

Free Radical and Radiation Biology

Director

- Douglas R. Spitz (Radiation Oncology/Pathology)

Faculty: <https://frrbp.medicine.uiowa.edu/faculty-and-staff>

Website: <https://frrbp.medicine.uiowa.edu/>

The Free Radical and Radiation Biology Program provides in-depth training and research experience in the physical, chemical, and biological effects of radiation. It also focuses on the metabolic production of free radicals and their role in biology and medicine.

Free radicals are of interest to researchers and clinicians due to their role in a variety of diseases and pathological states, including degenerative diseases of aging and cancer. Manipulation of free radical reactions and redox biology holds great promise for the future development of new therapies for a variety of human diseases. The Free Radical and Radiation Biology Program stresses the importance of these areas of research to basic science, translational research, and public health.

Undergraduate Education

Three courses offered by the Free Radical and Radiation Biology Program are open to University of Iowa undergraduate students: FRRB:3130 Radiation Safety and Radiobiology; FRRB:4000 Special Topics: Advanced Undergraduates; and with instructor approval, FRRB:5000 Radiation Biology. Students looking for an overview of the biological effects of radiation, including the role of free radicals, will find FRRB:5000 especially appropriate.

Graduate Education

See Carver College of Medicine and Graduate College in the Catalog for general information about study in medicine and graduate study at the University.

Postgraduate Training

Postdoctoral training is available by arrangement with the program's director and individual faculty members. Contact the Free Radical and Radiation Biology Program.

Programs

Graduate Programs of Study

Majors

- Master of Science in Free Radical and Radiation Biology
- Doctor of Philosophy in Free Radical and Radiation Biology

Students interested in doctoral studies in free radical and radiation biology should apply under the umbrella program in Biomedical Science (select free radical and radiation biology subprogram). Direct applications to the M.S. and Ph.D. in free radical and radiation biology are not currently being considered.

Facilities

The Free Radical and Radiation Biology Program is the home of the Radiation and Free Radical Research Core Lab (RFRR). The lab operates radiation sources including an Xstrahl Small Animal Radiation Research Platform (SARRP) and a 5,000-Curie Cs-137 irradiator (Ionizing Radiation Services). Students and staff have access to additional core lab support through RFRR, with services and expertise related to analytical chemistry (Electron Paramagnetic Resonance Services) and redox biology, biochemistry (Antioxidant Enzyme Services), and linear accelerators in the Department of Radiation Oncology.

The program has a number of radiation detectors and counters, including liquid scintillation counters. It also has ultraviolet/visible spectrophotometers; various types of equipment for densitometry, chromatography, and electrophoresis; modern tissue culture facilities; Seahorse metabolic profiling instruments; molecular biology equipment, including thermal cyclers; an automatic cell counter and particle sizer; tissue culture facilities; Typhoon phosphorimager; high performance liquid chromatography (HPLC); electron spin resonance spectrometers; and nitric oxide analyzers. Visit Research Core on the program's website to learn more.

Courses

Free Radical and Radiation Biology Courses

FRRB:3110 Medical Physics I **1-3 s.h.**

Introduction to radiation used in clinical setting; fundamental physical units, measurements, principles, atomic structure and types of radiation; X-ray generating equipment, X-ray production, and its interaction with matter. Requirements: admission to free radical and radiation biology program or acceptance to radiation sciences therapy program, and maxillofacial or radiation oncology resident. Same as RSTH:3110.

FRRB:3130 Radiation Safety and Radiobiology **2 s.h.**

Instruction on safe operation of radiation producing equipment and handling of radioactive materials; origin and/or derivation of certain formulae and techniques useful in radiation protection programs; regulatory agencies, regulations, and regulatory guides pertinent to student's field; emphasis on applied aspects of radiation protection; characteristics and biological effects of ionizing radiations, properties and uses of radioisotopes, medical applications, and biological basis for protection procedures. Requirements: enrollment in radiation sciences or nuclear medicine technology program. Same as RSP:3130.

FRRB:3215 Medical Physics II **0-3 s.h.**

Treatment units used in external radiation therapy; beam calculations, isodose distributions, brachytherapy, quality assurance and quality management, protection and safety. Prerequisites: RSTH:3110. Requirements: admission to free radical and radiation biology program or acceptance to radiation sciences therapy program. Same as RSTH:3215.

FRRB:4000 Special Topics: Advanced Undergraduates **arr.**

Readings and/or laboratory experience. Offered fall semesters.

FRRB:5000 Radiation Biology 4 s.h.

Comprehensive study of molecular and biological effects of ionizing radiations with emphasis on biomedical therapeutic applications; mammalian radiobiology, contribution of metabolism to radiation effects, and therapeutic applications of radiation in cancer therapy. Offered fall semesters.

Prerequisites: CHEM:2210 and BMB:3120. Requirements: college-level physics.

FRRB:5001 Research: Special Topics arr.**FRRB:5005 Rigor and Reproducibility in Redox Biology 1 s.h.**

Experiments in redox biology are prone to artifact due to unwanted or unknown oxidations, misunderstanding of how laboratory tools work, assumptions by the investigator that do not hold, and more; faculty and students discuss common experimental approaches used in research in the field—their strengths, weakness, and current best approaches to avoid artifacts—and best approaches to present data to stand the test of time and are easily understood by readers.

FRRB:6000 Seminar: Free Radical and Radiation Biology 1 s.h.

Seminar presentations of cutting edge science in the field of free radical and radiation biology, given by experts in the field as well as trainees.

FRRB:6004 Research: Free Radical and Radiation Biology arr.

Representation of intensive laboratory-based studies in the field of free radical and radiation biology, determined by mutual agreement between faculty members sponsoring the research and consultation with graduate student.

FRRB:6006 Topics in Free Radical Biology and Medicine 1 s.h.

Discussion and presentation of new literature reports in the field of free radical biology and medicine in journal club format.

FRRB:6008 Topics in Radiation and Cancer Biology 1 s.h.

Emerging concepts in the biological effects of radiation and cancer biology; current topics in journal club format.

FRRB:7000 Redox Biology and Medicine 4 s.h.

Chemistry of free radicals, related oxidants, and antioxidants; antioxidant (redox) enzymes—their structure, biochemical function, regulation, and function in redox biology; targets of oxidants—lipids, proteins, DNA; redox biology of health (infants to healthy aging) and disease (cancer, cardiovascular disease, diabetes, neurodegenerative diseases). Offered spring semesters of even years. Prerequisites: BMB:3120 or CHEM:2210.

FRRB:7001 Molecular and Cellular Biology of Cancer 3 s.h.

Fundamental aspects of oncology at cellular and molecular levels; mechanisms of cancer initiation and progression, oncogene action, DNA damage and repair, carcinogenesis by radiation, chemicals, viruses; tumor immunology, anticancer therapies. Offered spring semesters. Requirements: strong basic science background. Same as PATH:7001.