899: Thesis Research <i>(Recommend 3 credits or as many needed to bring total up to semester credit minimum)</i> Defend Master's Thesis
Notes: <ul style="list-style-type: none"> Electives can be taken in any semester, depending on course availability Can continue beyond 3 year if needed, but must be Registered each fall and spring semester for at least the MS credit minimum, and can use PSL 899 credits during these semesters to fulfil it. Defense can be in the summer semester; if so, you must enroll in the minimum number credits to be considered a full time student during the summer semester. Consult MCIP leaders for specific guidance. Defense must occur within 6 years from entry into the Master's program 		

Enrollment Minimums to be Considered Full Time:

- If NOT on an Assistantship: need to be registered for **9** total credits each fall and spring
- If on an Assistantship: need to be registered for **6** total credits each fall and spring (9 maximum)
- Summer: Do not need to register for credits *unless* taking a summer course or defending in summer

Note: MS Students must complete 30 total credits to be eligible for degree

More information can be found at: <https://physiology.natsci.msu.edu/academics/graduate/molecular-cellular-and-integrative-physiology-graduate-handbook/>

Sample Electives for Molecular, Cellular and Integrative Physiology

4-11 elective credits are required for the MCIP Master's program.

The purpose of elective courses is to support the student's specific research training career interests. Students are therefore recommended to confer with their thesis mentor, guidance committee, and/or the MCIP Graduate Program Director to identify relevant elective courses to facilitate their training goals.

Below is a list of elective course suggestions, but students are not confined to these topics or specific choices.

Animal Science

ANS 901: Visualization of Scientific Data (Fall, 1 credit)

Biochemistry and Molecular Biology

BMB 801: Molecular Biology (Fall, 3 credits)

BMB 802: Metabolic Regulation and Signal Transduction (Spring, 3 credits)

BMB 805: Protein Structure, Design, and Mechanism (Spring, 3 credits)

BMB 825: Cell Structure and Function (Spring, 3 credits)

BMB 829: Special Problems in Macromolecular Analysis and Synthesis (Fall, *Must take 301 + any others*)

- Module 301: Introduction to Methods in Biochemistry and Molecular Biology (1 credit)
- Module 302: Recombinant DNA and Genome Editing (1 credit)
- Module 303: Discovery and Analysis of Molecular Interactions (1 credit)
- Module 304: Separation and Analysis of Cells and Molecules (1 credit)
- Module 305: Molecular Structure Elucidation and Analysis (1 credit)

Cell and Molecular Biology

CMB 855: Advanced Mammalian Genetics (Fall, 1 credit)

Computational Mathematics, Science and Engineering

CMSE 890: Bioinformatics (*Offered in 1 credit modules. Complete 3 modules to fulfill one elective*)

- Module 301: Programming Foundations for Bioinformatics (1 credit)
- Module 302: Statistical Analysis and Visualization of Biological Data (1 credit)
- Module 303: Data Handling: Unix and Python (1 credit)
- Module 304: Intro to Genomics (1 credit)
- Module 305: Transcriptomic Data Analysis (1 credit)
- Module 310: Gaps, Errors and Missteps in Statistical Data Analysis (1 credit)

Microbiology, Genetics, and Immunology

MGI 852-854: Immunology (Fall odd years, three consecutive 1 credit modules)

MGI 835: Eukaryotic Molecular Genetics (Spring, 3 credits)

Microscopy

NSC 837: Confocal Microscopy (Fall and Spring, 3 credits)

Neuroscience

NEU 801: Molecular, Cellular and Developmental Neuroscience I (Fall, 3 credits)

NEU 802: Systems and Behavioral Neuroscience I (Fall, 3 credits)

NEU 803: Molecular, Cellular and Developmental Neuroscience II (Spring, 3 credits)

NEU 805: Systems and Behavioral Neuroscience II (Spring, 3 credits)

Pathology & Diagnostic Investigation

PDI: 851: Advanced General Pathology (Fall of even years, 3 credits)

Pharmacology

PHM 801: Fundamental Principles of Pharmacology and Toxicology (Fall, 3 credits)

PHM 802: Cellular, Molecular and Integrated Systems Pharmacology (Fall, Spring, 3 credits)

PHM 829: Neuropharmacology (Fall, 3 credits)

PHM 830: Experimental Design and Data Analysis (Fall or Summer, 3 credits, online, 3 credits)

PHM 980: Pharmacology of Excitable (Spring, 2 credits)

PHM 980 (Section 005): Pharmacology of Excitable Cells (Spring, 2 credits)

PSL 950 Courses

Two PSL 950 courses are required for the MCIP Master's program.

The purpose of PSL 950 courses is to examine a specific physiological topic and to engage in its scientific literature. Via participating in these courses students will acquire knowledge of the topic, as well as developing skill in critically evaluating primary literature, experimental design, and scientific communication.

Students must take two different PSL topics courses over the course of their training. This is because physiology is a broad field, and it is important to be exposed to multiple topics within this exciting discipline. (Also, variety is the spice of life, so try some!)

Below are PSL 950 topics offered in the past, but specific topics may vary by semester.

Motivated Behaviors (Fall semesters)

Instructors: Michelle Mazei-Robison, AJ Robison, Gina Leininger

This one credit seminar course will examine the neuronal circuitry regulating motivated behaviors, such as intake of drugs, natural rewards, or avoidance of aversive stress, anxiety or pain. The instructors' expertise ranges across many motivated behaviors, and together they support a broad, dynamic discussion of this field. Students will read, present and discuss journal articles with the group on the neuronal regulation of motivated behavior. Via these activities, students will learn the cutting-edge techniques used to study neural regulation of behavior, how to utilize them and their relative advantages and weaknesses. Students will also develop their skill in critical evaluation of the literature, experimental design and scientific communication.

Metabolic Engineering (Fall semesters)

Instructors: Robert Wiseman and Jason Bazil

Cellular metabolism engineering critically depends upon the ability to supply energy to the needed biosynthetic and functional systems in any dividing or terminally differentiated cell type that performs work. Traditional concepts of Michaelis-Menten kinetics about enzymatic processes and cross-over theory about key regulatory enzymes are surprisingly naïve. Modern concepts of metabolic control theory and application of metabolic control analysis show that even simple metabolic pathways like glycolysis run under “shared” control and regulation in vivo appears to be a matter of metabolic demand. This course will build upon simple but contemporary concepts to construct a more complete understanding of how metabolism is regulated in living tissue. Students will be expected to have a basic knowledge of biochemistry and be prepared to present and discuss papers each class period. Recognized national and international experts from the field of metabolism will present aspects of their work for critique and discussion throughout the semester. Computer models of metabolism will be introduced and utilized to focus on aspects of metabolic design and flux control throughout the semester. Class activities and assignments will be the basis for grading along with presentations and active participation in discussions. Class size will be limited, and Molecular, Cellular and Integrative Physiology

(MCIP) graduate students will be given preferential enrollment. However, we encourage first- and second-year graduate students in other programs to enroll with permission from instructor.

Immune Based Mechanisms of Disease (Spring semesters)

Instructors: Andrea Doseff, Kathy Gallo

This one credit seminar course will examine the mechanistic roles of the immune system in diseases, including Cancer, Atherosclerosis, Infectious Disease, and Autoimmunity. Each module will be introduced by a distinguished guest speaker and followed by student presentations and discussion of journal articles. The contribution of key immunoregulatory networks (Toll like receptors, NLRP, inflammasome, NF-kB) and molecular mechanisms significant to inflammation (immune evasion, T cell exhaustion, and tolerance) will be covered. The impact of these mechanisms on clinical applications will also be discussed. Please contact Dr. Andrea Doseff at doseffan@msu.edu. Taught in conjunction with PHM 980 - 006.

Research Seminars in Cancer Biology (Spring semesters)

Instructors: Eran Andrechek

Cancer-specific topics. Instructor approval needed for override into course - please contact Dr. Andrechek at andrech1@msu.edu

CMB 800: Principles of Effective Scientific Writing (Spring semesters) - 1 credit

Instructor: Margaret Petroff, PhD

Overview: The course is designed to teach and reinforce the principles of effective writing in the context of scientific abstracts, manuscripts, and grants. Material will range from use of impactful words to construction of sentences, paragraphs, and papers. Topics covered will include editing, word choice, writing within word limits, use of active/passive voice, effective punctuation, and the writing process. Course will be held in person and is available via zoom for Grand Rapids and other non-East Lansing students. We will use in-class lectures, discussions, and homework assignments.

RECR Requirements for the MCIP Masters' Program

Adapted from <https://grad.msu.edu/researchintegrity>

- Items in black text are tracked automatically in Ability
- Items in red, blue, purple text are tracked by MCIP Program in Grad Info

YEAR 1

Due by the
end of the
student's
1st year

Complete These 4 CITI Modules

- Introduction to the Responsible Conduct of Research
- Authorship
- Plagiarism
- Research Misconduct

Complete 3 Hours of Discussion-Based Training

This requirement can be met in the following ways:

- MCIP Program-Provided RCR Training in Fall and Spring (1.5 hr each)
- [Workshops offered by the Graduate School](#) (1.5 hr each)
- One-on-one or group discussions with your advisor(s) on RCR topics (topic, instructors, date, and amount of time must be well documented)

YEAR 2

Due by the
end of the
student's
2nd year
and see
NOTE
below

Complete 3 of the CITI Modules From The Following List

- Collaborative Research
- Conflicts of Interest
- Data Management
- Mentoring
- Peer Review
- Financial Responsibility

Complete 3 Hours of Discussion-Based Training

This requirement can be met in the following ways:

- MCIP Program-Provided RCR Training in Fall and Spring (1.5 hr each)
- [Workshops offered by the Graduate School](#) (1.5 hr each)
- One-on-one or group discussions with your advisor(s) on RCR topics (topic, instructors, date, and amount of time must be well documented)

NOTE: You must have completed at least 6 hours total of discussion-based training before graduation.

YEAR 3 and EACH YEAR AFTER

Complete 3 Hours of Annual Refresher Training

This requirement can be met in the following ways:

- Complete additional CITI modules (from the supplemental modules listed in CITI, each module counts as 45 min)
- Completing additional [face-to-face workshops from the Graduate School](#)
- MCIP Program-Provided RCR Training in Fall and Spring (1.5 hr each)
- One-on-one or group discussions with your advisor(s) on RCR topics (topic, instructors, date, and amount of time must be well documented)

Why Does MSU Require Research Integrity Training?

Research integrity is foundational to our scholarship, creative work, and core identity as MSU Spartans. It is not only required by rules (including federal, state, research sponsors, and MSU's [research](#) and [training](#) policies), integrity is essential for our research to have legitimacy and impact. Research integrity is so important to our development as scholars and creators that the Graduate School has developed minimum education requirements for all graduate students regarding the Responsible Conduct of Research, Scholarship, and Creative Activities (RCRSA, RCR for short). The Graduate School's RCRSA program requires (a) initial, basic education, and (b) supplemental, refresher training (see diagram on page 1).

Documenting Completion of Your Requirements

The university's training tracking system, [Ability](#), will automatically record completion of all CITI modules and Graduate School workshops. Students should work with their graduate program to document unit-led RCRSA training. Students must document discussion hours with their advisor by submitting them in the new Campus Solutions system. See instructions for all of the above on the [MSU Office of Regulatory Affairs's RCRSA website](#).

CITI Instructions

To complete the basic and supplemental CITI modules, follow these steps:

1. Log-in to CITI using your MSU NetID and password.
 - a. Click on the "CITI (actual training modules)" button below, *or*
 - b. Go directly to the [CITI Program website](#) and click "log-in through my institution."
2. (For first-time MSU CITI users) Follow the ['Get Started' instructions from MSU's Office of Regulatory Affairs \(ORA\)](#).
3. Under "Courses Ready to Begin", click "Start" next to "MSU Graduate School RCR Requirements."
4. Complete the 4 basic modules by the end of your first year.
5. For Master's students, complete 3 modules from the "Supplemental Modules" also listed on this page (due before graduation).

Applicability

The requirement that doctoral students must complete their 6 hours of discussion-based training before the comprehensive examination applies to doctoral students starting in Fall 2020 or later. Doctoral students who started between Spring 2017 and Summer 2020 must complete their 6 hours of discussion-based training before graduation. Departments and programs may have more specific requirements to meet the discussion-based and annual training. Students who entered in fall 2016, or before, have the option of following the academic unit's previous plan or the new requirements. Students should consult with their program about which option works best with their program of study.

Questions: Contact the MCIP Program Director, Gina Leininger (leinining@msu.edu) and Bradley Robinson (robin454@msu.edu)