

Biomedical Science, PhD

Free Radical and Radiation Biology

The Doctor of Philosophy in biomedical science with a free radical and radiation biology subprogram is interdisciplinary and requires 72 s.h. of graduate credit. Students must maintain a cumulative grade-point average of at least 3.00 to earn the degree. The possibility exists for a major emphasis in radiation biology or redox biology with a focus on cancer or degenerative diseases associated with aging. Although students with diverse academic backgrounds may enter the program, each student should have a science background which includes at least two years of chemistry, including organic chemistry and biochemistry; one year of physics; two years of biology; and mathematics, including at least one semester of calculus.

FRRB:5000 Radiation Biology and FRRB:7000 Redox Biology and Medicine each only need to be taken one time. They may be taken either in the first or second year of the program.

The PhD in biomedical science with a free radical and radiation biology subprogram requires the following coursework.

Typical Curriculum

First Year, Fall

Course #	Title	Hours
BMED:5207	Principles of Molecular and Cellular Biology	3
BMED:5208	Topics in Principles of Molecular and Cellular Biology	1
BMED:7777	Biomedical Science Seminar	1
BMED:7888	Biomedical Science Research	arr.
FRRB:5000	Radiation Biology	4
PCOL:5204	Basic Biostatistics and Experimental Design	1

First Year, Spring

Course #	Title	Hours
BMED:7777	Biomedical Science Seminar	1
BMED:7888	Biomedical Science Research	arr.
FRRB:7000	Redox Biology and Medicine	4
MMED:6260	Methods for Molecular and Translational Medicine	1
PATH:5270/ IGPI:5270/ MMED:5270	Pathogenesis of Major Human Diseases	3
PHAR:6504	Mastering Reproducible Science	1

Second Year, Fall

Course #	Title	Hours
BMED:7270	Scholarly Integrity/ Responsible Conduct of Research I	0

FRRB:5000	Radiation Biology	4
FRRB:6000	Seminar: Free Radical and Radiation Biology	1
FRRB:6004	Research: Free Radical and Radiation Biology	arr.
FRRB:6006	Topics in Free Radical Biology and Medicine	1
FRRB:6008	Topics in Radiation and Cancer Biology	1

Electives (as appropriate)

Second Year, Spring

Course #	Title	Hours
BMED:7271	Scholarly Integrity/ Responsible Conduct of Research II	0
FRRB:6000	Seminar: Free Radical and Radiation Biology	1
FRRB:6004	Research: Free Radical and Radiation Biology	arr.
FRRB:6006	Topics in Free Radical Biology and Medicine	1
FRRB:6008	Topics in Radiation and Cancer Biology	1
FRRB:7000	Redox Biology and Medicine	4

Electives (as appropriate)

Elective Courses

Elective courses can be tailored to the student's area of interest.

Course #	Title	Hours
ACB:5203	Gross Human Anatomy for Graduate Students	5-6
ACB:6237	Critical Thinking in Biochemistry and Molecular Biology	1
ACB:6238	Critical Thinking in Genetics	1
ACB:6239	Critical Thinking in Cell Biology	1
ACB:6252/ PTRS:6253	Functional Neuroanatomy	arr.
BIOL:3172	Evolution	4
BIOL:3713	Molecular Genetics (fall)	4
BIOL:4333	Genes and Development	3
BIOL:5412	Fundamental Genetics: Graduate Lecture	3
BIOL:5512	Readings in Genetics	2
BIOS:4120	Introduction to Biostatistics	3
BMB:3140	Experimental Biochemistry (spring)	3
BMB:7251	Introduction to Protein Structures (fall)	1
BMB:7252	Enzymes, Carbohydrates, Nucleic Acids, Lipids, and Membranes (fall)	1
BMB:7253	Introduction to Metabolism (fall)	1
BMB:7254	Metabolism I (spring)	1
BMB:7255	Metabolism II (spring)	1
BMB:7256	Molecular Biology (spring)	1

CS:5110/IGPI:5110	Introduction to Informatics	3
CBIO:7001/ FRRB:7001/ PATH:7001	Molecular and Cellular Biology of Cancer	3
GENE:6150	Genetic Analysis of Biological Systems	3
GENE:7191	Human Molecular Genetics	3
IMMU:6241	Writing a Scientific Proposal	2
IMMU:7221/ MICR:7207	Advanced Topics in Immunology	3
MICR:2157	General Microbiology (fall and spring)	3
MICR:3147	Immunology and Human Disease (fall)	3
MICR:6201/ IMMU:6201	Graduate Immunology (spring)	3
MICR:6247/ IMMU:6247	Graduate Immunology and Human Disease	4
MICR:6259	Graduate Bacteria and Human Disease	3-4
MICR:6267	Graduate Viruses and Human Disease	3
MICR:6268	Biology and Pathogenesis of Viruses	2
MICR:6270	Graduate Bacterial Genetics	3
MMED:6220/ ACB:6220/ MPB:6220	Mechanisms of Cellular Organization (fall)	3
MMED:6226/ ACB:6226/ MPB:6226	Cell Cycle Control	1
MMED:6227/ ACB:6227/ MPB:6227	Cell Fate Decisions (spring)	1
MPB:5153	Graduate Physiology	4
NEUR:7235/ NSCI:7235	Neurobiology of Disease	3
NSCI:5653/ BIOL:5653/ PSY:5203	Fundamental Neurobiology I	3
OEH:6710	Human Toxicology and Risk Assessment (spring)	3
PATH:5270/ IGPI:5270/ MMED:5270	Pathogenesis of Major Human Diseases	3
PATH:8133	Introduction to Human Pathology for Graduate Students (fall)	2-4
PCOL:5135	Principles of Pharmacology	1
PCOL:5136	Pharmacogenetics and Pharmacogenomics	1
PCOL:5137	Neurotransmitters	1
PCOL:6207	Ion Channel Pharmacology	1
PCOL:6225	Growth Factor Receptor Signaling	1
PHAR:5542	Molecular Recognition	3
PSQF:6217/ GRAD:6217	Seminar in College Teaching (fall and spring)	1-3
PTRS:6224	Activity-Based Neural and Musculoskeletal Plasticity in Health Care	4

Additional Requirements

Laboratory Rotations

Graduate students rotate through at least three different free radical and radiation biology laboratories during their first academic year with primary and secondary faculty.

Seminar and Journal Clubs

Students must enroll in one seminar for credit once a year for three years as well as a thesis defense seminar. Students should not register for the seminar during their first academic year.

Students enrolled for research credit are required to submit a research report to their advisor on the last day of class each semester. The report is evaluated and graded by the advisor. The report, written in a form that is appropriate for a peer-reviewed publication, should define the goals, aims, and objectives for the specific semester, and describe the progress made by the student toward completion of the research objectives.

Topics in Free Radical Biology and Medicine (FRRB:6006) and Topics in Radiation and Cancer Biology (FRRB:6008) must each be taken at least two times.

Publication Requirements

Students must submit at least one first-author manuscript prior to the thesis defense. All PhD students are expected to have co-author publications prior to graduation and these publications should include first authorship.

Grant Writing Opportunities

National Institutes of Health (NIH) research grant proposals (i.e., F30, F31) and/or equivalent grant submissions are encouraged based on a student's work. The free radical and radiation biology program will provide resources and critiques of the application prior to submission. Students should review the instructions provided in the NIH publication, PHS-398, available from the National Institutes of Health website.

Comprehensive Examination

Students who have successfully completed four semesters since enrollment must take their comprehensive exam no later than February of their third year in the program. Students need to maintain full-time status (minimum of 9 s.h. per semester) prior to their comprehensive examination. The comprehensive examination includes both a written and an oral presentation on the topic of the student's dissertation research. The written proposal needs to be organized following the National Institutes of Health guidelines for an R01 application. Students are encouraged to consult with their mentors and members of their PhD advisory/examination committee as they develop their research hypothesis and specific aims; this should be limited to one page. Once the hypothesis and aims page has been approved by the committee, the mentor and committee members will not have any input into the development and writing of the rest of the proposal. If appropriate, students are allowed a second attempt at the comprehensive examination. A second attempt needs to be completed no later than August of the same year as the first attempt of the comprehensive examination.

The written proposal is typically 14 pages, which includes an abstract (half-page summary, as a separate page), the hypothesis and aims (one page), the body of the proposal (12 pages), and references not included in the page count. A title

page (not included in the page count) with only administrative information, such as the title of the proposal, name of the student, date of examination, and other such information is encouraged. The proposal should be prepared as single-spaced text, in 11-point Arial font.

Final Examination

The final examination is a defense of the thesis and explanation of the scientific principles involved, given in a public seminar and closed-door oral exam, with committee members. The student's research must be summarized in the format required by the Graduate College.

Combined Programs

PhD/MD

Students may work toward the Doctor of Medicine degree and a PhD in biomedical science (free radical and radiation biology subprogram) in a combined degree program offered by the Graduate College and the Carver College of Medicine. Applicants must be admitted to both programs before they may be admitted to the combined degree program. See the Medical Scientist Training Program (Carver College of Medicine) in the catalog.