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I. Introduction

Welcome to the Biomedical Sciences (BMS) Graduate Program with Options in Biochemistry and Molecular Genetics (BMG), Translational Therapeutics (TT), and Virology and Immunology (VIRIM) at the Penn State College of Medicine. The integrated nature of the Program and Options permits students to choose their dissertation adviser and committee members from the approximately 150 faculty members of the Program who represent more than 20 basic science and clinical departments. Research interests of Program faculty members are wide-ranging in both scientific disciplines and specific research interests. Graduate students benefit from the opportunity to tailor both their coursework and research to align closely with their particular interests.

This Student Handbook has been compiled as an aid and resource for graduate students and faculty in the Program. It contains current information and degree requirements for the Program. Additional University requirements can be found in The Pennsylvania State University Bulletin of Graduate Degree Programs (www.psu.edu/bulletins/whitebook) and the Thesis Guide (available at http://www.gradsch.psu.edu/current/thesis.html).

A. Objective of BMS Graduate Program

The objective of the BMS Graduate Program is to train individuals for advanced professional careers in the biomedical sciences and related fields. The Program is directed toward students who plan to pursue the Doctor of Philosophy (Ph.D.) degree. Successful completion of the Program implies that the student has (1) achieved a satisfactory knowledge in biomedical sciences and related areas; (2) demonstrated accomplishment in research; (3) consistently demonstrated high standards of scholarship and academic integrity; (4) demonstrated the ability to read and critically evaluate scientific literature; and (5) demonstrated effective scientific communication in written and oral presentations. Upon successful completion of the degree program, the individual should have the competence to engage in independent research and education in the biomedical sciences or related fields.

B. Degree Programs

The BMS Graduate Program and its Options confer the Ph.D. degree and, in special situations, the Master of Science (M.S.) degree. However, students are generally not admitted to the Program to pursue the M.S. degree. The objective for students enrolled in the Ph.D. degree program is to demonstrate excellence in research, scholarship, and scientific experimentation in biomedical sciences. The M.S. degree is strongly research oriented and is designed to develop research competence.

C. Responsibilities of the Student, Dissertation Adviser, and Committee

Each student is responsible for ensuring that the Graduate School and BMS Graduate Program requirements for his/her degree program are met at appropriate times. Because of the time and effort required to fulfill the degree requirements of the BMS Graduate Program, students must
have permission from their dissertation adviser and other individuals designated by the Graduate School to seek concurrent employment (http://www.gradsch.psu.edu/current/assistantships.html) or undertake additional educational programs (see Section VI. Concurrent Degree Programs of this handbook and http://www.gradsch.psu.edu/policies/faculty/concurrent.html).

Students, dissertation advisers, and committees are responsible to fulfill appropriate deadlines for meetings and examinations required by the Graduate School and the BMS Graduate Program. Specific functions for the Ph.D. committee are described in sections III. C.

On an annual basis, the BMS support staff will provide the ‘Graduate Student Progress – Annual Review Form’ (form in Appendix A) to the student and Dissertation Adviser to be reviewed, updated, signed, and returned to the BMS Program Office.

II. Laboratory Rotations and Selection of Dissertation Adviser
(Section V. outlines these procedures for M.D./Ph.D. candidates.)

A. Selecting Laboratory Rotations
A key decision during the first year is selecting a dissertation adviser and the laboratory in which to conduct dissertation research. The BMS Graduate Program Advisory Committee provides advice and oversight during this process. A number of opportunities during the first year provide information to assist in making this choice.

1. Research interest presentations occur during orientation. As a follow-up to these presentations, appointments should be scheduled to talk in more detail with faculty about research areas of particular interest.

2. Laboratory rotations during the first year provide an opportunity to spend time with faculty members of particular interest to learn more about their research program and laboratory environment. These rotations also provide opportunities to design and conduct experiments, collect and analyze data, and present results in written and oral reports. These are all critical skills required for success in a scientific career. Students do at least three rotations that are approximately 8 weeks in length to sample the breadth of research opportunities. The times for doing the rotations are arranged by the student in consultation with the Program Chair and the faculty with whom they rotate. Rotations can be done in the Fall, Spring, and/or Summer semesters.

B. Rotation Reports and Presentation
A written report is required for two of the rotations. Many students choose not to write a report for the last rotation of the Spring semester to provide more time to prepare for the candidacy exam. This report on the research conducted during the rotation is written solely by the student and submitted to the rotation adviser and the Chair of the BMS Graduate Program within one week after completion of each rotation. The reports are evaluated by the rotation adviser and another member of the BMS Graduate Faculty.

Each student also gives an oral presentation on one of his/her rotations during the Spring semester. Presentations are approximately 15 minutes in length and provide the background, approach(es), outcome(s), and discussion of the results for the chosen research rotation. The oral
presentation is evaluated by members of the BMS Graduate Program Advisory Committee.

Further details about the rotation reports and presentation are provided in the description of the BMS 596 course.

The written and oral reports provide an opportunity to evaluate (1) the progress of each student in understanding experimental design, conducting experiments, and critically analyzing results and (2) the written and oral presentation skills of each student. In part, these reports also assess whether the English Competence requirement of the Graduate School has been fulfilled. Other mechanisms for evaluating English Competence are provided by the various oral presentations and written answers to essay questions that students provide during their graduate study. Proficiency in English must be demonstrated prior to administration of the comprehensive exam.

C. Choosing a Dissertation Adviser

Selection of a dissertation adviser is based on a) student interest in the research program, b) consent of the faculty member, and c) available funding to support the student in the lab of interest, which includes written approval from the intended adviser’s departmental Chair. Typically, this decision is finalized after completion of the candidacy exam.

A student who at any time becomes concerned that his/her choice of dissertation adviser may not have been appropriate, needs to discuss the situation with the Director of their Program or Option and their dissertation adviser as soon as possible. If the student ultimately decides s/he would like to try to identify a new dissertation adviser, the student will provide at least four-weeks written notice to his/her Director and current dissertation adviser. During this time, the student must identify a new adviser willing to accept him/her into the laboratory and assume financial responsibility for the student (see above) at the end of his/her time in the current laboratory. The current dissertation adviser retains all laboratory notebooks, reagents (antibodies, cell lines, etc.), experimental protocols, and other research materials.

D. Student Responsibilities in Choosing Advisers

Identification of advisers for rotations and the final choice of a dissertation adviser and committee members are the responsibility of the student. Failure to choose a dissertation adviser by the end of the Fall semester of the student’s second year can be considered lack of academic progress. Failure to develop an extended professional relationship with a dissertation adviser that permits development of the scholarship and rigor necessary to obtain a Ph.D. in the biomedical sciences can be considered unsatisfactory scholarship. Lack of academic progress or unsatisfactory scholarship could result in termination from the graduate degree program.

III. Requirements for the Doctor of Philosophy (Ph.D.) Degree

To advance to full-time research, each student must: (A) complete the appropriate curricular track maintaining at least a 3.00 grade-point average (GPA) as defined below (4. Curricular Requirements) for the Ph.D. degree in the BMS Graduate Program; (B) pass the candidacy exam typically at the end of year one; (C) constitute his/her Doctoral Committee; (D)
demonstrate high-level competence in the use of the English language in reading, writing, and speaking prior to scheduling the comprehensive exam; (E) pass the comprehensive exam typically prior to the beginning of year three; (F) conduct dissertation research; and (G) prepare a dissertation and defend it in the final oral examination.

At the end of this section, a checklist is provided for following progress toward the degree.

A. Curriculum

1. Choice of Curricular Track

By the end of the first year, each student chooses among four curricular tracks that focus coursework on different disciplines. Generally, the choices of the curricular track and the dissertation adviser are finalized at the same time. The four tracks are the Biomedical Sciences (BMS) track, the Biochemistry and Molecular Genetics (BMG) track, the Translational Therapeutics (TT) track, and the Virology and Immunology (VIRIM) track. These tracks align with the BMS Program and the three Options in the Program, respectively.

2. Registration

Each student is responsible for proper registration each semester via eLion. Prior to completion of the comprehensive exam, a student must be registered for at least 9 credits each semester (excluding the summer semester) to maintain full-time student status. In situations where the total number of credits derived from formal coursework does not equal 9, additional required credits are secured by registering for an appropriate number of credits of Individual Studies (BMS 596) prior to passing the candidacy examination or Thesis Research (BMS 600) after passing the candidacy exam. It is important to note that students with a half-time assistantship may register for no more than 12 credits. Therefore, there may be circumstances where a student may be engaged in laboratory rotations or dissertation research but may not, due to the 12-credit maximum, register for Individual Studies or Thesis Research.

All formal coursework is generally completed prior to the scheduling of the comprehensive examination. After completion of the comprehensive exam, students register for Thesis Preparation (601) for 0 credits. A student remains eligible to take courses following successful completion of this exam, although this eligibility may have limitations. Each student should consult with his/her Dissertation Adviser and/or the appropriate Director for details and limitations.

3. Coursework and Scholarship and Research Integrity

Table 1 lists the required courses for the four curricular tracks during the first two years of the program with the typical time for taking each course. Elective courses in the first year are chosen in consultation with the Program Chair or appropriate Director. Electives in the second year are chosen in consultation with the Dissertation Adviser and/or Doctoral Committee.

In 2009, The Graduate School instituted a new requirement for training in Scholarship and Research Integrity (SARI), which for BMS students includes two components:

* Completion of the CITI module ‘Responsible Conduct of Research’ (completed independently online prior to June 30th of year one; https://www.citiprogram.org/default.asp)
* Pass the course BMS 591 – Ethics in the Life Sciences

More information can be found at http://www.pennstatehershey.org/web/gsa/home/integrity.

4. Curricular Requirements

The Ph.D. degree in Biomedical Sciences with any appropriate Option is conferred on a student in recognition of excellent attainment and productive scholarship in biomedical sciences. In addition to the course requirements provided above, the student must achieve:

a minimum GPA of 3.00 to advance to candidacy, qualify for the comprehensive examination, and graduate. Grades for Foundations of Biomedical Research (BMS 597A), Colloquium (590), Individual Studies (596), and Thesis Research (600) are not counted in calculating this GPA for the BMS Graduate Program;

a minimum of 30 graduate credits not including BMS 600 and 601 (33 for the VIRIM Option), of which 20 must be from Penn State, and up to 10 credits of graduate work may be transferred from another institution. For limitations on transfer of credits see ‘Off-Campus and Transfer Credit’ at http://bulletins-psu.edu/bulletins/whitebook/degree_requirements.cfm?section=degreeReq1. The BMS Advisory Committee must approve the credit transfer request prior to submission of the request to the Office of Graduate Enrollment Services for final approval; and

at least 18 credits at the 500-600 level.

A student who fails to make acceptable progress in a degree program will be dropped from the program. One or more failing grades or a cumulative GPA below 3.00, calculated based on the BMS Program policy on GPA for the Ph.D. degree described above, for any semester or session or combination of semesters and/or sessions may be considered evidence of failure to maintain satisfactory scholarship. A GPA below 3.00 automatically places a student on academic probation and the student must meet with the Program Chair or the appropriate Director to determine the course of action required to address this situation and avoid dismissal from the Program. A student receiving grades of C or below in two of the three core courses during the first semester (BMS 501, 502, and 503) may be dismissed from the Program. Except in extreme circumstances, a student will only be permitted to drop one course during the first year because of academic difficulties in the course. The Program Advisory Committee may initiate action as described in Appendix III of the Graduate School Bulletin (http://bulletins-psu.edu/bulletins/whitebook/appendices.cfm?section=appendix3).
### Table 1: Typical Coursework Schedule for Ph.D. Degree for the Four Curricular Tracks: Years 1 and 2

<table>
<thead>
<tr>
<th>CORE REQUIREMENTS FOR ALL STUDENTS</th>
<th>BMS PROGRAM TRACK</th>
<th>BMG OPTION TRACK</th>
<th>TT OPTION TRACK</th>
<th>VIRIM OPTION TRACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 Credits</td>
<td>13 Core Requirement Credits</td>
<td>10 Program Required Credits</td>
<td>7 Elective Credits</td>
<td>13 Core Requirement Credits</td>
</tr>
<tr>
<td></td>
<td>10 Program Required Credits</td>
<td>7 Elective Credits</td>
<td>13 Core Requirement Credits</td>
<td>11 VIRIM Option Required Credits</td>
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<tr>
<td></td>
<td>7 Elective Credits</td>
<td>13 Core Requirement Credits</td>
<td>7 Elective Credits</td>
<td>6 Elective Credits</td>
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#### Fall Year 1 (11 credits)

<table>
<thead>
<tr>
<th>Core Requirement (3)</th>
<th>BMS 501 Regulation of Cellular &amp; Systemic Energy Metabolism (3)</th>
<th>BMS 501 Regulation of Cellular &amp; Systemic Energy Metabolism (3)</th>
<th>BMS 501 Regulation of Cellular &amp; Systemic Energy Metabolism (3)</th>
<th>BMS 501 Regulation of Cellular &amp; Systemic Energy Metabolism (3)</th>
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<tbody>
<tr>
<td>Core Requirement (3)</td>
<td>BMS 502 Cell &amp; Systems Biology (3)</td>
<td>BMS 502 Cell &amp; Systems Biology (3)</td>
<td>BMS 502 Cell &amp; Systems Biology (3)</td>
<td>BMS 502 Cell &amp; Systems Biology (3)</td>
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<tr>
<td>Core Requirement (3)</td>
<td>BMS 503 Flow of Cellular Information (3)</td>
<td>BMS 503 Flow of Cellular Information (3)</td>
<td>BMS 503 Flow of Cellular Information (3)</td>
<td>BMS 503 Flow of Cellular Information (3)</td>
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<tr>
<td>Core Requirement (1)</td>
<td>BMS 504 Art of Scientific Communication I (1)</td>
<td>BMS 504 Art of Scientific Communication I (1)</td>
<td>BMS 504 Art of Scientific Communication I (1)</td>
<td>BMS 504 Art of Scientific Communication I (1)</td>
</tr>
<tr>
<td>Core Requirement (1)</td>
<td>BMS 506 Individual Studies: Research Rotation (1)</td>
<td>BMS 506 Individual Studies: Research Rotation (1)</td>
<td>BMS 506 Individual Studies: Research Rotation (1)</td>
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#### Spring Year 1 (6 to 9 credits)

<table>
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<tr>
<th>Core Requirement (1)</th>
<th>BMS 505 Art of Scientific Communication II (1)</th>
<th>BMS 505 Art of Scientific Communication II (1)</th>
<th>BMS 505 Art of Scientific Communication II (1)</th>
<th>BMS 505 Art of Scientific Communication II (1)</th>
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<tbody>
<tr>
<td>Option Specific</td>
<td>BMS 596 Individual Studies; Research Rotation (2)</td>
<td>BMS 596 Individual Studies; Research Rotation (2)</td>
<td>PHARM 520 Principles of Drug Action (2)</td>
<td>BMS 596 Individual Studies; Research Rotation (2)</td>
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<td>(PROGRAM ELECTIVE)</td>
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<tr>
<td>Option Specific</td>
<td>BMS 520 Integrative Physiology (3)</td>
<td>BCHEM 522 Molecular Genetics: Genes to Genomes (3)</td>
<td>BMS 596 Individual Studies; Research Rotation (2)</td>
<td>MICRO 550 Medical Microbiology: Topics in Molecular Pathogenesis (2)</td>
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<td>(PROGRAM ELECTIVE)</td>
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#### Decision regarding Program or Option; BMS Graduate Program Candidacy Examination - Enter laboratory for dissertation research

<table>
<thead>
<tr>
<th>Core Requirement (1)</th>
<th>BMS 591 Ethics (1)</th>
<th>BMS 591 Ethics (1)</th>
<th>BMS 591 Ethics (1)</th>
<th>BMS 591 Ethics (1)</th>
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<tbody>
<tr>
<td>Option Specific</td>
<td>BMS 590 Colloquium (1)</td>
<td>BCHEM 590 Colloquium (1)</td>
<td>PHARM 551 Anti-infective Therapeutics (1)</td>
<td>MICRO 553 Science of Virology (4)</td>
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<td>(PROGRAM ELECTIVE)</td>
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<tr>
<td>Option Specific</td>
<td>BCHEM 521 Structure, Function, &amp; Regulation of Biological Molecules (3)</td>
<td>PHARM 552 Integrated Systems Pharmacology (1)</td>
<td>JOURNAL CLUB (1)</td>
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<td>(PROGRAM ELECTIVE)</td>
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<tr>
<td>Option Specific</td>
<td>PHARM 553 Gastrointestinal &amp; Immunomodulatory Therapeutics (1)</td>
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<tr>
<td>Option Specific</td>
<td>PHARM 554 Anticancer Therapeutics (1)</td>
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<td>Option Specific</td>
<td>(PROGRAM ELECTIVE)</td>
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#### Fall Year 2 (2 to 8 credits)

<table>
<thead>
<tr>
<th>Core Requirement (1)</th>
<th>BMS 590 Colloquium (1)</th>
<th>BCHEM 590 Colloquium (1)</th>
<th>PHARM 561 Neuropharmacology (2)</th>
<th>MICRO 560 Concepts in Immunology (4)</th>
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<tbody>
<tr>
<td>Option Specific</td>
<td>BMS 590 Colloquium (1)</td>
<td>BCHEM 590 Colloquium (1)</td>
<td>PHARM 562 Endocrine Pharmacology (2)</td>
<td>GENET 581 Genetics of Model Organisms A: Bacterial and Viral Pathogenesis (1)</td>
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<td>(PROGRAM ELECTIVE)</td>
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#### Spring Year 2 (2 to 8 credits)

<table>
<thead>
<tr>
<th>Core Requirement (1)</th>
<th>BMS 591 Molecular &amp; Translational Approaches to Human Disease (3)</th>
<th>BCHEM 591 Molecular &amp; Translational Approaches to Human Disease (3)</th>
<th>PHARM 561 Neuropharmacology (2)</th>
<th>MICRO 560 Concepts in Immunology (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option Specific</td>
<td>BMS 590 Colloquium (1)</td>
<td>BCHEM 590 Colloquium (1)</td>
<td>PHARM 562 Endocrine Pharmacology (2)</td>
<td>GENET 581 Genetics of Model Organisms A: Bacterial and Viral Pathogenesis (1)</td>
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<td>(PROGRAM ELECTIVE)</td>
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#### Comprehensive Exam

1. The minimum number of elective credits required is shown. In consultation with their Dissertation Adviser, students may take additional credits. One potential timing of elective credits for each track is indicated by “PROGRAM ELECTIVE”.

2. VIRIM students must take either MICRO 553 Science of Virology or MICRO 560 Concepts in Immunology. This choice must be made in consultation with the student’s dissertation adviser.

3. To complete the Journal Club elective, VIRIM students must register either for IBIOS 580 Critical Readings in Immunology (1) in the Fall semester or MICRO 572 Literature Report (1) in the Spring semester.

4. Numbers in parentheses indicate credit hours for each course.
5. Seminar and Journal Club Presentations and Attendance

Students in the Program are required to attend seminars given in the BMS Student Seminar Series. Beginning in the second year, each student will present a seminar in this series on an annual basis. Students may also be required to give seminars in other series such as the seminar series in the department of their adviser.

Students are also required to attend presentations given by invited speakers in the BMS Seminar Series. Attendance at other relevant seminars is highly recommended and may be required by the thesis adviser or the department of the adviser. These seminars are excellent opportunities to enhance knowledge of associated fields.

Students are also required to participate annually in a journal club.

B. Candidacy Exam

1. Purpose of the candidacy exam

The candidacy exam serves to assess the student’s mastery of the basic body of knowledge and development of the breadth and depth of scholarship that is expected of Ph.D. candidates. The formal purpose for the exam is to determine whether the student has earned admission to candidacy, and can hence begin a period of research aimed toward a Ph.D. dissertation. This exam provides the Candidacy Exam Committee and the student with a gauge of the capabilities of the student. It can also point out deficiencies that can be corrected by coursework or independent study. Finally, the candidacy serves as another mechanism for evaluating the student’s communication skills.

2. When does a student take the candidacy exam?

The University regulation is that a student may take the candidacy exam after completion of 18 credits of graded coursework following the Baccalaureate. The University also requires that the exam be taken within three semesters after admission to the Program (excluding summers). Hence, a student admitted in the Fall of one calendar year must take the exam by the end of the Fall semester of the next calendar year. Typically, the candidacy is usually administered after the first year of coursework is completed. All students are required to have a minimum GPA of 3.00 as defined by the Program and to have satisfactorily completed all courses in the Fall core curriculum at the time the candidacy is taken.

3. Who administers the candidacy exam?

The BMS Advisory Committee will choose members of the BMS Graduate Faculty to write questions and administer the oral component of the exam.

4. Format of the candidacy exam

The student should be prepared to answer questions related to aspects of the biomedical sciences encountered in their first-year curriculum as well as material students should have acquired from other resources (e.g., undergraduate education, seminars, laboratory rotations). The candidacy exam has a written and an oral component.

The written component will have up to twelve questions and students will have at least two days to answer the questions. The answers will be evaluated in terms of the student’s breadth and
depth of knowledge as well as competence in English. The graded responses to the written portion will be returned to the student prior to the oral component.

The oral portion of the exam will follow within approximately two weeks of the written section. To be eligible to take the oral exam, the student must pass the written exam. The oral portion of the exam provides an opportunity to determine whether or not incorrect responses on the written component indicate serious deficiencies as well as to probe the breadth and depth of scholarship of the student in other areas.

Specific details about the exam will be provided approximately four weeks prior to administration of the exam.

5. Grading of the candidacy exam

Graded responses to each written question are averaged to determine the overall performance on the written portion.

Following the oral portion of the exam, each member of the committee assigns a grade and these grades are averaged to determine the overall performance on the oral portion.

6. Approval of the candidacy exam results

After the student passes the candidacy exam, the Chair of the BMS Graduate Program completes the proper forms and sends them to the Office of Graduate Enrollment Services. The Chair will also provide a written statement attesting to the student's English competence or recommendations for additional studies.

7. What happens if a student fails the candidacy exam?

A student who fails either the written or oral portion of the candidacy exam may be given the opportunity to retake that portion at a future date or may be required to withdraw from the Ph.D. program depending on their level of performance on the exam and in other aspects of the Ph.D. program. The decision of whether to permit a second exam and to determine the appropriate time for its administration is at the discretion of the BMS Advisory Committee. If permitted to retake the exam, the student may proceed with laboratory rotations and/or selection of a dissertation adviser and establishment of a Doctoral Committee. However, the Doctoral Committee cannot be officially formed until the candidacy exam is successfully completed. A student who fails a second candidacy exam will be required to withdraw from the Ph.D. program.

C. Doctoral Committee

1. Members

The student should confer with his/her Dissertation Adviser when considering members to suggest for their Doctoral Committee and the committee must conform to the guidelines of the Graduate School (http://bulletins.psu.edu/graduate/degreerequirements/degreeReq1). This committee consists of four or more active members of the Graduate Faculty. The Advisory Committee recommends that five members be appointed to the Doctoral Committee, particularly in those situations where two members of the committee are from the same research group. The Dissertation Adviser must be a member of the Doctoral Committee and usually serves as chair. At least one member of the committee must be an “Outside Field Member” who must represent a field outside the candidate’s major field of study to provide a broader range of disciplinary perspectives and expertise. This member may be from a different department than the Dissertation Adviser or from a Program or Option different than that of the student. In addition,
there must be at least one regular member of the committee whose primary appointment is in an administrative unit outside the unit in which the dissertation adviser’s primary appointment is held. Additionally, this “Outside Unit Member” should have no budgetary connection to the Dissertation Adviser or other members of the Doctoral Committee. Examples of conflicts of interest that would disqualify someone as the Outside Unit Member include serving as co-principal investigator on grants or other funding sources with any other member of the Doctoral Committee. The same individual may serve as both the Outside Field and Outside Unit Member if they fulfill the appropriate criteria.

The Dissertation Adviser submits the suggested names of members for the Doctoral Committee to the BMS Advisory Committee. All Doctoral Committees must be approved by the BMS Advisory Committee and reviewed periodically to ensure its members continue to qualify for service in their designated roles.

The Doctoral Committee should meet at least once a year. Required paperwork from this meeting (see Appendix A Graduate Student Progress – Annual Review Form) must be filed with the BMS Program Office.

2. Responsibilities of the Doctoral Committee

The Doctoral Committee is responsible for approving the broad outline of the student’s program and should review the program as soon as possible after the student’s admission to candidacy. Continuing communication among the student, the Dissertation Adviser, and members of the committee is strongly recommended to preclude misunderstandings and to develop a collegial relation between the candidate and the committee.

D. English Competency

All Ph.D. candidates are required to demonstrate high-level competence in the use of the English language, including reading, writing, and speaking. The Graduate School requires the Program to formally attest to a student's English competency before the comprehensive exam can be scheduled.

All students are evaluated for their English competency as part of their written and oral rotation reports, candidacy exam, Colloquium, and other components of the degree program. If the student does not demonstrate acceptable competence based on the above evaluations, the student's adviser will be responsible for providing mechanisms for improving these skills. Examples include: 1) verbal critiques of assigned professional papers, 2) presentations in laboratory meetings, 3) additional presentations in Colloquium, and/or 4) successful completion of specific courses designated by the Advisory Committee and targeted toward written and/or spoken English as appropriate. If remediation is required, the Doctoral Committee will re-evaluate the student following completion of the required studies and the student's adviser will notify the Program Chair in writing when the student has met the English competency requirement.

E. Comprehensive Exam

1. Purpose of a comprehensive exam

Successful completion of the comprehensive exam indicates that the student has a broad and in-depth background in biomedical sciences. It marks the watershed from taking courses to being a
full-time researcher. The exam serves to allow the committee to thoroughly examine the student's preparation for dissertation research.

2. When does a student take the comprehensive exam?

To schedule and take the comprehensive exam, a student must be registered full or part-time, and must have a GPA of 3.00 as defined by the Program. Generally, the comprehensive exam is taken when a student has finished essentially all coursework and is ready to focus on research work for the dissertation. Typically, students take the exam some time after the second year; however, it is strongly encouraged not to delay beyond the third year. At the request of the appropriate Program or Option Director, the Associate Dean of the Graduate School officially schedules the exam. The date, time and place must be agreed upon by the student and all members of the Doctoral Committee. Once the date, time, and place are determined, and at least three weeks prior to the date, the student must notify the BMS Program Office to schedule the exam through the Office of Graduate Enrollment Services.

3. Who administers the comprehensive exam?

The student's Doctoral Committee administers the comprehensive exam.

4. Format of the comprehensive exam

The exam includes both writing and orally defending a research grant proposal. Specific requirements for the comprehensive exam vary among the curricular tracks. Students should consult the Director of their curricular track for specific guidelines related to the required format.

5. Who grades the comprehensive exam?

The comprehensive exam is not given a letter grade. Two-thirds of the Doctoral Committee must agree that the student has passed the exam. If a failure occurs, it is the discretion of the committee to permit a second exam and to determine the approximate time for administration of the second exam. The comprehensive exam will only be given twice. A second failure will result in the withdrawal from Ph.D. candidacy. This information is relayed to the BMS Program Office, which notifies the Office of Graduate Enrollment Services for official entry into the student's record.

6. What are the requirements of the student after completion of the comprehensive?

The student must keep the Doctoral Committee informed of his/her progress on an annual basis. The Dissertation Adviser should be consulted in planning regular meetings of the Committee. At the discretion of the Committee, the student may be required to submit an annual written progress report. Meeting dates of the Committee are recorded on the ‘Graduate Student Progress – Annual Review Form’.

F. Dissertation Research

Critical components of Ph.D. training are gaining the abilities to select a worthy research problem, to organize an approach for problem solving, to design and execute meaningful experiments, to interpret results cogently in light of the work of others, and to produce a scholarly exposition in written form. The candidate will assemble an independent body of work during their dissertation research that demonstrates they have gained these abilities.
It is expected that students will have at least one first-author manuscript submitted or published based on their dissertation research prior to the Final Oral Examination.

**G. Dissertation Preparation and Final Oral Examination**

Both the Dissertation Adviser and the student are responsible for ensuring the completion of the written dissertation and for adequate consultation with members of the Doctoral Committee. A formal meeting of the Doctoral Committee with the student to discuss the written dissertation is required prior to scheduling the Final Oral Examination. The written dissertation should be in its final form, with appropriate notes, bibliography, tables, etc., exhibiting polished content and style, and be reviewed and approved by the adviser for the distribution to committee members at least two weeks prior to the scheduled meeting.

Normally, no less than three months must elapse between the Comprehensive Exam and Final Oral Examination. Additionally, the graduate program must be completed within six years of passing the Comprehensive Exam or a second Comprehensive Exam is required.

After the doctoral candidate has satisfied all other requirements for the degree and upon recommendation of the Dissertation Adviser and the committee that the written dissertation is acceptable, the Program Chair will submit a request to the Office of Graduate Enrollment Services to schedule the Final Oral Examination. Major revisions to the written dissertation should be completed before scheduling the oral examination and this revised document should be distributed to committee members at least two weeks prior to the Final Oral Examination.

The Final Oral Examination should be a public seminar followed by an oral dissertation defense. The following points may be used as guidelines for evaluation.

Is the research original?

Are proper experimental designs, appropriate techniques, and interpretation of results described in the dissertation?

Is the candidate able to defend the methods, findings, and conclusions of the research?

Is the candidate sufficiently knowledgeable of the literature to place his or her contribution in proper context?

Is the dissertation research worthy of publication?

The decision of the committee will be reported to the Program Chair and to the Graduate School on the forms provided by the Graduate School.

**H. Time Limitation**

A doctoral student is required to complete the program, including acceptance of the doctoral thesis, within eight years from the date of successful completion of the candidacy examination. Extensions may be granted by the Director of Graduate Enrollment Services in appropriate circumstances.
Ph.D. Degree Check List

1. Admitted to Graduate School: ________ (date)

2. Candidacy Examination: (within three semesters after enrollment in the Ph.D. program)

3. Selection of Dissertation Adviser (immediately following candidacy examination)

4. Recommend members for Doctoral Committee: (in consultation with Dissertation Adviser; completed within one semester of candidacy examination)
   
   i. Official appointment of Ph.D. Doctoral Committee by the Dean of the Graduate School following recommendation by BMS Advisory Committee

5. Committee meetings must be scheduled at least once a year and the Committee-meeting-report form must be filed with the BMS Program Office within two weeks after the Committee meeting.

6. Coursework (variable depending on curricular track and student interests; only core required courses are listed; students should consult Table 1 of this Handbook, their first-year adviser, and http://www.pennstatehershey.org/web/gsa/home/studentresources/current/courses, for required and elective courses for the curricular track(s) of interest)

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|   |   |   |
| Spring |   |   |
| Course Number | Course Title | Credits |
| BMS 505 | Sci Comm  | 1 |
| BMS 596 | Indiv Studies  | 0-2 |

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<td>BMS 600</td>
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|   |   |   |
| Spring |   |   |
| Course Number | Course Title | Credits |
| BMS 600 | Thesis Research | 1-9 |
7. Complete communication requirements (prior to comprehensive examination).

8. Comprehensive examination (typically prior to the beginning of year three; at least 3 months prior to final examination) arranged through Program Chair and Dean of the Graduate School.

9. In consultation with your Dissertation Adviser and Doctoral Committee, determine when your dissertation research is nearing completion and you can begin to concentrate on writing your dissertation.


11. Activate intent to graduate on eLion during the semester of intended graduation; see Thesis Office Calendar (http://www.gradsch.psu.edu/current/thesis.html); deadline is typically within the first two weeks of the semester.

12. By the semester deadline date (http://www.gradsch.psu.edu/current/thesis.html) submit a draft of the dissertation to the Thesis Office for format review

13. Draft of dissertation submitted to Dissertation Adviser (at least 4 weeks before anticipated submission to all members of Doctoral Committee)

14. Copies of the draft dissertation including the abstract consistent with the ProQuest/UMI Agreement (limit 350 words) and vitae (one page maximum) in approved Graduate School form to all members of Doctoral Committee

15. Reviewed draft dissertation returned to graduate student for correction (within 2 weeks after received)

16. Receive approval from Doctoral Committee to schedule Final Oral Examination after major corrections are made

17. Schedule Final Oral Examination through BMS Program Office (at least 3 weeks in advance). The Final Oral Examination must be scheduled on a date no later than the published Graduate School deadline for graduation in that semester (http://www.gradsch.psu.edu/calendar/)

18. Public seminar and Final Oral Examination

19. Final revisions to thesis in response to comments from Doctoral Committee

20. Obtain signatures of Dissertation Adviser and Doctoral Committee members on Approval Page

21. Review and approval of dissertation by Program Chair (allow 1 week for review)

22. Submit final dissertation to the eTD Website (http://www.etd.psu.edu/) by the deadline date

23. Submit signed doctoral approval page, ProQuest/UMI Agreement, Survey of Earned Doctorates, and fee (payable at http://www.gradsch.psu.edu/current/thesis.html) to the Office of Theses and Dissertations

24. Acceptance of dissertation by The Graduate School

*NOTE: The student is responsible for meeting all time schedule requirements for their degree.*
IV. Requirements for the Master of Science (M.S.) Degree

To advance to full-time research, each student must: (A) complete the appropriate curricular track maintaining at least a 3.00 GPA as defined for the M.S. degree in this handbook; (B) constitute his/her Masters Committee; (C) demonstrate high-level competence in the use of the English language in reading, writing, and speaking; (D) conduct thesis research; and (E) prepare a thesis or publish a paper as a first author in a peer-reviewed journal.

At the end of this section, a checklist is provided for following progress toward the degree.

A. Curriculum

1. Choice of Curricular Track

By the end of the first year, each student chooses among four curricular tracks that focus coursework on different disciplines. These four tracks are the Biomedical Sciences (BMS) track, the Biochemistry and Molecular Genetics (BMG) track, the Translational Therapeutics (TT) track, and the Virology and Immunology (VIRIM) track. These tracks align with the BMS Program and the three Options in the Program, respectively.

2. Registration

Each student is responsible for proper registration each semester via eLion. A student must be registered for at least 9 credits each semester (excluding the summer semester) to maintain full-time student status. In situations where the total number of credits derived from formal coursework does not equal 9, additional required credits are secured by registering for an appropriate number of credits of Individual Studies (BMS 596) or Thesis Research (BMS 600). It is important to note that students with a half-time assistantship may register for no more than 12 credits. Therefore, there may be circumstances where a student may be engaged in laboratory rotations or thesis research but may not, due to the 12-credit maximum, register for Individual Studies or Thesis Research.

3. Coursework and Scholarship and Research Integrity

Table 2 lists the required courses for the four curricular tracks during the program with the typical time for taking each course. Elective courses in the first year are chosen in consultation with the Program Chair or appropriate Director. Electives in the second year are chosen in consultation with the Thesis Adviser and/or Masters Committee.

In 2009, The Graduate School instituted a new requirement for training in Scholarship and Research Integrity (SARI), which for BMS students includes two components:

* Completion of the CITI module ‘Responsible Conduct of Research’ (completed independently online prior to June 30th of year one; https://www.citiprogram.org/default.asp)

* Pass the course BMS 591 – Ethics in the Life Sciences

More information can be found at http://www.pennstatehershey.org/web/gsa/home/integrity.
Table 2: Typical Coursework Schedule for the M.S. Degree for the Four Curricular Tracks

<table>
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<tr>
<th>CORE REQUIREMENTS FOR ALL STUDENTS</th>
<th>BMS PROGRAM TRACK</th>
<th>BMG OPTION TRACK</th>
<th>TT OPTION TRACK</th>
<th>VIRIM OPTION TRACK</th>
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<td>10 TT Option Required Credits</td>
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<td>6 BMS 600 Credits</td>
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<td>1 Elective Credit3</td>
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<td>18 Program Required Credits</td>
<td>13 Core Requirement Credits</td>
<td>13 Core Requirement Credits</td>
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Fall Year 1 (11 credits)

| Core Requirement (3) | BMS 501 Regulation of Cellular & Systemic Energy Metabolism (3) | BMS 501 Regulation of Cellular & Systemic Energy Metabolism (3) | BMS 501 Regulation of Cellular & Systemic Energy Metabolism (3) | BMS 501 Regulation of Cellular & Systemic Energy Metabolism (3) |
| Core Requirement (3) | BMS 502 Cell & Systems Biology (3) | BMS 502 Cell & Systems Biology (3) | BMS 502 Cell & Systems Biology (3) | BMS 502 Cell & Systems Biology (3) |
| Core Requirement (3) | BMS 503 Flow of Cellular Information (3) | BMS 503 Flow of Cellular Information (3) | BMS 503 Flow of Cellular Information (3) | BMS 503 Flow of Cellular Information (3) |
| Core Requirement (1) | BMS 504 Art of Scientific Communication I (1) | BMS 504 Art of Scientific Communication I (1) | BMS 504 Art of Scientific Communication I (1) | BMS 504 Art of Scientific Communication I (1) |
| Core Requirement (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) |
| Core Requirement (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) | BMS 596 Individual Studies: Research Rotation (1) |

Spring Year 1 (6 to 9 credits)

| Core Requirement (1) | BMS 505 Art of Scientific Communication II (1) | BMS 505 Art of Scientific Communication II (1) | BMS 505 Art of Scientific Communication II (1) | BMS 505 Art of Scientific Communication II (1) |
| Option Specific | BMS 596 Individual Studies: Research Rotation (2) | PHARM 520 Principles of Drug Action (2) | BMS 596 Individual Studies: Research Rotation (2) | MICRO 550 Medical Microbiology: Topics in Molecular Pathogenesis (2) |
| Option Specific | BCHEM 521 Structure, Function, & Regulation of Biological Molecules (3) | BMS 596 Individual Studies: Research Rotation (2) | MICRO 581 Principles of Immunology A (1) |
| Option Specific | BCHEM 522 Molecular Genetics: Genes to Genomes (3) | MICRO 582 Principles of Immunology B (1) |

Decision regarding Program or Option; Enter laboratory for thesis research

Fall Year 2 (2 to 8 credits)

| Core Requirement (1) | BMS 591 Ethics (1) | BMS 591 Ethics (1) | BMS 591 Ethics (1) | BMS 591 Ethics (1) |
| Option Specific | BMS 590 Colloquium (1) | BCHEM 590 Colloquium (1) | PHARM 551 Anti-infective Therapeutics (1) | MICRO 555 Science of Virology2 (4) |
| Option Specific | BMS 600 Thesis Research (≥3) | BMS 600 Thesis Research (≥3) | PHARM 552 Integrated Systems Pharmacology (1) | BMS 600 Thesis Research (≥3) |
| Option Specific | (PROGRAM ELECTIVE) | (PROGRAM ELECTIVE) | PHARM 553 Gastrointestinal & Immunomodulatory Therapeutics (1) | JOURNAL CLUB3 (1) |
| Option Specific | | | PHARM 554 Anticancer Therapeutics (1) |
| Option Specific | | | (PROGRAM ELECTIVE) |
| Option Specific | | | (PROGRAM ELECTIVE) |

Spring Year 2 (2 to 8 credits)

| Option Specific | BMS 590 Colloquium (1) | BCHEM 590 Colloquium (1) | PHARM 561 Neuropharmacology (2) | MICRO 560 Concepts in Immunology3 (4) |
| Option Specific | BMS 581 Molecular & Translational Approaches to Human Disease (3) | (PROGRAM ELECTIVE) | PHARM 562 Endocrine Pharmacology (2) | GENET 581 Genetics of Model Organisms A: Bacterial and Viral Pathogenesis (1) |
| Option Specific | BMS 600 Thesis Research (≥3) | BMS 600 Thesis Research (≥3) | (PROGRAM ELECTIVE) | MICRO 590 Colloquium (1) |
| Option Specific | (PROGRAM ELECTIVE) | (PROGRAM ELECTIVE) | BMS 600 Thesis Research (≥3) |

1 The minimum number of elective credits required is shown. In consultation with their Thesis Adviser, students may take additional credits. One potential timing of elective credits for each track is indicated by “PROGRAM ELECTIVE”.
2 VIRIM students must take either MICRO 553 Science of Virology or MICRO 560 Concepts in Immunology. This choice must be made in consultation with the student’s dissertation adviser.
3 To complete the Journal Club elective, VIRIM students must register either for IBIOS 580 Critical Readings in Immunology (1) in the Fall semester or MICRO 572 Literature Report (1) in the Spring semester Numbers in parentheses indicate credit hours for each course.
4. Curricular Requirements

The Master of Science degree in Biomedical Sciences with any appropriate Option is conferred on a student in recognition of high attainment and productive scholarship in biomedical sciences. In addition to the course requirements provided above, the student must achieve:

- a minimum GPA of 3.00. Grades for all courses including Colloquium (590), up to 2 credits of Individual Studies (596), and up to 6 credits of Thesis Research (600) are counted in calculating this GPA for the M.S. degree in the BMS Graduate Program;
- a minimum of 30 graduate credits, of which 20 must be from Penn State, and up to 10 credits of graduate work may be transferred from another institution. For limitations on transfer of credits see ‘Transfer Credit’ at http://bulletins.psu.edu/bulletins/whitebook/degree_requirements.cfm?section=masters#masters Admission. The BMS Advisory Committee must approve the credit transfer request prior to submission of the request to the Office of Graduate Enrollment Services for final approval; and
- at least 18 credits at the 500-600 level of which at least 6 must be BMS 600.

A student who fails to make acceptable progress in a degree program will be dropped from the program. One or more failing grades or a cumulative GPA below 3.00, calculated based on the BMS Program policy on GPA for the M.S. degree described above, for any semester or session or combination of semesters and/or sessions may be considered evidence of failure to maintain satisfactory scholarship. A GPA below 3.00 automatically places a student on academic probation and the student must meet with the Program Chair or the appropriate Director to determine the course of action required to address this situation and avoid dismissal from the Program. A student receiving grades of C or below in two of the three core courses during the first semester (BMS 501, 502, and 503) may be dismissed from the Program. The Program Advisory Committee may initiate action as described in Appendix III of the Graduate School Bulletin (http://bulletins.psu.edu/bulletins/whitebook/appendices.cfm?section=appendix3).

5. Thesis Adviser Requirement

The master’s candidate must identify a thesis adviser willing to accept the student into his/her laboratory. Since the BMS Graduate Program does not provide financial support (neither stipend nor tuition) for master’s candidates, the student is responsible for paying tuition and having sufficient resources for living expenses.

6. Seminar and Journal Club Presentations and Attendance

Students in the Program are required to attend seminars given in the BMS Student Seminar Series. Beginning in the second year, each student will present a seminar in this series on an annual basis. Students may also be required to give seminars in other series such as the seminar series in the department of their adviser.

Students are also required to attend presentations given by invited speakers in the BMS Seminar Series. Attendance at other relevant seminars is highly recommended and may be required by the thesis adviser or the department of the adviser. These seminars are excellent opportunities to enhance knowledge of associated fields.

Students are also required to participate annually in a journal club.
B. Masters Committee

1. Members

The student should confer with his/her Thesis Adviser when considering members to suggest for their Masters Committee. This committee consists of three or more active members of the Graduate Faculty. The Thesis Adviser must be a member of the Masters Committee and usually serves as chair.

The Thesis Adviser submits the suggested names of members for the Masters Committee to the BMS Advisory Committee. All Masters Committees must be approved by the BMS Advisory Committee and reviewed periodically to ensure its members continue to qualify for service in their designated roles.

The Masters Committee meets at least twice a year. Required paperwork from this meeting (see Appendix A Graduate Student Progress – Annual Review Form) must be filed with the BMS Program Office.

2. Responsibilities of the Masters Committee

The Masters Committee is responsible for approving the broad outline of the student’s program and should review the program as soon as possible after the student’s admission to the Master’s Program. Continuing communication among the student, the Thesis Adviser, and members of the committee is strongly recommended to preclude misunderstandings and to develop a collegial relation between the candidate and the committee.

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The following points may be used as guidelines for evaluation of the M.S. thesis or publication by the thesis committee:

Is the research original?

Are proper experimental designs, appropriate techniques, and interpretation of results described in the thesis or paper?

Does the thesis or paper demonstrate that the candidate is sufficiently knowledgeable of the literature to place his or her contribution in proper context?

Is the thesis research worthy of publication?

The decision of the committee will be reported to the Program Chair and to the Graduate School on the forms provided by the Graduate School.

F. Time Limitation
All requirements for the M.S. degree (including acceptance of a thesis or paper) must be met within eight years of admission to degree status. Extensions may be granted by the Director of Graduate Enrollment Services in appropriate circumstances.
M.S. Degree Check List

1. Admitted to Graduate School: __________ (date)

2. Selection of Thesis Adviser (immediately following admission to the M.S. program)

3. Recommend members for Thesis Committee: (in consultation with Thesis Adviser; completed within one semester of entering the M.S. program)

4. Committee meetings must be scheduled at least twice a year and the Committee-meeting-report form must be filed with the BMS Program Office.

5. Coursework (variable depending on curricular track and student interests; only core required courses are listed; students should consult Table 2 of this Handbook, their first-year adviser, and http://www.pennstatehershey.org/web/gsa/home/studentresources/current/courses, for required and elective courses for the curricular track(s) of interest)

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<td>Credits</td>
<td>Course Number</td>
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<tr>
<td>Number</td>
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</tr>
<tr>
<td>BMS 591</td>
<td>Ethics</td>
<td>1</td>
<td>BMS 600</td>
</tr>
<tr>
<td>BMS 600</td>
<td>Thesis Research</td>
<td>1-8</td>
<td></td>
</tr>
</tbody>
</table>

22
6. Complete communication requirements.

7. In consultation with your Thesis Adviser and Masters Committee, determine when your thesis research is nearing completion and you can begin to concentrate on writing your thesis.


9. Activate intent to graduate on eLion during the semester of intended graduation; see Thesis Office Calendar (http://www.gradsch.psu.edu/current/thesis.html); deadline is typically within the first two weeks of the semester.

10. By the semester deadline date (http://www.gradsch.psu.edu/current/thesis.html) submit a draft of the thesis to the Thesis Office for format review

11. Draft of thesis (or published paper) submitted to Thesis Adviser for approval to distribute to other members of Masters Committee

12. Copies of the draft thesis to all members of Masters Committee

13. Reviewed draft thesis returned to graduate student for correction (within 2 weeks after received)

14. Copies of revised draft thesis distributed to all Committee members

15. Final revisions to thesis in response to comments from members of Masters Committee

16. Obtain signatures of Thesis Adviser and Masters Committee members on Approval Page

17. Review and approval of thesis by Program Chair (allow 1 week for review)

18. Submit final thesis to the eTD Website (http://www.etd.psu.edu/) by the deadline date

19. Submit signed master’s approval page and fee (payable at http://www.gradsch.psu.edu/current/thesis.html) to the Office of Theses and Dissertations

20. Acceptance of thesis by The Graduate School

NOTE: The student is responsible for meeting all time schedule requirements for their degree.
V. Ph.D. Requirements for the M.D./Ph.D.-Joint Degree

The National Institutes of Health (NIH) has long recognized the need for dually trained physician-scientists to translate the discoveries of basic science laboratories into effective clinical treatments. Scientists with doctoral level training in both the practice of clinical medicine and research are among the most important practitioners of this critical step in the discovery of new medical treatments. The College of Medicine has had a formal M.D./Ph.D. joint-degree program in support of this goal since 1995.

After completion of the first two years of medical school (M1 and M2), the candidate enters the BMS Graduate Program to pursue the work required for the Ph.D. degree. To advance to full-time research, each student must: (A) complete the appropriate curricular track maintaining at least a 3.00 grade-point average (GPA) as defined below (4. Curricular Requirements) for the M.D./Ph.D. degree in the BMS Graduate Program; (B) pass the United States Medical Licensing Examination (USMLE) Step 1 exam, which serves as the candidacy exam for candidates for the M.D./Ph.D. degree; (C) constitute his/her Doctoral Committee; (D) demonstrate high-level competence in the use of the English language in reading, writing, and speaking prior to scheduling the comprehensive exam; (E) pass the comprehensive exam typically prior to the beginning of the second year of graduate school (G2); (F) conduct dissertation research; and (G) prepare a dissertation and defend it in the final oral examination.

At the end of this section, a checklist is provided for following progress toward the degree.

A. Laboratory Rotations and Selection of Dissertation Adviser

At least three laboratory rotations are completed during M1 and M2 as detailed by the M.D./Ph.D. Program. Typically, the Dissertation Adviser is selected during the M2 year and the student enters this research laboratory after passing the USMLE Step 1 exam.

B. Curriculum

1. Choice of Curricular Track

By the end of the first year of graduate work (G1), each student chooses among four curricular tracks that focus coursework on different disciplines. These four tracks are the Biomedical Sciences (BMS) track, the Biochemistry and Molecular Genetics (BMG) track, the Translational Therapeutics (TT) track, and the Virology and Immunology (VIRIM) track. These tracks align with the BMS Program and the three Options in the Program, respectively.

2. Registration

Each student is responsible for proper registration each semester via eLion. Prior to completion of the comprehensive exam, a student must be registered for at least 9 credits each semester (excluding the summer semester) to maintain full-time student status. In situations where the total number of credits derived from formal coursework does not equal 9, additional required credits are secured by registering for an appropriate number of credits of Thesis Research (BMS 600). It is important to note that students with a half-time assistantship may register for no more than 12 credits. Therefore, there may be circumstances where a student may be engaged in dissertation research but may not, due to the 12-credit maximum, register for Thesis Research.
Most formal coursework is generally completed prior to the scheduling of the comprehensive examination. After completion of the comprehensive exam, students register for Thesis Preparation (601) for 0 credits. A student remains eligible to take courses following successful completion of this exam, although this eligibility may have limitations. Each student should consult with his/her Dissertation Adviser and/or the appropriate Director for details and limitations.

3. Coursework and Scholarship and Research Integrity

Table 3 lists the required courses for the four curricular tracks during the G1 and G2 years of the M.D./Ph.D. joint-degree program with the typical time for taking each course. Elective courses in the G1 year are chosen in consultation with the Program Chair, the appropriate Director, and/or the Dissertation Adviser. Electives in the second year are chosen in consultation with the Dissertation Adviser and/or Doctoral Committee.

In 2009, The Graduate School instituted a new requirement for training in Scholarship and Research Integrity (SARI), which for BMS students includes two components:

* Completion of the CITI module ‘Responsible Conduct of Research’ (completed independently online prior to June 30th of year one; [https://www.citiprogram.org/default.asp](https://www.citiprogram.org/default.asp))
* Pass the course BMS 591 – Ethics in the Life Sciences

More information can be found at [http://www.pennstatehershey.org/web/gsa/home/integrity](http://www.pennstatehershey.org/web/gsa/home/integrity).

4. Curricular Requirements

The Ph.D. degree in the M.D./Ph.D. joint-degree program in Biomedical Sciences with any appropriate Option is conferred on a student in recognition of excellent attainment and productive scholarship in biomedical sciences. In addition to the course requirements provided above, the student must achieve:

- passing grades in CMBMP 711 and CMBMP 712;
- a minimum GPA of 3.00 in 500- and 600-level courses to qualify for the comprehensive examination and to graduate. Note that grades for Colloquium (590), and Thesis Research (600) are not counted in calculating this GPA for the BMS Graduate Program; and
- the credit requirements at the 500-600 level indicated in Table 3.

A student who fails to make acceptable progress in a degree program will be dropped from the program. One or more failing grades or a cumulative GPA below 3.00, calculated based on the BMS Program policy on GPA described above, for any semester or session or combination of semesters and/or sessions may be considered evidence of failure to maintain satisfactory scholarship. A GPA below 3.00 automatically places a student on academic probation and the student must meet with the Program Chair or the appropriate Director to determine the course of action required to address this situation and avoid dismissal from the Program. The Program Advisory Committee may initiate action as described in Appendix III of the Graduate School Bulletin ([http://bulletins.psu.edu/bulletins/whitebook/appendices.cfm?section=appendix3](http://bulletins.psu.edu/bulletins/whitebook/appendices.cfm?section=appendix3)).
Table 3: Typical Coursework Schedule for the M.D./Ph.D. Degree for the Four Curricular Tracks: Years G1 and G2

<table>
<thead>
<tr>
<th>COURSES</th>
<th>BMS PROGRAM TRACK</th>
<th>BMG OPTION TRACK</th>
<th>TT OPTION TRACK</th>
<th>VIRIM OPTION TRACK</th>
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</thead>
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<tr>
<td>Required Credits</td>
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<td>15 Core Requirement Credits</td>
<td>15 Core Requirement Credits</td>
<td>15 Core Requirement Credits</td>
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<tr>
<td></td>
<td>5 Program Required Credits</td>
<td>8 BMG Option Required Credits</td>
<td>3 TT Option Required Credits</td>
<td>7 VIRIM Option Required Credits</td>
</tr>
<tr>
<td></td>
<td>4 Elective Credits†</td>
<td>1 Elective Credit†</td>
<td>7 Elective Credits†</td>
<td>2 Elective Credits†</td>
</tr>
<tr>
<td>Core Requirement (12)</td>
<td>CMBMP 711 and 712 (12)</td>
<td>CMBMP 711 and 712 (12)</td>
<td>CMBMP 711 and 712 (12)</td>
<td>CMBMP 711 and 712 (12)</td>
</tr>
<tr>
<td>Medical School Courses</td>
<td>(taken in year M1; replace BMS 501, 502, 503, and 596.)</td>
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End of M2 Year: USMLE Step 1 (replaces BMS Graduate Program Candidacy Examination) - Enter laboratory for dissertation research

<table>
<thead>
<tr>
<th>Fall Year G1 (2 to 5 credits)</th>
<th>BMS 504 Art of Scientific Communication I (1)</th>
<th>BMS 504 Art of Scientific Communication I (1)</th>
<th>BMS 504 Art of Scientific Communication I (1)</th>
<th>BMS 504 Art of Scientific Communication I (1)</th>
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</thead>
<tbody>
<tr>
<td>Core Requirement (1)</td>
<td>BMS 591 Ethics (1)</td>
<td>BMS 591 Ethics (1)</td>
<td>BMS 591 Ethics (1)</td>
<td>BMS 591 Ethics (1)</td>
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<tr>
<td>Option Specific</td>
<td>PROGRAM ELECTIVE</td>
<td>BCHEM 521 Structure, Function, &amp; Regulation of Biological Molecules (3)</td>
<td></td>
<td>MICRO 553 Science of Virology (4)</td>
</tr>
<tr>
<td>Spring Year G1 (1 to 4 credits)</td>
<td>BMS 505 Art of Scientific Communication II (1)</td>
<td>BMS 505 Art of Scientific Communication II (1)</td>
<td>BMS 505 Art of Scientific Communication II (1)</td>
<td>BMS 505 Art of Scientific Communication II (1)</td>
</tr>
<tr>
<td>Option Specific</td>
<td>BMS 581 Molecular &amp; Translational Approaches to Human Disease (3)</td>
<td>BCHEM 522 Molecular Genetics: Genes to Genomes (3)</td>
<td>PHARM 520 Principles of Drug Action (2)</td>
<td>MICRO 560 Concepts in Immunology (4)</td>
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Decision regarding Program or Option Comprehensive Exam

<table>
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<tr>
<th>Fall Year G2 (1 to 8 credits)</th>
<th>BMS 590 Colloquium (1)</th>
<th>BCHEM 590 Colloquium (1)</th>
<th>PROGRAM ELECTIVE</th>
<th>JOURNAL CLUB† (1)</th>
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<tbody>
<tr>
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<td>PROGRAM ELECTIVE</td>
<td>PROGRAM ELECTIVE</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
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<tr>
<th>Spring Year G2 (0 to 8 credits)</th>
<th>BMS 590 Colloquium (1)</th>
<th>BCHEM 590 Colloquium (1)</th>
<th>PROGRAM ELECTIVE</th>
<th>GENET 581 Genetics of Model Organisms A: Bacterial and Viral Pathogenesis (1)</th>
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</thead>
<tbody>
<tr>
<td>Option Specific</td>
<td>PROGRAM ELECTIVE</td>
<td>PROGRAM ELECTIVE</td>
<td></td>
<td>MICRO 590 Colloquium (1)</td>
</tr>
</tbody>
</table>

1 The minimum number of elective credits required is shown. In consultation with their Dissertation Adviser, students may take additional credits. One potential timing of elective credits for each track is indicated by “PROGRAM ELECTIVE”.

2 VIRIM students must take either MICRO 553 Science of Virology or MICRO 560 Concepts in Immunology. This choice must be made in consultation with the student’s dissertation adviser.

3 To complete the Journal Club elective, VIRIM students must register either for IBIOS 580 Critical Readings in Immunology (1) in the Fall semester or MICRO 572 Literature Report (1) in the Spring semester. Numbers in parentheses indicate credit hours for each course.
5. Seminar and Journal Club Presentations and Attendance

Students in the Program are required to attend seminars given in the BMS Student Seminar Series. Beginning in the G2 year, each student will present a seminar in this series on an annual basis. Students may also be required to give seminars in other series such as the seminar series in the department of their adviser.

Students are also required to attend presentations given by invited speakers in the BMS Seminar Series. Attendance at other relevant seminars is highly recommended and may be required by the thesis adviser or the department of the adviser. These seminars are excellent opportunities to enhance knowledge of associated fields.

Students are also required to participate annually in a journal club.

C. Candidacy Exam

1. The USMLE Step 1 exams replaces the candidacy exam for M.D./Ph.D. candidates

Passage of the USMLE Step 1 exam replaces the requirement for passing the candidacy exam.

2. Approval of the candidacy exam results

After the student passes the USMLE Step 1 exam, the M.D./Ph.D. Program Administrator completes the proper forms and sends them to the Office of Graduate Enrollment Services. The Chair will also provide a written statement attesting to the student's English competence or recommendations for additional studies.

3. What happens if a student fails the USMLE Step 1 exam?

A student who fails the USMLE Step 1 exam may be given the opportunity to retake it at a future date or may be required to withdraw from the M.D./Ph.D. program depending on their level of performance on the exam and in other aspects of the joint-degree program. The decision of whether to permit a second exam and to determine the appropriate time for its administration is at the discretion of the M.D./Ph.D. Co-Directors. If permitted to retake the exam, the student may proceed with selection of a dissertation adviser and establishment of a Doctoral Committee. However, the Doctoral Committee cannot be officially formed until the USMLE Step 1 exam is successfully completed. If a student fails the Step 1 exam three times, they are dismissed from the medical school and from the M.D./Ph.D. Program. It is at the discretion of the BMS Advisory Committee and the thesis adviser as to whether the student is permitted to continue in the Ph.D. If allowed, the student must take and pass the BMS Candidacy exam.

D. Doctoral Committee

1. Members

The student should confer with his/her Dissertation Adviser when considering members to suggest for their Doctoral Committee and the committee must conform to the guidelines of the Graduate School (http://bulletins.psu.edu/graduate/degreerequirements/degreeReq1). This committee consists of four or more active members of the Graduate Faculty. At least one committee member must be a member of the M.D./Ph.D. Steering Committee. The Advisory
Committee recommends that five members be appointed to the Doctoral Committee, particularly in those situations where two members of the committee are from the same research group. The Dissertation Adviser must be a member of the Doctoral Committee and usually serves as chair. At least one member of the committee must be an “Outside Field Member” who must represent a field outside the candidate’s major field of study to provide a broader range of disciplinary perspectives and expertise. This member may be from a different department than the Dissertation Adviser or from a Program or Option different than that of the student. In addition, there must be at least one regular member of the committee whose primary appointment is in an administrative unit outside the unit in which the dissertation adviser’s primary appointment is held. Additionally, this “Outside Unit Member” should have no budgetary connection to the Dissertation Adviser or other members of the Doctoral Committee. Examples of conflicts of interest that would disqualify someone as the Outside Unit Member include serving as co-principal investigator on grants or other funding sources with any other member of the Doctoral Committee. The same individual may serve as both the Outside Field and Outside Unit Member if they fulfill the appropriate criteria.

The Dissertation Adviser submits the suggested names of members for the Doctoral Committee to the BMS Advisory Committee. All Doctoral Committees must be approved by the BMS Advisory Committee and reviewed periodically to ensure its members continue to qualify for service in their designated roles.

The Doctoral Committee meets at least twice a year. The Committee-report form with signatures from this meeting (available from the M.D./Ph.D. Program Administrator) must be filed with the BMS Program Office and the M.D./Ph.D. Program Office.

2. Responsibilities of the Doctoral Committee

The Doctoral Committee is responsible for approving the broad outline of the student’s program and should review the program as soon as possible after the student’s admission to candidacy. Continuing communication among the student, the Dissertation Adviser, and members of the committee is strongly recommended to preclude misunderstandings and to develop a collegial relation between the candidate and the committee.

E. English Competency

All M.D./Ph.D. candidates are required to demonstrate high-level competence in the use of the English language, including reading, writing, and speaking. The Graduate School requires the Program to formally attest to a student's English competency before the comprehensive exam can be scheduled.

All students are evaluated for their English competency as part of required presentations and writings in BMS 504 and 505, seminar presentations, Colloquium, and other components of the degree program. If the student does not demonstrate acceptable competence based on the above evaluations, the student's adviser will be responsible for providing mechanisms for improving these skills. Examples include: 1) verbal critiques of assigned professional papers, 2) presentations in laboratory meetings, 3) additional presentations in Colloquium, and/or 4) successful completion of specific courses designated by the Advisory Committee and targeted toward written and/or spoken English as appropriate. If remediation is required, the Doctoral Committee will re-evaluate the student following completion of the required studies and the student's adviser will notify the Program Chair in writing when the student has met the English competency requirement.
F. Comprehensive Exam

1. Purpose of a comprehensive exam
Successful completion of the comprehensive exam indicates that the student has a broad and in-depth background in biomedical sciences. It marks the watershed from taking courses to being a full-time researcher. The exam serves to allow the committee to thoroughly examine the student's preparation for dissertation research.

2. When does a student take the comprehensive exam?
To schedule and take the comprehensive exam, a student must be registered full or part-time, and must have a GPA of 3.00 as defined for the M.D./Ph.D. degree by the Program (see above). Generally, the comprehensive exam is taken when a student has finished essentially all coursework and is ready to focus on research work for the dissertation. Typically, students take the exam at the end of the G1 year or the beginning of the G2 year. It is strongly encouraged not to delay beyond the end of the G2 year. At the request of the appropriate Program or Option Director, the Associate Dean of the Graduate School officially schedules the exam. The date, time and place must be agreed upon by the student and all members of the Doctoral Committee. Once the date, time, and place are determined, and at least three weeks prior to the date, the student must notify the BMS Program Office to schedule the exam through the Office of Graduate Enrollment Services.

3. Who administers the comprehensive exam?
The student's Doctoral Committee administers the comprehensive exam.

4. Format of the comprehensive exam
The exam includes both writing and orally defending a research grant proposal. Specific requirements for the comprehensive exam vary among the curricular tracks. Students should consult the Director of their curricular track for specific guidelines related to the required format. The exam content should be the same as the thesis research project.

5. Who grades the comprehensive exam?
The comprehensive exam is not given a letter grade. Two-thirds of the Doctoral Committee must agree that the student has passed the exam. If a failure occurs, it is the discretion of the committee to permit a second exam and to determine the approximate time for administration of the second exam. The comprehensive exam will only be given twice. A second failure will result in the withdrawal from Ph.D. candidacy. This information is relayed to the BMS Program Office, which then notifies the Office of Graduate Enrollment Services for official entry into the student's record.

6. What are the requirements of the student after completion of the comprehensive?
The student must keep the Doctoral Committee informed of his/her progress by at least two committee meetings per year and completing the committee meeting form following each meeting. The Dissertation Adviser should be consulted in planning regular meetings of the Committee.
G. Dissertation Research

Critical components of Ph.D. training are gaining the abilities to select a worthy research problem, to organize an approach for problem solving, to design and execute meaningful experiments, to interpret results cogently in light of the work of others, and to produce a scholarly exposition in written form. The candidate will assemble an independent body of work during their dissertation research that demonstrates they have gained these abilities.

H. Dissertation Preparation and Final Oral Examination

Both the Dissertation Adviser and the student are responsible for ensuring the completion of the written dissertation and for adequate consultation with members of the Doctoral Committee. A formal meeting of the Doctoral Committee with the student to discuss the written dissertation is required prior to scheduling the Final Oral Examination. The written dissertation should be in its final form, with appropriate notes, bibliography, tables, etc., exhibiting polished content and style, and be reviewed and approved by the adviser for the distribution to committee members at least two weeks prior to the scheduled meeting.

Normally, no less than three months must elapse between the Comprehensive Exam and Final Oral Examination. Additionally, the graduate program must be completed within six years of passing the Comprehensive Exam or a second Comprehensive Exam is required.

After the doctoral candidate has satisfied all other requirements for the degree and upon recommendation of the Dissertation Adviser and the committee that the written dissertation is acceptable, the Program Chair will submit a request to the Office of Graduate Enrollment Services to schedule the Final Oral Examination. Major revisions to the written dissertation should be completed before scheduling the oral examination and this revised document should be distributed to committee members at least two weeks prior to the Final Oral Examination.

The Final Oral Examination should be a public seminar followed by an oral dissertation defense. The following points may be used as guidelines for evaluation.

Is the research original?

Are proper experimental designs, appropriate techniques, and interpretation of results described in the dissertation?

Is the candidate able to defend the methods, findings, and conclusions of the research?

Is the candidate sufficiently knowledgeable of the literature to place his or her contribution in proper context?

Is the dissertation research worthy of publication?

The decision of the committee will be reported to the Program Chair and to the Graduate School on the forms provided by the Graduate School.

I. Time Limitation

A doctoral student is required to complete the program, including acceptance of the doctoral thesis, within eight years from the date of successful completion of the candidacy examination. Extensions may be granted by the Director of Graduate Enrollment Services in appropriate circumstances.
M.D./Ph.D. Degree Check List

1. Admitted to Graduate School: __________ (date)

2. USMLE Step 1 Examination: (typically prior to entering the dissertation-research lab)

3. Selection of Dissertation Adviser and graduate program (during the M2 year)

4. Recommend members for Doctoral Committee: (in consultation with Dissertation Adviser; completed during the first semester of the G1 year)
   i. At least one member of the M.D./Ph.D. Steering Committee must be on the Doctoral Committee
   ii. Official appointment of Ph.D. Doctoral Committee by the Dean of the Graduate School following recommendation by BMS Advisory Committee

5. Committee meetings must be scheduled at least twice a year and the Committee meeting report form (available from the M.D./Ph.D. Program Administrator) must be filed with the BMS Program Office and the M.D./Ph.D. Program Office.

6. Coursework (variable depending on curricular track and student interests; only core required courses are listed; students should consult Table 1 of this Handbook, their first-year adviser, and http://www.pennstatehershey.org/web/gsa/home/studentresources/current/courses, for required and elective courses for the curricular track(s) of interest)

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<th>YEAR M1: CMBMP 711 and CMBMP 712</th>
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<td>1-8</td>
<td>BMS 600</td>
<td>Thesis Research</td>
<td>1-9</td>
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</table>
7. Complete communication requirements (prior to comprehensive examination).
8. Comprehensive examination (typically prior to the beginning of G3 year; at least 3 months prior to final examination) arranged through Program Chair and Dean of the Graduate School.
9. In consultation with your Dissertation Adviser and Doctoral Committee, determine when your dissertation research is nearing completion and you can begin to concentrate on writing your dissertation. The defense should be scheduled for no later than March of the year you plan to return to M3.


11. Activate intent to graduate on eLion during the semester of intended graduation; see Thesis Office Calendar (http://www.gradsch.psu.edu/current/thesis.html); deadline is typically within the first two weeks of the semester.

12. By the semester deadline date (http://www.gradsch.psu.edu/current/thesis.html) submit a draft of the dissertation to the Thesis Office for format review.

13. Draft of dissertation submitted to Dissertation Adviser (at least 4 weeks before anticipated submission to all members of Doctoral Committee).

14. Copies of the draft dissertation including the abstract consistent with the ProQuest/UMI Agreement (limit 350 words) and vitae (one page maximum) in approved Graduate School form to all members of Doctoral Committee.

15. Reviewed draft dissertation returned to graduate student for correction (within 2 weeks after received).

16. Receive approval from Doctoral Committee to schedule Final Oral Examination after major corrections are made.

17. Schedule Final Oral Examination through BMS Program Office (at least 3 weeks in advance). The Final Oral Examination must be scheduled on a date no later than the published Graduate School deadline for graduation in that semester (http://www.gradsch.psu.edu/calendar/).

18. Public seminar and Final Oral Examination no later than March of the year you plan to return to M3.

19. Final revisions to thesis in response to comments from Doctoral Committee.

20. Obtain signatures of Dissertation Adviser and Doctoral Committee members on Approval Page.

21. Review and approval of dissertation by Program Chair (allow 1 week for review).

22. Submit final dissertation to the eTD Website (http://www.etd.psu.edu/) by the deadline date.

23. Submit signed doctoral approval page, ProQuest/UMI Agreement, Survey of Earned Doctorates, and fee (payable at http://www.gradsch.psu.edu/current/thesis.html) to the Office of Theses and Dissertations.

25. Return to M3 year of the M.D. degree program The earliest date to return is May 1 and the latest date is July 1. Note: In 2013 the medical school will start third year clerkships on May 1 instead of July 1

26. M.D./Ph.D. students are required to have at least one first-author publication submitted or published based on their dissertation research prior to the Final Oral Examination.

NOTE: The student is responsible for meeting all time schedule requirements for their degree.
VI. Concurrent Degree Programs

The Graduate School of Penn State University permits undertaking concurrent degrees (http://www.gradsch.psu.edu/policies/faculty/concurrent.html). For example, some students have received Ph.D./M.B.A. concurrent degrees. Students may file a concurrent degree proposal following successful completion of the comprehensive exam. Undertaking a concurrent degree program requires the approval of the dissertation adviser, doctoral committee, the Director of the student’s Program or Option, and the Head of the proposed concurrent degree program, as well as approval from the Office of Graduate Enrollment Services. Registration for a concurrent degree program may require payment of applicable tuition charges by the student.

VII. General Information

Stipend – Penn State University is a direct-deposit pay only institution. You will receive your stipend at the end of each month.

Taxation of Stipend – This is determined by governmental agencies.

E-mail – Penn State access/e-mail accounts are acquired at Graduate Orientation. All Graduate Education/student information is relayed through Penn State email. Please READ your e-mail.

Vacation/Sick Leave – Full-time graduate students in the BMS Graduate Program who receive stipends are permitted two weeks of vacation leave per academic year (July 1 to June 30). Leave should be arranged at least two weeks in advance with consent of the Program Chair (first-year students) or dissertation/thesis adviser (second-year and above students). Students will not be routinely granted vacation leave while enrolled in class work.

For extenuating circumstances, special arrangements may be made for additional vacation days. Such arrangements need approval of the Program Chair (first-year students) or the dissertation/thesis adviser (advanced students). Vacation leave days do not accrue from year to year, Holidays designated by The Pennsylvania State University are separate and in addition to vacation days.

No sick leave is formally assigned or earned, but may be used as necessary with approval of the adviser or Program Chair (first-year students) or the dissertation/thesis adviser (advanced students). Under normal circumstances, up to five days of sick leave per calendar year will be granted, when necessary. Sick leave in excess of five days will be recorded as vacation time. It is the student’s responsibility to contact the Program Chair or dissertation/thesis adviser when he/she is absent from the classroom or laboratory due to illness.

VIII. BMS Faculty Members

The most up-to-date list of the faculty members of the BMS Program with descriptions of their research interests can be found at http://www2.med.psu.edu/faculty/program-faculty/
IX. BMS Advisory Committee

Ralph L. Keil, Ph.D.
Chair, BMS Graduate Program; rkeil@psu.edu; 717-531-8595; COM Rm. C5702

Sarah K. Bronson, Ph.D.
Director, BMS Graduate Program; sbronson@psu.edu; 717-531-5194; COM Rm. C4710

John Flanagan, Ph.D.
Director, BMG Option; jflanagan@psu.edu; 717-531-4189; COM Rm. C5747

Clare Sample, Ph.D.
Director, VIRIM Option; csample@hmc.psu.edu; 717-531-0003 x287150; COM Rm. C6741

Jong Yun, Ph.D.
Director, TT Option; jky1@psu.edu; 717-531-1508; HCAR Rm. 3017

Karen Shields
Program Coordinator; kbp2@psu.edu; 717-531-1045; COM Rm. C3850

Kristin Smith
Enrollment Specialist; kec17@psu.edu; 717-531-0003 x285864; COM Rm. C3850

X. Appendix:
# Graduate Student Progress – Annual Review Form

**Penn State College of Medicine Graduate Student Progress – Annual Review Form**

<table>
<thead>
<tr>
<th>Student’s name</th>
<th>Student’s number</th>
<th>Date Matriculated</th>
<th>Student’s advisor</th>
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### Academic Progress

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<th>2nd year</th>
<th>3rd year</th>
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<th>Pass/Fail</th>
<th>Quality</th>
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Doctoral committee formed: __________

### Thesis Committee Meetings

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<th>E</th>
<th>S</th>
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### Thesis Research Progress

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### Overall Progress

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<th>Program Director</th>
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Signatures

O - Outstanding  
E - Excellent  
S - Satisfactory  
U - Unsatisfactory