Cancer Cell Biology, Ph.D.

Degrees Offered

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

Nature of the Program

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

- Emidio Pistilli - Ph.D. (West Virginia University)

PROFESSORS

- Yehenew Agazie - Ph.D. (University of Saskatchewan)
- Steven Frisch - Ph.D. (University of California, Berkeley)
- Nancy Lan Guo - Ph.D. (West Virginia University)
- Lori Hazlehurst - Ph.D. (University of Vermont)
- Valery Khramtsov - Ph.D. (Institute of Kinetics & Combustion, Novosibirsk) (Russia)
- David Klinke - Ph.D. (Northwestern University)

- 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

- Cristopher Cifarelli - M.D./Ph.D. (Thomas Jefferson University)
- Timothy Eubank - Ph.D. (Ohio State University)
- Werner Geldenhuys - Ph.D. (North-West University)
- Hannah Hazard - M.D. (West Virginia University)
- Brock Lindsey - M.D. (University of Cincinnati)
- Jun Liu - Ph.D. (University of Oxford)
- Ivan Martinez - Ph.D. (University of Pittsburgh)
- Ed Pistilli - Ph.D. (West Virginia University)
- Elena Pugacheva - Ph.D. (Russian Academy of Sciences)
- Mark Tsylein - Ph.D. (Russian Academy of Sciences, Kazan)
- Scott Weed - Ph.D. (Yale University)

ASSISTANT PROFESSORS

- Sonikpreet Aulakh - MBBS (Shyam Shah Medical College, India)
- Margaret Bennewitz - Ph.D. (Yale University)
- Brian Boone - M.D. (University of South Florida)
- Jonathan Busada - Ph.D. (East Carolina University)
- Benoit Driesschaert - Ph.D. (University Catholique de Louvian, Belgium)
- Michael Hu - Ph.D. (Peking University, China)
- Tracy Liu - Ph.D. (University of Toronto)
- William Walker - PhD (Ohio State University)
- Bradley Webb - Ph.D. (Queen’s University, Canada)

RESEARCH ASSISTANT PROFESSOR

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

SERVICE PROFESSOR

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

Doctor of Philosophy

MAJOR REQUIREMENTS

Code	Title	Hours
Cancer Cell Biology Major Requirements		
BMS 700	Scientific Integrity	1
BMS 701	Scientific Rigor and Ethics	1
BMS 702	Biomedical Lab Experience	2
BMS 706	Biomedical Research 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
BMM 715	Molecular Genetics	
BMM 751	Advanced Molecular Biology	
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.

Dissertation Proposal/Ph.D. Candidacy

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 701	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.

Students will:

- Independently plan and implement a research project that emphasizes cancer in the context of human disease and health.
- Understand cancer biology at the population, individual, cellular and molecular levels.
- Demonstrate knowledge of subject-specific techniques and methods in self-directed bench science that incorporates scientific rigor and transparency in the application of knowledge.
- Analyze and critique experimental questions, to become proficient at technical troubleshooting, and to objectively evaluate scientific data (their own and that published in the literature) with high ethical standard.
- Evaluate the scientific literature with scholarly aptitude within their chosen discipline.
- Apply their skills in written, oral and visual communication to foster effective communication of research.
- Apply and expand their knowledge while engaged in experiential learning in areas outside of their discipline.