Biomedical Science, PhD

The Biomedical Science Graduate Program optimizes students' mobility and their ability to explore several graduate programs during their first academic year before affiliating with a specific biomedical science subprogram—cancer biology, cell and developmental biology, experimental pathology, free radical and radiation biology, molecular medicine, molecular physiology and biophysics, or pharmacology.

Students thrive in a collaborative environment in which they explore subprograms by performing three research rotations in the laboratories of any of the biomedical science faculty, regardless of their departmental or program affiliation. Biomedical science students are advised regarding course selections, research rotations, and registration by a designated faculty academic advisor. Students can tailor their choice of electives based on their interests.

Following completion of the first year, it is expected that students will be able to select a research laboratory and subprogram affiliation. The specific subprogram students choose for thesis training determines their curriculum for subsequent years.

Core Curriculum

First Year, Fall

Course #	Title	Hours
One of these:		
BIOS:4120	Introduction to Biostatistics	3
PCOL:5204	Basic Biostatistics and Experimental Design	1
All of these:		
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.
Elective course(s)		

First Year, Spring

Course #	Title	Hours
BMED:7777	Biomedical Science Seminar	1
BMED:7888	Biomedical Science Research	arr.
MMED:6260	Methods for Molecular and Translational Medicine	1
PHAR:6504	Mastering Reproducible Science	1
One of these:		
FRRB:7000	Redox Biology and Medicine	4
FRRB:7001	Molecular and Cellular Biology of Cancer	3
PATH:5270	Pathogenesis of Major Human Diseases	3
PCOL:5130	Basic Concepts in Pharmacology	3

Admission

Applicants must have a baccalaureate degree from a regionally accredited U.S. college or university, or an equivalent degree from another country as determined by University of Iowa Admissions. They must also have an undergraduate grade-point average of at least 3.00. Applicants must meet the admission requirements of the Graduate College.

Appropriate preparation includes a one-year, college-level course in biology, chemistry (inorganic and organic), and mathematics through calculus.

Learning Outcomes

Core Learning Outcomes

Students will:

- demonstrate expertise in foundational aspects of molecular and cellular biology, particularly in a human biomedical context;
- develop hypotheses and experimental methods that can be used to explore questions in molecular biology;
- apply knowledge of biomedical science to human disease through translational research paradigms;
- describe fundamental techniques, statistical methods, and core principles of rigor and reproducibility in biomedical science;
- describe the range of career pathways in the sciences for the biomedical PhD;
- develop proficiency in reading and interpreting scientific literature; and
- develop skills in written and oral communication of scientific work.

Cancer Biology

Students will:

- master foundational knowledge in cancer biology and demonstrate in-depth knowledge in their area of emphasis;
- understand and apply the scientific method, design experiments, and conduct research utilizing team-based collaboration, knowledge of current literature, and current laboratory methods;
- gain an appreciation of clinical management and therapeutic approaches to treat cancer;
- develop advanced skills in scientific writing and oral presentations in order to effectively communicate research progress and goals;
- exhibit and foster the highest ethical standards in the areas of education, publication, and scientific inquiry; and
- publish at least one first-author paper and write a grant application.

Cell and Developmental Biology

Students will:

- master foundational knowledge in cellular and developmental biology;
- engage in designing and executing experiments to test scientific hypotheses;

- critically evaluate scientific findings;
- communicate scientific findings effectively to diverse audiences;
- exhibit and foster ethics in the areas of education, publication, and scientific inquiry; and
- become an effective teacher of the biological sciences.

Experimental Pathology

Students will:

- demonstrate subject matter expertise in basic cell and molecular biology, biostatistics/bioinformatics, and pathobiology/mechanisms of human disease;
- understand and apply scientific methods allowing for the appropriate development and testing of hypotheses, problem-solving, and utilization of current literature and contemporary laboratory approaches;
- understand and apply the need to conduct research using a team-based approach, including ongoing input from the thesis mentor/committee as well as peers within the laboratory and graduate program environment;
- understand and apply the key principles of carrying out research and interpreting results using the highest ethical standards; and
- acquire the ability to effectively communicate research goals, approaches, and results using both written and oral means.

Free Radical and Radiation Biology

Students will:

- demonstrate comprehensive knowledge of foundational principals in free radical and radiation biology, a clear understanding of all free radical and radiation biology course material, and a thorough knowledge of the literature in their area of major emphasis;
- demonstrate a functional comprehension of scientific research, such as the use of relevant literature, the formulation of a hypothesis, hypothesis testing, data interpretation, and the lucid presentation of the research in both written and oral form;
- acquire and develop classroom and laboratory teaching skills;
- acquire advanced scientific writing and communication skills competing at the national level for visibility in scholarly activities and funding opportunities;
- produce research results worthy of publication in high-impact peer-reviewed journals relevant to the field of study; and
- participate in career development and networking activities at the local, regional, and national levels.

Molecular Medicine

Students will gain knowledge in:

- tracks for specialized coursework—demonstrate broad-based understanding of one of three tracks selected by students in their second year of studies (metabolic disorders, cardiovascular biology, or molecular and cellular medicine);
- oral and written presentation of scientific data—demonstrate proficiency in scientific writing as evidenced by external fellowship application requirement; organize, defend, and communicate ideas effectively in scientific oral presentations and settings; opportunities to present posters, full-length seminar presentations, short-form data blitzes, lay audience elevator pitches; comprehensive exam; on-topic or off-topic NRSA-style research proposal that is orally defended to a comprehensive exam committee comprised of subject-matter experts; scientific editing and research communication core; and service promoted to students to get one-on-one instruction in scientific editing, focused especially on grant writing;
- experimental design—instruction on experiment design provided by their mentor, experiences in the critical thinking course, and in the basic biostatistics and experimental design course;
- proficiency in research—three laboratory rotations before affiliating to a lab, conduct research in a responsible and ethical manner, carry out an in-depth research project, and contribute intellectually and technically to all parts of its development, execution, and analysis; and
- professional skills development—journal clubs, a course in critical thinking, and career development series.

Molecular Physiology and Biophysics

Students will:

- demonstrate a basic knowledge of physiology and biophysics that will serve as the foundation for the student's academic, scholarly, and research endeavors;
- exhibit the necessary practical, methodological, and technical expertise to perform original experimental work in an area of physiological research;
- gain professional skills required for successful academic or research-based careers, including skills in publishing, grant writing, presentation, and teaching; and
- acquire knowledge and respect for principles of biomedical research ethics.

Pharmacology

Students will:

- identify important research problems through the development of subject matter expertise related to pharmacology, and critical evaluation of the current state of knowledge in that area of expertise;
- formulate valid and testable hypotheses and/or research questions, and then plan feasible experiments to address them;
- conduct, analyze, and interpret independent original research that contributes new knowledge to the field of pharmacology;
- effectively communicate research results to a range of audiences in both written and oral formats; and
- conduct all aspects of research and communication of results with the highest ethical standards.