Biomedical Sciences, M.S., Ph.D.

Degrees Offered

- Master of Science
- Doctor of Philosophy

Nature of the Program

The Masters of Science (M.S.) in the Biomedical Sciences is designed to assist in the selection of a career path, such as industry, teaching, or a professional program, and/or for the transition to a biomedical Doctor of Philosophy (Ph.D.) program. The M.S. degree has a thesis and non-thesis option, the latter with additional elective coursework that should align with career goals. Completion of the M.S. degree is realized when the student successfully presents the research results to faculty of the student’s graduate thesis committee. Typically, two to three years are required to realize this goal.

A Ph.D. in the Biomedical Sciences at West Virginia University offers the student the unique opportunity to explore multiple disciplines and areas of research in the biomedical sciences but to also fast track into a dissertation laboratory and a graduate program within one semester. Earning the Ph.D. will be through one of the 7 degree granting programs in the Biomedical Sciences: Biochemistry and Molecular Biology, Cancer Cell Biology, Cellular and Integrative Physiology, Exercise Physiology, Immunology and Microbial Pathogenesis, Neuroscience, and Pharmaceutical and Pharmacological Sciences. These programs share a common admission’s process and a common core curriculum in the first semester. Students will rotate through 3 laboratories during the fall semester with the potential to select a dissertation adviser by the end of the semester.

Doctoral study in these graduate programs allows the development of research and critical thinking skills as well as preparation in career development to prepare the student for entry into a myriad of careers in research, teaching, industry, government, and other positions that require specialized training at the graduate level.

All students will:

- start with an orientation that will prepare him/her to successfully transition into graduate studies, and to interact with an orientation adviser, faculty investigators, and current students;
- have the opportunity to match with a faculty mentor, or thesis or dissertation adviser through laboratory rotations during the first semester;
- have formal training in scientific writing;
- have the opportunity to participate in seminar series, workshops, experiential learning, and career-development sessions.

FACULTY

DIRECTOR M.D./PH.D. PROGRAM
- Albert Berrebi - PhD

PROGRAM COORDINATOR
- Joseph Andria
- Connor Ferguson

Admissions

All applications are accepted electronically and must be submitted electronically via the official WVU Graduate Education application: https://westvirginia.force.com/wvugrad/TX_SiteLogin?startURL=%2Fwvugrad%2FTargetX_Portal__PB (https://westvirginia.force.com/wvugrad/TX_SiteLogin/?startURL=%2Fwvugrad%2FTargetX_Portal__PB).

Applications are reviewed beginning in November by a Common Admissions Committee comprised of the graduate directors or faculty representatives of our seven Ph.D. graduate training programs and a senior graduate student representing the Graduate Student Organization. The Assistant Vice President for Graduate Education is an ex officio member. The deadline for receipt of applications is December 15 for admission in the Fall semester of the next academic year. Students are not admitted for the spring semester.

All students interested in one of the 7 Biomedical Ph.D. programs must apply through a common admissions portal. Choice of a specific graduate program occurs during the first year of graduate study after selection of an adviser for your dissertation research and choosing one of the degree granting programs. Applications to both the Ph.D. and M.S. programs include a Personal Statement, transcripts from all Colleges or Universities attended, and 3 letters of recommendation. Applicants must arrange to have official copies of transcripts sent directly to the WVU Office of Graduate Admissions and Recruitment, PO Box 6510, Morgantown, WV 26506-6510.

Additional Information:
Biomedical Sciences, M.S., Ph.D.

To review the programs and application process, please visit:

For Ph.D. applicants:  http://www.hsc.wvu.edu/resoff/graduate-education/phd-programs/biomedical-sciences/prospective-students/

For M.S. applicants:  http://www.hsc.wvu.edu/resoff/graduate-education/ms-programs/biomedical-sciences/

Qualified Ph.D. applicants are invited to an all-expense paid, 2.5 day visit/interview to the campus. Qualified M.S. applicants may be interviewed in person or by phone. Students with excellent credentials and who can clearly describe their past research and demonstrate passion for research at the interview are seriously considered for acceptance. Decisions of acceptance are made on a rolling basis, and all decisions made by the Admissions Committee are final. For maximum admissions consideration and eligibility for graduate merit fellowships with enhanced benefits, we recommend that you apply as early as possible.

MS Major Code: 8340

Master of Science

MAJOR REQUIREMENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>BMS 700</td>
<td>Scientific Integrity</td>
<td>1</td>
</tr>
<tr>
<td>BMS 701</td>
<td>Scientific Rigor and Ethics</td>
<td>1</td>
</tr>
<tr>
<td>BMS 706</td>
<td>Biomedical Research Methods</td>
<td>1</td>
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<tr>
<td>Select one of the following:</td>
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<td></td>
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<tr>
<td>BMS 715</td>
<td>Molecular Genetics (Recommended)</td>
<td></td>
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<tr>
<td>Elective (approved by advisor and advisory committee)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMS 720</td>
<td>Scientific Writing</td>
<td>2</td>
</tr>
<tr>
<td>Program- specific elective</td>
<td>3</td>
<td></td>
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<tr>
<td>Journal Clubs</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BMS 702</td>
<td>Biomedical Lab Experience</td>
<td>2</td>
</tr>
<tr>
<td>BMS 747</td>
<td>Foundations for Contemporary Biomedical Research 1</td>
<td>4</td>
</tr>
<tr>
<td>BMS 777</td>
<td>Foundations for Contemporary Biomedical Research 2</td>
<td>4</td>
</tr>
<tr>
<td>Select either the thesis or non-thesis option:</td>
<td>18</td>
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Thesis Option

| Elective (3 hours)                                      |       |
| Research (15 hours)                                     |       |
| BMS 797                                               |       |
| Thesis Proposal                                        |       |
| Thesis Defense                                         |       |

Non-Thesis Option

| Electives (12 hours)                                   |       |
| Research (6 hours)                                     |       |
| BMS 797                                               |       |

Total Hours 42

Seminars and Research Forum

It is recommended that students attend a weekly seminar in their chosen research area during each semester enrolled in the program.

Journal Club

Students are required to enroll in three Journal Clubs during their M.S. studies. 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.

Masters Research

Students will conduct research with a thesis mentor during time in the program. Students register for research credits each semester, and their performance is graded by their thesis mentor.

Thesis Proposal

The thesis proposal is completed in the beginning of the second year of study.
Thesis Defense

The final examination for the M.S. degree consists of orally defending a written thesis in private to the thesis committee – a prior public presentation is encouraged. Satisfactory performance in the oral defense will result in recommendation for granting of the M.S. degree.

Suggested Plan of Study

**THESIS OPTION**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<tbody>
<tr>
<td></td>
<td>1 BMS 700</td>
<td>1 BMS 701</td>
<td>1 BMS 797</td>
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<tr>
<td></td>
<td>1 BMS 706</td>
<td>1 BMS 715</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2 Program Specific Elective</td>
<td>3</td>
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<tr>
<td>BMS 702</td>
<td>4 Journal Club</td>
<td>1</td>
<td></td>
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<tr>
<td>BMS 747</td>
<td>4 BMS 797</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BMS 777</td>
<td>12</td>
<td>9</td>
<td>3</td>
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<table>
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<th>Spring Hours</th>
<th>Summer Hours</th>
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<tr>
<td></td>
<td>12</td>
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<td>3</td>
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**NON THESIS OPTION**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<tbody>
<tr>
<td></td>
<td>1 BMS 700</td>
<td>1 BMS 701</td>
<td>1 BMS 797</td>
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<tr>
<td></td>
<td>1 BMS 706</td>
<td>1 BMS 715</td>
<td>3</td>
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<td></td>
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<td>5</td>
<td>3</td>
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</table>

Total credit hours: 42

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.
Major Learning Outcomes

BIOMEDICAL SCIENCES

This program is designed to assist in the selection of a career path, albeit industry, teaching, or a professional program, and/or for the transition to a biomedical Ph.D. program. The first-year curriculum imparts a fundamental understanding of the functional components of a cell and the basis for regulation of cellular processes and organ systems. After selecting a mentor, students take additional courses that align with their research interests.

Students will:

• Integrate molecular, cellular, and integrative systems concepts
• Critically interpret the current scientific literature
• Develop critical thinking and problem-solving skills
• Demonstrate technical skills in conducting scientific experimentation
• Design and interpret experiments to test molecular, cellular, and integrative systems mechanisms
• Articulate, verbally and in writing, their understanding of concepts during scientific discussions
• Discuss relevant scientific ethical issues presented as case studies
• Engage with fellow students and faculty and demonstrate teamwork

Doctor of Philosophy (Ph.D.) in one of 7 biomedical Ph.D. programs

Students in the first semester of year one in the Biomedical Sciences Graduate Programs take a common core curriculum that covers topics important to all biomedical sciences graduate programs. In addition, they begin training in the responsible conduct of research, and they conduct three short lab experiences to assist in the selection of a faculty mentor for dissertation research. The intended outcomes the first year in graduate school are to match with a faculty investigator who will guide the student to completion of dissertation research, and to successfully transfer into one of the Ph.D. degree-granting biomedical sciences programs.

By the end of the first year students will:

• Integrate molecular, cellular, and integrative systems concepts
• Identify the relevant scientific literature for their proposed area of research
• Conduct and optimize select laboratory procedures
• Develop an oral presentation on a topic that is new to them
• Discuss relevant scientific ethical issues presented as case studies
• Apply responsible research practices to the conduct of their experiments
• Engage with fellow students and faculty and demonstrate teamwork

The individual PhD programs have additional learning outcomes specific to the advanced skills required of a PhD and the specific discipline of that program and the student's research.

COURSES

BMS 684. Journal Club and Seminar. 1 Hour.
PR: Students must be enrolled in the MS in Health Science Program. A study of contemporary topics selected from recent developments in the biomedical sciences and public health.

BMS 685. Professionalism in Health Care. 2 Hours.
PR: Students must be enrolled in the MS in Health Sciences Program. A discussion of the key elements of professionalism in the health care industry.

BMS 693. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

BMS 694. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

BMS 695. Independent Study. 1-9 Hours.
Faculty-supervised study of topics not available through regular course offerings.

BMS 700. Scientific Integrity. 1 Hour.
A course in scientific ethics that is led by individual faculty and incorporates small and large group discussions of ethical issues in science presented as case studies.

BMS 701. Scientific Rigor and Ethics. 1 Hour.
This is the second half of the training in the Responsible Conduct of Research that is required by the National Institutes of Health. The course also incorporates required training in Rigor and Reproducibility.
BMS 702. Biomedical Lab Experience. 2 Hours.
Five week lab rotations within the laboratories of faculty affiliated with the biomedical graduate programs. They are designed for first year graduate students to gain laboratory experience and to pick a laboratory for their dissertation research.

BMS 705. Cell Structure and Metabolism. 1-4 Hours.
This course emphasizes general principles of cell biology, membrane structure and transport, and signaling, proliferation, death and structure of cells and incorporates a literature-based journal club.

BMS 706. Biomedical Research Methods. 1 Hour.
A lecture-based survey of research techniques used in contemporary biomedical science. The emphasis is on the theory behind techniques. Students will learn about standard techniques used in biomedical research from in vitro to in vivo including the use of humans in research. An emphasis is placed on techniques using core facilities at WVU.

BMS 707. Experiential Learning for Biomedical Trainees. 1,2 Hour.
PR: BMS 700, 2 semesters with a grade of P and consent. Experiential learning is an opportunity for graduate students in the biomedical sciences to gain experiences and/or skills outside of their dissertation laboratory that lead to more informed decisions regarding their research questions or their career goals. These experiences are organized by the student and then proposed and approved/disapproved by a faculty committee prior to beginning the experience.

BMS 710. Fundamentals of Integrated Systems. 1-4 Hours.
This course emphasizes four areas of integrated biology - endocrinology, neurobiology, immunology and microbial pathogenesis, with an overview of pharmacology and incorporates a literature-based journal club.

BMS 715. Molecular Genetics. 1-3 Hours.
This course emphasizes general principles of molecular biology (the progression of information from the gene to the production of the active protein or the active RNA) and incorporates a literature-based journal club.

BMS 720. Scientific Writing. 2 Hours.
This course introduces students to scientific writing and requires them to write a journal article and a pre-doctoral grant proposal, based on the format used by NIH.

BMS 736. Immunology and Microbial Pathogenesis. 3 Hours.
PR: BMS 710. An expansion of the concepts and mechanisms of basic immunology and microbial pathogenesis previously introduced in Fundamentals of Integrated Systems BMS 710.

BMS 738. Muscle Structure and Function. 2-3 Hours.
This course examines in-depth the concepts in muscle structure and function with emphasis on normal physiology and applications to overload/exercise and disuse or aging.

BMS 747. Foundations for Contemporary Biomedical Research I. 4 Hours.
This course is the first of a two-part package that provides students with a foundation in cellular and molecular systems. It enables students to evaluate normal and pathological pathways while examining common issues that alter normal function. Students considering any research path directed toward human health and disease will find this course valuable.

BMS 777. Foundations for Contemporary Biomedical Research 2. 4 Hours.
PR: BMS 747. This course is the second of a two-part package that provides students with a foundation in cellular and molecular systems. It enables students to evaluate normal and pathological pathways while examining common issues that alter normal function. Students considering any research path directed toward human health and disease will find this course valuable.

BMS 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of biomedical sciences. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be P/F.).

BMS 791A. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation in advanced topics that are not covered in regularly scheduled courses.

BMS 792. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

BMS 793A-B. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

BMS 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

BMS 796. Graduate Seminar. 1-3 Hours.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

BMS 797. Research. 1-9 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).