

PH.D. IN CELL AND MOLECULAR BIOLOGY

Requirements Effective Fall 2024

| Code | Title | Credits |
|--|---|-------------|
| 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 ^{1,2} | 4-10 |
| CM 793 | Seminar ^{1,2} | 4-10 |
| Select one course from the following: | | 4 |
| BC 563 | Molecular Genetics | |
| BC 565 | Molecular Regulation of Cell Function | |
| Independent Study and Dissertation (select a minimum of 6 credits): | | 6-30 |
| CM 795 | Independent Study ² | |
| CM 799 | Dissertation ² | |
| 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 ³ | | 3 |
| Master's Degree Credit (a maximum of 30 credits may be accepted from a master's degree) | | 30 |
| Program Total Credits: | | 72 |

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 (preferred course) | 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 |

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| 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 | Clinical Research Design and 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 |
|---|---|---------|
| Preferred Course: | | |
| 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 |
| BSPM 530/SOCR 530 | Scientific Writing | 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 of electives 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 |
| BZ 565/MIP 565 | Next Generation Sequencing Platform/ Libraries | 1 |
| 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 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 503/BMS 503 | Developmental Neurobiology | 3 |
| NB 501 | Cellular and Molecular Neurophysiology | 2 |

¹ CM 792 and CM 793 must be taken every year.

² 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 graduate advisory committee.

³ Course selection depends on each student's focus within Cell & Molecular Biology and must be approved by the student's graduate advisory committee.