

GRADUATE COLLEGE OF BIOMEDICAL SCIENCES

Master of Science in Biomedical Sciences

PROGRAM GOALS

To train post-graduate students in the principles and experimental methodologies of biomedical science as they relate to human and animal health and disease. Graduates will develop the requisite critical thinking skills and knowledge to satisfy a goal of becoming leaders in biomedical research, in academics, or biomedical technology.

PROGRAM OVERVIEW

A minimum of 40 semester credit hours is required for completion of the MS program. This includes 28 hours of didactic study and 12 hours of research credits, leading to a thesis. The program emphasizes research in the biomedical sciences.

PROGRAM FACULTY

Program faculty are from the College of Osteopathic Medicine, Veterinary Sciences, Pharmacy, Dental Medicine, Optometry and Podiatry. Their areas of research emphasis include pharmacology, molecular biology, microbiology, biochemistry, immunology, neuroscience, anatomy and physiology.

APPLICATION AND ADMISSIONS REQUIREMENTS

Applicants must possess a Bachelor of Science degree with strong science component.

Minimum criteria to receive consideration for admission follow. Meeting these criteria, however, does not guarantee admission into the program.

- A completed Western University of Health Sciences Graduate Application form (including all supplemental information for international applicants).
- Official transcripts of all undergraduate and graduate coursework with an overall GPA of 3.0 or greater on a 4-point scale.
- Official test scores for the general aptitude portion (verbal, quantitative, and analytical) of the Graduate Record Examination (GRE) taken within the last five (5) years, with a score of greater than or equal to 1000 on the combined verbal and quantitative.
- Three letters of reference from individuals familiar with the applicant's scholarship and research potential.

Application Deadline:

Applications must be received (including all supporting application materials) no later than September 1 for the spring semester (January) and March 1 for the fall semester (August). Completed applications that arrive before the deadline may be considered on a rolling basis.

Transfer Credit

A maximum of 10 graduate credits in which the student has earned an "A" from an equivalent program from another university will be honored towards the MS in Biomedical Sciences for students transferring into Western U. The Dean of GCBS must approve all transfer credit, and the decision of the Dean is final.

TUITION AND FEES

In estimating costs for one academic year of study at Western University of Health Sciences' MS-BS program, you should include tuition and fees, laptop computer and printer, books and supplies, room and board, and other miscellaneous expenses. Actions of the Board of Trustees setting tuition and fees for the academic year are established during the previous spring term. The most current tuition and fees are as follows (subject to change):

- Tuition - \$603 per credit hour in 2009-2010 Academic Year.
- Other Mandatory fees specific to the College of Biomedical Sciences will be provided separately.
- Application Fee - Non-refundable \$50 fee for those applying to the Western University MS-BS program.

Other Fees

\$200	Graduation Fee (Assessed on candidates for graduation only)
\$400	(annual) Western University Parking Permit Fee (Optional)
\$30	(per day) Late Registration Fee

\$40	Lost Mail Locker Key
\$6	(each) Copy of Official Transcript
\$21	(each) Rush Transcript, First Class Mail
\$25	(each) Rush Transcript, Federal Express
\$10	Lost ID Badge
\$0.25 (per page)	Copy of Student File Material
(replacement cost)	Breakage Fee

FINANCIAL SUPPORT

Financial support, which includes a stipend and full payment of tuition, is available to qualified applicants on a limited, competitive basis in the form of teaching and research assistantships. Support is for 12 months (including summers) and is limited to a total of two consecutive years for any student.

Students may also receive a travel stipend, which allows for travel to a national meeting.

ACADEMIC POLICIES AND PROCEDURES

Program Outcomes

1. **Critical Thinking:** The MS-BS graduate will be able to identify and understand critical issues in biomedical sciences. They should possess the ability to challenge and evaluation information using evidence-based research principles, as well as synthesize and integrate knowledge in the discipline, leading to new ideas, approaches and research.
2. **Breadth and Depth of Knowledge:** The MS-BS graduate will understand the current and historical theories, concepts, and models of biomedical sciences. They should possess the ability to access and evaluate the literature of the discipline and understand the major issues in the current state of knowledge. They should also possess an ability to transcend traditional disciplinary boundaries and effectively conduct original, discovery-based or applied research in biomedical sciences under the direct guidance of a faculty member.
3. **Interpersonal Skills:** The MS-BS graduate will possess the ability to write and speak about the current issues of biomedical sciences to peers, practitioners and the public. They should be able to articulate and demonstrate knowledge of the discipline and write and present scholarship to professionals.
4. **Collaboration Skills:** The MS-BS graduate will be able to collaborate with other members of the research team, with colleagues (both within the discipline and across related disciplines), and if appropriate, with other communities of interest in the conduct of a research program.
5. **Ethical and Moral Decision Making (Humanistic Skills):** The MS-BS graduate will understand and exhibit the professional standards for responsible and ethical conduct of research in pharmaceutical sciences.
6. **Life-Long Learning:** The MS-BS student should be able to engage in life-long, self-directed learning to maintain and expand competence in the discipline, including staying abreast of current issues, methods and approaches in biomedical sciences.
7. **Evidence-Based Research:** The M-BPS student will have a solid grounding in the literature pertaining to a particular question and be able to understand and appropriately use the methods and techniques of advancing knowledge in their field of study. They should be capable of designing, working within, and coordinating multi-disciplinary research programs.

Attendance and Absences

Attendance is required at all scheduled instructional periods. Absence from instructional periods for any reason does not relieve the student from responsibility for the material covered during the periods missed. Unexcused absences for any reason will result in a loss of TA wages for the period of the absence.

Vacation and Emergencies

Students receive two weeks' vacation each year over the Christmas break. Students may not expect to take more time than this, may not leave early or return late from the break. Vacations are not provided during academic semesters. Summers are the optimal time for focused research effort and as such no vacation time is allowed for this period. Under special circumstances, a student may arrange a brief 1 -3 days off at the discretion of the program chair director and their faculty supervisor in advance. It is the Dean's and faculty supervisor's prerogative whether to grant the time off and is not guaranteed. Students should not enter the program with the expectation of taking time off for other pursuits (i.e. Interviews for other programs, leaving the country, hobbies, etc.)

Emergencies, including medical problems or serious personal/family issues, which result in less than 15 academic days (3 calendar weeks) away from campus, may be granted upon approval by a student's faculty mentor, in conjunction with the Dean, GCBS. Any missed course material is the responsibility of the student, and students may be required to complete alternative assignments, at the discretion of course faculty.

Students with emergencies resulting in more than 15 academic days (3 calendar weeks) away from campus must apply in writing for a Leave of Absence to the appropriate Academic Dean or his/her designee. Please see the University Catalog's "General Academic Policies and Procedures" for more specific information on a Leave of Absence.

Faculty Advisor and Thesis Advisory Committee

The faculty advisor serves as the Chair of the student's Thesis Advisory Committee and helps the student in his/her choice of electives and research projects/thesis topic. Further, the advisor may also assist the student in obtaining a research assistantship if funds are available. The Chair is responsible for the satisfactory academic progress of the student, and must hold committee meetings with the student on a regular basis.

Students will be assigned a faculty advisor prior to admission to the program, and must remain with that advisor for the duration of the degree program.

The thesis advisory committee consists of at least three faculty members (the faculty advisor plus two other faculty members). The Chair and at least two of the committee members must be full time faculty at the Western University of Health Sciences. Upon approval by the Dean, GCBS, a fourth member from within Western University of Health Sciences may be eligible for appointment to the committee.

Thesis

The thesis will be based on a research project that the student will undertake during the MS program. The faculty advisor will help the student select a topic and mentor the student in his/her progress.

MS candidates are required to present a written report of the thesis and present it to the thesis advisory committee for approval. In addition, students will be required to defend their thesis via an oral presentation for the content at the end of their program. The oral defense may also include questions based on the required course work completed by the student. The defense committee will consist of the thesis committee and an external member from within the Western University of Health Sciences faculty whose role will be to ensure that the defense is conducted fairly.

All candidates must pass a comprehensive examination covering the major and minor field, as well as the research and thesis. This usually is a two-hour oral examination. Members of the university faculty not on the thesis advisory committee may attend any oral examination as visitors. The faculty advisor will schedule the oral examination not later than the date of the deadline set by the Dean, GCBS. Successful completion requires the unanimous support of all members of the thesis advisory committee. If a student fails the oral examination, one re-examination may be accorded the student based on its recommendation by the thesis advisory committee and approval by the Dean, GCBS. Further re-examinations may be allowed only under exceptional circumstances and only with the approval of the Dean, GCBS.

Upon satisfactorily passing all exams, students are to provide 7-8 professionally printed copies of their thesis for: their committee members (3-4), the department (1 copy), the Dean's Office (1 copy) and the university library (2 copies).

A fee will be charged to the student for microfilming their thesis.

Grading System

Official grades are turned in to the Registrar from the College of Pharmacy Dean, at which time the online student records system, BanWeb, is updated. Official grade reports and unofficial transcripts will be available on the BanWeb student records system throughout the academic year. For more information on how to access the BanWeb student records system, visit the Registrar's website at <http://www.westernu.edu/registrar>.

Western University of Health Sciences makes use of letter grades, which may include a plus/minus (+/-) system of grading. The MSPS program makes use of letter grades only. A four-valued letter grade scale will be given, indicating:

Grade			Quality Points
A	-	Excellent	4
B	-	Good	3
C	-	Satisfactory	2
U	-	Unsatisfactory	0
I	-	Incomplete	0
Au	-	Audit	0
W	-	Withdrawal	0
M	-	Missing	0
CR	-	Credit	0
NCR	-	Non-credit	0

Courses are rated at one semester hour for each 12 contact hours. The grade point average is calculated at the end of each semester as the sum of earned grade points divided by the sum of semester hours passed and failed. A cumulative grade point average will be calculated and posted on the transcript.

No grade will be changed unless the instructor certifies in writing that an error in computing or recording the grade has occurred or that the student has completed course requirements for an Incomplete grade or remediated an Unsatisfactory grade.

Withdrawing from Courses

Courses may be dropped without academic penalty on or before end of the third week of the semester. A course may be dropped after the third week of the semester only under unusual conditions. When the Department Chair approves dropping the course under such circumstances, a "W" will be assigned for the course.

Incomplete

An Incomplete grade ("I") will only be assigned to students whose professional commitments and/or personal responsibilities prevent him or her from completing the requirements of the course. A student may remove an incomplete by completing course requirements within the following six calendar months or the final grade will be permanently recorded as a "U". This rule applies regardless of the student's enrollment status. A student not enrolled during the following six months must still successfully remove the "I" grade. The instructor must certify any grade changes. The I grade will remain on the student's transcript, along with the final grade assigned by the instructor.

Academic Standing

Only grades in Western University of Health Sciences courses approved for graduate credit will be used in determining the overall grade point average for continuation in the MSPS program. If, at the end of any semester, the cumulative grade point average falls below 3.0, the student will be placed on academic probation, and financial support will be discontinued. A 2.0 (C) grade earned in any class may be applied toward graduation only if the overall grade point average at the time of application for graduation continues at a minimum 3.0 (B) cumulative grade point average. Any grade below a 2.0 (C) may not be applied toward graduation.

Dismissal

If the cumulative grade point average remains below a 3.0 after the student completes a total of 9 (nine) graded credit units subsequent to being placed on academic probation, the student will be dismissed from the program. The student may be readmitted only after completion of a remediation plan recommended by the Thesis Advisory Committee. No course work taken as part of the remediation plan will be counted toward the MSPS degree or

incorporated into the student's cumulative grade point average. Graduate level courses for which grades below "C" were earned may not be repeated during the remediation period.

Standards of Academic and Professional Conduct: GCBS Honor Code

Honesty and integrity are among the most valued traits of academic researchers and health-related scientists. Each student is expected to assume personal responsibility for those traits. Academic dishonesty includes cheating, plagiarism, using unauthorized resources during examination(s), sabotaging other students and mentors research as well as signing another person's name to an attendance or examination document. Matters of academic dishonesty and professional misconduct will be handled consistently with the University's guidelines for Hearings involving alleged violations of the standards of professional conduct as described in the University's General Academic Policies and Procedures. ANY INDIVIDUAL WHO WITNESSES OR BECOMES AWARE OF A POSSIBLE VIOLATION OF THE HONOR CODE IS BOUND TO REPORT THE INCIDENT. STAFF OR STUDENTS MUST REPORT THE INCIDENT TO A FACULTY MEMBER AND FACULTY MEMBERS MUST REPORT THE INCIDENT TO THE DEAN, GCBS.

Upon receipt of an allegation of misconduct, the Dean, GCBS will either address the matter directly or will appoint an ad hoc committee of the Faculty and student(s) of the program to investigate the allegation and forward a recommendation on a course of appropriate action to the Dean, GCBS. Potential sanctions could include placing the student on probation, require the student to undertake specific remedial activities, suspension for a defined period of time, or dismissal from the program. Decisions of the Dean in matters of conduct may be appealed following the procedure outlined in the Overview section of this Catalog.

Graduation Requirements

For successful completion of the MSPS program, the faculty of the College of Pharmacy has established guidelines and requirements in addition to the courses and optional requirements listed above. Minimum requirements for graduation with an MS include:

- a. A minimum grade of 2.0 in each graduate course taken as part of the program.
- b. Overall 3.0 GPA of course work taken in the program
- c. Satisfactory completion and oral defense of a written thesis as well as satisfactory completion of all approved coursework.
- d. Attendance at the commencement ceremony during which time the degree will be awarded. Requests to be excused from this requirement must be submitted in writing to the President and approved subject to whatever additional stipulations the President shall make.
- e. All financial and other obligations to the University have been met.

No student may graduate until all "I" (incomplete) and "M" (missing) grades are removed, and the removal must be completed at least three weeks before the date of graduation, regardless of whether the course is included on the student's Plan of Studies

The program of studies must be completed within a minimum of two and a maximum of three calendar years.

PROGRAM DESCRIPTION

To graduate, students must complete a minimum of 40 credit hours, including 20 credit hours of the six core courses, 8 credit hours of Electives, and 12 credit hours of Research and Thesis.

Required Courses

GCBS 5000	Introduction to Biomedical Sciences	4 credits
GCBS 5040	Molecular and Cellular Basis of Life	4 credits
GCBS 5060	Introduction to Biotechnology	2 credits
GCBS 5080	Biological Systems in Human Disease	4 credits
GCBS 5090	Biomedical Statistics and Research	2 credits
GCBS 6999	Thesis	12 credits

Elective Courses

GCBS 6000	Advanced Topics in Immunology/Molecular Biology	4 credits
GCBS 6201	Advanced topics in Pharmacology	2 credits
GCBS 6301	Advanced topics in virology	2 credits
GCBS 6302	Advanced topics in Genetics	2credits
GCBS 6401	Advanced topics in Structural Biology	2credits
GCBS 6501	Advanced topics in Neurobiology	2credits

GCBS 6601	Research Rotations	2 credits
GCBS 6701	Directed Reading	1-5 credits
GCBS 6702	Advanced Biotechnology	4 credits

Example Degree Schedule

Semester	Course	Credits
Fall, Year 1	Introduction to Biomedical Sciences	4
	Molecular and Cellular Basis of Life	4
	Introduction to Biotechnology	2
Spring, Year 1	Biological Systems in Human Disease	4
	Research Laboratory Rotations	4
	Biomedical Statistics and Research	2
Summer	Paid Summer Research	No Credits
Fall, Year 2	Elective I	4
	Graduate Seminar	2
	Thesis	4
Spring, Year 2	Elective II	4
	Graduate Seminar	2
	Thesis	4
	Total	40

COURSE DESCRIPTIONS

GCBS 5000 Introduction to Biomedical Sciences 4 credit hours (Graded)

This course covers a wide range of topics such as biochemistry, microbiology, pharmacology and immunology, Some laboratory safety and research techniques will also be discussed in the course.

GCBS 5040 Molecular and Cellular Basis of Life 4 credit hours (Graded)

This course covers a wide range of topics in molecular and cellular basis of life. The goal of this course is to provide an integrative view of the general principles in molecular biology, genomics, biochemistry, cellular physiology, metabolism and basic histology.

GCBS5060 Introduction to Biotechnology 2 credit hours (Graded)

This course will provide theoretical knowledge, hands-on laboratory experience and practical computer skills necessary and sufficient to start practical work in biotechnology projects..

GCBS 5080 Biological Systems in Human Disease 4 credit hours (Graded)

This course is designed to provide the first year biomedical graduate student with a comprehensive foundation in the biological systems, microbial pathogens and the immune response. The primary goal of this course is to provide an integrative view of the general principles in systems biology, microbiology and immunology.

GCBS 5090 Biomedical Statistics and Research 2 credit hours (Graded)

This course will cover various topics in descriptive and inferential statistics intended to introduce the student to the theoretical and practical aspects of statistics in research. Various topics will include central tendency, variability, hypothesis testing, multi-factorial analysis of variance, trend analysis, regression analysis and correlation.

GCBS 6000 Graduate Seminar 2 credit hours (Cr/NCr)

This is an elective course. Repeatable to a maximum of 4 credit hours

GCBS 6201 Advanced Topics in Pharmacology 2 credit hours (Graded)

This advanced elective will address concepts and principles of neuronal identify and function that are germane to pharmaceutical sciences. Principles will be introduced followed by experimental applications. The course will integrate molecular, cellular, and behavioral concepts when applicable. Course topics include chemical and electrical transmission, neurotransmitter chemistry, neuroreceptor pharmacology and signal transduction mechanisms, structure and function of ion channels and ligand binding sites, synaptic plasticity with an introduction to electrophysiology. Relevant and recent primary literature articles will be introduced for reading and subsequent group discussion.

GCBS 6301 Advanced Topics in Virology 2 credit hours (Graded)

Advanced discussions on topics in virology. Classes are organized around recent papers in the virological literature. Topics include HIV, hantavirus infection, prions, and the hepatitis viruses.

GCBS 6302 Advanced Topics in Genetics 2 credit hours (Graded)

This course is designed to focus on how genetic and molecular mechanisms influence multiple aspects of biological life. The course will cover physical and chemical properties of genes, transmission mechanisms, and processes by which genes are manifested as physical characteristics in a whole organism. The control of gene expression is an important concept covered in this course.

GCBS 6401 Advanced Topics in Structural Biology 4 credit hours (Graded)

This advanced elective will address concepts and principles of structural biology and immunology with an emphasis in molecular neuroimmunology. Topics will include cells, organs and effect tor systems involved in both cell-mediated and humoral-mediated immune activity. Time will be spent looking at regulatory interactions among different components of the immune system and the deleterious effects of aberrant immune processes. Principles will be introduced, followed by experimental applications. Relevant and recent primary literature articles will be introduced for reading and subsequent group discussion.

GCBS 6501 Advanced Topics in Neurobiology 2 credit hours (Graded)

This advanced elective course will address concepts in neurobiology.

GCBS 6601 Laboratory Rotations 2 credit hours (Graded)

Assigned laboratory experiences introducing students to the research techniques and protocols under the guidance of faculty members at the Western University of Health Sciences.

GCBS 6701 Directed Readings 1-5 credit hours (Graded)

Selected study of topics in the Biomedical sciences. Repeatable to a maximum of 5 credit hours

GCBS 6702 Advanced Biotechnology 4 credit hours (Graded)

This course covers advanced topics in biotechnology and their application in biomedical sciences.

GCBS 6999 Thesis 1-5 credit hours (CR/NCR)

Completion of a thesis is mandatory for the Master of Science in Biomedical Sciences degree program. The thesis will be based on a research project that the student will work on during the MS-BS program. The faculty advisor (thesis advisor) will help the student select a topic and mentor the student in his/her progress. Students are expected to prepare a thesis proposal, attend regular meetings with course instructors and his/her thesis/faculty advisor. Submission and oral defense of the written thesis is required to complete the program. The last part of thesis defense included a comprehensive examination. Repeatable to a maximum of 10 credit hours.

Academic Calendar 2009-2010
MS-BS PROGRAM
(subject to change)

Monday, Jan. 4, 2010
Spring Semester Classes begin

Monday, Jan. 11, 2010
Martin Luther King Day

Monday, Feb. 15, 2010
Presidents Day

Thursday, May 20, 2010
Commencement

Friday, May 21, 2010
Last Day of Spring Semester

Monday, May 31, 2010
Memorial Day