

# PH.D. IN CELL AND MOLECULAR BIOLOGY, CANCER BIOLOGY SPECIALIZATION

## Requirements Effective Fall 2024

A maximum of 30 credits at the master's degree level may be accepted toward the Ph.D. A professional post baccalaureate degree in Medicine, Veterinary Medicine, Dentistry, or Pharmacy may be accepted for a maximum of 30 credits.

Code	Title	Credits
<b>Required Courses:</b>		
CM 510	Introduction to Cell and Molecular Biology	1
CM 544/MIP 544	Reproducible Biomedical Research Methods	3
CM 792	Cell and Molecular Biology Seminar <sup>1, 2</sup>	4-10
CM 793	Seminar <sup>1, 2</sup>	4-10
<b>Select one course from the following:</b>		<b>4</b>
BC 563	Molecular Genetics	
BC 565	Molecular Regulation of Cell Function	
<b>Select a minimum of five credits from the following:</b>		<b>5</b>
ERHS 510/VS 510	Cancer Biology	
ERHS 611	Cancer Genetics	
ERHS 733	Environmental Carcinogenesis	
VS 718	Cancer Biology Clinical Practicum	
<b>Independent Study and Dissertation (select a minimum of 6 credits from the following):</b>		<b>6</b>
CM 795	Independent Study <sup>2</sup>	
CM 799	Dissertation <sup>2</sup>	
Ethics Elective (see list below)		1-3
Statistics Elective (see list below)		3
Topics Elective (see list below)		1
Writing Elective (see list below)		1
Cell & Molecular Biology Elective (see list below)		3
Master's Degree Credit (a maximum of 30 credits may be accepted from a master's degree)		30
<b>Program Total Credits:</b>		<b>72</b>

A minimum of 72 credits are required to complete this program.

## Ethics Electives

Code	Title	Credits
Select at least one course from the following:		
BC 601	Responsible Conduct in Biochemistry	1
GRAD 544	Ethical Conduct of Research	1
MIP 554	Research Policies and Regulations	1
NSCI 575/GRAD 575	Ethical Issues in Big Data Research	1

## Statistics Electives

A minimum of 3 credits are required. This list is not exhaustive.

Code	Title	Credits
ERHS 535	R Programming for Research	3
ERHS 537A	R Programming: Research I	1
ERHS 537B	R Programming: Research II	2
ERHS 544/STAT 544	Biostatistical Methods for Quantitative Data	3
STAR 501	Data Wrangling/Visualization for Researchers	2
STAR 502	Multivariate Analysis for Researchers	2
STAR 511	Design and Data Analysis for Researchers I	4
STAR 512	Design and Data Analysis for Researchers II	4
STAR 513	Regression Models for Researchers	2
STAR 514	Experimental Design/Analysis for Researchers	2
STAR 531	Generalized Regression Models for Researchers	2
STAR 532	Mixed Models for Researchers	2
STAR 534	Machine Learning for Researchers	2
STAT 540	Data Analysis and Regression	3
VS 562	Applied Data Analysis	3
VS 733	Advanced Veterinary Epidemiology	4

## Topics Electives

Topics Electives provide guided practice in reading, interpreting, and critiquing scientific literature relevant to the field of Cell & Molecular Biology. A minimum of 1 credit is required.

Code	Title	Credits
<b>Preferred Course:</b>		
CM 700	Critical Analysis of Scientific Literature	1
Courses that may substitute for CM 700 (select in consultation with advisor):		
BMS 796A/NB 796C	Group Study: Topics in Neuroscience	1-4
BMS 796B	Group Study: Cardiopulmonary Physiology	1-18
BMS 796C	Group Study: Reproductive Physiology	1-18
BSPM 502B	Topics in Plant Pathology: Plant Bacteriology	1
CHEM 651B	Special Topics in Chemistry: Inorganic Chemistry	1-4
FSHN 650A	Recent Developments in Human Nutrition: Topics in Community Nutrition	2
FSHN 650B	Recent Developments in Human Nutrition: Carbohydrates, Lipids, and Energy	2
FSHN 650C	Recent Developments in Human Nutrition: Genomic, Proteomics, and Metabolomics	2
MIP 700	Topics in Microbiology	1
SOCR 730	Topics in Plant Breeding and Genetics	1

## Writing Electives

A minimum of 1 credit is required.

Code	Title	Credits
BC 701	Grant Proposal Writing and Reviewing	1
BZ 544	Presenting Research in Biology	2
HES 700	Professional Skills in Bioenergetics	3
MIP 643	Grant Writing for Microbiology/Pathology	1
MIP 666	Writing Scientific Manuscripts	3
NB 771	Writing, Submitting, and Reviewing Grants	1

## Cell & Molecular Biology Electives

A minimum of 3 credits related to the student's research area are required. Some possible options are listed, but this list is not exhaustive.

Code	Title	Credits
AB 511	Microbiome of Plant Systems	3
ANEQ 505	Microbiome of Animal Systems	3
ANEQ 545	Molecular Methods in Animal Genetics	3
ANEQ 575	Computational Biology in Animal Breeding	3
BC 511	Structural Biology I	4
BC 563	Molecular Genetics	4
BC 565	Molecular Regulation of Cell Function	4
BC 571	Quantitative Biochemistry	1
BC 611	Structural Biology II	2
BC 663	Gene Expression	2
BC 665A	Advanced Topics in Cell Regulation: Microscopic Methods	2
BIOM 525/MECH 525	Cell and Tissue Engineering	3
BIOM 533/CIVE 533	Biomolecular Tools for Engineers	3
BMS 500	Mammalian Physiology I	4
BMS 501	Mammalian Physiology II	4
BZ 565/MIP 565	Next Generation Sequencing Platform/ Libraries	1
BZ 570	Molecular Aspects of Plant Development	3
BZ 576/BZ 476	Genetics of Model Organisms	4
CBE 560	Engineering of Protein Expression Systems	3
DSCI 511	Genomics Data Analysis in Python	2
DSCI 512	RNA-Sequencing Data Analysis	1
MIP 530	Advanced Molecular Virology	4
MIP 543	RNA Biology	3
MIP 545	Microbial Metagenomics/Genomics Data Analysis	2
MIP 670	Molecular Immunology and Immunogenetics	3
MIP 730/ERHS 730	Principles of Flow Cytometry & Cell Sorting	2
NB 501	Cellular and Molecular Neurophysiology	2
NB 503/BMS 503	Developmental Neurobiology	3

<sup>1</sup> CM 792 and CM 793 must be taken every academic year.

<sup>2</sup> Students must complete at least one credit from each CM 795 and CM 799, and select enough independent study, dissertation, seminar, and other elective course credits to bring the program total to a minimum of 72 credits, with approval of the graduate advisory committee.