

**MANUAL FOR GRADUATE STUDY IN
MICROBIOLOGY & MOLECULAR GENETICS**

**Colleges of Human Medicine, Natural Science,
Osteopathic Medicine, Veterinary Medicine,
and the Agricultural Experiment Station**

Michigan State University

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PLEASE KEEP FOR FUTURE REFERENCE

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1. INTRODUCTION

The Manual for Graduate Study of the Department of Microbiology & Molecular Genetics (MMG) contains directives, regulations and policies that pertain primarily to the administration of graduate education. The Manual is a reference document for graduate education in the department, but it is not a substitute for the Graduate Catalog of the University (www.reg.msu.edu/UCC/AcademicPrograms.asp). The objective of the manual is to provide working guidelines that allow for reasonable changes and interpretation.

The objective of the MMG graduate program is to provide an opportunity for qualified students to enhance their potential as scientists to the maximum of their ability. The major emphasis of the graduate program is on the training of Ph.D. students whose primary career objectives include research and/or teaching. The Ph.D. degree is a research-oriented degree; the emphasis is on experimental and creative work, and the aim is to enable the student to become a self-educating and originating scholar. The MMG graduate program also includes the training of B.S./M.S., M.S., and Industrial Microbiology Professional M.S. students.

Students enrolled in the MMG graduate program can take advantage of several additional educational opportunities. For example, Ph.D. students may earn a Ph.D. Specialization in Environmental Science and Policy (www.environment.msu.edu/specialization/index.html) or obtain a dual major in Environmental and Integrative Toxicological Sciences (www.cit.msu.edu) or in Quantitative Biology (<http://biomodel.msu.edu/>). Dual degrees with any of three professional medical programs are possible (see section 8). Masters students may earn an M.S. Graduate Specialization in Food Safety (foodsafety.msu.edu/students/index.htm) or a Multidisciplinary M.S. Specialization in Environmental Toxicology (<http://www.iet.msu.edu/>). Finally, students with a particular interest in College-level teaching can earn a Certificate in Teaching of College Science and Mathematics (<http://www.ns.msu.edu/TAcertificate/>).

2. GENERAL INFORMATION

2.1 Administration

The department is administered jointly by the Colleges of Natural Science, Veterinary Medicine, Human Medicine, and Osteopathic Medicine. Part of the research effort is also administered by the Agricultural Experiment Station.

The chief administrative officer of the department is the Chairperson, who is responsible for the educational, research and service programs, the budget, physical facilities, and personnel. The Director of Graduate Studies (DGS) is responsible for graduate student affairs and the Graduate Recruiting Officer (GRO) and the Director of the Professional M.S. Program in Industrial Microbiology are responsible for identifying and recruiting prospective graduate students.

2.2 Advisement

Incoming students will be advised by the DGS. This arrangement is meant to provide the students with early, pertinent advice without obligating them to choose a major professor(s) prematurely. Entering Ph.D. students should discuss potential research areas with several faculty members (and also current graduate students) and rotate through the laboratories of three professors before choosing a major advisor.

By the end of their second semester, the student should decide on a major professor(s) for continuing guidance. Further detail on rotations and major professor selection is provided in Sections 7.2 and 7.3. M.S. students are expected to choose a major professor as soon as possible after or prior to entering their graduate degree program.

The responsibility for the guidance of a graduate student resides with the student's research guidance committee. Selection and formation of the research guidance committee is accomplished by the student in cooperation with his/her major professor(s). Further details on guidance committee selection and duties are provided in Sections 3.8, 6.4 and 7.4. The student's research guidance committee provides a critical adjunct to the major professor (and DGS) in providing depth and balance to advising, examining, and serving as an advocate to a student throughout her/his career, even after graduation.

3. ACADEMIC INFORMATION

3.1 Degree Programs

Graduate study leading to the Master of Science degree (Plan A or B) and Doctor of Philosophy degree in MMG is offered in the department. Graduate study concurrent with professional education is available for students in human medicine, osteopathic medicine, and veterinary medicine curricula.

3.2 Academic Catalogues and Schedule of Courses

The MSU Academic Programs Catalogue contains the official description of all degree programs in MMG. Updated versions of this and the MSU Description of Courses catalogue are available under "Information for Students" at the MSU web site (www.msu.edu/current/index.html). Course schedule information can also be obtained through this location.

3.3 Program of Courses

Development of a program of course study other than specific required courses is the responsibility of the student in consultation with her/his major professor(s) and research guidance committee. The final program requires the completion of a Report of the Guidance Committee form (see www.grad.msu.edu/forms/rogc.doc or www.grad.msu.edu/forms/rogc.pdf) with approval of the student, the major professor(s), the research guidance committee, the Chairperson, and the Dean of the college in which the student is enrolled. The program specifies the student's minimum course requirements for obtaining the degree. Logical and necessary changes in the program are permitted but require the written consent of all the above parties.

3.4 Course Credit Load

By University policy, graduate assistants must be registered each semester in which they hold an assistantship as indicated below. Most MMG graduate students are supported by half-time assistantships.

1. Doctoral students with quarter-time assistantships or half-time assistantships must carry at least 3 credits. They may carry a maximum of 16 course credits, excluding 899/999 credits. Doctoral students who are doing off-campus fieldwork related to their dissertation need only enroll for one credit. Also, those who have passed comprehensive exams may enroll for 1 credit starting the semester after the student's

completed exam form is submitted to the appropriate college Associate Dean.

2. Master's students with quarter-time assistantships or half-time assistantships must carry at least 6 credits. They may carry a maximum of 12 course credits, excluding 899/999 credits.

3. During the summer session, graduate assistants must carry a minimum of 3 credits.*

4. Visitor credits may count as part of a student's credit load if approved in writing by the student's department chair, college and the Dean of the Graduate School.

5. Deviations from the minimum enrollment requirements listed above, except as noted for doctoral students, are permitted only during the semester in which the degree is granted, when students must enroll for at least the number of credits required to complete the degree or meet the University minimum registration requirement of one credit.

*Doctoral students may enroll for 1 credit as described in (1) above.

3.5 Graduate Grading System

The usual University grading system for graduate courses is either the numerical system (4.0 - 0.0), or credit-no credit (Cr-NC). A grade of Cr shall be awarded for performance at a level of 3.0 or above, a grade of NC shall be given for performance below 3.0. The Pass-No grade (P-N) system is used for MMG 892 (Seminar) and 899/999 (the final grade for research is deferred until completion of the degree). DF is for a deferred grade and must be completed within 6 months or it changes to U, unfinished.

3.6 Appointments and Reappointment to Assistantships and Fellowships

Graduate assistantship appointments at the Ph.D. level are normally made for the academic year beginning in Fall semester. Incoming Ph.D. students are typically appointed as level 1 assistants. Advancement to level 2 usually requires satisfactory completion of one year of study towards the Ph.D. within the department. Advancement to level 3 requires a master's degree or equivalent plus 9 additional semesters of satisfactory experience as a research assistant or 6 semesters as a teaching assistant in the Graduate Employees Union (see contract at www.grad.msu.edu/geu/agree.pdf). Within the ranges established for the University, the stipend at each level will depend on the qualifications of the individual, and on the availability of funds. All appointments are contingent upon satisfactory progress in the degree program and on availability of funds. Graduate support comes from a mixture of departmental funds, faculty grant funding, teaching assistantships and fellowships. Typically, departmental support is provided for the first two semesters, after which students are supported via faculty grants or other sources. Assistantship appointments include a tuition waiver, matriculation fee waiver and healthcare insurance program. Stipend levels vary annually; consult with the department Graduate Office for the latest levels. See also Section 5.1.

3.7 Registration

Graduate students arrange a tentative course schedule with the major professor(s) or DGS and enroll via computer preregistration as scheduled by the University. Registration for any given semester entitles graduate students to receive available University services from the first day of registration of that semester to the first day of registration for the following semester.

Students must be registered the semester in which the thesis defense is completed and passed (see University Regulations).

3.8 Annual Committee Meetings and Reports

At least once a year, each student will initiate a meeting with her/his research guidance committee (a typical Ph.D. graduate student timeline is summarized in Appendix 1). See Section 6.4 (M.S.) or 7.4 (Ph.D.) for further details on guidance committee selection. The student will report on progress in research and coursework since the last committee meeting, along with her/his plans for the future. The research guidance committee report must be completed by the departmental representative, signed by all members of the research guidance committee and student and filed with the DGS to serve as an audit and a record in the student's file.

The grade point average will serve as another index of satisfactory progress. The student should maintain at least a 3.0 average exclusive of seminar, research, and collateral course credits. (Collateral courses in the department are defined as those courses in the undergraduate program below the 400 series, and those courses specifically designated by the research guidance committee as not directly applicable to the graduate degree). If the student is failing to make satisfactory progress in her/his thesis research or if the 3.0 grade average is not maintained, the research guidance committee will consider remedial actions up to and including the removal of the student from the program. Recommendations of the guidance committee go to the DGS and Chairperson for review.

3.9 Evaluation of Progress of First-year Students

It is in the interest of the student and of the department to evaluate progress at the end of the first year of graduate school. Since in most cases a research guidance committee will not have been formed, the DGS will review the academic and research progress of each student at the end of her/his first academic year.

3.10 Retention

The department accepts only those students who are believed to have the potential to successfully complete the degree program. Where a student encounters difficulties in meeting the requirements of the program, her/his major professor(s) (if one has been chosen), the DGS, and the research guidance committee (or the Graduate Committee) work together with the student to overcome these problems. As noted in Sections 3.8 and 3.9, the Graduate Committee or research guidance committee may conclude that it is in the best interest of the student (and/or the department) for the student to be dismissed from the program. Such a recommendation requires the approval of the Chairperson and the appropriate Dean. In cases of dismissal or instances in which a student voluntarily leaves the program, the DGS and/or major professor(s) will work with the student to identify and take advantage of alternative career opportunities.

3.11 Department Seminar

One hour per week is reserved in Fall and Spring semesters for departmental seminars. All graduate students are expected to attend regularly.

3.12 Ethical Standards

Graduate students in the department are expected to adhere to the ethical standards set forth in University regulations and those conventionally used in the conduct of scientific research (see Guidelines for Integrity in Research and Creative Studies at

<http://psychology.msu.edu/GradInfo/researchintegrityguidelines.htm>). The department endorses and adheres to MSU's Rights and Responsibilities of Graduate Students and Regulations as defined in Spartan Life (www.vps.msu.edu/SpLife/gradrights.htm). The monograph published by the Committee on the Conduct of Science (On Being a Scientist, National Academy Press 2nd edition, 1995 (books.nap.edu/catalog/4917.html)); a book entitled "Integrity in Scientific Research: Creating an Environment that Promotes Responsible Conduct: (National Academies Press, 2002; www.nap.edu/books/0309084792/html); and Harvard Medical School's "Guidelines for Investigators in Scientific Research" (see Appendix 2) offer excellent discourses on crucial matters affecting scientific integrity and conflict resolution and are practices/guidelines generally accepted by our faculty. In addition, each student is required to enroll for a seminar course or equivalent experience on research integrity (section 7.6).

In the rare situation in which a student is charged with violating the standards described above, the student's research guidance committee will judge the validity of the charge and, if necessary, recommend to the Chairperson the appropriate action to be taken. If the student in question does not have a research guidance committee, the Graduate Committee will act in its place. In extreme cases, the Chairperson may choose to recommend dismissal of the student from the graduate program. As indicated in Section 11 of this Manual (Judicial Structure), the student may appeal the Chairperson's decision to the Graduate Committee or other appropriate judicial body in the College/University.

4. ORGANIZATIONS, AWARDS, AND CAREER PLANNING

4.1. Microbiology & Molecular Genetics Graduate Student Organization

Embracing all registered graduate students of the department, this organization (also called Graduate Student Workshop or GSW) serves as an assembly for open discussion, distribution of department, college and University regulations and policies, and social functions. It is a resource for nominees to the graduate student committee structures of the University at large, and it organizes workshops, parties and picnics. This organization also invites and hosts speakers for the departmental seminars subject to approval by the MMG seminar committee. All students are expected to participate in the Graduate Student Organization-selected presentations.

4.2 Departmental, College, and University Committees

The bylaws of the department, the colleges under which the department is administered (Human Medicine, Natural Science, Osteopathic Medicine, and Veterinary Medicine), and the University specify the committees on which graduate

students are eligible to serve. In MMG, this typically includes the Graduate and Curriculum Committee, among others, and generally two graduate students representatives attend open portions of department faculty meetings.

4.3 Honors and Awards

A variety of annual graduate student Fellowships, Scholarships, and Awards are chosen competitively by a selection committee comprised of the Graduate Committee, GRO (and AGRO), DGS, and Chair. To aid the selection committee in their deliberations, nominees will be asked to present a 10-minute talk to the department with 5 minutes of time for discussion. Further information is available under "Graduate Studies" at the departmental web site (www.msu.edu/unit/mic/). Most Award recipients are selected and announced in late Spring and honored at a reception in the Fall semester.

4.4 Membership in Professional Societies

Graduate students are encouraged to seek membership in professional societies, for example, the American Society for Microbiology (ASM). A Michigan Branch functions in the state.

4.5 Professional Development and Career Planning

Students are encouraged to participate in the PREP (planning, resilience, engagement, and professionalism) program offered by the Graduate School to enhance their professional development. Three to four semesters before a graduate student anticipates completion of the degree, he/she should begin to plan for future employment. The Graduate School runs career planning workshops to help students consider their options (<http://grad.msu.edu/professional.htm>). The major professor(s), other MSU faculty, the Career Connections Job Search of the ASM (www.asm.org), the Michigan State University Career Services and Placement unit (www.csp.msu.edu) and the CNS web site (www.ns.msu.edu/acrc/index.asp) may all provide help. For students contemplating academic careers, postdoctoral research experience has become almost essential. The departmental seminar series (Section 3.11) can be an additional mechanism to help students meet leading scientists and explore postdoctoral opportunities, as can student travel to meetings (Section 5.2). The department regularly participates with similar graduate programs on campus in sponsoring a graduate student "Career Day" with invited speakers from business, academia, research centers and other areas of potential scientific employment.

5. FINANCIAL SUPPORT AND EMPLOYMENT

5.1 Financial Assistance

The department attempts to provide or identify graduate research assistantships for all incoming Ph.D. students for the first two semesters of study. Thereafter, graduate assistantships are generally from research grants or other sources available to the student's major professor. If and when graduate support from the major professor is temporarily unavailable, the department makes every effort to identify alternative support mechanisms, so that the student's progress towards the degree is not adversely affected. All students are encouraged to apply for any available fellowships or other financial aid, internal or external to MSU. Support for students in M.S. programs is provided on an as-available basis, with a lower priority for departmentally administered

support than that for students in the Ph.D. program. Assistantship appointments include a tuition and matriculation fee waiver and healthcare insurance program. Stipend levels vary annually; consult with the department Graduate Office for the latest levels. When a stipend is provided, it is usually done so on a half-time (or quarter-time) basis. Appointments may be for the academic year of two semesters or for the three-semester calendar year (Ph.D. candidates). Initial appointment and changes become effective only at the beginning of a semester.

Financial assistance in all cases is subject to the availability of departmental and grant funds. Support by grant or contract funds subjects the student to the terms and requirements of that grant or contract. The status of the student within his/her graduate program and the requirements imposed by that program are independent of a student's mode of financial assistance or lack thereof. However, a student must remain in good standing and continue to demonstrate acceptable progress towards the degree to be eligible for support.

Individuals who are regularly employed as a means of earning a livelihood are not encouraged to undertake a regular graduate program concurrently. Employed persons admitted to a graduate program normally plan a leave of absence to devote full-time to research.

5.2 Travel Assistance

Financial support for travel of graduate students will be considered in categories of internal and external support. External MMG support is from grants and contracts and will be at the discretion of the principal investigator. Internal support will be from University General and Experiment Station funds and requires approval of the department Chairperson.

Graduate students are also encouraged to present papers at branch and local meetings, without financial subsidy.

Travel to national meetings will be appropriate mainly for doctoral students in their last year or two of work, and for postdoctoral associates. Other students scheduled to present research papers at national meetings will also be considered for funding. The department will provide a flat rate for graduate students subject to availability of funds.

5.3 Vacation

Graduate assistants appointed for 12 months are expected to be on campus and actively pursuing graduate education for at least 11 months. Breaks between semesters, if taken, are considered part of the annual vacation. The major professor should be informed of the vacation schedule.

5.4 Illness/injury/pregnancy leave

A graduate assistant unable to fulfill the duties of her/his appointment because of illness or injury shall notify the major professor (and course instructor, if a teaching assistant) and Chairperson or DGS as soon as circumstances permit. Similarly, a graduate assistant unable to fulfill the duties of her appointment because of pregnancy shall notify the Chair or DGS as soon as circumstances permit.

During the illness, injury, or pregnancy the department will adjust (reduce, waive, or reschedule) the graduate assistant's duties as those duties and the assistant's physical circumstances reasonably dictate. If total absence from duties

is necessary, the department will maintain the stipend of the appointment, provided the graduate assistant is still enrolled, for a period of two months, or to the end of the appointment period, whichever is sooner.

The graduate assistant shall have the right to return to the assistantship, within the original semesters of the appointment, at such time as they are able to reassume the duties of the position.

6. MASTER'S PROGRAM

6.1 Overview and Admission

The B.S./M.S. and Professional M.S. programs described below are Plan B Master's programs that require oral and written research reports, but no thesis. Except for these two programs, the department rarely accepts applicants for the M.S. program, except under unusual circumstances. In such cases, students complete a Plan A M.S. that involves preparation and defense of a thesis. Admission procedures and criteria are generally similar to those for the Ph.D. program (Section 7.1), including the requirement of a minimum grade-point average of 3.0. Consult the MMG website (www.msu.edu/unit/mic/) "Graduate Studies" section, and/or the DGS (micgrad@msu.edu) for detailed information.

6.2 Professional M.S. in Industrial Microbiology (Plan B)

This program provides advanced training for students who intend a career in biotechnology, bioremediation and other microbiology-related industries. It includes an independent research project, a written and oral report (but no thesis) on that project, an industrial internship experience, and a Business Communication Certificate program. The latter involves a series of weekend workshops run by the Graduate School to help develop business related skills. Further details are available as noted above in Section 6.1.

6.3 B.S./M.S. Combined Degree Program

This program is available to MSU undergraduates in MMG or other departments who wish to extend their studies by (at least) one year and earn both the B.S. and M.S. degrees. Although it is a non-thesis (plan B) program, a multi-year research experience is required, along with a written and oral report on that research. A total of 150 credits are required for both degrees. Students are encouraged to begin the B.S./M.S. program in their junior year. The academic performance of students prior to and after entering the B.S./M.S. program should be consistent with the criteria for admission to the regular Masters programs (Sec. 6.1). Interested students should consult their undergraduate advisor, the department's Director of Undergraduate Studies and/or the department web page at www.msu.edu/unit/mic/.

6.4 Planning a Master's Program and the Appointment of a Research Guidance Committee

Upon enrolling for any of the available M.S. programs, the student should complete the selection of an area of research and a major professor(s), working with the DGS and/or the Director of the Professional M.S. program as needed. As soon as feasible after choosing a major professor(s), the student and major professor(s) select a research guidance committee. This committee shall consist of the major professor(s), and two additional members, one of whom may be from outside the department. No more than 40% of the members of the

research guidance committee may be from outside the department. In the case of the Professional M.S. an industrial mentor typically should be included, in addition to the three required faculty committee members.

The student may have a co-major professor at MSU, either within or outside the department, if the Chairperson approves this in advance. However, at least one MMG faculty member must be identified to accept major responsibility for the student.

At the time of the formation of a research guidance committee, the Master's program will be drawn up, acted upon and signed by the major professor(s) and research guidance committee. Then it will be submitted to the DGS and the Dean of the appropriate college for their approval.

6.5 Program of Study

The M.S. degree requirements consist of coursework, research, and a thesis (Plan A) or research report (Plan B). Students must earn a minimum of 30 credits, with more than half of these at the 800 or 900 level and the remainder at the 400 level or greater, unless specifically approved by the relevant Dean.

6.5.1 Research Credits

These are earned by providing reasonable evidence to a research guidance committee of the ability to critically examine scientific literature and organize it as the background information for stated problems, to formulate hypotheses and design experiments to test them, to organize and tabulate data, to interpret and set down inferences on the basis of these data and to suggest either practical or theoretical relevance for these data. Evidence to satisfy these criteria shall be a written thesis (Plan A) or a research report (Plan B) and an oral defense thereof. A minimum of five (Plan A) or seven (Plan B) and a maximum of fifteen credits are required in research (MMG 899 or MMG 890, respectively).

6.5.2 Thesis (Plan A only)

For information on the preparation of thesis and abstract, a Formatting Guide and additional assistance are available from The MSU Graduate School (look under "Resources" at www.grad.msu.edu/format.htm). Thesis requirements for the Plan A M.S. are generally similar to those for the Ph.D. described in Section 7.13 below.

6.5.3 Research Report (Plan B)

The Professional M.S. in Industrial Microbiology and the B.S./M.S. programs require preparation of a research report in a form generally suitable for submission to a reviewed journal, for example one of those published by the ASM.

6.5.4 Coursework

Generally 15-25 credits of coursework are required in addition to the MMG 890 (Plan B) or 899 (Plan A) credits (see 6.5.1). These will be as specified by the research guidance committee in the Master's program described in Section 6.4. More than half of the total 30 credits required for the Plan A M.S. must be at the 800 or 900 level (not including MMG 899) with the remainder at the 400 (or greater) level, unless specifically approved by the relevant Dean. The Prof. M.S. students must take more than half of their courses at the 800 or 900 level (not including MMG 890) with the remainder at the 400 (o

greater) level, with MMG 445 and MMG 801 typically required. The combined B.S./M.S. program requires a total of 150 credits, both graduate and undergraduate. The specifications above apply only to the 30 credits beyond those required for the B.S. In general, 50% or more of the coursework for all M.S. students will be in courses offered by the department. A course in research integrity (or the Responsible Conduct of Research workshop) is strongly encouraged for all M.S. students.

6.5.5 Industrial Internship (Prof. M.S. only)

The Professional M.S. in Industrial Microbiology requires an industrial internship experience. Typically this involves spending a period of about three months working at an industrial site chosen by the student and major professor. The industry in question may provide financial support to the student during the internship and, in some cases, for her/his on-campus research. An industrial mentor generally will be designated, in addition to the major professor, to advocate for, advise, and supervise the student, especially during the internship. A student may earn MMG 890 credits during the internship, pending the approval of a departmental faculty member who will be responsible for evaluating the research performed and providing the required grade.

6.5.6 Examination

A final oral examination is required over coursework and thesis (Plan A) or report (Plan B). The examination committee will consist of the research guidance committee. The examination will be chaired by the student's major professor(s). Each member must be provided a copy of the thesis (Plan A) or report (Plan B) at least two weeks prior to the examination.

A notice of the examination will be posted and distributed to MMG faculty two weeks prior to the examination. Faculty and students are invited to attend. The candidate will be examined over both the primary area of study and any related areas deemed appropriate by the committee, including defense of thesis (Plan A) or report (Plan B). The examining committee will deliberate in private. Passing the examination requires the unanimous support of the research guidance committee.

A numerical grade shall be assigned for MMG 899 by the major professor.

6.6 Teaching requirements

Although there are no specific teaching requirements for the M.S. degree, students can explore teaching assignments with their mentors.

6.7 Academic Standards

Satisfactory progress is deemed to be a 3.0 or higher average grade, in the 800-900 level credits, excluding thesis and collateral courses (see Section 3.8). Any grade below 3.0 in courses other than collateral may subject the student to review by the DGS (See Section 3.10 and/or the Academic Programs document described in Section 3.2). Grades of less than 3.0 are not included in the 30 credits needed for degree certification, and may require the student to repeat the course or otherwise remediate the deficiency. Repeats of courses with grades of 2.0 or 3.0 require approval by the Dean's office.

6.8 Transfer Credits

As many as 9 semester credits are allowed to be transferred from other accredited institutions. The transfer of these credits is subject to the approval of the departmental Chairperson and dean.

6.9 Off-Campus Work and Residence

Credit for courses taken at MSU off-campus centers/affiliates is equivalent to the credit for on-campus courses. However, for the M.S. degree, at least 6 credits must be earned in residence. A student who plans to take off-campus courses should discuss the possibilities of acceptance of such work toward the degree with their major professor(s) and the DGS. Such approval should be obtained before enrolling in an off-campus course, just as is done for an on-campus course.

6.10 Time Limit

The time limit will be 6 calendar years, starting with the semester in which the student is first enrolled. The Master's program normally should be completed within 2-3 years. The combined B.S./M.S. program is designed to be completed in a total of five years, although a longer time period may sometimes be required.

7. DOCTORAL PROGRAM

7.1 Admission

7.1.1 General Admission Requirements

Admission to the Ph. D. program is based on a detailed review of undergraduate (and, where applicable, previous graduate) performance, Graduate Record Examination scores, letters of recommendation, previous research experience, and a letter of intent and research interests. Applicants should have a minimum grade-point average of 3.0, grades of 3.0 or above in science and mathematics courses, and proficiency in written and spoken English. In general, applicants should have had the equivalent of at least one academic year each of physics, inorganic chemistry, and organic chemistry; one biochemistry course; mathematics through integral calculus, and one or more biology courses. Scores on the GRE General Test are required, along with a personal letter of intent and letters of reference. For more details on application information, consult the "Graduate Studies" section of the MMG website (www.msu.edu/unit/mic/), and/or the Graduate Office (micgrad@msu.edu).

7.1.2 Language Requirements

Applicants without full native fluency in English must fulfill proficiency requirements as part of admission on either a regular or provisional status. For example, TOEFL scores must be 560 on the written exam (no sub-score less than 52) or 250 on the web-based exam (no sub-score less than 25). More information is available from The Graduate School (www.grad.msu.edu). International graduate students are also required to participate in the International Graduate Assistant orientation program sponsored by the University. In order for a student to be a Teaching Assistant (as a member of the Graduate Employees Union) they must have a SPEAK score of at least 50 or waiver approval.

7.1.3 Readmission

Any person previously admitted to and in good standing with the Ph.D. program but who has not been in attendance at MSU for three or more semesters, including summer, should

secure an application for readmission form from the Office of Admissions. This application should be filed with the Registrar three weeks prior to the first day of registration of the semester in which he/she expects to resume their studies. Readmission is subject to approval of the DGS.

7.2 Graduate Student Rotations

As mentioned in Section 2.2, most Ph.D. students complete three research rotations (about 10 weeks each) during their first academic year. This is to aid entering graduate students in identifying a major professor and to give students intensive familiarity with cutting-edge research. The experience also substitutes for formal laboratory-based classwork. In rare instances, the DGS may accept 2 rotations as fulfilling the rotation requirement.

Assignment to rotations will be made by, and requires the approval of, the DGS in consultation with the student and the directors of the laboratories in question. Rotations can be carried out with any MSU faculty member or with individuals at associated organizations (e.g. the Van Andel Research Institute) as long as the work focuses on a research area relevant to the department.

Rotation mentors are asked to provide the student with a feasible, small individual research project and to evaluate the student's progress during the rotation period.

7.3 Selection of a Major Professor(s)

Students may elect a major professor(s) at any time, but must complete at least two and preferably three rotations. The selection need not be from among professors in whose laboratories rotations were carried out.

Students may select a major professor(s) whose primary appointment is not in the department. The Chairperson must approve such a selection in advance. In this instance, a faculty member in the department must agree to serve as co-major professor(s) for administrative purposes only, i.e. that individual may participate in the closed questioning portion of the comprehensive examination (Section 7.10.3.1).

In some cases, a student may wish to select co-major professors. One of the co-major professors must have an appointment in MMG and should be identified as the signatory for administrative purposes. Co-major professors are viewed together as a single entity, hence at least three additional faculty members are required to form a complete guidance committee as described in section 7.4. Likewise, both co-major professors are excused from participation in the closed questioning portion of the preliminary examination (Section 7.10.3.1). The selection of co-major professors must be approved in advance by the Chairperson.

7.4 Appointment of a Research Guidance Committee

Within two semesters after choosing a major professor(s), the student and major professor(s) must form a research guidance committee. The research guidance committee shall consist of the major professor(s) and three or four faculty members from areas related to the candidate's area of interest. One member of the research guidance committee will be appointed by the DGS in consultation with the Graduate Committee. At least three of the research guidance committee members must be from MMG, and one must be from outside the department (i.e., whose primary academic appointment is not in the department). Research guidance committee membership is

subject to approval by the DGS and Chairperson. In cases where a desired guidance committee member does not have an affiliation with MSU, that member must be in addition to the four MSU-affiliated members, and approval is also required from the Dean of the Graduate School. Changes in the research guidance committee similarly may be requested by the major professor(s) jointly with the student and require approval of the DGS, Chairperson, and the Dean of the appropriate College.

The student and major professor(s) will plan the candidate's program subject to suggestions and approval of the research guidance committee. This plan of study report (see www.grad.msu.edu/forms/rogc.doc or www.grad.msu.edu/forms/rogc.pdf) will be filed with the Dean of the College concerned (typically 14-18 months after joining the Ph.D. program) and shall be regarded as the statement of program requirements.

It is the student's responsibility to see that the research guidance committee will meet at least once per year to ascertain whether adequate progress is being made toward the degree (See Section 3.8). An outline or short written summary of goals and research progress (no more than five pages) and a status report on course requirements should be provided to the committee at least one week ahead of time. In addition, a CV, new publications by the student, and manuscripts in preparation by the student should be provided to the committee. Annual progress reports must be filed by the Departmental Representative in the departmental Graduate Office.

7.5 Program of Study

In the course of studies for the Ph.D. degree, a student will undertake the following requirements (see a typical timeline in Appendix 1):

1. complete courses in the major and related fields as prescribed by his/her research guidance committee (see section 7.6 for details).
2. conduct original research (see 7.9).
3. pass the doctoral comprehensive examination (see 7.10).
4. gain experience in teaching by assisting faculty in designated courses (see 7.11).
5. prepare a publishable manuscript and, desirably, publish or at least submit it for publication (see 7.12).
6. prepare a dissertation (see 7.13).
7. present her/his doctoral research at a public seminar and then pass a final oral examination in defense of the dissertation (see 7.14).

7.6 Course Requirements

Prior to selection of a major professor and formulation of a research guidance committee, the student will engage in coursework recommended in consultation with the DGS. Thereafter an individualized program of study formulated by the major professor(s) and the research guidance committee in consultation with the candidate to ensure that the student will have comprehensive knowledge of the general field of Microbiology & Molecular Genetics, detailed knowledge of a

specialized area in the field, and supportive knowledge of cognitive subjects. This minimum program (with possible additional courses specified by the research guidance committee) must include:

1. Four courses at the 800 or 900 level, excluding topics and seminar courses, at least two of which are offered by MMG. The four required lecture courses will normally include as a requirement: a graduate level course in molecular biology or genetics, such as BMB 801, MMG 833 or MMG 835, and at least one graduate level course that includes discussion of cellular physiology or cell biology, such as MMG 801, BMB 802, or MMG 825. Electives should be chosen to enhance the depth and breadth of the student's knowledge of microbiology. In consultation with their mentor(s), members of the research guidance committee, and DGS, students may take other courses as needed depending on their specific area of research specialization.
2. Participation in three seminar courses (MMG 803, MMG 892 or MMG 991 or the equivalent) involving student presentations. These courses may be substituted by equivalent seminar courses offered by other departments/programs subject to approval by the student's guidance committee and DGS.
3. A course in research integrity (e.g., NSC 830) or enrollment in the "Responsible Conduct of Research" seminar series.
4. Training in college-level teaching such as SME 870 "Teaching of College Science" or enrollment in MMG 892 section 2 during the semester when teaching at least two credits of undergraduate instruction under the supervision of a faculty mentor.
5. Students entering the doctoral program with one or more deficiencies in undergraduate coursework may be asked by the DGS or guidance committee to take the appropriate courses as a part of the degree requirement.

Satisfactory completion of the course requirements entails earning a grade of 3.0 or higher, or a P (or Cr) in a P-N (Cr-NC) course. Where a grade below 3.0 is received in a required course, the following options are available:

1. The student may retake the course and receive a 3.0 or higher grade after obtaining appropriate approval from Dean's office.
2. With the approval of the DGS and Graduate Committee, a different graduate level (non-seminar) course or other option may be taken. The substitute course together with the remediated course will count as just one required course.
3. The accumulation of grades below 3.0 in three courses of 3 or more credits each, or deferred grades in three courses of 3 or more credits each at any

given time, or a combination of the above in three courses will be grounds for dismissal of the student from the program.

7.7 Residence and Transfer Credits

The minimum residence requirements when a student enters the Ph.D. program without taking the M.S. degree is three semesters on campus (or Kellogg Biological Station and Van Andel Research Institute), involving at least two consecutive semesters (counting summer as a semester) of six credits of graduate work/semester.

Graduate work may be transferred from other accredited graduate schools if it is appropriate to a student's new program, and provided it was completed within the time limits approved for earning the degree desired at MSU.

7.8 Academic Standards.

Satisfactory progress is deemed to be a 3.0 average, excluding thesis and collateral courses. Any grade below 3.0 in courses other than collateral may subject the student to review by the DGS. (See Section 3.10 and/or the Academic Programs document described in Section 3.2) If collateral courses (see Section 3.8) are required, they must be taken for credit and a grade less than 2.0 will be considered unsatisfactory fulfillment of the requirement.

7.9 Research Requirements

Research should be an independent, original, experimental study that results in a new and significant contribution to knowledge. The research requirement (24 credits of MMG 999) is the central feature of the Ph.D. program. Enrollment in MMG 999 is not allowed unless the student has been admitted to the doctoral program. Progress towards, and completion of, the doctoral research requirement is judged by the candidate's research guidance committee based on annual progress reports (see Section 3.8), performance in the comprehensive examination (7.10), submission of a publishable manuscript(s) (7.12) and dissertation (7.13), and the dissertation defense (7.14). All research involving human (www.humanresearch.msu.edu/overview/mission.htm) or animal (www.aucauc.msu.edu/) subjects must be approved by the relevant MSU Committee PRIOR to its initiation. Generally, the major professor will have obtained such approval, but the student will be required to verify that the necessary approval(s) has been obtained before her/his thesis will be accepted (Section 7.13), and it is the responsibility of the student to consult with the major professor(s) and ensure that this requirement has been met.

7.10 Comprehensive Examination

The comprehensive (preliminary) examination for candidacy to the Ph.D. will consist of three parts: 1) a written research proposal, 2) an open seminar and 3) closed questioning by the preliminary examination committee.

7.10.1 Research Proposal

The subject of the written proposal will normally be the student's doctoral dissertation research. The proposal will be in the format of a NIH or NSF postdoctoral application (~10 pages of single spaced text, not including references, figures and tables) and should include Specific Aims (often including Hypotheses), Background and Significance, Preliminary Studies/Progress Report, and Research Plans. All sources of

information ordinarily available to research workers may be utilized in the preparation of the proposal, including any of the major professor's own grant proposal(s) that he/she may wish to make available to the student. Prior to undertaking the writing, the student should engage in dialogue with the major professor(s) and guidance committee members regarding the feasibility of particular experiments. However, the spirit of the examination is that the written proposal must reflect the student's own ideas and thinking. While it is impossible (and inappropriate) to remove the influence of the major professor from the conception and definition of the student's project, the background and impetus for the research, the rationale of approach, the hypotheses to be tested, the experimental designs, and the anticipated results and significance of the work, should all be a product of the student's imagination and effort. The proposal must also meet accepted standards of original writing and attribution of source material. Students are encouraged to seek scientific and grammatical input on the proposal from coworkers, colleagues, and a member of the faculty, but (once the writing has begun) not from the advisor(s) or Guidance Committee members.

The written proposal must be submitted to each member of the research guidance committee two weeks before the open seminar and oral defense of the proposal. At this time, the seminar announcement will be posted and distributed.

7.10.2 Open Seminar

The student will present an open seminar formulated around the written proposal. The major professor(s) will be an observer at the seminar and will not assist in developing the talk (it is permissible, however, for the student to use introductory slides provided by the mentor). The seminar will normally include: a general introduction, rationale for the proposed research, preliminary results, proposed experimentation and potential conclusions. The seminar should take 40-50 minutes and should include a Power Point presentation or equivalent visual aids.

Following the seminar, the student will take questions from the audience, other than members of the preliminary examination committee.

7.10.3 Closed questioning by the preliminary examination committee

7.10.3.1 Preliminary examination committee members

This committee is composed of the student's research guidance committee and a departmental faculty member (appointed by the Graduate Committee) who is broadly conversant in the research area of the faculty mentor. The Graduate Committee representative will chair the closed questioning session and ensure consistency and equity of preliminary examinations. The major professor(s) will be excused from participation in the examination.

7.10.3.2 Guidelines for closed questioning

The criteria used by the committee to render a decision include an assessment of the candidate's ability to identify an important research problem, knowledge in the chosen area of interest and related areas, and his/her ability to design experiments for the solution of the problem and to effectively communicate these ideas both orally and in writing. In addition, questions relating to the proposal and pertinent coursework will be asked. The Graduate Committee member

is asked to ensure that the student's breadth of knowledge is challenged in a consistent and equitable fashion for all doctoral students.

7.10.3.3 Outcomes of preliminary examination

In arriving at a decision, the preliminary examination committee will evaluate the student's performance on the written proposal, seminar presentation and closed questioning.

Three outcomes are possible:

1. **PASS** – requires a unanimous vote of the examination committee. The student is thus admitted to official Ph.D. candidacy.
2. **FAIL** – requires a unanimous vote of the examination committee. If this decision is reached, no remediation is available and the student will be recommended for dismissal from the doctoral program. The student may continue toward an M.S. degree if the major professor(s) concurs. Upon completion of the M.S., the student may reapply to the Ph.D. program. At this time, the M.S. guidance committee will evaluate the student's potential for a doctoral degree and decide whether to recommend the student for acceptance into the MMG doctoral program.
3. **DELAY** - If the examination committee chooses neither of the above options and can identify a deficiency in the student's performance that is believed to be correctable within a reasonably short period of time, it will attempt to detail, both verbally and in a letter to the student, the nature of the problem(s) and the requirements for successful remediation. A time limit, not to exceed two months, will be set. If, in the opinion of the committee, the student fails to adequately remediate the deficiency in the specified time frame, he/she will be recommended for dismissal from the doctoral program. If the student is judged to have remediated it successfully, she/he will then have passed the exam. Situations that may warrant a "DELAY" include: (i) a serious pitfall in an otherwise satisfactory proposal that can be remedied by revision of an experimental design or method of analysis; (ii) the failure to recognize, deal with or interpret a likely alternative outcome(s) of an experiment and its implication; (iii) a poorly written or poorly documented section of the proposal requiring substantial revision; and (iv) the lack of sufficient understanding of a method of data acquisition (e.g. an assay procedure) or analysis (e.g. appropriate statistical method) viewed as a critical component of the research. The "DELAY" should not be used to remedy a serious deficiency in fundamental knowledge that should have been attained by the student through required coursework. A remediation timeframe exceeding two months must be approved by the DGS.

7.10.3.4 Timing of preliminary examination

Students are encouraged to complete the preliminary examination as soon as feasible, but no later than 26 months after enrolling in the regular doctoral program. By this time, the student should have completed at least 80% of the required courses with an overall GPA of 3.0 or higher. Failure to

complete the exam by this deadline will initiate a review of the student's progress by the doctoral research guidance committee and DGS, who will either set a specific deadline for the preliminary examination, or recommend the student for dismissal from the program (See Section 3.10). Students who take the examination in Summer semester can request a waiver of the enrollment requirement.

7.11 Teaching

As previously described, learning oral communication skills is an important component of graduate training in MMG. An essential aspect of scholarly activity is the presentation of scientific material to peers and to students at various levels. Regardless of her/his eventual career goal or source of student assistantship support, all Ph.D. students can benefit from and are expected to participate in teaching with faculty mentoring. A special Certificate program (www.grad.msu.edu/teaching.htm) is available for those students who desire extra experience, training, and credentials in college-level teaching.

Generally, students will participate in one teaching assignment during their graduate career. Depending on student interest, needs of the department, and available funding, some students may perform additional teaching assignments. Furthermore, foreign graduate students are required to participate in the foreign student orientation program sponsored by the university.

The faculty member charged with responsibility for the courses that involve teaching assistants are expected to provide instruction and opportunities for those assistants to enhance their abilities and to provide feedback that can aid in future improvements. The nature of student responsibilities will vary according to the course in question.

MMG students who serve as Teaching Assistants are required to become a member of the Graduate Employees Union (contract available at www.grad.msu.edu/geu/agree.pdf).

7.12 Publishable Manuscripts

Two or more accepted publications (with at least one listing the student as first author or co-first author) in peer-reviewed journals is expected prior to completion of doctoral research. The student's Research Guidance Committee will review exceptions to this guideline. Publications by the student can be incorporated directly into the student's dissertation (see below); however, for cases where the student is not the first author the specific contributions of the student should be summarized on the chapter title page.

7.13 Dissertation

In general, the dissertation must conform to the guidelines and requirements of The MSU Graduate School. A publishing agreement with ProQuest provides an "Open Access Publishing Option" as an alternative to the traditional publishing option for interested students. For information on the preparation of thesis and abstract, a Formatting Guide and additional assistance are available from The Graduate School under "Resources", (www.grad.msu.edu/format.htm).

Approximately six months prior to the expected completion date, doctoral candidates must consult her/his research guidance committee to finalize plans. Items to be accomplished at this meeting are: a) evaluation of the current status of research and identification of areas to be completed

or strengthened, and b) identification of a realistic timetable for completion. The timetable must include sufficient time between the thesis defense and the student's planned departure to allow for adequate completion of changes and corrections specified by the research guidance committee.

The dissertation may be written in standard format, but the department encourages (and The Graduate School will accept) a modified form that embodies the requirement for a publishable manuscript. In this modified form, the publication manuscript(s) or reprint(s) is (are) directly incorporated into the dissertation, together with suitably integrative supplementary material. Supplemental chapters usually consist of a more thorough review of the literature and addenda with more detailed methods, results and/or discussion than are generally accepted in published journals. In recognition of the cooperative nature of modern research, material that involves more than two authors (i.e., the student and major professor) may be included in the body of the thesis or, preferably, as an Appendix. In such cases a brief explanation of what portion of the work described has been done by the student should be included. Samples of dissertations prepared with published manuscripts are available from the department Graduate Office.

All research involving human or animal subjects must be approved by the relevant MSU Committee PRIOR to its initiation. The student will be required to verify that the necessary approval(s) has been obtained before her/his thesis will be accepted. The student should obtain the required approval information from the major professor(s) that will enable them to verify this to The Graduate School.

The student must submit to the major professor(s) a complete draft of the thesis, abstract, and manuscript(s). The major professor(s) will review the draft and authorize the distribution of copies of the semi-final draft to the members of the research guidance committee. The committee members must have two weeks to edit and review the semi-final draft before the final oral examination. After the student has presented a seminar and passed an oral examination in its defense, the student must incorporate into the thesis any recommended changes and corrections before having it produced in final form and permanently bound. Committee members may require further review of the final draft before it is submitted or may choose to leave this responsibility to the major professor(s). The final copy submitted to The Graduate School contains a bookplate that must be signed by the major professor(s). By the posted deadline date for the semester in which the student intends to graduate, the final (unbound) copy of the dissertation, bookplate, human and/or animal subjects form and related materials must be submitted to The Graduate School. Students are strongly advised to consult The Graduate School (www.grad.msu.edu/current.htm) for exact details of what is required well in advance.

7.14 Final examination

The candidate must be registered during the semester in which the final examination is taken. An announcement is posted two weeks ahead of the final examination and distributed to all faculty. As part of the examination, the student presents an open seminar. Immediately after the public presentation and open discussion, the oral examination on the thesis will be conducted by the research guidance committee, chaired by the major professor(s). Satisfactory completion of the examination requires a unanimous decision of the examining committee.

At this time the student should have the "Record of Completion of Requirements for the Doctoral Degree" form (see www.grad.msu.edu/forms/oralexam.doc or www.grad.msu.edu/forms/oralexam.pdf) signed by the research guidance committee, and distributed as directed. The student's folder and a P (or N) grade for MMG 999 should be turned in to the department Graduate Office. The grade is reported on the Degree Certification form.

7.15 Time Limit

As specified by the university, all requirements for the Ph.D. degree must be completed within 8 years of a student's first enrollment for doctoral degree credit. Any exceptions must be approved by the Chairperson, Dean of the relevant College and the Dean of The Graduate School.

8. PH.D. PROGRAM CONCURRENT WITH PROFESSIONAL MEDICAL PROGRAM

8.1 Introduction

The department permits the development of concurrent Ph.D.-D.V.M., Ph.D.-M.D., or Ph.D.-D.O. programs for the exceptional professional student interested in academic research. The approval of such an arrangement for a given student requires a careful review of the applicant's qualifications, career aspirations, and other relevant factors. To be considered for a concurrent program, the prospective student must have exceptional academic and research capabilities. Unless otherwise agreed to in advance, the existing directives and requirements for the doctoral program will be followed for students in the concurrent programs. Additional directives and requirements for the concurrent degree programs will be the same for students in the College of Human Medicine, College of Veterinary Medicine, and College of Osteopathic Medicine unless otherwise agreed.

8.2 Admission

A student already enrolled in the curriculum of the Colleges of Human, Veterinary, or Osteopathic Medicine wishing to initiate a concurrent Ph.D. program may apply for admission to the doctoral program of the department. In this case, admission into the department graduate program is, in effect, admission into a concurrent M.D.-Ph.D., D.V.M.-Ph.D., or D.O.-Ph.D. program. Therefore, the student must address the following three criteria to aid in determining the appropriateness and feasibility of a combined program:

1. An area of research and a major professor(s) should be identified, or a rotation schedule should be proposed.
2. A course of graduate study will be established which is compatible with the appropriate medical school curriculum.
3. Personal interviews with either the Chairperson or the DGS of the department and the Assistant/Associate Dean for Admissions and Student Affairs of the appropriate college shall be completed.

A prospective student yet to be admitted either to a graduate program or to a professional program will need to apply independently to and be accepted by both the department (see Section 7.1) and the relevant College. Both applications should clearly state the desire for a concurrent dual degree

program and the three items above should be addressed during the application process.

In the case of a student already pursuing a Ph.D. in MMG and wishing to initiate a concurrent D.V.M., M.D., or D.O. program, the student shall meet the same criteria described above. It is strongly recommended that the student include endorsements from the major professor(s) and the DGS or Chairperson in the application to the professional school in question. Acceptance into the dual degree program will be determined by the Admissions Committee of the relevant professional school. If the student is accepted by the relevant College and already has a research guidance committee, it will remain intact but must include at least one member representing the appropriate medical college.

8.3 Course and Credit Requirements

Selected graduate school courses can be waived upon approval of the research guidance committee, when the required MMG courses in the student's professional curriculum provide adequate exposure to a subject area. Conversely, waiving of a MMG course in the medical curriculum will be permitted, if allowed by the student's respective college, and if graduate courses provide adequate exposure to the same subject matter.

8.4 Academic Standards

The academic achievement of a student in a combined program will be evaluated by established college and department standards (see Section 7). This evaluation will include those courses from the student's medical curriculum that have been prescribed as part of the Ph.D. program.

Students in a combined degree program are expected to make satisfactory progress towards both degrees simultaneously. When possible, the student should utilize vacation and elective time to take required graduate courses and conduct research. Unless free or elective time becomes available, students may be requested to temporarily stop their professional studies in order to take appropriate graduate courses and facilitate satisfactory simultaneous progress.

8.5 Time Limit

The time limit of the student's respective professional college shall apply to students in a dual program. In the Colleges of Human Medicine, Osteopathic Medicine, and Veterinary Medicine, comprehensive examinations must be taken within 5 years, and all requirements must be completed within 8 years from the time of the student's first enrollment into the doctoral program.

9. NON-DEGREE STUDENTS

9.1 Admission to Non-Degree Status

The department may permit any qualified person to pursue graduate coursework on a non-degree basis providing advisors and space are available. It is understood that admittance to a non-degree status does not imply that regular status will be forthcoming. (University regulations prohibit the transfer of more than 10 credits from a non-degree status toward a graduate degree.) Financial assistance is not available for non-degree study.

9.2 Admission to a Degree Program

Non-degree students who demonstrate the potential for academic excellence and seek admission to a degree program must apply to the Graduate Committee for admission and will be judged in competition with other applicants.

11. JUDICIAL STRUCTURE

The Graduate Committee will serve to hear student complaints at such times as this becomes necessary. This committee will hear student complaints only if the problem cannot be resolved after consulting with the Chairperson, DGS or the student's major professor(s). If satisfactory resolution of a conflict is not achieved, the student may seek resolution through appropriate college/university judiciary structure (See the Graduate Student Rights & Responsibilities document, www.vps.msu.edu/SpLife/gradrights.htm).

12. AMENDING AND REVISING THIS MANUAL

Any faculty member or graduate student may submit proposals to amend or revise the MMG Manual for Graduate Study. Amendments to be considered must be written and circulated to the faculty and graduate students not less than 14 days prior to the meeting at which they are to be voted upon. Amendments must be passed by a majority of the "voting faculty" as defined in the MMG bylaws.

13. APPENDICES

TYPICAL TIMELINE FOR A PH.D. STUDENT IN MMG (and section of manual related to each topic)

Year 1 - Fall Semester

- Entry into program (7.1)
- Advisement by DGS (7.2)
- Begin classes (7.6) (e.g., BMB 801 and MMG 801 or MMG 833)
- Initiate first 10-week laboratory rotation (7.2)
- Begin second 10-week laboratory rotation (7.2)

Year 1 - Spring Semester

- New classes begin (7.6) (e.g., BMB 802, MMG 825, or MMG 835)
- Begin third laboratory rotation (7.2)
- Select major professor by end of term (7.3) and begin thesis research project (7.9, 7.12)

Year 2 – Fall Semester

- Appropriate courses selected with mentor (7.6)
- Continue research (7.9, 7.12)
- Identify Guidance Committee members (7.4)
- First Guidance Committee meeting (3.8)

Year 2 – Spring Semester

- Additional courses as needed (7.6)
- Continue research (7.9, 7.12)
- Comprehensive examination during this semester or summer (7.10)

Year 3- Fall Semester

- Additional courses as needed (7.6)
- Continue research (7.9)
- Write first manuscript, if possible (7.12)
- Deadline for comprehensive examination: 26 months after beginning the program (7.10)

Year 4 – Spring Semester and beyond

- Additional courses as needed (7.6)
- Continue research (7.9)
- Work on manuscript(s) (7.12)
- Annual Guidance Committee meeting (3.8)

~ Year 5

- Complete manuscripts (7.12)
- Write Dissertation (7.13)
- Final Examination (7.14)

Added notes: Some students obtain permission from the DGS to complete only two rotations, while others request permission to do a fourth. Participation as a teaching assistant is required, but the timing varies. Additional information is provided on vacations (5.3), illness/injury/pregnancy leave (5.4), readmission (7.1.3), and other topics.

GUIDELINES FOR INVESTIGATORS IN SCIENTIFIC RESEARCH (REPRINTED FROM HARVARD MEDICAL SCHOOL)

I. Introduction

These guidelines describe practices generally accepted by members of the Faculty of Medicine and already in effect in their laboratories. The primary intent of codifying them is to bring them to the attention of those beginning their careers in scientific research. These recommendations are not intended as rules, but rather as guidelines from which each group of investigators can formulate its own set of specific procedures to ensure the quality and integrity of its research.

II. Supervision of Research Trainees:

Careful supervision of new investigators by their preceptors is in the best interest of the institution, the preceptor, the trainee, and the scientific community. The complexity of scientific methods, the necessity for caution in interpreting possibly ambiguous data, and the need for advanced statistical analysis, all require an active role for the preceptor in the guidance of new investigators. This is particularly true in the not uncommon circumstance of a trainee who arrives in a research unit without substantial experience in laboratory science.

Recommendations:

The responsibility for supervision of each junior investigator should be specifically assigned to some faculty member in each research unit.

The ratio of trainees to preceptors should be small enough that close interaction is possible for scientific interchange as well as oversight of the research at all stages.

The preceptor should supervise the design of experiments and the processes of acquiring, recording, examining, interpreting, and storing data. (A preceptor who limits his/her role to the editing of manuscripts does not provide adequate supervision.)

Collegial discussions among all preceptors and trainees constituting a research unit should be held regularly both to contribute to the scientific efforts of the members of the group and to provide informal peer review.

The preceptor should provide each new investigator (whether student, postdoctoral fellow, or junior faculty) with applicable governmental and institutional requirements for conduct of studies involving health volunteers or patients, animals, radioactive or other hazardous substances, and recombinant DNA.

III. Data Gathering, Storage, Retention:

A common denominator in most cases of alleged scientific misconduct has been the absence of a complete set of verifiable data. The retention of accurately recorded and retrievable results is of utmost importance for the progress of scientific inquiry. A scientist must have access to his/her original results in order to respond to questions including, but not limited to, those that may arise without any implication of impropriety. Moreover, errors may be mistaken for misconduct when the primary experimental results are unavailable. In addition, when statistical analysis is required in the interpretation of data, it should be used in the design of studies as well as in the evaluation of results.

Recommendations:

Custody of all original primary laboratory data must be retained by the unit in which they are generated. An investigator may make copies of the primary data for his/her own use.

Original experimental results should be recorded, when possible, in bound books with number pages. An index should be maintained to facilitate access to data.

Machine print-outs should be affixed to or referenced from the laboratory notebook.

Primary data should remain in the laboratory at all times and should be preserved as long as there is any reasonable need to refer to them. The chief of each research unit must decide whether to preserve such primary data for a given number of years or for the life of the unit. In no instance, however, should primary data be destroyed while investigators, colleagues, or readers of published results may raise questions answerable only by reference to such data.

IV. Authorship:

A gradual diffusion of responsibility for multi-authored or collaborative studies has led in recent years to the publication of papers for which no single author was prepared to take full responsibility. Two critical safeguards in the publication of accurate, scientific reports are the active participation of each co-author in verifying that part of a manuscript that falls with his/her specialty area and the designation of one author who is responsible for the validity of the entire manuscript.

Recommendations:

Criteria for authorship of a manuscript should be determined and announced by each department or research unit. The Committee considers the only reasonable criterion to be that the co-author has made a significant intellectual or practical contribution. The concept of "honorary authorship" is deplorable.

The first author should assure the head of each research unit or department chairperson that s/he has reviewed all the primary data on which the report is based and provide a brief description of the role of each co-author. (In multi-institutional collaborations, the senior investigator in each institution should prepare such statements.)

Appended to the final draft of the manuscript should be a signed statement from each co-author indicating that s/he has reviewed and approved the manuscript to the extent possible, given individual expertise.

V. Publication Practices:

The Committee has observed certain practices that make it difficult for reviewer and reader to follow a complete experimental sequence: the rapid publication of data without adequate tests of reproducibility or assessment of significance, the publication of fragments of a study, and the submission of multiple similar abstracts or manuscripts differing only slightly in content. In such circumstances, if any of the work is questioned, it is difficult to determine whether the research was done inaccurately, the methods were described imperfectly, the statistical analyses were flawed, or inappropriate conclusions were drawn. Investigators should

review each proposed manuscript with these principles in mind.

Recommendations:

The number of publications to be reviewed at times of faculty appointment or promotion should be limited in order to encourage and reward bibliographies containing fewer but more substantive publications rather than those including many insubstantial or fragmented reports. (It has been suggested, for example, that no more than 5 papers be reviewed for appointment as Assistant Professor(s), no more than 7 for Associate Professor(s), and no more than 10 for Professor(s).)

Simultaneous submission of multiple similar abstracts or manuscripts to journals is improper.

VI. Laboratory Guidelines:

Because each research unit addresses different scientific problems with different methods, each unit should develop its own specific guidelines to identify practices that seem most likely to enhance the quality of research conducted by its members. Those guidelines should be provided to the new investigator upon starting work.