Boston University School of Medicine

Program in Biomedical Sciences (PiBS)

Graduate Handbook
2017-2018

* Approved by the PiBS Executive Committee

CONTENTS

1. Welcome

Welcome to the Program in Biomedical Sciences (PiBS). We're pleased to have you join PiBS, which is a Ph.D. program within the Division of Graduate Medical Sciences (GMS) at Boston University School of Medicine. This umbrella program embodies 10 participating departments and programs within GMS (Departments of Biochemistry, Biophysics, Microbiology, Pathology, Physiology, Programs in Genetics & Genomics, Molecular & Translational Medicine, Nutrition & Metabolism, Oral Biology and Immunology Training Program). Students fulfill requirements of PiBS and upon choosing a dissertation laboratory and a department/program affiliation, requirements of the department/program are fulfilled as well.

This guide is intended to provide graduate students (as well as faculty members) within PiBS with a description of the policies and requirements of the graduate program. This guide was prepared to assist students in progressing through the program. This handbook is intended only to describe general PiBS requirements/policies, not those of the individual participating departments/programs *i.e.* as mentioned above, students are required to complete both PiBS as well as the department/program-specific requirements. As program policies and requirements may change, students are advised to consult with their advisors during the first year in the PiBS program and then with their dissertation advisors and the Directors of Graduate Studies of the departments/programs they join upon choosing a dissertation laboratory (see below for more information about this process). To be certain that they are in compliance with all policies and requirements, students must also adhere to the guidelines of GMS at Boston University School of Medicine, as well as Boston University at large, and they are advised to consult relevant administrative personnel for further information regarding graduate study at Boston University. It is each student's responsibility to be certain that all program requirements are fulfilled. The student is encouraged to consult regularly with his/her advisor to be certain that he/she is progressing as expected and that all requirements will be completed in time for the student's planned graduation.

2. PiBS Governance

The program is designed with a shared-governance philosophy that draws on faculty from all participating departments and programs. Included in the governance structure are the Program Director, the Executive Committee, the Steering Committee, the Admissions Committee and the Advising Committee. All work together to ensure that the program runs smoothly on a day to day basis, that new students are recruited annually, that students are properly guided through the program, that student progress is assessed, that new ideas are considered and new policies and initiatives disseminated to the home departments/programs and that the Associate Provost of GMS is kept abreast of program progress. This PiBS governance structure is designed to ensure that all ten programs have representation and that open communication between the leadership, the faculty and the students is in place.

3. Academic Advisors

Each student is assigned a faculty member as academic advisor upon entering the PiBS graduate program. The academic advisor functions as the student's formal administrative advisor until a permanent research advisor is assigned (at the end of the first academic year). The role of the academic advisor is to provide assistance and advice on all academic issues. The advisors are members of the PiBS Advising Committee.

4. Academic Requirements

The PiBS Ph.D. program requires 64 credits. Some of these credits are taken as formal courses and the remainder are earned by performing research and/or attending and actively participating in seminars. The specific PiBS requirements for students entering the program in 2016 are outlined below (Table I).

Table I. PiBS COURSE REQUIREMENTS

Semester	Credits	Course
Fall	2	FC701 Foundations in Biomedical Sciences Module I
Fall	2	FC702 Foundations in Biomedical Sciences Module II
Fall	2	FC703 Foundations in Biomedical Sciences Module III
Fall	2	FC764 Professional Skills
Spring	2	FC704 Foundations in Biomedical Sciences Module IV
Spring	2	FC708 Professional Development Skills

It is important to note that the PiBS coursework and rotations do not adhere to the posted University schedule. See Table II for the dates classes start and the last dates for administration of final examinations (ask professors of each class for specific final examination dates). The dates for the laboratory rotations are listed in the section on rotations below.

Table II. PiBS DATES TO REMEMBER

Event	Date
Orientation	September 1, 2017
Fall semester starts	September 5, 2017
Fall semester final exams end	December 21, 2017
Spring semester classes start	January 9, 2018
Spring semester final exams end	May 11, 2018

During the first year in the program, it is expected that students will register for up to 12 didactic course credits per semester. This will consist of the PiBS required courses listed in Table I (see Appendix #1 for course descriptions) as well as elective courses (see Appendix #2 for course descriptions). The latter are chosen in consultation with the advisor and may focus on a known area of interest or to explore a new area (which we strongly encourage)!

Once a student chooses a dissertation laboratory and a department/program of study, additional coursework will be dictated by the requirements of that department/program. All departments/programs require that the student submit, present and defend a dissertation based on original laboratory research performed under the direction of a member of the PiBS faculty (the faculty member must have a faculty appointment to one of the participating departments or programs as well as an appointment to the GMS faculty).

All graduate students are also required to attend Boston University's Program in Responsible Conduct of Research. Details can be found at: http://www.bu.edu/orctraining/rcr/.

Grades
GMS uses the following system of letter grades for evaluation.

A to B-	Pass with credit
C+ or below	Considered failure; no credit granted
P	Pass with credit; directed study, research courses at the 900 level as well as other courses deemed Pass/Fail
F	Fail; directed study, research courses at the 900 level as well as other courses deemed Pass/Fail
I	Incomplete, with additional work required
X	Unresolved status
J	Registration in same or continuing course in the following semester necessary (excluding summers)
AU	Audit, no credit
N	No credit granted toward a graduate degree
W	Withdrew after grace period
MG	Missing grade, grade not assigned

Incomplete Coursework and Failing Grades: When the work of a course has not been completed within the semester of registration, the grade of I is assigned. This automatically becomes an F unless coursework is completed within a specific timeframe to be determined in consultation with the course manager; this timeframe cannot exceed 1 year (12 months) from the time the grade of I is assigned. Grades of I or C+ or lower are interpreted as failures. A student receiving such grades in total of 8 credit hours is terminated. A student receiving a failing grade will not be permitted to take a make-up examination. Grades of C+ or lower must be remediated in required PiBS courses.

Additional Requirements and Guidelines
PiBS students are required to maintain a minimum cumulative grade point average (GPA) of B (3.0) or better in their courses. Students must maintain this GPA throughout their matriculation in graduate school; this includes the first year as well as subsequent years when the student joins a specific PiBS-affiliated program based on the choice of dissertation advisor. Students who fail to maintain a 3.0 grade point average will be placed on academic probation. The student has one year to remediate the deficiency and bring the total GPA to 3.0. If this is not achieved, the student will be dismissed from the program. Students on academic probation are not allowed to take Qualifying or Dissertation Defense examinations. Financial assistance is dependent upon the student remaining in good standing within the program.

All students are required to complete three laboratory rotations prior to choosing a laboratory in which to perform the dissertation research work. Students must be accepted into a dissertation lab and a department or program by June 30th of the first year in the program. Students who fail to do so will be dismissed from the program.

All students are required to be registered every semester at Boston University unless on an approved leave of absence as per GMS and University guidelines. Prior to assignment of a dissertation advisor, students' leave policies are dictated by the schedule of classes and rotations.

It is expected that all students conduct themselves in a professional manner. Prompt attendance is expected at all lectures and other events as arriving late is disruptive to others. Cell phones must be turned off and put away

while in class. The opinions of all others (students, staff and faculty) should be respected. Criticism of different opinions is embraced but should be delivered in a caring and constructive manner.

Any accusations of academic misconduct will be subject to deliberation and potential sanctions as dictated by the GMS Academic Conduct Code and Disciplinary Procedures.

5. Rotations

Experience in a range of laboratory research environments is an essential part of a graduate student's education. Thus, the process of having students rotate through several laboratories is an integral part of PiBS. Rotations expose students to a range of techniques and approaches used within the various biomedical science disciplines. The rotations also serve to allow students the opportunity to get a first hand view of laboratories in which they might eventually conduct their dissertation research.

Students are expected to complete three laboratory rotations (one in the Fall semester and two in the Spring semester). The rotation schedule is listed below (Table III). Students may petition to conduct one additional rotation after the third rotation (with approval of the Student Affairs Committee). The faculty members hosting rotation students should be selected from the list of laboratories that have available positions for new students. In order to decide upon laboratory rotations, programs/departments participating in PiBS will host events in the fall to introduce the program and its faculty. In addition, students are encouraged to learn about individual faculty interests on the PiBS website and by arranging meetings with faculty to discuss their research programs. No lab will host more than two PiBS students at any given time.

Table III. PiBS ROTATION DATES

Rotation	Start date	End date
#1	October 16, 2017	December 8, 2017
#2	January 8, 2018	March 2, 2018
#3	March 12, 2018	May 4, 2018

The student is expected to spend 15-20 hours per week in the rotation labs, including attending laboratory meetings whenever possible. During the rotations, it is expected that students will participate in a research project and will keep proper documentation consistent with the policies of the host laboratory. Students may be asked to present the results of their rotation work to the laboratory group at the end of the rotation period. In addition, students will be expected to give a presentation to the PiBS community that will be planned at the end of each rotation. After the completion of each rotation, the faculty will evaluate, in writing, the student's performance during the lab rotation (see Appendix #3). The faculty member is expected to go over the evaluation with the student prior to submitting it to the Advising Committee. The Rotation Evaluation report will become part of the student's permanent record. In addition, it will contribute to the final grade for the student's "research" credits during the semester(s) in which the rotations are performed.

6. Dissertation Advisor Assignment

The final assignment will be determined by the student, dissertation mentor and the director/chair of the sponsoring program or department.

7. Qualifying Examinations

All students must pass a written and oral qualifying examination. The qualifying examinations are designed and administered by the participating departments/programs which dictate the academic standards for allowing a student to take these exams.

8. Dissertation and Graduation

Once students pass their qualifying exams, an advisory committee will be assembled as per the guidelines of each department/program. The role of the dissertation advisory committee will be to both advise the student and assess his/her progress throughout the dissertation research portion of the Ph.D. program. Expectations for the dissertation are dictated by each department/program in keeping with GMS guidelines.

Appendices

Appendix #1

PROGRAM IN BIOMEDICAL SCIENCES (PiBS) REQUIRED CLASSES

The following classes are those required for all students in PiBS.

Fall semester

GMS FC 701 Foundations in Biomedical Sciences I: Protein Structure, Catalysis and Interaction
The first module of the Foundations in Biomedical Science course "Protein structure, catalysis and interactions" will provide students with a quantitative understanding of protein structure, function, posttranslational modification and the turnover of proteins in the cell. In addition, students will gain facility with thermodynamics, catalysis, kinetics and binding equilibria as they apply to proteins and also to other molecules in biological systems (e.g. nucleic acids, lipids, vitamins, etc.). This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. McKnight, Zaia. 2 cr, Fall sem.

GMS FC 702 Foundations in Biomedical Sciences II: Structure and Function of the Genome
The second module of the Foundations in Biomedical Sciences course will focus on the mechanisms of biological processes that influence the inheritance, regulation, and utilization of genes. Genetic and genomic, molecular, cell biological, and biochemical experimental approaches to understanding these processes will be explored. In addition, we will discuss the possibilities of utilizing these technologies in medical treatments. This course I part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. Dasgupta, Viglianti. 2 cr, Fall sem.

GMS FC 703 Foundations in Biomedical Sciences III: Architecture & Dynamics of the Cell
The third module of the Foundations in Biomedical Sciences course will focus on the movement of proteins and membranes, the secretory process, the cytoskeletal framework of the cell and the resulting cell-cell interaction and communication with the matrix. Molecular, cell biological, and biochemical experimental approaches to understanding these processes will be discussed. In addition, we will discuss the possibilities of utilizing these technologies in medical treatments. This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Science. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. Trinkaus-Randall, Zoeller. 2 cr, Fall sem.

GMS FC 764 Professional Skills
The goal of this course is to develop skills in writing and oral presentations that students need for their professional lives. Students will be exposed to different forms of oral presentations and give weekly talks. Sessions are highly interactive. Trinkaus-Randall. 2 cr, Fall sem.

Spring semester

GMS FC 704 Foundations in Biomedical Sciences IV: Mechanisms of Cell Communication
The fourth module of the Foundations in Biomedical Sciences course will focus on the mechanisms of cell communication. This module will begin by discussing overarching concepts before examining the specific types of molecules that initiate and transduce signals. Examples of cell signaling and subsequent cellular responses will then be considered in different contexts to provide a framework on which future learning can be applied. As the module progresses, the complexity of the systems explored will increase from individual cells to multicellular environments such as tissues, organs, and organisms. In addition, normal processes as well as the dysregulation of cell-cell communication is disease will be studied. This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete progressive sequence. Symes, Rahimi. 2 cr, Spring sem.

GMS FC 708 Professional Development Skills
This course proposes to extend the students' education beyond the traditional biomedical course content. Today's world of science is complex and today's student is faced with a wide variety of options to consider. The course begins to expose students to basic skills that all scientists must master (*e.g.* presentation skills), to issues of compliance/ethics & the law as well as to their personal professional development, the latter highlighted by students' working on an individual development plan by participating in the "myIDP" project. The course draws on a wide variety of experts throughout the university. Schreiber. 2 cr, Spring sem.

Appendix #2

PROGRAM IN BIOMEDICAL SCIENCES (PiBS) ELECTIVE CLASSES

The following classes are offered as electives during the first year in PiBS. Not all of the classes are offered every year and might depend upon enrollment. Some of the classes may be requirements for some of the participating departments/programs. Each department/program has designed a curriculum that will allow students who enter the program at the end of the first year in PiBS to complete these requirements after acceptance into a dissertation lab and department or program *i.e.* the choice of department or program isn't dictated by the program-specific requirements fulfilled during the first year.

Fall semester

GMS BI 777 Techniques in Biochemistry, Cell, and Molecular Biology
Prerequisites: consent of instructor. Success in biomedical research requires proposing, developing and testing a novel hypothesis. The generation of a novel hypothesis in turn requires the ability to apply the scientific method and then implement the appropriate techniques to address the experimental question. This course will complement the Foundations in Biomedical Sciences (FiBS) curriculum by providing students with a comprehensive understanding of the core experimental methods used in biomedical research. By the end of this course students will master the concepts behind a wide range of experimental techniques and technologies and then be prepared to apply the most appropriate experimental system to a given biological question. Biochemical knowledge regarding "how things work" and "how to cook from scratch in the lab" will enable students to develop their own experimental research strategies. Specific topics to be covered in the Fall 2017 include: the scientific method/lab basics, cell culture and gene transfer, protein extraction and analysis, DNA and cloning, PCR, DNA-protein interactions and chromatin, RNA and quantitative PCR, lipids, transgenic and knockout mice, mass spectrometry, flow cytometry, microarray and next generation sequencing, histology and confocal microscopy. This course is team taught and will use lectures, in class discussions, and focused problem sets. A concise final written assignment is designed to test the students' mastery of the subject matter. Layne. 2 cr, Fall sem.

GMS BY 762 Foundations of Biophysics and Structural Biology I
This course provides a thorough grounding in the theory and major experimental methods of Biophysics and Structural Biology. The course covers x-ray diffraction, crystallography, electron microscopy and image processing. Topics include:• Macromolecular conformation and the principles of symmetry, • Fourier transforms, • Structural electron microscopy and image processing, • X-ray diffraction, scattering and crystallography. Atkinson. 2 cr, Fall sem.

GMS BY 776 Macromolecular Assemblies I
This course covers concepts of the assembly of biomacromolecules, their structure and stabilizing forces, and biological function as related to structure. Examples are drawn from protein and protein-nucleic acid assemblies, and membrane proteins. Topics include:• Protein Folding Motifs and Quaternary Assembly,• Protein Assemblies: Hemoglobin, Clathrin, COP1 and COP2, Spectrin, and Tubulin,• Protein-Nucleic Acid Assemblies: Chromatin, Ribosomes, Helical and Spherical Viruses,• Membrane Proteins: G-Protein-Coupled Receptors, Ion (K, Na, Ca) Channels. Shipley, 2 cr, Fall sem.

GMS FC 709 Research Design and Statistical Methods for Biomedical Sciences
The overall objective of this course is to provide students with an understanding of basic concepts of research design and data analysis in the biomedical sciences. The primary didactic areas to be covered include framing hypotheses and objectives, the use of experimental designs and, to a lesser degree, non-experimental designs, problems of differential and non-differential error (including bias and confounding), foundational principles of data description and analysis (independent vs. correlated, parametric and non-parametric, measures of central tendency and dispersion), effect estimation, the use and limitations of statistical testing, and univariable and multivariable modeling. The course employs both didactic sessions and in-class discussion. Moore. 3 cr, Spring sem.

GMS MI 713 Comprehensive Immunology
Comprehensive introduction to immunologic principles and applications. This course consists of both interactive lectures and discussion sessions. Emphasis is placed on analysis and interpretation of data from the primary literature. Prior coursework in genetics and biochemistry is strongly recommended. Browning. 4 cr, Fall sem.

GMS MM 703 Cancer Biology and Genetics
This course will cover topics in human tumor biology including: Tumor progression, invasion, and metastasis; Viruses, immunodeficiency, and cancer; Chemical carcinogenesis; Signal transduction; Anti-oncogenes and familial cancer syndromes; Apoptosis and cancer; Cell cycle control; DNA repair; Principles of Cancer Therapy; Immunotherapy of Cancer; Anti-angiogenesis therapy; and modern molecular diagnostic techniques Prereq: consent of instructor. Flynn, Ganem. 2 cr, Fall sem.

GMS NU 755 Molecular, Biochemical and Physiologic Bases of Nutrition I: Energy Balance and Micronutrients
Prereq: at least one semester each of Biochemistry and Physiology, or equivalent, and permission of the instructor. This is the first semester of a 2 semester sequence (that can be taken in either order) that focuses on the Physiological, Biochemical and Molecular Bases of Nutrition. This semester will cover concepts of essential nutrients and methods for determining their requirements (DRIs), body composition, nutrition and growth, energy expenditure, regulation of energy intake, vitamins and macro-mineral metabolism (Ca, P) and micronutrients. Functions and roles of micronutrients in signaling from gene to whole organism will be discussed. Implications for nutrient requirements through the life cycle and in health and disease will be addressed. A discussion session will teach students to critically evaluate cutting-edge and seminal papers addressing each topic, and introduce students to state of the art research approaches and methodologies -- basic (cell and molecular), clinical and epidemiological. Weekly writing assignments on the papers will provide experience and hone skills with scientific writing. Deeney. 4 cr, Fall sem.

GMS NU 757 Molecular, Biochemical and Physiologic Bases of Nutrition: Regulation of Energy Balance (first half of semester)
This course examines mechanisms regulating body weight, body composition and food intake. Weekly discussion sessions will teach students to critically evaluate cutting-edge and seminal papers in the field, and introduce students to state of the art research approaches and methodologies - both basic (cell and molecular) and translational perspectives. Weekly writing assignments on the papers will provide experience and hone skills with scientific writing. Deeney 2 cr, Fall sem.

GMS OB 763 Basic Processes in Oral Biology
This course examines biological processes at the cellular and molecular levels. Provides a basis to understand the events that regulate inflammation; wound healing; bone formation and resorption; salivary proteins, the relevance to mineral homeostasis and anti-microbial activity; tooth development, eruption, and movement; and oral immune system and oral immunology protective and destructive aspects of oral tissues. Mochida. 2 cr, Fall sem. (followed by the 2 cr, Spring sem. class; OB 764)

GMS PA 710 Principles of Basic and Applied Pathology
This course will serve as 1) an introduction to the methods used in the practice of pathology to study disease and pathophysiology; and 2) a survey of research currently conducted in the field of pathology. There are two separate activities for this course; the first is a weekly 90 minute lecture/discussion where research concepts will be presented by pathology faculty followed by a review of an assigned paper(s) from the basic literature. The second activity will be attendance at the weekly research seminar series in the Department of Pathology and Laboratory Medicine. The students will provide a written evaluation of four of the research seminars. Panchenko. 2 cr, Fall sem.

Spring semester

GMS BY 763 Foundations of Biophysics and Structural Biology II
This graduate level course provides a thorough grounding in the theory and major experimental methods of Biophysics and Structural Biology. The course covers thermodynamic and spectroscopic methods, computational biology and structural NMR. Topics include:• Macromolecular conformation and the principles of symmetry, • Thermodynamic methods, • Spectroscopic methods, • Structural nuclear magnetic resonance, • Computational biology. Atkinson, 2 cr, Spring sem.

GMS BY 777 Macromolecular Assemblies II
This course covers the concepts of the assembly of biomacromolecules, their structure and stabilizing forces, and biological function as related to structure. Examples are drawn from assemblies of lipoproteins, phospholipids, and membrane proteins.Topics include: • Lipid Assemblies: Thermodynamics, Surface behavior, Structure, Mesomorphic states and liquid crystals, • Plasma Lipoproteins: Lipid, Lipid phase behavior, Apoproteins, Assembly, Interconversions, and Uptake,• Biological Membranes: Organization, Bacteriorhodopsin, Photosynthetic Reaction Center, Porins, Bacterial Toxins, Influenza Virus Hemaggutinin, and Potassium Channel. Shipley, 2 cr, Spring sem.

GMS FC 705 Translational Genetics and Genomics
Prereq: consent of instructor. This course will explore the process by which insights from basic science research ultimately lead to new strategies for patient care with a focus on examples from genetics and more recent genome-wide experimental approaches. The course will cover examples of translational research using genetic, epigenomic, transcriptomic, proteomic, approaches in human and/or model systems. Research that leads to new approaches for establishing disease diagnosis, prognosis, therapy, and personalized medicine will be discussed. The ethical and societal implications of these developments will also be considered. Fisher, Feng. 2 cr, Spring sem. Offered alternate years

GMS FC 706 Molecular Metabolism
Prereq: consent of instructor. This optional module of the Foundations in Biomedical Sciences curriculum focuses on the biochemical, cellular and molecular mechanisms that regulate cell and tissue-specific fuel metabolism. The course will present an integrated view of biochemistry and the control of cellular and organismal functions with regard to nutrient utilization. Classes include small group discussions of key papers. Mechanisms that allow cells to survive variations in nutrient supply (starvation, feeding, nutrient excess/stress) and how these mechanisms contribute to metabolic derangements contribute to disease pathogenesis (e.g. diabetes, obesity, cancer) will be discussed. TBD. 2cr, Spring sem. Offered alternate years

GMS FC 707 Physiology of Specialized Cells
Prereq: consent of instructor. This course is one of the elective course modules (Module V) of the Foundations in Biomedical Sciences curriculum. Knowledge of cellular and molecular physiology is critical to understanding the higher order of functioning of tissues, organs, and organs systems. The objective of the course is to discuss the specialized adaptations of cells that help them to function in their respective tissues and organs. This course will also provide a framework to bridge the gap between the biochemistry and the molecular and cellular biology that students have acquired in the core modules (I through IV) and organ physiology and pharmacology that will be addressed in the second year. Gabel. 2 cr, Spring sem.

GMS FC 720 Statistical Reasoning for the Basic Biomedical Sciences
Statistics is a key competency in scientific research—never more so than today—but too often is presented in a dry and detached manner, leaving the impression that statistics is an unfortunate but necessary hurdle to clear after the real science is done. In contrast to this view, we will approach the subject from the broader perspective of *reasoning under uncertainty* as an integral part of scientific research, and statistics as essential formalizations of foundational scientific methods. In addition to building up the relevant concepts, intuitions, and theory, we will engage in hands-on exercises in class using R Studio and best data-analytical practices using R Markdown, both of which are freely available and run under Windows, OSX, and Linux. Kepler. 2 cr, Spring sem.

GMS FC 762 Critical Thinking in Cell and Molecular Biology
Prereq: consent of instructor. The primary goal of this course is to use the framework of the scientific literature to develop Critical Thinking Skills to generate novel hypotheses with a focus on establishing novel biological mechanisms and pathways. Critical Thinking skills will be used to examine research findings and theories to uncover inconsistencies, bias, or faulty logic. The student will be expected to build on their careful evaluation and analysis of the papers to create a novel hypothesis each week and design a single experiment to address their question. The weekly course discussion will be student led and this will facilitate the development of teaching skills. Generally the papers to be discussed will be an older, classic paper, which established an important new concept and a newer paper that builds on that theme. Grading is based on weekly participation in class discussions, presentations, and a concise final written assignment. Layne. 2 cr, Spring sem.

GMS MI 701 Concepts in Virology (second half of semester)
This course is designed to provide a fundamental understanding of viruses and their relationship with their host. It will involve an introduction to virus replication cycles and focus in detail on mechanisms that viruses with different genome structures use to transcribe and replicate them. It will also include lectures on the ways that viruses take advantage of the host translation machinery and subvert antiviral defenses. Aspects of virus pathogenesis and epidemiology will be explored with emphasis in HIV pathogenesis, viral persistence, and the emergence of new viruses. The course will be aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The classes will be taught by Microbiology Department faculty with expertise in virology. The content will include a combination of traditional lectures and discussion of primary research papers. Reading materials will include primary literature and suggested review articles, as well as handouts provided by the faculty. Students will be evaluated on their discussion of papers and in a final examination designed to test the students' critical thinking and analytical skills. Connor, Gummuluru, Oberhaus, Zamansky, Fearns. 2 cr, Spring sem.

GMS MM 712 Stem Cells and Regenerative Medicine
This course is designed to teach basic research and translational research skills to students in the Molecular Medicine Curriculum, using general principles of stem cells and their potential use in regenerative medicine. Students will first be exposed to the basic concepts and definitions of stem cells, the detailed study of different types of adult *vs*. pluripotent stem cells, and discuss ethical and practical considerations. Students will also learn about stem cell manipulation by novel gene editing techniques, recent advances in disease modeling, and the potential use of stem cells in tissue and organ regeneration. Mostoslavsky. 2 cr, Spring sem.

GMS NU 756 Molecular, Biochemical and Physiologic Bases of Nutrition: Macronutrients
Prereq: at least one semester each of Biochemistry and Physiology and permission of the instructor. Regulation of lipid, carbohydrate, and protein digestion, absorption, transport, tissue and cellular metabolism. Integration of macronutrient metabolism in response to alteration in nutritional status (e.g. starvation, obesity) on a whole body and tissue-specific basis. Mechanism regulating macronutrient metabolism in response to stresses such as exercise and aging and disease. A discussion session will teach students to critically evaluate research papers, provide knowledge of seminal papers in the field, and introduce students to research approaches and state of the art methods (e.g. assessment of metabolic flux using stable isotopes, euglycemic clamps, metabolomics). Deeney. 4 cr, Spring sem.

GMS OB 764 Basic Processes in Oral Biology
This course examines biological processes at the cellular and molecular levels. Provides a basis to understand the events that regulate inflammation; wound healing; bone formation and resorption; salivary proteins, the relevance to mineral homeostasis and anti-microbial activity; tooth development, eruption, and movement; and oral immune system and oral immunology protective and destructive aspects of oral tissues. Mochida. 2 cr, Spring sem. (follows the 2 cr, Fall sem. class; OB 763)

GMS PA 700 Basic and Experimental Pathology
Basic principles of pathology are presented through lectures (students attend the GMS PA 600 lectures), and computer-assisted instruction. Related research articles and basic histology are discussed in small group session that complement the lectures. Blusztajn. 4 cr, Spring sem.

GMS PA 801S Protein Modification and Molecular Basis of Human Diseases
This course examines posttranslational modifications that contribute to the protein diversity of structure and function and examines how uncontrolled posttranslational modifications contribute to human diseases such as heart disease, cancer and diabetes, There are two separate activities for this course; the first is a weekly 50-60 minute lecture where research concepts will be presented by the instructor followed by additional 50-60 minute discussion of an assigned journal paper related to that particular topic presented by students. Rahimi, 2 cr, Spring sem.

Appendix #3

Program in Biomedical Sciences (PiBS)
Rotation Evaluation Form

Student:_____.

Faculty Member:_____.

Rotation Dates: _____.

Describe the student's overall performance in the laboratory rotation.

What were the student's strengths that he/she should aim to continue to enhance?

***What areas should the student try to improve*?**

What new techniques did the student learn?

Evaluation of presentation/final report:

Describe the student's overall performance in the laboratory rotation (including the possibility that the student can join your lab).

This form was filled in by_____.
(Rotation Advisor) (Date)

This completed form was discussed with_____.
(Student signature) (Date)

This form was submitted to the PiBS Advising Committee _____.
(Date)