Cancer Cell Biology

sweed@hsc.wvu.edu

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. Typically, four to 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 chemotherapy on the bone marrow microenvironment, stem cell regulation, leukemia/stromal interactions, effects of the extracellular matrix on angiogenesis and tumor cell invasion.
- **Mechanisms of Metastasis**: Role of proteases in cell motility, regulation of the actin cytoskeleton in invadopodia formation and migration, 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.
- **Heavy Metals and Cancer**: Effects of heavy metals on signal transduction pathways governing angiogenesis and tumor cell motility.
- **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, lipid kinase signaling in angiogenesis.
- **Cancer Bioinformatics**: Biomarker classification in cancer, predictive models of carcinogenesis.

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, 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

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

Doctor of Philosophy

MAJOR REQUIREMENTS

<table>
<thead>
<tr>
<th>Cancer Cell Biology Major Requirements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Integrity</strong></td>
<td>2</td>
</tr>
<tr>
<td>BMS 700</td>
<td>Scientific Integrity</td>
</tr>
<tr>
<td>BMS 702</td>
<td>Biomedical Lab Experience</td>
</tr>
<tr>
<td>BMS 706</td>
<td>Cellular Methods</td>
</tr>
<tr>
<td>BMS 707</td>
<td>Experiential Learning for Biomedical Trainees</td>
</tr>
<tr>
<td>BMS 715</td>
<td>Molecular Genetics</td>
</tr>
<tr>
<td>BMS 720</td>
<td>Scientific Writing</td>
</tr>
<tr>
<td>BMS 747</td>
<td>Foundations for Contemporary Biomedical Research I</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours Spring</th>
<th>Hours Summer</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMS 700</td>
<td>1 BMS 700</td>
<td>1 CCB 797</td>
<td>3</td>
</tr>
<tr>
<td>BMS 706</td>
<td>1 BMS 715</td>
<td>3 Qualifying Exam</td>
<td></td>
</tr>
<tr>
<td>BMS 702</td>
<td>2 CCB 730</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMS 747</td>
<td>4 CCB 705</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BMS 777</td>
<td>4 CCB 796</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CCB 797</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
</tr>
<tr>
<td>CCB 700</td>
</tr>
<tr>
<td>CCB 701</td>
</tr>
<tr>
<td>CCB 705</td>
</tr>
<tr>
<td>CCB 796</td>
</tr>
</tbody>
</table>

Total 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 Goals**

**CANCER CELL BIOLOGY**

- Stimulate critical thinking and communication of content related to cancer research to expert and non-expert audiences
- Understand the fundamental aspects of cancer origin, progression, and treatment
- Develop a basic understanding of the cancer types recognized as national health disparities to state residents
- Acquire in-depth knowledge about specific molecular and cellular aspects of cancer biology germane to the specific studied cancer type
- Become skilled in writing, publishing, and presenting cancer-based research findings to respected peer-reviewed journals, as well as at institutional, regional, and national meetings
- Understand the additional impact of student-based cancer research related to community outreach and health outcomes in the West Virginia, national, and international populations
- Understand how basic science advances in cancer research correspond and potentially impact changes in clinical patient management (bench to bedside)
- Be able to interact with and comprehend fundamental aspects of clinical cancer care in a cancer-specific manner and how it pertains to basic cancer research (bedside to bench)
- Remain current with recent advances in the cancer literature and with major advances in the field during and after graduation from the program
- Be competitive in securing and conducting post-doctoral research in academic, industrial, or government settings
- Be prepared to pursue alternative non-research careers related to cancer in fields of their choosing

**COURSES**

**CCB 700. Selected Topics in Cancer Cell Biology. 3 Hours.**
PR: BMS 730 or consent. This course is designed for upper level graduate students. An expansion of the concepts and mechanisms of cancer biology through review of selected topics including cellular signals and tumor microenvironment, as well as diagnostics and therapeutic strategies.

**CCB 701. Biochemical and Oncogenic Signaling. 3 Hours.**
This advanced course is designed for upper level graduate students. It will focus on the biochemical and oncogenic mechanisms of cellular signaling. Students will explore the experimental methodologies needed to understand the scientific literature in biochemistry and cancer.

**CCB 702. Cancer Pharmacologic and Therapeutics. 3 Hours.**
PR: BMS 730 or PCOL 761 or consent. This course is designed for upper level graduate students. Course will focus on the pharmacologic, diagnostic, and therapeutic axis of cancer care including therapeutic strategies, drug resistance/design and clinical trials.

**CCB 705. Journal Club. 1 Hour.**
PR: Consent. A study of contemporary topics selected from recent developments in the field of cancer research.
CCB 730. Cancer Cell Biology. 2-3 Hours.
This course emphasizes the cellular signals that direct tumor growth and invasive potential and explores how these same signals can be targeted for intervention to block tumor progression.

CCB 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

CCB 797. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).