

Cancer Cell Biology

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Degrees Offered

- Doctor of Philosophy
- Joint Doctor of Medicine and Doctor of Philosophy

Students in the doctoral program in **Cancer Cell Biology** receive comprehensive in-depth training in modern areas of cancer biology, with a strong emphasis on cellular and molecular aspects of cancer origin, progression and treatment and a focus on cancer types and issues relevant to international, national and West Virginia populations. The program is designed to produce scholarly researchers with aptitude in public speaking, community service, clinical engagement, and critical thinking. Completion of the Ph.D. degree is realized when the student successfully presents the research results to faculty of the graduate dissertation committee and program, and publishes original peer-reviewed research as the primary author. Typically, five years are required to realize this goal.

Research interests include biochemical, molecular, and cellular basis of cancer origin and progression. Current research areas include the following:

- *Tumor Microenvironment*: Tumor cell resistance to anoikis, effects of microenvironment on dormancy, stem cell regulation, leukemia/stromal interactions.
- *Mechanisms of Metastasis*: Role of proteases in cell motility, signaling pathways in invasion and metastasis, imaging of metastasis in animal models.
- *Genetic Regulation of Cancer*: Tumor suppressor genes and transcriptional regulation, post-translational modifications in transcriptional regulation, miRNA regulatory pathways in progression, epigenetics, HPV-driven cancers.
- *Nanotechnology and Cancer*: Effects of nanoparticles on signal transduction pathways governing cancer growth and progression.
- *Signal Transduction in Cancer*: Receptor tyrosine kinase signaling in cancer growth and metastasis, non-receptor tyrosine kinases in cell adhesion and proliferation, ROS in tumor progression.
- *Cancer Bioinformatics*: Biomarker classification in cancer, predictive models of carcinogenesis, secondary analysis of existing databases.
- *Systems Biology in Cancer*: Modeling signaling nodes in breast cancer, oncogenic pathway analysis.
- *Cancer Disparities in Appalachia*: Biological models of Appalachian disparities, prevention and control, cancer registry analysis.
- *Cancer Therapeutics*: High-throughput screening and novel drug discovery, applications and formulations, pre-clinical evaluation in animal models, immunotherapy.

Cancer cell biology investigators working in these research areas routinely incorporate biochemical, molecular, cellular, animal, and computational-based techniques that are currently utilized at the forefront of leading basic cancer research laboratories around the world. The main tumor types that are the current focus of cancer cell biology investigators are based on cancers with disproportionate incidences in West Virginia, including breast, leukemia, ovarian, cervical, lung, colorectal and head and neck cancers.

The doctor of philosophy program in cancer cell biology is designed to expose Ph.D. and M.D./Ph.D. level graduate students to a wide spectrum of opportunities available in basic and translational cancer research. In addition to mechanistic and therapeutic approaches to studying problems in cancer at the bench, students have the opportunity for exposure to more clinical elements of cancer practice, including participation in tumor boards, shadowing clinicians, and participation in the design and approval of clinical trials. The cancer cell biology program at WVU is a member of the Cancer Biology Training Consortium (CABTRAC), a national organization of similar cancer-specific Ph.D. programs that interact through annual regional and national meetings to improve and refine Ph.D. cancer training. Graduates of the cancer cell biology program are therefore well-equipped to enter into a number of different career paths. These include postdoctoral research, biotechnology, industry, government, science writing, core facilities management, and legal counsel as examples.

FACULTY

GRADUATE PROGRAM DIRECTOR

- Scott Weed - Ph.D. (Yale University)

CO-DIRECTOR

- Linda Vona-Davis - Ph.D. (West Virginia University)

PROFESSORS

- Steven Frisch - Ph.D. (University of California, Berkeley)
- Laura Gibson - Ph.D. (West Virginia University)
- Nancy Lan Guo - Ph.D. (West Virginia University)
- Lori Hazlehurst - Ph.D. (University of Vermont)

- Paul Lockman - Ph.D. (Texas Tech University)
- Mark McLaughlin - Ph.D. (Georgia Institute of Technology)
- William Petros - Pharm. D (Philadelphia College of Pharmacy)
- Yon Rojanasakul - Ph.D. (University of Wisconsin)
- Michael Ruppert - M.D./Ph.D. (Johns Hopkins University)
- Michael Schaller - Ph.D. (McMaster University)

ASSOCIATE PROFESSORS

- Yehene Agazie - Ph.D. (University of Saskatchewan)
- Timothy Eubank - Ph.D. (Ohio State University)
- Werner Geldenhuys - Ph.D. (North-West University)
- David Klinke - Ph.D. (Northwestern University)
- Jun Liu - Ph.D. (University of Oxford)
- Patrick Ma - M.D. (University of Toronto)
- Ed Pistilli - Ph.D. (West Virginia University)
- Elena Pugacheva - Ph.D. (Russian Academy of Sciences)
- Mohamad Salkeni - M.D. (University of Damascus)
- Peter Stoilov - Ph.D. (Max Plank Institute)

ASSISTANT PROFESSORS

- Erik Bey - Ph.D. (Cleveland Clinic)
- Cristopher Cifarelli - M.D./Ph.D. (Thomas Jefferson University)
- Wei Du - M.D./Ph.D. (Tohoku University)
- Brock Lindsay - M.D. (University of Cincinnati)
- Ivan Martinez - Ph.D. (University of Pittsburgh)

RESEARCH ASSOCIATE PROFESSOR

- Karen Martin - Ph.D. (Duke University)

RESEARCH ASSISTANT PROFESSOR

- Alexey Ivanov - Ph.D. (Russian Academy of Sciences)

Doctor of Philosophy

MAJOR REQUIREMENTS

Cancer Cell Biology Major Requirements

Scientific Integrity		2
BMS 700	Scientific Integrity	
BMS 702	Biomedical Lab Experience	2
BMS 706	Cellular Methods	1
BMS 707	Experiential Learning for Biomedical Trainees	2
BMS 720	Scientific Writing	2
BMS 747	Foundations for Contemporary Biomedical Research I	4
BMS 777	Foundations for Contemporary Biomedical Research 2	4
CCB 700	Selected Topics in Cancer Cell Biology	3
CCB 701	Biochemical and Oncogenic Signaling	3
CCB 702	Cancer Pharmacologic and Therapeutics	3
Journal Club		7
CCB 705	Journal Club	
CCB 730	Cancer Cell Biology	3
Graduate Seminar		7
CCB 796	Graduate Seminar	
Research		44
CCB 797	Research	

Elective Courses - select one of the following:	3
BIOC 751	Advance Molecular Biology
BMS 715	Molecular Genetics
MICB 720	Cellular Immunobiology
Candidacy Exam	
Dissertation Defense	
Total Hours	90

Seminars and Research Forum

Students attend seminar each semester. These seminars are either given by invited faculty or students.

Journal Club

Students are required to enroll in Journal Club each semester. The course involves the presentation and discussion of current research papers and will help acquaint students with the variety of methods used in scientific research.

Doctoral Research

Students will conduct research with a dissertation mentor during time in the program. Students register for research credits each semester, and their performance is graded by their dissertation mentor.

Qualifying and Dissertation Proposal/Ph.D. Candidacy

The written qualifying exam is given at the end of the first year of study. The candidacy exam is completed in the third year of study. Admission to Ph.D. candidacy occurs following the successful defense of the candidacy exam.

Dissertation Defense and First-Author Paper Requirement

Students are allowed to defend their dissertation when a minimum of one manuscript with the student as first author, based on dissertation research, is accepted in a peer-reviewed journal. The final examination for the Ph.D. degree consists of orally defending a written dissertation in a public seminar and then in private to the dissertation committee. Satisfactory performance in the oral defense will result in recommendation for granting of the Ph.D. degree.

Suggested Plan of Study*

First Year

Fall	Hours Spring	Hours Summer	Hours
BMS 700	1 BMS 700	1 CCB 797	3
BMS 706	1 CCB 730	3	
BMS 702	2 CCB 705	1	
BMS 747	4 CCB 796	1	
BMS 777	4 CCB 797	1	
	Electives Course	3	
	12	10	3

Second Year

Fall	Hours Spring	Hours Summer	Hours
CCB 700	3 CCB 702	3 BMS 720	2
CCB 701	3 CCB 705	1 CCB 797	1
CCB 705	1 CCB 796	1	
CCB 796	1 CCB 797	4	
CCB 797	1		
	9	9	3

Third Year

Fall	Hours Spring	Hours Summer	Hours
CCB 705	1 CCB 705	1 BMS 707	2
CCB 796	1 CCB 796	1 CCB 797	3
CCB 797	7 CCB 797	7	
	9	9	5

Fourth Year

Fall	Hours Spring	Hours Summer	Hours
CCB 705	1 CCB 705	1 CCB 797	3
CCB 796	1 CCB 796	1	
CCB 797	7 CCB 797	7	
	9	9	3

Total credit hours: 90

NOTE: The graduate curriculum is finalized with a plan of study once the mentor and laboratory have been selected in the first year. The plan of study is developed by the graduate committee in consultation with the student. The courses listed above include the required and elective coursework necessary for the student to finalize his/her plan of study. When the student enters the laboratory of his/her doctoral dissertation mentor repetitive enrollments in research, seminars, and colloquia are typical and will determine total hours necessary for degree completion.

*This is a suggested plan of study. Course sequences and length of time in program may vary depending on student and altered total credit hours.

Major Learning Outcomes

CANCER CELL BIOLOGY

Student learning outcomes in the CCB Graduate Program have been partially adapted from the guidelines set forth by Cancer Biology Training Consortium (CABTRAC), along with recommendations from the CCB Scholarship Committee and Faculty. They are as follows:

- Students will conduct a research project that emphasizes cancer in the context of human disease and health.
- Students will become proficient in their understanding of cancer biology at the population, individual, cellular and molecular levels.
- Students will demonstrate technical competence and proficiency in self-directed bench science that incorporates scientific rigor and transparency in the application of knowledge.
- Students will be able to critically analyze experimental questions, become proficient at technical troubleshooting, and to objectively evaluate scientific data (their own and that published in the literature) with high ethical standard.
- Students will acquire scholarly aptitude within their chosen discipline.
- Students will acquire written, oral and visual communication skills to foster effective communication of research.
- Students will be engaged in experiential learning in areas outside of their discipline.