

HANDBOOK: Cellular and Molecular Biomedical Science Master's Program**I. Outline of Study**

The Master's Program in Cellular and Molecular Biomedical Science (CMBS-MS) at the University of Maryland emphasizes medically-relevant scientific research and education, utilizing state-of-the-art resources. The program is designed as a 2 year curriculum for full-time students, but may be completed over 5 years for part-time, working students. Students will become fluent in the study and implementation of biomedical research and will be well-prepared as skilled researchers for careers in academic research centers, government, and industry, including biotechnology firms and pharmaceutical companies.

Cellular and Molecular Biomedical Science combines traditional areas of biomedical study, including cancer biology, human genetics, molecular and cell biology, pathology, pharmacology, and physiology into a unique interdisciplinary graduate training program. Specifically designed to develop scientists for the post-genomic era, CMBS-MS students will gain knowledge, research skills, and familiarity with the state-of-the-art biomedical tools and methodologies to solve important and timely questions in biomedical science.

The Basic Research Track is designed to provide graduate training leading to positions as laboratory managers and skilled technicians, and prepare students for further training in doctoral programs. Graduates of this program typically accept positions in industry or continue their studies in PhD programs, Medical School, Dental School, or other professional programs.

The Translational Research Track is designed to train students in the NIH-CTSA Core Competencies for Translational Research. Graduates will be prepared to fill the increasing demand for skilled translational researchers in academic research centers, government, and industry, including biotechnology firms and pharmaceutical companies. Areas of concentration include: Stem Cell Research, Translational Cancer Research, and Pharmacogenomics. This track is a great option for traditional graduate students as well as current industry employees and professional degree holders (MD, RN, PharmD, DDS) looking to advance their careers in the field of translational research.

II. Thesis / Non-thesis option

CMBS-MS students select either a thesis or non-thesis option. The thesis option is a research-based program in which the student selects a mentor and undertakes a research project culminating in a written thesis and public seminar. The non-thesis option entails laboratory rotations and focused coursework.

Non-thesis:

Students selecting the non-thesis option will take a minimum of 30 credits, of which 3-6 must be laboratory rotations (*GPLS 609, section 7*), taken up to 3 credits per semester. Two rotations are required; we suggest taking 2 rotations for 2 credits each. The remaining credits will be coursework selected by the student and approved by the program director. The program director will serve as the non-thesis student's academic advisor.

Thesis:

Students selecting the thesis option are required to take a minimum of 6 credits of MS thesis research (*GPLS 799, section 2*) and must take a minimum of 12 credits of coursework (8 credits of which will be the Core Course, *GPLS 601*, taken during the first semester), the balance of the credits may consist of laboratory rotations (3-6 credits), or additional courses.

1.) *Mentor*. Students choosing to pursue the thesis option will select a research mentor. The mentor will guide all aspects of the research program, assist in course selection, and mentor the student in their thesis preparation and presentation. The program director continues to sign off on all paper work for the student. Mentors can be selected from throughout the University, and because the program director is recognized by the University as the student's advisor, mentors may also be chosen off-campus or from outside the University of Maryland system. In this case, the student should arrange to have the mentor's CV forwarded to the program director. A great place to start searching for a mentor by research topic is the research portal link below: <http://www.experts.scival.com/maryland/>. It is strongly recommended that students begin the process of identifying a thesis mentor in the first semester and arrange a laboratory rotation for the start of the spring semester.

2.) *Thesis project*. The research undertaken as part of the thesis is guided by the thesis mentor and the student. In most cases, the mentor will provide substantial input into the project goals and design. It is important that the student and mentor design a project that is consistent with the time frame of the CMBS-MS degree, i.e., 2-3 semesters of dedicated research time.

3.) *Thesis proposal*: The CMBS-MS program does not have a strict requirement for a thesis proposal. However, it is strongly recommended that students write a short proposal of the thesis research, including an introduction with hypothesis, methods, and time line, and file this with the program director and thesis committee.

4.) *Thesis committee*: The thesis committee should consist of 3-5 members, one of whom is the thesis mentor. At least one member of the committee must be a regular member of the graduate faculty. Refer to the Graduate School website

(http://graduate.umaryland.edu/graduate_people/list/grad_faculty.html) for a list of graduate faculty members. Committee members should be selected that can assist the student in guiding their thesis research. Thus, the committee should be identified as early as possible so that their expertise is available. Committee members should be selected by the student and mentor in consultation with the Program Director. The names of the thesis committee should be forwarded to the Program Director as soon as available. The student should arrange for committee meetings each semester to ensure progress is being monitored in a consistent manner.

5. *Thesis requirements*: There is no specified length for the thesis. However, the written document should be complete and follow the guidelines set forth by the Graduate School ("Thesis and dissertation style guide"). CMBS-MS theses are filed electronically, although it is appropriate to provide the mentor and members of the thesis committee a bound hard copy. Information on thesis preparation and guidelines can be found at http://www.graduate.umaryland.edu/current_students/degree_cert.html. A finished draft of the thesis should be provided to the committee at least 4 weeks prior to the scheduled seminar (see below). The committee will determine if the thesis is defensible and provide feedback and suggestions for the written document. If the thesis is deemed not defensible, the student must address the issues raised by the committee before continuing forward.

6. *Final exam*: The final exam consists of a public seminar and a closed oral exam. The seminar should be scheduled upon confirmation by the committee that the thesis is defensible and publicized through the program director. CMBS-MS thesis seminars are generally 40 minutes in length, followed by questions from the audience. The oral exam is closed to the public and includes only the thesis committee. One member of the committee will be assigned as the Dean's representative and be responsible for communicating the results of the final exam to the graduate school, as well as serving as the chair of the committee. The oral exam should not exceed 2 hours in length, and specific guidelines for all aspects of the MS thesis exam are provided in http://graduate.umaryland.edu/documents/ms_exam.pdf.

III. Track selection

Students must select one of 2 tracks in the Cellular and Molecular Biomedical Science Master's Program:

Molecular Medicine Research - designed to provide graduate training leading to positions as laboratory managers and skilled technicians, and to prepare students for further training in doctoral programs. Graduates of this program typically accept positions in industry or continue their studies in PhD programs, Medical School, Dental School, or other professional programs.

Translational Research - designed to train students in the NIH-CTSA Core Competencies for Translational Research. Graduates will be prepared to fill the increasing demand for skilled translational researchers in academic research centers,

government, and industry, including biotechnology firms and pharmaceutical companies. Areas of concentration include: Stem Cell Research, Translational Cancer Research, and Pharmacogenomics. This track is a great option for traditional graduate students as well as current industry employees and professional degree holders (MD, RN, PharmD, DDS) looking to advance their careers in the field of translational research.

Please see detailed track requirements below:

A. Molecular Medicine Research: Non-Thesis Option

GPLS 601 - Core Course Mechanisms in Biomedical Sciences (8 credits)

Choose 1 course out of the courses listed below to take with the Core Course (1 credit):

GPLS 690 – Current Topics in Vascular and Stem Cell Biology

GPLS 691 – Molecular Neuroscience and Biophysics

GPLS 692 Current Topics in Genetics/Genomics

CIPP 907 - Responsible Conduct of Research (1 credit)

GPLS 609, Section 07 - Laboratory Rotations (2 x 2 credits suggested, 6 credits max)

GPLS 630 – Fundamentals of Biostatistics (or equivalent) (2 credits)

In addition to these required courses, students will take elective courses in an area of emphasis, such as physiology, pharmacology, or molecular and cell biology. Students will work with the faculty director of the MS program to choose a course of study that forms a coherent structure and provides advanced expertise in the chosen area of emphasis.

B. Molecular Medicine Research: Thesis Option

GPLS 601 - Core Course Mechanisms in Biomedical Sciences (8 credits)

Choose 1 course out of the courses listed below to take with the Core Course (1 credit):

GPLS 690 – Current Topics in Vascular and Stem Cell Biology

GPLS 691 – Molecular Neuroscience and Biophysics

GPLS 692 Current Topics in Genetics/Genomics

CIPP 907 - Responsible Conduct of Research (1 credit)

GPLS 609, Section 07 - Laboratory Rotations (1 or 2 x 2 credits suggested)

GPLS 630 – Fundamentals of Biostatistics (or equivalent) (2 credits)

GPILS 799, Section 02 - Master's Thesis Research (6 credits min, 18 credits max, 1-6 per semester)

In addition to these required courses, students will take elective courses in an area of emphasis, such as physiology, pharmacology, or molecular and cell biology. Students will work with their thesis advisor and the faculty director of the MS program to choose a course of study that forms a coherent structure and provides advanced expertise in the chosen area of emphasis.

C) Translational Research: Non-Thesis Option

GPLS 600 – Translational MS Core Course (5 credits)

Choose 1 course out of the courses listed below to take with the Core Course (1 credit):

GPLS 690 – Current Topics in Vascular and Stem Cell Biology

GPLS 691 – Molecular Neuroscience and Biophysics
GPLS 692 Current Topics in Genetics/Genomics
GPLS 609, Section 07 - Laboratory Rotations (2 x 2 credits suggested, 6 credits max)
PREV 616 - Introduction to Clinical and Translational Research (2 credits)
CIPP 907 - Responsible Conduct of Research (1 credit)
GPLS 791 - From Bench to Bedside: Steps in Trans Research (2 credits)
GPLS 630 - Fundamentals of Biostatistics (or equivalent) (2 credits)
Course Work in Area of Emphasis: (6 credits selected from one of the below)

Stem Cell Research

GPLS 792 - Stem Cells: Hot Topics and Techniques (2 credits)
GPLS 665 - Cancer Biology: Basic Research to the Clinic (3 credits)
GPLS 690 - Current Topics in Vascular/Stem Cell Biology (1 credit)
GPLS 717 - Molecular Genetics/Model Organisms (2 credits)

Translational Cancer Biology

GPLS 624 - Oncopharmacology (3 credits)
GPLS 665 - Cancer Biology: Basic Research to the Clinic (3 credits)
GPLS 790 - Advanced Cancer Biology (3 credits)

Pharmacogenomics

GPLS 692 - Current Topics in Genome Biology (1 credit)
GPLS 716 - Genomics and Bioinformatics (3 credits)
GPLS 607 - Principles of Pharmacology (3 credits)
HGEN 601 - Basic Human Genetics I (4 credits)
PHAR 622 - Advanced Pharmacogenomics (2 credits)

D) Translational Research: Thesis Option

GPLS 601 - Core Course Mechanisms in Biomedical Sciences (8 credits)
Choose 1 course out of the courses listed below to take with the Core Course (1 credit):
GPLS 690 – Current Topics in Vascular and Stem Cell Biology
GPLS 691 – Molecular Neuroscience and Biophysics
GPLS 692 Current Topics in Genetics/Genomics
GPLS 609, Section 07 - Laboratory Rotations (1 or 2 x 2 credits suggested, 6 credits max)
PREV 616 - Introduction to Clinical and Translational Research (2 credits)
CIPP 907 - Responsible Conduct of Research (1 credit)
GPLS 791 - From Bench to Bedside: Steps in Trans Research (2 credits)
GPLS 630 - Fundamentals of Biostatistics (or equivalent) (2 credits)
GPLS 799, Section 02 - Master's Thesis Research (6 credits min, 18 credits max, 1-6 credits per semester)
Course Work in Area of Emphasis: (6 credits selected from one of the below)

Stem Cell Research

GPLS 792 - Stem Cells: Hot Topics and Techniques (2 credits)
GPLS 665 - Cancer Biology: Basic Research to the Clinic (3 credits)
GPLS 690 - Current Topics in Vascular/Stem Cell Biology (1 credit)
GPLS 717 - Molecular Genetics/Model Organisms (2 credits)

Translational Cancer Biology

GPLS 624 - Oncopharmacology (3 credits)

GPLS 665 - Cancer Biology: Basic Research to the Clinic (3 credits)

GPLS 790 - Advanced Cancer Biology (3 credits)

Pharmacogenomics

GPLS 692 - Current Topics in Genome Biology (1 credit)

GPLS 716 - Genomics and Bioinformatics (3 credits)

GPLS 607 - Principles of Pharmacology (3 credits)

HGEN 601 - Basic Human Genetics I (4 credits)

PHAR 622 - Advanced Pharmacogenomics (2 credits)

IV. Coursework

A minimum of 30 credits with a GPA of 3.0 or hire is required for graduation for all students. CMBS-MS students may select courses from any program within GPLS. Some courses in other professional schools on campus and schools in the University of Maryland System may be acceptable for enrollment, but students must seek the approval of the program director prior to registering for any courses outside of GPLS. Please see detailed course requirements by thesis option and track above.

Note: Thesis students must be registered for at least 1 credit of course work in the final semester that they defend their thesis.

Note: International students must be registered for a minimum of 9 credits in each semester except their final semester of the program.

V. Registration

The program director will register students for their first semester, and thereafter students will register themselves through SURFS after obtaining approval from the program director. Students should submit the course registration form found in http://www.graduate.umaryland.edu/academics/course_schedule.html to the program director for approval prior to registration. Students are responsible for completing their registration in a timely manner.

VI. Lab Rotations

The purpose of laboratory rotations is to introduce students to bench research and provide an opportunity for potential mentors and students to work together prior to selecting a thesis laboratory. A maximum of 6 laboratory rotation credits (GPLS 609, Section 07) may be applied towards graduation. Students selecting the thesis option may take a single rotation and are encouraged to rotate with a mentor that is a potential thesis advisor. In this case, research performed during the rotation may be included in the thesis, i.e., the rotation serves as part of the thesis research. Non-thesis students are required to undertake two rotations in different laboratories. In general, rotations are 8 weeks in duration, with the daily schedule set by the student and rotation mentor. A laboratory rotation proposal should be filled out prior to the rotation, and a laboratory rotation completion form completed following the rotation and submitted to the program

director. Rotation mentors must complete the grade form in order for students to receive a grade (pass/fail) for the rotation. Please see website for required forms:

http://lifesciences.umaryland.edu/CMBS/student_resources.aspx

VII. Finances

Fee structure can be found at:

<http://www.umaryland.edu/institutionalresearch/tuition/FY2014TuitionandFeesBORApproved051513.pdf>

The CMBS-MS program does not offer stipends, scholarships, or assistantships. Faculty mentors ARE NOT required to provide payment for MS students in their laboratories. You must make this very clear when approaching a faculty member to rotate or perform thesis research with them. You may be eligible for financial assistance - please see <http://www.umaryland.edu/fin/index.html> for information on financial aid. MS students may also be employed at their discretion. Please see <http://www.umaryland.edu/campuslife/howeare/studentemployment.html> for campus employment opportunities. In specific circumstances, students may be employed on campus as, for example, laboratory technicians. Some campus employment contracts offer the benefit of tuition remission.

VIII. Application to the MMED-PhD Program

The Program in Cellular and Molecular Biomedical Science does not “transfer” CMBS-MS students into the PhD program. Rather, students must file a new application with all required components including application fee by the scheduled deadlines, to be considered in the yearly applicant pool. *In order to be eligible to apply to any PhD program in the Graduate Program in Life Sciences, MS students must achieve a grade of B or better in the Core Course (GPLS 601).*

IX. International Students

The Office of International Services will assist international students with document processing and facilitate visa services. They are located in the Suite 302 of the SMC Campus Center (<http://www.umaryland.edu/ois>). In addition, information on international student support can be found at: <http://www.umaryland.edu/ois/index.html>

X. Student Academic Misconduct

Students pursuing an M.S. in Cellular and Molecular Biomedical Science are expected to perform within the norms of academic and scientific ethics. Please refer to the Graduate School policies regarding academic misconduct at http://www.graduate.umaryland.edu/grad_policies/misconduct.html. Plagiarism is a common form of academic misconduct. A student can be accused of plagiarism if he or she quotes someone else, either verbatim or in extensive paraphrasing, without proper citation of that quote. In preparing for a classroom assignment, if you are not aware of

the proper procedure in avoiding plagiarism, please discuss this with your mentor, the course director.

XI. Academic Dismissal

Students must have a cumulative 3.0 grade point average to graduate. Any student finishing an academic semester with a GPA less than 3.0 will be placed on academic probation and be required to submit a remediation plan to the program director and graduate school. The graduate school may dismiss students whose grade point average is low enough that achieving a 3.0 is highly unlikely. CMBS-MS students will not be dismissed for grades of B- or below in the Core Course unless the semester grade point is considered too far from 3.0 to recover.

XII. Graduation Requirements

Documents and deadlines for graduation can be found at: http://www.graduate.umaryland.edu/graduate_people/index.html. Students are responsible for meeting all graduation deadlines.

XIII. Typical Timeline

Semester 1 (fall):

- Core Course + 1 credit elective
- Thesis Option: Identify/contact possible research mentors

Semester 2 (spring):

- Elective courses
- First laboratory rotation
- Thesis Option: Confirm research mentor as early as possible

Summer:

- Thesis Option: Thesis proposal

Semester 3 (fall):

- Elective courses
- Non-thesis Option: Second laboratory rotation
- Thesis Option: Research and committee meeting

Semester 4 (spring):

- Register for spring graduation if applicable
- Elective courses
- Thesis Option: research and thesis preparation

Summer:

- Thesis Option: Thesis Defense

XIII. Contact Information

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