

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

Graduates from our program will have strong foundations in core cell and molecular biology principles, state-of-the-art training in technical laboratory and computational skills, and leadership and communication skills necessary for professional achievement. The Cancer Biology Specialization is a focus area within the Cell and Molecular Biology graduate program that includes over two dozen faculty members from six departments in three colleges who share a strong interest and a broad expertise in molecular and clinical aspects of the development and treatment of cancer. The basic science and translational research activities of the focus area are closely linked with the clinical research and clinical trials programs of the Robert H. and Mary G. Flint Animal Cancer Center (<https://www.csuanimalcancercenter.org/>). (<https://www.csuanimalcancercenter.org/>)

Clinical cancer treatment of pet animals is a major strength of the cancer biology curriculum. The Cancer Biology Specialization combines nationally recognized research training, focused on cutting edge approaches to cancer diagnosis and treatment, with innovative clinical trials. Students who choose the Cancer Biology Specialization complete all of the requirements of the Cell and Molecular Biology graduate program, including the three laboratory rotations during their first year, plus an additional 5 credits of coursework.

Students interested in graduate work should refer to the Graduate and Professional Bulletin (<https://catalog.colostate.edu/general-catalog/graduate-bulletin/>) or visit the Cell and Molecular Biology website (<https://cmb.colostate.edu/>) for further details.

Learning Objectives

Graduates from our program will have strong foundations in core cell and molecular biology principles, state-of-the-art training in technical laboratory and computational skills, and leadership and communication skills necessary for professional achievement.

Upon successful completion of the Ph.D. with a Cancer Biology Specialization, students will be able to:

1. Demonstrate and apply detailed state-of-the-art knowledge of the molecular processes by which genetic material is replicated, expressed, and regulated (molecular biology) and/or the cellular processes involved in membrane formation, organelle biogenesis, cell communication/shape/motility and how these are linked with growth, aging, and death.
2. Demonstrate advanced knowledge of the molecular and cellular biology of cancer and carcinogenesis (cancer biology).
3. Evaluate primary research papers in the field of cell and molecular biology, including discerning the major questions/hypotheses being addressed, critically interpreting the data presented, assessing whether the conclusions are adequately supported by evidence, and relating the findings to the broader context and significance in the field.
4. Derive and synthesize knowledge from peer-reviewed publications.

5. Collaborate effectively with others in the design and execution of research and other projects.
6. Independently design, execute, analyze, and document rigorous and reproducible cell and molecular biology experiments.
7. Maintain high standards for conduct of rigorous, reproducible, and ethically sound research.
8. Demonstrate technical mastery of laboratory/computational approaches.
9. Communicate research orally to specialist and general audiences.
10. Compose publication-quality scientific manuscripts in the field of cell and molecular biology, based on research findings or literature review.
11. Formulate novel hypotheses based on prior published research and/or their own discoveries and design rigorous and ethically sound experiments to test them.
12. Apply appropriate statistical tests to generate and analyze data and determine statistical and biological relevance.
13. Demonstrate skills such as leadership, management, teaching and mentoring to support future careers beyond academia.

Requirements Effective Fall 2026

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
Required Courses:		
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}	8-20
Select one course from the following:		4
BC 563	Molecular Genetics	
BC 565	Molecular Regulation of Cell Function	
Select a minimum of five credits from the following:		5
ERHS 510/VS 510	Cancer Biology	
ERHS 513	Environmental Carcinogenesis	
ERHS 611	Cancer Genetics	
Independent Study, Dissertation, and Supervised College Teaching (select a minimum of 6 credits):		6
CM 784	Supervised College Teaching ²	
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 (see list below) ³		3
Master's Degree Credit (a maximum of 30 credits may be accepted from a master's degree) ⁴		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	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	Clinical Research Design and Data Analysis	3

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
FSHN 650A	Recent Developments in Human Nutrition: Topics in Community Nutrition	2
FSHN 650B	Recent Developments in Human Nutrition: Functional Foods and Phytochemicals	2
FSHN 650C	Recent Developments in Human Nutrition: Precision Nutrition	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
CBE 560	Engineering of Protein Expression Systems	3
DSCI 511	Genomics Data Analysis in Python	2
DSCI 512	RNA-Sequencing Data Analysis	1
MIP 543	RNA Biology	3
MIP 545	Microbial Metagenomics/Genomics Data Analysis	2
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

¹ CM 792 must be taken every semester.

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 (including supervised college teaching (CM 784 or equivalent)) to bring the program total to a minimum of 72 credits, with approval of the graduate advisory committee.

- ³ Course selection depends on each student's focus within Cell & Molecular Biology and must be approved by the student's advisory committee.
- ⁴ An MS degree is not required. Students who do not have an MS degree will complete 30 additional credits including independent study, and elective classes to bring the total number of credits to 72.

Non-Coursework Requirements:

Radiation/Cancer Biology-Comparative Oncology Seminar - Students enrolled in the Cancer Biology Specialization are expected to participate in the ERHS770 Radiation/Cancer Biology-Comparative Oncology Seminar each semester and present their research once a year.

Lab Rotations - Students admitted as teaching assistants identify and complete up to four short term research experiences in different labs to explore projects and mentorship styles prior to picking a lab for their dissertation project. Students admitted directly into a lab as research assistants do not generally participate in rotations.

Preliminary Examination - Written and oral examination focused on the student's research project must be completed by the end of the 5th semester in order to advance to candidacy. The student submits a research proposal based on their planned and completed research and also develops an independent aim. The student's advisory committee conducts the examination which assesses foundational knowledge as well as in depth understanding of the project and research area. Detailed instructions are found in the Program Policies & Procedures posted on the CMB website.

Dissertation and Defense - PhD candidates must complete and document a substantial independent research project that contributes new knowledge to the field. A project proposal is approved by the advisory committee within one year of joining a laboratory. Upon completion of the data collection and analysis portion of the project the student prepares a dissertation which is presented publicly at the Oral Defense. Following the public presentation, the advisory committee conducts additional examination in a closed Q&A session. Detailed instructions are found in the Program Policies & Procedures posted on the CMB website.

Publication - A first author manuscript describing research performed during the PhD must be submitted for publication in a peer-reviewed journal prior to graduation. Publication to a pre-print server is encouraged, but cannot meet this requirement on it's own.

Progress Reports - The student must prepare an annual report describing plans and progress and submit to their committee for review at least one week prior to the annual committee meeting. This report must be approved by the committee and submitted to the CMB Program Office within one week following the meeting. Failure to meet this requirement can result in a hold on registration.

Internships - Internships are not required but are allowed with approval of the advisor and committee.

Teaching & Mentoring - Teaching and mentoring are not required but are encouraged and credit for Supervised College Teaching (CM 784 or equivalent) may be applied to the degree as an elective replacing Independent Study (CM 795). A graduate teaching certificate is offered through The Institute for Teaching and Learning.

Teamwork - Students are expected to work collaboratively on projects when appropriate.

Conference Presentation - Students are expected to present their research findings at local, national and/or international conferences annually after the first year.

Grant Writing - In addition to fulfilling the writing elective coursework requirement, students are encouraged to apply for funding from both external and internal agencies.

Professional Development - All students complete an individual development plan annually to identify and build expertise in areas not covered by the required curriculum (such as leadership, project management, science policy etc). This plan is discussed with the advisor, committee members and others able to facilitate the desired outcomes.

Field and Department Specific Activities - Cell & Molecular Biology students conduct their research under the mentorship of faculty in a wide range of departments and research focus areas. They are strongly encouraged to actively participate in field- and department-specific seminars, colloquia, events and activities with the support of their advisor and committee.

Requirements for All Graduate Degrees

For more information, please visit Requirements for All Graduate Degrees (<https://catalog.colostate.edu/general-catalog/graduate-bulletin/graduate-study/procedures-requirements-all-degrees/>) in the Graduate and Professional Bulletin (<https://catalog.colostate.edu/general-catalog/graduate-bulletin/>).

Summary of Procedures for the Master's and Doctoral Degrees

NOTE: Each semester the Graduate School publishes a schedule of deadlines. Deadlines are available on the Graduate School website (<https://graduateschool.colostate.edu/deadline-dates/>). Students should consult this schedule whenever they approach important steps in their careers.

Forms (<https://graduateschool.colostate.edu/forms/>) are available online.

Step	Due Date
1. Application for admission (online)	Six months before first registration
2. Diagnostic examination when required	Before first registration
3. Appointment of advisor	Before first registration
4. Selection of graduate committee	Before the time of fourth regular semester registration
5. Filing of program of study (GS Form 6)	Before the time of fourth regular semester registration
6. Preliminary examination (Ph.D. and PD)	Two terms prior to final examination
7. Report of preliminary examination (GS Form 16) - (Ph.D. and PD)	Within two working days after results are known
8. Changes in committee (GS Form 9A)	When change is made
9. Application for Graduation (GS Form 25)	Refer to published deadlines from the Graduate School Website

9a. Reapplication for Graduation (online)	Failure to graduate requires Reapplication for Graduation (online) for the next time term for which you are applying
10. Submit thesis or dissertation to committee	At least two weeks prior to the examination or at the discretion of the graduate committee
11. Final examination	Refer to published deadlines from the Graduate School Website
12. Report of final examination (GS Form 24)	Within two working days after results are known; refer to published deadlines from the Graduate School website
13. Submit a signed Thesis/ Dissertation Submission Form (GS Form 30) to the Graduate School and Submit the Survey of Earned Doctorates (Ph.D. only) prior to submitting the electronic thesis/ dissertation	Refer to published deadlines from the Graduate School website.
14. Submit the thesis/dissertation electronically	Refer to published deadlines from the Graduate School website
15. Graduation	Ceremony information is available from the Graduate School website