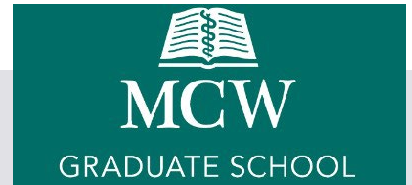


2024-25

## CELL & DEVELOPMENTAL BIOLOGY

Degree Offered: Doctor of Philosophy



### Program Description

The graduate program in Cell and Developmental Biology (CDB) provides state of the art research training in cellular based experimental biology, including studies of organismal development, cell and organ homeostasis, and mechanisms of disease.

Specific areas of focus include regulation of cellular differentiation, the molecular basis of regeneration, how neurons sense their environment, the intricacies of signal transduction, and the mechanisms of disease pathology. The graduate program is hosted by the Department of Cell Biology, Neurobiology and Anatomy, but includes faculty mentors across multiple Departments and Centers of the Medical College of Wisconsin. Students enter CDB through one of several routes: Direct Admission, the Interdisciplinary Program in Biomedical Sciences (IDP), the Neuroscience Doctoral Program (NDP), or the Medical Scientist Training Program (MSTP). Successful completion of this program leads to a Doctor of Philosophy (PhD) degree. This is accomplished through a combination of coursework, seminars, journal clubs, and "hands-on" research in the laboratory of a faculty mentor. CDB graduates have outstanding track record of entering a wide variety of research-related careers including academic post-doctoral research fellowships, industry research scientist positions, employment with consulting firms, science writing positions, among other professions.

### Admission Requirements

In addition to the general [Graduate School admission requirements](#), this program has no additional specific requirements.

Entry to the Cell and Developmental Biology Graduate Program is through Direct Admission, [Interdisciplinary Program in Biomedical Sciences](#) (IDP), [the Neuroscience Doctoral Program](#) (NDP), or the [Medical Scientist Training Program](#) (MSTP). The student is admitted after completion of the first-year curriculum or through the Medical Scientist Training Program following the second year of Medical School. The student elects to complete their dissertation work with faculty of the Cell and Developmental Biology Graduate Program. The student will then have the opportunity to continue graduate studies by selecting among a wide range of courses offered from the Graduate School as well as other programs affiliated with the Medical College.

Courses to be taken are based on the student's interests and consultation with the student's advisor.

### Fields of Study

- Cellular and molecular mechanisms in developmental biology and neurobiology, which employ genetic approaches, including those in mice, zebrafish, stem cells, and invertebrate organisms.
- Development and diseases of the heart, liver, muscle, the nervous system, eye, and early embryo, among other tissues.
- Mechanisms of pain.
- Biology of vision.

- Mechanisms of cell signaling.
- Mechanisms of regeneration.
- Neuronal homeostasis and neurodegeneration.
- Molecular basis of drug interactions.
- Cancer biology.

## Credits Required to Graduate

60 credits minimum

## Program Credit Requirements

Nine credits coursework after the first-year semester is completed.

The curriculum consists of a core of courses required by the Graduate Entry Programs, plus additional courses selected by the student. In addition, Readings and Research is taken annually. Attendance at the departmental sponsored presentations is considered a major part of the educational experience.

## Required Courses

### **10222 Ethics and Integrity in Science.** *1 credit.*

This course provides the basis for understanding the ethical issues related to basic scientific and medical research, including animal and human subject research, fraud, and misconduct, and governmental, institutional, and researcher responsibilities. Bioethics 10222 is offered during the spring and summer terms only.

### **10444 Research Ethics Discussion Series.** *1 credit.*

*Prerequisite: 10222 Ethics and Integrity in Science.*

The course is directed by members of the Bioethics Faculty and provides facilitated discussions of a series of topics in research ethics. Discussions are led by members of the Basic Science faculty and are focused on ethical issues that commonly come up in biomedical research. The course is meant to not only reinforce the basic ethics taught in the online course Ethics and Integrity in Science, which is a prerequisite, but also to explore the gray areas of the individual topics. The intent is to offer students illustrative examples of ethical issues that might arise in their careers, to emphasize the ethical principles that apply in such situations, and to provide practical guidance on how these types of situations should be correctly handled. This course is offered as a discussion series. Students are expected to attend and participate in the discussion. Bioethics 10444 is offered during the spring terms only.

### **31295 Reading and Research.** *1-9 credit(s).*

The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

### **31301 Seminars in Cellular Biology.** *1 credit.*

This course consists of scholarly presentations on current topics in cellular biology and related areas by visiting professors, resident faculty, post-doctoral fellows, and graduate students. Attendance is required for all full-time Cell and Developmental Biology graduate students, except those with pre-approved relevant scholarly conflicts.

### **31399 Doctoral Dissertation.** 9 credits.

This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

### **Required Courses as Needed**

#### **31002 Master's Thesis Continuation.** 0 credits.

This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

#### **31003 Doctoral Dissertation Continuation.** 0 credits.

This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

#### **31299 Master's Thesis.** 1-6 credit(s).

Students in the PhD degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

### **Elective Courses**

Electives are chosen by the student in concert with faculty advisor to best support area of interest and the student's thesis proposal. While there are no specific course requirements, CDB students often take several of the following:

#### **12221 Advanced Systems Neuroscience.** 3 credits.

*Prerequisite: 12211 or consent of the course director.*

Readings and discussion in cellular, molecular, and developmental neurobiology. Among the topics covered in this course are ion channels and the ionic basis of potentials; mechanisms of synaptic transmission; neurotransmitter receptors and their receptors; sensory signal transduction and neural development.

#### **12237 Cellular and Molecular Neurobiology.** 3 credits.

*Prerequisite: 12211 or consent of the course director.*

Readings and discussion in cellular, molecular, and developmental neurobiology. Among the topics covered in this course are ion channels and the ionic basis of potentials; mechanisms of synaptic transmission; neurotransmitter receptors and their receptors; sensory signal transduction and neural development.

#### **16271 Fundamentals of Neuroscience.** 3.5 credits.

Fundamentals of Neuroscience follows a multidisciplinary approach to current knowledge about the structural and functional properties of the nervous system. The mechanisms of the nervous system are described at the molecular, cellular, systems and complex brain function

levels. The course includes in-class lectures, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

**16273 Advanced Cell Biology.** *3 credits.*

Advanced Cell Biology is an upper level, 3-credit hour cell biology course that focuses on a variety of advanced topics in contemporary Cell Biology. Students will gain an in depth understanding of specific selected topics through the use of a variety of resources including web-based webinars and podcasts, detailed in-class discussion of papers from the scientific literature and through preparation and presentation of a lecture on a cell biological topic directly relevant to the student's own research interests. Lectures by faculty will be minimized.

**16276 Developmental and Stem Cell Biology.** *3 credits.*

The offered course provides a detailed introduction to Developmental and Stem Cell Biology. The course uses a lecture-style format supplemented with paper discussions. The intent of the course is to provide a solid academic background in developmental biology to graduate students embarking upon research into cell differentiation and development.

**31154 Neurobiology of Pain.** *1 credit.*

This course will provide students with an overview of pain neurobiology. By the end of this course, students should be able to: 1. Describe the molecular mechanisms underlying noxious stimuli detection and transmission in the peripheral and central nervous systems. 2. Illustrate the peripheral and central anatomical circuits important for pain sensation and perception. 3. Easily and appropriately discuss concepts that are part of the pain basic science vernacular (e.g., "nociceptor" "gate theory", "wind up", "central sensitization") 4. Identify important questions that have yet to be answered in the field of pain basic science.

**31207 Introduction to Neuroscience.** *2 credits.*

This course provides an introduction to the neurosciences. A brief but integrated overview of neuroanatomy, neurophysiology and neurochemistry will be provided. The course consists of both lectures and laboratory exercises.

**31257 Biology of Vision.** *3 credits.*

This course covers core fundamentals in ocular biology and vision. Emphasis is placed on anatomy, pathology, and cellular function within the eye. In addition, visual processing within the central nervous system will also be presented. Core topics include overall eye globe anatomy, development of neural and non-neural systems, basic retinal circuitry and physiology, phototransduction, cell biology of photoreceptor cells and the retinal pigment epithelium, central anatomy and higher order processing, energy metabolism in the visual system, emmetropization and myopia, aqueous humor physiology, glaucoma, photoreceptor diseases, and cornea biology.

**31298 Journal Club.** *1 credit.*

Critical reviews of current research topics.